Power and Water Resources of Arid Landscapes

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Abstract. Why the transmission lines of electric infrastructure are so important compared to the network of water supply? How can we restore the natural balance? If cyberspace did not exist without electricity, humanity could not survive without water. It is possible to take advantage of using electric grid for helping improve water resources. Transmission towers' structure with an additional structural reinforcement could provide support to a network of artificial clouds made of light galvanized steel bars and strings, nebulizers system and silver iodide canyons. Under these clouds there are closed and open water reservoirs with shade balls depending on topography, climate and soil conditions and they are connected from mountains to the city. Electric lines are much like water pipes. In the case of transmission lines, the higher the voltage, the more electricity that can be transmitted, just like a wide water pipe can carry a larger volume of water. Electrical transmission lines operate at high voltages and carry large amounts of electricity over long distances. New water networks would make use of topography, soil permeability and existing infrastructure. These micro-clouds are also important to reduce fire risk, one of the consequences of droughts. Nature's endorsement of tensegrity structures are efficient because per unit mass, spider fibber is the strongest natural fibber and these structures are transferrable from nano-to mega scale. This is a great challenge to develop scientific procedures to create smart tensegrity structures that can regulate the flux of water resources, as well as thermal, mechanical and electrical energy in a material system by proper choice of material, geometry and controls.

Keywords: Landscape Architecture; Power lines; Water storage; Sustainability: Tensegrite structures.

Introduction

1. Power transmission lines. Tower structure

Transmission towers' structure with an additional structural reinforcement could provide support to a new artificial clouds network made of light galvanized steel bars and strings, nebulizers system and silver iodide canyons. Under these clouds there are closed and open water reservoirs with shade balls depending on topography, climate and soil conditions and they are connected from mountains to the city. Electric lines are just like wide water pipes can carry a larger volume of water. Electrical transmission lines operate at high voltages and carry large amounts of electricity over long distances. Electric infrastructure is reinforced with additional water infrastructure, but it does not interfere with its day-to-day management.

The goal is to use the same topographic infrastructure and the same light structure for supporting snow canyons and for hanging micro-clouds referring to produce rain that is stored in water reservoirs covered with shade balls and connected each other by gravity. New water network would make use of topography, soil permeability and existing infrastructure.

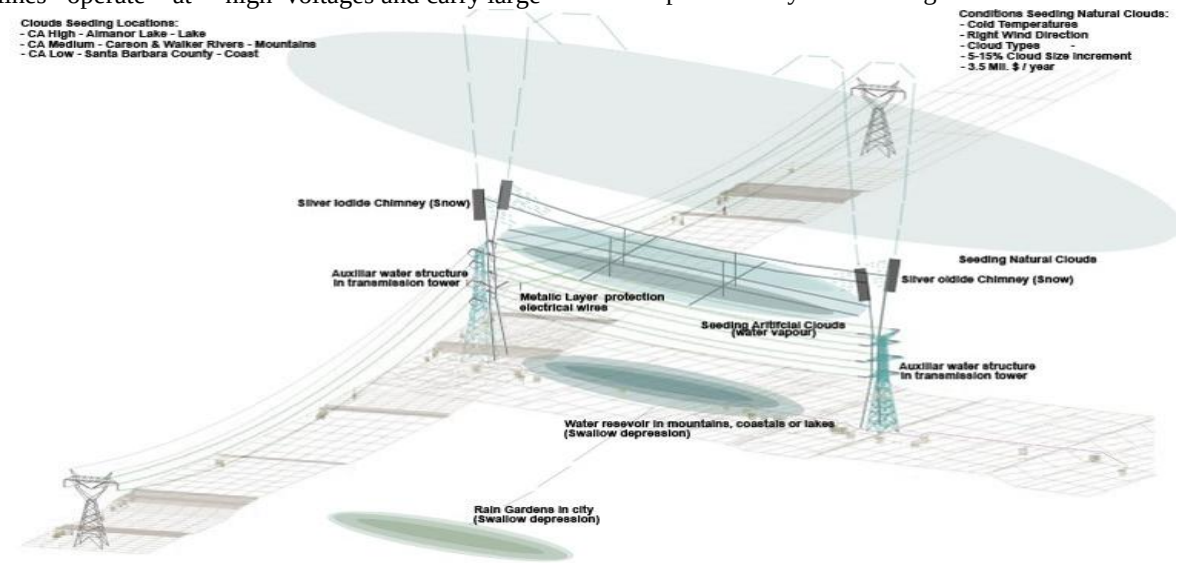

Fig. 1. Key sketch of power and water infrastructure [Source: material from author personal archive]

Fig. 2. California maps: CA1 High Richardson & Roaring Creek, CA2 Mid Upper San; Joaquin River., CA3 Low Santa Barbara County, 2015
[Source: material from author personal archive]

The location of the power & water lines are: CA1 High Richardson & Roaring Creek, CA2 Mid Upper San Joaquin River, CA3 Low Santa Barbara County.

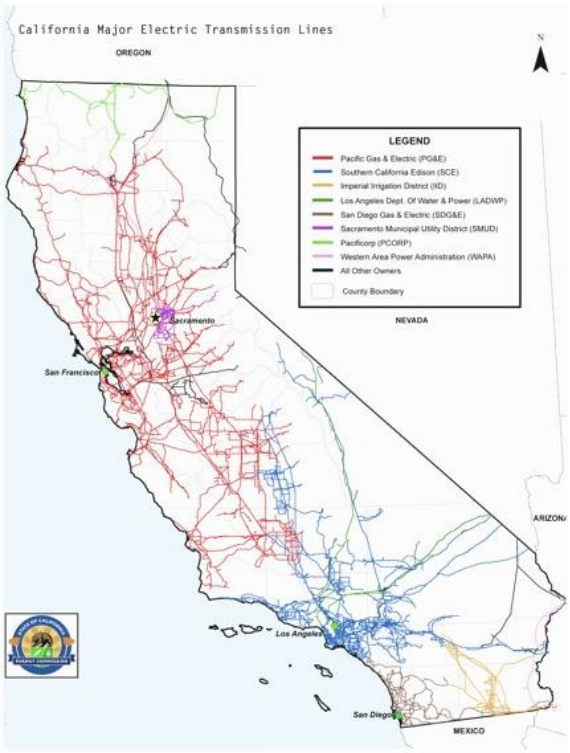

Fig. 3. California major electric transmission lines, 2011
[Source: material from author personal archive]

Pacific Intertie. The Pacific DC Intertie (also called Path 65) is an electric power transmission line that transmits electricity from the Pacific Northwest to the Los Angeles area using high voltage direct current (HVDC). The line capacity is 3,100 megawatts, which is enough to serve two to three million Los Angeles households and represents almost half (48.7 %) of the Los Angeles Department of Water and Power (LADWP) electrical system's peak capacity [1].

Future energy projects. Magnetic fields. An interesting new paper suggests that the ritual practice of burning parts of villages to the ground in southern Africa had an unanticipated side-effect: resetting the ground's magnetic data storage potential. The ground, then, is actually an archive of the Earth's magnetic field [2].

2. Water transmission lines. Micro-clouds structures

Water transmission surfaces. Water managers have being exploring precipitation enhancement via cloud seeding as alternative to augment water resources. Clouds seeding created a way of experimenting with supercooled clouds using a deep freeze unit of potential agents to stimulate ice crystal growth, i.e., salt, talcum powder, soils, dust and various chemical agents with minor effect. In the micro-clouds' network are employed small dust seed chimneys located in the reinforcement of transmission tower creating reservoirs for local use as well as water pipelines to build infrastructure to store and transport water to where it is needed. The location of the power & water lines are: CA1

High Richardson: Pacific Gas & Electric Co., CA2 Mid Madison: Desert Research Institute, CA3 Low Diablo canyon Power Plant: Santa Barbara County.

Atmospheric chemistry at the University of California-San Diego (Kim Prather). On snowy days, the clouds contained dust from a faraway source. Dust had made its way across the Pacific; clear from Asia and even Africa, the Middle East where there are these big dust storms. Takes about 7-to-10 days to get to California, but it makes it. It's not a lot of dust. It's just the right amount of dust that seeds the very top of the clouds. There's only so much water available and in order to get rain, you have to have big enough droplets for them to fall. The more seeds you have, you have many more tiny droplets. If you have too many seeds, you're not going to get precipitation out of that cloud [3].

Desert Research Institute in Reno. Water needs some sort of substance to condense upon. Clouds are made of millions of tiny water droplets, but the droplets don't automatically fall as rain or snow. They stick to tiny particles like dust. Cloud seeding only works in certain conditions: cold temperatures with the right wind direction and cloud types. Even more, cloud seeding has been used for six decades in California. Across the country, water agencies and utilities spend $3-to-5 million a year on seeding. It can be one tool in the toolkit and it's a cost-effective one [4].

Future water structures. The Great Lakes region is intimately connected to one of the largest fresh water systems on Earth, a full 20 % of the world's fresh surface water. Unfortunately, this great privilege is being threatened by the leading source of water pollution: incorrect management of rain and storm water. Communities can take action against rain and snowmelt flowing off of yards, roofs, and sidewalks and washing pollution into water systems. Rain gardens are designed to collect and absorb runoff from a roof or parking lot, the way nature intends rain to soak into the soil. Even it is a way to stop evaporation over water reservoirs [5].

Future atmospheric structures. Laboratory for Atmospheres at NASA's Goddard Space Flight Centre. Dan Cziczo's team contacted NASA for samples of dust thought to be similar in composition to dust on Mars (it was actually collected from U.S. deserts) and placed them in the cloud, adjusting its temperature and relative humidity to levels that have been observed on Mars. The experiment successfully formed a water-ice cloud [6].

Future green structures. The space agency is planning to send seeds on its next Mars rover, which is scheduled to launch in mid-2020 and land on the red planet in 2021. The mission, known as the Mars Plant Experiment (MPX), aims to create a small Martian greenhouse which, if successful, could pave the way for humans living on the planet [7].

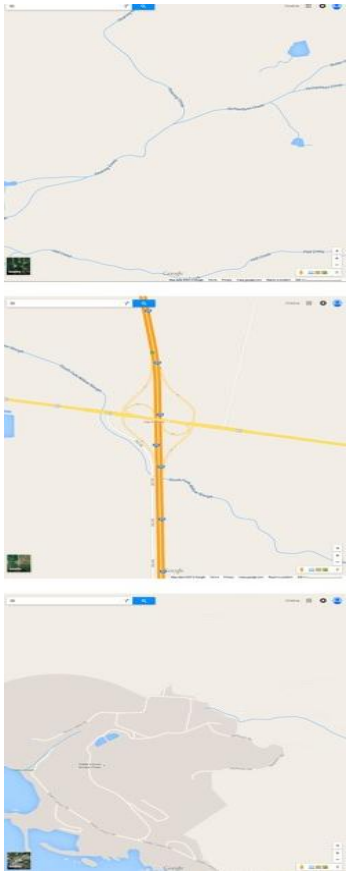

Fig. 4. California electric maps; CA1 High Richardson: Pacific Gas & Electric Co., CA2 Mid Madison: Desert Research Institute, CA3 Low Diablo canyon Power Plant: Santa Barbara County., 2015
[Source: material from author personal archive]

Fig. 5. California weather modifications project areas, 2011
[Source: material from author personal archive]

Research and methodology

The use of self-similar structures allows finding minimal mass subject to a specified buckling constraint. Light structure is calculated for wind and snow loads. The components of the micro-clouds structure are:

1. Reinforcement of transmission tower's structure. The same galvanized steel profiles of the original transmission tower are used in the reinforcement with dry assembly and earth connection. Micro-clouds system is hanging from prestressed strings from one tower to another.
2. Silver iodide canyon structure. Clouds seeding created a way of experimenting with supercooled clouds using a deep freeze unit of potential agents to stimulate ice crystal growth, i.e., salt, talcum powder, soils, dust and various chemical agents with minor effect. The chimney located in the reinforcement of tower structure releases tiny particles of silver iodide over the micro-clouds. The goal of iodide salt canyon is to disperse substances into the air that serve as cloud condensation or ice nuclei, which alter the microphysical processes within the cloud.
3. Micro-Cloud Structure. Tensegrity structures consist of strings (in tension) and bars (in compression). Strings are strong, light, and foldable, so these structures have the potential to be light but strong and deployable. Pretensing all strings makes its shape robust to various loading forces. The shape of a tensegrity structure can be changed substantially with little change in the potential energy of the structure.
4. Nebulizer network. Nebulizers system is incorporated over tensegrity structure each 20cm and can operate automatically by using solenoid valves and specific hydraulic station. The high-pressure of nebulizers is carried out by high-grade steel jets with tiny apertures of 120 microns in diameter, through which the water is forced at a pressure of 80 bars onto fine needle points directly above the apertures and atomised into innumerable tiny droplets 4 to 10 microns in diameter, as Blur's project.
5. Water transmission surfaces. Water managers have being exploring precipitation enhancement via cloud seeding as alternative to augment water resources. In the micro-clouds' network are employed small dust seed chimneys located in the reinforcement of transmission tower creating reservoirs such as water tanks for local use as well as water pipelines to build infrastructure to store and transport water to where it is needed.
6. Rain gardens. It is a shallow depression that is planted with deep-rooted native plants and grasses. Their characteristic are: reduces flooding and erosion, less imported water used for yard

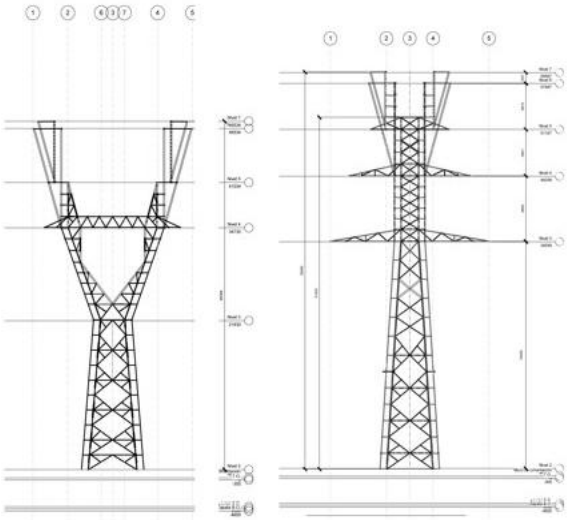

Fig. 6. Reinforcement of transmission tower's structure
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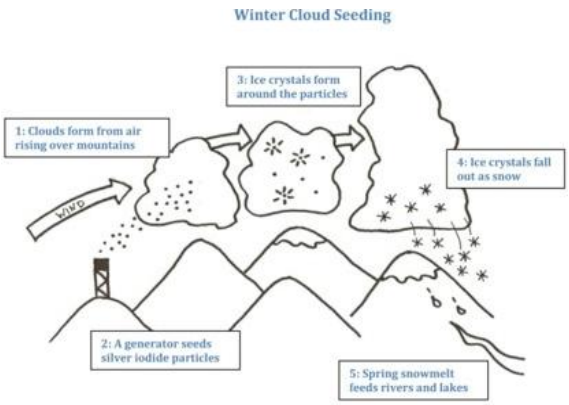

Fig. 7. Silver iodide canyon structure
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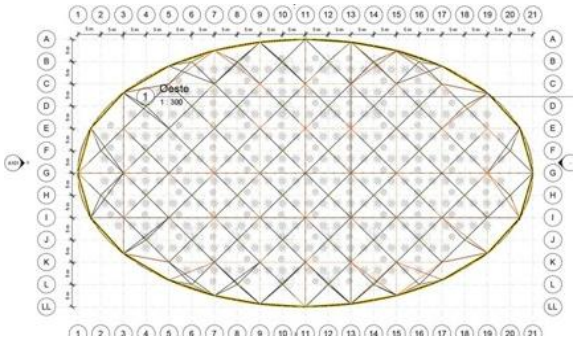

Fig. 8. Micro-Cloud Structure of Tensegrity structure
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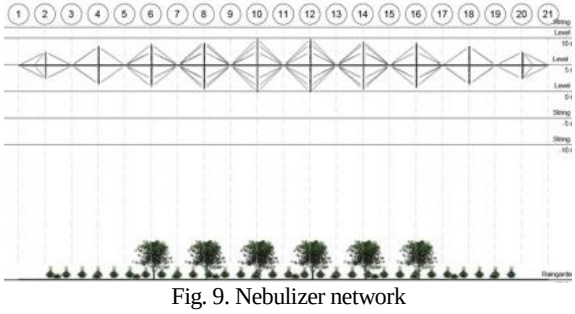

Fig. 9. Nebulizer network
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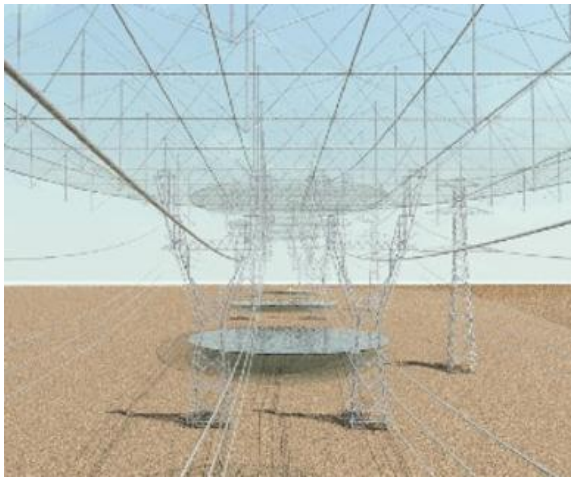

Fig. 10. Water transmission surfaces
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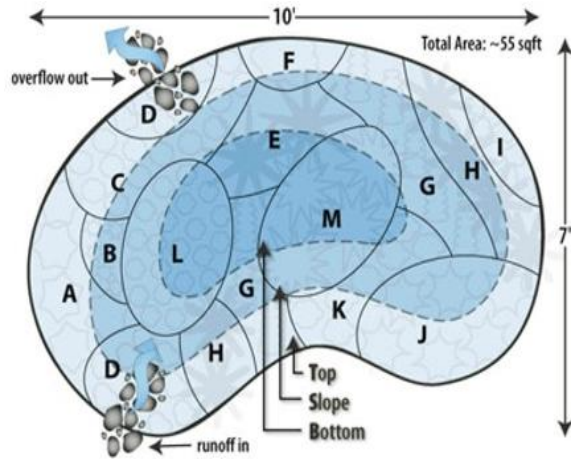

Fig. 11. Rain gardens surfaces
[Source: material from author personal archive]

irrigation, lower water bills, less polluted storm water runoff and biodiversity recovery. It is an action against rain and snowmelt flowing off of yards, roofs, and sidewalks and washing pollution into water systems. Rain gardens are designed to collect and absorb runoff from a roof or parking lot, the way nature intends rain to soak into the soil. Even it is a way to stop evaporation over water reservoirs.

To summarize, the structural elements are:

1. Pillar bars (circular hollow section ROR 101,6x10 mm).
2. Beam bars (circular hollow section ROR 219,1x10-101,6 x10 mm).
3. Strings (circular M30-50mm).
4. Nebulizers (high-grade steel jets/20cm).
5. Tower Structure Reinforcement (IPE 100-50-UPN 100).
6. Silver iodide canyons.
7. Water pressure group.
8. Water tanks (PE pond).
9. Water canals and pipelines between tanks.
10. Rainwater gardens construction.

Results and discussions

It is worth noting that there are previous researches about how to deal with light and atmospheric structures. In relation with natural resources, Patrick Geddes showed the Valley section and the purpose of his theory and understanding of relationships among the units of society was to find equilibrium among people and the environment to improve such conditions. "The valley section is a longitudinal section which begins high up in the mountains and then follows the course of a river down the mountains and through a plain toward its estuary at the coast. He expresses in the valley region that Enlightenment theory of social evolution describes mankind's development through the four stages of hunting, pastoral, and agriculture toward commercial societies" [8].

Firstly, the futurist project named "Cloud 9" of Buckminster Fuller is a floating city that uses tensegrite structures of half-mile (0.8 km) diameter. It would weigh only 1/1000 of the weigh of the air inside of it and if the internal air were heated by either solar energy or human activity inside, it would only take a one degree shift in Fahrenheit over the external temperature to make the cloud float. One of the most practical uses he proposed of them was as disaster sites for emergencies [9].

Secondly, Paul Maymont used the project named "Village vacances suspend" to explain how to recover the lost harmony with the environment by hanging cities. He created a vertical and modular stratification that allows a very high density of around 10.000 inhabitants per km2. Considering that traffic movement is a waste of time, Paul Maymont explained that suspended highways interconnected these modules [10].

In "Cité des sables", Paul Maymont studied the future of the cities in different environments with the minimal impact on them.

Thirdly, "Blur project" of Diller & Scoffidio talked about the use of recycled materials we can find in the surrounding environment such as the water of the lake. It is a fog mass resulting from Lake Neuchatel whose water is pumped, filtered and shot as a fine mist through 35,000 high-pressure nozzles. The lightweight tensegrite structure measures 300 feet long by 200 feet wide by 75 feet high and is supported by four columns [11].

Finally, environmental engineering firm Transsolar and Japanese studio Tetsuo Kondo Architects prepared an atmospheric installation called "Cloudscapes" which is created by pumping three layers of air into the space: cold dry air at the bottom, hot humid air in the middle and hot dry air at the top. They have suspended a cloud inside the Arsenal exhibition space at the Venice Architecture Biennale in 2010 [12].

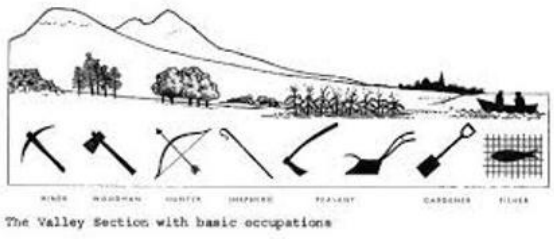

Fig. 12. Patrick Geddes. Valley Section, 1909
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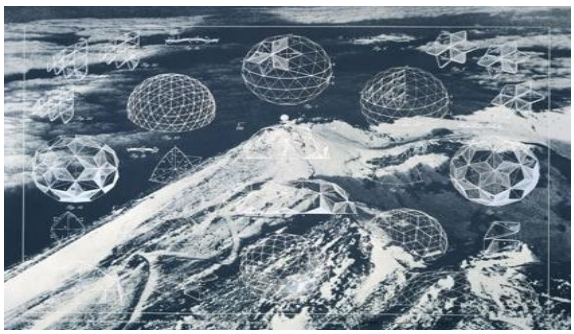

Fig. 13. Buckminster Fuller. Cloud 9.
Project for a Floating city, 1930s-1950s
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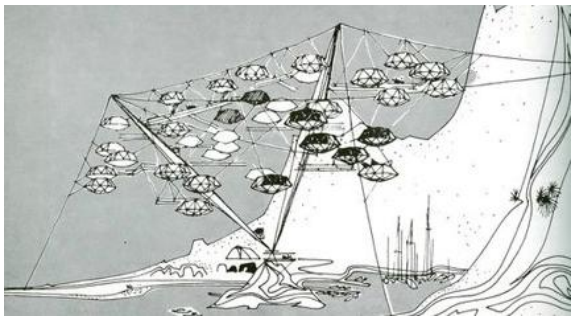

Fig. 14. Paul Maymont. Village vacances suspendu. 1960s
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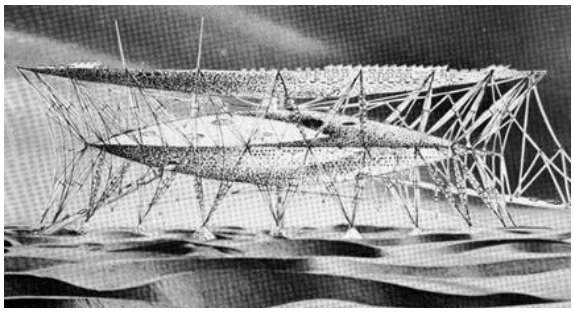

Fig. 15. Paul Maymont. Cité des sables. 1960s
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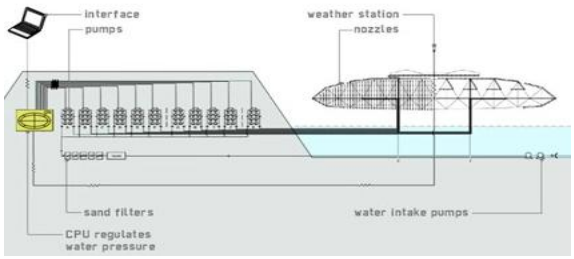

Fig. 16. Diller & Scoffidio & Renfro. Blur's project.
Expo Hannover, 2002 [4]

Fig. 17. Transsolar&Tetsuo Kondo., Bienal Venezia, 2010 [5]

Fig. 18. California maps; CA1 High Richardson & Roaring Creek, CA2 Mid Madison, CA3 Low Diablo Canyon Nuclear Power Plan [Source: material from author personal archive]

There will be three projects' areas: CA1 High Richardson & Roaring Creek, CA2 Mid Madison, CA3 Low Diablo Canyon Nuclear Power Plan.

These water banks create additional supply water system for local residents and transmission water surfaces connecting the whole micro water reservoirs. The initial amount of water required for nebulizers system from water reservoirs will be recovered and incremented by micro-clouds's rain caused by silver iodide canyon, which transform water vapour into snow. New water networks would profit topography.

1. *CA1 Location. Mountains (CA High).* It is a rural topography with density of scrubs and large forest.

CA1 Climatic parameters:

- Semi-arid Mediterranean climate.
- Sunlight (Tmax=38ºC/TºMin=-8,0ºC).
- Wind: Delta breeze Summer E.
- Precipitation (470mm/year).

CA1 Existing Water resources:

- California aqueduct. It is part of State Water Project. It takes water from San Joaquin and Sacramento Rivers in North California to irrigate agricultural crops of Central Valley and transfer water through los Angeles;
- Sacramento. It is the second most flood susceptible city in the United States after New Orleans.

CA1 High Richardson & Roaring Creek. The new management of aquifers is the main theme. The excessive extraction of subterranean water has left groundwater level below local vegetation's roots generating great amount of salt that is the origin of dust formation. Salinization, aquifer depletion and progressive accumulation of sediments reveal the instability of hydraulic system. Water bank could be an instrument to manage droughts. Experience acquired in emergency drought water banks in California provides certain lessons for the future development of these banks. These micro-clouds act as sprinklers grid that try to reduce dust dispersed into lakes for recovering biodiversity, at least bird's settlements. At the same time, micro-clouds' reservoirs try to increase the amount of water of subterranean aquifers.

CA1 High Richardson & Roaring Creek (Mountains) Intervention is linked with the recovery of soil permeability. Aridity extends water research along vast distances, from the melting of the glaciers in the Rocky and Sierra Morena Mountains. Runoff is stored and separated from territory to transport water through kilometric tubes and pipes to hermetic reservoirs located in the city. Topography is ignored by energy efforts such as pumping stations, which invert the decreasing field of potential energy. Water is relocated and disconnected from local topography because of

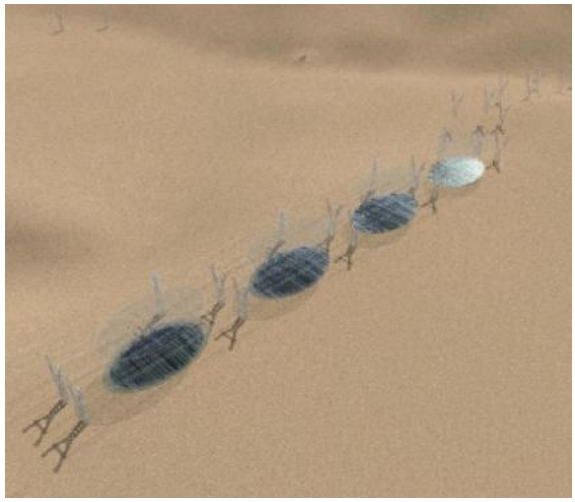

Fig. 19. Power & Water location;
CA1 High Richardson & Roaring Creek
[Source: material from author private archive]

Fig. 20. Power & Water structure;
CA1 High Richardson & Roaring Creek
[Source: material from author private archive]

pipelines' network that provides water supply and sewage, treatment plants, purifiers and the point of effluent discharge in the Pacific. For those reasons, connecting micro-clouds' reservoirs could be an alternative porous proposal to the tubes and pipes.

2. *CA2 Location. Agricultural lands (CA Mid).* It is a field where the agricultural and animal production area conditions the surroundings.

CA2 Climatic parameters:

- Hot-summer Mediterranean climate.
- Sunlight (Tmax=48ºC/TºMin=-8,0ºC).
- Frost to December through February.
- Precipitation (845mm/year).
- Fog: December to January: Tule fog.

CA2 Existing Water resources:

- Shasta Dam on the Sacramento River. It provides a considerable level of flood protection for Redding. The dam is capable of controlling flows up to 79,000 cubic feet (7,300 cubic meters) per second.
- Keswick Dam. Just upstream of Redding, it marks the end of the free-flowing reach of the Sacramento River. It is the highest point upstream at which salmon and steelhead spawn.

CA2 Mid Agricultural lands. The original geometry will be affected by the impacts of extreme weather events and the time of day or night; moving away from the desire to impose static order such as rigid geometric design on nature which is rare, and usually temporary, passing through the micro to the macro scale of thermodynamic /climatic parameters. Landscapes are dynamic and the result of physical processes (such as erosion and sedimentation) and biological processes (involving growth, blossoming and decay).

CA2 Mid Madison. The decentralization of engineered infrastructure must make way for practical reclamation of biophysical processes and reintegration of ecological flows, relating the macro to the micro-scale of biological studies. In the case of small biotopes, connected islands of landscape reveal the possibility of using balanced resources, which consist of the right qualities and proportions of water, drainage, minerals and electricity need to maintain growth. Biotopes networks and polycentric nodes of resources are generating live-work patterns that are increasingly distributed and dispersed.

3. CA3 Location. Coastal zones (CA Low). It is an approach to the riparian and coastal vegetation dynamics.

CA3 Climatic parameters CA Low:

- Subtropical-Mediterranean climate.
- Sunlight (Tmax=45ºC/TºMin=-4,0ºC).
- Wind: Santa Ana winds (Wild fire risk).

CA3 Existing Water resources CA Low:

- Los Angeles Aqueduct, 1913. It is the first built as part of State Water Project. It takes water from Owens River in East Sierra Nevada Mountains through north California. It has 359km length and 3,7m diameter and 2 hydroelectric plants. It is extended 220km in 1940.
- Colorado River Aqueduct, 1941. It takes water from Lake Havasu in Arizona, along 390 km.

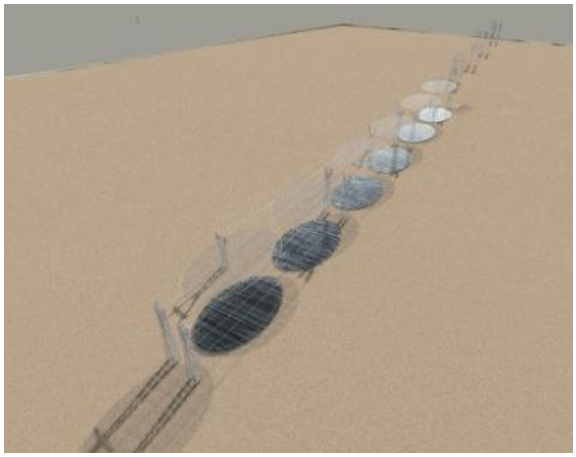

Fig. 21. Power & Water location; CA2 Location. Agricultural lands (CA Mid)
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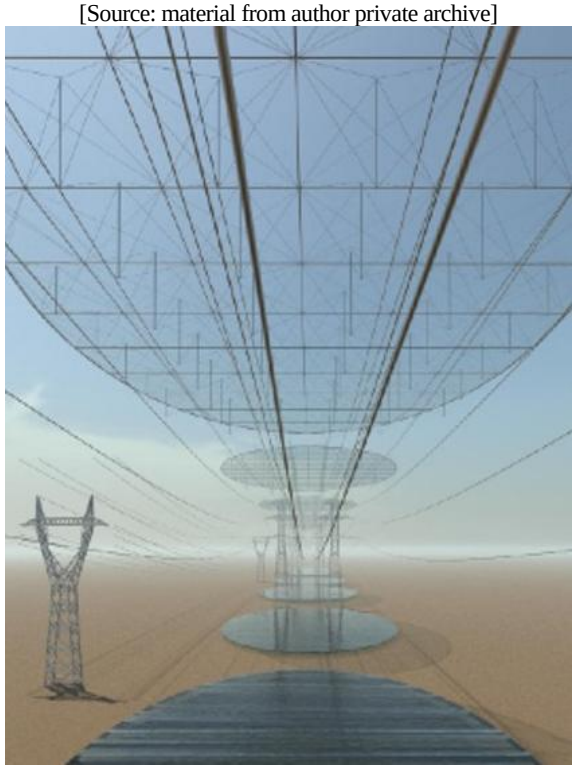

Fig. 22. Power & Water structure;
CA2 Location. Agricultural lands (CA Mid)
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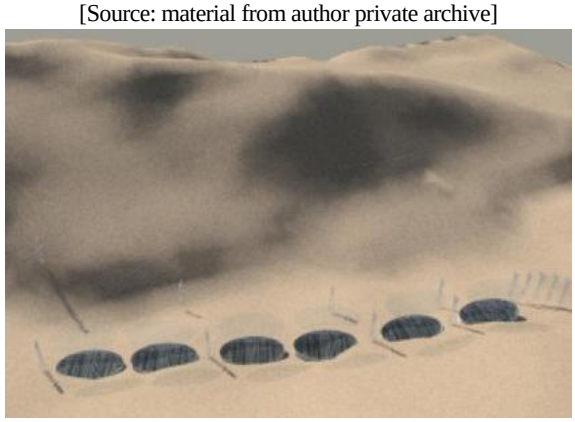

Fig. 23. Power & Water location;
CA3 Location. Coastal zones (CA Low)
[Source: material from author private archive]

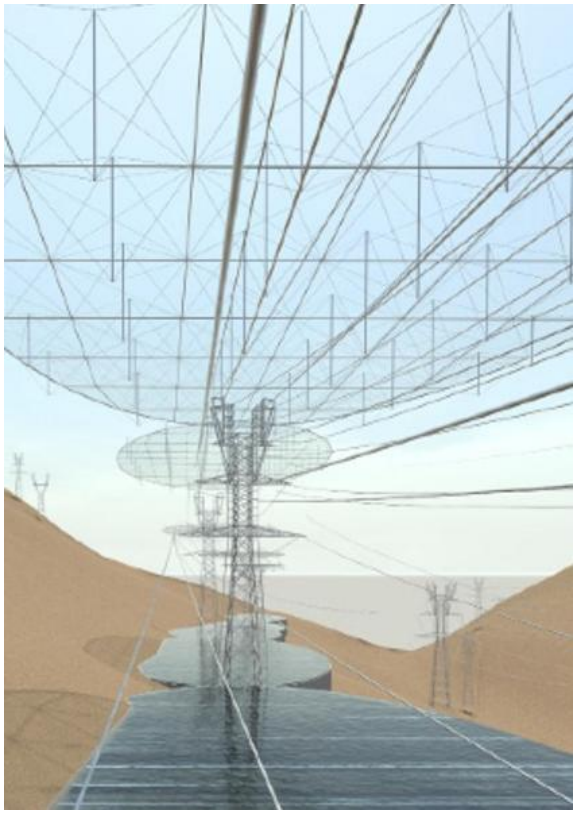

Fig. 24. Power & Water structure; CA3 Location. Coastal zones (CA Low)
[Source: material from author private archive]

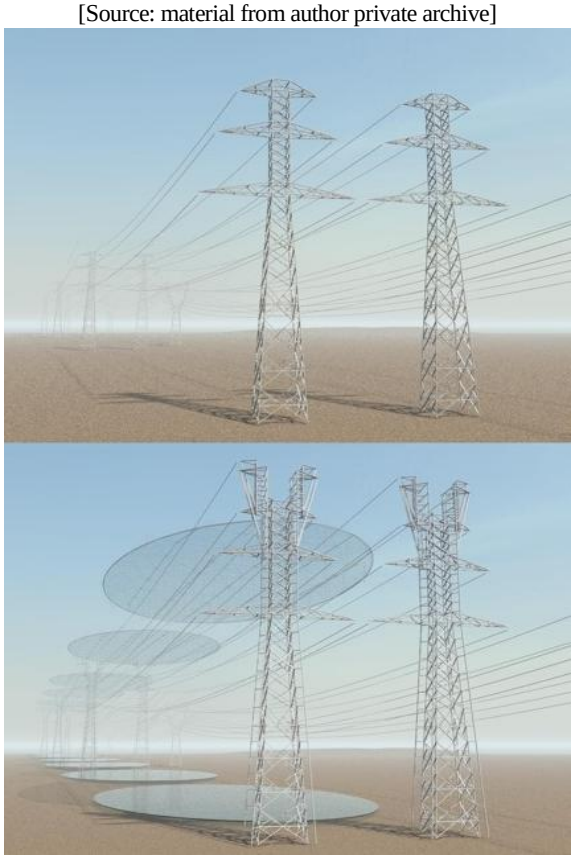

Fig. 25. Power & Water resources project without and with reinforcement structure
[Source: material from author private archive]

The aqueduct raise water 492 m by 5 water pumping stadions;

- Hoover Dam, 1936. It is made possible the development of California, Nevada, Utah y Arizona.
- Los Angeles microclimate. This area is also subject to phenomena typical of a microclimate, causing extreme variations in temperature in close physical proximity to each other.
- El Niño. Wet years are usually associated with warm water El Niño conditions in the Pacific, dry years with cooler water La Niña episode.

CA3 Low Coast zones. The multiple non-electric applications of nuclear energy and cogeneration allow to visualize new topographies which are small landform buildings with large areas of production: salt fields, water desalination plants, hydrogen generators, transport research centres (airdromes, ship propulsion, nuclear submarines, supply spacecraft energy), district heating, and natural reserve centres.

- Mounds as inclined platforms were the initial human response to flooding by artificial reefs, which have long been used to reduce wave height and dissipate the waves energy.
- Voids are also used for coastal adaptation to make more room for floodwaters.
- Islands are artificial surfaces that are designed to move, pushed along by waves, growing vertically by sediment or floating like dynamic landforms.

CA Low Diablo Canyon Power Plant. How can we use and protect the value of the landscape that surrounds a nuclear power station located closer to oceans or rivers by several safety protection cycles? Rivers and oceans are multi-faceted ecological, cultural, economic, and political agents, providing resources such as food, water, and transportation- and liabilities including flooding and drought. Both of them are cool water sources because of the steam must be cooled after it runs through a turbine to produce electricity and for that reason it is necessary to preserve water natural sources and ocean wildlife. At the same time the coastal area provide the possibility of topographical intervention by mounds of protection and foil storage, voids of salt stepper and desalinisations and islands of renewable energies.

Conclusion

As electric lines are much like water pipes, this project explores the possibilities of power installations to improve water resources in dry areas. In the case of transmission lines, the higher the voltage, the more electricity that can be transmitted, just like a wide water pipe can carry a larger volume of water. Moreover, electrical transmission lines

operate at high voltages and carry large amounts of electricity over long distances.

Summarizing, the future power & water resources in each of these three research areas are:

CA1 Location. Mountains (CA High). It is a rural topography with density of scrubs and large forest.

- Water banks with shade balls.
- Sprinklers grid to reduce fire risk.
- Porous water reservoirs.
- Artificial aquifers.
- Salt plants.
- Purifiers through lagoons with macrophytes.
- Increasing biodiversity: birds and small mammals.
- Drip irrigations in crops.

CA2 Location. Agricultural lands (CA Mid). It is a field where the agricultural and animal production area conditions the surroundings.

- Red porous surface. Landforms (macro, normal and micro) of the use of organic subtract not only under green areas, even in sand strips that depend on the weather conditions.
- Blue intensive surface. Water storage by drainage cells which are interlocked into a flat drainage blanket in raingardens in the city.
- Green extensive surface. Vertical designs of islands, stripes and embankments of concentrated energy resources integrating infrastructural technologies such as skyscrapers.
- Yellow lighting surface. Electric strategies for new car parks where green islands have the same rights as cars reducing maintenance costs.

CA3 Location. Coastal zones (CA Low). It is an approach to the riparian and coastal vegetation dynamics.

- Mounds of protection and storage. There are three robust storage of spent fuel: low-density pools, hardened dry-storage modules and mounds of dispersed dry-storage modules.
- Voids of salt steppes. Solar salt is the least expensive technology available favoured by a dry and windy weather and it is produced by natural evaporation of seawater (3,5 % salinity)
- Voids of desalination plants. The majority of current and planned cogeneration desalination plants use either fossil fuels or nuclear power as their source of energy.
- Islands of hydrogen production. The nuclear energy produce heat for changing water into steam and the electricity for breaking the steam down into hydrogen and oxygen.
- Islands of district heating. There are residential areas, which could be benefit from nuclear reactor for heat production.
- Islands of transport research (airplanes, ships, submarines, spacecraft).
- Islands of natural reserves. They are mixed with the wastewater treatment.

Nature's endorsement of tensegrity structures is efficient because per unit mass, spider fibber is the strongest natural fibber and these structures are transferrable form nano to mega scale. This is a great challenge to develop scientific procedures to create smart tensegrity structures that can regulate the flux of water resources, as well as, thermal, mechanical and electrical energy in a material system by proper choice of material, geometry and controls. New water networks would make use of topography, soil permeability and existing infrastructure. These micro-clouds are also important to reduce fire risk, one of the consequences of droughts.

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Kopsavilkums. Kāpēc elektrolīniju infrastruktūra ir tik svarīga, salīdzinot ar ūdensapgādes tīkliem? Kā mēs varam atjaunot dabisko līdzsvaru? Šādi un citi nozīmīgi jautājumi tiek analizēti un aplūkoti caur piemēriem šajā zinātniskajā rakstā. Kopumā pētījumā analizēti vairāki elektrolīniju infstrastruktūras apgabali, ietekme uz ainavtelpu un savstarpējie aspekti starp elektroapgādes tīklu sistēmām un ūdens resursiem, kā arī novietojums, ņemot vērā gan topogrāfiskos, gan klimatiskos apstākļus.