RICE UNIVERSITY

POWER STRUGGLE:
Explorations of a New Autonomy

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ABSTRACT

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We have lost the war with energy. Our post World War II dream of a suburban utopia based on cheap abundant energy is dead and has been rendered unsustainable. We have created a vast territory of simulated autonomy. This territory, still tethered to our energy networks, is a relentless swath of meandering streets flanked by banal serial repetitions of roof and shell stuffed with the latest inventions of modern electric living. Designed with a seemingly unlimited energy supply, the paper-thin structures have zero regard for efficiency, orientation, or even climatic region. They manifest themselves to be nothing more than a nuclear semi-hermetically sealed environment.

What is the future? The future of this territory is the reality of the post-war of energy and the creation of a new real autonomy. The architecture of energy will be based on responsiveness to its environment, its adaptability during times of crisis, its ability to become and produce energy (stored and potential), and its severed ties to the existing network.

Welcome home.
ACKNOWLEDGMENTS

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"When the electric system began over 120 years ago (starting with Pearl Street Station in NYC in 1882), generating plants were isolated and served dedicated customers. Over the next 50 years, "utilities" began linking multiple generating plants into isolated systems. By the mid-1930's, it was clear that connections between systems could bring additional reliability. They provided access to back-up generation in times of equipment failure, unexpected demand, or routine maintenance, as well as improved economics through reserve sharing and access to diverse energy resources. By the mid-1960's, the electric system had been transformed from isolated generators to an interregional "grid"."  
U.S. Department of Energy
Edison's Pearl Street Station was the world's first central generating plant. Located in New York City's financial district it occupied a 50' x 100' site and provided electricity for one square mile of NYC. The station emerges simultaneously as the first node in a larger network of power plants and as the first autonomous decentralized plant. A clear distinction of a relative scale and capacity emerges at an urban level. We see a direct relationship between the capacity of a plant and the urban form it can sustain.
The global ebb and flow of petroleum products stems from ten major hubs located around the world. Tracing the destinations of these flows the United States emerges as one of the single largest importers of foreign oil.
The establishment of the North American Grid during the 1960's manifests itself in this current state. Consisting of three main "interconnects" the United States is heavily linked to both Canada and Mexico.
A further break down of the North American Grid into the United States grid. The three main interconnects dissolve into smaller semi-autonomous grids all linked to at least one other grid across the system. Thus resulting in the creation of larger networks interconnected across the entire country.
NETWORKED ENERGY: A Growing Problem

By 2030 global energy consumption is projected to grow by 57%. This extreme demand for energy will place an unprecedented strain on our current system of networked energy. The issues plaguing our over scaled global and national networks are beginning to manifest in blackouts.

Northeast Blackout of 2003

The northeastern blackout of 2003 was the largest blackout in North American history. Ten million were without power in the Canadian province of Ontario, approximately 1/3 the population of Canada. Another forty million were without power in eight states accounting for approximately 1/7 the population of the United States. This led to international disputes as to the origin of the problem as well has tough criticism of the inadequacies of the current system.

2003 Italian Blackout

A complete meltdown of the Italian electricity grid after a storm damaged transmission lines powering Italy from Switzerland. The blackout affected 56 million people during the annual carnival celebration. The Italian blackout was the largest of several blackouts that occurred around the world in 2003.

In order to sustain current levels of continued urbanization we must shift from a large-scale centralized system to a more efficient local scale of power generation.
"The traditional model of electric power generation and delivery is based on the construction of large, centrally located power plants. "Central," in this case, ideally means that the power plants are located on hubs surrounded by major electrical load centers. For instance, a power plant may be located close to a city to serve the electrical loads in the city and its suburbs, or it may be located in the midpoint of a triangle formed by three cities."

U.S. Department of Energy
DECENTRALIZED ENERGY: Energy Footprint

Source acreage of plant 1000 homes powered per dot
DECENTRALIZED ENERGY: New Grid Possibilities

Minigrids
“One application of distributed energy (DE) is minigrids, a set of generators and load-reduction technologies that supply the entire electricity demand of a localized group of customers. By avoiding the cost of transmitting electricity from a distant central-station power plant or transporting fuel from a distant supply source, a minigrid (sometimes called a "microgrid") can significantly improve the economics of meeting energy needs using DE."

Power Parks
“Power parks (also called 'premium power parks') are an alternative to the traditional approach. They may include uninterruptible power supplies such as battery banks, ultracapacitors, or flywheels. They typically include an on-site power source to increase reliability.”

DC Microgrids
“Another concept for future power grids is to set up neighborhoods that run entirely on direct current (DC). A high-voltage DC line would interface with the rest of the grid through high-tech DC-to-AC converters.”

U.S. Department of Energy
Since its inception the post-war home has been commoditized. An obtainable dream for sale filled with the latest inventions required for modern electric living. The post World War II model of a suburban development is one of extremely low density and relentless homogeneity. This zone is a territory of a simulated autonomy, a territory that must be tethered to an existing large life support network.
The suburban model relies heavily on its ties to an existing network and its hierarchy. The home is placed in relation to its neighbor, its place on the cul-de-sac, the relationship to the residential street, the street feeding into the collector roads, and finally to the highways which deliver you to the city. The typical street is lined with the same tempered roof and shell, conditioned by a seemingly unlimited energy supply. Mass production of these homes was driven by cost, resulting in little consideration to efficiency, orientation, or climactic region.
The network diagrams illustrate the issues regarding the complexity of an add hoc system. In order to solve the energy problems currently facing us we must return to the simplicity of a regional system.
NEW POST-WAR TERRITORY OF ENERGY

The territory of the post-war of energy should be a truly real autonomous entity. The architecture of energy should be responsive to its environment and adaptable during crisis. It should have the ability to store and produce energy. There must be a greater emphasis on the collective and should no longer be about a self-contained nuclear unit. We must sever all ties to the existing networks. We can no longer rely on the car as the center of our daily lives, our needs must be provided for in a more local vicinity. This new territory should not be about the application of technology to an existing structure. For example applying solar panels to the roof of your home. Nor should it be about solely calling attention to a specific technology, such as the Hanover Pavilion by MVRDV.
The two most important economic areas vital to the Houston economy are the Houston Ship Channel and the commercial center of downtown. This is the new territory of energy, the new autonomous entity linking the downtown commercial heart of the city to its industrial counterpart. The new territory of energy relies on new energy corridors and civic institutions to sustain the neighborhood residents. The invasion of the new territory of energy grabs a foothold in the area similar to a virus. Over time the new network of mini grids permeate the existing infrastructure and gradually rid the community of the existing model of development.
The new territory of energy is based on a performative element. It is not about the application of technology, such as adding a wind turbine, solar panels, or a thermal chimney to an existing typology. It is also not about the gratuitous use of the same technology either, this is solely rendering the technology visible. It is about the performative aspect in which architecture can influence the technology.
POWER STRUGGLE

[Various diagrams and images related to power and struggle]

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