

Seeing Cyberspace: The Electrical Infrastructure is Architecture

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0. INTRODUCTION

0a. Abstract

Through architectural language, one can see the otherwise intangible Cyberspace materialized in the power, media, and technological systems of the Electrical Infrastructure. In so doing, pressing issues such as war, energy inefficiency, global warming, pollution, and economic instability can be structurally related to the seemingly separate experience online the Internet. Identifying this relationship can help to educate and organize citizens whom want to address common yet otherwise ignored needs of the representative human public.

1. INFRASTRUCTURE

1a. Tools, Buildings, and Systems

Cyberspace is the electronic internetwork materialized within the artifacts and assemblages of the Electrical Infrastructure, a symbolic new architecture representing electrical space-time, aesthetics, and culture. Its precedence is in the sublime, where metaphor itself becomes reality.

Envisioning this 'structure beneath' Electrical Civilization requires recognizing the vital interconnections between our tools, buildings, and their inherent but often invisible infrastructural systems.

Traditionally infrastructures have performed a critical role for understanding how a particular building exists in the world. For example, an architectural analysis of a classical Roman bath would be incomplete if it ignored the pipes, water, and remote aqueducts that enabled it to function.

Today the predominant infrastructure is not water but electricity in all of its phenomenal dimensions. It has become the new architectural order in the built environment. Consider Le Corbusier's cryptic statement in "Vers Une Architecture" in this regard:

"Architecture can be found in the telephone and in the Parthenon." [1.1]

Le Corbusier relates architecture with its infrastructural extension when juxtaposing the new order of electricity with the standard of architectural order in the Western tradition. This paradoxical statement makes conceptually visible the interconnection between the telephone and its assemblage of telephone lines, poles, switches, and buildings which enable it to function.

Examining the relationships between these different types of Electrical Tools, Buildings, and Systems allows the ongoing emergence and manifestation of the Electrical Infrastructure to be rationalized in architectural terms.

For example, Cyberspace remains an incomprehensible, immaterial, and abstract entity as long as we continue to disregard its physical foundation in the artifacts of the Electrical Infrastructure.

It is only an illusion that a 'virtual' building on a computer screen can be totally detached from the 'actual' world of architectural objects and their physics. The computer tool is housed by an electrical building connected to the electrical power system. Together this infrastructure materially represents and sustains the trompe l'oeil of otherworldly immateriality while simultaneously depending upon a physical assemblage of wires, plugs, and sockets to distribution lines and poles, transformers, transmission towers, and electrical power plants. Without these extensions, Cyberspace would cease to exist.

Seeing Cyberspace in turn enables us to better understand the new electrical space-time, aesthetics, and culture of the Electrical Civilization that we now live within.

As the discipline of architecture has taught legions of questing students, one must know well the foundation upon which one designs and builds. Thus we need to study the natural and artificial electrical worlds if we want to understand the virtual electrical world of Cyberspace.

Today's projection of an aestheticized 'virtual' image upon the world-screen of Cyberspace is not sufficient. The assemblage of electrical artifacts of the computer network themselves needs to be investigated: from the screen to the guts of circuitry, through power plugs and outlets and into the wires suspended from electrical poles and towers, traversing transformers and substations so as to arrive at the 'bricks and mortar' power plants which transform the coal, oil, atoms, water, wind, and sunlight of nature into power.

Underlying this artifice is an untold cosmology of the natural electrical world of molecules, atoms, and electrons which constitute matter, life, and thus humanity. The electromagnetic Earth, its charged atmosphere, and electrical lifeforms having evolved from the theoretical Big Bang of electromagnetic energy billions of years ago. Human beings ascended with an electrified brain, nervous system, senses, and consciousness which were essential for designing and building the Electrical Civilization we inhabit today.

While Cyberspace has always existed in the atmosphere of our minds, it is only now that we are able to literally see it externalized within our speed-of-light electrical technologies.

With so much complexity, enormously rapid change, and exponential evolution it may seem improbable that any larger holistic perspective of Cyberspace can be accurately integrated with the centuries which precede it. Yet, upon deep and sustained reflection this has been proven not to be the case, and reason will eventually prevail:

An Architecture exists within the Electrical Infrastructure. [1.2]

Subsequently, seeing Cyberspace requires seeing the Electrical Infrastructure as a representation of our economic, social, and political culture in built form. This not only allows one to decipher the interconnections between the natural, artificial, and virtual worlds but also provides overwhelming evidence that an Electrical Order permeates everything that exists.

Ironically, we have always built with electricity. It is the electrical force which resists the pull of gravity against the molecules that hold up the buildings made of brick, concrete, metals, and stone. Over the last 2500 years humanity has successfully harnessed this underlying mystery by bringing it to the surface of our reality, and we are now able to mediate and build with it directly. This is evidenced in all that is electronic: from the Human Genome Project mapping the human genetic code to the deep-space probes Voyager I and II which have exited our Solar System, extended as ambassadors of our emerging Electrical Civilization.

2. CYBERSPACE

2a. Electrical Energy

The grand project that is Cyberspace is grounded in the mundane realities of what it is required to sustain it. Today's multitudinous technological breakthroughs such as the Internet are still reliant upon ancient and recurring themes tying the diagnostic health of Electrical Civilization to its sources of energy, war, and economic stability.

Electrical Energy: In its current manifestation, generating electrical power is mainly a destructive endeavor of extracting resources from the Earth as fuel for the electrical grid of power plants and the technologies it runs. 2/3rds of the electrical power generated is lost to waste heat before it can ever be used, due to large scale, highly-centralized production facilities and the hundreds of miles of transmission and distribution power lines the energy must transit before being consumed. When the power finally reaches an electrical device even more energy is wasted in its inefficient use.

Futhermore, non-renewable fossil fuels are being burned at an ever increasing rate. Oil is still the lifeblood of Electrical Civilization, without it most every machine would cease to function. With its use also comes oil spills, toxic refinery emissions, and geopolitical wars to control the limited resource. Likewise, coal is a temporary but plentiful energy source, yet coal-fired power plants are at the same time the leading cause of greenhouse gases which are suspected of causing Global

Warming. So too, nuclear power plants are still widely used, even though there currently exists no safe way to dispose, no less store, the subsequent radioactive nuclear waste for hundreds of thousands of years into the future.

2b. Electrical Warfare

There is an intimately close relationship between the military-industrial complex, the energy sector, and energy policy. This is because energy is strategically important to national security and geopolitics. In the United States, for example, the Department of Energy [DoE] is a major part of the Department of Defense [DoD]. Likewise, the U.S. Atomic Energy Commission [AEC] oversees both research and development for nuclear power plants and weaponry. Energy is a keystone between national and international security agendas.

Thus any attempt to dramatically alter the development of the Electrical Infrastructure often fails outright because any challenge to the current policy, driven by an industrial worldview, falls back onto the shoulders of authorities in the national security and energy administrations and their military and industry contacts, all of whom have a vested and short-term special interest in keeping the bureaucracy of power functioning as it is, fundamentally unchanged.

Instead of implementing a proactive energy policy with conservation measures, public investment, and strategic redesign, there are energy wars.

Nuclear weaponry is devastatingly destructive. The theory of 'mutually assured destruction' (MAD) that kept Cold War superpowers in a precarious balancing act remains today, because with more actors on the world stage the likelihood of a regional nuclear war turning global increases. In addition, terrorists could detonate a device such as the infamous nuclear suitcase and destroy an entire city. Currently less than a dozen countries maintain an arsenal of tens of thousands of nuclear weapons.

The impact of nuclear weapons ranges from conventional explosive power to specific effects on the Electrical Infrastructure. Intercontinental ballistic missiles [ICBMs] can carry payloads of several nuclear warheads, each of which can annihilate an enormously large percentage of all buildings and inhabitants within several miles of impact, including making the environment radioactive and uninhabitable for generations thereafter.

One type of nuclear weapon specifically targets the Electrical Infrastructure and would likely be used in limited nuclear warfare. The electromagnetic pulse bomb is a small nuclear warhead detonated in the atmosphere above a targeted area. The electromagnetic pulse [EMP] it radiates is a bursting of gamma rays that disables or destroys all unshielded electronic equipment in the targeted area. Thus an EMP bomb could not only render much of the military inactive, but also all of the computers and regional networks that sustain Cyberspace. So too the electrical energy relied upon by millions of civilians for heat, light, and power would disappear instantaneously and indefinitely.

Oil embargos can also be used by oil-exporting countries to leverage their power over oil-importing countries for geopolitical ends. When the Organization of Petroleum Exporting Countries (OPEC) raised oil prices in the 1970s vast energy conservation measures were enacted in the U.S. to counter the total dependence upon this energy source. Ultimately, an oil embargo could devastate the entire communications, energy, and transportation infrastructure as it would be ground to a halt for a lack of oil to lubricate, power, and run the machinery keeping everything in motion.

Thus wars have and will continue to be waged to protect and exploit the world's energy resources in the name of national and international security. This is because today's geopolitics are energy politics whose policies are driven by an institutionalized energy ideology that protects often despotic industrial modes of operation.

A common tactic in electrical warfare specifically disables or destroys the Electrical Infrastructure, as the U.S. and its Allies have recently displayed. In Serbia a 'graphite bomb' cruise missile was tested in which canisters of graphite tape exploded into great nets of ribbon above power lines, which then short-circuited the electrical grid by causing power spikes and arcing. In the Gulf and Serbian wars, electronically guided 'smart bombs' sought out electrical power plants and telecommunications facilities via artificial intelligence (AI) software and global positioning systems (GPS) so as to disable the electrical command and control of the enemy forces.

Thus whole countries, their soldiers, and civilian populations can be cast into an isolated darkness within hours of war. It is one thing to have an act of nature cause a power outage, but another to have an enemy of war turning the lights off at will. This is the new nature of warfare, and the Electrical Infrastructure is the main target.

The electronic computer is critical to all of the above mentioned military technologies, yet nowhere are its potential capabilities for offensive and defensive action more likely to be fully expressed than in the realm of information warfare and electronic espionage.

Security Experts utilizing networked computers can manipulate electronic information, including turning off portions of the electrical grid. Computer viruses can be unleashed to damage networked computers on a global scale and disrupt electronic banking and global stock markets. And electronic surveillance technologies can be utilized by security agencies and others to covertly monitor Cyberspace under the aegis of looking for terrorists, spies, and subversives whom threaten the established order, the UKUSA Echelon network being the most notable of these.

The architect John Young is spearheading the effort to disseminate information on these societal, and thus architectural issues which includes cryptography, privacy rights, and designing building for protection from electromagnetic surveillance. [2.1]

Such advocacy work raises the ire of many in the reigning power system, as any effort to substantially alter the Electrical Infrastructure threatens the national and international security establishment if it opposes the outdated industrialized world view of total control and unquestionable authority that runs Electrical Civilization today.

Yet, if an energy policy guided by a shared human interest were to be enacted, it could invert the pyramid of electrical power by democratizing its present and future development.

2c. Electrical Economy

Cyberspace ceases to exist without electricity. And without the wars that sustain and protect it so too would the New Economy as it depends upon Electrical Power, Media, and Technology in order to function.

In the last one hundred years electrification has transformed the entire economic, social, and political culture from a pre-electric to an electrical state of affairs. Yet the industrial power plants of the Old Economy remain the foundation for the New Economy of the Internet and the World Wide Web. The electrical current generated at these plants are the vital prerequisite for electronic commerce in Cyberspace.

In particular, the automated and standardized manufacturing processes of the electrical factory of the Old Economy today still represents most all goods and services produced, sold, and consumed in today's global marketplace, including nearly every piece of computer hardware that makes the New Economy possible. All areas of the economy, both New and Old, are thus influenced by and reliant upon electricity in order to function.

The New Economy of Cyberspace represents a paradigm shift from the material tangibility of molecules of atoms into the abstraction of sub-atomic bits of electronic information, as Nicholas Negroponte first stated. For example, an Old Economy bank with human tellers is transformed by the New Economy into automatic teller machines (ATMs) and an online banking website, enabling transactions 24 hours/day and 7 days/week via an electromagnetic bank card.

This dualism of the Electrical Economy has created a fissure both locally and globally, and it is not yet known how or whether this gap will be bridged. The problems of the Old Economy are amplified in the New Economy where inequality, classism, and poverty persist unabated. Organizing labor in the high-tech work force and addressing the Digital Divide are two recurrent themes in a new guise.

The symbiotic relationship between the mature and elderly Old Economy and the exuberant and youthful New Economy can be seen in the electronic pulse of the stock markets. The most important fact being that both require the Electrical Infrastructure in order to keep their pulse, and profits, alive. If the electricity stops flowing, so does the money and economic devastation can be the result.

In summary, the electrical 'structure beneath' Cyberspace is dangerously energy inefficient. Wars are needed to obtain and protect strategic energy resources. And the local and global economy of Electrical Civilization depends upon this subsidization of power in order to function and to grow.

Challenging the underlying energy policy of the Electrical Infrastructure requires questioning the *modus operandi* of national and international security agencies, the energy industry, and government officials and their entrenched special interests. It must become our responsibility, as public citizens, to change this dystopic system for the better by transforming the rules by which it operates. An architectural 'way of seeing' the Electrical Infrastructure holds the key to this action.

3. CRISES

3a. Electrical Outages

Substantial reason exists for reconfiguring the Electrical Infrastructure as multiple crises threaten the daily sustenance of our Electrical Civilization. The impact of these critical lapses ultimately jeopardizes Cyberspace and the New 'Electrical' Economy.

Electrical power outages are increasingly common. Blackouts range from minutes to hours and days without electricity. Nature is often the cause with its earthquakes, hurricanes, blizzards, heat waves, tornadoes, floods, and thunderstorms. Going without power for any length of time reminds people of how critically dependent upon electricity we have become, and how we cannot fathom functioning normally without it. Basic skills such as cooking, cleaning, and communicating, and advanced skills such as telecommuting via a networked computer are all dependent upon a functioning electrical grid.

This dependency upon electricity is now causing a major crisis in California, such that the supply from all of the active power plants on the electrical grid can no longer meet the demand for power. The following scenario may foretell what might happen elsewhere when the New Economy takes hold.

California is well-known for its natural disasters such as droughts, earthquakes, and fires. But today the disaster is the Electrical Infrastructure, such that during the holiday season residents were asked not to use electrical lights for holiday decorations for fear of bringing down the electrical grid. Electrical power production has been at over 95% capacity dozens of times, and several times over 98.5% capacity, triggering 'rolling blackouts' where electrical power is turned off to roving sectors of the state in order to keep the rest of the grid up and running. Even with temporary power plants online and interstate power, the current demand for electricity cannot be met.

In the epicenter of the New Economy, the Silicon Valley of San Jose, the demand for electricity has increased because of the vast amounts of power needed

for buildings such as semiconductor fabrication plants (FABs) and web hosting Server Farms. Some companies like database software maker Oracle are building their own private power plants so as to not risk losing millions of dollars in manufacturing costs when the power goes out. Several large corporate customers receive rebates for voluntarily generating their own power in times of emergency. Ironically, at the same time there is great opposition to building a new power plant in the area while billion dollar companies such as Intel have stated they will not build new facilities in California if the electrical crisis is not resolved soon.

Add to this scenario the fact that electronic-commerce and dot-com companies in California cannot effectively function without a steady and reliable supply of electricity, and the state of disaster looms larger and larger. Furthermore, the deregulation of the electrical power supply in the state has resulted in electricity bills doubling and tripling in cost within a few months time, due to high demand in the marketplace for a limited supply of electrical power. In the State of the State Address the Governor, Gray Davis, spoke extensively of the power crisis and rhetorically threatened to use eminent domain to take public control of California's private power plants if necessary.

The electrical crisis continues day by day, and year by year, into the future. What is happening in California and the U.S. may well happen in other places the New Economy takes hold, and the Old Electrical Economy directs the action. While acts of terrorism, sabotage, war, and natural disasters all cause power outages, these events may soon become secondary to the disasters resulting from short-sighted energy policies which misguide our Electrical Civilization today.

3b. Electrical Inefficiency

The energy crisis of the 1970s led the United States and other countries towards energy conservation. Daylighting, passive and active solar, energy efficient windows, doors, and insulation optimized the energy efficiency of buildings, which temporarily reduced demand for electrical power, and thus oil, and the sense of threat to national security.

Still these gains did not affect the larger inefficiencies of the Electrical Infrastructure. Because of economies of scale most electrical power plants remain highly centralized with enormous generating capacities. More than 2/3rds of the power generated is lost to waste heat through its transmission through hundreds of miles of power lines in order to reach consumers. This centralized design is also strategically vulnerable to any concerted attack in that a few missiles could take down the entire electrical grid, whereas a decentralized power system would make this scenario improbable.

The electrical appliances industry has sought to make energy savings an issue. Electric washers and dryers and refrigerators all use less power, as do most computers. Even computer microprocessors like the Crusoe chip by Transmeta seeks to be as energy efficient as possible in an effort to maximize its effectiveness for use in mobile communications. Unfortunately these gains are minimized by some long standing problems. For example, the current battery life of a laptop

computer is 6 hours, a cell phone is a few days, and a personal digital assistant (PDA) is a few weeks. Rechargeable batteries do not store enough power for any substantial length of time, and disposable batteries waste enormous resources for their temporary supply, all of which makes the current battery technologies for portable electrical power untenable.

Another grand inefficiency exists in the planned obsolescence of electrical technologies, especially computers. Expensive computer hardware has a practical life span of only 2 or 3 years, while costly software devolves even more rapidly, requiring constant upgrades. Older computers and software are rendered obsolete as they are unable to function with the latest innovations. It is believed to be more economical to purchase an entirely new computer system every few years than attempt to upgrade an old computer at an equally great cost. This waste of manufactured resources and the energy it takes to create them is obscene and beyond reason.

In all, most every Electrical Tool, Building, and System of the Electrical Infrastructure- including the Internet and its Cyberspace - depends upon electrical power that is less than 33% energy efficient.

To say this is a crisis is an understatement- it is an unethical policy that benefits no one.

3c. Electrical Pollution

While the theory of Global Warming is currently being debated by scientists, everyone agrees that the weather has become increasingly unusual, and this has caused both more power outages from weather-related disasters and increased demand for electricity during statistically cooler and warmer than usual temperatures. Not only do the seasons of the year seem to be shifting, but the weather is becoming more violent, unpredictable, and extreme.

Not surprisingly, fossil-fuel electrical power plants are the number one cause of the pollutants released into the atmosphere which have led to this effect on the global environment. Yet no significant change in energy policy is in sight which would reverse this global trend.

Attempts at reducing greenhouse gas emissions in line with the U.N. Kyoto Protocol on Global Warming in 1997 have so far been unsuccessful. For example, at the November 2000 meeting in the Hague, Netherlands, the United States government opted for the short-term economic profits rather than risking changing the way the Electrical Infrastructure works. In 2001, the new U.S. Administration, heavily supported by the oil and energy sectors, continues to disregard the strategic importance of addressing these problems proactively.

Ignoring energy policy will be the Achilles heel of the New Electrical Economy.

Millions of tons of highly-toxic, non-biodegradable electronic equipment is discarded at city garbage dumps and landfills, causing pollution when their rare

minerals and radioactive components are left to stew, leaching toxins into the soil. Likewise, billions of disposable batteries are discarded, releasing toxins and contaminating the environment while their mined and manufactured resources are thrown out as pure waste.

Controversy also surrounds emissions from electromagnetic fields [EMFs] and whether or not they are cancer causing. International investigations have been launched to study communities transversed by high-voltage power lines whose residents have unusually high rates of cancer and birth defects. Similarly, research is being conducted which questions the relationship between mobile telephone use and brain tumors.

While the negative effects from EMFs are hotly contested, it is important to remember that we do not know the full effects of our increased exposure and proximity to EMFs on the human body and brain. At the same time we exist enveloped, en masse, in dense fields of electromagnetic radiation.

At some point a relationship between human health, disease, and living in an Electrical Civilization will be recognized. Two medical researchers are of note in this regard. Dr. Merrill Garnett whose work in electrogenetics offers a new approach to cancer treatment. [3.1] And Dr. Andrew Marino whose extensive work focuses on the relationship between human physiology and electromagnetism. [3.2]

The threat of contamination of humans and the environment by lethal doses of nuclear radiation is also ever-present. Nuclear war is one precedent. Another is revealed in the meltdown of reactors at nuclear power plants such as that in 1979 at Three Mile Island in Pennsylvania, USA, and in Chernobyl, Ukraine in 1986. Added to this is the very real possibility for a nuclear meltdown of the reactors onboard any of the hundred or so nuclear submarines, ships, and aircraft carriers patrolling the oceans of the world, or decommissioned and abandoned in naval graveyards.

Furthermore the spent fuel from all nuclear reactors has to be safely disposed of - yet this is currently not possible.

Attempts have been made to bury nuclear waste underground and in concrete casks in the oceans. Still, given the time needed for the radioactive elements to decay, these will inevitably leak deadly radiation. Humans will have to live with radioactive waste for generations upon generations to come. While the cost of generating nuclear power may seem cheap in terms of price per kilowatt hour or a good solution for Global Warming, the unknown costs are never included in the economic price tag. And the people will end up paying for the cleanup from nuclear contamination and for storing nuclear waste for hundreds of millennia to come.

Because of this, the true cost of our energy policies must include rendering the planet Earth increasingly uninhabitable for human beings. While nature will survive, we may not.

The crises of Electrical Civilization that we are now experiencing are caused by an outdated and destructive energy policy of the industrial era and mindset. Instead of changing its course, governments and industries have bunkered down to

protect the inherited Electrical Infrastructure in the name of short-term profit. This approach totally ignores the fact that the crown jewels of the New Economy and Cyberspace will no longer exist if the Electrical Infrastructure fails to function, which it will do unless we radically change our local and global energy strategies.

Concerned politicians, scientists, and activists have all been unable to accomplish this task by reason alone. There are too many special interests with too much power controlling the future direction and development of the Electrical Infrastructure, well outside of the public's democratic control.

A new common sense tactic is required which will unite public citizens whom want to change this outcome. With the passionate will of planners, designers, and architects supplementing that of the politicians, scientists, and activists the case for change will be made crystal clear:

A new public energy 'policy' will be constituted, ratified, and enacted in the democratic and grassroots redesign of the Electrical Tools, Buildings, and Systems that constitute our shared Electrical Civilization.

As Le Corbusier implied: architecture cannot be avoided. The revolutionary opportunity now exists to understand the Electrical Infrastructure as the literal representation of the reigning economic, social, and political order. If we can begin seeing Cyberspace as a physical extension of this 'structure beneath' Electrical Civilization, we can also commit ourselves to strategically rebuilding it in a more progressive direction, optimizing its long-term viability and thus our own.

Revisionist policies based on the virtues of the industrial power system, such as national security and cheap gasoline, are delusional in that they only serve the powers of the past, and which threaten the very democracy that supports them.

Instead, strategic energy policies are needed that will free the public from the crises that continually plague us, inherited through the industrial power system and its worldview. Our goal should be to inhabit a democratic, just, and two-thirds sustainable Electrical Civilization by 2100 common era.

4. STRATEGY

4a. Electrical Planning

What is needed to change the misguided industrial worldview that continues to develop the Electrical Infrastructure?

Public awareness through education of the cultural aspects of the Electrical Infrastructure. That is, to understand from both scientific and artistic vantages how our economic, social, and political systems are ordered by electrification.

With unified actions in Electrical Planning, Design, and Architecture working in collaboration with other disciplines, the human public can once again lay claim to its destiny to self-determine its future.

As a goal unique to our century, the strategic redesign of the Electrical Infrastructure will be the greatest building project of the 21st century, preparing the formwork and framework for a democratic and sustainable Electrical Civilization, into the future. The effects of doing nothing are predictable. More nuclear wars, increased pollution, and an irreparably broken society due to a lack of vision, courage, and a will to change the status quo.

A new holistic understanding of the Electrical Infrastructure can be revealed by investigating and interrogating everyday Electrical Tools, Buildings, and Systems. It consists of shared and open standards, is both cooperative and competitive, and is organized around public and private partnerships between governments, citizens, businesses, organizations, and professionals whom value social and economic profit alike. As a decentralized strategy it utilizes grassroots efforts to enact large scale changes that are otherwise impossible.

In this way, the problems of the past and the possibilities of future of the Electrical Civilization can be seen in their full spectrum, through a shared and multidisciplinary scientific and artistic awareness with which we can develop a working model for changing the industrial system of power.

Now it becomes absolutely essential for planners, designers, and architects amongst other artists, to coordinate their efforts so as to implement the necessary changes in the built environment as part of their civic duty as citizens of the world. By recognizing the vital importance of the Electrical Infrastructure our daily livelihoods, artists can create and sustain this new awareness for the public at large, which will someday become 'common' sense.

Electrical Planning investigates and interrogates Electrical Systems which need to be strategically organized by multidisciplinary planners so as to securely establish a democratic Electrical Infrastructure and the Cyberspace reliant upon it.

To do so requires planning a decentralized network of community-based power plants. When feasible electricity should be generated from alternative and clean energy sources including wind, solar, geothermal, and hydropower. In addition, small localized power plants burning natural gas, oil, and coal should be used to reduce the inefficiency and pollution caused by larger centralized plants. All residential, commercial, and industrial sectors will need to be required to generate a portion of their own power and to sell any excess back to the community electrical grid.

Microturbines and cogeneration technologies can help accomplish this task as can fuel cells, a technology which has existed for more than 150 years. Fuel cells create electrical power through an electrochemical reaction of oxygen and fuel, without combustion, with applications ranging from power plants to batteries. One future envisions fuel cell automobiles whose excess electrical power is fed into to the electrical grid when not in use. Also possible is that someday every building

may be powered by its own fuel cell. Even so, we can no longer wait for a theoretical silver bullet to solve today's planning problems sometime in the indefinite future.

The adoption and enforcement of energy conservation measures via local planning codes will be critical to any electrical planning initiative. All buildings new and old must be required to conserve energy when and wherever possible, and it should be a violation of the law if they do not.

Energy conservation is not only an environmental strategy but also an economic and military one, certainly not to be dismissed as "a personal virtue" as U.S. Vice President Cheney did, who heads the planning task force for the nation's public energy policy.

Planning for self-reliance and energy efficiency will limit power outages caused by disaster, decrease pollution, and reduce greenhouse gases. Localized power will also enable a new electrical grid to be built that communities will be in control of. Long term, a reduction in energy costs and less dependency upon foreign resources such as oil and gas will help deter and avert unnecessary energy wars. National and international security would also be strengthened by having hundreds of thousands of sources of electrical power rather than a small number of highly-centralized targets in times of war. Governments could spur these necessary changes by offering tax breaks, rebates, and subsidies.

The need for Electrical Planning is further strengthened if telecommunications technologies such as fiberoptics, cable, satellite, and broadband wireless are taken into account. For how are the electronic internetworks that constitute Cyberspace going to function if the Electrical Infrastructure can no longer maintain itself, due to a total dependence upon a centralized electrical power, as is proving to be the case in California?

Planning this new Electrical Infrastructure will demand both public and private collaboration and investment, and a shared and public vision of what kind of world we want to live within during the next century. Profit will be realized from investing in large-scale cultural transformation. And a bond between citizens, businesses, and government will form, solidifying and stabilizing communities by raising the standard of living through long-term planning for a sustainable Electrical Civilization.

4b. Electrical Design

Electrical Design investigates and interrogates Electrical Tools. The creation and innovative use of Electrical Tools by designers and artists is essential for strategically realigning Electrical Civilization with a public purpose.

Of the trillions of Electrical Tools in the present world almost all rely upon electrical power plants and batteries, including websites, movies, microwaves, cell phones, and light bulbs. Their use cannot be separated from the negative effects of the Electrical Infrastructure, including war, pollution, and inefficiency. But this

relationship can first be identified and then changed. And designers and artists have the freedom and opportunity to help in transforming the cultural reality.

Industrial designers can have an enormous impact on the future development of Electrical Civilization by promoting standardization, reuse, upgradeability, sustainability, energy efficiency, and recycling of millions of products that are placed on the market every year. The throwaway culture of Electrical Design we have inherited needs to be disposed of, and its salvagable parts and processes recycled and put to better use.

Electrical appliances offer one example of how energy conservation has been adopted by industry, but this is nowhere near enough. Every product should be designed to meet strict but reasonable guidelines for maximizing energy efficiency, product lifespan, and product recycling.

If private industry cannot pursue this vision, then government regulation at the local or national or international levels will be required. It is not about private choice but about public duty. Nobody profits when products waste energy, resources, and pollute the environment. Our time to act is rapidly diminishing.

Product design could play a unique role by creating public awareness of the total energy cost of a product, making sustainable Electrical Tools into a marketable design goal.

Further, as Anthony Dunne states, electronic product design needs to "[go] beyond optimization to explore critical and aesthetic roles for electronic products ... raising awareness of the electromagnetic qualities of our environment." [4.1] One such opportunity exists in the desperate need to redesign the chaos of electrical plugs, cords, and outlets which in the U.S. remain fundamentally unchanged since the 1930s.

Visual designers, painters, filmmakers, and sculptors can make Cyberspace and the Electrical Infrastructure more readily visible to the public by using electrical iconography in their work.

For example, the oil paintings Telephone Pole and Sun on Allen Alley (1994) and Telephone Pole (1994) by Joe Blanchette materialize the abstract electronic internetwork of Cyberspace in the everyday built environment by presenting the electrical distribution pole as an aesthetic artifact. [4.2]

So too, various artists including electronic, computer, Internet and video artists, filmmakers, composers, and musicians can explore the relationship between the medium of their work and the system of electrical power upon which it depends.

As a case in point, Powerlines, the film by Helen Hall, poetically documents the effects of electromagnetic radiation upon biological organisms through the mediums of dance, film, music, and narration. [4.3]

Using unique skills and vantages, designers and artists can thus raise public awareness of the system of electrical power by radically reinterpreting it, becoming the vanguard for redesigning Electrical Civilization.

4c. Electrical Architecture

Electrical Architecture investigates and interrogates Electrical Buildings as an extension of the Electrical Infrastructure.

A generic term with a generic definition, Electrical Architecture is the architectural exploration of electrical phenomena which makes possible the logical analysis of the buildings of Electrical Power, Media, and Technology. Understanding any Electrical Building requires comprehending the infrastructure of Electrical Tools and Systems which enable it to function.

For example, to understand an electrical dwelling today it becomes necessary to acknowledge its programmatic and structural relationship to power plants, radio and television stations, and telecommunications facilities. Without these other buildings, their tools, and infrastructural systems such as power lines, distribution poles and transmission towers, the dwelling would have no light, no heat, no power and by default no connection to Cyberspace. The inhabitants would no longer exist in the 21st century, but in the pre-industrial era of the 18th century Enlightenment. Which is exactly where architecture exists today for those whom continue to deny or disregard this most basic fact of life.

The traditional architectural concepts of form, light, structure, space, and materiality have been transformed through electrical knowledge. Light consists of electrically charged photons, spatiotemporal phenomena are electromagnetic, and building materials are composed of atoms held together by electrons in orbit. But these are not just opinions. They are universal truths which the reigning system of traditional architectural knowledge stands in defiance of.

Yet now that architectural explorers are beginning to see electrical lights shining everywhere in the form of the screens of Cyberspace, the opportunity exists to rationalize the origins and meaning of electricity in relation to architecture. This requires dissolving the overruling paradigm of total authority over expert but limited knowledge, and freeing the idea of architecture by allowing it to be reborn anew in the 21st century context of Electrical Civilization.

Once a basic knowledge of electricity is established, the dependency of architecture upon the Electrical Infrastructure can be revealed for what it is. Doing so will reawaken the discipline to its vital mission as public servants of the natural and built environment and will give rise to an architectural movement addressing the ongoing issues of pollution, inefficiency, and war that are eternally waiting to be addressed by the profession. With this new vantage Electrical Buildings can be strategically redesigned, with the possibilities limited only by the architectural imagination.

Immediate results will come from 'seeing Cyberspace' from an architectural point of view. That is to say that the ethereal and immaterial aspects of the Internet and WWW are actually grounded in the everyday electrical artifacts

which exist as a new order in the built environment. Seeing Cyberspace thus means seeing electrical space-time, aesthetics, and culture in the electrical distribution poles populating the world by the billions, similar to the columns of the Greek and Roman classical orders. Building in both thought and action, architecture can make clear what no other discipline can.

For example, Electrical Buildings can integrate distribution poles and power lines into their designs, juxtaposing Cyberspace and actual space. Analysis of this symbolism could unveil what has previously been considered invisible and nonexistent. That is, that Cyberspace is a physical and tangible place, all around us in the built form of the Electrical Infrastructure.

Furthermore, electrical iconography can be explored in a way like no other, as every electrical artifact from meters and antennas to power lines and computers can be reinterpreted for their symbolic architectural meaning. This exploration could delve into the expression, improvement, and conceptual coordination of these disparate parts.

Seeing Cyberspace is only the first step. If people can 'see' Cyberspace they can also begin to comprehend the much larger Electrical Infrastructure of Power, Media, and Technology. Doing so will be the impetus for an Electrical Architecture which integrates the sustainable Electrical Systems of planners with the innovative work and Electrical Tools of designers.

With enough awareness of the phenomena of electricity and architectural study of the Electrical Infrastructure, a paradigmatic state of reasoning will be unveiled showing that electricity is beyond doubt the new architectural order in the built environment. And, remembering Le Corbusier's sage statement that the engineer's aesthetic is architectural, the Electrical Infrastructure will then be transformed into an Architecture of Electricity for those whose mind's eye can see it and build it.

The current configuration of the Electrical Infrastructure is unacceptable and must be challenged and fundamentally changed through the strategic redesign of Electrical Tools, Buildings, and Systems. Planners, designers, and architects are thus needed to aid the work of politicians, scientists, and activists, along with other citizens, businesses, and organizations to redirect the course of Electrical Civilization on a scale thus far inaccessible to the public will.

Once the fundamental importance of the electrical 'structure beneath' our everyday lives and livelihoods can be realized, we can begin to rebuild a locally controlled, democratic, and sustainable Electrical Civilization. But to do so we first need to find a way to work together, despite our differences

5. OBJECTIVE

5a. Electrical Order

Electrical Order is cosmological, beginning with the Big Bang billions of years ago. As the natural world of electromagnetic matter and energy evolved, so did humanity. Using our electrical minds we researched and helped develop this new order over a period of 2500 years, creating millions of electrical artifacts as a result. In the last 200 years we constituted the artificial electrical world with electrical generators. In the last 100 years we harnessed this artifice to lay claim to the virtual world of Cyberspace through the telecommunications technologies of the telephone, radio, television, and networked computer.

As our understanding of electricity has evolved so too has our awareness of the Electrical Order everywhere around us. From atomic bombs to deep space probes, we have become ever more reliant upon this force, to the point where the order of tradition has been surpassed by the predominant model of electrical space and time, aesthetics, and culture.

This new Electrical Order, common to humanity, manifests itself within the assemblage of Electrical Power, Media, and Technology whereupon the subliminal force of nature literally surfaces in the artificial and virtual worlds of Electrical Civilization. This paradigmatic event culminates in the symbolic transformation of metaphor into reality: the Electrical Infrastructure becomes Architecture, representing economic, social, and political culture in built form.

Our critical task of the 21st century requires a basic understanding of this new Architecture of Electricity and an awareness of the design flaws in the current infrastructure upon which Electrical Civilization depends; including the negative aspects of the current Electrical Order that need to be publicly recognized before they can be radically readjusted.

Yet at the turn of this millennium conceptualizing a 'world order' based upon electricity carries with it the extremely negative connotation attributed to the ideologies of globalism and the 'new world order' which to many promotes inhumane, unjust, and corrupt policies. As a case in point, Craig Baldwin's hybrid sci-fi/documentary film "Spectres of the Spectrum" (S.O.S.) explores the total control of the 'new electromagnetic order' by transnational corporations, and the resistance movement against this all-encompassing power. [5.1] S.O.S. offers a realistic critique on where discourse begins today, at the point of war and the gathering of forces to reclaim our future back from the past.

The main contributor to this decline of Electrical Civilization is the industrial worldview which constrains all economic, social, and political decision-making to only those options sanctioned by the reigning order of tradition, locally and globally. As a result, the Electrical Infrastructure has become the severely broken foundation of 21st century society, which under the rubric of change will only become more and more centralized and secure in its total control of power and authority over the cultural order of things.

This dangerously undemocratic power system and its policy can, must, and will be fundamentally changed. We, as fellow human beings, require it for our collective survival.

5b. Call to Action

The Electrical Order is neither inherently good nor bad- but it can be designed to promote the status quo or change it. This explains the paradox of seeing Cyberspace in the Electrical Infrastructure common around the world. Doing so enables one to compare and critique both paradigms, new and old, through their ordering of space and time, aesthetics, and culture in built form.

Seeing Cyberspace within Electrical Tools, Buildings, and Systems provides an immediate opportunity to unveil the epic story of electricity and its role in defining the larger world-picture. Through an architectural awareness the new Electrical Order can be seen in every nation on Earth in the electrical power plants, transmission pylons, substations, distribution poles, and power lines of the Electrical Infrastructure.

By recognizing this common Architecture of Electricity in our everyday lives, the potential exists for the democratic and sustainable redesign of Electrical Civilization. This is a call to arms for all planners, designers, architects, patrons, citizens, businesses, organizations, and governments to pledge their support to facilitating this enormous and important public endeavor.

Only by working together can we redirect the course of Electrical Civilization for the better by renewing its greater sense of cultural and ethical purpose, and our own. Please join this effort and contribute your unique skills to this public pursuit through working on these, our shared goals.

5c. Electronetworking

Please join this effort and contribute your unique skills to the public pursuit of electronetworking:

* Public Energy Network:

Collaborate with citizens around the world to help establish and promote a democratic energy policy initiative that is sustainable, feasible, and is representative of the public interest.

<http://www.electronetwork.org/works/pen/>

* Electronetwork.org:

Join the Electromagnetic Internetwork and help raise public awareness of electromagnetism - matter, energy, & in-formation:

<http://www.electronetwork.org/>

* Electronetwork Databases:

Register to add contact information for individuals, businesses, governments, and organizations whose work involves electromagnetism and its related issues.

<http://www.electronetwork.org/databases/>

* Electronetwork Resources:

Contribute educational and multidisciplinary hyperlinks of electromagnetic resources available online, to the Directory of Electromagnetism:
<http://www.electronetwork.org/resources/>

* **Electronetwork Features:**

Submit freely available online works, essays, reviews, and exhibits focussing on electromagnetic reality for review and inclusion:
<http://www.electronetwork.org/features/>

* **Support Electronetwork.org:**

non-monetary grants, donations, and sponsorships of computer and research equipment & services are needed to keep this public effort alive and growing. For more details see:

<http://www.electronetwork.org/support/>

{ matter, energy, and in-formation }

NOTES

[1.1] *Towards a New Architecture*. Le Corbusier, 1927. Translated by Fredrick Etchells. Holt, Rinehart and Winston, New York, 1960. Page 19.

[1.2] *The Architecture of Electricity*. Brian Thomas Carroll, 2000. Logical proof that the electrical infrastructure is architecture. Online thesis at <http://www.architecturez.com/ae/>

[2.1] *Cryptome*. John Young, Architect, 1997-present. Materials on freedom of expression, privacy, cryptology, dual-use technologies, national security and intelligence. Online at <http://www.cryptome.org/>

[3.1] Dr. Merrill Garnett. Medical research reveals "the presence of corollary dynamics of the genetic code by which specific DNA coded segments and cell membranes exchange ultra-low frequency sinusoidal electrical currents" For more information see: <http://www.electrogenetics.com/>

[3.2] Dr. Andrew A. Marino. Research includes the books *Electromagnetism & Life*, *Electric Wilderness*, and *Foundations of Modern Bioelectricity*. See website for more information: <http://www.ortho.lsumc.edu/Faculty/Marino/Marino.html>

[4.1] *Hertzian Tales: Electronic Products, Aesthetic Experience and Critical Design*. Dr. Anthony Dunne, 1999. <http://www.crd.rca.ac.uk/dunne-raby/>

[4.2] Joe Blanchette, Painter. Works explore 'the interplay of light upon surfaces and objects and how they effect the viewer at an emotive level, specifically in relation to awe.' Paintings online at: <http://www.jwfinearts.com/artists/blanchette/>

[4.3] *Powerlines*. Film and Soundtrack, 1998. Helen Hall. Interprets the mysteries of electromagnetism. Online at:

<http://www.electronetwork.org/works/hh/powerlines/>

[5.1] *Spectres of the Spectrum*. Film, 1999. Craig Baldwin. More info at:
<http://www.othercinema.com/sosframe.html>

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