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The Centrality of Ecological Design:
Achieving Sustainability in an Era of Free-Market Capitalist Framework

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ABSTRACT

Sustainability has become a key word in describing the role of the environmental movement in society today. Capitalism makes it difficult to achieve environmental goals because the priority of a capitalist system is achieving wealth through limitless economic growth. The goals set forth by sustainability aim to make cities function more like natural ecosystems through sustainable design practices such as bio mimicry. Capitalism and sustainability are at odds with each other and their ultimate goals are in direct conflict with their own respective frameworks. In the following paper I will discuss how design can be used to mitigate many of the economic and social problems that environmentalism alone has not been able to address within a political system primarily driven by capitalism. My analysis will consist of a combination of a historical analysis of capitalism alongside environmental economics, ethical theory, and environmental design in order to develop design principles that will serve as a structure for environmentally and socially responsible design within a free-market capitalist framework.

INTRODUCTION

Energy is perhaps the most basic unit one can use to measure life on earth. Every organism ranging from plants, insects, animals, and humans, are all interconnected through cycles of energy production. The scale of energy production has exponentially exploded from powering single organisms such as plants through photosynthesis, to powering entire city grids, electronics, cars, and many of the commodities that encompass the notion of a comfortable human life-style in the developed world. This explosion in energy output has

mainly been achieved through unsustainable means of energy production. While the long-term negative consequences of using dirty fuels and other inefficient technologies outweigh their immediate benefits, economic growth is a priority among nations worldwide and shapes the political structure of the world we live in today. Capitalism's ability to generate growth in a short amount of time creates limits and boundaries which encase global politics and cause a plethora environmental and social justice issues. In order to understand the viability of environmental design and the true meaning of sustainability, one must recognize that current politics satisfy the hunger of the capitalist machine at the expense of the environment, the worker, and future generations.

The unparalleled boom in economic growth that has taken place over the past two centuries has been largely credited to capitalism. While it may seem that capitalism does a good job at creating wealth, it also manages to conceal its flaws through commoditization. Human activities, especially after industrialization, have completely altered the planet and changed the quality of life for its inhabitants (both human and non-human). The evidence for environmental degradation and that the earth indeed has a set carrying capacity is not a myth. In his book, *Global Environmental Ethics*, Dr. Louis Paul Pojman claims that "Humanity replaces natural selection as the decisive force in the development of life on Earth."¹ Humanity is indeed responsible for most of the development of life on Earth; however, humanity is also responsible for all of the destructive trends that have overtaken the environment over the past couple of hundred years. Some of the more evident changes to the planet include climate change, deforestation, desertification, loss of freshwater sources and fisheries, and a loss of biodiversity.

¹ Louis P. Pojman, *Global Environmental Ethics* (Mountain View, California: Mayfield Publishing Company, 2000), 3.

In the words of James Gustave Speth, author of *The Bridge at the Edge of the World*, “we are not living off nature’s interest but instead are drawing down its capital.”² As long as government and policy makers are intent on measuring well-being through GDP, the majority of the growing population on earth will continue to contribute to the degradation of the planet that has taken place after industrialization represented in *Figure 1*:

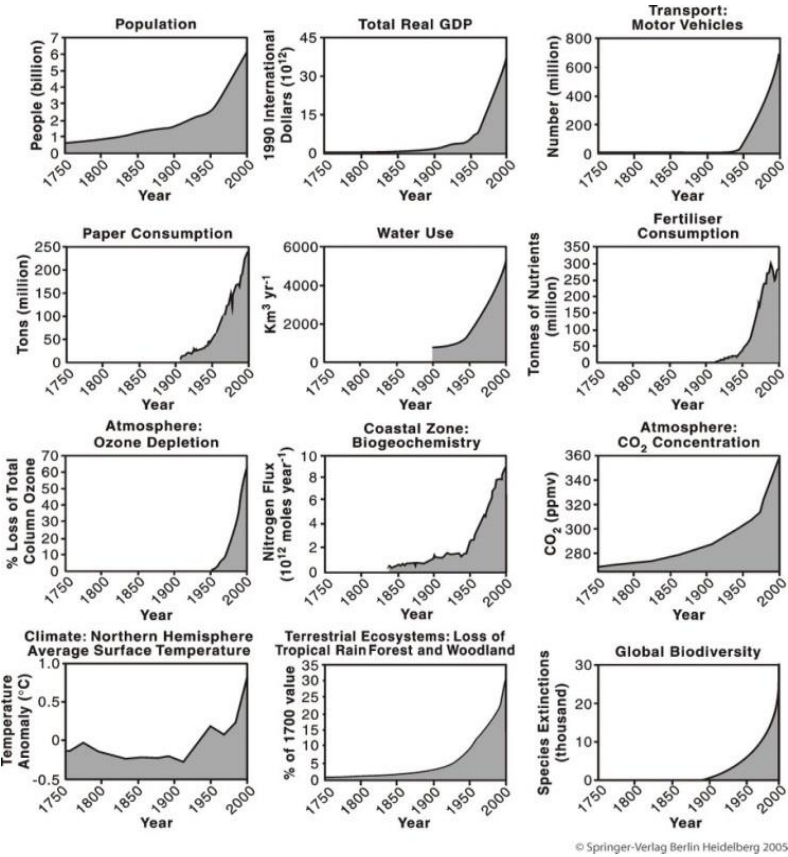


Figure 1 - James Gustav Speth's "Great Collision"³

The flaws of the capitalist system are embedded within its history. To understand how capitalism creates economic growth one must understand how it functions within markets. Markets do not necessarily entail capitalism; they are a pre-existing condition to capitalism. The key factor that transforms wealth into capital under a capitalist system is the property of

² James Gustav Speth, *The Bridge at the Edge of the World* (New Haven: Yale University Press, 2008), 41.
³ James Gustav Speth, *The Bridge at the Edge of the World*, xx.

growth. In capitalism, growth is a priority and creates an endless cycle in which the creation of capital has no physical limits. In his work, *Capital Volume I*, Karl Marx outlines the role growth plays in a capitalist market:

The simple circulation of commodities – selling in order to buy – is a means to a final goal which lies outside circulation, namely the appropriation of use-values, the satisfaction of needs. As against this, the circulation of money as capital is an end in itself, for the valorization of value takes place only within this constantly renewed movement. The movement of capital is therefore limitless.⁴

Marx's observations of the social conditions within capitalism create a problem for anyone who lives in a world that does not have unlimited resources. Unfortunately, planet Earth is not blessed with endless resources and the effects of the overexploitation of renewable resources by a capitalist political economy creates a ripple of environmental destruction. Half of the world's temperate and tropical forests which house two-thirds of our planet's species have already been lost to climate change, loss of economic value, and industry.⁵ Desertification in the U.S. increases every year and fifty million acres "become too degraded for crop production or are lost to urban sprawl."⁶ Even sixty percent of the world's freshwater sources have been compromised due to damming and other construction.⁷ The negligence of these environmental issues has increased alongside rising levels of population and expanding economies in the post-

⁴ Karl Marx, *Capital: A critique of political economy* (London: Penguin Books, 1990), 253.

⁵ Speth, *The Bridge at the Edge of the World*, 30.

⁶ Speth, *The Bridge at the Edge of the World*, 31.

⁷ Speth, *The Bridge at the Edge of the World*, 32.

industrialized world and environmental degradation provides evidence for the limits of growth in a capitalist structure. Most capitalists, politicians, and corporations refuse to acknowledge such a limit as it would reveal a major flaw in the system, market failure.

In the following section of the paper I will historically approach market failure alongside capitalism in order to clarify the inherent flaws within the system from its conception. After evaluating market failure, I will look at possible solutions to this problem within the context of environmental ethics and environmental economics. Finally, after evaluating our current technological level, I will develop a set of design principles which will serve as the groundwork for implementing sustainable design as a solution to many of the flaws brought about by the capitalist structure.

MARKET FAILURE

In his book, *How Markets Fail*, Journalist John Cassidy uses a historical approach to outline how market failure is embedded within the illusions of a free market system created by utopian economics. Cassidy argues that:

Markets encourage power companies to despoil the environment and cause global warming; health insurers to exclude sick people from coverage; computer makers to force customers to buy software programs they don't need; and CEOs to stuff their own pockets at the expense of their stockholders.⁸

Market failure occurs when the market fails to adequately price in externalities created by the circulation and redistribution of capital. When the market fails to price in externalities, Self-

⁸ John Cassidy, *How Markets Fail* (New York: Picador, 2010), 9.

interested agents capitalize on this opportunity through what Cassidy calls “rational irrationality.” The neglected costs are then passed down to be paid at the expense others or the environment. Under capitalism, market failure is inevitable because the global market economy facilitates the exclusion of “free” environmental resources (water, pollution, waste etc.) and exploitative labor costs (low wages, child labor, sweat shops etc.) used in the production of commodities. If properly measured, these unaccounted “free” ecosystem values and services sum up in the trillions.⁹ Utopian based economics lead to market failure as it fails to recognize the “realism of psychology”¹⁰ which actively influences decisions made within the market.

Market failure originates within the fundamental ideas about the division of labor that Adam Smith proposed in his book, *An Inquiry into the Nature and Causes of the Wealth of Nations*. Smith proposed that the division of labor increases the total efficiency in society by:

First, to the increase of dexterity in every particular workman;
secondly, to the saving of the time which is commonly lost in passing from one species of work to another, and lastly, to the invention of a great number of machines which facilitate and abridge labour, and enable one man to do the work of many.¹¹

Smith’s division of labor and invisible hand theories created the illusion that capitalism improves living standards. Under Smith’s ideal model, “the market system is efficient in that human and physical resources are directed to where they are most needed and prices are tied to

⁹ Paul Hawken, *Natural Capitalism: Creating the Next Industrial Revolution* (Boston: Little, Brown, 1999), 154.

¹⁰ Cassidy, *How markets Fail*, 10.

¹¹ Adam Smith, *An inquiry into the Nature and Causes of the Wealth of Nations* (Indianapolis: Hackett Publishing Company, 1993), 6.

costs.”¹² Under such a system, the market regulates itself through the price mechanism and requires no government intervention, thus laissez-faire economics is born. This model of economic thought does not accurately price in the costs of certain public goods consumed by the means of production; human capital and ecological capital are merely exchanged for false measurement of economic capital. An example of such a measurement would be a country’s Gross Domestic Product (GDP), which does not accurately measure a country’s wealth as it excludes social and environmental costs from the equation. Paul Hawken, author of *Natural Capitalism*, explains that the flaw with capital itself is in that it is not accurately measured. Hawken claims that capital consists of human capital, financial capital, manufactured capital, and natural capital. Conventional capitalism neglects natural capital which represents all of the natural resources provided by living systems and ecosystem services.¹³ Hawken’s insight on the valuation of natural capital is a response to many of the issues brought about by climate change in modern society. The exploitative tendencies that exist within capitalism were identified long before climate change and exist independently within Adam Smith’s division of labor theories.

Karl Marx addressed Smith’s division of labor and recognized that the process increased productivity; however, Marx proposed that this technical increase of productivity came at a social cost and this is made more evident with increases in technology. Marx argues that:

Machinery is misused in order to transform the worker, from his very childhood, into a part of a specialized machine. In this way, not only are the expenses necessary for his reproduction considerably lessened, but at the same time his helpless

¹² Cassidy, *How Markets Fail*, 30.

¹³ Hawken, *Natural Capitalism*, 4.

dependence upon the factory ... and ... the capitalist, is rendered complete ... increased productivity which is due to the development of the social process of production, and that which is due to the exploitation by the capitalists of that development.¹⁴

Marx broke down how the process of the social division of labor creates greater profits for capitalists through exploitation. Gains in productivity do not save the laborer time, instead, they increase the output of commodities while keeping the laborer's wage and time worked the same. The costs resulting from the surplus production of commodities are externalized and the worker pays through the exploitation of his/her labor. Foundationally, the division of labor under capitalism creates economic growth by externalizing the costs of labor through exploitation.

FIXING THE MARKET

The topic of externalized of costs and benefits in economies has become central to proponents of market reform. Twentieth century economist Alfred C. Pigou was among the first to propose the idea of pricing in externalities to the production of goods and services. Pigou argued it was "feasible for governments to control the play of economic forces in such ways to promote the economic welfare, and through that, the total welfare of their citizens as a whole."¹⁵ Pigou sought to "take some of the 'failures and imperfections' of the market and develop them into a systematic case for public intervention."¹⁶ Pigou emphasized the importance of accurately pricing social costs, such as the destruction of the woods by sparks from a railroad engine, into

¹⁴ Marx, *Capital*, 547.

¹⁵ Cassidy, *How Markets Fail*, 116.

¹⁶ Cassidy, *How Markets Fail*, 116.

a company's expenditures.¹⁷ Pigou's idea to price in externalities acknowledges the failure of free markets to recognize the need to balance social costs with social benefits. Utopian economics leaves this function up to the free market; however, as Paul Hawken put it in *Natural Capitalism*, "Markets are only tools. They make a good servant but a bad master and a worse religion."¹⁸ Leaving the balancing of social and environmental capital to the invisible hand of the market is no better than leaving it in the blind hands of faith. Pigou proposed that in large scale cases of industrial pollution or urban blight "government intervention, even though it may create some problems of its own, was often the best option available."¹⁹

Many proposals for environmental policies such as cap and trade are derived from Pigou's school of economic thought. With legislation such as the Clean Water Act and Clean Air Acts, the Environmental Protection Agency has managed to declare certain locations such as the polluted Hudson River as superfund sites and order polluters to pay for the damages inflicted on environments and communities.²⁰ The "Pigovian tax" proposes to eliminate perverse subsidies on coal and gasoline by imposing a tax on the substances relative to how much greenhouse gasses the products emit.²¹ This taxation does bring the private cost of carbon closer to its social cost; however, this proposition will also increase the overall price of energy, making it very difficult for society under a certain income to afford. Global warming is an environmental factor that offers evidence for failing markets and while economic thinkers such as Pigou propose to price in externalities in order to correct these failures, the root of the

¹⁷ Cassidy, *How Markets Fail*, 117.

¹⁸ Hawken, *Natural Capitalism*, 261.

¹⁹ Cassidy, *How Markets Fail*, 121.

²⁰ Cassidy, *How Markets Fail*, 121.

²¹ Cassidy, *How Markets Fail*, 122.

problem rests within the system as a whole. Pricing in externalities will increase the prices of goods and services while reducing the standards of living for many average-lower income families. Once again, this market failure brings us back to Marx's exploitation of labor and the unethical distribution of wealth.

As long as the market remains an untamed force within capitalist structure, humanity will repeat the same mistakes that make sustainability nearly impossible to reach. Many of the problems that Marx identified in *Capital* are directly linked to growth, however as economic thought evolves, so can the definition of "capital" itself. Paul Hawken's *Natural Capitalism*, is a perfect example of economic thought evolving to fit the needs of people, the environment, and future generations. Hawken's solution is market-based and revolves around extending "the sound principles of the market to all sources material value, not just to those that by accidents of history were first appropriated into the market system."²² The definition of capital has to evolve along with earth's history where markets can be the tools that will encourage real progress. Through ethically responsible political motivations, the market can be adjusted to encourage sustainability by subsidizing green technology and phasing out older inefficient forms of energy such as fossil fuels. A reliance on fossil fuels and unsustainable practices only takes short-term gains into consideration and ignores the negative long-term consequences caused directly by economic growth fueled by unsustainable means of production. This means of production creates the environmentally and socially destructive cycle plaguing the modern world.

FREE MARKET ILLUSION

²² Hawken, *Natural Capitalism*, 261.

The commodity is the perfect blindfold by which people willingly take part in a “free” market system that facilitates the exploitation of another individual and resources at little or no costs to the producers of said commodities. John Bowe’s *Nobodies* analyzes how the global market economy paved the way for modern slavery. Bowe argues that free trade “is not a force of nature, controlled by God or science. It is designed and controlled by men and women, who ... have rather predictable, deluded, and self –serving responses to power.”²³ Selfish decision making along with the wrong kind of government intervention drive a wedge between the social classes created by the free market. The free market is an ironic term as it does not accordingly price in the social injustices suffered by children who live in slum cities discussed by Mike Davis in *Planet of Slums*. Davis points to a study on child labor in the slums of Dhaka, which contains “the largest number of child laborers in Asia (about 750,000), and their earnings provide half of the income in poor, female-headed households.”²⁴ Poverty and a lack of basic human rights in nations with “free” market economies only reinforces the inadequacy of the market to produce proper mathematical values that truly reflect the all of the social costs of production.

The problem with a system like free market economics rests on its origin. There is no such thing as self-regulating entities that will provide maximize the efficiency of natural and human capital. Any system in which one individual can succeed at the cost of another is anything but “free.” Marx’s views on how capitalism externalizes labor to create profit are central to the criticism of why free markets are ultimately flawed. Pigou proposed the idea of

²³ John Bowe, *Nobodies: Modern American Slave Labor and the Dark Side of the New Global Economy* (New York: Random House, 2007), 271.

²⁴ Mike Davis, *Planet of Slums* (New York: Verso, 2007), 186.

pricing in externalities to the economy, however, this solution does not really address the extent of the flawed levels of wealth distribution within the system. If current political trends continue on the same path nothing will change and growth will continue serving the “interests of governments by boosting approval ratings, keeping difficult social justice and other issues on the back burner and generating larger revenues without raising tax rates.”²⁵ If society continues to rely on the flawed capitalist ideology, it is only a matter of time until the system runs out of externalities to convert into so-called “growth.” The ultimate tragedy of capitalism is the idea of limitless growth. As outlined by Bill Mckibben in *Deep Economy*, “growth is no longer making us happy ... though our economy has been growing, most of us have relatively little to show for it.”²⁶ Growth has always come at a cost; capitalism simply externalizes these costs while commodities create a social blindfold that hides the whole process.

The social and environmental costs of capitalism in modern economies are directly fueled by dirty fuels such as coal, oil, and gas.²⁷ The commodity itself is a byproduct of some kind of fossil fuel. Energy is the main component of every aspect of life including production. Capitalist growth and free market economies rely on fossil fuels. Fossil fuels are ineffective at efficiently creating energy because of all their negative output yet they remain the cheapest form of energy. Hawken explains that fossil fuels are cheaper than new technology because “to one degree or another, more accurately internalize their costs to the environment and future generations ... we are thus substituting noxious coal for intelligent design and engineering.”²⁸

²⁵ Speth, *The Bridge at the Edge of the World*, 62.

²⁶ Bill Mckibben, *Deep Economy: The Wealth of Communities and the Durable Future* (New York: Henry Holt and Company, 2007), 11.

²⁷ Mckibben, *Deep Economy*, 15.

²⁸ Paul Hawken, *The Ecology of Commerce: A Declaration of Sustainability* (New York: HarperCollins, 1993), 87.

The energy market is a perfect example of free market economics failing to promote clean and efficient technologies that would have a genuine impact in increasing the overall quality of life for humanity.

TECHNOLOGY & ENERGY

Developments in technology over the last century have established many theories in renewable energy, an idea that to some seems impossible. With the development in solar, wind, and biomass systems, renewable energy is well on its way to replacing unsustainable fuels such as oil, coal, and natural gas. These new technologies hold the answer to some of our most devastating environmental and economic problems. Not only can sustainable energy mitigate issues such as climate change, it can create instrumental jobs and offer a solution to the economic recession affecting the country. The United States can become a leader in sustainable technology and set an example for other nations to quit their addictions to oil. Moving away from dirty fuels and towards renewable ones is the next step towards increasing the overall quality of life for the planet as a whole.

The incentives behind new technologies are constantly improving and some new technology even proves more reliable than conventional methods. For instance,

Wind energy is now the least expensive option among all energy technologies ... some farmers, notably in the U.S. Midwest, have found that they can generate more income per hectare from the

electricity generated by a wind turbine than from their crop or ranching proceeds.²⁹

While wind power can play an essential role in the mid-west, the energy crisis in cities could be mitigated through the use of “photovoltaic (solar) panels and solar hot water heaters.³⁰” Adapting these technologies to buildings “can help reduce energy costs, dramatically shave peak-power demands, produce a healthier living environment, and increase the overall energy supply.”³¹ The economic viability and efficiency of the technology only improves over time as it becomes cheaper to produce and is effective in locations ranging from deserts to cities.³² The environmental incentives for shifting to these technologies are clear, but over time the economic incentives have become tempting as well. The only reason prices of oil, coal, and natural gas remain competitive to renewable energy sources is because the government subsidizes these costs and all the environmental costs are not factored into the actual price of the products.³³ Both solar and wind energy do not externalize environmental costs because they produce clean renewable energy. There are no emissions that come from these technologies and they can mitigate a lot of the rising energy demands without further contributing to global warming.

Innovations in water management systems over the past 10 years have proven to be a viable alternative to expensive water treatment and purification systems. Water availability is a growing concern as the frequency of droughts caused by climate change increase and the “water stored in glaciers and snowpack ... decline[s], reducing water supplies to more than a

²⁹ Antonia V. Herzog, Timothy E. Lipman, Jennifer L. Edwards, and Daniel M. Kammen. 2001. "Renewable Energy: A Viable Choice." *Environment* 43 (10): 10. <http://search.proquest.com/docview/224024192?accountid=10932>.

³⁰ Herzog, "Renewable Energy," 10.

³¹ Herzog, "Renewable Energy," 10.

³² Herzog, "Renewable Energy," 11.

³³ Herzog, "Renewable Energy," 12-13.

billion people.”³⁴ With the help of comprehensive accounting, many governments and municipalities have begun to take watershed restoration projects seriously. Watershed restoration technology is designed so that it provides “flood control and water purification” more efficiently than “engineering river channels and installing new treatment equipment.”³⁵ The financial and ecological benefits of watershed restoration have become evident in cities such as New York with their various watershed restoration projects taking place under the Bloomberg administrations’ PlaNYC.

While technology seems like a viable answer to the environmental load that a growth driven system places on society, it alone is not a solution for the greater environmental and social threats posed by capitalism. Thanks to technology and the green revolution, earth’s carrying capacity has been increased; however, this does not mean that the limits for growth can simply be disregarded with technological advancement. In his book, *The Ecology of Commerce*, Paul Hawken claims that even technology has its limits. He claims “human society has already collided with this outer limit in the realm of fisheries, ozone depletion, and possibly the greenhouse effect.”³⁶ Hawken and other proponents of sustainability propose that there can be no growth because the earth has reached its carrying capacity. The key to growth rests in energy cycles and production. Capital, both natural and economic, relies on the production of energy to generate growth. Growth’s limits can be defined by the global output of energy that can be created through technology. If accurately measured through a reformed market that accurately prices production by including currently neglected externalities, dirty fuels such as

³⁴ Speth, *The Bridge at the Edge of the World*, 22.

³⁵ Sim Van der Ryn, *Ecological Design* (Washington DC: Island Press, 2007), 12.

³⁶ Hawken, *The Ecology of Commerce*, 32.

oil would prove to be expensive and inefficient compared to alternative sources of energy such as wind and solar power. With green technologies producing renewable energy, growth can be appropriately measured and sustainability can provide a means for maximizing the quality of life on earth.

With so many incentives to switch over to renewable energy, why don't we? The answer to that question simply lies in irresponsible political decision-making. Society cannot solely rely on markets or technology to repair the environments as "it is highly unlikely that renewable energy sources will ever achieve the high energy return on energy invested that fossil fuels have historically afforded; thus they are likely to be more expensive."³⁷ Society has become spoiled by fossil fuels because their true cost has never been reflected. As long as the U.S. government creates subsidies for oil, private investors and capital will continue to work towards increasing profits at the cost of the environment. Furthermore, as a model for developing countries, the U.S. further encourages the use of dirty fuels which in turn increases the rates of climate change. Unless serious changes in policy occur to promote the use of renewable energy, green technology, and sustainable living, both the economy and the environment will continue to suffer the consequences. Without a proper ethic to evaluate and facilitate the transition into renewable energy, market failure will continue to obscure the socio-economic benefits behind this cleaner and more efficient technology.

PROBLEMS IN ETHICS & POLITICS

In November of 2011 a large demonstration of protestors surrounded the white house in hopes of convincing President Barack Obama to maintain his 2008 promise to "be the

³⁷ Richard Heinberg, *The Post Carbon Reader: Managing the 21st Century's Sustainability Crisis* (California: Watershed Media, 2010), 339.

generation that finally frees America from the tyranny of oil." This demonstration was in response to the Keystone XL pipeline project that proposed to bring oil from the tar sands in Alberta to Port Author and Houston. Ultimately, the President delayed the project and denied the Pipeline because a Congress pressured a decision by February and this would not give the President enough time to go over the environmental assessments. This issue was extensively covered in the media mainly because of its relevance to the election and tensions between the U.S. political parties. Many facts and implications behind the project were obscured by biased political agendas on both sides of American politics. Essentially, the Keystone pipeline is a seven billion dollar project proposed by TransCanada to facilitate the transportation of oil across 1,661 miles between "Hardisty, Alberta, to Nederland, Texas, and traverse Montana, South Dakota, Nebraska, Kansas, Oklahoma, and Texas."³⁸ After completion, the pipeline would transport about "900,000 barrels a day of a mixture of synthetic crude oil and diluted bitumen."³⁹

One of the main environmental concerns behind this project is the extraction of oil from the Tar-sands in Canada. Tar sands contain "a combination of clay, sand, water, and bitumen" which requires high levels of heating in order to extract and "processing tar sands requires three to four times more energy than conventional oil drilling."⁴⁰ The tar sands region itself is located in a heavily forested area and surrounded by wetlands. Furthermore, possible leaks and toxins released from the extraction of the oil threaten wildlife, pollute local ecosystems, and

³⁸ Janna Palliser, "The Keystone XL Pipeline," *Science Scope* 35.9 (2012): 8. *ProQuest Education Journals; ProQuest Research Library*.

³⁹ Palliser, "The Keystone XL Pipeline," 8.

⁴⁰ Palliser, "The Keystone XL Pipeline," 8-9.

pose a danger to local populations (increased cancer rates in the Chipewyan First Nation⁴¹) through both air and water contamination.⁴² Why would both Canadian and American governments consider embarking on such a venture with so many risks to both human and environmental health? One of the simple answers provided by proponents of the pipeline is the creation of about 20,000 jobs and a much needed stimulation of the U.S. Economy. Furthermore, the positive international relations between Canada and the United States facilitate a constant and stable supply of oil. International relations are important in energy markets because the poor relations in the Middle East and South America factor into the inconsistent price of foreign oil.⁴³ TransCanada plans to reapply for another presidential permit in the after altering the route of the pipeline in order to avoid environmentally sensitive areas such as the underground Ogallala Aquifer.⁴⁴ America has become increasingly dependent on foreign oil because of the political and economic pressures created by capitalism and globalism. The global increase in the price of oil has led the media to coin the term, "energy crisis." The energy crisis is did not begin with oil; it is a supply problem created by many of the same economic factors that lead to market failure.

When mixing politics and economics there needs to be a medium through which decisions can be evaluated. Some theories in Environmental ethics provide a guideline through which economic and political decisions can truly benefit the overall social well-being of society and the environment. As it currently stands a free-market approach to environmental issues only encourages negative externalities, furthermore, this method provides and inaccurate way

⁴¹ Stephen Bocking, "Our Wicked Addiction," *Alternatives Journal* 37, no. 5 (2011), 18.

⁴² Palliser, "The Keystone XL Pipeline," 8-10.

⁴³ Palliser, "The Keystone XL Pipeline," 10-11.

⁴⁴ Palliser, "The Keystone XL Pipeline," 11.

to measure the overall social-well-being. Implementing an environmental ethics framework alongside economics has developed solutions to the measurement problem within the free-market economy. The human development index (HDI), genuine progress indicator (GPI), and gross national happiness (GNH) are only a few of the several solutions that include a measurement of the environment, quality of life, and overall social progress instead of a purely economic measurement of well-being.

Paul Hawken's ethical framework for sustainable development provides a guideline for government and business ethics that advocates social and environmental responsibility. He claims that both companies and governments must act in socially responsible ways and "what we have is not a management problem but a design problem."⁴⁵ Hawken suggests several strategies for sustainability that address the political, economic, and design problems with projects such as the Keystone Pipeline XL. In order to address the problems of externalities, Hawken advocates adjusting the price of products to reflect their price. In this new pricing mechanism, "every purchase must reflect ...not only the direct cost of production but also the costs to the air, water, and soil; the cost to future generations; the cost to the worker health; the cost of waste, pollution, and toxicity."⁴⁶ If the price of dirty fuels like the tar sands oil were adjusted to reflect the harm they cause to human health and the environment, it would not only be unethical to continue using them, but also, their continued use would not make any economic sense. Such thinking could make renewable resources a viable alternative because zero emission energy sources do not contribute to climate change and their price would not

⁴⁵ Paul Hawken, "A Declaration of Sustainability," *Environmental Philosophy: From Animal Rights to Radical Ecology* (New Jersey: Pearson Prentice Hall, 2005), 420.

⁴⁶ Hawken, "A Declaration of Sustainability," 422.

have to be adjusted to reflect that. Furthermore, the use of dirty fuels could slowly be eliminated by restructuring the tax system. Hawken argues that the present tax system “encourages waste, discourages conservation, and rewards consumption.”⁴⁷ Hawken’s claims are backed by the countless government subsidies that make the use of fossil fuels affordable. Hawken suggests that replacing the current tax system with one structured around “green fees” would bring the price of products, energy, and services closer to their “actual” costs.⁴⁸ He goes on to provide a grace period of 20 years so that the transition could be slow and create instability within our current socioeconomic constructs. Both of these suggestions tackle the political and economic issues that currently promote the use of fossil fuels, simultaneously threaten human health, and destroy the environment.

Hawken’s utilitarian approach to environmental ethics is anthropocentric where the “concept of value, ecosystems and the services they provide have value to human societies because people derive utility from their use, either directly or indirectly (use values). People also value ecosystem services that they are not currently using (non-use values).”⁴⁹ Ascribing to an ethic such as Hawken’s requires more than a change in economic policy, government, and development practices; such changes can only be brought about through a better understanding of the “bigger picture.” Paul Taylor uses virtue and deontological ethics in order to develop a life-centered ethic in which individual organisms have moral standing and all organisms have equal inherent worth. Different to Hawken’s anthropocentric approach, Taylor’s ethic is non-utilitarian (non-anthropocentric) in that his approach “proceeds from a variety of ethical,

⁴⁷ Hawken, “A Declaration of Sustainability,” 423.

⁴⁸ Hawken, “A Declaration of Sustainability,” 423.

⁴⁹ J. Baird Callicott, “Concepts of Ecosystem Value and Valuation Approaches,” *Ecosystems and human well-being: a framework for assessment* (Washington, DC: Island Press, 2003), 127.

cultural, religious, and philosophical bases. These differ in the specific entities that are deemed to have value and in the interpretation of what having non-utilitarian value means.”⁵⁰ Through Taylor’s approach, humans have social responsibility to environments and future generations because “ecological, sociocultural, and intrinsic values” are ascribed to things humans deem to be important.⁵¹ Humans owe prima facie moral responsibilities to natural ecosystems and biotic communities under Taylor’s framework as he uses a biologically-informed observation based on Darwin’s theory of evolution to develop humanity’s place on the planet.⁵² By developing renewable energy technologies and promoting sustainable development one could minimize the impacts humans have on their immediate biotic community through a respect-for-life approach. Perhaps Taylor’s most important principle that could truly change the “business as usual” reflected in the recent Keystone Pipeline XL controversy is his “denial of human superiority.”⁵³ Taylor argues all organisms are teleological centers of life having a good of their own. Furthermore, humans claim superiority based on reason, yet just as other species lack the capacity to reason, so too do humans lack certain abilities possessed by other animals.⁵⁴ Destroying the forests and wetlands in Alberta to develop the tar sands, potentially threatening the Sand Hills and Ogallala aquifer with oil spills, and continued dependence on the same fossil fuels which continue to destroy the atmosphere and threaten future generations do not reflect the choices made by a “superior” species. Perhaps by adopting Taylor’s biocentric outlook,

⁵⁰ Callicott, “Concepts of Ecosystem Value and Valuation Approaches,” 127.

⁵¹ Callicott, “Concepts of Ecosystem Value and Valuation Approaches,” 127.

⁵² Paul Taylor, “The Ethics of Respect for Nature,” *Environmental Philosophy: From Animal Rights to Radical Ecology* (New Jersey: Pearson Prentice Hall, 2005), 67-69.

⁵³ Taylor, “Respect for Nature,” 74.

⁵⁴ Taylor, “Respect for Nature,” 75-81.

governments, businesses, and individuals can truly begin to take the first steps towards a truly sustainable world.

Sustainable ethics and biocentrism both provide frameworks to deal with the political, economics, and social problems plaguing the environment. Both extensionist and intrinsic value approaches like Aldo Leopold's land ethic and Paul Taylor's biocentrism are already embodied in various U.S. environmental laws such the Endangered Species Act, and the national park/preserve system which state that the nature/species in question should be preserved and protected for its intrinsic value, regardless of whether this is economically valuable or has instrumental human value in some other way.⁵⁵ Current technological endeavors such as the Keystone Pipeline XL project goes against all the values these theories represent. Taylor proposed a denial of human superiority; however, those who still wish to believe that humans truly are a superior species should use their superiority to come up with solutions to the problems brought about by a flawed ideology such as limitless growth. Growth requires consumption and consumption is limited by earth's resources. Sustainable development exhibits an understanding of the limits on growth and attempts to solve them through design. A truly superior species would not be limited by issues such as the energy crisis and climate change. Our species has the technological prowess to overcome such limitations but is limited by flawed priorities brought about through a false sense of superiority.

ECOLOGICAL DESIGN

While the capitalist system is largely responsible for the negative economic and political pressures placed on people and the environment, design is an important element that reinforces

⁵⁵ Callicott, "Concepts of Ecosystem Value and Valuation Approaches," 145-146.

flawed capitalist ideals. Contemporary design has evolved into a process that is manipulated by the socio-economic pressures of capitalism and globalization. Rather than using design and technology to find humanity's place within the environment, it has become a mere tool used to exploit people and valuable ecological resources. David Orr, author of *The Nature of Design*, claims "the perennial problem of human ecology is how different cultures provision themselves with food, shelter, energy, and the means of livelihood by extracting energy and materials from their surroundings."⁵⁶ Design under capitalism seeks to maximize natural resource extraction in order to increase levels of production. Combined with increasing consumer populations, this form of design consumes resources faster than natural ecosystems can replace them and leads to the overexploitation of natural systems. Sustainability requires traditional design methods to evolve into what some architects, engineers, and scholars have defined as "ecological design."

Ecological design is "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes."⁵⁷ Effectively adapting and integrating current design processes with natural ecosystems will reduce pollution and waste while efficiently producing the energy needed to maintain the quality of conditions necessary for human standards of living. The concept of ecological design seeks to integrate human systems to existing ecological conditions in a way which won't destroy or over-exploit the natural capital that ecosystems provide. When applying the concepts of ecological design a cycle is created under which the incentives and benefits of ecosystems outweigh those of conventional design methods that tend to produce large amounts of waste.

⁵⁶ David Orr, *The Nature of Design: Ecology, Culture, and Human Intention* (New York: Oxford University Press, 2002), 14.

⁵⁷ Sim Van der Ryn, *Ecological Design*, 33.

Reducing waste is central to an ecological design framework. Food production alone creates 3200 pounds of waste for every 100 pounds of product created.⁵⁸ The problem with creating this much waste is that it filters down to all levels of society. Waste requires energy to dispose of, especially if that waste contains products cannot be processed through natural ecosystem services. Natural ecosystems such as wetlands are balanced and efficiently eliminate waste created by all organisms; one organism's waste is another's means of subsistence. Examples of smart ecological design already exist in natural systems; it is up to human ingenuity to figure out how to adapt these natural systems into contemporary design practices. In order to understand how to design ecologically, one must recognize the valuable examples and energy cycles that already exist within ecosystem. Learning how to integrate elements of "nature's design" into our own methods will minimize negative environmental impacts and increase the overall quality of life for all organisms within a system. Perhaps the best example of efficient design within nature is the energy cycle and trophic levels that extend throughout various different ecological climates. Perhaps the most important structure within nature that design needs to mimic is the way in which organisms process energy effectively creating closed ecological systems that naturally minimize waste and maximize the efficient use of energy from the sun.

Design affects all aspects of life, whether it is something as small as a water bottle, or something as large as a skyscraper; design is everywhere. While many focus on the aesthetics of design, at its core, it is a method of problem-solving. In his book, *Cradle to Cradle*, Architect William McDonough identifies flaws of the traditional design model that have created more

⁵⁸ Orr, *The Nature of Design*, 15.

problems than they have solved. According to McDonough, Traditional design creates billions of pounds of waste and toxic material released into the environment every year. Furthermore, much like the capitalist system, “design measures productivity by how few people are working” and creates “prosperity” through “cutting down natural resources and then burying or burning them.”⁵⁹ Interestingly enough, McDonough uses much more than words to explain the flaws with contemporary design practices, his book is printed on “synthetic paper” which does not use “wood pulp or cotton fiber” and it can be “broken down and circulated indefinitely in industrial cycles.”⁶⁰ The vision for the design of the book truly results in a very different product which can be completely recycled and is fully biodegradable. With the proper design behind it, even something as simple as a book can be designed to sustainable standards.

A common approach to achieving eco-efficiency has been “the 3 R’s” which are reduce, reuse, and recycle (McDonough adds one more “R” to this list – regulate). This traditional method to eco-efficiency has not proven to achieve the sustainable standards necessary to completely stop climate change. For instance, the reduce principle “does not halt depletion and destruction - it only slows them down, allowing them to take place in smaller increments over a longer period of time.”⁶¹ The regulation principle suggested in *Cradle to Cradle* is crucial to encouraging markets to reuse waste and many of the toxins and chemicals created in the production of commodities can be repurposed into something more useful instead of being incinerated or dumped into landfills or water bodies. The Newtown Creek Wastewater Treatment plant in Brooklyn takes advantage of this useful principle effectively treating sewage

⁵⁹ William McDonough, *Cradle to Cradle: Remaking the Way We Make Things* (New York: North Point Press, 2002), 18.

⁶⁰ McDonough, *Cradle to Cradle*, 5.

⁶¹ McDonough, *Cradle to Cradle*, 54.

and sludge through digester eggs and turning waste into electricity and fertilizer. Recycling is as effective as how many times the materials get put through the process. McDonough refers to this as “downcycling” because most recycling methods actually reduce the quality of material over time.⁶² An example of this effect can be seen when recycling metals – in car manufacturing the high-grade metals used in cars get mixed with chemicals, paint, cables, and other lower-grade metals, once these get melted down, the resulting product is of lesser quality.⁶³ While these basic principles are not perfect, they are a good start for creating a framework for eco-efficiency and perhaps by optimizing these already existing methods, design can be improved to eliminate waste altogether.

Waste has proven to be the biggest challenge facing design. The post industrialized world developed a linear design process embodied by the “cradle-to-grave model.” In this model, “resources are extracted, shaped into products, sold, and eventually disposed of in a ‘grave’ of some kind, usually a landfill or incinerator.”⁶⁴ The post-industrial economic expansion in the United States is an excellent example of the cradle-to-grave design model. Powered by coal, industrialization in the U.S. created 194 landfills and 161 holding ponds strictly for ash.⁶⁵ Ash and other chemically ridden synthetic products are not easily disposed of or recycled; this usually leads to inefficient land usage along with air and water pollution. Coupled with consumer culture, this linear approach to design create waste creates many problems that future generations will have to face. In the United States,

⁶² McDonough, *Cradle to Cradle*, 56.

⁶³ McDonough, *Cradle to Cradle*, 56.

⁶⁴ McDonough, *Cradle to Cradle*, 27.

⁶⁵ Lester R. Brown, *World on the Edge How to Prevent Environmental and Economic Collapse* (New York: Norton & Company, 2011), 189.

Every American consumes about 136 pounds of resources a week, while 2,000 pounds of waste are discarded to support that consumption. This waste consists of everything from paper to CO₂, from agricultural wastes to effluents, from packaging material to nitrous oxides... For every 100 tons of trash, incinerators produce 30 tons of fly ash.⁶⁶

By rethinking the way things are designed they can be repurposed or recycled so that they do not contribute to the ever-expanding abyss of landfills and harmful pollutants released from incinerators.

Good design requires a sense of planning and foresight in order to reassure that any resulting product fulfills its duty while avoiding any negative side effects. Unfortunately most contemporary design methods are shortsighted and do not take the future into account. In fact, because capitalism encourages a constant cycle of consumption, many goods are now designed to be disposable or endure a short life span. Take the iPhone for example, the difference between every model released between production cycles is minimal, yet, iPhone production requires columbite-tantalite, a conflict mineral found in the Congo which motivates warlords to fund their armies through slave-mining operations.⁶⁷ Poor design choices aren't solely limited to environmental degradation but socially irresponsible decisions lead to many ethically troubling results. David Orr suggests the following set of ecological design principles as questions that anyone designing ecologically should ask:

⁶⁶ Hawken, *Ecology of Commerce*, 37 & 47.

⁶⁷ "Coltan: a new blood mineral," *CBC news*, December 10, 2010 (<http://www.cbc.ca/news/technology/story/2010/12/10/coltan-faq.html>).

- Do we need it?
- Is it ethical?
- What impact does it have on the community?
- Is it safe to make and use?
- Is it fair?
- Can it be repaired or reused?
- What is the full cost over its expected lifetime?
- Is there a better way to do it?⁶⁸

Using McDonough's book as an example, it was designed to fulfill its main purpose as book, but at the same time the designer had some foresight in analyzing the longevity of a book. Typically many people finish reading a book and it collects dust in a bookshelf somewhere before it gets thrown out. This book was designed not only to be durable, but biodegradable, so that if it does get thrown out, there would be a minimal impact on the environment. In a sense, in order to reduce the waste caused by the design process, one must think of designing something backwards. McDonough's "Cradle-to-Cradle" form of design mimics earth's biological system in which "major nutrients – carbon, hydrogen, oxygen, nitrogen – are cycled and recycled. Waste equals food."⁶⁹ Cradle-to-Cradle design proposes that "to eliminate the concept of waste means to design things – products, packaging, and systems - from the very beginning on the understanding that waste does not exist."⁷⁰ This specific approach to design echoes Janine Benyus' concept of bio-mimicry which uses "nature as a model." She defines bio-mimicry as "a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g. a solar cell inspired by a leaf."⁷¹ Natural ecosystems are made up of thousands of different organisms that each play a vital role

⁶⁸ Orr, *The Nature of Design*, 28.

⁶⁹ McDonough, *Cradle to Cradle*, 92.

⁷⁰ McDonough, *Cradle to Cradle*, 104.

⁷¹ Janine M. Benyus, *Biomimicry: Innovation Inspired by Nature* (New York: Morrow, 1997) 1.

in maintaining their environment in order to survive. Nature is designed for sustainability, so why not learn from it and develop design methods that will compliment natural systems that took millions of years of trial and error to develop?

CASE STUDY: THE VERTICAL FARM

Applying many of the aforementioned ecological design principles to small-scale objects such as water bottles, books, electronics, and other everyday commodities will prove useful in controlling the environmental and social damages brought about by consumer culture. However, larger scale societal changes require greater undertakings in design. The vertical farm model aims to solve many of the problems created in food production by a linear capitalist mode of production.

The “green revolution” of the 1950’s doubled land productivity and managed to increase grain harvest in a 23-year-span that matched the amount of food produced in the preceding 11,000 years.⁷² Unfortunately the methods used to overcome our food limits involved a heavy concentration of pesticides and a spread of irrigation which led to other issues such as water shortages and the side-effects of harmful pesticides such as DDT and other PCB’s. The land productivity gained from these methods has capped out. Lester Brown, author of *World on the Edge*, explains that “further gains in yields from plant breeding, even including genetic modifications, do not come easily. Expanding the irrigated area is difficult. Returns on the use of additional fertilizer are diminishing in many countries.”⁷³ It has become evident that current methods for farming will not satisfy the rates for future growth. Food production is a crucial

⁷² Brown, *World on the Edge*, 165.

⁷³ Brown, *World on the Edge*, 167.

element for population growth, and with population growth rates rising all over the world, there are many concerns being raised regarding food availability for future generations.

The agricultural process is riddled with risks mainly related to weather patterns. Vertical farm projects aim to reduce this risk by containing agriculture within a structure that can regulate both water usage and temperatures in order to grow food anywhere and year-round. Some other benefits of the vertical farms include reducing the reliance on fossil fuels for food transportation by having these structures built within cities themselves. Vertical farms represent a design-centered solution to the future food production problems that the world faces. By combining engineering, architecture, and the agricultural process the vertical farm can be designed to address multiple environmental issues on different platforms. The project aims to eliminate waste, clean and optimize water usage, and reduce the pollution caused by traditional means of farming.⁷⁴ Dr. Dickson Despommier, author of *The Vertical Farm*, contends that “if the built environment could behave by reflecting the integration of functions equivalent to that of an ecosystem, life would be a lot more bearable for all of us, and more economically stable, too.”⁷⁵ The vertical farm project is a large scale biomimicry project that adopts many of the design principles discussed in Sim Van Der Ryn’s *Ecological Design*, David Orr’s *The Nature of Design*, and William McDonough’s *Cradle to Cradle*. The design process of this revolutionary way to think of agriculture is ecologically sound because it was developed by looking at how nutrients have been recycled within natural biomes for over 400 million years.⁷⁶

⁷⁴ Dickson Despommier, *The Vertical Farm: Feeding the World in the 21st Century* (New York: Thomas Dunne Books, 2010), 5-9.

⁷⁵ Despommier, *The Vertical Farm*, 16.

⁷⁶ Despommier, *The Vertical Farm*, 18.

The vertical farm concept recreates the agricultural process inside of multistory buildings by using hydroponic and aeroponic farming methods along with sustainable energy production methods and efficient grey-water irrigation systems. Having farms indoors is a huge advantage when farming year-round because farmers can grow any crop they want year round and “take advantage of seasonal markets that may permit a crop to be sold at a much higher than normal price.”⁷⁷ Furthermore, indoor food production prevents weather-related crop failures due to “floods, droughts, tornadoes, hailstorms, cyclones, hurricanes, and high winds.”⁷⁸ Properly using grey-water systems in vertical farms will eliminate agricultural runoff responsible for destroying fresh and saltwater ecosystems. The nitrogen and pesticide filled runoff that traditional farming methods create enters surrounding bodies of water creating a “killing field”⁷⁹ for many organisms. Through structural design in conjunction with hydroponic and aeroponic technologies, the vertical farm will keep out unwanted organisms and reduce eliminate the need for pesticides and herbicides.

Perhaps one of the biggest advantages of vertical farming is the reduction of water waste through hydroponic and aeroponic technologies. Despommier notes that these technologies can reduce water used in farming by 70-95 percent.⁸⁰ Hydroponics monitors concentrations of essential nutrients needed by plants in a controlled environment without soil. Plants do not need soil to grow and hydroponic farming replaces the soil with a system of specially constructed piping. Plants are then “electronically monitored for concentrations of each element

⁷⁷ Despommier, *The Vertical Farm*, 147.

⁷⁸ Despommier, *The Vertical Farm*, 148.

⁷⁹ Despommier, *The Vertical Farm*, 151.

⁸⁰ Despommier, *The Vertical Farm*, 162

and organic nitrogen. The result is uniform plant growth under optimal conditions.”⁸¹ Aeroponics is a newer technology that uses “small nozzles located under the plants [which] spray a nutrient-laden mist onto the roots, supplying them with everything they need.”⁸² The advantage of aeroponic farming over hydroponics is that it consumes about 70 percent less water than hydroponics.

The high demands for locally grown organic food has already encouraged some cities to adopt the vertical farm model as a sustainable means of boosting local food economies. A 90,000 sq. ft. windowless, two story abandoned warehouse is currently being used for farming in Bedford Park, Illinois. The company developing the space is called *Farmed Here* and is currently producing greens such as basil and arugula. The company plans to employ 200 people once it reaches its full production potential. The challenges currently faced by this project do include high energy consumption because it is a windowless two-story repurposed building, however these can simply be overcome by a combination of windows for natural lighting and some solar panels on the roof as a source of sustainable energy. Vertical farming is a relatively new idea; however, a responsible long-term cost-benefit evaluation of the idea is still required to encourage private investment. The technology needed for vertical farms already exists, but the only real barrier is the startup costs of a project.

SUSTAINABLE DESIGN AND CAPITALISM

As it stands today, sustainability is at odds with capitalism. The design process itself has become commodified by capitalism into a tool used strictly for promoting consumption. Design alone cannot solve all of the problems created by market failure; however, it can serve as

⁸¹ Despommier, *The Vertical Farm*, 165.

⁸² Despommier, *The Vertical Farm*, 165.

the framework for incorporating sustainable ideals into the very commodities which capitalism revolves around. From a purely economic perspective, efficiency increases value. The sustainability model makes the most sense to adopt because it is an efficient system in which waste is minimized or even non-existent. With a strong set of design principles and some political pressure, sustainability can be injected into the capitalist machine eventually influencing the principles it was founded on. Ideally capitalism was intended to increase the quality of life through economic prosperity, however, 300 years later and the ecological, social, and political inefficiencies are evident. The failures of modern capitalism are largely attributed to a stubbornness exhibited by small groups who represent a concentration of wealth built on inefficient systems, technologies and designs.

The design process plays an influential role in creating many of the commodities that modern capitalism is dependent on. Using a general and widely applicable structure, I will develop a set guidelines aimed at applying sustainable design to a capitalist model; these guidelines will be known as *Ecosocial Design Principles*. The following set of ecosocial design principles will serve as a general guideline for creating sustainable designs aimed at optimizing capitalist socioeconomic conditions into existing natural systems.

1. *Think energy, not capital*

Energy processes are central to not only natural systems but economic systems as well. Energy consumption and production serves as the crossroads where socioeconomic human activity and ecological systems meet. Capital cannot exist without energy, and as technology as evolves, so do the energy sources required for generating capital. A great example of how energy evolves into capital is written in the world's agricultural history. The agricultural

process evolved from requiring physically labor-intensive energy produced by humans and animals to increasing production by means of technology which heavily relies on the use of fossil fuels. Technology played a key role in defining the green revolution; however, using non-renewable energy sources to power production is like taking out a loan against the planet that you cannot afford to pay back. The interest comes in the form of climate change and future generations are then responsible for the large amounts of debt generated by unsustainable energy use.

When conceptualizing ideas, instead of thinking of the cost of production we must think of how much energy will this take to produce and how much energy will the object use. Both of these factors must then be evaluated through a cost-benefit analysis centered on long-term energy consumption and sustainability. Optimizing the design process to consume less energy will reduce the costs that traditional capitalist modes of production place on the environment. In his book, *Reinventing Fire*, Amory Lovins outlines how the transportation, business, and industrial sectors can benefit from and optimize energy use by 2050 and reduce the United States' dependence on fossil fuels.⁸³ Productivity is limited by available energy and optimizing energy technologies and consumption will increase overall productivity. Energy use should be evaluated using a long-term assessment in order to further avoid contributing to market failure. Long-term evaluation can prevent perverse subsidies such as those currently used to justify the continued use of fossil fuels and other inefficient forms of energy.

2. *Designing for multiple-uses*

⁸³ Amory B. Lovins, *Reinventing Fire: Bold Business Solutions for the New Energy Era* (Vermont: Chelsea Green Publishing, 2011), 10-11.

When conceptualizing a design there is a clear problem-solving process at play. The most successful designs integrate multiple functionalities into a single object. For instance, the success of the iPhone and other smart phones are largely attributed to the multiple uses and connectivity that the device offers. Smart phones managed to integrate cameras, telephones, video-recording, email, GPS, and a multitude of other functionalities through software and apps. Multi-functional design is an effective way of reducing production costs and energy usage while capitalizing on the end result.

Multi-functional design is not only limited to technology. With the recent devastation that hurricane sandy caused in New York, several ecological-based designs are being implemented as storm surge barriers. An example of multifunctional storm-surge barriers in New York are the sand dunes being built up in the Rockaways as way to control the potential damage from incoming storm surges. Sand dunes protect coastal areas from flooding, enrich coastal biodiversity, and improve water quality in coastal wetlands.

3. DDRR – Durable, Disposable, Recyclable, Repurposed

When considering any design one must question its durability. The durability of any design defines whether or not it will become waste. Things can and should be designed to not become a burden on the environment or society once they have outlived their use. Long-term design causes maximizes the energy used in production. Traditionally disposable design creates waste; however with advancements in biomass technology, disposable bio-degradable products can be reconverted into energy. While recycling is better than piling waste onto a landfill, it still requires energy to operate and this energy typically comes from fossil-fuel operated power plants. Reconfiguring recycling plants to run on sustainable power sources such as solar or

wind energy will maximize their efficiency by making recycling more sustainable. Repurposing already existing designs and adapting new designs to fit older ones extends the use and longevity of objects that have fulfilled their conceptual purpose. This practice is becoming more common in high density cities. The repurposed vertical farm warehouse noted above makes use of all of the elements used in this principle.

4. Solutions already exist in natural systems

Bio-mimicry has proven effective in producing sustainable products and technologies. Natural systems follow sustainable principles while providing a multitude of ecosystem services to various species. The benefits of merging local ecological systems with the modes of production will assure that the resulting product will have minimal negative impacts on the environment and species of a particular place. Creating systems that work with nature instead of against nature reduces the negative ecological friction created by designs that ignore natural systems. Designs are unique to place so location, space, and natural systems must always be considered whenever conceptualizing anything.

5. Transform Design into an interdisciplinary process

Interdisciplinary design uses elements from all aspects of society in order to create well-informed long-term solutions. Every discipline has its strengths and can contribute to the design process as a whole. A larger-scale design such as the vertical farm is an example of an interdisciplinary design concept. The structure is influenced by environmental architecture and engineering. The farming element of the vertical farm requires agricultural knowledge and biochemistry. The concept of vertical farming itself is heavily based on a historical analysis of farming and the ethics of modern food production. The more disciplines included in a design,

the stronger the concept. Cooperation between all of the disciplines is the key element in revolutionizing the future of design.

CONCLUSION

Capitalism, globalization, and the free-market have shaped the rules by which humanity defines its existence, both for present and future generation. Unfortunately, this system is designed so that even with its flaws, any alternatives system that does not promote consumer culture is generally dismissed and not taken seriously. The most pressing problems that people face are the direct result of the poor design choices that a politically corrupt system not only allows to happen, but actively endorses and promotes. My suggestion for design principles based on sound environmental economics is a direct response to capitalism after putting it through an ethical audit. While these guidelines can provide a step in the right direction, a real change in priorities and adjustment of what we as a species considers “valuable” needs to be made. Design is the key to the future; however, politics, economics, and species stubbornness dictates whether these solutions can even be implemented in the first place.

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