Energy: Escaping the Fossil Fuel Trap

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Introduction:

The United States now competes with the world in terms of manufacturing, job creation, energy and resources. America's recent foray into Iraq underscores our need for oil. What legacy would George W. Bush leave if instead of squandering $500 billion in Iraq, the money had instead been spent to support renewable technologies and energy efficiency?

Sadly, what's done is done. What can we do now? What is happening elsewhere?

Some context is important. If we compare the energy performance of Europe and the United States we are already at a competitive disadvantage. European utilities are twice as efficient as ours and the gap is widening because the EU has a standing commitment to energy efficiency and some EU countries, like Germany, have significant and growing investments in solar power. Utility scale power in the U.S. delivers electricity at roughly 10% efficiency when we consider the transformation of the original energy source into power, conversion, and line losses prior to delivery at the plug. We "pay for 100 and get 10" in the words of Peter Garforth. Efficiency increases go straight to the bottom line. Whether utility, city or individual, the scale does not matter.

As a nation we have made choices about our sources of energy and the technologies to deliver energy services. In the last 40 years the landscape has slowly changed around us. We have clung to what, in essence, is 1950s technology. Without focused, concerted action on the part of government, business and the general population, the energy policy we have implemented for the last 100 years will be the swan song of our prosperity. The rude awakening has begun.

This need not be the case. The challenge we face is more one of attitude and beliefs than any daunting obstacle. There are technological barriers, but they are no more significant than the effort that put humans on the moon. There are technical opportunities for invention, innovation, and new ventures that provide energy alternates to business as usual. This is an opportunity of unprecedented importance. Our civilization is in the process of making a fundamental transition in how energy is used and sourced. Those who innovate boldly will be handsomely rewarded.

An Integrated System:

An integrated energy policy is a multi-dimensional approach to suppling the energy needs of our civilization. With our reliance on oil and coal, doubts are beginning to emerge about the economics and the ecological impact of what has become a "mature" system. Energy sources need to be diversified. There is good thinking and credible work, more underway and much in the pipeline. Advances in technologies like photovoltaics, fuel cells and hydrogen continue. To put it simply, we need an energy policy that is not only diversified, but whose goal is the benign creation of power. What follows considers how a transition from fossil fuels to renewables might be driven, best practice, radical energy efficiency, fuel sources and their implications, scale of generation, costs, externalities (for example, the health care cost of coal), economics, buildings (new and existing) and community planning.

Transition:

The events that will force America to act are in progress now. Energy has begun its relentless rise in our consciousness, in price, in importance. Since an economy is fundamentally the exchange of energy, the basis of the transaction should be stable and durable for the long

view. The long view here is not the next quarter, not 10 years, not 1,000 years. Let's think with respect to the idea that we might want to live here and plumb the possibilities of humanity for, say, 100 million years. Our associates in science note the sun has approximately 5 billion years of fuel left, so if there is one thing we don't have it's a shortage of time. A long view begins to take into consideration climate change (whether we're the cause or not), planetary catastrophes, evolution and geological time. Hard to put the mind around such things, yet we can look at the night sky and even without the ability to truly embrace the infinite cosmos, appreciate the enormity of what we see. We are a miracle, top to bottom, rich to poor, fool to genius. We invent our world through our beliefs. At the moment, the feedback indicates our beliefs may diverge from expected results. In fact, we've known something was wrong since Rachel Carson wrote Silent Spring, but the whisper of progress was a siren song, technology wouldn't fail us; science would come to the rescue.

These days, the open question for the inquiring mind is whether we have passed the crest of Peak Oil: drawing down half or more of available crude oil reserves. The current spike in oil prices may not be a clear indicator. The United States, with its Iraq adventure, has changed the balance of power in the Middle East. We are delightfully oblivious here, but the reality is that we have inadvertently increased the flow of money to both sides of the "War on Terror". The down side is that we have scrambled the economy while increasing our collective debt and paying directly into the coffers of those who act against our interests. Shouldn't we be more nervous?

As this is written, the world economy is in recession and the price of oil has fallen from a midyear high of $147 per barrel to approximately $50 per barrel. Happy days are not here again; this is just a respite as the economic system readjusts to a broken credit market in need of improved oversight and tightened rules.

For the sake of argument, let us begin with the belief that American ingenuity is alive and well. We have to awaken from our somnambulance and look the situation directly in the eye. In a transition of any kind, intentional or accidental, the existing system fights tooth and nail to maintain its supremacy. There is inertia embedded: the inertia of institutions, traditions and relationships. To move in a coordinated fashion to a benign energy system, some investments will be forfeit, some careers will end. This is change with a capital "C". The front end of the process must recognize casualties in business and a commitment must be made for retooling and retraining the good people who make their living in ways that we now realize will no longer be the way of the future.

Best Practice:

Part of the notion of best practice not only describes research and technologies, but a way of looking at the challenges we face in new ways. Consciously creating a problem's boundaries are as important as attacking the problem itself. To put this another way, without the context of the methods and processes we use to create energy now, the engineering and design disciplines who serve this system provide their skills in a manner consistent with the highest standards of their respective professions. Our predicament emerges from the invisible assumptions we have made about the creation and delivery of energy to American society as a whole.

In the late 19th century, the confluence of industrial growth, the discovery of vast reserves of oil on American soil and the relentless growth of the young United States worked synergistically to cause the emergence of fossil fuels as the primary energy source for our growing country. Oil was available in abundance. The United States reached its Peak Oil event in the early 1970s, coincident with the oil shock of 1973. Coal became an established fuel

source for transportation and heating. Like a child running downhill, we have relentlessly picked up speed and now find ourselves nearly ready to go head over heels.

Flirting with the edge of chaos we realize that change may have benefits. If we can begin a sideways movement down our metaphorical hill perhaps the inertia gained over the last century can slowly be given up. A way forward lies in a measured, careful search for the best methodologies and technologies, whether real or emerging.

Best practice in the context of a long term energy policy is based first on asking the right questions. Let us consider the problem in light of some features from current conditions that are best avoided in a long view scenario. First, finite fuel sources such as oil and coal are handicapped by multiple problems. The uneven distribution of oil resources and its depletion in countries once rich with oil reserves (like the United States) places increasing pressure on its use going forward. Although fossil fuel combustion creates pollution, over the last couple of decades, automotive technologies have mitigated much of fossil fuel's worst polluting tendencies. Even in this context, pollution control technologies are required, far from the best practice in pollution prevention. The final blow was the revelation that carbon dioxide was a greenhouse gas, dangerous in the vast quantities created by global human civilization. An added challenge with fossil fuels, coal in particular, is the health related effects of fine particulates from coal combustion. Many coal plants are grandfathered into the Clean Air Act and, as a result, avoid the requirements for scrubbers that catch particulate matter. The result is a huge burden on the health care system from people with respiratory disease and children with asthma.

We can conclude that fossil fuels suffer from several fundamental problems:

1. Uneven availability of resources.
2. Extraction and use of fossil fuels disrupts ecosystems and human society causing pollution and habitat destruction.
3. Fossil fuels cause external health effects whose costs are shifted to society at large.
4. Fossil fuels have created businesses with economic power that influences the political process in a way that does not serve the broader interests of society as a whole.
5. Fossil fuel usage shifts costs and risk from individual businesses to society as a whole.

These are serious concerns. What if we were to invert the problems outlined above? What kind of fit might we see with renewable energy?

1. Make energy available based on geography, local climate and appropriate choice of technology.
2. Disruption of ecosystems is minimized; pollution is minimized or eliminated.
3. External health effects are eliminated.
4. Businesses engaged in renewable technologies seek the best environment to maximize their opportunity to engage the market.
5. Rather than externalizing risk and socializing cost, renewables reduce risk and cost simultaneously.

Indeed, this starts to look very much like best practice worthy of attention going forward.

Experimentation:

Taking chances on new ideas and supporting research is the heart and soul of innovation. Taking a three pronged approach that provides support from government, academic institutions, and individual venture capitalists would create a burgeoning number of businesses dedicated to improving renewable energy technologies.

Implementing seed projects allows investments at many scales. Different types of technologies can be tested. Some work can support and enhance currently available

techniques. Other ideas can reach far into the extremes of imagination and seek breakthroughs with unprecedented potential. We must understand and tolerate failure. The creation of programs that analyze and provide feedback to the emerging energy economy is essential to validate investment in both the public and private sectors.

The final, and most important part, of encouraging experimentation is learning from the results. As noted above, we accept the reality of failure. Competing ideas will emerge with varying levels of potential. Government funded programs may tend toward the conservative side. Venture capitalists will take great risks to nurture a technology. And we understand that great risks may also entail great rewards. Or great failure. Regardless, the continuum of renewable energy research, particularly failures of all types, must be potentially available for scrutiny at the discretion of the business or governmental entities who oversee the work.

Efficiency:

Our society relentlessly stresses the importance of growth. Listen to the news, read the paper, check the financial reports on any given day and the word "growth" is ubiquitous. We define our success literally via valuations of how much growth has occurred in the previous quarter, year or decade. When growth stops or reduces its pace, the sense of unease within the markets multiplies, equity values fall and the gnashing of teeth begins. Everything humans do in the west is geared towards creating, benefitting and realizing growth.

How does this compare with the patterns of nature? All organisms grow, mature, reproduce, then die. Death transforms the organism, ultimately becoming nutrients for new life in all ecosystems. We are not immune and, in this sense, ironically, we are also immortal. We just change form. In the context of our standing economic theories, growth is essential and undeniable.

Growth is also fundamentally tied to energy. Only so much is available in any given allotment of time. As human needs grow, we inexorably take energy from other organisms, therefore reducing diversity as a result. This is not an optimal choice given the tuning and patterns of life planet-wide.

In the life patterns of the Earth, growth is important, but something more subtle is present and requires acknowledgment. In ecosystems the context continually changes. Immature ecosystems value growth: essential, quick and brutal. Expansion of life is important in the dispersion of life forms and the uptake of energy. Over time the emphasis slowly changes. In ecology this is called succession, a complex and subtle process that works organically to transform what we consider essential (now) to a form that we would consider completely alien. Over the passage of centuries, diversity emerges as the predominant pattern for mature ecosystems.

Today, any corporate guru emphasizes growth and competition. Winners and losers are the rigor on any given day. Performance is the yardstick for corporate success. The Olympics drive home the principle: we honor the best in the world at a particular sport. A lifetime of training is culminated, judged and spent in the time required to walk to the street and collect the morning paper.

A mature ecosystem, by contrast, takes advantage, not of competition, but mutualism; shared life cycles, extreme energy efficiency and long life spans. As we look to a vision for escaping the fossil fuel trap, beginning the transformation from a growth mentality to embracing efficiency puts us at the forefront of a transformation consistent with principles in force in ecosystems since the emergence of life.

In the context of energy, efficiency is the cat's meow. Every reduction in demand reduces pressure on the system. There are proven methods to reduce energy usage in buildings, residential and commercial. Paybacks vary depending on the context and extent of the work, but generally speaking in any given structure the opportunity for efficiency increases is low hanging fruit, ripe for picking. Strategically looking at the United States since the first energy shocks of the 1970s reveals that energy use has increased, but in the context of the overall economic system efficiency shows us a net usage decrease in the context of all economic activity. The American Council for an Energy Efficient Economy puts it succinctly: "Total primary energy use per capita in the United States in 2000 was almost identical to that in 1973. Over the same 27-year period economic output (GDP) per capita increased 74 percent." This is the power of efficiency writ large. And, more importantly, we can do even better with clearly articulated efficiency goals.

Fuel Sources:

The usual suspects deserve first consideration: coal, natural gas, nuclear power, and oil. Finite energy sources. It is wise to remember that we need these energy supplies until a transition is complete. Even after transition, some small supply of fossil fuel derived products will be needed. Tiny by comparison to current demands, but some throughput will be needed nonetheless.

On the opposite side of the coin are renewables: energy derived from the sun or natural processes of energy exchange as a result of earth systems fueled by the sun. In this context, we see remarkable growth in the deployment of photovoltaics and wind. Recent wind mapping completed by NOAA at 80 meters and above indicates that over 40,000 megawatts of wind power is available in the northern half of Indiana alone. Statewide, Indiana currently generates a rough baseload of 10,000 megawatts. Wind, if fully deployed, could supply four times this amount. Between 2007 and 2008, PV market growth was 62% in one year from 1328 megawatts to 2826 megawatts worldwide. The United States is now the fourth largest market globally. (Solarbuzz.com/2008). The point is simple: renewable energy is available every second. The question is how best to take advantage of the vast power available from the sun and wind.

Hydro electric power has been used for centuries, first for mechanical power in mills, then to create electricity from dams, mighty and modest, sprinkled throughout the United States. Generally speaking, hydro is relatively benign. Careful consideration is required though given the ecological impacts of large hydro projects.

Other technologies of interest include geothermal (using the earth's internal heat) and tidal power (taking advantage of the daily change in elevation of the ocean's surface). These systems are tactical, appropriate for a particular situation and geography. Nonetheless they receive attention and continue to develop steadily.

More leading edge technology includes fuel cells, which create electricity via an electro-chemical process. International research continues in the public and private sectors. Applications include stationary (power for building systems in varying forms), transportation, telecommunications, and waste water treatment. More exotic research focuses on fuel cell use in trains, aircraft and ships. (See www.fuelcells.org) Fuel sources vary and several technologies exist, but the resulting power creates only water and heat. In large scale installations, fuel cells with efficiencies of about 40% can see efficiency increases of up to 85% with the deployment of cogeneration technologies which capture the heat from fuel cell processes. A working fuel cell makes no noise, is reliable and its operation continues as long fuel is provided to the device. One promising input for fuel cells is hydrogen[1]. Aggressive

programs for the deployment of fuel cells are underway in automobiles. Early examples in use now include BMW and Honda's FCX.

Scale:
Scale is challenging, particularly in the context of business. There are advantages in large enterprises and advantages in small, tactical solutions to the production of energy. Utilities offer high reliability, but have low efficiency and face rising costs as supplies are reduced. In turn, the result is inflation on the cost of essential services and increasing economic pressure on the user. It is essential to remember that "users" are real people. Sudden changes in the cost of energy have consequences that can be catastrophic.

Conversely, energy produced for individual buildings, whether homes or businesses, has the advantage of an investment which pays for itself over a given period of time. Upon completion of the payback period real money is put back in the pockets of the owner. However, if a breakdown occurs, the individual is left to their own devices to figure out how to keep the refrigerator cool, the computers running or the house warm in winter.

This paradox seems to suggest there may be advantages in both. In the United States the basic large scale electrical utility infrastructure is in place. The open question is how best to implement a policy that creates a win for the user and the utility. What is clear is that the understanding of utilities, their work within the community and how energy is created are going to evolve and change. The question then focuses on how best to create energy in a variety of contexts and places using a mix of technologies. Some are owned by individuals, some are leased perhaps by a particular industry, some are at the scale of cities and large scale utility power sources are fit within a broader mesh of energy supplies.

The main electrical grid becomes a back-up, a connective tissue that allows flexibility in a larger context. The emergent system creates energy locally from the scale of single buildings, groupings of buildings, takes advantage of density in cities, for example, and considers the uses within a particular place. This starts to have the feel of a more sophisticated, evolving system that mimics living organisms and their complex relationships. As we go forward, rather then answering the question of providing power with more we answer instead with efficiency, diversity, and benign technologies.

Cost:
We are inculcated from birth with the notion of cost. The amazing flexibility of our economic system allows us access to a staggering variety of goods and services. Ask anyone coming to the United State for the first time. They will most likely answer that, confronted with any retail outlet, from Wal-Mart to Saks Fifth Avenue, such abundance is almost unimaginable. We have become expert at the production and consumption of things.

These things, material goods, are a significant part of our economy. Our commerce system defines cost in a variety of ways. In addition, we also exclude certain costs as well. These exclusions, in classic economic terms, are called externalities and will be visited in the next section. Of all costs, the most well known is first cost: simple payment for goods or services. This is a basic value calculation: Is what I am buying worth what I am paying? No more intellectual activity is needed once the question is answered.

In a broader view, life cycle costing considers what something costs over its useful life. Context becomes important here. If I buy cheap clothing and replace it annually versus expensive clothing that I can wear for 10 years, which costs less in the long view? Life cycle cost considers the cost of a product in the context of its quality, durability and secondary

costs. Better to buy a car and keep it many years or to lease and trade every 36 months? On complex machines like automobiles other costs swim into view as well like the cost of maintenance and insurance. Life cycle costs begin to take an ecological perspective and, from here, the work gets more interesting.

We tend to look at the world we have grown up with and imagine that this is just as things should be. The choices made are suitable for our needs and how best to live. However, over time many costs have been absorbed by our governments, state and federal, through the tax system. The common term for these costs is "subsidies." Depending on the context of the conversation or the advent of an election year, the S word can be used negatively to indicate some foolish expenditure or in a positive sense to advance a program that offers an apparent advantage over current policy.

Practically, we subsidize a system to provide a particular service. A perfect example is our road system. At the beginning of the twentieth century, driving was truly an adventure as there were few roads and those roads that did exist were largely dirt. When it rained the roads became impassable rivers of mud. During the 20th Century, the United States built its roads. Setting aside private roads, tax money pays for our local, state and federal highways. There is a tacit assumption that this system will always be supported by the tax base; we will continue to grow as a nation and this growth will provide funds for all our systemic needs. Or will it? In our governments, where multiple systems now vie for shrinking budgets side by side with education, health care, public safety, defense, government facilities, government employees, homeland security, social security, and more, what does the limit of revenue look like? How should the cost for our society be apportioned?

By any logical measure, the American economy operates within the life and energy created by the Earth. This is important: in fact it is critical. We continue to behave as if our economic activity has no effect on the planet. In the 19th century this position was not unreasonable. As human populations and activity have exploded in the last 200 years, we have begun to see that our actions do indeed effect the environment. From smog in our cities to climate change, the human effects on the Earth have grown to clearly visible proportions. We look around us now and realize it is time to act.

Ecological costs are simultaneously subtle and writ large upon the land. Some aspects in this exchange are difficult to quantify like the loss of species; what is the value of a species that goes extinct? More obvious is the collapse of ocean fisheries, which alarms us all and destroys the livelihood of many. Our economic system has steadfastly resisted taking into account the value of an ecosystem. From a simple common sense standpoint, we are safe to say that our broad based ecosystems in the oceans and land are effectively priceless. Hence, seeking a balance between human needs and living ecosystems must be sought and more fully understood.

There is a planetary aspect to energy that deserves attention: the sun fuels this planet. Think of it as the big bank account. Much of the energy that falls upon the earth reflects back into space. Of the huge quantities of energy that are absorbed, the cycle from input to action in the form of weather, ocean temperature, the life cycle of insects or the duration of a human life present cycles connected at a level of complexity beyond our understanding. What is comprehensible is that the energy available from the planet, from the Earth as a whole, while enormous, is indeed finite. Also, we can only access so much energy in any finite slice of time as we are limited by our technology at any given moment. We also reduce the ability of the planetary system to take up energy by destroying ecosystems. The relentless increase of humanity's reach takes energy from the system overall and reduces diversity.

Externalities:
We have agreed to create a conceptual fence around the definition of our economic system, allowing certain limits to our economy, how it affects us as individuals and in the definition of interactions between business entities. Some ideas are kept within the corral: first cost, life cycle cost, credit, debt, amortization, supply and demand, micro and macro economics. Let's look beyond the fence briefly and see what we might learn.

There are certain things we ignore. We refuse to consider the value of ecosystems in our consideration of economics. This has been the case since the discipline of modern economics was defined by Adam Smith in *The Wealth of Nations* first published in the late 18th century. When Smith posited the invisible hand, the discipline of ecology effectively did not exist. We simply inhabited a vast planet with unlimited resources.

Times have changed. Resources are no longer unlimited, in fact some basics are available in less supply than in decades passed. Water. Oil. Food. Our system is strained at home and our relationships abroad are compromised and challenged, particularly with respect to oil. Competition with emerging powers like India and China increase demand and, no surprise, cost. Smith's invisible hand still has some sway. Some of our leaders answer that we must have more. The problem with more is that we continue to make withdrawals from accounts created deep within the earth over millions of years - these accounts are finite and the results of our use have consequences beyond simply using a resource for a specific purpose. Facing the wake up call of a finite planet begs us to return to the idea of how the fence of economic concepts is drawn.

Let's consider a specific example. We generate electricity using coal and fine particulates are released into the atmosphere as a result of combustion. Does pollution from burning coal effect human health? What does it cost the health system? Is there a connection between burning coal and asthma? Heart disease? The answer is yes. In testimony before the Indiana Regulatory Flexibility Committee in September, 2006, Dr. Stephen Jay, Chair of the Indiana University School of Medicine Department of Public Health asserted that fine particulates from coal combustion cost the Indiana economy over $5 billion each year.

The approximate book value of the Indiana coal industry is between $1 and $2 billion annually.[2] If the coal industry was forced to bear the health financial burden above they would be out of business. Our laws do not recognize this connection. If this were to change, coal would be replaced by other, less expensive technologies. The coal industry has no obligation to accept the apparent connection and the externality of health impacts remains blissfully disconnected from the day to day business of mining, processing and selling the material. Now if we include the utility companies who burn coal as accessories in this interesting exercise, one can deduce that both parties are extremely interested in debunking any research that even hints that coal presents a health problem for the general populace. In this context, the unrecognized health costs of coal extraction and combustion provides an economic advantage to coal producers and utilities.

This brings us to an idea that creates tension between activists, the general population, and business. The question on the table is the notion of risk and reward. A careful scrutiny of the behavior of utilities and the coal industry indicates a pattern that privatizes reward and socializes risk. Who bears the economic burden of a system that segregates the behaviors of business entities and their effects upon the general population? In this system, the answer is simple: we do. Shareholder wealth is enhanced by ignoring the health consequences of coal and its use to create electrical power. Externalities in this context present a problem for the long term that, at present, remains unaddressed ethically and legally.

More broadly, externalities completely surround our economic system. This is a strategic choice that allows us to place limits on how our civilization exchanges energy. The limiting factors are the inertia of our present system, ignorance, and fear. The reality is that humans now cause the steady loss of species, loss of diversity, destruction of ocean fisheries, release of greenhouse gasses, and the relentless expansion of human systems against planetary ecosystems. The resistance to these principles is fierce: to accept them would turn some industries on their heads and destroy others. However, until the value of our ecosystems is written permanently into human law, we will play dice with our future.

Creating Jobs and Innovation:

Job creation is closely related to the emergence of renewable technologies. There is truth in the argument that production efficiency over time should increase requiring less work per person in the creation of energy. Old economy observers pick at renewables noting that they are inefficient and, hence expensive, implying that inefficiency or cost is an irreproachable argument for retaining and expanding existing energy sources. Indeed, emerging green technologies in wind, solar, biomass and geothermal have inefficiencies. However, in only the last 20 years, what were gross ineffficiencies are steadily being reduced. In fact, the ongoing rate of cost reductions mitigates the arguments of the nay sayers. Indeed, the position that renewable energy creates jobs is valid because the deployment of wind power, for example, requires an ongoing effort to build, connect and service the technology. This is, quite simply, brand new work. In addition, the turbines are dispersed over a broad area unlike a centralized power plant. The land for turbines is leased creating steady income for the land owners, farmers in many cases who benefit from guaranteed income. Jobs are indeed created and the cost of wind power is slowly closing on the cost of coal. When wind overtakes coal, the only surviving argument for the use of coal will be the need for baseload power on demand.

Renewable energy businesses take many forms. Some, like wind, are existing technologies in the process of coming to maturity, new technologies like tidal power are now deployed as proof of concept seeking additional financing, and fledgling businesses like Nanosolar use venture capital and take great risks for potentially enormous rewards. Creativity is harnessed to keen business sense and intelligence drives innovation. This is economic development at its best. Ambitious minds study the world around us and literally see new ways to create energy with new devices and at levels of efficiency never before imagined.

Renewable energy is part of a new economy using principles foreign to the current paradigm: the established, mature technologies that have provided energy to our civilization for over two centuries. At the dawn of the industrial revolution, coal power was dirty and expensive, but it was clear there was promise. Now coal is dirty and cheap. Technology offers possible scenarios for the use of coal which hold the promise of burning the fuel cleanly. New coal plants burn fuel with lower emissions, but the reality is that toxics are still released to the atmosphere. With carbon cap and trade on the horizon, the lure of coal power pales further regardless of how much remains beneath our contiguous land surface. In addition, the idea of sequestering carbon beneath the earth's surface is a nonexistent technology with cost implications that are the province of imagination at the moment. To chase an imaginary technology like carbon capture through the pocketbook of the taxpayer and/or ratepayer is to continue down the old economy path. Simply put, this is skill, money (energy) and resources wasted irretrievably.

Enormous investments have been, and continue to be made. There is inertia in the utility businesses that mine, process, transport and use coal. Renewables are a threat: as a result we see people of two minds, confused by the fact that many derive their livelihoods from an industry that erodes the common wealth while supporting opportunities to implement

renewable technologies. The final stumbling block is reliability. If we can solve create power on demand with benign energy sources, as needed, the dominance of fossil fuels is over.

Renewable energy offers more options. The basic principles transcend taking fossil fuel from the earth, changing the calculus from consumption to replenishing our energy sources from the vast power exchanged in planetary systems on a daily basis. There is without doubt sufficient power to run our civilization indefinitely. Our challenge is to continue to apply, support and nurture the curious minds who see power in unlikely places and imagine a human world taking up vast quantities of energy with no effect on planetary systems.

Buildings and Community Planning:

Within our buildings and cities lies an uncut diamond of opportunity as we seek an integrated energy policy. In most dialogues regarding energy, the focus is on power creation, deployment, efficiency and environmental issues. There is an implicit acceptance that the basic fabric of our cities, communities and rural areas remains more or less untouched. I contend that we miss a huge opportunity by cleaving to this assumption.

The explosion of interest in green building over the last ten years has illuminated the simple fact that buildings, residential and commercial, take almost 40% of the energy and materials created by human artifice. What is worse is that we are not particularly good at converting energy and materials into our built environment. Waste is everywhere from manufacturing processes to transport to packaging to site and installation. Even minor improvements are a big deal. Steady effort, clever technologies, and innovative work provide breakthrough examples. Moving from business as usual to buildings with tremendous improvements in technology, design quality and little or no environmental impact occupy the minds of designers worldwide. Already many examples exist that prove significant improvements in energy, materials use and indoor environmental quality are achievable and make economic sense.

Although the lure of the sustainable building is an important pursuit, there are concerns as great that demand attention. The design of our communities begs for greater care. Current zoning laws separate uses, forcing the population into their automobiles to obtain basic services. Many american cities' transportation systems rely almost solely on the automobile. Planning mandates at the municipal and state level to diversify transportation systems would slowly transform our cities. The result would be a mix of ways to move from place to place. Going a long distance? Take the train or an airplane. Going to work? Take the car, train, bus or walk. With a diversified transportation system there is a choice of how to get from place to place. Why is this important? The nature of transport choice has a direct relationship to the amount of energy used. Less energy use, walking for example, means a direct reduction in the resulting environmental impact. Let's say I walk to my neighborhood center to buy milk. No automobile was required; no greenhouse gases were emitted and I got a bit of exercise. In many places this scenario cannot happen with existing laws and policies. Changes in planning and zoning allow development (and redevelopment) to take place organically in response to specific local conditions. All that's lacking in many cases is will.

The fabric of our settlements also includes the suburbs. How do we look at existing suburban investments in a way that allows businesses to be reintroduced to support walkability? Should density be increased? Should land be given back to become native ecosystems again? If a suburban environment was transformed, might the housing stock be reworked in a manner that allowed the planting of crops for the inhabitants?

Any of the previous are possible depending on the context of land, the nature of the development and surrounding ecosystems. For example, many suburban areas of Indianapolis were farms prior to being developed. It is possible that suburban housing could be

reconfigured over a period of years so that some houses are demolished or salvaged and moved. Clusters of homes are the result. The home owner's association then leases the land to grow crops. Some portion of the crops could be made available to the local home owners free of charge as part of the business arrangement.

Transforming a suburban development into a settlement along with food production juxtaposes two uses that formerly would have been assumed to be separate simply as a matter of course. Current zoning law frowns on arrangements such as this. Another scenario might be a phased project within a suburban development that increases density and creates a neighborhood center. The increased density supports the economic needs of the neighborhood businesses. The businesses are competitive because their products, while costing more, are comparable in cost when compared to what the buyer spends by leaving the car at home. Such arrangements are new forms, additive to existing settlements with specific, untested legal challenges in the areas of property, but interesting nonetheless.

If we are serious about creating a sustainable future by use of an integrated energy policy, the work ahead is both in the city and the suburbs. In point of fact, it may be argued that we have invested so much in our suburban developments, that experiments in redefining the suburbs should be encouraged, perhaps even incentivized. Transforming suburban and urban spaces can create synergy between each while opening new opportunities for energy efficiency along with intelligent, thoughtful reuse of our settlements.

Competition and the Dark Side:

It is important is to recognize that the new technologies we advocate may have shortcomings of their own. I had this driven home while doing research on utility scale wind. In England, there are problems with large wind turbines that apparently create sub-sonic sound at particular wind speeds making people who live near the turbines nauseated. We are obligated not to gloss over shortcomings, but to face them head on and work for solutions where and as needed.

The European Union is in process of hammering out an energy policy. In particular, CO2 release reductions, reducing dependence on foreign oil and creating business opportunities. Nuclear power is a given in Europe's calculations. Natural gas and oil from Russia and the Middle East also seem to be givens. Based on this information we have the opportunity to seize an advantage with the benign energy mantra.

European policy emphasizes how EU member states will work together describing the author's intentions for cooperation, transparency, fairness, oversight and achievable goals. Sounds good. The European Union suffers some flaws however. Chiefly their dependence on the good will of the Russians who can be recalcitrant and grumpy when they feel slighted. Also, nuclear, while clearly a source of steady on demand power, presents energy that is not benign.

At first glance, Europe, for the moment, is in the lead. In a longer perspective, we can argue that perhaps the EU has liabilities that will become problematic over time. The mantra "make it visible" is essential in this work. Literally. We have to look for opportunities to create what we imagine. These kinds of projects completed in concert with allies from the local community provide proof of what we're talking about. We take policy from paper to reality. Another aspect of work like this is that the results can inform the evolution of the principles over time.

Last Word:

In closing, if you believe this is bleeding heart liberal hogwash, then skip the consideration of ecology, ethics and diversity, and cut straight to the economics. From the standpoint of cost,

we are better served by choosing to implement the ideas and policies described here. None of these ideas is partisan; this is about quality of life, not only for humans, but for all life forms.

This paper is as much about how we think as it is a study of policy with regard to energy efficiency. We would be wise to carefully consider our attitude towards the environment. We can continue to insist that we are separate, special and aloof from the remarkable life of the planet around us. If instead we embrace the realization that we are truly and inextricably linked to the life within and all around us, the "policy" espoused here, while essential at the beginning, will be overcome by a cultural transformation that returns us to balance with the planet.

We are best served by action with an emphasis on the "state of the solution" and not the "state of the problem." We won't be perfect. We will have a plan though: a plan that learns, that improves and ultimately provides a template for the transformation of our society. The way forward is an integrated approach to energy; its origins, distribution, technology, communal planning, use of transport. This is truly a long view position. At full implementation, the result would be an energy profile for our civilization that can last indefinitely with an imperceptible footprint on the earth.

[1] Accepting the goal of benign energy sources effectively takes coal, oil and nuclear off the playing field.

[2] Projections based on Indiana Department of Natural Resources "Coal Economics" - see:http://www.in.gov/dnr_old/reclamation/coal_IN/coalecon.html