

# **Carbon Pricing is Just One Piece of the Puzzle: Towards a Comprehensive Climate and Energy Policy**

**Michael Hoexter, Ph.D.**

**Terraverde Consulting**

**Belmont, CA, USA**

**Part 1. Carbon Pricing (Cap and Trade/Carbon Tax) is Just One Piece of the Puzzle: Two Economic Worldviews**

**Part 2. Carbon Pricing...: Theory and Practice of Carbon Pricing**

**Part 3. Carbon Pricing...: A Survey of Market Failures in Technology and Infrastructure**

**Part 4. Carbon Pricing...: The Scope of a Comprehensive Climate and Energy Policy**

**Part 5. Carbon Pricing...: Outline of a Comprehensive Policy**

**(January – February 2009)**

**(also available on the web at <http://greenthoughts.us/policy/comprehensive/>)**

## Part I. Carbon Pricing (Cap and Trade/Carbon Tax) is Just One Piece of the Puzzle: Two Economic Worldviews

(originally published January 26, 2009)



Sir Nicholas Stern was commissioned by the British Government to assess the economic impacts of climate change and the costs associated with mitigating carbon emissions. The Stern Review remains the most comprehensive economic study of climate change.

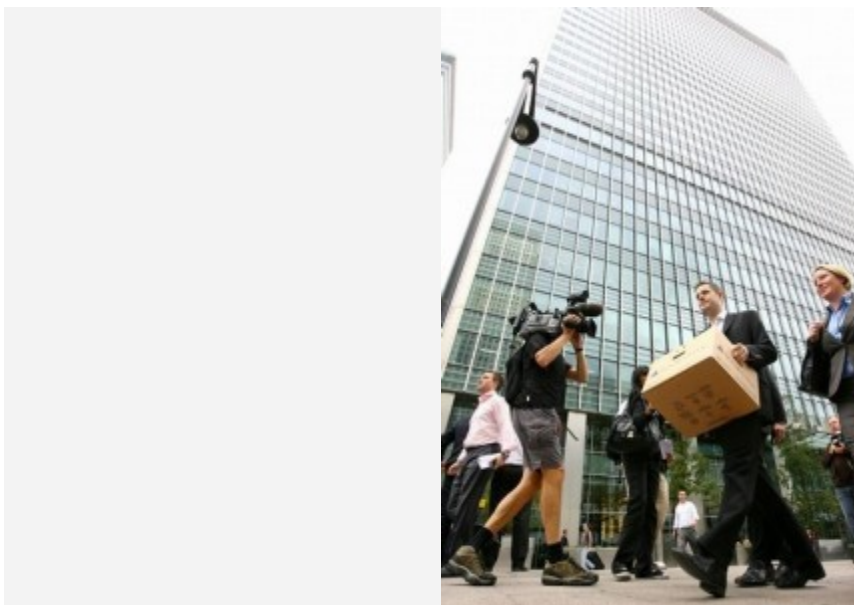
In 2006 in the [Stern Review on the Economics of Climate Change](#), the economist Sir Nicholas Stern called climate change, “the greatest market failure the world has seen.” Throughout [the almost 20 year history of climate policy](#), some economists and climate policy designers have attempted to remedy this failure by assigning a price to carbon emissions thereby bringing this negative externality (to the market) into the reckoning of market actors. However I believe the primary focus on carbon pricing ignores certain fundamental realities of economies, of technological development and of physics which will lead to frustration as we try to reach some very ambitious climate and economic goals by 2020 and 2050.

As then President-elect Barack Obama said in [a speech](#) to the nation, our economy will not recover if we rely on “worn out dogmas of the past”. Despite the recent emergence of the first proposals for cap and trade systems in the US, a monocular focus on pricing carbon bears many traces of past economic orthodoxies, which are now under revision in light of very recent events. The resistance to carbon pricing on the part of the Bush administration and deniers of climate change has obscured the fact that this policy instrument hovers just a little bit above and to one side of some of the main economic and energy challenges facing us in the next decade. In other words, the enemy (cap and trade) of my enemy (deniers), from the point of view of climate activists, is not necessarily always a friend.

Much of the risk involved in designing a long-range policy that is intended to have a discrete physical impact on our atmosphere and climate has to do with lack of certainty within economic theories, particular as regards the benefits and limits of market

mechanisms. We, and economists, can't seem to be able to make up our minds about the appropriate types of interaction between public and private actors within a prosperous and, now a carbon-emission-reducing, economy. While some see the range of choices as a sign of our freedom and part of the "fun" of disputes in economic and political discourse, if we are choosing among partial or even false ideas and if the conflict itself causes distortions in our understanding, we are in trouble. Do we need to choose between the "magic of the market" and beneficent government-sponsored programs? Or is the picture more complex, less packagable into sound-bites, but reality-based?

### **Crisis of the Self-Regulating Market Ideal**



The bankruptcy of 150 year old investment bank Lehman Brothers in September 2008 shocked the financial world and has led to a dramatic restructuring of the financial industry both voluntarily and with government assistance.

In the last several months there has been a sudden and complete about-face in the direction of economic policy actions with regard to the rightness of government's role in the economy. Conceptual development and informed deliberation about this sudden spate of impromptu regulations and huge expenditures has lagged far behind the actions themselves. Faced with the collapse of major banks and other financial institutions, the conservative Bush Administration and governments around the world suddenly intervened massively in areas of the economy in ways which months before were inconceivable. While perhaps the US President most ideologically committed to the notion that markets can regulate themselves, George Bush in his last few months in office oversaw the expenditure of hundreds of billions of taxpayer money to prop up the economy in moves that have socialized economic risk for many large corporations. These ill-coordinated moves may have nevertheless prevented or at least delayed a slide into pure economic chaos.

A sign of a sea change in economic thinking can be observed in the mild mea culpa's of Alan Greenspan, the retired head of the US federal reserve bank who had been seen as

one of the principle architects of a hands-off market policy by the US government with much influence abroad. While previously a believer in the stabilizing effect of financial derivatives and limiting government regulation of finance, Greenspan recently expressed surprise that lenders had not acted in their own best self-interest by refusing to issue or buy risky loans and loan packages. Dominant in economics and economic policy since the late 1970's, Greenspan was only the latest dean of the so-called monetarist school which advocates maximal market self-regulation, a tradition that includes economists [Milton Friedman](#) and [Friedrich von Hayek](#). Another self-regulating market philosophy, called [supply-side economics](#), also came to have a highly influential role in the United States and elsewhere, which emphasized that simply cutting business and upper-income taxes and decreasing government spending on social welfare would increase private investment and therefore the supply of desirable goods, spurring, in turn, economic growth.

Common among advocates and theorists of self-regulating markets, a.k.a. monetarists and supply-siders, are assumptions that people are more rational and economic information is more accurate than they and it actually are. The recent housing bubble progressed and mushroomed to enormous size resting largely on these assumptions, as borrowers, lenders, securitizing firms, insurers and rating agencies created a self-reinforcing circle of denial of the downsides and risks involved. These views may have been held sincerely, even naively, by some or, for others, as part of a self-interested calculus in which it was OK to assume the best if one also quickly divested oneself of responsibility for or connection with the consequences of risky decisions.

While there is now a large experimental literature in the newer field of [behavioral economics](#) that has shown that people are not nearly as rational as self-regulating market theory assumes, the assumption that people are most often protective of their best interests is contained in the numerous policy recommendations and statements by politicians, from the Bush Administration but also Administrations past. The call that the best economic stimulus is always putting more money in private hands via tax cuts or tax rebates, rests on the assumption that these economic actors will always, in all contexts, alone and in aggregate, act in their best interest and in that of the entire economy. In other words, the idea is that economic surpluses are always best left or rapidly returned to individual or corporate actors in markets rather than remain part of a government spending program, however efficient or well-regarded.



Friedrich von Hayek, a leader of the Austrian School of Economics, one of the prominent "free market" schools of economics, did not think of himself as a conservative but a "liberal" in the European sense; he saw as his main opponents Communism and Keynesian economics. His work was inspirational to Margaret Thatcher, one of the promoters of the new libertarian vogue in economics in the mid 1970's.

In another, conflicting account of the financial collapse, true believers in a totally unregulated and unsubsidized private market, [libertarians](#), contend that the current economic situation is in fact caused by too much regulation and the socialization of risk prior to the credit crunch. Criticizing both the Bush administration and its Democratic critics, these libertarians point out how various companies knew they were “too big to fail” and made risky financial bets on the assumption that they would be bailed out or could in the end rely on government to save them. The Bush administration may have flirted with this more radical policy orientation in allowing [Lehman Brothers to fail in September](#) only to become terrified of the resulting credit crunch.

Libertarian advocates of a “pure” market, claim that a consistent, hands-off approach would have better results, helping all corporations and individuals learn to become more responsible market actors. As we have had no governments that adhere to this vision in power in recent memory, it is difficult to say what the consequences would be but in all probability we would see, as happened in the latter half of the 19th Century when [laissez faire policies](#) were the norm, an even more extreme polarization of wealth, more pronounced boom and bust cycles, and more rampant environmental degradation without the intermediation of regulation and government programs. There is no room in the “pure” market view for pricing in market externalities, as market actors are thought to be in full command of all economically-relevant issues and information. For some reason, the military and military spending are exempted from this same scrutiny by these commentators, perhaps because there are no private market alternatives to these institutions.

## Revived and Updated Keynesianism: A Rush Delivery



John Maynard Keynes was the most influential economist of the mid-20th Century, credited with supplying the theory that helped explain how market economies emerged from the Great Depression. While dissatisfaction with Keynesianism peaked in the 1970's and 1980's in political circles, the Keynesian approach is credited with lengthening the periods of economic growth and shortening recessions in post-WWII economies.

The economic school which the latest crop of monetarists and other “free market” advocates reacted against was [Keynesianism](#), which ruled Western economic discourse from the mid 1930's to the 1970's. Based on the work of the British economist John Maynard Keynes, the climate of opinion that is Keynesianism believes that government involvement in the economy and in particular government spending is necessary to balance the tendencies of the market towards boom and bust. Keynesians believe that regulation of market actors by government is in many cases warranted. Keynesians in general support some form of social welfare spending, with those to the political left supporting a comprehensive social safety net paid through tax revenue.

Inequality is not only a moral problem to Keynesians but also, in Keynes's words, [a “magneto” \(kinetic-mechanical\) economic problem](#) leading to insufficient overall demand for goods in economic downturns, demand that needs to be stimulated by loosening monetary policy, direct government spending, including public works programs and unemployment insurance. People with relatively less means tend to spend more of their money as a percentage of their income than the rich, who by virtue of being rich, cannot or can choose not to spend so much and still survive. Keynes observed and theorized that people prefer to hold onto their liquid assets (to save) during economic downturns and the concomitant deflationary period, reducing overall

economic activity and further exacerbating the recession. This is one aspect of what is called people's "[liquidity preference](#)".

From a vocal fringe that has had inordinate influence on popular economic discourse for three decades, libertarians contend that Keynesianism has remained the philosophy of government economic policy [even during the Bush Administration](#) despite its talking up of the virtues of the market and private initiative. From this radical perspective, all who interfere with the market are Keynesians or "socialists", therefore erasing the differences between the regulatory policies of the Bush Administration and what we imagine to be the policies of the beginnings of the Obama Administration or the Roosevelt, Eisenhower, and Johnson Administrations of the past. This accusation also overlooks the fact that Keynesianism is itself [an effort to preserve capitalism](#) rather than supplant it with another economic system.

Important for this discussion is Keynesianism's agnosticism towards some forms of [economic planning especially as applied to areas of public investment like infrastructure](#). In the Cold War confrontation with the Soviet Union, planning was thought to be an attribute of Soviet style economies yet in the US, federal, state and local governments continued to plan to manage their own investments and budgets. With the rise of the libertarian ideal in the 1980s, planning was considered to be inefficient or a "taboo", as the play of market forces was thought to be the optimal solution to all economic problems. If we re-emerge into an era where public funds are once again used to build infrastructure or invest in other public goods, the need for planning once again comes to the fore despite the ideological wars that have surrounded the term. As a sure sign that the rush away from planning has now "bottomed-out", one hears lifelong capitalist and conservative T. Boone Pickens now publicly [lamenting the lack of planning in the area of energy](#) in the US over the past 40 years.

While before the collapse of 2008 and monetarism/supply-side's precipitous fall from grace, public praise in recent decades for Keynes and Keynesianism was hard to find, we now find ourselves in an era when economists and the public are engaging in a crash study course of the works of Keynes and notable Keynesians like John Kenneth Galbraith. Most significantly, President Obama quoted Keynes almost exactly in his [inaugural address](#) by citing that our productive capacity remains underutilized in this financial downturn. Paul Krugman, the recent Nobel Prize winner in Economics, has become one of the most vocal advocates for a rediscovery of Keynes in the US, using his influential op-ed pieces and [blog at the New York Times](#) to revive interest in a positive relationship to targeted government involvement in the economy. One needn't however look to a left-leaning economist like Krugman or political leaders to find voices that recommend that government needs to do more to regulate the extremes of the business cycle and business practice, as billionaires [Warren Buffett and George Soros](#) have for the last several years questioned the existing hands-off policy.



The Works Progress Administration or WPA was one of Roosevelt's New Deal programs that functioned as a fiscal stimulus, training workers and putting them to work on public works projects. Conservatives argue that the WPA and other New Deal programs were ineffective and lengthened the Great Depression while liberal economists claim that they were insufficiently large and stimulative in comparison to the WWII mobilization which ultimately ended the Great Depression.

In current debates, the key arguments are around the role of so-called “fiscal stimulus” to the economy, as opposed to “monetary policy”, as well as the size and duration of that fiscal stimulus. Fiscal stimulus means the government spends money out of its budgets (fiscal) to stimulate economic demand and jumpstart the economy, rather than rely solely on adjusting interest rates. In the years in which Keynesianism was in the political and, to a lesser degree, academic doghouse, fiscal stimulus was considered to be taboo and dangerously inflationary. Using fiscal stimulus can lead to deficit spending, meaning governments running up their deficits and risking decreasing the value of the national currency. Opposition to the stimulus package proposed by President Obama will draw liberally from these criticisms and fears. Economic blogs are rife now with discussions of [the potential effects](#) and [risks](#) associated with large stimulus programs.

“Monetary policy” usually involves the adjustment of interest rates by central banks, the instrument which has been periodically used throughout the period of monetarism’s dominance of economic discourse. With interest rates currently effectively at zero, monetary policy has no more stimulus to offer to the economy. While in this crisis most commentators on economic policy accept the need for fiscal stimulus of some kind, there are key arguments and decisions to be made about the duration of the fiscal stimulus or direct government involvement in the economy. Is this fiscal spending an emergency measure or part of a new economic common sense?

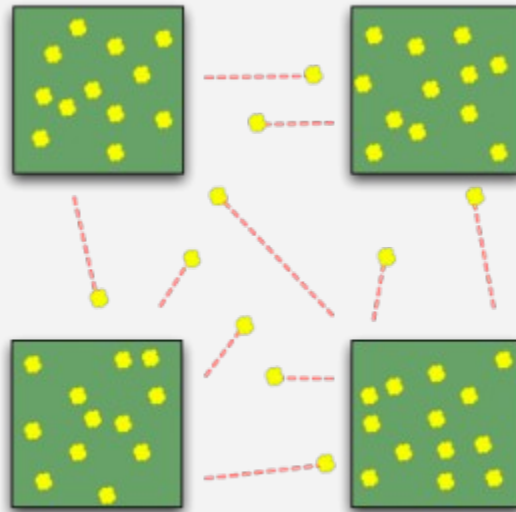
The responses to our economic crisis that President Obama has announced so far come largely from the Keynesian playbook even though he has not surrounded himself with economic advisors that historically have advocated nor are known for their emphasis on government investment and regulation. From outside Obama’s inner circle, [Krugman](#), [former Secretary of Labor Robert Reich](#), and [economic commentator Bob Kuttner](#) have praised the direction of policy but criticized the amount of fiscal stimulus

that Obama has proposed, saying that [the stimulus amounts will not cover the shortfall in economic activity](#) expected to be caused by the downturn. The calculation of exactly how much stimulus is needed and for how long is a crucial affair, depending largely on one's theory of how government should act in the economy in a downturn and, just as importantly, during normal economic times.

The role of tax breaks within President Obama's proposed stimulus is hotly disputed among politicians and within the economic profession and is an area of compromise with the monetarist camp. Monetarists believe that private economic actors, individuals and businesses, will know best what to do with tax monies, and believe that money in their individual pockets will be most effective in stimulating the economy. Keynesians are more conscious of the liquidity trap, where economic uncertainty to the downside leads people to save and not spend. [Data collected about the tax rebate of 2008](#) indicate that the Keynesians in this matter may be right: people tended to pay existing bills or saved the rebate rather than spend it on new purchases. This data point may not be enough to persuade believers in monetarist or supply-side ideals that government can spend social surpluses wisely and effectively outside of the areas of which monetarists approve: defense spending and administering the legal system.

It is not yet clear whether President Obama and for that matter other world leaders are "re-embracing" the notion that government has a rightful place in both good times and bad times in delivering services directly to citizens, building infrastructure, and creating new markets deemed socially useful. It is safe to say that at least some forms of regulation and government oversight are now considered to be desirable on an ongoing basis, so there is a partial move towards the Keynesian playbook worldwide.

## Comparing the Monetarist/Supply-Side and the Keynesian Worldviews



Brownian motion is the random movement in all directions of particles and molecules in a stationary fluid, the result of their random collisions. In a more general philosophical sense, the monetarist/neoclassical model of economies sees economies as composites of independently moving economic actors that respond to forces like supply and demand (price). For these economists, government interventions would constrain or direct these economic actors interfering with their, in the free market view, optimal, natural distribution through their interactions.

These crucial decisions about the economy are based on conflicts in worldviews that underlie the choice of a “free market” vs. a Keynesian approach to economic problems. The various flavors of monetarist and supply-side worldview see economic reality as a composite of “particulate” atoms; actors that act independently and uniformly in their own self interest, more often than not competing with each other. The expansion of the role of markets implies that competition between economic actors is not only the “state of nature” but is universal, necessary and salutary; cooperation is achieved on a case-by-case contractual basis. “Free market” economics which had its heyday among the monied classes prior to the 1929 stock market crash, became in the 1980’s, a populist view, as the notion that people “know what to do with their money” rather than surrender some in taxes flattered people, both the rich and the aspiring-to-be-rich, that they knew better than the government. To maintain the political appeal of freeing the market from regulation, there was an ongoing campaign to downgrade and some would say malign the competency of government to handle money and deliver services. In this worldview, the government is characterized as a covert profit-seeking and overt and covert power-mad entity that wishes to expand itself and enrich itself through intervening in the economy.

The Keynesian world view is more of a climate of opinion than an organized theory and is therefore more difficult to characterize and condense. Keynesianism sees that

economic actors come in a number of types, public and private. Also in Keynesianism, there is a legitimate place for the roles of regulator and not-profit-seeking entities like the government to play in the economy; in this view of the world, there is the potential for multiple complementary or cooperative roles rather than the competition of all actors with each other. Because of this complementarity, it is possible to imagine that new systems like infrastructure can be built within the economy with the sponsorship or leadership of government. It is more likely to speak of “systems” and to take a systemic view of the economy or sectors within the economy from a Keynesian point of view.

Keynesianism also offers a larger set of strategy alternatives within macroeconomics (the management of national and global economies) and therefore for political leaders and regulators; this set includes the regulation of the money supply, the monetarists’ main concern and policy tool but goes beyond monetary policy. In the Keynesian view, it is conceivable to imagine that government officials and politicians as well as other economic and political actors could be motivated by impulses other than profit-seeking or narrow self-interest. Therefore in this view, government officials might actually be both motivated to do good and to create value in the economy. To free market advocates, this is all merely a façade covering to them the “real” intentions of government described above, i.e. the acquisition of more power and money.



This French national health ID card entitles the insured to reimbursement for 70% of medical services, with many very expensive life saving procedures covered 100%. Through a process of negotiation, the French have worked out a system of universal health insurance regulated by but not administered by the French government, which effectively defines a wide set of medical procedures and services as "needs" or entitlements rather than "wants". Universal publicly-financed primary and secondary education in the US in effect defines education up to the 12th grade as an entitlement.

There is also a crucial difference in how each camp classifies human desires, which is not simply a matter of academic or philosophical interest for economists and for policy makers. Monetarists and laissez-faire oriented political actors are inclined to lump all desires into the category of “wants” as does conventional neoclassical economics. A theoretical entirely unregulated market system would tend to treat all desires as optional and discretionary. The [health care proposals](#) put forward, for instance, by the McCain campaign last year, suggested that people could treat health care expenditure as part of each person’s or family’s individual discretionary budget and would compete with other

wants and spending. In Keynesianism, though also an heir to the neoclassical tradition, it is possible for government to except certain activities from being treated simply as another “want” in the marketplace by mandating programs that for instance guarantee pensions, health care, etc. In this way, there is a recognition of “needs” or as they are sometimes called “entitlements” rather than simply a category which mixes all “wants” together. Free market advocates recognize that entitlement *programs* exist but view them as sub-optimal departures from a philosophy that views all desires as optional.

The two worldviews also diverge in the valuation placed on human knowledge, science and forethought. Monetarists and other free-market advocates tend to see human knowledge as fatally flawed when extended beyond a personal or local orbit and requiring [the turn of events or experience to validate the rightness of any bit of knowledge or understanding](#). Even then that knowledge is thought to be mostly of temporary or local value. Keynesians may share some of this utilitarian view but additionally are more likely to view science and accumulated human knowledge as having some validity through time and space and therefore potentially the basis for action for the common good now or in the future. These fundamental differences in philosophy lead to radically different valuations of natural science and the ability for us to plan aspects of our future based on current knowledge and projections into the future.

The “mixedness” and diversity of the Keynesian playbook and worldview, which might be a strength in giving governments a greater range of policy choices, has also been a political liability for it in comparison to the relatively simple message of monetarists and supply-siders, as broadcast by [Ronald Reagan](#), [Margaret Thatcher](#) and their successors. In the Keynesian world there is not such a stark division between economic good and evil, while in monetarist and supply-side views, the bad government folk are almost always the economic enemy. Keynesians, who range from just right of center to left-liberal and social democratic, have not developed the compact political message that their monetarist critics have been able to project.

The Obama Administration has shown signs that it is aware of the challenges of re-creating a positive role for government in the economy after three decades, in which many elected officials heaped negatives onto the government that they were supposedly leading. The creation of [a Chief Performance Officer](#) position to which President Obama has appointed Nancy Killefer, indicates that Obama wants government institutions to become more economically efficient. Contained within at least its conceptualization is the belief in a positive good to be delivered by government which can and should be delivered better. Under a number of previous Administrations, we might imagine that someone in this position would be focused only on cutting budgets and, with that, services. We are hoping that this new Administration can deliver on the promise of better, not necessarily less, government services delivered more cost-effectively, perhaps developing a self-disciplined Keynesian approach to government’s role.

The qualitative characterizations of these two worldviews are not simply “hand-waving” arguments but form the basis for concrete policies that involve investments of billions of dollars on a regular basis as well as quite different legal frameworks that govern economic activity. How people believe people and social and economic institutions behave and select the essential truths of and goods in social and economic life turns out to be more than simply a philosophical argument.

*Part II will continue by describing the economic assumptions and designs of proposed carbon pricing systems.*

## 2. Carbon Pricing...:Theory and Practice of Carbon Pricing

(originally published February 4, 2009)

*In [Part 1](#), I called attention to the rapid shift in general economic policy in the last 6 months. I developed an outline of two distinct economic schools, one that holds up the ideal of a self-sufficient, self-regulating market and another that sees markets as having shortcomings that require government to supplement and regulate where the market fails. The first school might be called monetarist/supply-side and the second Keynesian with varying tendencies within that school. I highlighted how each of these schools is attached to a particular worldview or set of worldviews. The conflict within economics will necessarily have impacts on climate policy.*

### Reliance on Carbon Pricing: Hanging Onto an Idealized View of Markets?



The Scottish inventor, James Watt, invented the steam engine, powered by coal, in the 1760's and 1770's. At that point in time, coal had already a long history as a heat source. Most accounts of the history of the industrial revolution and of modern economies downplay the importance of fossil fuels in spurring economic growth and the modern economy and focus on changes in end-use technologies. A post-carbon economy will require a revolution in our thinking about and focus on energy and how it is sourced.

Climate activists have been focused since the early 1990's on instituting a cap and trade system that they feel, almost singlehandedly, would induce or compel economic actors to emit only up to a certain "cap" of greenhouse gas emissions. The [Kyoto Protocol](#), ratified by 180 countries, is an attempt at an international cap and trade system. Both cap and trade and its near competitor, a [carbon tax](#) are "market-based" policy instruments that attempt to curb greenhouse gas emissions by assigning a price to greenhouse gases. The price will function as a signal (largely in the form of a disincentive) to market actors to change technologies and procedures to emit less carbon into the atmosphere. These policies are "[market-based](#)" because they rely on the pricing mechanism and allow market actors to decide how they reduce their emissions as opposed to more directive, so-called "command and control" regulations that tell market actors what exactly they must do. An environmentally-sensitized variation on the monetarist/free market

worldview and policy orientation, the idea is that the private economic actors, mostly businesses, know best what to do if given the appropriate price signal.

Climate change concerns and a climate protection movement have emerged in the last two decades, an era of monetarist/free market dominance of economic policy and to a lesser extent the economics profession. Carbon taxes, though a tax and therefore viewed with suspicion by free market advocates, have a single “market-based” layer in introducing a carbon price into the calculations of market actors, a disincentive to which they can respond as they choose. Cap and trade systems add an additional carbon permit and [offset trading](#) market, in addition to introducing a (varying) price on carbon, so are doubly market-based. Despite these efforts made to introduce market-emulating mechanisms into environmental regulation, [the political advocates of free markets](#) are almost universally opposed to cap and trade, carbon taxes and direct regulation; they generally show themselves to be unconcerned about climate change and are more concerned about how any regulation will interfere with smooth and unhindered market functioning, which to them is the [summum bonum](#) (Latin for the highest ethical good).

Much [discussion and dispute has been focused on the choice](#) of which of the two main market-based instruments will do the heavy lifting in climate policy. The carbon tax assigns a price directly to carbon emissions and is levied directly by governments. It is relatively simple instrument, favored by many economists and some industries, but criticized by many climate activists who feel that it is insufficiently rigorous. Others have criticized a tax because it is politically unpalatable in an anti-tax era, still others because it does not in its initial designs utilize carbon trading. Despite this, two leaders in the climate protection movement, [Al Gore](#) and [Jim Hansen](#), prefer an stringent carbon tax policy to the cap and trade systems proposed, though both have suggested that it should not represent a net increase in the overall tax burden by cutting other taxes or returning a dividend.

Carbon taxes and cap and trade can be distinguished as follows: the cap and trade system sets the amount of allowable GHG pollution and, if permits are auctioned rather than given away, the price follows from the cap; a carbon tax sets the price which would limit emissions via the amount of direct economic losses inflicted or fear thereof on economic actors. In a cap and trade systems, punitive fines and potential criminal proceedings can follow from exceeding the permitted amount of pollution. A lower cap produces fewer and therefore more expensive permits (in an auction) and a higher carbon tax inhibits emissions because of their increased expense thereby leading economic actors to lower levels of emissions.

The revenues from both permit auctions and the carbon tax can be directed any number of different ways: to offset or reduce other taxes, to be spent on carbon emissions reduction, or be returned to taxpayers in the form of a dividend. The latter idea is an effort to diminish the generally regressive income distribution effect of carbon pricing: the carbon price will, percentage-wise, through higher prices for energy and high-carbon

intensity represent a higher portion of the budgets of lower income families more than upper-income ones. The latter system is called a “[cap and dividend](#)” or a carbon tax dividend. As it has been developed, the basic carbon pricing “concept” does not recommend or entail any particular use for the funds collected, therefore the diversity of proposals.



Cap and trade regulations were originally applied as a way to incentivize power utilities to install sulphur dioxide emissions scrubbers on their coal fired power plants, like the unit attached to the smokestack above. While these emission scrubbers sometimes cost upwards of \$1 billion, more than the original cost of some power plants, they significantly reduce acid rain but do not reduce carbon dioxide emissions. Ultimately the joint cost of complying with regulations and the technology itself is borne by utility ratepayers through increases in the cost of electricity, which ends up being an indirect route to pay for the positive externality of less acid rain.

Despite the support of some renowned climate activists for the carbon tax, during the years of the Bush Presidency support for a cap and trade system with 100% auction of permits and a tight, progressively more restrictive cap, has been considered to be the mark of serious action to stem carbon emissions. The historical model for greenhouse gas cap and trade systems were the systems introduced in [North America in 1990 to limit the emission of acid rain](#) causing pollution from power plants, called SO<sub>x</sub> emissions. Designed explicitly as an experiment in market based regulation and an alternative to directive regulation of power plants by governments, these power plants were incentivized to adopt SO<sub>x</sub> scrubbing technology by being allowed to pollute up to the number of permits that they purchased in a permit auction. If the power utility was able to emit less than the permits they purchased, they could sell these permits to firms that polluted more at a profit, introducing, per the market-oriented theory behind the program design, a profit motive into the process of adopting the emissions scrubber technology.

Carbon cap and trade systems are similar in design to SO<sub>x</sub> cap and trade systems but are many times larger in the scope of their application and also present market actors with a

vastly larger number of possible choices to reduce or offset their emissions as compared to the SO<sub>x</sub> systems. The most rigorous cap and trade system uses 100% auction of pollution permits with a high reserve price and an aggressive overall pollution cap. The least aggressive gives out permits and has a “loose” or higher cap, which has [been a criticism of the initial round of the Kyoto protocol](#). As compared to carbon taxes, a cap and trade system is much more complicated. However, there are [hybrid systems that place pricing floors and caps](#) on pollution permit prices, effectively offering a carbon price within a range, similar to a variable carbon tax.

## **Carbon Pricing and “Not Knowing” the Solutions**

The premise of carbon pricing as a complete climate solution, as opposed to "command and control" regulation, is that regulators and the designers of a carbon pricing do not know the technological solutions to reducing carbon emissions, in keeping with the monetarist/free market tendency to view scientific knowledge as limited in scope and not generalizable. The market becomes a "[black box](#)" that produces innovation or favorable and/or efficient social results. In practical terms this could mean that designers of the policy are thought not to be cognizant of industry inside knowledge or that no one can know what the future will bring in terms of technological development. Entering into a carbon pricing system then means embarking on a technological and economic “voyage of discovery”.

If one believes that one knows or we know at least a portion of the technological solutions to reducing carbon emissions, carbon pricing would be in many instances a roundabout solution for supporting those solutions.

## **The Benefits and Limits of Carbon Pricing**

In an era of lingering climate change denial and resistance by fossil fuel and industrial interests to change, the real consequences of carbon pricing policies have tended to be glossed over by its advocates. The thought has been “we must get this passed, no matter what”, “you’re for us or you’re against us”, or alternatively “this is the only politically realistic climate policy.” Usually these sentiments are applied to the more widely considered and discussed cap and trade systems.

Troubling though is the finding that these policies, in particular cap and trade systems, were selected because of allegiances to now-questioned but politically popular economic theories, rather than the real effectiveness of these policies. In [a little noticed review](#), Gar Lipow has pointed out that straight “command and control” regulatory schemes in Germany and Italy reduced acid rain pollution far more than the US SO<sub>x</sub> cap and trade system upon which the Kyoto protocol and other cap and trade systems were based. In Germany SO<sub>x</sub> emissions fell 87%, in Italy 62%, while in the US in the same period they only fell 31%, with comparable disparities in the absolute levels of these pollutants on the two continents at the end of the study period (2001).

Furthermore, the notion that cap and trade systems spurred innovation has come under question by economists. Margaret Taylor in [an analysis of patenting activity](#) has found that patents related to emissions scrubbers for SOx were not significantly affected by the institution of cap and trade systems as opposed to a spate of other regulatory mechanisms worldwide. Studies have also shown that the costs to firms to reduce their SOx under a cap and trade systems as opposed to direct regulation were roughly equivalent.

If conventional regulation is simpler, about as costly, and substantially more effective than historical cap and trade systems, why the enthusiasm for cap and trade to tackle the far broader problem of carbon dioxide and GHG emissions? The coincidence of the now somewhat discredited political fashion for expanding market mechanisms to almost every social problem seems to account at least in part for the adoption of cap and trade systems during the market-focused 1990's and early 2000's.

Additionally the choice of cap and trade in the 1990's may have seemed more justifiable out of a sense by international regulators of uncertainty about what the technological solutions to curbing carbon emissions might be. We have advanced since then in our understanding of workable technological solutions to reduce carbon emissions substantially, some which are now "marketable" and some of which require the help of supportive policies or regulations to make it on the markets. We have not arrived necessarily at definitive solutions for all technological carbon emissions reduction challenges but we have [many adequate "starter" solutions](#).

### **Assessing the Benefits of Carbon Pricing**



The Kyoto cap and trade system's Clean Development Mechanism or CDM, enables organizations from richer countries to fund carbon emissions reductions efforts in less developed countries to "offset" that organization's domestic emissions. At this project in Karnataka, India, field wastes are collected and used to generate electricity and heat, which otherwise would decompose in the fields. CDM has been an area of controversy because some CDM offsets have either not represented real emissions reductions or those projects were not truly "additional", meaning they would not have happened otherwise.

In our era of idealized and now somewhat disenchanting views of what markets are and how they function, it is difficult to make a neutral assessment of the benefits of carbon

pricing especially cap and trade; in other words, we have a somewhat “bipolar” conception of markets and the self-interested behavior upon which they rest. Not only is this a matter of perception but a deep economic and sociological problem: we have no rigorous description of markets as institutions like other institutions so we tend to treat them as “sui generis”. If markets are unique it is more difficult to formulate how to reshape or re-energize them, if that is what is on the agenda.

Advocates of carbon pricing have tended to list the fact that cap and trade, in particular, is “market-based” as in-and-of-itself a recommendation of these instruments. If this is simply a matter of saying that it conforms to the monetarist economic fashion of the last three decades, then this is no longer such a recommendation, at least to many who are now viewing the economy of the recent past more critically. A finance-heavy economy dependent upon trading seems to have had more of a downside than its proponents and defenders would have had us believe.

Furthermore, beyond intellectual allegiances, if the trading element or market-based element was a signal to powerful economic interests that carbon regulation would potentially be a profitable instrument within some reasonable bounds this might be politically and ethically defensible. However if the rush to declare carbon regulations as market-based a signal that they might be corruptible instruments with the lure of windfall profits, this would appear unseemly and, in the end, defeat the purpose of carbon regulation, regulations that would raise energy and goods prices for all sectors within the economy.

Here I will attempt to abstract from the proposed structure of carbon pricing in both its carbon tax and cap and trade forms, the “socially useful” and politically defensible components of carbon pricing that go beyond theoretical commitment to the market mechanism:

1. **"Viral"** - The influence of a carbon price could spread virally - as carbon pricing will be applied to energy and other basic goods, the price will effect all economic sectors and “work its way” into many unforeseen types of transactions that ultimately will influence carbon emissions.
2. **(Potentially) Global** - A tradable carbon credit or permit could allow cross-border involvement and participation of less-developed countries in carbon sequestration and emissions reduction efforts (addressing the global nature of climate change).
3. **Incremental** - Carbon pricing will encourage incremental changes based on the price level - carbon pricing then will encourage energy efficiency, behavior changes with approximately equivalent costs, land use change, bio-sequestration, and small to mid-sized capital investments
4. **Monetary** - Carbon pricing is directly attached to money and financial calculations, the most compact decision-making form for individuals and organizations. I have proposed a much more complex decision making tool for

big, high-level decisions but a simple price fits relatively snugly into most existing financial instruments like cash flows, net present value, etc.

5. **Quasi-universal equivalent or signifier** – Related to “2” and “4”, the carbon price can allow comparison and trade of equivalents between unlike activities like afforestation, energy efficiency and renewable energy. They all would be assigned a monetary value according to their impact on carbon emissions.
6. **Induces Action** – changes in prices induce actions or the propensity to take action.
7. **Internalizing Carbon Externality** – Of course, the main reason for the program, to attach to global warming gases an disincentive/incentive that creates a carbon market or carbon “line-item” in economic calculations.

### **The Limitations of Carbon Pricing**

Even if we accept that policy is always co-produced by political and economic vogues and enthusiasms, there are troubling limits to relying exclusively or largely on carbon pricing to drive innovation or rapid deployment of clean technologies. Below are a listing of some questionable assumptions in and real constraints on carbon pricing.

- 1) **“Private actors know best”** – For one, the assumption that businesses and individuals will know which solutions will work best for them to reduce emissions is flawed. Most businesses will be following the recommendations of government sponsored studies of which technologies will work and which will not. Most businesses and families do not monitor and measure their GHG emissions as a matter of course, nor are they necessarily experts in the selection of new technologies, some of which will never have been deployed before on the market en masse. Furthermore, to become experts in the selection of technologies, firms will need to spend resources, potentially reduplicating the efforts of other firms, often outside the areas of their core competencies.
- 2) **“Price signal will be clear”** – As a result of the above, both cap and trade and carbon tax systems will probably end up relying on large “look-up tables” of engineering analyses of different technologies and use some type of carbon emissions calculator to assess the degree to which they will be able to reduce greenhouse gases. The price “signal” will not be the original means by which firms will calibrate their efforts to reduce greenhouse gases but will instead be facing a series of capital investment decisions that will yield either discrete emissions reductions “equivalents” or a range of reductions depending upon their actual usage, which would need to be measured after the fact. Therefore the market in emissions will involve a series of translations of expected emissions reductions with actual reductions that independent monitors will verify. So the price signal will be felt over a period of time and will not be necessarily clear. Probably the most effective aspect of this signal would be the perception that in

the future, economic losses will be very high as rises in the carbon price are anticipated, so the price signal may be most effective as a blunt instrument of fear.



The price of goods and services is one of the primary attributes that influence buying decisions. A lower price means that buyers do not have to sacrifice as many other buying opportunities for the purchase in question. In a small segment of premium goods, a higher price may signal to some potential buyers higher quality or prestige. The hope in carbon pricing is that lower emissions goods and services will succeed in the marketplace against goods and services that represent higher carbon emissions.

- 3) **Politically feasible carbon price is low** - Almost all observers agree that carbon pricing, whether arrived at through permit auctions or via direct taxation, will not in the first years be particularly high. Expectations put pricing in the neighborhood of \$15/tonne or less; the current worldwide [price in the economic downturn is around \\$12/tonne](#). At this price level, some efforts to improve efficiency or purchase offsets will be inspired but the effect on energy prices will be minimal, the equivalent of 13 cents per gallon of gasoline or less. Most affected at this price level will be energy intensive industries which if subject to the carbon price will be incentivized to pursue energy efficiency measures. However at these low price levels not much action will occur though as a society we will start to “at least go in the right direction”. More impressive to businesses and private citizens would be the future threat of increases in this carbon price within the framework of an aggressively administered and supported program. Political sentiment may change enabling more aggressive and higher carbon pricing which will boost the effectiveness of the carbon price substantially.
- 4) **“Economic actors already have choice on the solutions market”**The market paradigm is effective in the short term if market actors have a choice between two significantly different alternatives in terms of their carbon emissions that are made attractive or even tenable investments with the aid of the carbon price. Exceptions to this requirement are costless conservation measures and changes in behavior. Solutions need to be “on the market” or emerging onto the market for the price to actually effect decisions. The hope and theory in carbon pricing is that innovators

will be providing these solutions that respond to demand from people and companies suffering or anticipating suffering from paying more for emissions-intensive products and energy. Demand for product innovation could be driven just as well or in addition by other mechanisms including straight energy taxes, conventional regulations, positive incentives, or government investment. In many sectors and technology areas, currently a very low or zero carbon alternative technology is either a) not yet on the market, b) requires a very high carbon price to be made competitive or c) requires the presence of technological preconditions, i.e. infrastructure, for the cleaner technology to function as an equivalent to existing polluting technologies. We see this in many elements of building the [renewable electron economy](#) and/or the [Repower America](#) plan. The carbon pricing model seems most appropriate to increasing energy and resource efficiency, the marketing of offsets, land-use changes or encouraging some behavioral changes by individuals rather than new paradigm development or infrastructure change. Energy efficiency or carbon offsets (which can be packaged in increments) allow for the incremental approach in the world of actual emissions reductions that matches the gradual increase of the carbon price.

- 5) **“Emitters are morally responsible for climate change”** - While designers of carbon pricing schemes may deny that they are attaching a moral evaluation to the amount of carbon tax or pollution permits that a polluter pays, the market based system ultimately holds individual or individual corporate actors responsible for solutions and implies that the worst polluters will suffer the consequences of their polluting ways. Eventually some of the economic pain would be spread around but would depend upon the actions or inaction of the polluters. This focus on what I have called a “particulate” or atomized set of actors, denies the integrated or systemic view of an economy which demands certain products that historically have required carbon emissions. A strong ethical case can be made that those who demand goods and services that depend on fossil resources or GHG emissions are as responsible as the actual emitters. Co-responsibility through a systemic approach might augment or in some areas replace a model that turns on pinning responsibility on polluters. Both individual responsibility and societal co-responsibility should not be viewed as mutually exclusive alternatives.
- 6) **Carbon price will fluctuate dramatically (cap and trade)** – The instability of the carbon price under [cap and trade will make long-term investments difficult](#) because there will be substantial uncertainty about the costs over time of paying for permits or reducing emissions to be able to re-sell permits. Carbon prices, because of the economic slowdown and the dramatic drops in the price of fossil energy, have sunk from \$30/tonne in the summer of 2008 to currently around \$12/tonne. This will make calculating financial benefits of various emissions-reduction investments using instruments like net present value difficult if not impossible. Additionally, on the other side of permit auctions, if the

proceeds of carbon auctions under cap and trade systems are used as a revenue source or dividend, it will be an unreliable revenue source. This will also make long-term investments that depend on revenues from carbon auctions difficult.

- 7) **Carbon pricing is, like all boosts in energy prices, regressive** – As are all energy-related taxes or fees, [carbon pricing is regressive](#), meaning that the resulting changes in prices will effect the middle class and the poor more than the rich. There are a number of suggestions about how to remedy this including returning all the resulting revenues as a flat dividend to people or to replace regressive taxes like the payroll tax with carbon taxes. The dividend idea will mute the price signal of the carbon price to some degree for the less advantaged.
- 8) **Non-specific and frontloaded promotion of more costly solutions** – One of the intentions of carbon pricing is to “level the playing field” for renewable energy and other more expensive clean energy generation systems. However, the carbon price by raising the price of fossil fuels and contributing to raising the price of almost every good in society, will only spur the development of renewable energy at a high price level if purchasing decisions are made based largely on present or near-term cost. This is the equivalent of building a large and elaborate scaffolding around a tree to reach the top of it rather than using a ladder or a “bucket truck”
- 9) **Unintended suppression of economic activity with poor calibration** – If emissions reduction or energy efficiency technology is not ready or not affordable, there may be a net reduction in economic activity. This would reduce emissions but not as intended by cap and trade or carbon tax policy designers. There could be sector by sector systems that calibrate to a given market but this would defeat some of the intentions of a price on carbon and would increase complexity considerably. Business interests which want to do nothing about climate will use this as an excuse to try to delay or stop climate legislation.
- 10) **Ties climate policy and activism to the downside of climate change** – The theory of carbon pricing is so relentlessly focused on the downside of climate change that it is left open what positive emissions-reducing activities would be funded by revenues from either a carbon tax or cap and trade auctions; the negative, punitive effect of the price signal alone is supposed to suffice. Disincentives outweigh incentives in carbon pricing systems; carbon pricing is designed to say “stop” to polluters (us). The negativity of this policy instrument is a political liability, as popular support for taking steps to address climate change is key in designing an effective policy.
- 11) **Assumes symmetry of opposites between problem and remedy**– The mechanism of carbon pricing is structured as an economic force that is both symmetrically arrayed against and opposed to the emission of GHGs into the atmosphere. Carbon pricing is so relentlessly focused on emissions themselves that it may blind leaders and market actors to the possibility that the remedy for

carbon emissions may be asymmetrical with the problem itself. The solution may “reframe” the problem rather than simply remain focused on the problem itself alone. For instance, related to “8” above, the remedy may be to invent new positive reasons to take action on climate and change our way of producing goods and services. While it is hoped in carbon pricing that the black box of the market will produce this new positive post-carbon society, there are reasons to believe that a more directive approach in certain areas may be necessary, especially with the tight timeframe given to us by climate scientists.



Lawrence Berkeley National Laboratory is one of a series of research laboratories funded in part or in full by the government, that have produced many scientific and technological innovations. In the innovation process, the market seems to have a greater role in the latter stages of development of scientific and technological ideas.

- 12) **Technological innovation often originates outside of the market** – The idealization of market mechanisms has attributed much innovation to the market when, in fact, non-market mechanisms have shepherded much technical innovation to the prototype stage or further. The market is treated by those who idealize it as a magical innovation “black box”. While fame and fortune are clear motivations for many innovators, the initial contexts or financing sources of innovation are [often in government run laboratories or grants](#) to university or industry scientists and engineers. With large capital goods, it is difficult for innovation to occur without the sponsorship, support, or regulatory approval of government. The presence “somewhere” of a market outlet for innovative ideas is often important but the market is not as much the site of innovation that was assumed in the context of the idealized market phenomenon.
- 13) **Value of third-party carbon traders unclear (cap and trade)** – If we accept the idealized picture of the market, the role of third-party traders add liquidity to markets. However if we view markets as one mechanism among a number, third-party carbon traders may lead to businesses either paying too much or too little for permits and add to carbon permit price volatility. Additionally, the potential for bad or disengaged market actors manipulating markets increases, interfering with

the ability of businesses to make long-term investments in carbon reduction technologies.

- 14) **“No one is in control” (cap and trade)** – A cap and trade system sets up a complex system that is mandated by governments but runs in parallel to them and if it fails in some way, direct intervention is difficult; the carbon market is supposed to run on its own. Within the monetarist/free market worldview (amended to include the carbon emissions externality) the notion that “no one is in control” is a good thing, seeing that this frustrates what this group feels to be the power-hungry ambitions of governments. However, if we shift to the Keynesian or some “not anti-Keynesian” view that some government direction and regulation is necessary, the need for someone to be “at the switches” may be desirable in regulating carbon policy. This would speak for a carbon tax system, which could be changed quickly by legislative motion or executive fiat to better calibrate it.

Given the above, the carbon pricing instrument looks more limited in its scope of application than is usually discussed. Carbon pricing has some potential but expectations need to be tempered. As we shall see, a combination of a number of instruments is going to be more effective than loading every expectation onto carbon pricing policy.

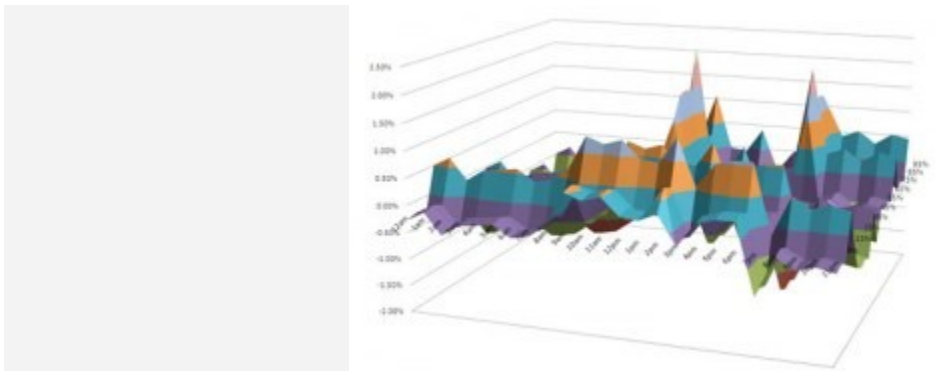
*In Part III, we will look at crucial market failures that are not adequately addressed by carbon pricing.*

### 3. Carbon Pricing...:A Survey of Market Failures in Technology and Infrastructure

(Originally published February 11, 2009)

*In [part 1](#) of this very long blog post, I described how the current economic crisis has reversed the prestige and standing of two competing schools of economic thought that are also attached to distinct worldviews, monetarism/supply side vs. Keynesianism. In [part 2](#), I suggested that the main policy instrument discussed by climate activists, carbon pricing in both its cap and trade and carbon tax forms, uses the toolkit of the now somewhat discredited monetarist/supply-side school. I attempted to document the benefits but also questionable assumptions involved in reliance on carbon pricing as the mainstay of climate and energy policy. Part 3 discusses how there are multiple ongoing market failures that have a decisive impact on climate policy rather than the singular failure of discounting the impact of carbon emissions.*

#### **Absolute and Local Carbon Minima, a.k.a. Peaks and Valleys**



If you can imagine our societal carbon emissions as the height of these contours, we must descend from the highest peak to the lowest valley in order to reduce the carbon content of the atmosphere and slow the acidification of the ocean. Carbon pricing without other policy support will push us down the nearest downward slope but will in many locations not get us to the lowest valleys of zero or negative net carbon emissions.

Another potential limitation of carbon pricing involves the target carbon dioxide level that will enable us to maintain a livable climate. With climate scientists and climate activists urging us to take on very ambitious goals that mean a net subtraction, not just a reduction in the rate of emission, in the current amount of carbon in the atmosphere within a period of decades, it would seem we are targeting what might be called an “absolute minimum” of carbon emissions. The renewable electron economy that I have promoted or the nationally-advertised [Repower America](#) proposal by the Alliance for Climate Protection are targeting something close to the absolute minimum in carbon emissions in an advanced energy-intensive economy. In general any proposal that seeks to replace fossil fueled transport and other end-use machines with electric end-use

devices can target zero emissions, as we have a number of ways to achieve very low or no carbon emissions in the electricity generation sector.

A carbon pricing system, especially in its first years, will encourage investment in what might be called “local minima” or the currently less expensive carbon reduction technology or practice. In some cases, these local minima may be zero-carbon or potentially part of a net zero carbon emitting economy, but in most cases these choices will entail the more efficient use of fossil resources or switching to “second-best” alternative fuel systems like substituting natural gas for petroleum. Many of the easier-to-achieve fuel efficiency measures for fossil fuels are necessary investments (switching to a more efficient internal combustion engines, for instance), especially if we assume that they will have a useful lifetime of perhaps ten years. However commitments to second-best, long-lived infrastructure with a useful lifetime of 40 or 50 years that commits us to a lot of carbon emissions during that period appear to be ultimately a waste of resources. If we take, for instance, the proposal in [the Pickens Plan](#) to convert our transport system to natural gas (which cuts emissions by only 35% relative to petroleum), this would involve massive investment in a new compressed natural gas infrastructure, though the size of this investment would be smaller than the conversion to an all electric transport infrastructure (assuming just an evolutionary increase in the energy content and manufacturing efficiency of batteries).

Imagine, as a model of this phenomenon, a 3-dimensional undulating surface like a contour map of a mountainous landscape with height equaling the rate we are adding carbon dioxide (or you like carbon dioxide equivalents) to the atmosphere. We are currently at the top of the highest mountain as a society though perhaps individual firms and organizations are already doing better than they were and could be pictured on a “downslope”. If we look down from the (rising) mountain top we are on we see a number of different routes downward. Some of the paths lead eventually to valleys, the floor of which are still at a high “altitude” (some net carbon emissions) and which are surrounded by “ridges” (local peaks in carbon emissions). Other paths lead to valleys that are at “sea level” or zero emissions and some might even lead to valleys below sea level (carbon negativity). Not all paths are “arrayed equally” before us as some require the traverse of intermediate peaks and ridges (infrastructure investments or evolution of technology).

A carbon price will drive us down this mountain toward some of the valleys but I believe because of its structure and foreseeable price evolution, will drive us without a strong assist from other policy instruments towards “local minima” that are not necessarily the “absolute minima”, the deep Rift Valleys and Death Valleys that we are targeting. A policy scheme that hinges largely on carbon pricing assumes that local minima will lead to the absolute minima, yet only in the (still extremely important) areas of energy efficiency, in particular electrical energy efficiency and land use, is this true. Therefore carbon pricing can be seen as, potentially, an effective incentive for energy efficiency but not necessarily arriving at the zero or negative carbon society. Focused as it is on the

market, it does not aid us to see much beyond the horizon of concerns of individual market actors, and therefore we may be missing the “big picture”.

### **New Low/Zero-Carbon Infrastructure: Enabling Effective Market Choice**



The densely settled cities and towns of Europe and Japan already offer residents functional and price-competitive alternatives to oil-dependent passenger transportation. With aggressive carbon pricing, the attractiveness of already existing lower carbon options will increase, leading to extension of these services but less of a requirement for the building of new infrastructure than we will find in the US and Canada under a carbon pricing regime.

It is a common lament heard around US metropolitan areas with fairly good public transportation or walkable downtowns and neighborhoods that people with awareness of global warming or other ecological impacts complain that they “have to use” their cars to do certain errands or to get to work. I live in a part of Northern California with much better than average public transportation but where use of automobiles is the difference between living an average as opposed to a restricted lifestyle. The areas of the US where automobile use is optional to lead a comfortable or middle class lifestyle are extremely limited. Peak Oil analysts warn of (or celebrate) the “[end of suburbia](#)” with a rise in petroleum prices as supplies decrease. In the US (and Canada), almost every aspect of life depends on relatively cheap fossil fuels.

Carbon pricing will push us gently at first towards more efficient use of our existing infrastructure but will not by itself build or point us towards the zero-carbon enabling infrastructure. In order for economic actors to be able to respond to carbon pricing, they will need to have the concrete choice of modes of transport and modes of living, that are undergirded by a changed infrastructure. Our current infrastructure in the US commits us to emit carbon copiously. In Europe and Japan, particularly in the area of transport, the amount of infrastructure change required to go to a zero-carbon society is less though these countries also happen to have less options in the area of clean electricity generation than the US. For transport in these more densely populated countries, carbon pricing may be enough to push for expanded use of existing low and potentially zero carbon infrastructure, as this involves intensified use and expansion of existing rails and

public transport. The relative population density of these societies and historically higher energy prices are a boon to more efficient end use devices.

Building new infrastructure, even if it will support a lower or zero carbon emissions, will, in an era of fossil fueled construction machines and industrial processes, represent more emissions for the period of building that infrastructure. This is unavoidable if we need rapidly to achieve essentially a zero net carbon emissions society, which will inevitably require new infrastructure. If we assume a longer timeframe, it is conceivable that the contribution of emissions from large infrastructure projects would be less, though the delay in building that infrastructure would have many negative consequences.

### **Infrastructure, the Persistent Market Failure**



The 2007 collapse of a bridge carrying Interstate 35 in Minnesota was a high profile event that called attention to years of neglect in maintaining and building infrastructure in the US. While infrastructure is taken for granted by participants in commerce, it has become more difficult to persuade legislators and the public to pay for infrastructure and its maintenance in an anti-tax era. The idealization of markets as self-sufficient and self-sustaining has functioned as a justification to ignoring the failure of infrastructure.

In the recent era of idealization of the market, market externalities were considered to be exceptional circumstances or “unmentionables” in an era of ideological polemic. We are re-discovering now that in fact those externalities may in fact be more common and may represent an unavoidable and even necessary part of all economies. Nicholas Stern’s observation that carbon emissions are the greatest market failure of modern industrial economies may be true but contains within it the implication (not necessarily Stern’s personal view) that market failures, even in this massive and long lasting form, are events bounded in time rather than persistent and “business as usual”.

If instead we assume that the market coexists with and even requires both natural and social positive externalities and creates or falls victim to negative externalities for which it fails to fully account, the organization and replenishment of positive externalities and the management of negative externalities becomes as vital an economic activity as the activities of market actors within the market. These natural and social externalities of the positive type are sometimes treated as “public goods” by economists but are more easily

recognized by economists of the Keynesian persuasion. Despite the efforts of these economists, the examination of public goods is a minority concern within contemporary economics, especially in models that assume or imply a self-sufficient or all-encompassing market.



Project Better Place is a start up that hopes to build a network of electric vehicle battery swap and fast recharge stations which will allow subscribers to their service to use electric vehicles with little regard to the state of charge of their batteries. Better Place is a private company partnering with large automobile manufacturers and with governments to develop a new infrastructure design. Public-private partnerships may help build new infrastructure but maintaining and extending existing infrastructure involves substantial government participation and investment.

The building and maintenance of infrastructure seems to be one area where market participants are not likely to be moved voluntarily, i.e. by their wants, to address. It is here that governments have stepped in to fill in where private market participants have either lost interest (passenger rail), abandoned assets, or not built (roads and bridges) the necessary infrastructure to keep the economy going. In the era of idealization of markets, it was assumed that markets could provide or did not really require the public goods which had in the earlier part of the 20th century had been assumed to be the province of government. These efforts have not yielded much in the way of actual progress in creating infrastructure owned and operated by private industry. We are now facing, in the US, an aging infrastructure that, furthermore, is not designed to support a functional zero-carbon society.

The “confession” that markets cannot provide these services would until recently be considered something like apostasy within those areas of economics and the economical “common sense” promoted in the media and in policy circles. On the other hand, if one takes the perspective of an economic historian or a Keynesian of most varieties, the notion that government would provide or help finance these services would seem to be the norm. While it may seem an unusual move to some, all I am assuming is that markets are not perfectable or self-sufficient.

The efforts then made to represent carbon pricing as the main means to achieve a zero-carbon society by steering market actors via the price signal ignores the persistent market failure in the area of infrastructure and reveal the degree to which the assumptions of the market paradigm have been internalized in the climate policy community. If we are to re-adopt at least some of the lessons learned by Keynes and those who worked in his tradition in the post-WWII period, climate policy might look quite different.

### **A Choice of Infrastructures...and Fiscal Stimulus**

As discussed elsewhere and implied above, the choice of energy infrastructures has a lot to do with which target carbon dioxide concentration we are attempting to achieve and how fast we want to achieve it. As I highlighted in the preceding post about the post-carbon decision space, we are facing in the area of infrastructure a number of areas of choice that can be outlined as follows:

- 1) Energy sourcing and generation (renewable, nuclear, fossil)
- 2) Energy distribution system (wires, pipelines, rail, road)
- 3) Form of transport energy (electricity, gas, biofuel, hydrogen)
- 4) Form of building energy (electricity, liquid, or gas)
- 5) Balance between individual vs. aggregated group conveyance
- 6) Balance between grid-tied vs. autonomous vehicles
- 7) Balance between guideway-constrained vs. road-going vehicles

For instance the renewable electron economy that I written about can, in a number of configurations, get us to or very close to a zero net emissions society. The ambitious Repower America plan currently advertised on TV throughout the US foresees generating most electricity renewably. To achieve society-wide net or near-zero emissions, I would add to its scope, powering land transportation using electricity either directly through wires or stored in batteries, which is the intention of many advocates of electric transport.



In order to move rapidly into a zero-emissions world, overhead trolley wires like these in British Columbia would need to be built over many high traffic streets to enable dual mode and dedicated trolley buses and trolley trucks to use grid electricity for locomotion. More efficient than on-board energy storage and available now, this solution involves the building out of the electrical distribution system for transportation in cooperation with electric utilities. Dual-mode vehicles could attach and detach from the grid as needed within a few seconds.

To make the zero net emissions renewable electron economy a reality, a number of large pieces of infrastructure are required to allow electricity to come from clean sources, to be used efficiently in buildings, and to be used in a majority of transport tasks. Firstly the Unified National Smart Grid, which is contained in the Repower America plan, would involve the building of a number of high voltage transmission lines from high renewable energy resource areas (windy Great Plains, sunny Southwest, offshore high wind areas) to existing transmission lines with sufficient capacity or directly to regional and national demand centers. Furthermore, local grid reinforcement and energy storage facilities would need to be built to balance renewable resource fluctuations and allow quick re-charging of large numbers of electric vehicles during times of peak demand. Electrification and build-out of the rail system needs to occur to allow for increased freight and passenger traffic with zero emissions. High traffic roads may need to be electrified with overhead wires or other means to allow large vehicles to traverse them without the need to store all energy on-board. The degree to which batteries or portable energy storage devices progress in durability and energy content will reduce the need for electrifying roads, though rail electrification, the internationally recognized top choice in rail locomotion, is a no-brainer in any scenario.

Other clean or cleaner energy proposals require more or less new infrastructure though they have other drawbacks or do not target zero or negative net carbon emissions. A clean hydrogen economy would require 2-3 times the generating capacity as the renewable electron economy as well as improvements in hydrogen storage and distribution. Hydrogen fueled transport would also require the build-out of [Unified National Smart Grid](#) with approximately 3 times the transmission capacity. An energy economy dependent on, still experimental or speculative, [4th generation nuclear plants](#),

would not require as much long-distance transmission and energy storage but would require a similar build out of electric transport infrastructure. A shift of transport to natural gas and electricity to renewables, as recently advanced by T. Boone Pickens, would require less build-out of an electric transport infrastructure or at least a delay thereof but the expansion of a the natural gas distribution network, in all probability financed and owned by the private sector as is our petroleum infrastructure. Pickens' proposal, however, does not target zero net emissions.

Investment for the new clean energy infrastructure for the United States economy as a whole will, over a period of a decade or two, number in the trillions of dollars, though these trillions will largely be spent in the United States on productive assets.

Furthermore, it is not clear that a carbon price will provide the appropriate incentive/disincentive to motivate an economic actor (who?... mostly governments or public-private partnerships) to build pieces of this infrastructure, though it might provide revenue for these projects. In this regard, well-informed leaders of governments and their advisors will need to take many of the key steps, informed one hopes by a process not unlike [the decision space tool](#).

While advocates of carbon pricing and in particular the carbon tax have attempted to emphasize that most carbon pricing proposals are revenue neutral or of low cost, if one is concerned about forging ahead rapidly towards a carbon neutral society, as well as funding employment-generating infrastructure projects, it would make sense to use some of the revenue from carbon pricing schemes to help fund these efforts. If one advances from a view of economics that takes public goods for granted to one that sees the building and maintenance of public goods as necessary and a part of the scope of government involvement in the economy, the financing of this type of project eventually through a combination of tax and use fee revenue becomes a key task (in the depths of a deep recession, Keynesians would turn to deficit spending followed by paying off the resulting debt during better times through taxes and use fees).

## Electricity and Markets: An Uneasy Mix



The equipment required to run a regional or national high voltage electric grid is so large and long-lasting that fast-paced markets looking at quarterly earnings statements discount the value of such investments. Private corporations under government regulation or government owned utilities are able to take a long-term planning perspective to allow the building out of the largely unseen but still massive electricity generation and distribution system.

The market mechanism assumes that there are multiple actors that can supply or demand a good or service from each other and market participants can legally “dispose of” relationships that are no longer profitable for either party. The electricity system, at least one that is professionally managed on an interconnected grid, is a natural monopoly because of the physics of electrical circuits and difficulties of energizing and managing those circuits all the time. Furthermore, electricity in most settings needs to be produced and consumed immediately, so cannot be easily stored or inventoried like most other goods. In other words, it is economically inefficient for there to be two or more electric grids built in one area, as the electricity transmission and distribution system is such a huge expense that consumers would end up needing to pay for the resulting doubled expense.

There have up to the 1990’s been two main forms of ownership of the electricity system both within the US and abroad: public or state ownership and investor-owned regional monopolies overseen by government regulators.

Within the same timeframe that the first climate policies were formulated in the late 1980’s and 1990’s, politicians in the US were attempting to experiment with deregulation of the power industry with mixed and sometimes disastrous results. In deregulation, regional power generation markets were to be created within which competition was to be maximized and therefore, it was hoped, the economic efficiencies of the market would be brought to the utility industry. In deregulation efforts worldwide, public power companies were sometimes sold off to investors and private monopolies were required to open their distribution systems to privately owned generators.

To create a wholesale electricity market, non-profit independent system operating companies were formed that functioned as an exchange that brokered wholesale generation bids from generators to electricity retailers and managed day to day grid functioning. Consumers were also allowed to buy electricity from power companies (not specific generators) that did not actually serve them power through the distribution network but nevertheless operated generators or at least paid for power generation somewhere else. The regulated investor owned power companies that had acted as regional monopolies and still owned most of the power distribution system in a given area, spun off unregulated subsidiaries to develop and own new generators anywhere on the national power grid.

While deregulation has had some benefits in opening up a very conservative industry especially to renewable generators owned by third-parties, the declared goal of lower electricity rates has not been achieved, so the claimed efficiency benefits of deregulation and markets have not taken place with the electric grid. Deregulation has also caused the utilities to look long and hard at investing in their transmission and distribution infrastructure, which is not only for their own use but has also become an asset to their competitors in the area of retail power delivery.



While Enron undoubtedly attracted some bad actors outside of the norm, its early success and downfall are also an expression of a broader economic culture that uncritically idealized markets and trading. The interaction of Enron's trading culture and business model and the electric grid helped expose deep flaws in the rush to deregulate the electricity industry.

In almost every account of the future post-carbon energy system, electricity will play an even more central role. The mechanisms introduced into the electricity industry via deregulation do not get us much closer to building the vital additional electric infrastructure that will be required for a transition to non-carbon sources: a renewable supergrid and self-generated renewable energy on private premises. In fact, the primary competition in electricity will be at some point in the future not between generators of similar types but between different technologies and systems of delivering electricity, self- or local generation and centralized generation and distribution. While partisans of either the local vs. the continental and trans-continental options can be found in abundance, we currently do not need to foster direct competition between the distributed

vs. centralized modes of distribution except in theoretical discussions as there is so much carbon-dependent energy to replace by any means with little time to do so. Some in the climate community support conventional 3rd generation and new forms of nuclear power as climate solutions, these too are not easily developed and delivered by conventional market mechanisms without large government assists; they will continue to require an intimate relationship with government for research and development, insurance and waste disposal.

To realize the most likely near-term technological solution to reducing carbon emissions from electricity, the Repower America program, one would need large-scale cooperation and public financing options to create a Unified National Smart Grid that tapped into the resources of the best renewable energy regions of the US. Given the size of this investment it behooves us to find the most efficient means to finance this project, which also could function as an economic stimulus over the short and medium terms. As always with the electrical system, there will need to be efforts including industry representatives, regulators and legislators, independent of ideological commitments, to find the best solution appropriate to this technology and the challenges ahead. Some parts of this grid may be investor-owned while others may become part of the already existing federally owned electricity transmission system. Despite the deregulatory efforts of the past two decades, the electrical industry, more than, for instance, consumer electronics, is by its physical structure, more Keynesian than free market/monetarist, requiring a combination of public and private initiative to grow and thrive.

### **Scientific Research: Another Persistent Market Failure**



Bell Labs, one of the few industry-owned laboratories that engaged in basic scientific research flourished during an era where scientists were able to take a longer view via the support of the AT&T telephone monopoly and from the US government. In the era after telephone deregulation, Bell Labs like other industry based laboratories became focused more on projects with more obvious commercial applications; rather than being an innovation panacea, markets focus scientists and administrators on research that will more immediately affect the company's bottom line and competitive position vis-a-vis other companies.

Unless they are extreme market ideologues willing to throw everything upon the altar of unregulated markets, most political actors realize that government has and will continue to have a key role in funding basic scientific research of all types including research in the area of energy and climate. In a plenary session focused on carbon pricing at the 2009 American Economic Association meeting, the panel discussion, while informative, was airtight in its focus on the singular market failure of carbon emissions and the carbon pricing solutions. After I commented from the floor that clean energy infrastructure would not necessarily get built via carbon pricing, [Lawrence Goulder of Stanford](#), brought up that research was another ongoing market failure that was not addressed by carbon pricing. As it turned out this was the only voice from the podium that brought up boundary conditions which fall outside or to one side of the idealized model of market actors responding to pricing

Most people who are concerned about climate change support an increase in government funding for clean technology research. It is encouraging that President-elect Obama has appointed some world renowned scientists to his team, including his Secretary of Energy, [Steven Chu](#) and has talked of \$15 billion per year in funding for clean energy research. Some call for still more funding in this area.

Despite the unanimity among all science advocates and their political allies, it is rare to find economists who factor this into the foundations of their economic models. The ongoing role of government in this area may be too obvious but calling it a “market failure” may help spur more realistic economic modeling of how technology change occurs.

## Waiting for a Technological “Deus Ex Machina”



In ancient Greek drama, playwrights tied up loose ends in the plot by lowering a "god" via a rigging "machine" to distribute justice or other plot instruments deemed necessary. Because of the rapid changes in the area of information technology and software, consumers have come to expect "deus ex machina" solutions to their everyday technology wishes and headaches. Breakthroughs on the level of more basic technologies including in the area of energy, have not been as rapid and seems to require more patience than is typical in our society.

In the area of scientific research and innovation as well there are advocates, largely not economists, who are hoping for a “deus ex machina” in the area of one or many technological breakthroughs which would make the transition to a post-carbon economy cheap and easy. These advocates feel that one must pay attention only or largely to finding an as yet undiscovered technological fix for our clean energy and climate dilemmas. Some in this camp take the view that this must be a massive government funded research program, using the metaphor of the Apollo project, while others feel that daring and innovative entrepreneurs will lead us into a post-carbon world. As the latter view meshes perfectly with the monetarist/supply-side view of economics, the Bush Administration despite its indifference and/or hostility to aggressive climate action, occasionally spoke of the ability of entrepreneurs to innovate in the area of clean energy.

Some of Google's clean energy initiatives, the [Breakthrough Institute](#), and a number of venture capitalists have notably come forward with the notion that we will innovate our way out of this problem with minimal extra expense to the general population. While each of these actors is convinced that they have a fresh, even revolutionary message, this discourse touches a well-worn groove in the American psyche, and carries with it the various fantasies we all have for devices that will make our lives easier and more

painless. Additionally this view underplays other failures of the market, including its dependence upon but tendency to neglect public goods like infrastructure.

To emit zero or negative net carbon into the atmosphere, we are going to need at least an evolution of current technology, if not a revolution in some technologies, to live well according to our current standards. These changes will eventually bring down the costs of most of these technologies. However, making carbon strategy contingent on a breakthrough or revolution in technologies is choosing perhaps a politically more comfortable but nevertheless a higher risk strategy than we really need to adopt. More perniciously, this type of technological over-optimism functions in actual fact as a block to taking action now in improving and deploying the already good technologies in search of the perfect, cheap clean technologies. The political comfort comes from postponing or ignoring expenditure of funds now on existing adequate technologies and infrastructure, in a sense reassuring the public that no costs will be incurred now.

Google's [RE<C](#) (Renewable Energy cheaper than Coal) is one such initiative that has many laudable intentions yet ultimately encourages passivity in deploying real existing technologies that are not yet cheaper than coal. Google's announcements imply, echoing the concerns of some climate activists on the global scene, that worthwhile post-carbon technologies **MUST** be affordable for rapidly industrializing countries (China and India) overlooking or downgrading the existing technologies that are slightly more expensive but affordable now in some of the developed countries. I have pointed out [elsewhere](#) that this phenomenon is "making the perfect (cheap and clean) the enemy of the good (mid-priced and clean)".

## 4. Carbon Pricing...: The Scope of a Comprehensive Climate and Energy Policy

(originally published on February 20, 2009)

### Why Not Bring Positive Externalities Into Market Pricing?



Evidence of the power of renewable energy incentives can be found in California's San Geronio and Altamont Passes, where the generous PURPA standard offer contracts of the 1980's created an attractive business opportunity for project developers. Most of California's wind generation portfolio still dates from that period, despite advances in turbine technology. Newer feed in tariffs based on the standard offer model will be better calibrated to the needs of the current power generation market and will help states and utilities achieve their renewable energy generation goals.

One of the limitations of carbon pricing is that, as a support for renewable energy or other clean generation technologies, it is a roundabout and scattered means of “leveling the playing field”. Energy markets that still enjoy the climate-altering bonanza of fossil fuels are generally less excited from a narrow utilitarian perspective about renewable energy without heavy policy support, excepting in some areas large onshore wind projects. One of the motivations in carbon pricing is to level the field by attaching so significant a carbon price to fossil fuels that renewable energy will be competitive with or gain a market advantage over fossil fuels. As renewable electric generation technologies in general require some form of storage to generate energy in a way that is exactly equivalent or superior to fossil resources as well as perhaps new infrastructure like transmission, the cost of accessory technologies would also need to be accounted for in order to truly level the playing field. This carbon price would need, in the case of some renewable technologies, to be at least one order of magnitude higher than we expect that price to be (expectations run between \$10 to \$20/tonne CO<sub>2</sub>).

The price gap between sources of renewable energy and fossil energy has to do both with the sunk costs of an economy built around fossil fuels plus the comparative physics of renewable vs. fossil energy. Renewable energy is generally diffuse, except in some extreme locations; otherwise, if it were not diffuse, most living creatures would not have

been able to evolve in such a high-energy and therefore harsh. To capture large swaths of renewable energy requires the building of large facilities that then concentrate or store the energy for use. These large facilities mean that renewable energy generators require a large up front investment that ultimately, if planned right, returns many times the amount of energy and money that was invested in it but over a period of years. To surmount this hurdle requires a commitment on the part of policymakers and regulators to renewable energy that operates in a longer time frame than that dictated by fluctuations in the energy markets. In addition, most renewable energy comes in the form of an energy flow rather than an energy store, which is the form of fossil and nuclear fuels. Tapping into energy flows to do useful work requires a different engineering orientation as well as additional energy storage devices.

Energy markets, represented by energy traders and energy consumers, remain relatively unmoved by these technical and physical challenges related to the price gap between fossil and clean functional replacements for fossil generators. The focus of markets is upon the current availability and pricing of energy assets, products and services. For a longer term view of energy whether fossil, nuclear or renewable to be incorporated into markets almost invariably requires the support and direction of government, either through subsidy or regulations. The recent drop in oil prices due to the economic downturn has endangered and postponed plans to build renewable generators, as even with the current tax incentives, these investments look less attractive than business as usual. As with many capital intensive industries, investors need assurances that the long-term investment in large and expensive facilities will pay off over a period of decades.

While a full accounting of the negative externalities of fossil fuel use would put renewable energy in a very favorable light, the sudden application of these costs to the entire economy that is dependent on fossil fuels for 85% of its energy would penalize most energy users severely and disrupt the economy in ways that are not intended by even the advocates of an aggressive carbon pricing regime. Historically, policymakers have attempted to incentivize renewable energy development by rewarding renewable energy developers with incentives that can be viewed as way to price in at least some of the positive externalities related to renewable energy: notably its clean-ness, local or regional origin and its sustainability.

Most studies of the relative cost of various carbon emissions reductions solutions place renewable energy at a significantly higher level than many readily available energy efficiency technologies that under many circumstances now pay for themselves without any aid. So a carbon price that is designed to level the playing field for some energy efficiency measures, would be far lower than one that made renewable energy projects “win” over existing or even some new fossil resources. The exception to this are large onshore wind projects that would receive a substantial boost from a lower carbon price, though wind alone cannot, at least with our current technology, fully displace fossil resources.

The foreseeable initial carbon price will also not yet spur some of the more aggressive energy efficiency measures in the area of space conditioning, which accounts for 30% of total energy use in the US. Ground source heat pumps and solar adsorption cooling are technologies that can radically reduce building energy use but currently [offer paybacks in the region of 8 to 12 years](#) depending on the space conditioning load of the building and the climatic zone. For some building owners these are already affordable but may require an additional incentive for them to consider a new technology. Again, leveling the playing field for these promising technology through disincentivizing fossil fuels may not lead the market to embrace a new paradigm without incentives.



The price of electricity is determined through a process of negotiation between public utilities commissions and utilities or via an internal pricing determination by a publicly owned utility under the supervision of a political board. In deregulated markets these negotiations yield a methodology for determining prices on the wholesale electricity market. More and more regions of the country and world are looking for ways to pay for sustainable energy through the electric rate structure.

The most direct method of incentivizing renewable energy development is by creating [a wholesale electricity rate structure](#) that assigns higher and more secure long-term value to energy generated by different renewable technologies, allowing project developers to get financing for their large upfront fixed capital costs. The [renewable energy payment systems](#), also called “feed in tariffs” are one means by which legislators and power system regulators have rewarded renewable energy generators for their positive attributes. Most often, however, the form of this reward is not by enumerating and pricing the specific positive externalities but by using the formula “cost of generation plus a reasonable profit” averaged across an industry at a given point in time. “[Cost plus reasonable profit](#)” is the formula used for building large one-of-a-kind structures either in power generation or construction that because of their uniqueness cannot find a workable price via the market. The security of this arrangement, guaranteeing them a premium rate for their electricity generated over a period of 20 years, enables project developers to at least survive and with greater cost efficiency to thrive as businesses. The fixed premium rate allows for cost recovery plus a reasonable profit on the initial investment in the renewable energy facility.

The additional cost of the premium payments are pooled among all electricity ratepayers which raises electricity costs slightly. However, this rise in electricity rates can also have the virtuous effect of encouraging more energy efficiency, so a renewable energy payment system can create a virtuous economic circle.

Other methods of incentivizing renewable energy development have proved to be less reliable. Tax credits that have been part of the US toolkit to incentivize renewable energy on and off for 30 years have provided some help but have varied in their effectiveness, in part because they draw on revenue from other parts of government budgets which can lead to disputes about which program deserves to be cut in favor of favorable tax treatment for renewable energy. Furthermore, these credits have not had the same stimulative effect as feed in tariffs to jump starting a renewable energy industry. With the current financial crisis, there is also a major shortfall of tax equity, meaning a dropoff in firms and investors that have made their money elsewhere and seek investments in renewable energy as a tax benefit. If tax benefits are to continue providing an incentivizing effect for renewable energy, other credit instruments like a federally guaranteed renewable energy bank or renewable energy payment systems would need to pick up this shortfall.

Another area where positive externalities can be brought into the market by policy is in the introduction of zero emissions vehicles to the road, most notably electric vehicles. The initial investment in batteries as opposed to a gas tank, as with renewable energy, adds a sizeable increment to the cost of a vehicle despite its overall lower cost of ownership. Proposals that offer tax credits or rebates to individuals and businesses that lower this hurdle would again be offering a payment for a positive externality that the market currently does not recognize. Current economic stimulus packages proposed by the Obama administration as well as the US Senate, include tax incentives for electric vehicles calibrated to the amount of all-electric range these vehicles offer.



Ground source (a.k.a. geothermal) heat pumps, like the appliances above in combination with a long loop of tubing in the ground, use one half to one third the energy of conventional furnaces and air conditioning, generate domestic hot water, while running on electricity alone. While the appliance itself is not that expensive the digging or drilling of the ground loop makes the cost of the system substantially more than conventional units. As this represents a paradigm shift in heating and cooling, rebate programs by utilities or governments can help build a still small industry.

In the area of energy efficiency, rebates for new technologies have also proved to be a means to generate new markets for somewhat more costly technologies with positive externalities. California's energy efficiency rebate program has helped that state level its per capita energy use over the last 30 years and has helped drive the US market for energy efficient devices and innovation.

The relentless focus of policy on a disincentive (the carbon price) ignores key aspects of human psychology within which a combination of incentives and disincentives enables optimal learning rather than the simple application of either one or the other. The current low ranking of climate change in polls of people's concerns during the current downturn may have something to do with the general message of restraint that has been paired with climate change rather than opportunity and hope. If we think about it, children raised only on disincentives (guilt, shame or punishments) or only on incentives (praise, bribes) are likely to end up twisted or lacking self-discipline in ways that are myriad and complex. Beyond what can be achieved through information, persuasion and expressions of intent, a coherent mixture of carrot and stick approaches seems commonsensical to healthy growth and learning. As we are entering a new world in transforming the basic energy foundation of our economy from carbon to non-carbon sources and energy use constraint, we and our economic growth engines stand in ways like children before our own demand for energy and the need to change it. Surely we should apply our best understanding to this task and not just one fraction of what we know.

### **A Comprehensive Climate and Energy Policy**

If we turn our focus from a singular catastrophic market failure to multiple market failures, the form and timing of climate and energy policy initiatives will start to match more closely the actual physical array of assets with which actual real economies are currently working. The notion of a singular market failure, however huge, bears with it the unspoken assumption (not necessarily a belief of [Nicholas Stern](#)) that markets are otherwise self-sufficient and well-functioning. We have seen that in fact markets, along with their strengths, are, in most sober assessments of economic history, [failure-prone](#) or critically dependent on non-market institutions in a number of areas, some which were outlined earlier. To some, this sounds like heresy but this sensitivity to criticism of markets is more a function of the recent tendency towards hagiography of the market mechanisms rather than the product of a honest effort to balance their benefits and weaknesses.

The monocular or central focus on carbon pricing as a climate policy has borne the traces of the neo-classical economic "tail" wagging the climate and energy "dog". An allegiance to an economic theory that overvalues market mechanisms has seemed to have shaped climate policy more than a consideration of the on-the-ground facts. The notion of the singular market failure leads to the overvaluation of carbon pricing as the prime means to achieve a carbon neutral society. As we are now experiencing a sea

change in our economic common sense, it makes sense to revise climate policy in response to this sea change.

Rather than simply a choice between political preferences or allegiances, there is a concrete difference in how these economic theories and by extension the resulting policy instruments interact with the target of their regulations and investments. A carbon pricing system acts upon the economy as a series of individual (inclusive of corporations as “individuals”) actors or “atoms” which respond to the price signal in their own unique ways. A policy orientation that seeks to re-engineer and re-organize economic systems like infrastructure that requires the coordination and cooperation of individual actors and “parts” of the system, interacts with the world as ensembles of actors rather than a series of independent individual actors. A dogmatic allegiance to the monetarist/supply side view prohibits or proscribes the latter orientation. A realistic assessment of the tasks ahead will require both kinds of orientation to the world built into climate policy.

### **A Policy Orientation Commensurate with the Task**



Prior to the industrial use of fossil energy, most exosomatic energy came from animal power supplemented in some contexts by river power and wind power. Creating a highly-developed post-carbon economy in most locations around the globe will involve entering into a "4th" industrial revolution; it's not simply a matter of "unplugging" from fossil sources and plugging into clean sources.

Changing our ways of using energy and land is a huge task, a task that advocates have for some understandable reasons attempted to minimize. Exosomatic energy, energy that comes from non-food sources like fossil fuels, nuclear fuels and renewable energy, has been the primary support for economic development over the course of the various industrial revolutions of the last two centuries. Up to a certain, fairly high, minimum of energy use, economic development and wealth correlates with exosomatic energy use. The heroic narrative of increased technological sophistication and human ingenuity has hidden the brute facts of rising consumption of what have been largely fossil fuels. That one person can now do the work of fifty or one hundred manual laborers has everything to do with the continuous availability of concentrated energy products or services at a fairly low price. Our economic system is also based on an agricultural, food and fiber

system that not only is highly dependent on fossil fuels but also uses land in ways that do not conserve the soil or stabilize atmospheric concentrations of greenhouse gases.

The scientists who have documented our contribution to a changing climate have endured much criticism for suggesting that the energy and land-use foundations of our economy are endangering the long-term sustainability of the earth. However, understandably, they have not also wanted or been able at one fell swoop to outline how we might reverse the political and economic orientation of our society, which at the time was praising markets and the pursuit of narrow self-interest perhaps leavened with voluntary charitable or altruistic acts. Both Al Gore and Jim Hansen, the two main targets of much criticism and scorn, have made the goals we have increasingly clear but have, in my opinion, at times held back from exploring the scale and extent of the work and expenditure needed to do an “energy transplant” on our society from dirty to clean energy sources.

If in fact, the future of the world and all of what might be considered human wealth depends on reducing carbon emissions, isn't it worth it for us to pay something towards that goal? Policy recommendations should reflect the seriousness of that goal and a recognition that most people should contribute something towards that goal, as it benefits them. Policy suggestions that minimize the cost or need for participation by a majority of the population in building this new energy basis for our societies are selling people short.

### **Public Expenditures...for What?**



Roosevelt signs the extension of the Lend Lease program in 1943. Most commentators agree that the Great Depression was ended by the massive spending program and mobilization that was World War II. It remains to be seen whether we will be able to pull ourselves out of the current economic downturn with current levels of government spending or whether we would need to declare a full-scale "Green Energy War" as has John Geesman.

Currently it appears as though as a nation we will spend somewhere between one and four trillion dollars to bail out the banking system after it rushed earlier this decade to take advantage of some highly risky opportunities to make a profit. Yes, borrowers are

also partly to blame for buying houses which they couldn't afford, but financial common sense had been sacrificed several years before by the leaders of the financial system and by regulators who did not believe in regulation. We may never see concrete results from this massive expenditure of tax payer dollars only that we may have prevented a full-scale collapse of the financial system and economy into chaos.

An even more controversial area to discuss is the degree to which the government should commit resources to the already overweighted housing sector, now in a deep crisis. Not only has the economy expanded in the area of finance but also became overly dependent on housing and real estate before the big crash of 2008. Many Americans were simply not earning enough money to afford the homes that were being built or sold in the last few years of the bubble. Should a large portion of our public assets be committed to propping up home values beyond the ability of Americans to pay for those homes through income from other sectors of the economy? A balance may need to be struck between managing the crisis, future housing needs, real estate as investment, and non-housing sectors of the economy.

On the other hand, a transformation of our energy and transport system will boost an underweighted area of our economy. I have termed the US historical relationship with energy, the "[Cheap Energy Contract](#)" which restricts the amount of money that the energy sector can charge per unit energy; to build a clean energy economy quickly, there will need to be revenue from a variety of sources in excess of what we currently spend to build the useful infrastructure required. Industrial and construction jobs, far from being part of our past, may become again part of what helps bring living wages and buying power back to the American consumer, independent of commercial and residential real estate and finance sectors.

Furthermore, our infrastructure is deteriorating and as noted in Part III, inadequate to the task of reducing carbon emissions. There is no other way to pay for some of this infrastructure other than through public funds and it will serve the public and other businesses well to have a better rail system, a cleaner electricity and energy system, and avoiding dependence on the fossil fuel roller-coaster. Therefore everything speaks for a substantial commitment of public funds to these public goods which support the economy as a whole, especially now that we are in search of the economic solutions to our dire situation. In the end, the amount of

### **A Climate and Energy Policy for the Committed and the Indifferent**

Currently climate change ranks as one of the last concerns in polls of American public opinion, despite the commitment of the Obama administration to take steps towards reducing carbon dioxide emissions. The task then for both climate activists and the new Administration is then to construct a climate policy that, in addition to educating the public about the dangers of continued unchecked carbon emissions, makes it worthwhile for people to care about climate change.

An important element of the existing climate action proposals is that they both try to lower their profiles in terms of fiscal impact and rely largely on “negative reinforcement” or punishment of “bad behavior” in relationship to emitting carbon. While the small minority of the population that is appropriately terrified of the effects of climate change or has enough financial liquidity to pay the penalties is accepting of these disincentives, the vast majority either doesn’t understand the proposals or is worried about their impact on their personal finances. A vocal minority opposes any and all climate regulations or regulations in general, and are increasingly a force to be acknowledged in passing but not taken into consideration in formulating effective policy.

What I am calling a “Comprehensive Climate and Energy Policy” is designed then to be an instrument that addresses the concerns of the vast majority of people who care about their communities and families but is not yet predicated on an overwhelming concern for the climate. A Comprehensive Climate and Energy Policy, relying on both incentives and disincentives, will help address the more pressing concerns of Americans as well as be a more effective means to achieve many of the goals of the climate action community. Including areas where there is overlap between the goals of these communities can help create momentum for our economy in general and in particular, towards an economy that emits less carbon into the atmosphere.



At Mesalands Community College in New Mexico, students study wind energy and turbine maintenance using a single utility scale wind turbine erected for training purposes. For there to be a successful and long-lasting green jobs movement, there will need to be more training facilities such as this for skilled workers and engineering students.

The [Green Jobs movement](#), led by among others [Van Jones](#), has pioneered this approach to climate policy with an emphasis on the jobs generated by building a new clean energy infrastructure. One of the products of a Comprehensive Climate and Energy Policy would be the stable domestic jobs that Jones and others have called for.

If general economic theory needs to borrow from Keynes as well as neoclassical economics, shapers of climate and energy strategy may be then freer to choose the appropriate instruments for the many tasks related to building a post-carbon economy. In

a society dependent upon market exchange of goods and services, economic policy and with it climate and energy policy are meant to address failures within the spontaneous commerce of markets to deliver goods and services that are vital for economic and social wellbeing.

We have located here not one but approximately three and half market failures that are relevant to climate and energy policy which specifically address the challenges related to our upcoming climate and energy challenges in the US.

### ***Market Failures***

1. Externalizes costs of climate change attributable to carbon emissions
2. Externalizes costs of infrastructure building and maintenance and high fixed capital costs of long-term private capital investment
  - a. Deployment of capital intensive clean energy technologies
  - b. Coordination of management and finance of upgrades to electric grid.
  - c. Re-design and electrification of transport infrastructure
3. Externalizes costs of scientific research and development

Rather than subsume all of these challenges under “1”, a comprehensive climate and energy policy is able to flexibly address the existing challenges in a given context by applying measures where needed to reduce carbon emissions with the goal of a carbon neutral society

The value of a comprehensive policy becomes clear if we look at national differences in emissions level, infrastructure and other sunk costs, and overall level of economic development. In Switzerland, for instance, [per capita carbon emissions](#) are approximately one quarter of those in the US. Much more densely populated, Switzerland already possesses an [almost entirely electrified](#) rail network and adequate public transportation in many of their cities and towns. Electricity in Switzerland is [generated largely via hydro and nuclear](#). Already possessing an infrastructure that can be configured for lower or zero-carbon emissions, a carbon pricing regime may help Swiss consumers and businesses utilize that infrastructure even more efficiently and use energy more efficiently. By contrast, the United States has a long way to go in building an infrastructure with a similar capability.



Following the American and European model of economic development is problematic for India and other densely populated, rapidly industrializing nations not only from the point of view of carbon emissions. India has some of the world's worst traffic, even when a majority of the population cannot afford cars or other motorized conveyances. The Indian government will need to take a leadership role in figuring out a way a more prosperous citizenry can enjoy some of the freedoms afforded by increased wealth without impairing the quality of life of other Indians, including the building of the appropriate infrastructure.

With 4 times the population of the US and 150 times the population of Switzerland, India possesses still different challenges as it is both a rapidly industrializing and a less-developed country depending on region, economic sector and social class. India has a per capita emissions level one quarter of that of Switzerland and one sixteenth that of the US but because of its massive and growing population is starting to contribute substantially to overall worldwide carbon emissions. The Indian government and the world development community would like to see the average Indian make substantial strides in terms of their overall welfare and use of services with a stable level and even a decrease in net per capital carbon emissions. In the last few years before the current downturn, there has been a move by the rapidly growing Indian middle class to emulate the petroleum and energy consuming ways of the West including [the use of petroleum-fueled automobiles](#). Because of its high population density, it would make sense for India to build a potentially zero-carbon electric public transport system, as [there would be literally no physical space in India to build a car culture](#) like that of North America, even if all those vehicles were zero emissions. Carbon pricing alone will neither inspire nor finance such a massive undertaking. On the other hand, within the carbon trading system, some projects have been built as part of the “Clean Development Mechanism” and some version of this may remain a source of investment for projects that can show a quick reduction in carbon emissions.

The “hard problem” of rapidly industrializing and less developed countries becomes a little easier if we don’t assume that governments in those countries are passive bystanders or simply funnels for a global carbon pricing regime. The Indian government,

as will other governments, need to devise national and regional strategies that rely on public as well as private funding of low- and zero-carbon facilities.

## 5. Carbon Pricing...: Outline of a Comprehensive Policy

(Originally published February 26, 2009)

*In the first three parts of this long piece ([one](#), [two](#), [three](#)), I outlined how our economic common sense has changed since the economic crisis of late 2008; monetarism/supply-side economics has given way to some newer version of Keynesianism. I went on to claim that a primary focus on carbon pricing shows traces of the idealized vision of the market that one finds in the "free market" schools of economics; climate activists have pinned most of their hopes on carbon pricing to remedy the singular catastrophic market failure of unaccounted-for carbon emissions. In [part 4](#), I pointed out that there are two other important market failures which block effective action on climate in the US and elsewhere. We then have the following list of market failures that are relevant to climate and energy policy:*

- 1. Externalization of costs of climate change attributable to carbon emissions*
- 2. Externalization of costs of infrastructure building and maintenance and high fixed capital costs of long-term private capital investment*
  - a. Deployment of capital intensive clean energy technologies*
  - b. Coordination of management and finance of upgrades to electric grid.*
  - c. Re-design and electrification of transport infrastructure*
- 3. Externalization of costs of scientific research and development*

### Outline of a Comprehensive Climate and Energy Policy



A comprehensive climate and energy policy is motivated by the emerging crisis in our climate, as fossil carbon in the atmosphere is unbalancing the self-regulatory processes of the climate system. Significant melting of Arctic and Antarctic ice sheets will increase the absorption of the sun's radiation and spur further warming.

A comprehensive climate and energy policy can allow for differentiated roles for national states, regional and local governments, and for private businesses and individuals with differing potential contributions to reducing carbon emissions and building a 21st century sustainable economy. Thus a view of economies as not just a uniform collection of individual actors responding to a pricing regime makes the picture more complex but also potentially more effective.

### **Assumptions**

1. A reversal in emissions trends is necessary within the next 5 years
2. Sharp reductions in emissions are necessary within the next 10 years
3. A “glide path” to zero net emissions needs to be entered into within the next 3 years, there is no time for commitment to new long-lasting infrastructure with incremental reductions.
4. The US and the world population are generally not yet ready to pay anything more than a fraction of the externalized cost of current carbon emissions.
5. Uncertainties and changes in economic theory and assumptions require an examination of the degree to which climate policy contains disputed assumptions about economic behavior change and investment behavior.
6. Government policy and leaders have a key role in addressing failures of the market to respond to challenges both internal to and external to the market.
7. Costs and benefits of government policies and expenditures must be adequately explained and accounted for by policymakers and political leaders.
8. The economically stimulative effects and benefits of a comprehensive policy will either match or exceed its net costs for the United States, involving outlays and revenues in the area of several trillion dollars over the period of a decade.

### **“Traditional” Regulation (partially addresses “Market Failure 1”)**



The power sector is particularly used to and suited to traditional regulation as the building and maintenance of power plants is highly regulated in almost every country in the world. New regulations are sometimes feared and resisted but enough pressure and negotiation can make most rules effective in ways that are more difficult in other economic sectors.

If governments can and at times must take a leadership role in managing the economy, they can do so in part by imposing laws that are in our long-term benefit. Especially if ample consideration is made of the resulting costs and administrative overhead required to implement laws and new rules, these new rules can remove long-standing barriers to making progress in the area of energy, energy efficiency and climate protections.

We have seen that carbon pricing was proposed as a means of avoiding some of the supposed bureaucratic drawbacks of traditional regulation. As it turns out in the case of sulphur dioxide that traditional regulation that dictated the installation of emissions scrubbers was, in some countries, [more effective than the US cap and trade system](#) in reducing acid rain pollution. In addition to a fascination with a particular partial economic model, relying on carbon pricing alone might be simply an abdication of the authority of government in the face of resistance by industry. Sometimes leaders need to "put their foot down", if there is an overwhelming case to be made for new rules made and administered wisely.

1. **Coal Plant Moratorium** - The primary regulation that must be a part of a comprehensive climate and energy policy is a [moratorium](#) on new coal-fired power plants without carbon capture and sequestration. If power utilities find this onerous, they must lobby for regulations and subsidies that make this possible for them on all levels of their businesses. There is no time to wait for the erection of a carbon pricing system to "suggest" that this should happen through an array of artfully calibrated disincentives.
2. **Utility Revenue Decoupling** - An additional key regulation that is often overlooked is [decoupling the revenues](#) of investor-owned power utilities from the amount of energy sales, which is the regulatory regime in California. This allows power utilities to participate in energy efficiency projects as it carries with it a fairly significant financial incentive for them to cut energy use by end users as they receive higher power rates the subsequent year from the public utilities commission if they have achieved their goals.
3. **National Building Codes that Meet or Exceed California Title 24** – California has led the nation in energy efficiency requirements for new buildings and renovations with its [Title 24 standard](#). A much more ambitious standard that would require a revolution in the home construction and renovation industry in the US would be to adopt [the passive house standard in which space conditioning costs are slashed by 80 to 90%](#). Additionally "smart codes" may help urban planners and developers site and build buildings and communities with lower total energy requirements by developing "in-fill".
4. **National Renewable Electricity Standard (as Target)** - The adoption of a percentage [minimum renewable energy for the national electric grid](#)- is productive as long as it is
  - a. ambitious (25% or greater by 2020),
  - b. paired with substantial finance support for renewable energy,

- c. a rising percentage of renewable energy projects are built as replacements for fossil resources (dispatchable or synchronous with power demand)
- d. is pro-rated based on renewable resource base per region thereby balancing risk between regions dependent on their resource wealth.



5.

This "passive house" in Germany uses high performance windows, very tight construction, super-insulation, and a high-throughput ventilation system that keeps indoor air fresh without the need for much re-heating or re-cooling. Sunlight, heat from appliances, and people keep these houses warm on all but the coldest days and shading, insulation and the ventilation system keeps out hot air in the summer. Building or renovating homes and commercial buildings to passive house standards in the US would slash heating and cooling costs by 80% or more.

**National Energy Efficiency Standards** - Utilities and government can be mandated to cut energy use by an aggressive percentage per 4 year period (10-15%). As in California, a portion of electric rates collected can be used to pay for a portion of the efficiency upgrades in the form of rebates. Additionally [the Energy Star](#) program and minimum efficiency standards for hard goods should be expanded and made more aggressive. A carbon price can hasten the implementation of an efficiency standard by raising the price of energy.

- 6. **Aggressive Auto Efficiency Standard (CAFE)** - Without high fuel prices, auto efficiency standards are difficult to impose as buyers tend to demand larger, less efficient vehicles. Still, an efficiency standard can create targets based on engineering best practices that may help automakers plan their auto line as well as function as a public expression of intent.

From a position of government authority but responsiveness about the imposed costs and implementation path, governments can generate new direct regulations that may be as effective or more effective than existing instruments. If we believe that government has a regulatory role in financial markets, it makes sense to consider how effective rule-making by the government has in the past and can continue to spur economic progress in the area of energy.

**Effective Carbon Pricing (partially addresses “Market Failure 1”)**

If we take away the expectation that carbon pricing will across the board address all key issues related to a future looking carbon policy, we can more easily define the parameters that would make a carbon pricing system effective. A carbon pricing model assumes a market of independent actors who have choices to make as to how to structure their business and private lives, which the price will influence to emit less carbon. Secondly, depending on a still unfinished political process, the collected revenues may either function to displace other taxes, return a dividend or finance clean energy projects. The following then should be criteria by which the effectiveness of a carbon pricing policy should be judged (all carbon pricing systems will not qualify for every criterion):

1. Noticeably effects the price of fossil energy, carbon intensive products, carbon emitting activities and land-use practices whether in or outside the current market. Must inflict some economic “pain” in its first edition in order to be effective and this pain has to have information value for market participants.
2. Through this pricing. increases the desirability of lower or non-carbon emitting activities and products
3. Enables effective choice of a broadening category of lower carbon alternatives on economic grounds alone
4. Signals a will to curb carbon emissions among the leadership, and additionally inspiring voluntary “above and beyond” cuts in carbon emissions.
5. Creates a competition between carbon emitters to emit less than their peers.
6. Generates a revenue stream and incentive structure for allowing movement towards or maintenance of carbon sequestering land use practices
7. Enables an international trade in or regulation of trade of carbon equivalents
8. Would dampen or eliminate price volatility in the carbon price to enable effective investment planning on the basis of the carbon price and/or the revenues generated therefrom.
9. Progressively raises carbon price in a planned sequence to exert pressure for further emissions cuts.
10. Creates or energizes the market for carbon-emissions reducing innovations, spurring research and development.
11. Is directly adjustable by regulators/legislators to enable the system to learn from experience.
12. Is not so onerous to the taxpayers/consumers that it becomes politically vulnerable (this is partly a function of public outreach about the link between climate change, carbon pricing, and economic development as well as design of the system)

### **Carbon Pricing Instruments**

At a House Ways and Means committee hearing earlier today, the options associated with carbon pricing instruments were not fully laid out for lawmakers to review the interlocking parts and options available. The packages that were presented were "cap

and investment" and "tax and dividend"...these are not the only options, policymakers can mix and match depending on how they weight the above criteria.

### ***Pricing Determination and Administration***

#### 1. Carbon Tax



Grover Norquist, inspired by Ronald Reagan, is one of the most influential anti-tax activists in the United States. Attitudes about the value and meaning of taxation have had profound impact on the formulation of climate policies, including the selection of an instrument to administer the carbon price. The success of libertarians like Norquist in branding taxation as an almost total loss to individuals and their wealth has until recently been almost total.

2. Cap and Trade - There are many variations to cap and trade -- it is an exceedingly complex instrument and outlining all permutations goes beyond the scope of this analysis.
  - a. Full Auction of Permits
  - b. Partial Auction/Partial give-away
  - c. Full give-away of permits (no price)
3. "Hybrid" Cap and Trade (Price Ceiling and Floor for Permits) - a hybrid of a cap and trade and a carbon tax stabilizing the carbon price in a range.

The selection of the carbon price administration mechanism will emerge from political negotiations between the different interest groups involved.

### ***Revenue Distribution***

Any of the above instruments can be mated with any combination of the below mechanisms to distribute the revenue from either permit auctions or tax collection. There is no inherent relationship of the carbon tax or the cap and trade systems with any particular means to use the resulting funds collected.

1. Carbon-Emissions Mitigating Investment - devotes the proceeds of the program to emissions reduction
2. Partial or Complete Dividend - attempts to soften the effect of rising energy and goods prices by returning revenue on a per capita basis

3. Displacement of other Taxes/Revenue Streams - phasing out a payroll or other taxes by using carbon revenues.
4. Need-based Dividend or Investment - focal efforts to soften the impact of carbon pricing by either a dividend mechanism or targeted investment in energy efficiency for the neediest.

The selection of the distribution mechanism has everything to do with the political design of the ultimate carbon pricing program and how it is introduced to voters and consumers. The potential complexity of both the resulting instrument and the process by which we will arrive there makes reliance only on carbon pricing a politically risky maneuver for people who are concerned about protecting the climate.

### **Design, Fund, Incentivize Zero- and Lower Carbon Infrastructure and Fixed Capital Investment (Addresses Market Failure “2”)**

While it would have been preferable for governments to have engaged in a full scale “countercyclical” policy of collecting tax revenue during the boom years of the last few decades to reduce debt, we are now facing a period in which it is “do or die” for economies to stimulate demand, restructure their financial systems, and halt the slide into a Global Great Depression II. Engaging in deficit spending to build or expand existing infrastructure to halt rising carbon emissions is a worthwhile cause to risk future inflation for current and mid-term economic and environmental benefits. Some private capital may be organized to build some of this infrastructure but with significant



The Obama Administration's stimulus package has already found a "shovel-ready" renewable energy infrastructure project in building out the transmission system of the federally owned Bonneville Power Administration to serve new wind farms in the Northwest. Bonneville is one of a number of federal agencies that already own transmission leading from the system of federally owned dams in the West. Bonneville's transmission system will most probably form part of the basis of the National Unified Smart Grid, which in all probability will be part government owned and partly owned by private investors.

Different countries and regions have different infrastructure needs but for the US the following projects would add value to communities as well as represent a significant

economic stimulus. China is currently pushing ahead with a much more aggressive infrastructure program than the US, including rail building. The selection of projects should be based on transparent criteria that include both needs assessment and short, medium and long-term cost/benefit analysis:

1. Build an electrified passenger and freight rail network for the US
  - a. Create a national rail plan that allows efficient co-mingling of freight and passenger rail along existing and new, non-HSR rail lines
  - b. [Grade separate](#) existing rail lines (with multiple positive externalities associated) in high traffic areas.
  - c. Build a [high speed rail](#) (HSR) network along high traffic corridors
2. Incentivize and create the regulatory structures to build a [National Unified Smart Grid](#) to link renewable energy zones to demand centers; most likely there will be a mixture of public and private ownership of transmission.
3. Incentivize the building of renewable electric generators through secure, premium wholesale electricity rates ([Renewable Energy Payments](#)).
4. Rebate and tax credit incentives for energy efficiency upgrades to existing buildings.
5. Incentivize the building of clean energy storage through incentivizing non-fossil grid ancillary services.
6. While preserving or extending existing levels of mass transit service, electrify high traffic bus routes.
7. Incentivize building of electric vehicle [fast charge](#) and [trickle charge](#) networks in cooperation with municipalities and utilities.

### **Increase funding for Clean Energy Research and Development (addresses Market Failure 3)**

While the federal government has continued to fund clean energy research even through the Bush Administration, an increase in funding for research into renewable energy technologies, clean energy storage, sustainable biofuel alternatives, and cleaner, more efficient nuclear technologies are important to see if we can “leapfrog” existing technologies or reduce costs in the building of clean energy infrastructure. Some have suggested budgets ranging from \$3 billion to as much as \$40 billion per year as a means of expanding scientific exploration, creativity and innovation in the area of clean energy. If there is a reasonable chance that an innovation can open a new source of clean energy or increase the efficiency or cost-effectiveness of existing options, we should not hesitate to pursue it. On the other hand, oversight over these budgets should keep the focus on what can pay off within the next ten to fifteen years.

### **The Principle of Non-Perfectability**

While very simple systems may reach something called “perfection”, complex systems, including living things, social and economic systems, and the earth’s climate will never be “perfected”. The advocates of self-regulating markets tended to treat markets as a

“pure” or perfect social institution. In chronicling so many market failures and needed programs to remedy them, I am not suggesting that policy will “perfect” the market or be able to completely address these market failures.

### **Purpose of a Comprehensive Policy**

The purpose of this piece is to outline what a revised, reality-based economic and political framework for understanding both the course of previous energy and climate policy and the trajectory for effective future policy will look like. The lore of a self-sufficient, self-regulating market put policymakers and clean energy advocates on the defensive and narrowed the focus largely to transforming the actions of individual market actors. In response, efforts were made to “perfect” the market through a carbon price. If we are to create a reality-based set of policy instruments we have to face facts both about the nature of economic models and the physical realities on which they are supposed to act. I am supportive of [the Repower America](#) program, but feel it does not fill out enough the actual mechanisms by which it would achieve its ambitious goals, therefore the proposed framework. A comprehensive climate and energy policy addresses both flaws in systemic functioning and problems of incentives and disincentives that cause individual market actors to continue to ignore the very serious consequences of anthropogenic warming.