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TAX REFORM, ENERGY AND THE ENVIRONMENT

WORLD RESOURCES INSTITUTE

POLICY BRIEF

A GREEN EMPLOYMENT INITIATIVE: ~~TAX SWAP:~~

USING A CARBON BURNING FEE ~~TAX~~ TO FINANCE A TRANSITION TO SUSTAINABLE / RENEWABLE ENERGY ~~PAYROLL TAX RELIEF~~

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EXECUTIVE SUMMARY

As the new Congress convenes, both Democratic and Republican lawmakers are proposing limits on greenhouse gas emissions. ~~Most of these proposals are for carbon cap and trade systems similar to the European Union Emissions Trading System.~~

A carbon tax (reframed herein as a carbon burning fee) is another way to influence sustainable life style choices and limit emissions. This reframed policy brief describes how a carbon burning fee ~~tax~~ could be implemented ~~and presents an analysis of a Green Employment Tax Swap (GETS).~~ Under this proposal, a national tax on carbon emissions is used to fund a carbon burning "replacement/ reparation" work program. ~~paired with a reduction in the payroll tax.~~ In particular, the brief assesses the impact of a tax of $15 per metric ton of carbon dioxide (CO_2), and a carbon burning fee anchored to the Real World cost of replacing the non-renewable energy extracted from the Earth and repairing the damage done by burning this resource then dumping the waste combustion products into the air, water and soil. ~~which is used to rebate the federal payroll tax on the first $3,660 of earnings per worker. This reform is both revenue-neutral and distributionally neutral~~

Congress is currently considering various legislative proposals to curb greenhouse gas emissions in the United States. ~~and a number of bills to establish carbon cap and trade schemes have been put forward.~~[1] A carbon burning fee ~~tax~~ is an additional policy instrument that can be used to control carbon emissions and more importantly influence choices in a manner that is consistent with sustainable living for the foreseeable future. To illustrate how a carbon burning fee tax could be implemented, this policy brief discusses a Green Employment Initiative. ~~Tax Swap (GETS) in which a tax of $15 per metric ton of carbon dioxide (CO2) is used to rebate the federal payroll tax on the first $3,660 of earnings per worker.~~[2]

I. A GREEN EMPLOYMENT TAX SWAP AS A POLLUTION TAX

Economists have long extolled the virtues of pollution taxes to address the social damages arising from polluting activities. A central tenet of economics is that market prices do not reflect the social cost of resource use when economic activities externalize/ignore Real World costs such as ~~result in~~ pollution. The private cost of polluting activities falls short of the cost to society from the pollution. **A tax on pollution is a simple way to ensure that private firms use resources that take into account the full (social) cost of their behavior. We propose adding a "replacement" fee on top of the "pollution remediation tax."** Support for pollution taxes intended to internalize externalities (ignored costs), also known as Pigouvian taxes, cuts across the political spectrum. N. Gregory Mankiw, professor of economics at Harvard and a former Chair of the Council of Economic Advisors under President George W. Bush, has argued in favor of higher gas taxes.[3] He has established the Pigou Club, an "elite group of pundits and policy wonks with the good sense to advocate higher Pigouvian taxes."[4] Other supporters of pollution taxes include *New York Times* columnists David Brooks and Thomas Friedman, economist and columnist Paul Krugman, economists Martin Feldstein and Joe Stiglitz, and former Vice President Al Gore.

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A carbon burning fee ~~tax~~ is simply a ~~pollution~~ Pigouvian tax intended to update an antiquated economic system by incorporating externalities so that the system more aptly influences human behavior to make sustainable choices related to energy use.

Setting the Stage for an updated economic system:

Finite Earth / Finite Resources

Our "Blue Marble" traveling in the vastness of space. Our Planet Earth is large but finite. Our planet is an ever changing complex system that supports diverse forms of Life. 1.9 million living species have been documented to date. Today, Earth is the home of over seven (7) billion homo sapiens.

All forms of Life share the common finite resources required for Life. All harvest the energy from the Sun (current or recent)(directly or indirectly) to sustain their lives, except one. All Borrow / Return every atom of the Earth's resources in a sustainable manner except certain members of one exception-all species: homo sapiens. Most of us Americans are currently making choices and living our lives in a manner that is not sustainable. Yet our choices are consistent with our American political/economic system. We are law abiding and generally frugal. But we extract Earth's finite resources, consider them to be "mine" and consume them so they are no longer available to future generations. This behavior is inconsiderate, irresponsible and immoral in the finite Real World, yet totally acceptable in the American economic system – the system we created – the system we designed to influence our choices – the system in pursuit of Life, Liberty and Happiness.

By looking around at the examples provided by our 1.9 million cousin species, we can see how to live sustainably. We know that any "consumption" of a finite resource is unsustainable.

Even as children, we learn that if we start with 100 pieces of candy and eat (consume) only 1% (1 piece) each day, after just 100 days we have no candy left. However, if we go to the library where there are 100 books and we Borrow and Return 1% (1 book) a day, we are able to use the books and they seem to last forever. The "Library System" is actually designed to work in the Real World. It acknowledges that some people "consume" books. Some people borrow a book, then they forget to return the book, or they lose the book, or they damage the book, or their dog eats the book, etc. Generally the book borrower who consumes a book is assessed a "book consumption fee" theoretically designed to be commensurate of the cost to replace or repair the original book. Kids understand the Library system; they get it and behave sustainably – they don't "Mine" books – they "Borrow / Return."

All forms of Life borrow the basic elements (listed in the periodic table) required to live and to thrive. These basic elements are stable and don't wear out like library books. Hydrogen atoms are at least 13.4 billion years old. All the other elements used to construct our bodies (there are about 26 needed for the human body) emerged between 13.4 and 5 billion years ago from the furnaces of supernova stars in our galaxy. These elements above hydrogen including carbon, oxygen, etc. and essential to life and seem to have a plan to be around for much longer.

E**xample 1.** An Iron atom (Fe^{25} in the periodic table) can and does naturally combine with Oxygen atoms (i.e. oxidizes and forms rust) and give off some heat in the process, but humans have learned how to add energy (e.g. in a blast furnace) and reverse the process (i.e. reduce the iron oxide ore) and get the original Iron atom back to make steel that can then be used to make a car. We then "Borrow" the car, use it as long as we want, then "Return" the car so every Iron atom can be recycled (used to fashion something else for someone else sometime in the future). When we use energy from a renewable source (e.g. use a furnace powered directly by concentrated solar thermal energy or by electricity generated by wind or solar photovoltaic modules, etc) to reformulate the

steel to make another car, etc. we can borrow and return these same Iron atoms for millions of years.

Example 2. The One World Trade Tower is nearing completion in Manhattan. 95% of the 43,000 tons of steel used in its construction is recycled steel.

Example 3. Our body requires iron – about 20 mg each day for the production of new red blood cells. Our naturally evolved bodies have resulted in a system that allows us to recycle most of that iron from our old red blood cells.

Nothing profound here – just First Grade arithmetic: Given any finite number, If you subtract any portion of it, the remainder is smaller than the original number. If you keep subtracting, eventually you end up with zero. The same arithmetic taught us that if you subtract a portion of the original number and then sometime later add the same portion back, the original number stays the same. Sustainable living is not a hard concept to grasp.

"Borrow what resources you need /Return all that you borrow[1]" is sustainable utilization of Earth's finite resources (assuming we use only energy from renewable sources for our recycling/recreating processes).

Notice that we did not have to introduce any politics, economic ideology, or even a specific ethical or religious belief system to describe this first aspect of sustainability – just the simple observation that the Earth is finite and its common life support system is also finite.

Our American economic system does a great job applying this 'finite resource' concept when it comes to a bank account, a loan or a mortgage. The banking system even "enhances" the concept by adding the commonly accepted practice of usury.

They Say: Want to borrow 100,000 and pay it back over 30 years? No Problem. We have great rates today – we can get you in at 5.3045%.

You say: How much will it cost?

They say: Just $555.55 a month.

You say: But $555.55 per month for 30 years is $200,000.

They say: So is that a problem?

As we look around us, we see that natural systems in the Real World are not based on usury. If you Borrow (our-owe) one (1) kg [2.2 pounds] of Iron, when you are finished using it, nature expects you to return **every atom** of that 1 kg of Iron so it is available for the next user. No more. No less. Incidently, that's about 1.095×10^{25} atoms.

Unfortunately our American economic system does not apply this 'finite resource' concept to our basic materials needed to sustain our life – so called natural resources. We Americans seem to assume there are infinite quantities of these resources so why even bother thinking about balancing our accounts. We don't even think about how much we still have left in our resource account.[2]

Our American system does not consider the inherent value of these natural resources in situ. The value associated with a natural resource is set by the labor costs to extract this resource and shape it into a product that can be sold with the addition of as much profit as the market can be taught to bear(through tax deductible /avoidance advertizing. In effect, We the People pay the corporations to trick us into thinking we should buy their product).

Our American system does not encourage us to design and create products from these resources that are 100% recyclable. Our economic system tells us it's 'cheaper' to throw things in the trash (land fill, ocean, etc.) and buy a new one.

Our American system does not influence us to use manufacturing processes driven by power from renewable energy sources. Instead everyone knows it is more profitable to burn one-time-only ancient reserves of hydrocarbon with no intent whatsoever of including a replacement cost for this consumed energy resource in the selling price of the product, with no intent of ever paying this energy back for future generations, with no consideration for repairing any damage created in the wake of our semi-conscious anthropocentric behavior.

So how could the American economic system by updated to better inform us about finite resources and the sustainable use of these resources – we are not trying to say that homo sapiens should not use natural resources to express their sustainable

[1] (in the same or better condition that you found them)

[2] A recent documentary aired on the History TV channel in the fall of 2012 called "What's the Earth Worth?" We have written a separate paper that "reframes" this documentary. The bottom line after an application of the American economic system was that the "Earth is worth" $6,800 trillion.

creativity – just the opposite – we are saying there is a responsible way for our generation to express our creativity – enjoy the wonderful, thrilling, beautiful, life enhancing tools that can be constructed from the earth's resources – the 82 some stable elements in the periodic table (someday we may get smart enough to properly handle the unstable radioactive elements above atomic number 82 as well but not at this moment). But we do so with a different worldview – a finite world view of Borrow/Return every atom we check out of the Earth's library of elements.

What we are describing would have seemed impossible 50 years ago. But when you learn about the amount of data the military- industrial complex is now collecting, processing, storing, retrieving, keeping track of the Earth's resources would be a piece of cake. And it would be value added. Not to be too paranoid, but one of these over-reaching agencies is probably recording each of my keystrokes as I attempt to put these ideas into electronic form.

There is no doubt that my local bank is keeping meticulous account of every penny in my account – particularly the usury that is carefully calculated and conveniently rounded in their favor – the house always wins. Governments win. Corporations win. Systems we have created with people hidden inside win. We the People, our 1.9 million cousin species, and our planet are not winning at the moment.

We who use natural resources cannot be trusted to return these same resources for use by the next generation. We are so used to "mine-ing" the resources in the human-created "real world", we forget that in the Real World we are actually "our owe-ing" the resources. The Real World encourages us to use its resources to create new tools that extend our capabilities and contribute to our increased awareness/consciousness and promote collective learning. As long as when you done using these resources, we return them in an orderly manner for use by the next life (be it human or non-human)

We promote "mine-ing"

Waste Zero Discharge
How much is the Earth worth?

Energy Sources

Timeframe. Our Sun has enough hydrogen to provide Earth with life sustaining energy, sunlight, for several more billion years – just as it has for the past 4.56 billion. The fossil record indicates Life has been evolving on Earth for about 3.5 billion years. 600 million years ago, Life emerged from the oceans and began populating the land. 250 million years ago, reptiles, including dinosaurs, were the dominate life form living on a unified land mass called Pangea. Tectonic plates continue to shift and have separated into the seven continents we see today. After the mass extinction of the dinosaurs around 65 million years ago, mammalian species began to thrive and diversifiy. *Homo habilis*, called "handy man" (because of the wealth of tools that have been found with fossil remains) appeared about 2 million years ago. Homo sapiens, we humans, emerged from Africa around 150,000 years ago to proliferate to now over 7 billion souls and inhabit every continent. Earth itself is projected to be habitable for life as we know it for at least another 500 million years IF we homo sapiens can learn to live sustainably on our finite planet with finite resources and the Sun as our primary sustainable source of energy. This is the Real World.

Now let's contrast that with the human-created "real world." An individual human with an expected life span of 75 years might typically think ahead 30-40 years to their retirement years. That's long range planning at an individual level in the "real world." A corporation that theoretically has an unlimited life-span thinks ahead to quarterly earnings, annual stockholder reports, occasionally five year plans – and some (e.g. forestry, petroleum,…) even construct 20-30 year plans to placate their stockholders of their long range stability and foresight. That's long range planning in the corporate "real world." Governments that also are intended to have unlimited lives look ahead to 12 month fiscal years, and certain agencies (e.g. DoD, NASA,…) even prepare 5 year plans to provide wedges for "long term" congressional funding. That's typical long range planning in the political "real world."

We have one notable exception: America's National Parks.

"…. this uniquely American thing called the National Parks, an invention we now take for granted like the

air that we breathe, the water we drink…for the first time in human history, land—great sections of our natural landscape—was set aside, not for kings or noblemen or the very rich, but for everyone, for all time… Americans had invented such a wonderful thing, that this idea, like our articulation of universal political freedom in the Declaration of Independence, should be so widely admired and copied throughout the world. During the course of our investigation, we began to gain a new, intimate awareness of the flabbergasting and nearly incalculable geological forces at work and on display in the parks. "One of the things I think we witness when we go to the parks," the historian William Cronon told us in an interview for our film, "is the immensity and the intimacy of time. On the one hand, we experience the immensity of time which is the creation itself. It is the universe unfolding before us. And yet it is also time shared with the people that we visit these places with. . . . We remember when our parents took us for the first time. . . . And then we as parents passing them on to our children, a kind of intimate transmission from generation to generation to generation of the love of place, the love of nation, that the national parks are meant to stand for."

Human Interdependency. As we look around us, we can see (and have documented) 1.9 million cousin species living with us interdependently on our common planet. Some estimates indicate there are at least 8 million still to be documented. Some of these species have only a few endangered individuals still clinging to life and will soon become extinct. Some species have trillions of individual instances.

> *Death is the end of life, but extinction is a whole different thing – it is the end of birth ……Anon.*

The lives of over seven (7) billion Homo sapiens are now woven into a fabric of interdependent life on the planet. This three dimensional fabric of Life covers the land and extends into the oceans as it serves to distribute life supporting energy from the Sun to all living beings. We humans exist only because our cousins exist. This is true from an evolutionary / genetic /DNA perspective as illustrated in the Phylogentic Tree of Life and from an energy network perspective as illustrated by the food chain. Autotrophs depend on the Sun for their source of energy; heterotrophs depend on autotrophs (and other heterotrophs) for their source of energy.

All Life shares and requires Earth's common resources and the energy from the Sun. We humans can thrive only when all Life thrives.

Human Independence / Free Will. Because homo sapiens are such a capable species, we see ourselves as having "free will" meaning our behavior is self determined based on choices we ourselves make – behavior that transcends the instinctual behavior we observe in most of our cousins.

Human Folly (To Be Written Later)
Human Awareness / Consciousness (TBWL)
What is Sustainable? (TBWL)
What is Unsustainable? (TBWL)
Biomimicry (TBWL)
Insights from the Universe.

For the past 13.7 billion years the Universe has been expanding and changing. We can see a common direction some call Emergence: The creation of "something more" from "nothing but" as a result of new relationships.

Human are pretty good at observing the Universe and noticing change – even long term change – although many other species are also uncanny in their ability to observe and remember – salmon coming back to their place of conception to spawn another generation; sea turtles hatched from a specific beach will return years later to make a nest of their eggs then leave for the hatchlings to find their way into the water and in turn return someday, birds and butterflies that migrate to adapt to seasonal changes; Living beings seem to be inherently curious – humans / primates very much so. It like there is an innate question built into all life – Can I live/grow there too? Can I see what's beyond? Why? That we ask questions? That we can conceive of a question. Or perhaps its trial and error - Let's try this spot. Oops! That's didn't work.

Human Free Will (TBWL)

Anthropocentric vs. Ecocentric Worldview. and have a significant degree of consciousness, and excel at collective learning that allows us to pass knowledge efficiently from one generation to the next, we have learned that our capabilities might be

considered as having "free will." We worship our individual freedom. We have also observed that because we have so many possible choices, some of which are not life serving, that we did better if we remembered and passed along our Lessons Learned to others. So patterns, traditions, customs, superstitions, rules, laws, behavioral system (politics, economic, religious, ethical, spiritual systems were created to help us make life serving choices among the infinite number available to us.

An economic (and political and ethical/spiritual) **system anchored in this Real World** (consistent with the "laws" of the Universe) **is required to influence our choices so we select only those alternatives that are sustainable for the foreseeable future.**

Adaptation to a changing world. For the past 13.7 billion years the Universe has been expanding and appears destined to do so for as many more billions of years.

That's the anthropocentric viewpoint. 1.9 million other living species (that we have documented so far) also evolved to be present today. The fossil record seems to indicate that for every species alive today, there are probably 1000 that are now extinct.

changing. As we look around we can see our expanding Universe, our Sun consuming its finite amount of hydrogen fuel, our Earth's tectonic plates shifting, Life on Earth continuing to explore diversity and complexity. There is no such thing as status quo.

is Change As we look around and connect with our living cousins we understand that we all are champions having arrived here today – having successfully navigated 3.5 billion years of ever changing surroundings.

We life forms have been able to adapt and are still here today; those that couldn't are recorded in the Earth's fossilized record of former life.

All of us living and thriving today are directly or indirectly dependent on the energy from the Sun for our very existence. Without this light driven chemistry, life is reduced to dust, basic elements of the period table – disordered star stuff. Autotrophs look at the Sun and snatch its energy, convert and conserve some of this solar energy in a form that can be shared (chemical bonds within biomass), some into heat for its own well being, and the rest is radiated away. Heterotrophs (unable to look directly at the Sun) look to Sun's energy now stored within autotrophs (and other heterotrophs) for their life sustaining energy. With this interdependent web of life, a human might say that Light is able to find pathways to consciousness and even look back upon itself. A poet or mystic might say that Life is how Light can experience the joy of a sunrise, reflect on a sunset, marvel at a birth and experience the grief of a death.

DNA sequencing now indicates that we Homo sapiens emerged from eastern Africa to begin populating the entire planet around 3000 generations (100,000 years) ago. Ignoring "game over" climate change, but using our current rate of consumption (burning), our one-time-only reserves of hydrocarbon will last for another 3-5 generations (90-150 years). Our legacy is that our great grandchildren and all generations of humans beyond that will just have to live without these ancient hydrocarbons - unless we change our current behavior – unless we start to make choices that are sustainable – unless we update our current economic/political/spiritual/worldview constructs to influence us to make sustainable choices.

Metcalf is suggesting one step that will update our economic system by internalizing an externality to move us in the direction of sustainable living – a carbon tax. We are suggesting a slightly larger step - a carbon burning fee.

A carbon burning fee internalizes two basic cost components: energy replacement cost and a remediation cost (the original pollution tax Metcalf addresses).

From "Mine-ing" to "Our Owe- ing / Return-ing"

Replacement Cost: Burning ancient hydrocarbons (coal, petroleum, natural gas, tar sands oil, shale oil) as we currently do is unsustainable human behavior for several reasons. 1) Ancient hydrocarbons are a one-time-only non-renewable resource too valuable to burn/consume. 2) When we burn it, the

resource is no longer availability for future generations 3) Burning hydrocarbons at the rate we do, and dumping our waste combustion products into the common air, water, and soil is altering the living environment for all life on the planet. This particular human behavior is compromising the ability of all life (including our own) to reach its potential.

	$ /
$107.14	MWh

with no thought of replacing this

Reparation Cost:
Burning recent hydrocarbons (biomass) without sequestering the CO_2 is currently unsustainable human behavior for 7 billion people. As indicated by Amory Lovins, "Reinventing Fire" is mandatory. Fortunately there are viable alternatives to burning hydrocarbon for our energy needs but our broken economic system with its externalites does not influence us to choose these alternatives.

Carbon dioxide emissions are a form of greenhouse gas emissions contributing to global warming. The societal damages from global warming have been extensively documented.[5] Concerns about global warming led the United States to sign the Framework Convention on Greenhouse Gases in 1992. Many countries have moved forward to address greenhouse gas emissions by signing the Kyoto Protocol. While the United States has not signed that protocol, it has recognized the dangers of global warming. Last year, for example, the U.S. Senate passed a non-binding resolution calling for a "national program of mandatory market-based limits and incentives on greenhouse gases."[6] In his most recent State of the Union Address, President George Bush acknowledged the need "to confront the serious challenge of global climate change."[7]

At this point, the reframing effort diverges from Metcalf because of the difference approach to uses of the revenue from this fee/tax. Our approach is to use the revenue for its intended purpose replacement / Reparation only. The fee/tax itself will change the slope of the playing field and allow the free market to re-run the number and choice what is the "cheapest" approach. To choose sustainable clean renewable energy (Sunlight and its derivatives) or to continue to burn hydrocarbons, pay to replace it and pay to clean up the mess. The purpose of the updated economic system is to bring it in line with the Real World and present an honest complete perspective to the free market – a perspective that does not externalize any Real World costs. Although it is very tempting to retain a distorted marketplace and play games with tax swaping/revenue sharing etc. that is not a sustainable system either.

Pollution taxes have an even stronger appeal because of the opportunities for using the tax revenues to lower other distorting taxes, as we propose in the GETS reform. This reform focuses on payroll taxes, which have become increasingly burdensome for working families. In fact, for nearly three-quarters of all households, payroll taxes are their single largest tax to the federal government.[8] Because the payroll tax is a flat-rate tax up to a payroll limit of $90,000 (as of 2005), it is generally acknowledged to be a regressive tax.[9] Using the carbon tax to reduce the payroll tax burden would reduce the tax burden on working households, especially for those households earning less than the median income in the United States.

In addition to ~~possible~~ improvements in the progressivity of the tax code, using a carbon tax to lower the tax rate on wage income could improve the efficiency of the U.S. tax code. Economists have long noted the benefits of this second dividend from a tax on pollution. In general, taxes on labor supply discourage labor and create economic losses to workers over and above any taxes collected. Workers forego opportunities to work longer hours or engage in training that increases their productivity and wages. Moreover, workers may choose not to enter the labor force in response to taxes on wage income. Tax reductions can encourage additional labor supply either on the intensive margin (hours worked) or the extensive margin (the decision to enter the labor force). The revenue from the carbon Burning Fee will go directly into The Green Employment initiative to finance a transition to sustainable / renewable energy – this encourages additional labor demand. ~~supply on the extensive margin.~~

Table 1	Share of Environmental Taxes in Total Tax Revenue, 2003
Country	Share (percent)
Canada	3.99
Denmark	10.27
France	4.91
Germany	7.44
Japan	6.58
Netherlands	8.93
Norway	6.86
Sweden	5.84
United Kingdom	7.57
United States	3.46

Source: European Environment Agency. http://www2.oecd.org/ecoinst/queries/index.htm accessed Jan. 25, 2007.

Finally, the United States is currently an outlier in its use of environmental taxes relative to other high-income countries in Europe and elsewhere. Table 1 presents the share of total tax revenues generated by environmental taxes for a sample of countries for 2003. The United States has the lowest share of taxes on environmental activities among the 27 OECD countries reporting data for 2003. As an example, the tax on gasoline in the United States is roughly one-eighth the value of the average rate across all countries in the OECD.[10]

II. IMPLEMENTING THE GREEN EMPLOYMENT INITIATIVE ~~TAX SWAP~~

A carbon burning fee ~~tax~~ could best be implemented in an *upstream* system by taxing the carbon content of the hydrocarbon ~~fuels~~ at their source. For coal, this would be the mine mouth for domestic coal and the border for imported coal.[11] Natural gas would be taxed at the wellhead. Petroleum products would be taxed at the refinery on the various products produced from crude oil. Levying the carbon tax on refinery outputs is preferable because crude oil can have different emission factors (carbon per barrel of crude) for different shipments; for example, a single tanker could have batches of oil with different emission factors.

An upstream tax would require a few simple adjustments based on how much of the carbon becomes un-sequestered – transitioned to CO_2 and dumped into the atmosphere.

First, if the hydrocarbon extracted is to be used sustainably (not burned or otherwise lowered in energy level and recycled), then it is not subject to the carbon burning fee.

> Examples include: carbon combined with iron to produce steel that can be recycled, hydrocarbon used to make carbon fiber for composite light weight materials that can be recycled; hydrocarbon used to produce recyclable non-toxic plastic (if such a material exists); etc.).

Second, electric power plants that sequester carbon should receive a rebate consistent with the "reparation cost" embedded in the carbon burning fee. ~~for carbon taxes~~ previously paid at the upstream "source." ~~on the sequestered carbon.~~ The "replacement cost" component of the carbon burning fee is still passed on to the end consumer of the electrical power.

In addition, non-energy carbon dioxide (and other related GHG) emissions should also be brought into the system. Such emissions come from a variety of sources.

Cement production is also a major source of CO2 being dumped into the atmosphere. For example, calcination of limestone to make clinker, an intermediate product in cement production, releases carbon. Applying the carbon tax to clinker production would address carbon emissions in the cement industry.

> **Carbon Dioxide or Carbon?**
> Carbon emissions can be reported in units of carbon or carbon dioxide. By weight, 44 units of carbon dioxide contain 12 units of carbon. To convert carbon dioxide to carbon, multiply the amount of carbon dioxide by 12/44. To convert a tax rate per unit of carbon dioxide to a rate per unit of carbon, multiply the former rate by 44/12.

An upstream carbon tax would be relatively straightforward to administer with a small number of filers responsible for remitting tax revenues to the government. Ease in administration would help keep administrative and compliance costs down.

III. ASSESSING A SWAP

This brief considers a carbon burning fee ~~tax~~ set at a rate of $15 per metric ton of carbon dioxide[12] ($55 per metric ton of carbon). Emissions of carbon dioxide in 2005 are estimated to be just over 6,000 million metric tons.[13] Had a carbon tax of $15 per ton of CO_2 been in place in 2005, the tax would have raised $89.2 billion, assuming no behavioral response. Ironically the intent of the carbon burning fee is to influence a change in behavior so that humans make choices that are sustainable – i.e. no longer burn hydrocarbons. Because demand for carbon-intensive products will fall in response to a carbon burning fee ~~tax~~, carbon emissions in the short run would fall by an estimated 700 million metric tons of CO_2 in response to the levy (12.1 percent based on price and quantity data from 2005).[14] Please let's make it clear that a 12% reduction in the amount of hydrocarbon that is being burned is only a drop in the bucket compared to the 100% reduction we need for sustainable living. If we start at $15 / metric tonne, this levy must be increased rapidly within the next several years.

Using a graduated approach creates a dilemma. It seems "Fair" to give the extractor a heads up. However, we know from experience and common sense that if such a change to the system is signaled before hand, then the extraction industry will attempt to immediately extract as much as possible to circumvent the levy before the carbon burning fee takes effect. This would be disastrous. The levy will have to include a retroactive clause that taxes any significant increase in production during the transition years.

Table 2 Short-Run Price and Output Effects of a $15 per metric ton CO_2 Tax

Energy Source	Unit	Price per Unit (2005) ($)	Tax per Unit of Energy ($)	Price Change (%)	Change in Energy Usage (%)	Emissions Reduction (million $MTCO_2$)
Coal	short ton	31.22	28.55	91.4	-32.0	648.8
Crude Oil	bbl	50.28	6.48	12.9	-2.0	57.4
Natural Gas	mcf	12.81	0.82	6.4	-1.0	11.4
Total						717.6

Source: Author's calculations. See text for details.

Table 2 (REFRAMED) Short-Run Price and Output Effects of a Carbon Burning Fee per metric ton CO_2

Energy Source	Unit	Price per Unit (2011) ($)	CO_2 (metric tonnes) per Unit	Carbon Burning Fee ($ / tonne)[3]	Tax per Unit of Energy ($)	Price Change (%)	Change in Energy Usage (%)	Emissions Reduction (million $MTCO_2$)
Coal	short ton	**57.64**[4]	2.06	150	309	536	-32.0	648.8
Crude Oil	bbl	**94.88**[5]	.46	150	69	72.7	-2.0	57.4
Natural Gas	mcf	**11.74**[6]	.0546	50	2.72	23.2	-1.0	11.4
Total								717.6

Source: Reframer's calculations. See text for details.

[3] Although $15/ metric tonne might be a starting point, an analysis at MIT for three different types of hydrocarbon burning plants indicates that "…mitigation costs of $121 per tonne of CO_2 avoided for a capture IGCC plant, $168 per tonne of CO_2 avoided for a capture PC plant and $49 per tonne of CO_2 avoided for a capture NGCC plant." are values closer to the actual externalized (ignored) cost in the Real World. Nomenclature: IGCC (integrated coal gasification combined cycles), PC (pulverized coal-fired simple cycles), and NGCC (natural gas-fired combined cycles). Ref: **THE COST OF CARBON CAPTURE, Jeremy David and Howard Herzog,** Massachusetts Institute of Technology (MIT), Cambridge, MA, USA http://sequestration.mit.edu/pdf/David_and_Herzog.pdf

[4] U.S. bituminous coal (used for coking coal), U.S. Energy Information Administration, http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0709

[5] WTI - Cushing, Oklahoma Crude oil, http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=A

[6] Oct 2012, Natural Gas Residential price, http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm

Table 2 presents price and output impacts of the tax once it has been fully phased in. Table 2 (Reframed) attempts to mimic the work of Metcalf for the Carbon Burning Fee scenario.

Energy prices for the three fuel sources are average prices in 2005. ~~A tax of $15 per metric ton of CO_2 would nearly double the price of coal, assuming the tax is fully passed forward.~~ So if the carbon burning fee for a pulverized coal fired plant were $150 per metric tonne of CO_2, we would expect the price of coal to increase by a factor of 5. Petroleum products would increase in price by nearly 70 percent and natural gas by just under 25 percent. As a point of comparison, a carbon tax of this magnitude would raise gasoline prices by approximately 130 cents ($1.30) per gallon, assuming the tax is fully passed forward into consumer prices. This represents a price increase of less than 70 percent using average gas prices for 2005.

The largest impact would be on the coal industry. Coal consumption would decline by nearly one-third. Successful carbon capture and sequestration (CCS) will blunt the impact on the coal industry. Pricing carbon is a necessary condition for a financially viable CCS program. Revenue from the Carbon Burning Fee will be used to fund the CCS program. The impact on petroleum and natural gas output is very small. Emissions of CO_2 would fall by over 700 million metric tons of CO_2, a decline of 12.1 percent. Most of the decline results from decreased coal use.

Allowing for these short-run demand adjustments, the carbon tax would have collected $78.5 billion if it had been in place in 2005. The GETS reform uses the revenue to reduce payroll taxes by providing a rebate of the employer and employee payroll taxes on the first $3,660 of earnings per worker. This amounts to a maximum rebate of $560 per covered worker. Given payroll tax collections of approximately $727 billion in 2005,[15] a carbon tax of $15 per MT CO_2 could lower payroll tax burdens on average by just under 11 percent. The benefits of the payroll tax reduction would differ by wage income. Table 3 illustrates the tax reduction for several different wage levels. The GETS reform benefit is greatest for low-wage workers. For a worker earning $5,000 a year, nearly three-quarters of his or her payroll taxes would be rebated. In contrast, at the maximum covered earnings, 4 percent of the tax would be rebated. Later in this brief, we analyze the impact of the GETS reform across households.[16]

Table 3 Effect of GETS Reform on Payroll Taxes

Payroll Tax Wages ($)	Before Rebate ($)	After Rebate ($)	Reduction (%)
5,000	765	205	73
10,000	1,530	970	37
15,000	2,295	1,735	24
20,000	3,060	2,500	18
30,000	4,590	4,030	12
50,000	7,650	7,090	7
90,000	13,770	13,210	4

Source: Author's calculation. Rebate of $560 per covered worker assumed.

IV. RESPONDING TO CONCERNS ABOUT A CARBON TAX

The most common objection to a carbon tax is that it will 'hurt economic growth' in the United States.

Let's take this one on and reframe it. Those who use this "argument" against a carbon burning fee are traditional economists married to the current, obsolete, broken economic system that is influencing American choices to live unsustainably. If you crawl into their sandbox and play their human created "real world" game by their rules that conveniently externalizes key impacts to life on planet Earth, you too will end up agreeing with them.

So we choose to refuse to play in their classical economic sandbox because it is influencing us to make choices that are, to be frank, suicidal – choices that are not in the interests of furthering life on planet earth.

We choose to stay in what the majority of conscious people around the world agree is the Real World – the one with a finite Earth requiring human population management – the one with finite resources that makes an economic system based on perpetual 'economic growth' the laughing stock of ignorance – the one where sustainable living for the next 500 million years requires ZERO consumption of Earth's finite resources, where "Borrowing (Our-Owing)/ Returning" resources replaces "Mine-ing" – the one where homo sapiens learn to mimic their 1.9 million cousin species and return to living by harvesting current/recent sunlight – not by consuming one-time-only ancient hydrocarbon reserves by

burning them for energy – the one requiring an updated economic system that reflects the finite Real World and that influences our choices so that we return to living sustainably.

However, research suggests that most industry groups would not be appreciably affected by a carbon tax swap for two reasons. First, the price impacts for most industries are small. Second, the GETS reform ensures that overall tax burdens will not rise. Offsetting the higher price of products due to the carbon tax is the higher after-tax income resulting from the reduction in the payroll tax in the GETS reform.

To illustrate the first point, Table 4 summarizes the impact on industry product prices of a carbon tax.[17] The table shows the price increases for the ten industries with the greatest price increases. With the exception of three industries—petroleum and coal products, coal mining, and utilities—the price impacts are less than 4 percent for a $15 / metric tonne carbon tax.

Table 4 Industry-Level Price Impacts of a Carbon Tax

Industry Product	Price Increase (%)
Petroleum and coal products	16.1
Coal mining	15.0
Utilities	11.2
Mining, except coal, oil and gas	3.9
Primary metals	3.2
Pipeline transportation	2.4
Air transportation	1.8
Waste management and remediation services	1.7
Nonmetallic mineral products	1.6
Paper products	1.3

Source: Metcalf (2005). Industry final price increases assuming a $15 per ton CO_2 carbon tax is passed fully forward to consumers.

Coal in particular is significantly impacted by a carbon tax. But this is the natural consequence of any policy to reduce carbon emissions in the United States. We simply cannot reduce carbon emissions unless we reduce our use of coal or capture and sequester its emissions. An important benefit of the carbon tax is the inducement it provides for improvements in technology that allow for coal to be burned without releasing carbon. New technologies like integrated gasification combined cycle (IGCC), which are more efficient and can be combined with carbon sequestration (the removal of carbon for storage underground), provide a future for the coal industry. Making the transition to this future will be difficult until we price coal to reflect the damages resulting from carbon emissions.[18] **OUTSTANDING**

Another argument commonly made against a carbon tax is that—like other energy-related taxes—it is regressive. While the carbon tax in isolation may be regressive, a carbon tax reform need not be regressive.[19] when used in conjunction with a progressive income tax structure similar to that in place in the 1950s. As demonstrated below, the GETS reform is specifically designed to be distributionally neutral.

A third argument against a carbon tax is that it will put U.S. produced goods at a competitive disadvantage with other countries that do not price carbon. This is a concern for any policy that prices carbon, including cap-and-trade systems. A carbon tax would put the United States on an equal footing with members of the European Union, which have priced carbon with the EU Emissions Trading System since 2005. To date, there is **no evidence that carbon trading in Europe has hurt Europe's trade competitiveness.**

Evidence also suggests that concerns with carbon leakage—the shifting of production of carbon-intensive goods out of a country that prices carbon—**may be overblown**.[20]

Fourth, some have expressed concerns about revenue stability with a carbon burning fee ~~tax~~. Clearly, carbon emissions will fall in response to the Green Employment Initiative ~~Tax Swap~~ to finance a transition to sustainable / renewable energy. The initial carbon burning fee ~~tax rate~~ can be set based on the current free market "replacement / reparation" costs. In other words, the cost of replacing this extracted hydrocarbon (for the purpose of burning) with an equivalent amount of energy is the cost of harvesting an equivalent amount of energy from a renewable energy source. Ideally the replacement energy will be in a similar "storable/stable" form similar to that of the original hydrocarbon – not sure what that might be since hydrocarbons derived from biomass are the ideal method of storing energy / sequestering carbon.

To begin, we will use the cost of a residential solar PV system to reflect a sustainable method of harvesting current sunlight to replace this hydrocarbon energy. The rate at which the hydrocarbon is being consumed is a primary consideration because the sustainable source (i.e. wind or solar) is rate limited. Because in the Real World, we receive energy from the Sun at a well defined finite rate (albeit for millions of years into the future), humans may have to begin considering the pace / fury of their life styles – in other words, to live sustainably we may have to live a life style that consumes energy consistent with the rate we harvest energy - at least on an annual basis.

Correspondingly, the free market reparation cost would be the cost of capturing and sequestering the CO_2 as an integral part of the burning / thermal energy generation process.

As the competitive nature of the free market continues to drive down the costs or replacement/reparation, the carbon burning fee could be adjusted downward accordingly.

The astute reader who is always one step ahead of the author will be saying to herself, "But if the carbon burning fee includes the replacement cost based on actually sustainably generating an equivalent amount of renewable energy why wouldn't we just put the newly generated energy directly into the grid and bypass the whole hydrocarbon burning process?" We would then eliminate the entire CO_2 emission /re- sequestering / climate change / global warming contribution, etc.

The response of course is, EXACTLY.

When we create an economic system that is truthfully anchored in the Real World, as opposed to the human-created "real world" we can often eliminate a lot of our human-created problems.

The jobs associated with the vast hydrocarbon industry do not go away totally. But there will be less demand for hydrocarbons for burning – but that allows us to focus on uses of this valuable resource in ways in which the hydrocarbon can be essentially 100% recycled – or at least used in a way where there is zero discharge of CO_2 and other GHGs.

On the other side of the coin, we have mentioned that when humans are influenced to make choices to use energy derived from sustainable sources, this creates jobs in the so called Green sector – there will be more demand for systems that look to the Sun (and wind derived indirectly from the Sun), use geothermal energy, etc. This demand results in more Green jobs here in America.

Of course if the U.S. does not have any corporations left who wish to get in on Green technology and hire Americans, then indeed, the economic system is still broken and we need to delve deeper into why not? But that's another story. Sometimes we are so concerned about adjusting the economic system to influence individual behavior and forget it is also created to influence corporate behavior so corporations make choices that result in sustainable living.

….in anticipation of this emissions decline to ensure adequate revenues are collected.

The following portion of the original paper is interesting, but not germane to this reframing exercise - our goal is actually to put a system in place that reflects Real World costs and allows people to make choices that will be sustainable – if that means virtually eliminating the extraction of hydrocarbons for the purpose of burning, that's a good thing for the planet, even though it will result in the decrease of this revenue stream. The concern might be that initially there will be a demand for capital investment in carbon sequestering facilities that eventually (hopefully will be abandoned) because there is no longer any need when humans will stop burning. Of course if these facilities were still in place, the public might choose to continue to operate them – continue to sequester CO2 beyond the rate at which it is being introduced into the atmosphere in an effort to reverse the climate change initiated by earlier human behavior. Whereas it may take hundreds of years for nature to find a new equilibrium, humans could remediate their previous actions by continuing to operate these facilities for a few decades.

Revenue stability then depends on the fundamental volatility of tax collections. An analysis of historic carbon emissions and payroll tax collections indicates that the GETS reform will enhance revenue stability. One measure of revenue stability is the coefficient of variation (CV). Lower values of the CV indicate greater revenue stability.[21] The coefficient of variation for a carbon tax using historic emissions from 1959 through 2005 is 0.19, while the CV for real payroll tax collections

over that period is 0.56. This suggests that carbon tax collections should be even more predictable than payroll tax collections.[22]

Finally, some may argue that if the carbon tax is effective at reducing carbon emissions, tax collections will fall over time as new technologies come into play that allow for lower carbon emissions per dollar of GDP. This is undoubtedly true. The ability of firms to adjust production to reduce their demand for fossil fuels is greater in the long run than the short run. In fact this is the actual desired outcome indicating the updated economic system is influencing human behavior as it should – influencing us to make sustainable choices – this is a good thing.

But this should not deter policy makers from considering this policy because it brings the outdated economic system more in line with the Real World and better reflects the actual costs of burning hydrocarbons.

Taxing carbon to reflect its social marginal damage contributes to an improvement in economic efficiency, first by internalizing the carbon externality, and second by raising funds with which we can lower

the payroll tax. This tax cut contributes to greater economic efficiency by raising after-tax wages and thus the benefit to working. In the long run, we may raise less revenue per dollar of GDP than in the short run. This may require a modest upward adjustment to the payroll tax over time as the United States reduces its carbon emissions.[23] But even in the long run, payroll tax burdens will be lower than if we don't implement the GETS reform.

V. THE IMPACT ON HOUSEHOLD INCOME AND SPENDING

For a more detailed analysis of the impact on household income and spending of a Green Employment Tax Swap, we present results from an analysis using the 2003 Consumer Expenditure Survey. Table 5 provides estimates of price increases for selected commodities if a carbon tax were put in place in 2003 with a rate of $15 per ton of carbon dioxide.[24]

Table 5 Consumer Price Impacts of a Carbon Tax

Commodity	Price Increase (%)
Electricity and Natural Gas	14.1
Home Heating	10.9
Gasoline	8.8
Air Travel	2.2
Other Commodities	0.3 to 1.0

Source: Author's calculations using the Input/Output Accounts and the Consumer Expenditure Survey. A 2003 tax of $15 per metric ton of CO_2 (year 2005 dollars) is assumed to be passed fully forward to consumers.

Except for energy products, the $15 carbon tax has modest impacts on consumer prices. These budget impacts for the carbon tax assume no consumer behavioral response. This of course is not the case when a carbon burning fee is applied. We expect and intend to create a behavioral response toward sustainable living. Consumer substitution away from more carbon-intensive products will contribute to an erosion of the carbon burning fee ~~tax~~ base, as discussed above. The burden for consumers, however, will not be reduced as much as tax collections fall. Firms incur costs to shift away from carbon-intensive inputs. These costs will be passed forward to consumers. **Consumers also will engage in welfare-reducing activities as they shift their consumption activities to avoid paying the full carbon burning fee ~~tax~~ – exactly what is intended.** An economic system that influences humans to make choices that are sustainable. While the impacts reported here do not take account of the range of economic responses to the tax, the impacts provide a reasonable first approximation of the welfare impacts of a carbon tax.

The GETS reform uses the revenue from the carbon tax to reduce the payroll tax by funding a rebate to workers in each household equal to their first $560 in payroll taxes, including both the employer and employee contribution.[25] This is equivalent to exempting from payroll taxation the first $3,660 of wages per covered worker.

Table 6 details the distributional impact of this carbon tax swap for households sorted on the basis of annual household income as a measure of their economic well-being. Using an annual income measure to group households, the carbon tax in isolation is mildly regressive. The lowest half of the population faces tax increases ranging from 1.8 to 3.6 percent of their income, while the top half of the population faces tax increases between 0.8 and 1.5 percent of income.

Rebating the first $560 of employer and employee payroll taxes offsets this regressivity quite markedly. As a fraction of income, the average payroll tax reduction falls with income. The lowest income group receives a reduction worth 2.7 percent of income, and the highest income group a reduction worth 0.8 percent of income.

Table 6 Distributional Impacts of the Green Employment Tax Swap

Income Group (decile)	Change in Taxes ($)			Change in ATR (%)		
	Carbon Tax	Payroll Tax	Net	Carbon Tax	Payroll Tax	Net
1 (lowest)	289	-208	81	3.6	-2.7	0.9
2	421	-284	137	3.2	-2.1	1.1
3	487	-428	59	2.4	-2.2	0.3
4	545	-557	-12	2.0	-2.1	0.0
5	637	-669	-33	1.8	-1.9	-0.1
6	671	-804	-132	1.5	-1.8	-0.3
7	767	-918	-151	1.3	-1.6	-0.3
8	878	-978	-100	1.2	-1.4	-0.1
9	955	-1,035	-80	1.0	-1.1	-0.1
10 (highest)	1,257	-1,093	164	0.8	-0.8	0.0

Source: Author's calculations. The lowest decile includes households in the 5th to 10th percentiles. Mean tax changes within each decile are reported. Positive numbers indicate a tax increase and negative numbers a tax decrease. ATR refers to average tax rate.

The final column in Table 6 shows that the lowest 20 percent of the population would face modest net tax increases of just 1 percent of income, but that otherwise the tax reform is essentially distribution-ally neutral.[26]

Table 7 illustrates how the tax rebate is affected by changing the carbon tax rate. The rebate rises slightly faster than the tax rate, since rebated taxes can never exceed actual payroll taxes paid by employers and employees.

The environmental tax reform illustrated in Table 6 emphasizes an essential point: while a carbon tax may be regressive, a carbon tax reform can be designed to be distributionally neutral. The use of the carbon tax revenue to lower payroll taxes makes this distributional neutrality possible. If the revenue is not rebated or a cap-and-trade system is implemented with freely allocated permits—such that the market permit price equaled $15 per ton of CO_2—the reform would raise prices, as illustrated in the first column of Table 6, but would not allow the offsetting reduction in the payroll tax to achieve distributional neutrality.[27]

Table 7 Varying the Green Employment Tax Swap

Carbon Tax Rate ($/ton CO_2)	Rebated Taxes ($)	Income Threshold ($)
5	180	1,176
15	560	3,660
25	960	6,275

Source: Author's calculations. Rebated taxes include employer and employee taxes. Income threshold are the amount of wage income for which payroll taxes are rebated.

VI. CONCLUSION

Concerns about global warming have raised policy interest in the United States in some mechanism for discouraging carbon emissions. One such mechanism is a carbon tax. The GETS reform uses a carbon tax to rebate payroll taxes for the first $3,660 of earnings per worker. This reform is revenue and distributionally neutral and makes clear that while a carbon tax alone may be regressive, a carbon tax reform package can be designed to achieve any desired change in progressivity. While the focus here has been on distribution, carbon tax revenues provide flexibility in the policy process to help achieve any number of objectives. Fairness in taxation is one objective. But carbon tax revenues could also be used to contribute to simplification in the tax code or improved efficiency. A transparent linkage between a carbon tax and a thoughtful tax reduction could help build support for an environmental tax reform that brings the United States into closer alignment with other developed countries in their reliance on environmental taxation and in efforts to reduce global warming.

REFRAMED. Observations of our (American) current behavior indicate we are making choices that are unsustainable.

In general we Americans are living in a manner that is consistent with the behavioral influences provided by our legal / political/ economic/educational/ ethical/ spiritual system(s).

In general, we choose to be law abiding, exercise our right to vote for people to represent us in a republican form of democracy, participate in the free market and choose goods and serves that appear to be recommended by the economic system and are generally least expensive, attempt to navigate the formal educational system as we are able, follow the Golden Rule, and maintain a personal belief system often in-line with one of the world's religions – yet we are making choices under these diverse attempts to influence our behavior that are unsustainable – choices that put us on the path of self-destruction as well as the destruction of others.

Nevertheless, our choices are unsustainable.

One specific unsustainable behavior is, "burning non-renewable one-time-only hydrocarbon resources for our energy needs when there are alternative renewable sources of energy," and one specific influence is our "American economic system." This pair is singled out for closer evaluation.

Yes, we are growing more and more concerned about things we can see: weather extremes and rising sea levels. Despite the campaign of misinformation, many of us are concerned about the unseen such as global warming and climate change – phenomena being linked to another non-seeable thing called the Earth's heat balance that is being affected by this invisible stuff called greenhouse gases (GHG) such as carbon dioxide (CO_2) and methane (CH_4 - natural gas). Everyone knows from the natural gas industry ads on TV that natural gas (methane) is clean (even though it has a much worse GHG effect than CO_2) so let's pick on CO_2 as the bad guy – the same stuff that we exhale with every breath – the same stuff that every living being either takes in (plants) or expels (animals). Or not.

The current rate of anthropocentric CO_2 emission is certainly unsustainable, but it is merely a symptom of a more fundamental unsustainable human behavior – BURNING ANCIENT HYDROCARBONS. This human behavior must stop now if we care about leaving a habitable planet for our grandchildren generation and beyond. There are viable alternatives available today and even better alternatives tomorrow if we begin searching for them. Yet our American economic system still influences use to choose burning for our energy needs – because it's cheaper (thanks to the way the human-created economic system ignores Real World costs). A human-created economic system that advocates unsustainable behavior that is self-destructive is a system that is broken and needs to be updated – not thrown out but certainly modified. Is a carbon emission tax the update that is needed to fix the system? Possibly. Or is a Pigouvian "carbon burning fee" that attempts to introduce Real World externalities a more appropriate & comprehensive way to influence sustainable behavior?

The original author appropriately examines the "fairness" of whatever tax/fee is used to assure fairness. The only "reframing" suggestion that is herein introduced is to consider offsetting any unfairness with an adjustment to a progressive income / accumulated

wealth tax. The wealthy among us have taught us to believe that a marginal tax rate of 35% for them iis Metcalf goes on to The One such mechanism is a carbon tax. The GETS reform uses a carbon tax to rebate payroll taxes for the first $3,660 of earnings per worker. This reform is revenue and distributionally neutral and makes clear that while a carbon tax alone may be regressive, a carbon tax reform package can be designed to achieve any desired change in progressivity. While the focus here has been on distribution, carbon tax revenues provide flexibility in the policy process to help achieve any number of objectives. Fairness in taxation is one objective. But carbon tax revenues could also be used to contribute to simplification in the tax code or improved efficiency. A transparent linkage between a carbon tax and a thoughtful tax reduction could help build support for an environmental tax reform that brings the United States into closer alignment with other developed countries in their reliance on environmental taxation and in efforts to reduce global warming.

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For more information about this or other *Tax Reform, Energy and The Environment* policy briefs, please contact Craig Hanson at WRI or David Sandalow at The Brookings Institution.

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NOTES

1. See discussion and analysis in Felicity Barringer and Andrew C. Revkin, 2007. "The 110th Congress; Measures on Global Warming Move to Spotlight in the New Congress." *New York Times*, January 18, 2007.
2. The payroll tax is the federal employer and employee tax that partially funds the Social Security and Medicare programs.
3. See Gregory Mankiw, "Raise the Gas Tax", *Wall Street Journal*, October 20, 2006.
4. See Mankiw's blog at http://gregmankiw.blogspot.com/2006/10/pig-ou-club-manifesto.html for his *Wall Street Journal* column as well as links to other discussions of Pigouvian taxes.
5. See, for example, Intergovernmental Panel on Climate Change, 2001. *Climate Change 2001: Synthesis Report: Third Assessment Report of the Intergovernmental panel on Climate Change*. Cambridge: Cambridge University Press., Intergovernmental Panel on Climate Change, 2007. "Climate Change 2007: The Physical Science Basis." IPCC: Geneva., as well as previous IPCC reports from 1990 and 1995.
6. S. Amend. 866 to HR 6.
7. A transcript of this address is available at http://www.whitehouse.gov/news/releases/2007/01/20070123-2.html.
8. Tax data reported by the Tax Policy Center indicate that 70 percent of all households that pay either payroll or income taxes faced higher payroll taxes than income taxes in the year 2000. See http://www.taxpolicycenter.org/TaxFacts/TFDB/TFTemplate.cfm?Docid= 230&Topic2id=50.
9. A regressive tax is a tax whose burden falls disproportionately on lower income people. More precisely, the share of taxes in income falls as income

rises for a regressive tax. In contrast, the share of taxes in income for a progressive tax rises with income.

10. See Gilbert E. Metcalf, 2006. "Federal Tax Policy Toward Energy." NBER Working Paper No. 12568. Cambridge, MA: National Bureau of Economic Research, as well as Craig Hanson and David Sandalow, 2006. Greening the Tax Code. Washington, DC: Brookings Institution and World Resources Institute.
11. The United States had 1,415 functioning mines in 2005 (see Energy Information Administration. 2006. *Annual Coal Report 2005*. Washington, DC: Energy Information Administration.) The administration of the tax could be simplified by providing an exemption for small mines. As coal mining is relatively concentrated among large firms (340 mines accounted for 90 percent of coal production in 2005), a small mine exemption would mean that relatively few mines would be required to comply with the tax.
12. The carbon rate is set to be roughly consistent with the cost of a permit for carbon dioxide under the EU ETS trading system in 2006. It is also consistent with recent estimates of the optimal initial carbon tax from Nordhaus's RICE-2001 model. See William D. Nordhaus, 2005. "Life after Kyoto: Alternative Approaches to Global Warming Policies." NBER Working Paper No 11889. Cambridge, MA: National Bureau of Economic Research. A $15 / metric tonne of CO_2 is about 10% of the real cost to re-sequester the CO_2 Suspect the economic "models" do not work if the levy was $150 / metric tonne for a pulverized coal burning electric power generation plant. Obviously the convenient assumption "assuming no behavioral change" would not be valid as the utility company passed this cost on to the consumer. Economists will of course argue that such an "excessive" carbon burning fee, one that actually represented the Real World cost of remediation of the atmosphere would be unacceptable to the public – so it is better to pretend and live in the "real world" created by humans and ponder why the seal level is rising along with the average temperature of the planet. And don't forget to add in the "replacement cost" to harvest equivalent amount energy from renewable energy sources. That should bring us to about $200 /metric tonne of CO_2.
13. See Energy Information Administration, 2006. "Emissions of Greenhouse Gases in the United States 2005." U.S. Department of Energy: Washington, DC.
14. Output responses are based on elasticities implied from Table 2.2 from A. Lans Bovenberg and Lawrence Goulder. 2000. "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?" In Carlo Carraro and Gilbert E. Metcalf, eds. *Distributional and Behavioral Effects of Environmental Policy*. Chicago: University of Chicago Press. They phase in a carbon tax over a three-year period. The output responses are reported for the third year of the tax.
15. This is a comprehensive measure including OASDI, HI, and railroad retirement funds.
16. A reduction in the payroll tax rate could induce additional labor supply, especially among second earners in households, and an increase in payroll tax receipts. Thus payroll tax rates could potentially be lowered further than modeled in this policy brief.
17. See Gilbert E. Metcalf, "Tax Reform and Environmental Taxation." NBER Working Paper No. 11665. Cambridge, MA: National Bureau of Economic Research. 2005.
18. For new coal-fired power plant construction, a CO_2 tax of about $30 per metric ton would make carbon capture and sequestration (CCS) cost competitive with conventional coal power. See the recently released James Katzer *et. al,* 2007. "The Future of Coal: Options for a Carbon-Constrained World." Massachusetts Institute of Technology on this point as well as for a discussion of policy recommendations to facilitate the development and implementation of CCS technology on a large scale.
19. The distinction between environmental taxes and environmental tax reforms is elaborated in Gilbert E. Mecalf, 1999. "A Distributional Analysis of Green Tax Reforms." *National Tax Journal* 52 (4): 655–81.
20. See, for example, Matthew E. Kahn, 2003. "The Geography of U.S Pollution Intensive Trade: Evidence from 1958-1994." *Regional Science and Urban Economics 33(4): 383-400*.
21. The coefficient of variation is defined as the ratio of the standard deviation divided by the mean of a variable. The chance that a normally distributed random variable will be further than ± *v* times the mean of the random variable is roughly one-third, where *v* is the CV. Thus if the CV equals 0.2, the random variable will be within 20 percent of its mean value approximately two-thirds of the time.
22. An alternative measure of revenue stability is the conditional standard deviation of the percentage change in tax revenue after controlling for trend growth. Again, lower values indicate greater revenue stability. The conditional standard deviation for the carbon tax is 0.029 while the measure for the payroll tax is 0.042. Because payroll tax rates grew between 1959 and 2005, these statistics are also reported for the period 1988–2005, a period during which little change in payroll tax rates occurred. The carbon tax continues to be less volatile than the payroll tax.
23. A revenue target in the carbon tax for payroll tax relief could be set and taxes adjusted to ensure the given funds for payroll relief will be available. Congress might, for example, adjust carbon tax rates up as carbon emissions decline to maintain revenue neutrality. Alternatively, policy makers might adjust the payroll tax exemption down as carbon tax revenues fall. Finally, Congress could make the tax reform revenue-neutral over a given time period, say five or ten years, taking into account anticipated emission reductions in response to the

carbon tax. Congress would initially set the carbon tax rate and payroll tax exemption so that the carbon tax revenues exceed the payroll tax reduction, thereby building up a surplus for the latter part of the period when carbon revenues fell short of the payroll tax reduction. At the end of that period, policy makers could reset the exemption and carbon tax rates for a subsequent period of time.

24. The methodology for computing price increases is detailed in Metcalf 1999.

1 The payroll tax reduction is assumed to be fully shifted to the worker. This is a common assumption among labor economists. See Victor R. Fuchs, Alan B. Krueger, and James M. Poterba, 1998. "Economists' Views about Parameters, Values, and Policies: Survey Results in Labor and Public Economics." *Journal of Economic Literature* 36 (3):1387–1425.

2 Further refinements could reduce the net tax burden in the lowest two deciles. But the example illustrates the point that a distribution-ally neutral reform is possible.

3 The converse is also true. Permits in a cap-and-trade system could be auctioned and the revenue used for the payroll tax reduction described in this brief, thereby providing the same distributional outcome as under the GETS reform.

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Other FAQs about Coal [Ref: EIA.org]

- Does EIA have county-level energy production data?
- From what country does the U.S. import the most coal?
- How do I convert between short tons and metric tons?
- How large are U.S. coal reserves?
  Ans: **estimated recoverable reserves = 258,619 million short tons**

  There are three separate components for U.S. coal reserves.
  Recoverable reserves
  Demonstrated reserve base
  Estimated recoverable reserves
  In 2011, the recoverable reserves at producing (active) mines totaled 19,223 million short tons.
  Recoverable reserves at producing mines represent the quantity of coal that can be recovered (i.e. mined) from existing coal reserves at reporting mines. These reserves essentially reflect the working inventory at producing mines.
  For 2011, the demonstrated reserve base was estimated to contain 482,898 million short tons.
  Demonstrated reserve base is composed of coal resources that have been identified to specified levels of accuracy and may support economic mining under current technologies. It includes publicly-available data on coal that has been mapped and verified to be technologically minable.
  In 2011, the estimated recoverable reserves totaled 258,619 million short tons. *Estimated recoverable reserves* is coal in the demonstrated reserve base considered recoverable after excluding coal estimated to be unavailable due to land use restrictions or currently economically unattractive for mining, and after applying assumed mining recovery rates.
  Learn more:
  Recoverable coal reserves at producing mines, estimated recoverable reserves, and demonstrated reserves by mining method (Coal Annual)
  Demonstrated coal reserve base by region and state
  Last updated: November 15, 2012

- How many and what kind of power plants are there in the United States?
  There are about 18,000 individual generators at about 5,800 operational power plants in the United States with a nameplate generation capacity of at least one MegaWatt. A power plant can have one or more generators, and some generators may use more than one type of fuel.

  Learn More:
  Electric Power Annual 2010, Table 1.2: Capacity by Energy Source and Table 5.1: Count of Electric Power Industry Power Plants, by Sector, by Predominant Energy Sources within Plant. (Some plants are double-counted by fuel type in Table 5.1.)
  Downloadable databases with detailed data on individual generators and power plants.
  Last updated: December 21, 2011

- How much coal, natural gas, or petroleum is used to generate a kilowatt-hour of electricity?
  The amount of fuel used to generate electricity depends on the efficiency or heat rate of the generator (or power plant) and the heat content of the fuel. Power plant efficiencies (heat rates) vary by types of generators, power plant emission controls, and other factors. Fuel heat contents also vary.

  Two formulas for calculating the amount of fuel used to generate a unit of electricity:
  - Amount of fuel used per kilowatt-hour (kWh) = Heat Rate (in Btu per kWh) / Fuel Heat Content (in Btu per physical unit)

- KWh generated per unit of fuel used = Fuel Heat Content (in Btu per physical unit) / Heat Rate (in Btu per kWh)

Calculation examples using these two formulas and the Assumptions below:

- Amount of fuel used to generate one kilowatt-hour (kWh):
  - Coal = 0.00052 Short Tons or 1.03 Pounds
  - Natural Gas = 0.01003 Mcf (1,000 cubic feet)
  - Residual Fuel Oil = 0.0016 Barrels
- KWh generated per unit of fuel used:
  - 1,942 kWh per Ton of Coal or 0.97 kWh per Pound of Coal
  - 100 kWh per Mcf (1,000 cubic feet) of Natural Gas
  - 610 kWh per Barrel of Residual Fuel Oil, or 14.5 kWh per Gallon

Assumptions:

Power plant heat rate = 10,300 Btu/kWh

Fuel heat contents

- Coal = 20,000,000 Btu per Short Ton (2,000 lbs) Note: heat contents of coal vary widely by types of coal.
- Natural Gas = 1,027,000 Btu per 1,000 Cubic Feet (Mcf)
- Residual Fuel Oil = 6,287,000 Btu per Barrel (42 gallons)

Last updated: July 16, 2012

- To what country does the U.S. export the most coal?
- What are the different types of coal prices published by EIA?
- What is the average heat (Btu) content of U.S. coal?
  In 2011, the average heat content or British thermal unit (Btu) value of U.S. coal consumed in the United States was 19.583 million Btu per short ton.
- What types and amounts of energy are produced in each state?
- Where can I find coking coal prices?
- Which states produce the most coal?

APPENDIX CO_2 Emissions [Ref: eia.org]

- How much carbon dioxide (CO_2) is produced per kilowatt-hour when **generating** electricity with fossil fuels?
  You can calculate the amount of CO_2 produced per kWh for specific fuels and specific types of generators by multiplying the CO_2 emissions factor for the fuel (in pounds of CO_2 per million Btu) by the heat rate of a generator (in millions of Btu per kWh generated).

  For example, here are the number of pounds of CO_2 produced by a steam-electric generator for different fuels using that formula and the average heat rates for steam-electric generators in 2010:

Fuel	Lbs of CO_2/Million Btu	Heat Rate (10^6 Btu/kWh)	Lbs CO_2/kWh
Coal			
Bituminous	205.573	0.010142	2.02
Sub-bituminous	212.700	0.010142	2.10
Lignite	215.400	0.010142	2.12
Natural gas	117.080	0.010416	1.12
Distillate Oil (No. 2)	161.386	0.010249	1.57
Residual Oil (No. 6)	173.906	0.010249	1.70

Last updated: February 22, 2012

- How much carbon dioxide (CO_2) is produced when different fuels are burned?

Different fuels emit different amounts of carbon dioxide in relation to the energy they produce. To compare emissions across fuels you must compare the amount of CO_2 emitted per unit of energy output or heat content.

	Unit of Fuel	Pounds of CO_2 emitted per million Btu	BTU / Unit of Fuel	CO_2 (metric tonnes) /Unit of Fuel
Coal (anthracite)	Short ton (2000 lbs)	227	20,000,000	2.06 (short ton) 2.26 (metric tonne)
Coal (bituminous)	Short ton	205		
Coal (lignite)	Short ton	215		
Coal (subbituminous)	Short ton	213		
Diesel fuel & heating oil	Bbl (42 gal)	161 22.4 lbs/gal	6,287,000	.46
Gasoline	gal	156 19.6 lbs /gal		
Propane		139		
Natural gas	mcf	117	1,027,000	.0546

Pounds of CO_2 emitted per million Btu of energy for various fuels:

- Coal = 20,000,000 Btu per Short Ton (2,000 lbs) Note: heat contents of coal vary widely by types of coal.
- Natural Gas = 1,027,000 Btu per 1,000 Cubic Feet (Mcf)
- Residual Fuel Oil = 6,287,000 Btu per Barrel (42 gallons)

The amount of CO_2 produced when a fuel is burned is a function of the carbon content of the fuel. The heat content or amount of energy produced when a fuel is burned is a function of primarily the carbon (C) and hydrogen (H) content of the fuel. Heat is produced when C and H combine with oxygen (O) during combustion. Because natural gas is primarily methane, or CH_4, it has a relatively high energy content relative to other fuels, and thus a relatively low CO_2 to energy content. Water and various elements such as sulfur and non-combustible elements in some fuels reduce their heating values and increase their CO_2 to heat contents.

- **How much carbon dioxide is produced by burning gasoline and diesel fuel?**

About 19.64 pounds of carbon dioxide (CO_2) are produced from burning a gallon of gasoline that does not contain ethanol. Most of the retail gasoline now sold in the U.S. contains about 10% ethanol by volume. Under international agreement, CO_2 from ethanol and other biofuels are not counted at the tailpipe, so burning a gallon of gasoline with 10% ethanol produces about 17.68 pounds of CO_2.

About 22.38 pounds of CO_2 are produced by burning a gallon of diesel fuel. It is possible to buy biodiesel fuel in some states. Burning a gallon of "B10" (diesel fuel containing 10% biodiesel by volume) results in emission of about 20 pounds of CO_2.

EIA estimates[1] that U.S. gasoline and diesel fuel consumption for transportation in 2011 resulted in the emission of about 1,089 and 430 million metric tons of CO_2 respectively, for a total of 1,519 million metric tons of CO_2. This total was equivalent to 82% of total CO_2 emissions by the U.S. transportation sector and 28% of total U.S. energy-related CO_2 emissions.

[1] As of March 28, 2012.

- How much of U.S. carbon dioxide emissions are associated with electricity generation?
- What are greenhouse gases and how do they affect the climate?
- What are the energy-related carbon dioxide (CO2) emissions by source and sector for the United States?

Energy-related CO_2 emissions by source and sector for the United States, 2011[1]

Sources	(Million Metric Tons)					
	Sectors					
	Residential	Commercial	Industrial	Transportation	Electric Power	**Source Total**
Coal	1	5	151	0	1,718	1,874
Natural Gas	256	171	419	39	411	1,296
Petroleum	78	49	345	1,802	25	2,299
Other[2]					11	11
Electricity[3]	827	767	567	4		
Sector Total	**1,162**	**992**	**1,482**	**1,845**	**2,166**	**5,481**

Total energy-related CO_2 emissions equal 5,481 million metric tons.

[1]Preliminary data for 2011.
[2]Miscellaneous wastes and from geothermal power generation.
[3]Electricity-related CO_2 emissions based on electricity use for each sector and associated electric power plant emissions.

- What are the sources of energy-related carbon dioxide emissions by type of fuel for the U.S. and the world?

The energy-related carbon dioxide emissions by type of fossil fuel and the amount in million metric tons, and by percent share in 2010:

	United States		World	
	Amount of CO_2 million metric tons	Share of Total	Amount of CO_2 million metric tons	Share of Total
Total from Fossil Fuels	5,610		31,780	
Coal	1,985	36%	14,231	42%
Natural Gas[1]	1,274	22%	6,374	22%
Petroleum	2,351	42%	11,175	37%

[1]Includes combustion and flaring of natural gas.

- Where can I find emission factors for greenhouse gases and air pollutants?

EIA publishes emission factors (or coefficients) for three major greenhouse gases: Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N20), and for the criteria air pollutants; Sulfur Dioxide (SO_2) and Nitrogen

Oxides (NO_x), which are released when fuels are burned and when electricity is generated and used as follows:

For combustion of fossil fuels:
CO_2 for common fuels
CO_2 for fuels used for electricity generation (PDF) (XLS)
For electricity — as generated:
CO_2, SO_2, and NO_x for electricity generated in each state for a specific year, in pounds per megawatthour, in Table 1 of State Electricity Profiles and averages for the United States.
CO_2, CH_4, and N_20 for electricity generated in each state and U.S. Census Region.
For electricity — as consumed:
CO_2 , CH_4, and N_20 for electricity consumed in U.S. electricity market regions and in other countries. These factors were used by participants in EIA's Voluntary Reporting of Greenhouse Gas Emissions program.

A source of emission factors for other substances and fuels is the U.S. Environmental Protection Agency.
Last updated: May 16, 2012

- Why do carbon dioxide emissions weigh more than the original fuel?

During complete combustion, each carbon atom in the fuel combines with two oxygen atoms in the air to make carbon dioxide. The addition of two oxygen atoms to each carbon atom forms carbon dioxide, which has an atomic weight of 44 — roughly 3.6667 times the atomic weight of the carbon (12).

For example, subbituminous coal is on average 51% carbon, so the carbon in a short ton (2,000 pounds) weighs 1,020 pounds. The carbon dioxide emissions from burning a short ton of subbituminous coal are approximately 3,740 pounds, or about 3.67 times the weight of the carbon in a short ton of coal, and 1.87 times the weight of a short ton of coal.
The periodic table of elements shows the atomic weights of all elements.

A Distributional Analysis of Green Tax Reforms [Much yet to be REFRAMED]

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Abstract - *I measure the distributional impact of a shift toward greater reliance on environmental taxes (a green tax reform) using both annual and lifetime income measures to rank households. An environmental tax reform can be designed that has a negligible impact on the income distribution when the funds are rebated to households through reductions in the payroll tax and personal income tax* ***rather than using the revenue to "replace and remediate"****. I also analyze trade-offs among competing goals of efficiency, equity, and ease of administration in the design of a green tax reform.*

INTRODUCTION

Should we raise environmental taxes?

This question has been asked increasingly in the face of widespread environmental problems, including global warming, air and water pollution, and a host of other environmental problems that we face today.

Let's make the question bigger.

Should we humans create an economic system that influences our choices to live sustainably within the interdependent web of life on a finite planet with finite resources?

Or should we continue to use the broken, obsolete, and purposely-designed-to-benefit-the-wealthy economic system we have today in the U.S. so Americans can continue to make choices that take us down the path of self-destruction as a nation, as a species, as a living planet?

Let's ask a more fundamental question.

Do we humans have a desire to continue to live on planet Earth into the foreseeable future? Beyond two to three more generations? Because at the rate we are currently consuming finite resources (hydrocarbons we are extracting and burning; precious minerals we are mining, using and then losing in a land fill, etc.) and altering Earth's life support systems (e.g. heat balance, oceanic conveyors, the interdependent food/energy chain, fresh water supply both above ground and in ancient underground aquifers by fracking, etc.), Life will start de-volving within the next 2-3 generations when the hydrocarbons are sucked dry; the precious minerals are gone; the climate has been altered causing thousands of species to lost their unique niches and become extinct; when our fresh water supply has been irreparably compromised by toxic human created chemicals.

From what we understand about the natural processes of the Universe, the Sun has enough fuel for several more billion years. The Earth should be habitable for life as we know it for at least another 500 million years. So our human longevity into the foreseeable future is dependent upon the choices we are making today – the lives of future generation (our grandchildren and beyond) is in our hands today. Our health and longevity depends on how we choose to live on a finite planet with finite resources.

Currently, we homo sapiens live (make choices) as if there are infinite resources to be consumed.
Currently, we humans live as if our choices, our actions, our behaviors have no effect or consequence on other humans or on other life on the planet.
Currently, we humans live as if we are totally independent from all other life on the planet, that we are self sufficient, and need not consider the health and well being of non-human life.

In fact, all resources are finite; human choices do affect all life on the planet, and we are totally dependent on the health and well being of non-human life for our own and our children's life.

In fact, how we 7 billion humans (and specifically us 0.3 billion Americans) make choices and live our lives does have an effect on all Life. There is no question, the choices Americans are making today are unsustainable and a threat to much of life on the planet – including our very own.

If one is concerned exclusively with efficiency, the answer to this (first) question would be yes, we certainly should raise taxes to the point where the tax equals the marginal social damage from pollution.

If one is concerned about the well being of human and non-human life on the planet, and the functioning of the life support systems of the planet itself (e.g. heat balance, ocean conveyors, weather / climate, clean air/ water/soil; …), we certainly should have economic/political/ethical/spiritual systems that influence us humans (with all our wonderful individual freedoms and free will) to make responsible choices that result in sustainable living. In other words, we must have an economic system that is anchored in the Real World - not one that externalizes costs so that we can show a "profit" but end up making choices that are suicidal – as we are now doing. An economic system that tells the market to buy a product (because it is the cheapest) made in China where there are no environmental "incentives or constraints" to protect the health and well being of human and non-human life, is a system that is broken and must be throw out as soon as possible before we humans have totally destroyed our planet. Whether we update the basic framework of our antiquated economic system or try to "fix" it (e.g. with another tax bandage that will be legislatively removed when we turn our back) is up to us.

Unfortunately, the "real world" is more complicated than a "textbook world."

Unfortunately, the "Real World" is even more important than the human created "real world." But let's continue to discuss the human created "real world" of economics – the anthropocentric world with infinite resources and no human responsibility beyond making a profit.

How do we measure marginal social damages (when we only consider certain people within our own society and marginalize all other people on the planet, when we marginalize all other non-human life on the planet as well as Earth's life support systems)?

Concerns about economic efficiency intrude given the widespread prevalence of other taxes.
Finally, distributional concerns come into play.

Environmental taxes (often considered Pigouvian taxes that are meant to acknowledge and consider an externality (an ignored cost so the product/service appears to show a profit) tend to be regressive: poor people pay a disproportionate share of their income in these taxes relative to rich people.

It's a bitch living in the Real World where Real Costs cannot be ignored.

As far as taxes are concerned, history records that after several hundred years of mucking around, the ancient Greeks threw out their flat tax, seeing it was just perpetrating unsustainable separation of wealth and adopted a progressive tax (similar to what Americans used in the 1950s) where people "paid as they were able." Such a system acknowledges that hoarding (money, power, property, etc.) is a mental illness and has no redeeming social value because hoarding takes resources out of the system where they are no available to others. But as the saying goes, those who cannot learn from history are doomed to repeat it. If the Real World economics results in a "regressive" burden on the low income people, then a progressive income / wealth tax is appropriate to level the playing field. In other words, hoarding is not worshiped or even admired and the economic system reflects those historically established and verified values.

Whether or not our political system we have today is able to accommodate a Real World requirement to reflect the actual cost of burning hydrocarbons is a totally different issue. Because the current political system is also broken. We the People do get to elect our representatives in this republican form of government, but We the People have little to say on how these elected representative actually vote. How they vote is determined by how many people flood their offices, and covertly offer their financial support for re-election or overtly threaten to oppose their re-election with millions of dollars of negative campaigning, but that's another story.

First the economic system must be re-examined and updated to eliminate all externalities (all conveniently ignored costs). To live sustainably, human need to be given the Real picture – not one intended to benefit a particular industry or corporation or a few individuals. A Pigouvian tax cannot be viewed as opposition to individuals and corporation seeking a profit. Identifying ignored costs and no longer externalizing these costs allows the free market to make choices on a level playing field so that producers of sustainable products will profit AND the whole planet profits as well. Assigning a "cost" to "social damages" is not as hard as it may seem if we make the problem bigger as Eisenhower suggests.

Life requires the flow of energy. Power. The primary source of sustainable energy for life on Earth is the Sun. Life has evolved – successful species have learned to harvest their own supply of energy from the Sun (directly or indirectly) A planet that increases its store of energy is growing in wealth. Right now, humans are consuming the stores of energy, withdrawing from the earth's resource bank AND there is no thought of ever paying back/depositing into these accounts – what's wrong with picture? I have lived my entire life withdrawing energy for my life style. At age 69, I began to live more sustainably and harvest the Sun's energy at a rate commensurate of my chosen life style. If I am able to get permission from our utility company to add 14 more solar panels to my roof (making a total of 38), I will be at a point where I am harvesting as much energy as I and my partner are consuming – but can I ever pay back all the energy I consumed prior to this? Probably not. But I am considering it and have a conceptual plan.

This paper addresses how one could design an environmental tax reform such that it reduces or even eliminates the regressive nature of environmental taxes. It considers reforms that combine environmental taxes with reductions in other taxes such that the increased regressivity of the environmental taxes is offset by increased progressivity resulting from reductions in other taxes. Good idea. Would also like to see a simple progressive income / wealth tax design that also serves to eliminate the regressive nature of the Real Cost of no longer ignoring the replacement / reparation costs of burning hydrocarbons.

I also analyze trade-offs among competing goals of efficiency, equity, and ease of administration in the design of a green tax reform.

The next section provides some background on the issue of environmental (or green) tax reforms. Next, I describe how I measure the distributional impact of tax reforms and describe the data. The fourth section provides results from the analysis and a concluding section follows.

BACKGROUND ON GREEN TAX REFORMS

There has been a great deal of interest in recent years in the use of environmental tax revenues to substitute for some portion of existing tax collections.

The issue of a substitution of environmental for other taxes can be traced back to Tullock (1967) and more recently Terkla (1984). This early literature focused on the efficiency implications of an environmental reform and led to a debate over what has been dubbed the "Double Dividend Hypothesis."[1]
One strand of this literature (as typified by Terkla) considers a reform in which environmental regulations are replaced with tax instruments in such a fashion that pollution activities are unaffected. But the switch from a regulatory to a taxation mechanism for limiting pollution raises revenue that can be used to lower other distorting taxes. This shift has unambiguous welfare gains.

Another strand of the literature (typified by Pearce (1991) and Repetto et al. (1992)) focuses on the use of environmental taxes both to reduce pollution and to raise revenue to lower other taxes. While it is clear (see Bovenberg and deMooij (1994) as well as Parry (1995)) that there are also efficiency costs with environmental taxes (separate from the environmental benefits), it is also clear that the efficiency costs depend importantly on which taxes are reduced. Clearly, the benefits of the new revenues are greatest when used to lower the most distorting taxes. The debate over a green tax shift and the Double Dividend Hypothesis has focused on efficiency considerations.

In addition, distributional considerations are clearly important and little work has been done in this area. These concerns are relevant given the sense that most energy and environmental taxes are regressive. While some authors have challenged this perception by taking into account lifetime considerations (e.g., Poterba, 1991a; Bull, Hassett, and Metcalf, 1994), it is clear that distributional concerns limit political support for the greater use of environmental taxes.

Previous discussion of the distributional problem suffers by looking at the environmental taxes in isolation—that is, with lump-sum recycling of the tax revenues. While it might be the case that the imposition of an environmental tax by itself is regressive, it is quite possible that a revenue neutral tax reform, where an environmental tax replaces some other tax, could be progressive.[2] A recent study by Hamond et al. (1997) emphasizes this point. Below, I will consider reforms (based on suggestions in Hamond et al.) that are designed to maintain or perhaps increase the progressivity of the tax system. I will also consider other reforms to emphasize the trade-offs among equity, efficiency, and ease of administration.