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7 MYTHS ABOUT GREEN JOBS

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7 Myths About Green Jobs

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Abstract

A group of studies, rapidly gaining popularity, promise that a massive program of government mandates, subsidies, and forced technological interventions will reward the nation with an economy brimming with “green jobs.” Not only will these jobs allegedly improve the environment, but they will pay well, be very interesting, and foster unionization. These claims are built on 7 myths about economics, forecasting, and technology. Our team of researchers from universities across the nation surveyed this green jobs literature, analyzed its assumptions, and found that the special interest groups promoting the idea of green jobs have embedded dubious assumptions and techniques within their analyses. We found that the prescribed undertaking would lead to restructuring and possibly impoverishing our society. Therefore, our citizens deserve careful analysis and informed public debate about these assumptions and resulting recommendations before our nation can move forward towards a more eco-friendly nation. To do so, we need to expose these myths so that we can see the facts more clearly.

The Myths And The Facts

Myth 1: Everyone understands what a “green job” is.

Fact 1: No standard definition of a “green job” exists.

According to the studies most commonly quoted, green jobs pay well, are interesting to do, produce products that environmental groups prefer, and do so in a unionized workplace. Such criteria have little to do with the environmental impacts of the jobs. To build a political coalition, “green jobs” have become a mechanism to deliver something for members of many special interests in order to buy their support for a radical transformation of society. Committing hundreds of billions of dollars to promoting something lacking a transparent definition cannot be justified.

Myth 2: Creating green jobs will boost productive employment.

Fact 2: Green jobs estimates in these oft-quoted studies include huge numbers of clerical, bureaucratic, and administrative positions that do not produce goods and services for consumption.

These green jobs studies mistake any position receiving a paycheck for a position creating value. Simply hiring people to write and enforce regulations, fill-out forms, and process paperwork is not a recipe for creating wealth. Much of the promised boost in green employment turns out to be in non-productive - and expensive - positions that raise costs for consumers. These higher paying jobs that fail to create a more eco-friendly society dramatically skew the results in both number of green jobs created and salary levels of those jobs.

Myth 3: Green jobs forecasts are reliable.

Fact 3: The green jobs studies made estimates using poor economic models based on dubious assumptions.

The forecasts for green employment in these studies optimistically predict an employment boom that will take us to prosperity in a new green world. The forecasts, which are sometimes amazingly detailed, are unreliable because they are based on:

- a) Questionable estimates by interest groups of tiny base numbers in employment,
- b) Extrapolation of growth rates from those small base numbers, that does not take into consideration that growth rates eventually slow, plateau and even decline, and
- c) A biased and highly selective optimism about which technologies will improve.

Moreover, the estimates use a technique (input-output analysis) that is inappropriate to the conditions of technological change presumed by the green jobs literature itself. This yields seemingly precise estimates that give the illusion of scientific reliability to numbers that are actually based on faulty assumptions.

Myth 4: Green jobs promote employment growth.

Fact 4: By promoting more jobs instead of more productivity, the green jobs described in the literature actually encourage low-paying jobs in less desirable conditions. Economic growth cannot be ordered by Congress or by the United Nations (UN). Government interference in the economy – such as restricting successful technologies in favor of speculative technologies favored by special interests – will generate stagnation.

Green jobs estimates promise greatly expanded (and pleasant and well-paid) employment. This promise is false. The green jobs model is built on promoting inefficient use of labor. The studies favor technologies that employ large numbers of people rather than those technologies that use labor efficiently. In a competitive market, the factors of production, including labor, are paid for their productivity. By focusing on low productivity jobs, the green jobs literature dooms employees to low wages in a shrinking economy. The studies also generally ignore the millions of jobs that will be destroyed by the restrictions imposed by governments on disfavored products and technologies.

Myth 5: The world economy can be remade by reducing trade and relying on local production and reduced consumption without dramatically decreasing our standard of living.

Fact 5: History shows that individual nations cannot produce everything its citizens need or desire. People and countries have talents that allow specialization in products and services that make them ever more efficient, lower-cost producers, thereby enriching all people .

The green jobs literature rejects the benefits of trade, ignores opportunity costs, specialization, and fails to include consumer surplus in its welfare calculations. This is a recipe for an economic disaster. Even favored green technology, such as wind turbines, requires great expertise largely provided by foreigners. The twentieth century saw many experiments in creating societies that

did not engage in trade and did not value personal welfare. The economic and human disasters that resulted should have conclusively settled the question of whether nations can withdraw inside its borders.

Myth 6: Government mandates are a substitute for free markets.

Fact 6: Companies react more swiftly and efficiently to the demands of their customers/markets, than to cumbersome government mandates.

Green jobs supporters want to reorder society by mandating preferred technologies and expenditures through government entities. But the responses to government mandates are not the same as the responses to market incentives. We have powerful evidence that market incentives prompt the same resource conservation that green jobs advocates purport to desire. For example, the rising cost of energy is a major incentive to redesign production processes and products to use less energy. People do not want energy; they want the benefits of energy. Those who can deliver more desired goods and services by reducing the energy – and thus the cost of production – will be rewarded. On the other hand, we have no evidence to support the idea that command-and-control regimes accomplish conservation.

Myth 7: Wishing for technological progress is sufficient.

Fact 7: Some technologies preferred by the green jobs studies are not capable of efficiently reaching the scale necessary to meet today's demands.

The green jobs literature's preferred technologies face significant problems in scaling up to the levels they propose. These problems are well documented in readily available technical literature, yet are resolutely ignored in the green jobs reports. At the same time, existing viable technologies that fail to meet the green jobs supporters' political criteria are simply rejected out of hand. This selective technological optimism/pessimism is not a sufficient basis for remaking society to fit the dream of planners, politicians, or special interests who think they know best, despite empirical evidence to the contrary.

Exposing the Myths

An aggressive push for a green economy is underway in the United States. Policymakers now routinely assert that “green jobs” can improve environmental quality and reduce unemployment. A recent report from the U.S. Conference of Mayors, *Current and Potential Green Jobs in the U.S. Economy*, contends that investing in green jobs would produce a remarkable range of benefits from technological innovation to increased income. It also claims that these jobs would yield lower energy costs for business and individuals while improving environmental quality.²

Advocates of green jobs see no downside to their preferred policies, which will require hundreds of billions of public and private dollars to implement. As the solar-power industry trade association proclaims: “It is all good news.”³ The Mayors estimated that green jobs can provide “up to 10% of new job growth over the next 30 years”⁴ and others are similarly optimistic.⁵ A think tank with close ties to the Obama and Clinton Administrations asserts that “a green

economic recovery program ... could create about 2 million new jobs within the U.S. economy over two years.”⁶ The hype is bipartisan, with Republicans just as enthusiastic.⁷

Governments, non-governmental organizations (NGOs), and the U.N.⁸ seek to promote the creation of green jobs. Given the claims that every dollar spent on a host of green job programs will be repaid many times over, it is hard to see how creating green jobs or “greening” existing jobs could be seen as anything other than a fantastic opportunity. However, when examined closely the green jobs literature is rife with internal contradictions, vague terminology, dubious science, and a disregard of basic economic principles.

This paper examines green jobs claims by providing examples from four green jobs reports that are most often cited in the media and in public policy debates. They represent a range of special interest groups: 1) U.S. Conference of Mayors (Mayors), representing domestic politicians; 2) American Solar Energy Society (ASES), representing “green” industry interests; 3) Center for American Progress (CAP), representing left-wing think tanks tied to political interests; and 4) United Nations Environmental Programme (UNEP), representing international organizations hostile to open or free markets. We assess the green jobs literature by focusing on recent major reports from each these groups, which purport to demonstrate both the need for, and benefits of, green jobs. These reports are the most serious efforts to document claimed benefits. By focusing on them we are taking on the strongest cases made to date for green jobs spending.

Our analysis has three major parts. First, we examine the attempts to define when a job qualifies as “green.” Second, we analyze how the green jobs literature treats key economic concepts. Third, we provide an assessment of the assumptions and methods in the reports. Our analysis reveals that the reports’ conclusions are unacceptable due to (a) a lack of standard definitions of “green jobs,” (b) fundamental economic errors, and (c) poor assumptions combined to produce flawed methodology and thus flawed assessments. We conclude by suggesting that deep skepticism is the most appropriate response to the hyperbolic claims of the green jobs literature, and recommend continuing the debate with the facts – not the myths.

I. Defining “green” jobs

Four key definitional issues concerning green jobs must be addressed to understand the claims made by supporters. First, studies differ on what constitutes a green job with both existing jobs and jobs that might be created by new environmental initiatives. Green job estimates depend on definitions of “green” which differ from study to study. These differences render comparisons among green jobs claims fruitless and make it difficult to conduct a policy debate. More importantly, the varying definitions incorporate important, but often unstated, assumptions about environmental policy, economics, and quality of life. These differences could potentially produce counterproductive environmental policies that lead to a worsening environment, interfere with economic efficiency, and reduce the quality of life for many Americans.

Second, forecasts of potential growth in green jobs rely on extrapolating from recent growth rates in the numbers of existing green jobs. As a result of low base numbers, green jobs forecasts are likely to be over-optimistic about the potential for employment, no matter how they are defined. These calculations are largely based on surveys by interest groups and conjecture rather than on hard numbers from neutral sources. Policy debates over green job measures cannot be conducted without ensuring that those advocating particular strategies include the basis for the

extrapolations central to their claims.

Third, many green job estimates focus only on job gains without considering job losses that will occur as employment shifts away from disfavored industries (e.g. coal power plants) and to favored industries (e.g. solar power). This test for the *net* difference in jobs is critical to informed decision making. Even when the estimates attempt to calculate job losses, the effort lacks methodological rigor.

Finally, the green jobs literature often defines a job as “green” based on the inefficient use of labor in a production process. In other words, they prefer increasing the number of jobs, even if it means using a less efficient means of production. For example, the UNEP report calls for hand-picked fruit rather than fruit picked by machinery, even though hand-picked fruit would be more expensive and reduce the amount of fruit available. Low labor productivity, such as hand-picking fruit rather than use machinery, does not necessarily lead to a lower environmental impact, yet is a drag on the economy. This preference for inefficiency is, in part, an effort by those dissatisfied with a market-based economy to use environmental issues to achieve political objectives.

Further, by focusing green job expenditures on economic activity with low labor productivity, resources can be forced to be shifted from capital to favored workers in line with these groups’ political and economic priorities. To achieve these goals, the green jobs literature puts an inappropriate emphasis on promoting inefficient use of labor. In the U.S., this would often be accomplished by requiring the use of unionized labor to perform jobs subsidized by taxpayers.

A. What counts as “green”

Being green differs depending on who is doing the classification. For example, the Mayors defined a “green” job as:

Any activity that generates electricity using renewable or nuclear fuels, agriculture jobs supplying corn or soy for transportation fuels, manufacturing jobs producing goods used in renewable power generation, equipment dealers and wholesalers specializing in renewable energy or energy-efficiency products, construction and installation of energy and pollution management systems, government administration of environmental programs, and supporting jobs in the engineering, legal, research and consulting fields.⁹

In an odd twist, the Mayors report counts *current* nuclear power generation jobs as green jobs, yet does not count *future* jobs in nuclear power as green jobs.¹⁰ In contrast, the UNEP report defined “green jobs” more restrictively by excluding all nuclear power related jobs and many recycling jobs, while at the same time expanding the definition in other areas by including all jobs asserted to “contribute substantially to preserving or restoring environmental quality.”¹¹

The differences between these definitions are substantial. The more expansive supply chain claims included in the UNEP report allows the authors to claim credit for many jobs. For example, wind turbine towers involve “large amounts of steel” and so the supply chain for the wind power industry involves green jobs extending back into the steel industry so long as the steel ends up in a turbine.¹² The steel jobs themselves are not required to have a low environmental impact, only that the steel they produce go into a favored product. As a result, important value judgments are embedded in the definitions and are not explained. Comparing

these definitions illustrates the hurdles to establishing a consistent definition of a “green job.”

A related problem arises in the way some analyses consider almost anything green if the technology does not use fossil fuel without considering the alternative’s environmental impact. For example, the Mayors report touts biomass as a “group of technologies where additional investment and jobs will help to develop the nation’s alternative energy infrastructure.” It extols the virtues of generating energy using “wood waste and other byproducts, including agricultural byproducts, ethanol, paper pellets, used railroad ties, sludge wood, solid byproducts, and old utility poles. Several waste products are also used in biomass, including landfill gas, digester gas, municipal solid waste, and methane.”¹³ Unfortunately, biomass includes burning wood, a means of energy production associated with smog, air pollution, and massive release of carbon.¹⁴ Yet biomass is included “because of the short time needed to re-grow the energy source relative to fossil fuels.”¹⁵ In other words, biomass counts as green because it is not a fossil fuel, even though biomass causes environmental problems.

While we do not claim to know enough of the details of all the science concerning such diverse technical matters to provide a final judgment on how green particular biomass and biofuel programs are, the enthusiastic advocates of the green jobs programs do not either. They make simplistic assertions about what energy can be counted on to substitute for current supplies and offer only vague cost and environmental impact estimates.

These definitional issues are not simply inconveniences that make it impossible to compare the different reports’ claims.¹⁶ More importantly, they represent fundamental confusion about the idea of a “green job,” a confusion that must be resolved before committing hundreds of billions of taxpayer dollars and even larger sums of private resources. The lack of transparency about the assumptions underlying various definitions obscures policy choices that require thorough debate. Worse, these programs create incentives for special interest groups to work the political system to have their jobs designated as “green” and their rivals’ excluded. Developing open, clear definitions is critical to create public policy measures that promote green jobs and avoid turning the policy debate into special-interest extravaganzas unrelated to environmental quality.

B. What counts as a “job”

The second major problem with the green jobs literature is that it consistently counts jobs that do not produce useful outputs as a *benefit* of spending programs rather than as a *cost*. For example, the Mayors report labels as green “government administration of environmental programs, and supporting jobs in the engineering, legal, research and consulting fields.”¹⁷ Another estimate of green jobs found that the single biggest increases from green programs were secretarial positions; management analysts; then bookkeepers; followed by janitors. Management Information Services, the primary consultant on the ASES report, estimated that there would be fewer environmental scientists than any of these other categories.¹⁸

These numbers illustrate an important point. The purpose of a business, green or not, is not to *use* resources (e.g. labor, energy, raw materials, or capital). The purpose is to *produce* a good or service desired by consumers that can be sold for more than the cost of production. For a given level of output, businesses that use more resources are less efficient – have higher costs -- than those using fewer resources. Many jobs created in response to government mandates are not a *benefit* of environmental measures but a *cost* of such programs. Such costs may be worth incurring for the benefits a program produces, but they must be counted as costs not benefits.

The inclusion of lawyers and administrators as benefits of green job spending illustrates an important problem. By making labor the *end*, rather than treating labor as a *means* to production of environmentally friendly goods and services, the literature makes a foundational error. By promoting inefficient use of labor, green jobs policies steer resources towards technologies, firms, and industries that will be unable to compete in the marketplace without permanent subsidies due to the additional costs of these inefficiencies. Dooming the “environmentally friendly” sector to an unending regime of subsidies is fiscally irresponsible and harmful to any efforts to build a competitive and environmentally friendly economy.

C. Forecasting

Forecasts of green jobs are all optimistic. The Mayors report asserts that “wind energy is currently the fastest growing alternative energy source in the country” and “solar power is an alternative energy source providing opportunity for massive job growth”¹⁹ Similarly, the UNEP report claims that “[a]long with expanding investment flows and growing production capacities, employment in renewable energy is growing at a rapid pace, and this growth seems likely to accelerate in the years ahead.”²⁰

There are five major problems with these sunny forecasts:

- 1) Many of the sectors declared green are tiny. Even minor changes in capacity produce large percentage increases in growth. In other words, it is easy to double the number of jobs when you have one job, but not as easy when you have 1,000 jobs.
- 2) The growth rate forecasts are huge by any standard and raise serious questions about whether such forecasts are reliable. In the energy field, the projections in green job reports assume an astonishingly fast spread of new technologies, some of which do not currently exist in economically viable forms. Such assumptions are inconsistent with past experience with other technologies.
- 3) The green jobs literature exhibits selective technological optimism. It assumes away problems that might slow implementation of favored technologies and ignores the likelihood of technological improvements of disfavored ones. Selective optimism biases the forecasts, and is unsupported by evidence of systematically faster growth in favored technologies over their competitors.
- 4) Because many industries discussed as drivers of green jobs are small and new, no official statistics are available. As a result, many forecasts are based not on statistics collected by neutral analysts, but estimates made by interest groups pushing a particular outcome.²¹ Caution must be exercised in making policy decisions based on unsubstantiated numbers estimated by special interest groups.
- 5) The reports often provide job creation forecasts that appear precise, giving the illusion of scientific certainty. Yet these apparently detailed forecasts vary widely from estimate to estimate within the same report/among the various reports (?), illustrating the inappropriateness of reliance on their forecasts.

These reports provide impressive-looking statistical backing for recommendations and are illustrated with a dazzling array of tables and charts filled with seemingly precise numbers in

their forecasts. The problems with the numbers underlying this apparent precision are immense. These problems make the forecasts in the green jobs literature an unreliable basis for policy making.

D. Inappropriate use of input-output analysis

Those advocating green jobs claim that their programs will have a large impact because of the added jobs and other benefits created as those hired into green jobs spend their paychecks. This claim rests on “economic multiplier” analysis. Economic multipliers are routinely used to advocate for public subsidies for industries, sports stadiums, and higher education.²² Multipliers are based on the idea that an increase in activity by one firm will lead to an increase in activity by other related firms. For example, the contractor for a new football stadium buys concrete, the concrete subcontractor buys new tires for its trucks, all the firms’ workers go out to dinner, and so forth. Multipliers are difficult to observe and must be estimated by indirect means, usually a modeling technique known as “input-output analysis.”

Input-output analysis rests on two key assumptions, neither of which can be made for green jobs. The first is “constant coefficients production,” which means that the ratio of outputs to inputs is constant regardless of the scale of production or the time period. This eliminates the possibility that inputs may be substituted for each other, either because of technical progress or because of changes in factor prices.²³ For example, a typical assumption would be that if a dollar of energy was required to produce \$10 of steel at the time the input-output table was created, then this relation will continue to hold. In reality, if the price of energy increases, the relation is likely to change as higher energy prices induce steel producers to change production techniques to reduce the energy used per unit of steel. Since green jobs proponents concede that green energy will cost more per unit than conventional fuels,²⁴ the ratio of energy costs to production is not constant and this assumption is violated. As a result, input-output analysis cannot be accurately used to estimate green jobs.

The second crucial assumption for input-output analysis is that the relationship between production factor prices is constant. In most cases, the relation between inputs and outputs is calculated using dollar values rather than physical quantities. This approach is valid only if the physical quantities and the monetary values have a constant ratio, in other words if there are fixed prices. That is unlikely to be the case for green jobs since a key justification for public support for green technology is that oil and coal will become more expensive, either for technological reasons or because of a tax based on carbon dioxide emissions. Because of the pervasive role that energy plays, these changes will alter factor prices throughout the economy, again making the input-output analysis inappropriate.

Even if we ignore the problems necessary to create a good multiplier, we still must address the issue of where the multiplier should be applied. Green jobs advocates’ standard approach is to apply the multiplier to the gross amount of jobs in the green energy sector.²⁵ This is an overestimate, as some jobs reflect shifts of workers from one industry to another rather than an infusion of new economic activity.

The proper measure is not total jobs that exist in an area receiving a subsidy but additional *net* new employment. Many green jobs are substitutes for existing jobs. An increase in electricity generation from wind, solar, or other sources will substitute for energy from, say,

coal-fired generation, which in turn will reduce employment in coal mining and processing. The net impact on employment (before the multiplier) will depend on the relative labor intensity of energy production in the respective sectors at the margin of added or subtracted production. The multiplier should only be applied to the *net addition* in jobs, which is lower than the gross number of jobs.²⁶

Many green jobs reports start with the assumption that spending public money is the source of the additional economic activity. However, that expenditure comes from higher taxes now or in the future. Because people engage in activities to avoid taxation, the cost of the tax exceeds the revenue yielded by the tax, a phenomenon known as deadweight loss.²⁷ Including deadweight loss in the analysis will reduce the net benefit to which any multiplier should be applied. The green jobs literature does not incorporate such estimates, again overestimating the benefits. Perhaps the most glaring oversight is that these issues are not even mentioned in the literature, even though they are widely known among economists.

E. Promoting inefficient use of labor

Green jobs proponents have an inconsistent attitude toward efficiency. On the one hand, they see efficient use of non-labor inputs such as energy and raw materials as crucial to creating a green economy. The UNEP report states that “[g]reater efficiency in the use of energy, water, and materials is a core objective.”²⁸ On the other hand, green jobs proponents consider reducing the efficiency of labor as a virtue, not a cost. For example, the UNEP report argues that a negative feature of today’s economy is that it has increased labor productivity and so reduced the amount of labor necessary to deliver goods and services: “Any effort to create green jobs in food and agriculture must confront the fact that labor is being extruded from all points of the system, with the possible exception of retail.”²⁹ The same report criticizes the steel and oil industries for increasing labor productivity.³⁰

Measuring success by the maximum number of jobs created to do any particular task is highly problematic. First, the ultimate goal of economic activity is not the employment of labor or of other resources. The ultimate goal is the production of goods and services that satisfy human needs and wants. A new method of production that uses fewer inputs to produce the same outputs as an existing method means we can use those extra inputs to address additional human needs and wants. In other words, we can produce more goods and services with the same inputs, thus improving the standard of living for everyone.

Second, even assuming that substitution of capital and other inputs for labor sometimes has negative environmental consequences, it does not follow that such substitutions are either net negative contributions to the environment or inappropriate. Whether particular techniques are better or worse for the environment or for the individuals engaged in the labor is not an issue that can be settled by assuming that all labor intensive methods are to be preferred to all capital-intensive ones. Yet this is precisely what the green jobs literature does.

Third, even in the favored green industries, increasing labor efficiency has been an important component in making the technologies more commercially viable. For example, corn-based ethanol cost reductions in the United States have been driven in part by economies of scale in farm operations and the advanced technology necessary to convert corn into ethanol.³¹ If instead we had thousands of workers diligently squeezing corn by hand we would not produce more biofuel but we would vastly inflate the number of green jobs and dramatically increase the cost of the fuel.

The green jobs literature's focus on inefficient labor to maximize the number of jobs embodies three highly peculiar assumptions about human wellbeing:

- *It assumes that increasing labor productivity should be discouraged.* While many environmentalists have promoted reduced consumption for decades, adopting a policy of reducing the goods and services available to the all Americans is not the answer.
- *Low labor productivity produces low wages.* In a market economy each factor of production is paid according to its marginal productivity. Providing workers with more capital goods increases their productivity and their compensation. Reducing capital intensity will have the opposite effect. Creating a world of high-paying, low-productivity jobs, as green jobs advocates suggest, would require an economic structure unknown in human history.
- *Subsidizing labor at the expense of capital will delay the development of new technologies that increase the efficiency with which scarce resources are used.* For example, petroleum refining is a highly capital intensive process, but that capital intensity has yielded dramatic increases in the amount of fuels and specialty chemicals obtained from a barrel of crude oil. By increasing the yield, innovations have boosted the efficient use of natural resources. Biasing production away from capital intensity reduces the incentive to produce such innovations.

These problems cited here with the underlying framework of the green jobs studies are grounds for caution in accepting their ultimate conclusions and recommendations. Before trillions of dollars in public and private resources are directed into promoting a green jobs economy, we need to have a better understanding of the goal and of the details of how such programs will reach them. What jobs will be considered "green" and why? Who will decide which jobs are "green enough"? We should be skeptical about projections based on small base numbers and rapid expansion of technologies that are not well developed. We should worry about proposals that glorify low labor productivity, thereby reducing our standard of living.

II. Mistakes in economic analysis

As just reviewed, the green jobs literature not only disagree on what a "green job" is, but also contains highly problematic assumptions about the economics of employment. We now turn to some of its peculiar assertions about economics in general.

1. The green jobs literature rejects the existence of comparative advantage, suggesting a need to avoid trade.
2. The literature makes inappropriate calculations of consumer surplus, giving misleading results with respect to the benefits of the proposed policies.
3. The green jobs proposals frequently interchange responses to mandates and responses to free market, improperly extrapolating from one to predict the other.
4. The literature ignores the opportunity costs of the resources it proposes to devote to green jobs programs, thus overestimating net gains in jobs.
5. Green jobs analyses do not take into account how market incentives generate energy efficiency, instead assuming that energy efficiency results from

government mandates.

6. The literature exhibits a strong hostility to decentralized, market decision making.

That the literature contains so many basic economic errors is not accidental, but reveals that much of the green jobs literature is hostile towards free markets, and thus focuses on government solutions with no regard for market incentives that are imbedded in the American culture. Taken together, these reveal fatal flaws in the green jobs literature's analysis of the economics of green job policies.

1. Rejecting comparative advantage

The green jobs literature often asserts that green jobs are not subject to comparative advantage and so will be distributed abundantly everywhere. For example, CAP reports that green jobs will be created “in every region and state of the country,”³² while the Conference of Mayors takes pains to describe – in a 14-page appendix – how the green jobs will be distributed in every metropolitan area and “so cities and their metropolitan areas across the country can and are expected to compete to attract this job growth.”³³ The green jobs literature uniformly regards green jobs as desirable and easily obtainable in every neighborhood in America.

This anti-trade – or “buy local” – sentiment is embedded throughout the green jobs literature and is part of a larger criticism of the global economy. The UNEP report is among the most explicit in stating its overall anti-trade agenda. The report argues:

Companies like Wal-Mart (with its policy of global sourcing and especially its policy of searching for cheap products, with potential negative impacts for labor and the environment) are major drivers and symptoms of [increased global trade] ... Ultimately a more sustainable economic system will have to be based on shorter distances and thus reduced transportation needs. This is not so much a technical challenge as a fundamental systemic challenge.³⁴

But the green jobs literature fails to acknowledge that its anti-trade assumptions are contrary to standard economic theory, nor does it acknowledge the world's experience with trade and protectionism. By burying critical assumptions that are inconsistent with existing economic and trade policies (e.g. countries' commitments to the World Trade Organization), the green jobs literature is slipping in an economic policy under the guise of an environmental policy.

2. Consumer surplus

The green jobs literature asserts benefits of green jobs policies using a flawed conception of improvements in human welfare. In economics, policies are evaluated by the calculation of the net social benefits based on both consumer and producer surplus.³⁵ The green jobs literature contains little mention of the consumer side, focusing almost exclusively on costs and benefits to favored producers. For example, the UNEP report criticizes increased agricultural trade between the United States and Mexico because “cheap corn from the United States has hurt Mexican farmers who grow maize on small- to medium-sized plots in difficult environments using low levels of technology.”³⁶ No mention is made of benefits of cheaper corn to Mexican consumers, only the costs to uncompetitive domestic producers are considered.

In general, economic concepts and technologies that the special interests behind these reports do not like (e.g. fossil fuels, nuclear power, free markets, trade, lower prices for many consumers) are assumed to produce net costs. Those that the advocates prefer (e.g. small farms, local production, solar power) are assumed to produce net benefits. Counting only the benefits from the favored technologies and activities and only the costs from the disfavored ones distorts the outcome. Both costs and benefits must be counted for an accurate comparison to be made. In particular, careful estimates of consumer surplus are necessary to compare policies' impacts. This biased calculation is not an accidental oversight – the elimination of the benefits of market competition from the green jobs literature represents its sponsors' rejection of modern economics. Reinserting these economic precepts is a necessary step before accepting the literature's claims about how a future economy would work.

3. Mandates vs. markets

Many green jobs programs rest on government mandates to promote favored technologies over those chosen in a competitive economy. The rationale is that without these mandates, market actors would not make the choice to use green technology because they would not receive all of its benefits and/or would bear all the costs of using green alternatives. No doubt it is true that requiring all public buildings to be retrofitted or offering “strong financial incentives” to private building owners to engage in retrofitting, as CAP proposes, would create jobs.³⁷ Of course, so would requiring all public buildings to be painted purple or offering tax incentives to private building owners to paint their buildings purple. Painting jobs would increase, paint manufacturers would increase production of purple paint, paint stores may hire additional delivery help, paint brush manufacturers would increase production, and so forth.

The question is: What would have happened to the resources used to meet the purple paint mandate in the absence of the government program? Those resources would have been put to the building owners' highest and best use, and those uses would have also created demand for goods and services, even if not for purple paint. The same is true of retrofitting mandates. The implication of the necessity of a mandate is that profit-seeking building owners are too foolish to make investments in energy saving despite the alleged short-term paybacks.

While costs of alternative energy sources are unspecified in the reports advocating their adoption, the advocacy groups believe that the adoption of these alternative energy sources should be required. “To the extent that government mandates that such alternatives [such as solar power] be given equal access to the [electricity] grid, higher costs will be passed on to the consumers,” but, “as renewables mature technologically ... cost disadvantages disappear and may turn into a cost advantage.”³⁸ Implicit in this discussion is that utility companies are too short sighted to make investments in renewable energy projects that would produce profits. That premise is at odds with the desire of a number of utilities to be *allowed* to sink large amounts of capital to build nuclear and coal plants that take up to a decade to build and have a long recoupment period. If the people who make their living in the industry do not see the wisdom of investing in massive wind and solar farms (unless heavily subsidized), then the economic feasibility of such green projects is dubious.

Further, the premise that reorienting our economy in a “greener” direction by shifting to “sustainable” energy production will increase net employment in the economy is questionable because most jobs in renewable energy sectors appear to be subsidy driven. A large number of jobs in solar and wind energy rely heavily on taxpayer subsidies or mandates. For example, a

study done for the American Wind Energy Association and the Solar Energy Research and Education Foundation estimated that if the investment tax credit for solar/PV projects and the production tax credit for wind energy were not renewed at the end of 2008, then those industries could lose 77 percent of their jobs.³⁹

Indeed, U.S. subsidies for renewable energy projects are so attractive that in 2008, BP announced that it dropped plans to build wind farms and other renewable projects in Britain; instead it is shifting its renewables programs to the United States, where government incentives for clean energy projects provide “a convenient tax shelter for oil and gas revenues,” as a BP spokesman noted.⁴⁰ Royal Dutch Shell also announced it was abandoning wind energy projects in Britain in favor of the U.S.⁴¹ These developments lend support to the idea that renewable energy is viable only where there is taxpayer support or mandates.

4. Neglecting opportunity costs

A constant in the green jobs literature is the idea that maximizing employment, not maximizing human welfare, is the goal. They fail to consider what opportunities the government and businesses will forego since they do not have that money to spend.⁴² The costs are high: the CAP study asserts that if \$100 billion is spent on green activities that 935,200 jobs would be directly created,⁴³ implying a cost of \$107,000 per new job created. Most people could go to a modestly priced private or state university full time for four years for that sum.⁴⁴ Either the funds for these programs were taken from the pockets of people who now have \$100 billion less to spend on other things, causing an economic contraction in those other areas, or it is a bill passed on to the grandchildren of today’s taxpayers in the form of deficit spending. These costs are real and must be considered in any debate. We must ask what we are giving up to fund these programs. The green jobs literature ignores these questions.

5. Ignoring incentive effects

The green jobs literature focuses on public policies to induce greater energy efficiency, both to reduce greenhouse gas emissions and because it seeks to shift expenditures away from fossil fuels. However, energy efficiency occurs naturally as a result of market processes even without forced taxpayer support. Because the literature ignores this trend, it overstates the benefits of its conservation measures. Given the existence of the trend toward more efficient use of energy even without the policy measures, the proposals will induce less conservation than the studies predict because conservation will occur anyway.

Because energy is costly, the market has an incentive to produce and consume less energy. These are real: From the late 1970s to 2000, energy utilization per dollar of real GDP produced fell by 36 percent.⁴⁵ Total energy usage increased because of economic growth over that time, but efficiency increased more than growth in all major energy-using sectors. Using data from the United States and Great Britain, we can compare energy requirements across time. Compared to 1900, each unit of energy input in 2000 could provide four times as much useful heat, move a person 550 times farther, provide 50 times more illumination, and produce 12 times as much electricity.⁴⁶ One result of this increase in efficiency is that past forecasts of future energy use have *overestimated* future energy demands. For example, estimates done by knowledgeable researchers in the late 1970s for energy use in 2000 proved to be 60 to 80 percent higher than actual use in 2000.⁴⁷ That is, experts who knew efficiency would increase still greatly underestimated technical progress. Given the bias against disfavored technologies in the green jobs literature, we would expect its predictions to be even more off base.

Data on energy consumption across both producer and consumer goods (discussed in detail in our longer paper) demonstrates three key lessons relevant to the evaluation of green jobs claims:

- *Market forces provide a powerful incentive that drives greater efficiency with respect to costly inputs.* Net gains from green jobs policies mandating conservation are likely to produce fewer gains than claimed since some, or even more, than the efficiency gains claimed would occur in the absence of mandates.
- *Regulatory policies have, at times, slowed or blocked energy efficiency gains through unintended consequences.* Adopting mandates is thus not risk free with respect to energy efficiency.
- *The green jobs literature ignores history and fails to mention the extensive data on increases in energy efficiency over time in the industries they propose to regulate.* The authors of this paper are not experts on technical aspects of energy production or use, yet we were able to find from widely distributed, credible sources, extensive data on crucial issues in the green jobs literature that it ignores. Such gaps suggest a need for great skepticism in evaluating their claims of energy efficiency.

6. Market hostility

Underlying much of the green jobs literature is a deep hostility to free market societies that favor voluntary and decentralized decision making and a preference for centrally-directed programs built on mandates. The unprecedented increase in human welfare resulting from the industrial revolution is dismissed: “The story of economic change is, however, also a story about political choices. More often than not, these choices have put the accumulation of wealth before the needs of the majority.”⁴⁸ As a result, the green jobs literature’s answer to a perceived or real problem is almost always massive public expenditure or regulation rather than less intrusive interventions. For example, the UNEP report claims that the obstacle to greener buildings is due, in large part, to an information problem—people’s overestimation of the additional cost of green techniques. However, the recommendation is government intervention instead of the provision of information.⁴⁹ Nothing better captures the contempt for ordinary people that is rampant in the green jobs literature than the UNEP report’s suggestion that rickshaws could become a significant form of transportation in a green economy.⁵⁰ This contempt for decentralized, free societies leads to a focus on mandates and conceptual errors that render the results of these studies untrustworthy.

III. Ignoring technical literatures

The green jobs literature routinely ignores important technical literatures that raise doubt about some of the assumptions underlying green jobs programs. We first examine mass transit; then we turn to electricity generation.⁵¹ In each case, the literature ignores important facts that cast doubt on its claims by engaging in the sort of selective technological optimism we described earlier.

A. Mass transit

Green jobs proponents advocate investment in expanding public mass transportation as a way to create jobs with an environmentally friendly purpose. For example, CAP argues that

building light rail and subway systems will produce “job growth in engineering, electrical work, welding, metal fabrication, and engine assembly sectors” and such investment in “both urban and rural communities ... can be an engine for far broader economic activity.”⁵² CAP advocates more bus and subway services, reducing public transportation fares, increasing federal support for mass transit “to deal with increased ridership,” increased federal subsidies for employer-based mass transit incentives, and higher funding for mass transit programs.⁵³ It is an article of faith in the environmental community that mass transit is more energy efficient than automobiles.⁵⁴ A cursory examination of the amount of energy used to move a passenger by one mile reinforces this belief.

Table 1 shows the energy needed per passenger-mile for different modes of travel, starting with the least efficient and moving down to the most efficient. (Data for the Toyota Prius provide a sense of the possibilities of increasing efficiencies for automobiles.)

Note that bus transit is less efficient than automobiles, while rail transit is more efficient than automobiles. However, the raw numbers can be misleading. First, they do not account for rail transit’s need for an extensive bus feeder system to bring people to and from the rail stops. Taking this into account reduces, and may even eliminate, the savings in energy or reductions in CO₂ emissions shown in Table 1.

Table 1: Modal Energy Consumption and CO₂ Emissions per Passenger Mile.⁵⁵

Mode	BTUs	Pounds of CO₂
Ferry Boats	10,744	1.73
Automated Guideways	10,661	1.36
Light Trucks	4,423	0.69
Motor Buses	4,365	0.71
Trolley Buses	3,923	0.28
All Automobiles ⁵⁶	3,885	0.61
Light Rail	3,465	0.36
Passenger Cars	3,445	0.54
All Transit	3,444	0.47
Heavy Rail	2,600	0.25
Commuter Rail	2,558	0.29
Toyota Prius	1,659	0.26

Further, transit agencies typically increase bus service when they add rail to boost train ridership. Bus routes that used to serve the rail corridor are turned into feeder bus routes for the rail. But since many people drive to rail stations, the average passenger load of the feeder buses tends to be smaller than for the corridor buses they replaced. Consequently, the advent of new rail transit

lines can increase fuel usage because the average loads of the buses falls.

For example, in 1991, before St. Louis built its light rail system, its buses averaged more than 10 riders and consumed 4,600 BTUs per passenger mile. After the light-rail line opened, average bus loads in 1995 declined to 7 riders and energy consumed per passenger-mile increased to 5,300 BTUs. CO₂ emissions increased from 0.75 pounds to 0.88 pounds per passenger mile. Similarly, energy and CO₂ performance also deteriorated for Sacramento and Houston after rail transit was implemented.⁵⁷

Second, even if rail transit results in a net reduction in energy use and CO₂ emissions, these improvements may be more than offset by the energy required to construct the rail system. For example, Portland's North Interstate light rail line is estimated to save about 23 billion BTUs per year while its construction is estimated to consume 3.9 trillion BTUs. It will thus take 172 years to offset the energy used in construction.⁵⁸ Not only would this exceed the lifespan of the line, but "long before 172 years, automobiles are likely to be so energy efficient that light rail will offer no savings at all."⁵⁹

In sum, mass transit critics make a compelling case that it provides few, if any, benefits over the automobile and may even be counterproductive once the energy consumed during construction is considered. We do not expect green jobs proponents to necessarily agree with the mass transit critics, but a fair presentation would at least allow a debate on these issues.

B. Electricity Generation

The green jobs literature calls for massive shifts in power generation technologies. As noted earlier, the literature is selectively optimistic about favored power generation technologies (e.g. wind, solar, biomass) and selectively pessimistic about disfavored ones (e.g. coal, nuclear). Here we briefly survey the literature on three power generation technologies: wind, solar, and nuclear, and show how the green jobs literature fails to adequately address the technical issues involved with each.

Wind. Partly because of subsidies, the contribution of wind to *renewable electricity* generation is expected to increase from 7 percent in 2006 to 16 percent in 2020 and 20 percent in 2030.⁶⁰ However, despite being heavily subsidized, its total contribution to "energy security" is slight, and unlikely to rise to a significant level over the foreseeable future. Wind contributes less than 0.6% of total U.S. energy production (based on data from January through September 2008, according to federal statistics).⁶¹ According to the DOE's latest projections, it will account for less than 0.9% of total energy consumption in 2020 and 1.1% in 2030.⁶² (Wind plays an increasing role in electricity generation, but electricity is only a fraction of *energy* production in the U.S., which is why wind is such a tiny share of energy.)

Wind's contribution is diminished by its ability to deliver electricity only intermittently. Wind turbines cannot produce when wind speed is either too low or too high, or if the turbine blades or other critical components are iced up. This lack of reliability and the fact that the electricity cannot be stored and so wind capacity must be backed up by other electric generation sources increases the cost of wind energy substantially. So while wind is free, we must consider construction, installation and transmission costs, and acknowledge that wind turbines cannot satisfy consumers' need for reliability and continuous, round-the-clock availability.

Another problem associated with wind energy is that the most favorable locations for wind are often not accessible to the electrical grid.⁶³ According to the Department of Energy, it

would require an additional 12,000 miles of high-voltage transmission lines costing \$60 billion to increase the contribution of wind to national electricity production to 20 percent by 2030.⁶⁴

Further, efforts to increase wind generation capacity have run into major hurdles with regulatory laws and opposition by area residents.⁶⁵ Despite these widely known problems, which are never discussed in depth in the green jobs literature, green jobs policy proposals propose enormous increases in wind capacity without detailing a strategy for how these problems will be solved.

Solar. Solar power is another favored technology in the green jobs literature. As with wind energy, substantial – and largely unacknowledged – hurdles to a significant expansion in solar electric generation exist. First, despite decades of effort and high subsidies, the current contribution of solar to meeting the nation's energy needs is only 0.05%.⁶⁶ Most of this (95 percent) is from solar thermal and hot water production rather than electricity generation. The remainder is from solar photovoltaic (PV).⁶⁷ By 2030, the contribution of solar to energy consumption is projected by the EIA to rise to just 0.13%.⁶⁸ Although solar PV is projected to grow faster than other forms of solar energy, current technical analyses suggest that the costs of current solar PV installations so far exceeds its benefits. Indeed, no reasonable valuation of the benefits of greenhouse gas reductions would result in positive estimates for the total net benefits from solar PV.⁶⁹ Again, these issues are barely acknowledged in the green jobs literature.

Nuclear. In contrast to how the favored technologies are treated, the green jobs literature almost completely dismisses nuclear power generation. We are not advocating nuclear power generation but are noting the inconsistency of green jobs advocates' treatment of unproven technologies with serious technical problems, such as solar, compared to its treatment of an existing power-generating technology that emits no greenhouse gases, with widespread commercial use that produces about 20% of U.S. electric power. This difference reveals important embedded assumptions by the green jobs advocates that has little to do with environmental quality or economic sensibility.

IV. Conclusion

The costs of the green jobs programs proposed by various interest groups are staggering. For example, the UNEP report concludes that “No one knows how much a full-fledged green transition will cost, but needed investment will likely be in the hundreds of billions, and possibly trillions, of dollars.”⁷⁰ The scale of social change that would be imposed is also immense. Green jobs advocates propose dramatic shifts in energy production technologies, building practices, and food production. These calls for radical changes in every aspect of modern life are wrapped in a new package in the green jobs literature. They promise not only a revolution in our relationship with the environment but to employ millions in high paying, satisfying jobs. Unfortunately, the analysis provided in the green jobs literature is deeply flawed, resting on a series of myths about the economy, the environment, and technology. We have explored the problems in the green jobs and exposed the underlying myths.

To attempt to transform modern society on the scale proposed by the green jobs literature is an effort of staggering complexity and scale. To do so based on the wishful thinking and bad economics embodied in the green jobs literature would be the height of irresponsibility. We have no doubt that significant opportunities abound to develop new energy sources, new industries, and new jobs in the future. We are equally confident that a market-based discovery process will

do a far better job of developing those energy sources, industries, and jobs than could a series of mandates based on flawed data. It is time to bring this debate into the light and dispel the myths so that policies can be based on clear facts and analysis.

¹ This is a shortened version of *The Mythologies of Green Jobs* by the same authors. The longer article can be found at on SSRN and contains more extensive documentation.

² United States Conference of Mayors, U.S. METRO ECONOMIES: CURRENT AND POTENTIAL GREEN JOBS IN THE U.S. ECONOMY, 2008, available at: <http://www.usmayors.org/pressreleases/uploads/GreenJobsReport.pdf> at 2 (hereafter “Mayors”).

³ American Solar Energy Society, RENEWABLE ENERGY AND ENERGY EFFICIENCY: ECONOMIC DRIVERS FOR THE 21ST CENTURY, 2007, available at: <http://www.misi-net.com/publications/ASES-EconomicDrivers07.pdf> (hereafter “ASES”) at vii.

⁴ Mayors, *supra* note 2, at 17

⁵ In January, 2009, ASES projected over 37 million green jobs by 2030.

http://www.ases.org/index.php?option=com_content&view=article&id=465&Itemid=58. In 2007, the ASES estimate was over 40 million (assuming an “aggressive deployment forecast scenario”). ASES, *supra* note 3, at iv.

⁶ Center for American Progress, GREEN RECOVERY: A PROGRAM TO CREATE GOOD JOBS AND START BUILDING A LOW-CARBON ECONOMY, 2008, at 19 (hereafter “CAP”) available at:

http://www.americanprogress.org/issues/2008/09/pdf/green_recovery.pdf

⁷ During the 2008 presidential campaign, John McCain stated “We can move forward and clean up our climate and develop green technologies ... so that we can clean up our environment and, at the same time, get our economy going by creating millions of jobs.” In the same debate, Barack Obama stated that “if we create a new energy economy, we can create 5 million jobs, easily, here in the United States.” Jeanne Cummings, Can Green Jobs Save Us? POLITICO, Oct. 14, 2008; available at <http://www.politico.com/news/stories/1008/14551.html>.

⁸ See United Nations Environment Programme, GREEN JOBS: TOWARDS DECENT WORK IN A SUSTAINABLE, LOW-CARBON WORLD (2008) (hereafter “UNEP”), available at

http://www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf.

⁹ Mayors, *supra* note 2, at 5.

¹⁰ *Id.* at 12 (nuclear power jobs “are not included in our projection scenario.”).

¹¹ UNEP, *supra* note 8, at 3.

¹² *Id.* at 4. Creating a “sustainable” steel industry itself is also expected to produce green jobs. *Id.* at 15 (“Making steel mills greener and more competitive is a must for job retention.”).

¹³ Mayors, *supra* note 2, at 9.

¹⁴ Wood burning, despite its status as a renewable source, can be a major source of particulate matter air pollution. Michael Faust, Sacramento Metro Chamber, Testimony before Sacramento Metropolitan Air Quality Management District, RE: Wood Burning Rule 421, 09/26/07, p. 2, available at

<http://sacramentocacoc.weblinkconnect.com/cwt/external/wcpages/wcwebcontent/webcontentpage.aspx?contentid=1225>.

¹⁵ Mayors, *supra* note 2, at 9.

¹⁶ Even the UNEP study conceded that existing green jobs literature is made up of studies using quite different methodologies and assumptions. UNEP, *supra* note 8, at 101 (“One problem with the array of existing studies is that they employ a wide range of methodologies, assumptions, and reporting formats, which makes a direct comparison of their job findings—or any aggregation and extrapolation—very difficult or impossible.”)

¹⁷ Mayors, *supra* note 2, at 5.

¹⁸ Roger H. Bezdek, et al., *Environmental protection, the economy, and jobs: National and regional analyses*, 86 J. ENV'T'L MGT. 53, 66 (2008). Bezdek and his associates are primary authors of the ASES report.

¹⁹ Mayors, *supra* note 2, at 7.

²⁰ UNEP, *supra* note 8, at 6.

²¹ For example, the Department of Energy estimated that if the U.S. attempted to achieve 20 percent wind power by 2030 (which would be an incredible undertaking given the slow rate of growth), there would be 500,000 jobs at that time in the wind-related field, of which 150,000 were manufacturing, construction, and maintenance. U.S.

Department of Energy, 20% Wind Energy by 2030 at 13 (May 2008), available at:

<http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf>. That contrasts to the ASES claim that to achieve a goal of 15% renewable energy (wind, solar, etc.) by 2030 would mean 3.1 million jobs by then; a goal of 30% would mean 7.9 million new jobs in that sector of the economy by 2030. ASES, *supra* note 3, at 7. The ASES numbers are

not broken down by energy source, but they are vastly higher than the jobs numbers projected by the Department of Energy, which only looked at wind.

²² A critical review of the literature along with case studies of specific cities is provided in *SPORTS, JOBS, AND TAXES: THE ECONOMIC IMPACT OF SPORTS TEAMS AND STADIUMS* (Roger Noll & Andrew Zimbalist, eds. 1997). See also John J. Siegfried et al., *The Economic Impact of Colleges and Universities*, *CHANGE* (March/April 2008) at 24, available at: <http://www.carnegiefoundation.org/change/sub.asp?key=98&subkey=2552>. The authors reviewed 138 college economic-impact studies completed since 1992 and concluded that they are “public-relations documents masquerading as serious economic analysis.”

²³ S. TEGEN, M. MILLIGAN & M. GOLDBERG, NAT’L RENEWABLE ENERGY LABORATORY CONFERENCE PAPER NO. NREL/CP-500-41808, *ECONOMIC DEVELOPMENT IMPACTS OF WIND POWER: A COMPARATIVE ANALYSIS OF IMPACTS WITHIN THE WESTERN GOVERNORS’ ASSOCIATION STATES 9-10* (2007) mentions this issue.

²⁴ As CAP notes, \$1 million spent on solar energy would currently produce considerably less energy than \$1 million spent on oil, precisely because of the relative inefficiency of alternative energy technologies. CAP, *supra* note 6, at 21.

²⁵ This is the approach taken in the three of the four studies that we most closely analyze and which estimate induced employment resulting from green jobs. See CAP, *supra* note 6, at 24-26; Mayors, *supra* note 2, at 12-17; and ASES, *supra* note 3, at 30, 39, 46.

²⁶ Noll & Zimbalist, *supra* note 22, at 75, make this point. They go on to provide an example of incorrect analysis leading to vast overestimate of impact at 497-498.

²⁷ An exposition of deadweight loss can be found in Harvey Rosen and Ted Gayer, *Public Finance*, 8th ed., 2008. David Bradford (*Untangling the Income Tax*, 1986, at 135) defines deadweight loss as “the effective waste of purchasing power owing to the distorting effects arising from the effort to avoid tax.” Subsidies, too, have a deadweight loss as people alter their behavior to become eligible for the subsidy.

²⁸ UNEP, *supra* note 8, at 4.

²⁹ *Id.* at 228.

³⁰ *Id.* at 184 and 92.

³¹ W.G. Hettinga, et al., *Understanding the reductions in US corn ethanol production costs: An experience curve approach*, 27 *Energy Policy* 190, 201 (2008).

³² CAP, *supra* note 6, at 5.

³³ Mayors, *supra* note 2, at 18, Appendix, pp. 19-33.

³⁴ UNEP, *supra* note 8, at 162.

³⁵ Consumer surplus is the difference between the price that consumers are willing and able to pay for a good and the value they place on a good (the highest price they would be willing to pay). Producer surplus is the difference between the price received by a producer when a good or service is sold and the lowest price the producer would have been willing to accept and still engage in the exchange. The existence of such surpluses is the reason exchange occurs—both parties gain. ROGER MILLER & ROGER MEINERS, *INTERMEDIATE MICROECONOMICS*, 583 (3rd ed., 1986)

³⁶ UNEP, *supra* note 8, at 225.

³⁷ CAP, *supra* note 6, at 6-7

³⁸ UNEP, *supra* note 8, at 47.

³⁹ Navigant Consulting, *Economic Impacts of the Tax Credit Expiration*. Prepared for the American Wind Energy Association (AWEA) and the Solar Energy Research and Education Foundation (SEREF), 13 February, 2008, Navigant Consulting, Bedford, MA.

⁴⁰ Terry Macalister, *Blow to Brown as BP scraps British renewables plan to focus on US*, *THE GUARDIAN* (7 November 2008).

⁴¹ Danny Fortson, *Shell to quit wind projects*, *THE SUNDAY TIMES* (7 December 2008).

⁴² CAP does give some consideration to the issue. It asserts that more jobs will be created by the “green investment” program than if the money is used in other ways. The report notes that if \$100 billion was spent on domestic oil industry jobs only 542,000 jobs would be created—far fewer than the 935,200 their proposal would generate. Why? The oil industry would spend a lot of money “purchasing machines and supplies.” CAP, *supra* note 6, at 11. Apparently capital equipment is a bad, as are the jobs creating the equipment, compared to the more labor-intensive green jobs.

⁴³ *Id.* at 9.

⁴⁴ Full tuition at York College of Pennsylvania in 2008-09 is \$13,680. See <http://ycp.edu/admissions/208.htm>. Full tuition for an in-state student at Penn State in 2008-09 is \$13,014 for a freshman or sophomore and \$14,070 for a

junior or senior. See <http://tuition.psu.edu/Rates2008-09/UniversityPark.asp>. We are not arguing that a college education would necessarily be a better use of that much money (despite our self-interest in the growth of the higher-education industry), but the report gives no evidence that their prescription for the expenditure is better than the same amount spent on education or some other area of activity.

⁴⁵ Paul L. Joskow, *Energy Policies and Their Consequences After 25 Years*, 24 THE ENERGY JOURNAL 17 at 37 (2003).

⁴⁶ See Jesse H. Ausubel, *Technological Progress and Climate Change*, 23 ENERGY POLICY 411-416 (1995). Available at http://phe.rockefeller.edu/tech_prog/ and Table 1 in our larger paper.

⁴⁷ Joskow, *supra* note 45, at 35.

⁴⁸ UNEP, *supra* note 8, at 278.

⁴⁹ *Id.* at 139.

⁵⁰ *Id.* at 14 (“bicycles and modern bicycle rickshaws offer a sustainable alternative and create employment in manufacturing and transportation services.”). The romantic view of happy workers pulling or peddling rickshaws for a joyful life in service to others is provided by wealthy UN employees who may ride in them when visiting poor countries to dispense wisdom.

⁵¹ Our longer paper also discusses biofuels.

⁵² CAP, *supra* note 6, at 7-8.

⁵³ *Id.* at 7.

⁵⁴ UNEP, *supra* note 8, at 13 (UNEP: “Railways are more environment-friendly and labor intensive than the car industry.”); *id.* at 164 (“Public transit is less energy and carbon-intensive than automobiles.”).

⁵⁵ Randal O’Toole, *Does Rail Transit Save Energy or Reduce Greenhouse Gas Emissions?* Policy Analysis, No. 615, Cato Institute, 14 April 2008 at 4.

⁵⁶ Includes passenger cars and light trucks

⁵⁷ *Id.* at 14-15.

⁵⁸ *Id.*

⁵⁹ *Id.* at 15.

⁶⁰ EIA, *Annual Energy Outlook 2009 Early Release*, Report #:DOE/EIA-0383(2009). Release Date: December 2008. Table 17. This report, which is issued each year, provides the Department of Energy’s best estimate of future supply and demand for the energy sector, based on its judgments about economic growth, labor supply, technological change, and so forth. It “generally assumes that current laws and regulations affecting the energy sector remain unchanged” throughout the projection period (2030 for this document). See EIA (2009) at 2.

⁶¹ EIA, *Monthly Energy Review*, December 2008. Available at <http://www.eia.doe.gov/emeu/mer/overview.html>.

⁶² EIA *Early Release 2009*, *supra* note 60, at Tables 1 and 17.

⁶³ Matthew Wald, *The Energy Challenge: Wind Energy Bumps Into Power Grid’s Limits*, THE NEW YORK TIMES (29 August 2008) available at http://www.nytimes.com/2008/08/27/business/27grid.html?_r=1&pagewanted=print.

⁶⁴ Department of Energy, 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY’S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY. DOE/GO-102008-2567. July 2008. (DOE 2008 at 95, 98)

⁶⁵ Jonathan H. Adler, *Foul Winds for Renewable Energy*, NAT’L REV. ONLINE, Sept. 28, 2007, <http://article.nationalreview.com/?q=Mjg1YWVjNDZjZTBkNDhlODUzZjVhZThmM2U0YjAwNjE=#more>. The Cape Wind farm has some regulatory approvals after years of planning. Are all such permit requirements to be swept aside from now on? Cape Wind was proposed in 01; by early 09 it only had some permits; but was not finished with the permit process. Cape Wind: America’s First Wind Farm on Nantucket Sound, <http://www.capewind.org/> (last visited Feb. 21, 2009). See also Wendy Williams & Robert Whitcomb, CAPE WIND: MONEY, CELEBRITY, CLASS, POLITICS AND THE BATTLE FOR OUR ENERGY FUTURE ON NANTUCKET SOUND (2007).

⁶⁶ EIA, *Early Release 2009*, *supra* note 60, at Tables 1 and 17.

⁶⁷ *Id.*

⁶⁸ *Id.*

⁶⁹ An exception is Severin Borenstein, *The Market Value and Cost of Solar Photovoltaic Electricity Production*. Center for the Study of Energy Markets. Working Paper WP 176 (2008) and Severin Borenstein, *Response to Critiques of “The Market Value and Cost of Solar Photovoltaic Electricity Production”* (2008) available at <http://faculty.haas.berkeley.edu/borenste/SolarResponse.pdf>. Visited 16 February 2009.

⁷⁰ UNEP, *supra* note 8, at 306.