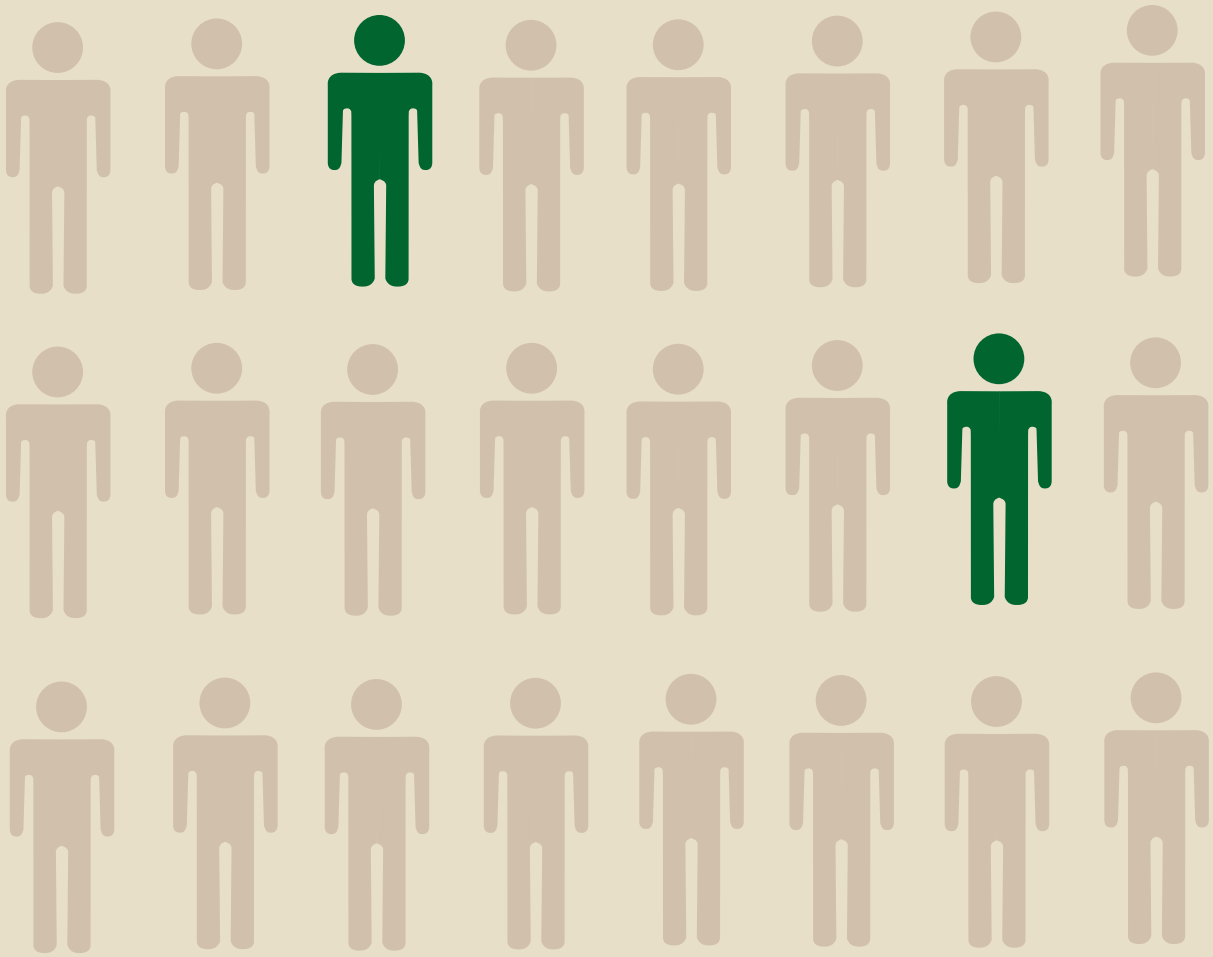
CALIFORNIA LUTHERAN UNIVERSITY CENTER FOR ECONOMIC RESEARCH AND FORECASTING

The Truth About Green Jobs and California

A Review of the Costs, Risks and Trade-offs of Green Job Policies



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Executive Summary

Many within the media, academia and the economic development communities have expressed enormous enthusiasm about the prospects for green jobs as a result of strong environmental legislation. Indeed, many claim that increased environmental regulation is a key to a newfound prosperity. In this paper, we try to sort these claims out and separate the truth from the hype.

One issue is defining a "Green Job." Since data are collected in a way that makes it difficult to identify green jobs, researchers tend to classify certain industries as "Green." This necessarily requires either grossly underestimating the positive impact of green jobs, if one is too selective, or grossly overestimating them if too inclusive. Not surprisingly, given the current political climate, the tendency is to be inclusive. In any event, until there is agreement on the definition, and actual data, results are difficult to evaluate and compare.

We approach the issues from several directions. We look at the experience of other countries. We look at the results across the United States. We critically review several selected technical-but-not-academic papers. We review the academic literature. Finally, we provide a theoretical model of economic growth through regulation.

The most enthusiastic proponents of man-caused global warming accept it as a certainty that will drive policy for the coming decades. For many others, perhaps a growing number, this assumption is much less certain. We tend to identify global warming as a possibility that policy makers need to consider seriously over the mid and long-term. Minimizing the risk is essentially an insurance problem, and it cannot be achieved without costs. To minimize the costs of that insurance, however, requires a robust and growing economy, maximizing market feedback, and reducing subsidies that place unfair burdens on other sectors.

Here, we summarize the sections of our report:

The foreign experience

Several European countries have several years of experience with environmental regulation. We look specifically at Spain, Germany, and Denmark. We find environmental regulation has not been an economic panacea. Regulation does tend to result in higher energy costs and higher taxes supporting non-competitive energy production methods, solar and wind. Indeed, the existence of these facilities is due in large part to subsidies.

Green Jobs in America

As has been the case in Europe, United States proponents of the "Green Revolution" have put forward an attractive vision of innovation and new economic vigor, promising not only a low-cost conversion to wind or solar power, but one that actually generates economic activity and prosperity. So far, we have seen high-cost jobs and high-cost energy production facilities that exist largely due to mandates from regulation or subsidies. Promised new manufacturing strength has not materialized, as new manufacturing is mostly done in only the most cost-competitive places.

Review of Selected Non-Academic Papers

We reviewed four technical, but non-academic papers. In general these papers argue that command-and-control greenhouse gas regulation will generate economic growth for California. These papers largely eschew the rigorous methods of academic researchers. As such, they tend to ignore relevant cost and both the time paths and the effects of timing.

If the present value of future economic benefits is less than the costs, it is difficult to argue that there is a gain. Similarly, jobs are an insufficient measure of the value of a program. It is possible, even likely that the costs of those jobs result in a net-negative in economic wellbeing, with potentially negative impacts on employment elsewhere in the economy.

Review of the Academic Literature

Fortunately, there is some high-quality academic literature on the costs of environmental regulation. These are papers by academic economists in peer-reviewed papers. For the most part the researchers are concerned about the possibility of global warming and generally are sympathetic to regulatory goals. This literature finds that there is no evidence of a free lunch. Climate Change regulation does have costs. Those costs are minimized when the regulatory method of meeting greenhouse gas emissions is by a carbon tax rebated through a reduction in a distortionary tax, or equivalently a cap and trade program with the revenues rebated through a reduction in a distortionary tax. The rebate is a key component of reducing the regulatory costs.

The literature finds that command-and-control regulation is considerably more costly than the more efficient rebated carbon tax. Indeed, perverse incentives, brought about by subsidies, can actually result in not only higher costs, but increased greenhouse gas emissions. Similarly, tough regulations in one locality can cause substitution to another low-regulatory location, for example from the US to China or California to Texas, resulting in higher greenhouse gas emissions.

A Theory of Environmental Regulation as a Source of Jobs

We provide a fairly technical presentation of a theory of regulation as a source of net-positive economic activity. It assumes that an inefficient technology is in use, solely as a result of historical accident. In this case, regulation requiring the unused-but-more-efficient technology should produce net economic growth. This theory could be relevant for small variances from optimality, and primitive economies with very incomplete markets, but for large scale modern economies, it is subject to rather dubious assumptions, particularly that private markets will ignore, or not see, the opportunity. The theory also ignores the impact of timing, or that the present value of the savings may not exceed the present value of the costs.

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Introduction

RENEWABLE ENERGY COSTS IN SPAIN

Given the much higher costs of renewable energy, the report estimates that each green megawatt installed destroys 5.28 jobs on average elsewhere in the economy: 8.99 by photovoltaics, 4.27 by wind energy, 5.05 by mini-hydro.

The Foreign Experience

In this country, the focus on green jobs is of fairly recent origin, linked primarily to the election of President Obama and a solidly Democratic Congress. Yet to understand how green policies function in a real economy, one does not have to depend on imaginary projections. There have been many foreign countries – most particularly in the European Union – that have embraced this approach for many years. A close look at the results suggests that the economic promise of job creation tied to renewable energy sectors has been far less fulfilled than is commonly claimed by environmental activists and their key corporate allies.

Investment in a "green revolution" already has become a centerpiece of the current British Labour Government's plan to revitalize the country's economy. In this, the UK will be following a path of massive subsidization of the renewable sector to rebuild its damaged economy in a "digital, low-carbon, high technology age." [i]

But there is growing evidence that the current pattern of subsidization is unsustainable. Germany, for example, has spent over 1.2 billion Euros on solar roofs… which now generate 0.4 percent of the country's electricity. The cost of green jobs is also very high. In Denmark, subsidies per job reach upwards of $150,000 a year; in Germany, the cost has been estimated as high as $250,000. [ii]

The Spanish Experience

Perhaps the most controversial analysis of notably high levels of subsidies for renewable energy has taken place in Spain. [iii] There, a report from Universidad Rey Juan Carlos takes on the very rationale for green jobs as a source of new employment. The report assumes that every dollar spent by the government represents one dollar less spent by private investors.

Given the much higher costs of renewable energy, the report estimates that each green megawatt installed destroys 5.28 jobs on average elsewhere in the economy: 8.99 by photovoltaics, 4.27 by wind energy, 5.05 by mini-hydro. The report has been hotly contested for being short-sighted and not counting both the environmental and long-term economic advantages of Spain's strong green energy policies.

Yet there is more widespread criticism of Spain's program. Many of the solar plants, for example, were of low quality and are likely never to be efficient. Given these problems and Spain's critical economic condition, in September 2009 the government abruptly changed course, cutting payments and capping solar construction.

Cassidy Deline analyzes the European solar market for IHS Emerging Energy Research, a renewable power consulting firm in Cambridge, Massachusetts; her research focuses on competitive strategies across the value chain. She believes that the Spanish experience shows the need for a more measured approach to green jobs, with lower levels of subsidies and stricter standards.

Spain's incentive plan is the most generous anywhere, 43 Euro cents (58 U.S. cents) per

kilowatt-hour. Thus far the results have not been impressive. Many leading solar companies have gone bankrupt, and others have reduced their employment considerably. [iv]

The German Experience

Few countries have stressed renewable energy and green jobs more than Germany, Europe's largest economic power. German politics have had a distinctly environmental tinge since the days of the Socialist-Green coalition that ruled from 1998 to 2005. The shift to renewables has taken place in part because nuclear power has been widely unpopular, leading to legislation mandating its elimination by 2020.

GREEN JOBS COSTS IN DENMARK

In Denmark, subsidies per job reach upwards of $150,000 a year; in Germany, the cost has been estimated as high as $250,000.

Some of Germany's problems with renewables lie with its climate: It is not a sunny country. At the same time, moving towards the use of solar and wind to the exclusion of nuclear power and of coal, Germany's one significant energy resource, has led to a greater reliance on Russia for relatively clean natural gas. The cost of this approach may be expensive energy and economic stagnation, but this might not deter the country from its current course.[v]

In Germany, as in Spain, there is considerable belief that the job creation afforded by investment in renewables has been more than offset by the impact of more expensive energy, which has slowed consumption and investment elsewhere in the economy. One recent report cites the possible growth of up to 400,000 jobs in the renewable sector, but concludes that these will be outpaced by higher costs passed on to both consumers and industrial firms outside the highly subsidized green sector. Overall, the report suggests that it is difficult to see how renewable employment effects "are positive at all." [vi]

A recent report states that the new taxes would affect four out of ten Danish companies "in high or severe degree," and that this puts Denmark's position of strength as one of the most energy efficient counties in danger, to the detriment of growth and employment.

The Danish Experience

Long before 'green jobs' gained mantric significance in other countries, Denmark established a leadership position in building renewable energy. Today, Danish windmill producers are among the world leaders in their field, and Danish manufacturers are considered among the World's most efficient.

But even in Denmark, there is a growing sense that draconian new taxes on energy will hurt this highly innovative economy. A recent report states that the new taxes would affect four out of ten Danish companies "in high or severe degree," and that this puts Denmark's position of strength as one of the most energy efficient counties in danger, to the detriment of growth and employment.

There is widespread concern among Danish firms, particularly in manufacturing, that their competitive position will be weakened by these new taxes. The biggest impact, they believe, will be on those firms that must compete internationally. Ironically, this affects the environmental sector. Danish companies have specialized in being energy efficient; energy efficiency has become a competitive advantage for Danish companies, helping to offset high Danish labor costs and generally weak Danish productivity trends. "But this position of strength will be destroyed if these companies [have imposed upon them] new special Danish energy taxes." [vii]

Green Jobs In America

It is not surprising, given both the severity of the recession and the desire to control greenhouse gases, that green jobs would provide an irresistible lure to American policy-makers. One recent report, "Green Recovery," from the Political Economy Research Institute, University of Massachusetts, Amherst / Center for American Progress, posits the effects of a $100 billion investment in green jobs as capable of creating upwards of two million jobs and significantly cutting unemployment. [viii]

The Big Promise

Green jobs are also seen as attractive since, particularly in home retrofitting, much of the work cannot be easily exported to other countries. The Council on Wisconsin Strategy reports that for every gigawatt of energy saved, 1.5 jobs will be created, and every $1 million spent on retrofits will result in eight to ten new jobs in construction. Retrofitting also has ripple effects. Each 50,000 MW in energy-efficiency gains yields 100,000 jobs in green energy equipment manufacturing, certified building materials manufacturing, wholesaling, trucking, and the like. [ix]

The irresistible political pull of green jobs is now fully reflected in the pattern of subsidies followed in places like Germany and Spain. The current federal Administration's preferences are for alternative fuels and the jobs connected to them. Today, according to estimates by The Energy Information Agency, solar energy receives $24.34 in federal subsidies per megawatt hour (MWh) of electricity produced. Electricity generated by wind receives $23.37 per MWh, natural gas receives 25 cents per MWh and nuclear power receives $1.59 per MWh. [x] [xi]

Rankings of subsidies and support on absolute amount and amounts per megawatthour of generation differ widely, reflecting substantial difference in the amount of generation across fuels.

Subsidies and Support to Electric Production by Selected Primary Energy Sources

Primary Energy Source	FY 2007 Net Generation (billion Kilowatthours)	Subsidies and Support Allocated to Electric Generation (million FY 2007 dollars)	Subsidies and Support per Unit of Production (dollars/megawatthour)
Natural Gas and PetroleumLiquids	919	227	0.25
Coal	1,946	854	0.44
Hydroelectric	258	174	0.67
Biomass	40	36	0.89
Geothermal	15	14	0.92
Nuclear	794	1,267	1.59
Wind	31	724	23.37
Solar	1	174	24.34
Refined Coal	72	2,156	29.81

Energy Information Adminstration, *Federal Financial Interventions and Subsidies in Energy Markets 2007* SR/CNEAF/2008-1 (Washington, DC, 2008).

[Solar Energy] installations in California were down 60 percent in the first quarter compared with the year before.

Another U Mass PERI report — and several other sources, according to the Wall Street Journal, — estimates that $1 invested in renewable energy or energy efficiency would yield up to four times as many jobs as $1 invested in oil and gas, where the basic infrastructure of wells, refineries and pipelines has been around for years. Moreover, those studies say, clean-energy jobs are likely to be centered in the US, unlike jobs in the oil and gas industry, which increasingly are spread around the world. [xii] [xiii]

Now the Reality - So Far

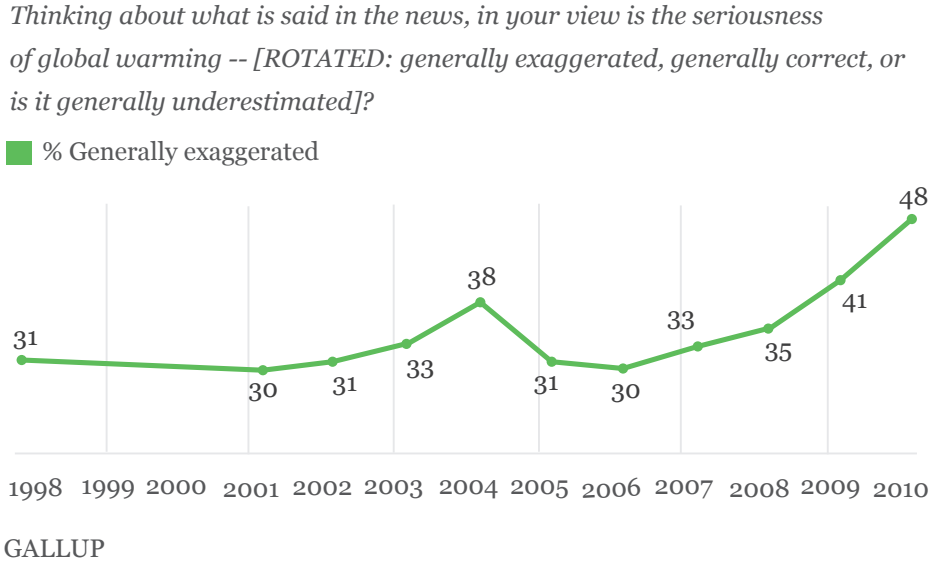
Yet, as in Europe, the jobs payback from environmental policies has been less than hoped for. Even as energy prices have increased, the growth of green jobs has been slower than expected. Indeed, there are widespread reports of renewable energy companies actually laying off workers. In fact, the solar power industry spent much of 2009 announcing layoffs.

"The vast majority of commercial projects are on hold," said Rhone Resch, president of the Solar Energy Industries Association, noting that installations in California were down 60 percent in the first quarter compared with the year before. One reason has been the decline in natural gas prices, which have dropped with the discovery of new finds. [xiv]

Future problems could lie in political realities. Stringent federal and local climate change legislation constituted the essential business rationale for renewable energy industries. But this rationale may be undermined as public concerns about global warming subside, evidenced in a series of polls conducted by Pew, Rasmussen and Gallup. The survey by Pew, an organization with a strong commitment to combat climate change, found that global warming ranked twentieth out of twenty top concerns among adult Americans.

Below: Gallup's annual update on Americans' attitudes toward the environment shows a public that over the last two years has become less worried about the threat of global warming, less convinced that its effects are already happening, and more likely to believe that scientists themselves are uncertain about its occurrence. In response to one key question, 48% of Americans now believe that the seriousness of global warming is generally exaggerated, up from 41% in 2009 and 31% in 1997, when Gallup first asked the question.

These results are based on the annual Gallup Social Series Environment poll, conducted March 4-7 of this year. The survey results show that the reversal in Americans' concerns about global warming that began last year has continued in 2010 -- in some cases reverting to the levels recorded when Gallup began tracking global warming measures more than a decade ago.



...in goods for reducing pollution, increasing energy efficiency, and producing renewable energy, America moved from a trade surplus of $14.4 billion in 1997 to a trade deficit of $8.9 billion in 2008.

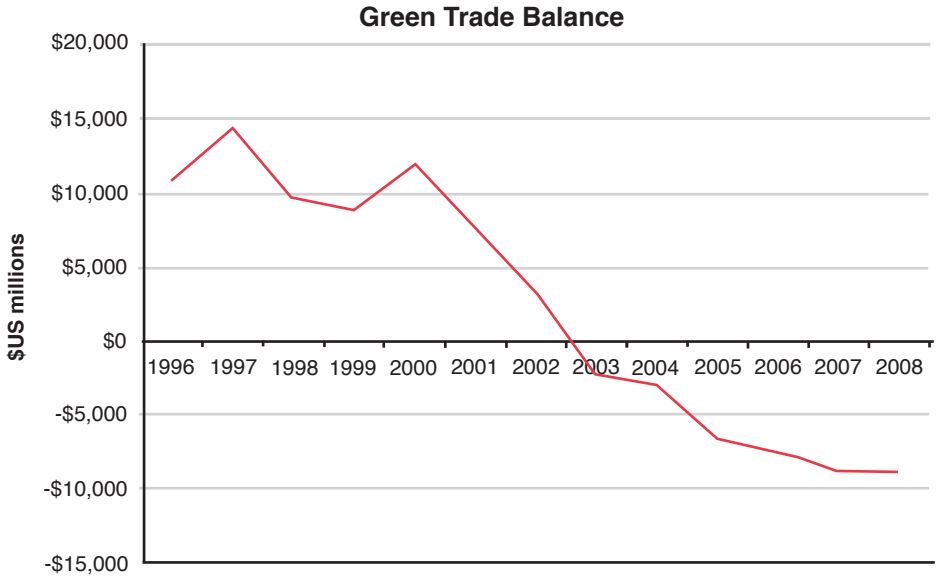
Public support for aggressive subsidies for renewables – either by direct credits or as a result of strict limits on greenhouse gasses – does appear to be ebbing, as can be seen in the resistance to "cap and trade" legislation and the recent decision by states such as Arizona to not adopt climate change-related mandates. At the same time, there is growing resistance to cost increases associated with renewable mandates at the local level, as evidenced by opposition to electricity rate increases in the City of Los Angeles. [xvi]

China Syndrome

At the same time, many of the manufacturing jobs associated with solar and wind energy now appear to be headed to China, which has the resources to out-subsidize virtually any American producer. This, combined with lower production costs and an expanding industrial base, threatens both U.S.-based and European producers. "The Chinese manufacturers can now make [solar panels] a lot cheaper than Europe, the US, and Japan because the whole supply chain is now available in China," says Martin Green, who runs the photovoltaic center at the University of South Wales in Australia." [xvii]

This has led to the closing of some factories, and relocations as U.S.-based producers send their production and assembly to China. The Gamesa wind turbine plant in western Pennsylvania announced late last year that it was laying off nearly half its 280 workers. So did General Electric, which plans to close a solar panel factory in Delaware, while Evergreen Solar, which received $58 million in state aid to build a 900-employee plant northwest of Boston, announced that it would move some assembly to China, costing 250 jobs.

We may also see Chinese-based companies setting up assembly operations in low-cost states like Arizona or Texas, but leaving the high-end research jobs and much of the raw material production back in China. According to a recent study by the office of Senator Ron Wyden (D-OR), the U.S. renewable energy trade deficit has increased 1400 percent in just the last five years. A 2009 New America Foundation study also finds disturbing evidence in this direction. It points out that in goods for reducing pollution, increasing energy efficiency, and producing renewable energy, America moved from a trade surplus of $14.4 billion in 1997 to a trade deficit of $8.9 billion in 2008. [xviii]



sources: Organization for Economic Cooperation and Development International Trade Commission

American firms and those in other western countries may find themselves subsidizing more opportunities for Chinese workers and engineers than for those workers closer to home. Applied Materials, for example, is a US company and the world's largest solar equipment manufacturer. It is building the world's most advanced solar R&D facility not in Silicon Valley, but in Xian, China. [xix]

This year, the Department of Energy's $2.3 billion in tax credits is designed to create 17,000 "clean tech" jobs. This works out to some $135,000 in subsidies per job, perhaps not the most efficient or fiscally responsible way to spur overall job growth.

America may find that renewables are an area which provides some lower-end installations for U.S. workers, but little in the way of new domestic industrial ventures outside of those that are highly subsidized by government.

The Cost of Green Jobs

It is difficult to state with certainty the impact of current and proposed policies to grow "green jobs." Some advocates believe that unemployment will be remedied by such things as the federal government's $11 billion plan to modernize the power grid. They also point out that only a fraction of Washington's support for green energy has been spent and it is too early to see the positive results of these expenditures. [xx]

But the evidence shows that green jobs and the regulations needed to spur them are expensive and can hurt the economy even more than the sole influence of higher energy prices.

This has clearly been the case in Europe. States such as California and New Jersey that have followed Spanish-style renewable energy subsidies have seen some growth in the industry, but not enough to withstand the ill-effects of the recession. Some argue that it is important to extend subsidies long enough for the industry to innovate and achieve economies of scale. Mike Ahearn, CEO of Arizona-based First Solar Corp, says that solar could be competitive "within a couple of years" if the industry gains scale through subsidies and other support: "It's a chicken and egg problem." [xxi]

Even if green jobs can be created, the cost of doing so – of essentially using more labor to create less energy – does not represent a positive economic result.

Critics generally point out the negative impacts of such high levels of subsidies. This year, the Department of Energy's $2.3 billion in tax credits is designed to create 17,000 "clean tech" jobs. This works out to some $135,000 in subsidies per job, perhaps not the most efficient or fiscally responsible way to spur overall job growth. [xxii]

Green jobs-oriented policies such as the proposed Waxman-Markey "cap and trade" bill could devastate many other parts of the economy. A recent analysis by the National Association of Manufacturers and the American Council for Capital Formation found that, even when newly-created green jobs are accounted for, as many as 2.4 million jobs would be lost.

Even if green jobs can be created, the cost of doing so – of essentially using more labor to create less energy – does not represent a positive economic result. It has been described in a Suffolk University study as part of a "make work path to poverty"; the report points out that most optimistic projections include assumptions that may not be feasible in the time frames cited, such as that 30 percent of all cars will be using renewable fuels, or that renewables will account for 40 percent of all energy use. [xxiv]

Finally, environmental and community groups have often raised strong objections to

green energy policies. They point out that large solar projects can threaten pristine desert environments, while windmills obscure views and kill millions of birds. Patrick Putnam, a field manager for the US Bureau of Land Management in southern Nevada, is currently considering the potential "undue environmental risks" posed by "dozens" of solar-energy projects that companies have proposed building on federal land in his jurisdiction.

This is not unique to Nevada. The Bureau of Land Management has reported a backlog of 200 proposed solar projects around the country, some of them now on the waiting list for years. As environmentally friendly companies in Denmark have learned, "green" policies are often not universally favorable to the creation of new employment and entrepreneurial opportunities. [xxv]

Summary of Review of the Current Economic Literature

We searched in vain for an academic paper that provided evidence that environmental regulation could increase economic activity and produce wealth. Instead, we found relatively few studies on how to minimize the economic costs of environmental regulation. We summarize some of the findings here. In a later section we examine the literature in detail with full cites.

For example, a carbon tax, or a cap and trade scheme that mimics a carbon tax, where the tax is rebated is the lowest-cost way to reduce GHG emissions.

Researchers who endorse a carbon tax generally agree that command-and-control-type regulations can actually result in increased GHG emissions, a byproduct of perverse incentives caused by subsidies (see individual reviews below).

Other policies can lead to perverse environmental results. For example, community designs to reduce GHG often support high-density development and derail sprawl. Recent studies in Australia, however, contradict the effectiveness of this notion, pointing to the high costs of energy associated with high-rise common areas, parking areas, and elevators. In addition, it may well be the case that high-density development actually increases traffic congestion, and, in the process, emissions.

But perhaps the most perverse impact of strong environmental legislation is its tendency to drive development from low-emission to higher-emission areas. This can be seen clearly in coastal California, where energy usage is low (due to the mild climate), but environmental regulation has driven consumer costs so high that there has been migration to less temperate, high-emissions areas, including out of state. Current land use restrictions, often implemented for local environmental reasons — to preserve open space, for example, or to reduce neighborhood traffic — often push new development towards the least environmentally friendly urban areas." [xxvi]

In contrast with the academic literature, there is a large non-academic literature that finds that environmental regulation does create jobs. As might be expected, these papers lack the completeness, thoroughness, rigor, and impartiality of the academic literature. At its extreme, some non-academic literature masquerading as rigorous research could lead regulators seriously astray if relied upon to develop effective public policy. For example, Next 10's paper, "Many Shades of Green" has been frequently cited as a source to prove the job growth potential

of California's green policies.

The Case of Oregon

Oregon has historically been on the forefront of environmental legislation and has suffered one of the persistently highest rates of unemployment in the nation. A recent UC Berkeley Labor Center report on the state's strong climate change legislation [xxvii] implied that the impacts would be felt most severely by the manufacturing industries that emit the most greenhouse gasses, but did not examine the impacts of higher energy costs on consumers, non-carbon-intensive manufacturers, or other businesses.

The omission is cause for serious concern about the report's validity. The state's strong greenhouse gas legislation seeks to cut emissions to 75 percent below 1990 levels by 2050. This will impact every Oregon business and consumer. To claim that it will only impact a small portion of Oregon's businesses, and then only analyze those selected industries, makes for an unjustifiably optimistic view.

The authors examined the impacts on the industries they identified as vulnerable. First, they attempt to measure the regulation's cost; next, they try to measure the production decline and job losses that would result from the cost increase.

In each attempt the methodology is troubling. The report vastly underestimates the costs as calculated by many economists, including Gilbert Metcalf in an influential 2007 paper conducted for the Brookings Institution; their calculations for price rises are one-third of those predicted by Metcalf. [xxviii] By understating the real costs and not analyzing the effects on the vast majority of Oregonians, the authors have not performed a service to Oregon or its citizens.

The correct way to analyze the impacts of GHG regulations on Oregon's citizens would be difficult, time consuming, and expensive. The first step would be to recognize the risky nature of the regulation and use a high price for carbon allocations. Next, the author of a reliable study would calculate the implied price increase for every sector, followed by the income effects and the much elasticity. All these results would be used to determine the total impact. The complexity would be challenging, but anything as large and risky as climate-change regulation deserves a quality analysis.

The Case of California

Like Oregon, California has been hard hit by the great recession. Since November 2007 the state has lost 1.37 million jobs. Its unemployment rate, now at 12.5 percent, is among the highest in the nation. And, again like Oregon, the state has often been regarded, and sees itself, as a trend-setter on environmental policy.

Not surprisingly, California policy-makers have targeted green jobs as a key element of the state's eventual economic recovery. Yet in reality, the job gains from this sector between 2003 and 2009 amounted to roughly 10,000 a year – hardly a major factor when considering that it will take perhaps 1.5 million jobs for the state to recover its losses just from the current recession. [xxix]

The state has enacted tough climate-change related legislation well ahead of national norms. Many of the ideas behind the regulations have been promoted in studies by climate change advocates. Support has included California Air Resources Board's own Scoping Plan Economic Analysis, [xxx]which predicts that the results will be essentially "cost free", or positive economic growth and job creation. Yet an analysis of various studies by environmental economist Robert Stavins and his team at Harvard's Kennedy School of Government is far less sanguine about likely impacts[xxi].

[Peer reviews] found CARB's analysis to "substantially" underestimate the cost of meeting California's 2020 target, saying that the study, "underestimate[s] costs by omitting important components of the costs of emission reduction efforts."

Although Stavins et al agreed there were opportunities for some no-cost emission reductions, they found CARB's analysis to "substantially" underestimate the cost of meeting California's 2020 target, saying that the study, "underestimate[s] costs by omitting important components of the costs of emission reduction efforts." The Harvard critics also claim that CARB overstated the offsetting savings from energy efficiency. Overall, the Stavins group believes that the CARB studies – which are frequently cited by climate change policy advocates — are off "on the order of billions of dollars," adding that "better analyses are needed to inform policymakers." [xxxii]

Indeed, while sympathetic to the scoping plan's objectives, Stavins says, "I have come to the inescapable conclusion that the economic analysis is terribly deficient in critical ways and should not be used by the State government or the public for the purpose of assessing the likely costs of CARB's plans."

A.B. 32: The Big Kahuna

Without question the passage and implementation of AB 32, "California's Global Warming Solutions Act," has emerged as the state's most critical piece of climate change legislation. Since its scope goes far beyond anything likely to be implemented on a national level, its employment impacts could be particularly critical to those California businesses which may have other options elsewhere in the country or abroad.

Sadly, as seen elsewhere, the projections of job gains from the legislation appear to be widely suspect, while approximations of the scale of negative impacts tend to be less than accurate. One prominent report , put together by the UC Berkeley Center for Labor

Research and Education by Carol Zabin and Andrea Buffa, asserts that energy efficiency incentives will encourage huge innovation, "presenting growth opportunities in traditional sectors and in new markets yet to be developed."

The Berkeley team reviews CARB's E-Dram and BEAR forecasts — sophisticated forecasting models — of the economic impacts of the AB32 Scoping Plan. It is not an unbiased scholastic analysis; rather, it's more of an argument. For example:

> "AB 32 offers tremendous economic opportunities for California. With successful implementation of AB 32, the state can become a center of green innovation and an export powerhouse for new technologies, products, and services. AB 32 will induce billions of dollars in private and public investment in energy efficiency retrofits, new construction, and renewable energy generation, presenting growth opportunities in traditional sectors and in new markets yet to be developed."

"Unfortunately, the discrepancies between the models undermine the credibility of either model's predictions of job loss or gain by sector."

The Berkeley team does note that the models have weaknesses, but then dismisses those weaknesses by saying, "While the models may not forecast the future completely accurately, they do represent the best forecasts we have." This admission is amazing, considering that CARB's models do not project overwhelming prosperity as a result of AB32. The BEAR model forecasts that AB32's implementation will result in a net gain of only 21,000 jobs (0.11 percent) over the baseline forecast between 2007 and 2020. The E-DRAM model forecasts that its implementation will yield a net gain of only 120,000 jobs (0.65 percent) over the same baseline forecast. Given the very small gains these forecasts predict for 13 years out, the possibility of job losses cannot be rejected with high probability. The authors must know that. Still, they talk about "…tremendous economic opportunities for California."

Peer review of CARB's report, and review by the Legislative Analyst's Office, has been devastating. Estimates of costs were described as inconsistent and incomplete. Four of the five reviewers cited very serious problems with the models and process.

Peer review of the CARB's report, and review by the Legislative Analyst's Office, has been devastating. Estimates of costs were described as inconsistent and incomplete. Four of the five reviewers cited very serious problems with the models and process. Our extensive review appears in the appendix to this report.

Given the critical weaknesses identified by objective analysts, we can only conclude that Zabin and Buffa's brief is not a serious analysis. [xxxiv] As Stavins acknowledges, even if we believe climate change to pose "…an important environmental threat which merits serious attention by policy makers… This will not be easy, and it will not be cheap. Indeed it will be costly, as clearly indicated by economic analyses that have been carried out around the world."

It is simply impossible to see how draconian legislation — particularly through mandates imposed in only one state — can not have serious deleterious economic impacts.

California's economy is too important to be determined by approaches that are far from well thought-out. As Matthew E. Kahn of the UCLA Institute of the Environment, Department of Economics, and Department of Public Policy has said, AB32 is being presented as a riskless "free lunch" for Californians[xxxv]. It is simply impossible to see how draconian legislation — particularly through mandates imposed in only one state — can not have serious deleterious economic impacts. Even those who are broadly sympathetic to AB 32's policy goals, including Kahn and Stavins, realize that substituting wishful thinking for sound policy represents an enormous risk.

Conclusion: Time To Get Real

All of the reports discussed here point to a more serious problem, one that economists have known about since the great French economist Frederic Bastiat identified it in his essay, "That which is Seen, and That Which is Not Seen," written not long before his death in 1850. In our current day case, regulation has been a source of at least some of the observed job growth. We see that. We can count the jobs. We can quibble over how to count them, but we can count them. What we don't see, though, is the jobs that might have been created absent the regulation responsible for the observed job growth. The correct measure of job growth would be a net-job-growth measure. The methodology would identify the jobs created as a result of the regulation, and it would identify the jobs lost as a result of the regulation. The result would be a measure that showed the difference between them. It could be positive, or it could be negative. We don't know what the result would be in the case of job growth.

In addition, we must ask: Is all job growth good? The advocates of green jobs assume that it is. However, consider a hypothetical regulation banning the use of tractors on California farms and ranches. Agricultural employment would increase, no doubt about that, and output would surely decline. Would society be better off because of the regulation? Clearly not, since output and consumption would decline.

The example is not as far-fetched as it may seem. The Next 10 report states, apparently approvingly, that 66 percent of the energy generation sector's employment is in solar, a far greater share of jobs than its share of energy production. We're back to Bastiat's observation about the seen and the unseen. We see these jobs. We don't see what these workers would produce in another job if we were to use a more efficient technology.

Ultimately, the best way to create green jobs would be to grow the economy, a growth that some environmentalists may not embrace as "climate friendly." In recent years, much of the growth in green-related jobs and construction has been not in California, but in pro-growth states such as Texas and Arizona.

Yet it is in precisely the industries most associated with greenhouse gas emissions – such as manufacturing and construction – where the prospects for green jobs are greatest, according to extensive research by EMSI, an economic consultancy. Explains Rob Sentz, a principal at the firm, " In reality, green is much less about "what" is being produced than "how" things are produced… in order to have "green" industry, you first need to have an industry that can be, if you will, "greened". [xxxvi]

The charts below illustrate this point:

Strategies for Green Economic Investment	Representative Jobs
Building Retrofitting	Electricians, Heating/Air Conditioning Installers, Carpenters, Construction Equipment Operators, Roofers, Insulation Workers, Carpenter Helpers, Industrial Truck Drivers, Construction Managers, Building Inspectors
Mass Transit/Freight Rail	Civil Engineers, Rail Track Layers, Electricians, Welders, Metal Fabricators, Engine Assemblers, Bus Drivers, Dispatchers, Locomotive Engineers, Railroad Conductors
Smart Grid	Computer Software Engineers, Electrical Engineers, Electrical Equipment Assemblers, Electrical Equipment Technicians, Machinists, Team Assemblers, Construction Laborers, Operating Engineers, Electrical Power Line Installers and Repairers
Wind Power	Environmental Engineers, Iron and Steel Workers, Millwrights, Sheet Metal Workers, Machinists, Electrical Equipment Assemblers, Construction Equipment Operators, Industrial Truck Drivers, Industrial Production Managers, First-Line Production Supervisors
Solar Power	Electrical Engineers, Electricians, Industrial Machinery Mechanics, Welders, Metal Fabricators, Electrical Equipment Assemblers, Construction Equipment Operators, Installation Helpers, Laborers, Construction Managers
Advanced Biofuels	Chemical Engineers, Chemists, Chemical Equipment Operators, Chemical Technicians, Mixing and Blending Machine Operators, Agricultural Workers, Industrial Truck Drivers, Farm Product Purchasers, Agricultural and Forestry Supervisors, Agricultural Inspectors

Table 1: Occupations for "Building Retrofitting," 2005-2008

SOC Code	Description	2005 Jobs	2008 Jobs	Change	% Change	New & Rep. Jobs	% New & Rep.	2007 Median Hourly Earnings	Education Level
11-9021	Construction managers	710,135	729,438	19,303	3%	54,468	8%	$20.89	Bachelor's degree
47-2031	Carpenters	1,696,988	1,674,590	(22,398)	(1%)	48,629	3%	$17.6	Long-term on-the-job training
47-2073	Operating engineers and other construction equipment operators	423,159	438,351	15,192	4%	41,129	10%	$19.39	Moderate-term on-the-job training
47-2111	Electricians	723,767	732,088	8,321	1%	67,107	9%	$21.39	Long-term on-the-job training
47-2131	Insulation workers	32,067	31,887	(180)	(1%)	2,049	6%	$16.01	Moderate-term on-the-job training
47-2181	Roofers	184,888	181,080	(3,808)	(2%)	9,220	5%	$16.27	Moderate-term on-the-job training
47-3012	Helpers, carpenters	97,096	94,319	(2,777)	(3%)	4,742	5%	$12.31	Short-term on-the-job training
47-4011	Construction and building inspectors	121,115	130,625	9,510	8%	16,666	14%	$22.55	Work experience in a related field
49-9021	Heating, air conditioning, and refrigeration mechanics and installers	324,449	334,516	10,067	3%	28,161	9%	$17.9	Long-term on-the-job training
53-7051	Industrial truck and tractor operators	641,566	630,903	(10,663)	(2%)	41,991	0.07	$13.65	Short-term on-the-job training
		4,955,229	**4,977,797**	**22,567**	**0%**	**314,164**	**6%**	**$18.29**	

Source: EMSI Complete Employment - Fall 2008 (National County Level Data)

We need to shift our focus to the ultimate costs of green energy, both to the overall economy, and to consumers. With renewable energy roughly three times more expensive than conventional sources, there has been mounting push-back to mandates in places as different as Los Angeles and Toronto. And when the jobs that are created need to be subsidized, this extracts a cost from the rest of the economy. [xxxvii]

Ultimately, these considerations need to be factored into the Green Jobs debate. Certainly, we want our productive economy to be greener and more energy efficient. But we also want it to generate employment that contributes to the overall economy, with a minimum of subsidies diverted from less-favored, non-green sectors, or paid for by taxpayers.

In conclusion, it is time for California to get real about the impact on jobs and the economy of green job policies. Let's acknowledge that there will be winners and losers, and that the net result of green policies may be negative for the economy. However, by maintaining a healthy and growing economy that can be "greened" we will minimize those costs and achieve our environmental goals.

Review of Selected Non-Academic Papers

Review of "Addressing the Employment Impacts of AB 32, California's Global Warming Solutions Act"

> *"AB 32 offers tremendous economic opportunities for California. With successful implementation of AB 32, the state can become a center of green innovation and an export powerhouse for new technologies, products, and services. AB 32 will induce billions of dollars in private and public investment in energy efficiency . retrofits, new construction, and renewable energy generation, presenting growth opportunities in traditional sectors and in new markets yet to be developed."*

We are here reviewing a policy brief by Carol Zabin, Ph.D. and Andrea Buffa of the UC Berkley Center for Labor Research and Education. In the brief, they review E-Dram and BEAR forecasts of the AB32 Scoping Plan. It is not an unbiased scholastic analysis. The paragraph quoted above is representative.

The authors do note that the models have weaknesses, but then they dismiss those weaknesses by saying *"While the models may not forecast the future completely accurately, they do represent the best forecasts we have."* This quote is amazing. It is not like the models are projecting overwhelming prosperity because of AB32. The BEAR model forecasts, as a result of AB32 implementation, a net gain of only 21,000 jobs (0.11 percent) over the baseline forecast between 2007 and 2020. The E-DRAM model forecasts, as a result of AB32 implementation, a net gain of only 120,000 jobs (0.65 percent) over the baseline forecast between 2007 and 2020. Given the size of confidence intervals for forecasts 13 years out, that possibility of job losses cannot be rejected with high probability. The authors must know that. Still, they talk about *"tremendous economic opportunities for California."*

Furthermore, the weakness referred to is, in fact, very serious, serious enough to be fatal. Indeed, one review, sympathetic to the scoping plan's objectives said "I have come to the inescapable conclusion that the economic analysis is terribly deficient in critical ways and should not be used by the State government or the public for the purpose of assessing the likely costs of CARB's plans."

The scoping plan's economic analysis was subject to peer review and review by the Legislative Analyst's Office. Each was devastating. Four of the five reviewers cited very serious problems with the models and process.

What exactly are the weaknesses of the modeling that Zabin and Buffa so cavalierly dismiss, yet would cause a respected sympathetic reviewer such anguish?

After review of all of LAO's report and the reports of the peer review team, we conclude that CARB's models and process are fatally flawed for the following reasons:

- The analysis is internally inconsistent.
- The analysis systematically under-estimates the cost of the plan.
- The analysis neglects the transition costs and the timing of costs.
- The analysis relies on excessive aggregation.
- The analysis ignores Alternative policies.
- The analysis is dependent on questionable assumptions.
- The analysis ignores consumer incentives.
- The analysis assumes always-efficient markets.
- The analysis concludes that a "free lunch" exist in contrast to economic theory and empirical research.
- The analysis ignores risk and the higher returns risk requires.
- The analysis ignores firm behaviors in the presence of significant cost differentials between California and other states.

- The analysis assumes large electricity price elasticity's, contrary to the peer-reviewed literature.
- The models produce results that are counter to other leading models.

Given the critical weaknesses identified by objective analysts, we can only conclude that Zabin and Buffa's brief is a whitewash and not serious analysis.

Review of "Many Shades of Green"

Many Shades of Green is difficult to review, because it's not a research paper, or a brief, or anything like what we are typically asked to review. We struggled to figure out exactly what it is. The piece has lots of numbers, and charts, and tables. It makes lots of assertions, but they are not backed up by sources, methodology, or references. Finally, we decided that "Many Shades of Green" is a 32 page marketing piece, not a study that should be relied upon for serious policy deliberations.

Essentially, the piece says that California's Green Jobs have been growing faster than other jobs, and this is good. As discussed below, this may or may not be true, depending on the economic and job costs of the underlying policy drivers for that result. They also assert that policy makers and businesses should embrace Green Jobs as a source of renewed California prosperity. Again, that assertion is only justified if it can be shown that the green job policies to be embraced will be a net positive for the California economy.

Of course, the first problem is defining "Green Jobs." To that end, the piece identifies a "Core Green Economy." This they define as businesses that:

- "Provide alternatives to carbon-based energy sources
- Conserve the use of energy and all natural resources
- Reduce pollution (including GHG emissions) and repurpose waste"

Thus green jobs include those created in entirely new industries as well as those in existing industries identified as "green" by the criteria above. The data is not described in a way that makes separating businesses and jobs by these criteria possible. The piece acknowledges this and the fact that there are multiple approaches to the problem. The piece also claims to have used the "most comprehensive" approach. Since it uses the word "comprehensive" and not "rigorous", they probably took the approach of minimizing the chance of missing a firm.

There are two possible types of errors in separating firms by NAICS codes. A type-one error would be missing firms that meet the criteria. A type-two error would be including firms that do not meet the separating criteria. A careful report would attempt to minimize type-two errors. It appears that the authors of this piece elected to minimize type-one errors. That is, their "comprehensive" approach attempted to identify all possible "Green" firms, and if they included a few "Non-Green" firms, well that's the cost of being "comprehensive."

So, they include energy Infrastructure firms that are in the cable and equipment and consulting and management services. They include venture capital and private equity investment firms. They include firms working on advance batteries (Li-ion, NiMH) and battery components and accessories. They include manufacturing and industrial firms working with advanced packaging and process management. The list goes on. The point is that they

include firms that may be "Green," but they may not be. Even many of the ones identified as "Green" would still exist, even if there was no push to "Green." Cables, for example, are used to move electricity, if it's generated using the dirtiest high-sulfur coal known or if it's generated with an efficient windmill.

Then, the piece points out that the sectors it has identified as "Green" saw more growth in firms and jobs than did the remaining sectors. We'll stipulate to that, but it is not clear what it means to California. Part of the problem is the "comprehensive approach" of counting so many existing jobs as green. Maybe all those jobs were created in firms that were not really "Green."

Of greater interest would be an assessment of the growth of jobs directly related to innovative green technologies, for example, but the comprehensive approach makes this impossible to assess.

It is a marketing piece and nothing more.

Review of "The Impact of Climate Change Policies on Carbon-Intensive Manufacturing Industries in Oregon"

"The Impact of Climate Change Policies on Carbon-Intensive Manufacturing Industries in Oregon" claim to be a policy brief on the impacts of climate-change policies on a small portion of Oregon's economy, carbon-intensive manufacturing. It is not an economic impact study of carbon-change policies. As such, it does not examine the impacts of higher energy costs on consumers, non-carbon-intensive manufacturers, or other businesses.

We hope that the limited scope of "The Impact of Climate Change Policies on Carbon-Intensive Manufacturing Industries in Oregon" was intentional, but it may be because the authors are a bit confused. On page 14 they say:

> "Climate change measures will not impact all manufacturing industries in Oregon—they will only impact the manufacturing industries that emit the most greenhouse gasses."

That is just absurd. On page 10, the authors said:

> "In order to address the threat of climate change, Oregon passed a bill in 2007 that set goals for reducing GHG emissions in the state. House Bill 3543 states that Oregon will begin to reduce GHG emissions by 2010, then reduce emissions to 10 percent below 1990 levels by 2020 and to 75 percent below 1990 levels by 2050. Oregon's GHG emissions are generated primarily by the electricity generation and transportation sectors of the economy."

The sort of energy and transportation price increases implicit in reducing GHG emissions to 75 percent below 1990 levels will impact every Oregon business and consumer. To state that the regulation will only impact a small portion of Oregon's businesses and then only analyze selected industries is the same as assuming that the regulation will have only a small impact. We're not surprised then to find that the authors only a small impact.

Having embraced their extreme Panglossian world view, the authors proceed to examine the impacts on the industries they identified as vulnerable. This proceeds in two steps. The first step attempts to measure the impact of the GHG regulation on the vulnerable industries' cost. The second step attempts to measure the production decline and job losses that would result from the cost increase.

We have trouble with the methodology of each step.

In the first step, the authors consider four possible prices for per-ton carbon allowances: $10, $15, $25, and $50. They present their findings, as percentage increases in total costs, in two tables on pages 20 and 21. However, in the summary and body of the report mainly, perhaps exclusively, discuss only the results for the $15 price. They claim they set the price range "to cover a broad range of predictions of the carbon allowances for various policy proposals…" They acknowledge that "After 2020, the price under both the national and California policy is expected to rise as the carbon cap is reduced; however, there are no price projections for future years."

In fact, their range is low, and there are price projections for future years. Gilbert Metcalf, in a very influential 2007 paper for the Brookings Institution estimates that the price will rise by 2050 to just under $60. Given the authors limited range, they should be analyzing the results for the $50 price than the $15 price. Of course those results are far more dramatic than the ones they chose to discuss.

In the second step, the authors identify all the jobs in sectors that the first step showed would see a percentage cost increase of 2 percent at the $15 price. They then "generously" assume all of those jobs would leave Oregon. They conclude that the state is a risk of losing only 12,745 jobs. Of course, if the actual price of a ton of carbon allocation exceeds $15, this is all just a waste of time.

We discuss the correct way to perform the analysis below. However, even given the authors' primitive method, this report could be done far better. Researchers must acknowledge that environmental regulation is risky and people are risk averse. Therefore, a price higher than $15 has to be used. It is also imperative to not assume that entire portions of the economy will be unaffected by the regulation. Price changes cause behavioral changes. In this case, we have both income and substitution effects. By ignoring the income effects and the vast majority of Oregon's economy, the authors have not performed a service to Oregon or its citizens. They have only contributed to the confusion.

The correct way to analyze GHG regulations' impacts on Oregonians would be difficult, time consuming, and expensive. The first step would be to recognize the risky nature of the regulation and use a high price for carbon allocations. Next, one would calculate the implied price increase for every sector. Then, you would calculate the income effects and the many elasticities. Finally, you would use these to determine the total impact. This is a challenge, but anything as large and risky as climate-change regulation deserves quality analysis.

Review of Selected Academic Papers

We searched in vain for an academic paper that provided evidence that environmental regulation could increase economic activity. Instead, we found a relatively small literature on how to minimize the economic costs of environmental regulation. The consensus is that, because the costs of the negative externalities associated with GHG emissions, a market solution is sub-optimal. Instead a carbon tax, or equivalently a cap and trade or permit scheme that mimics a carbon tax, where the tax is rebated, is the lowest-cost way to reduce GHG emissions. The rebate of the tax revenues in a way that removes some of the distortions

of the existing tax is critical to minimizing the cost of the tax or cap and trade scheme. Generally, the authors are sympathetic to the need to reduce GHG emissions, but they recognize GHG reductions come with economic costs. They seek to minimize those costs.

Not only do academic researchers find that a rebated carbon tax is optimal, they often find that command-and-control-type regulations can have perverse results. That is they find that some command-and-control regulations can actually result in increased GHG emissions. We briefly summarize a few of these papers below:

Greenhouse Gas Reductions under Low Carbon Fuel Standards? Stephen P. Holland, Christopher R. Knittel and Jonathon E. Hughes May 18, 2007

The authors first examine the theoretical results of low carbon fuel standards (LCFS) and similar types (fleet mileage requirements, for example) of environmental regulation. Using a sophisticated theoretical model, they find that "an energy-based low carbon fuel standard (i) cannot be efficient, (ii) can decrease or increase carbon emissions, and (iii) can increase or decrease efficiency." (Emphases theirs) The reason for potentially perverse results is that a standard works as a tax on the high-emission fuels, but a subsidy for low-emission fuels. The emissions from the increased production of the low-emission fuel may be more than the reduction in emissions resulting from the production cutbacks in the high-emission fuel.

The authors follow their theory sections with calibrated models and simulations using ethanol and gasoline. Here, they find that, while low carbon fuel standards are an expensive way to reduce carbon emissions, in practice they are unlikely to actually increase emissions. They conclude that "…, it is unlikely that an energy-based LCFS would be the preferred policy unless the range of alternative options were extremely limited."

The Greenness of Cities: Carbon Dioxide Emissions and Urban Development, by Edward L. Glaeser and Matthew E. Kahn, 2008-07

The authors first present a theoretical model that demonstrates that, because of un-priced negative externalities, private individuals will make inefficient locational decisions. They also find that even if the externalities are internalizes, say by a tax, locational decisions may still be sub-optimal in the presence of subsidized development in high-emission locals or if development is restricted in low-emission locals.

When they look at United States data, the authors find a weak correlation between emission levels and population growth. That is, population growth tends to occur in high-emission localities. They find a strong negative correlation between emissions and land use controls. Places with low emissions, such as much of California, have more restrictive development controls. The impacts can be perverse. In the authors' words "This fact suggests that current land use restrictions may be doing the opposite of what a climate change activist may have hoped. Those restrictions, often implemented for local environmental reasons (such as to preserve open space or reduce neighborhood traffic), seem to push new development towards the least environmentally friendly urban areas."

Modeling Economy-wide vs Sectoral Climate Policies Using Combined Aggregate-Sectoral Models, William Pizer, Dallas Burtraw, Winston Harrington, Richard Newell, and James Sanchirico, 2006

The authors use a sectoral model to identify cost differences between various emission-limiting regulations. The baseline regulation is an economy-wide auctioned permit system with the auction revenues going to reduce income taxes. They compare the baseline to a similar regulation that excludes some sectors, to a renewable portfolio standard (RPS, similar to the LCFS in the previously reviewed paper), and a corporate average fuel economy (CAFÉ) standard.

The authors find that the cost of an auction that excluded "some sectors—such as residential, construction, commercial, and government direct use of fossil fuels—does not noticeably affect the cost of an otherwise economy-wide tradable permit system." By contrast, they find that the RPS and CAFÉ approaches are extremely costly, increasing the cost of emission reduction by as much as ten times.

A Realistic Policy On International Carbon Offsets, Michael W. Wara and David G. Victor, April 2008

While international in scope, this paper highlights the inefficiencies of carbon offset programs. These are programs where a carbon source pays another carbon source to reduce emissions. The authors find that in practice, these programs are extremely expensive ways to reduce carbon emissions, because anticipated emissions reductions often do not occur. They give a particularly egregious example of HFC-23, a greenhouse byproduct gas resulting from the production of the refrigerant HFC-22. HFC-33 is 11,700 times more potent that CO2, very cheaply captured and destroyed. Because of the perverse incentives in carbon offset programs, the sales of credits for HFC-23 exceed the value of the production of the refrigerant. Offsets were being created by increasing the production of HFC-22, just to create HFC-23 to capture and destroy.

Too Good to Be True? An Examination of Three Economic Assessments of California Climate Change Policy, Robert N. Stavins, Judson Jaffe, and Todd Schatzki, March 2007

This report examines three 2006 studies that found that California could meet its 2020 CO2 emission targets at no net economic cost. The studies were performed by California's Climate Action Team, the Center for Clean Air Policy, and David Roland-Holst. Below we provide the third paragraph of the authors' Executive Summary:

"We find that although opportunities may exist for some no-cost emission reductions, these California studies substantially underestimate the cost of meeting California's 2020 target. The studies underestimate costs by omitting important components of the costs of emission reduction efforts, and by overestimating offsetting savings that some of those efforts yield through improved energy efficiency. In some cases, the studies focus on the costs of particular actions to reduce emissions, but fail to consider the effectiveness and costs of policies that would be necessary to bring about such actions. While quantifying the full extent of the resulting cost estimation is beyond the scope of our study, the underestimation is clearly economically significant. A few of the identified flaws individually lead to underestimation of annual costs on the order of billions of dollars. Hence, these studies do not offer reliable estimates of the cost of meeting California's 2020 target. Better analyses are needed to inform policymakers."

Proposal for a U.S. Carbon Tax Swap An Equitable Tax Reform to Address Global Climate Change, Gilbert E. Metcalf, October 2007

This paper provides a strong argument that a tax swap is the best way to decrease greenhouse gasses. It proposes a particular type of sway that would tax greenhouse gas emissions at an initial rate of $15 per ton of carbon, climbing to $65 by 2050. The revenues from the tax would be refunded through a tax credit for sequestration activities and a tax credit on personal income tax. The proposal as presented is, therefore, revenue neutral and distributionally neutral.

The Theory of Environmental Regulation as a Source of Jobs

Proponents of regulation as a source of economic growth talk about the gains from research and new technologies, but those gains could be realized far more cheaply by just investing in the research, instead of imposing immediate high energy costs on the economy. They also argue that higher prices will encourage conservation and free up resources for other uses. This argument has two problems: It assumes that the markets are sending the wrong signals, and it assumes that requiring an alternative energy source is the best solution to the problem. In the unlikely event that markets were sending the wrong signals, the best response would be to simply raise the price, by placing a tax on the offending energy source and refunding the tax revenue in a way independent of usage of the taxed energy source. This is a less-constrained option, and therefore preferred.

However, there is an economic argument to support the regulation.

The idea that increasing energy regulation could generate net-jobs gains relies implicitly on the argument that we are currently using an inefficient technology, and that use is an accident of history.

To illustrate, suppose that we have two competing technologies and that the cost of each technology declines with experience. Suppose that one of the technologies, call it Technology A, is everywhere more efficient than the other, Technology B.

Most people would say that we should use Technology A, but that is not necessarily true. Suppose, that because the resource that fuels Technology B was flowing out of the ground that we have lots of experience with Technology B but little experience with Technology A. So, we are using the inefficient technology.

Should we switch from Technology B to Technology A? That depends. It may be that the cost of getting us to a profitable point on the learning curve exceeds the benefits. That is, the present value of the savings of using Technology A is less than the present value of the conversion. The textbook example of this situation is the QWERTY keyboard, adopted precisely because it was slow, to keep mechanical typewriters from jamming. Any number of alternatives would be more efficient, but we don't change. Apparently, the cost of changing exceeds the benefits.

One could challenge the analysis in the previous paragraph by arguing that the benefits of converting to Technology A would accrue society in general, but the costs would be borne by only a few. That is, we have an incentive problem. In such a case, government intervention is appropriate, and this provides pro-regulation proponents with their strongest case.

Of course, the analysis so far has assumed that we know the cost curves of the various proposed technologies. In fact, we don't. To the extent that we do not know what the cost curve of an alternative technology looks like, both the timing and amount of any potential savings are more uncertain, making the adoption of the alternative less attractive ex-ante.

We are left with a gamble, one where we do not even know the odds.

The decision to accept the gamble is made more difficult by the fact that risk preferences differ. It is also complicated by the fact that any option will benefit some companies or individuals, while the costs are mostly diffuse. This creates a constituency for the option, and that constituency has strong incentives to push for the option, to categorize the potential risks as minimal and to emphasize any potential benefits.

There is another possibility. It is possible that the cost of the current technology, Technology B, eventually rises because the cost of the resource rises. This is the peak-oil argument.

Of course, resource prices should reflect the eventual scarcity of the resource. There are those who argue that peak oil production is imminent, and that prices do not reflect the soon-to-be-realized shortage. They have a decades-long record in predicting immediate shortages, but their track record provides no reason for confidence in their forecasts. While it seems certain that we will eventually run out of oil, prices do not reflect the arguments of the theory's most ardent supporters, that supplies will soon be consumed.

What does all this mean?

It means that it is possible that a new, currently costly, technology can eventually be cost efficient relative to an old technology, and that mandated adoption and/or government subsidies can facilitate the migration to the new technologies. However, even when cost schedules are known, there are issues of implementation and uncertainties about the eventual viability of the new technology. In particular, new technology requires investment, which includes a costly adoption period. Those implementation costs could exceed the benefits of the change in technologies.

Additionally, we do not actually know the costs curves look like, particularly the new technology's cost curve. Therefore, the implementation of a new technology is risky, akin to a gamble. The required rate of return to justify the investment is consequently very high. Therefore, while possible, it is not a foregone conclusion that Green technology can create sustainable economic activity, unsupported by government subsidy or mandated use.

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