Green Policies, Climate Change, and New Jobs:

Separating Fact From Fiction

Swank Program in Rural-Urban Policy Summary and Report
June 2010

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Executive Summary

Two words encompass the merger of environmental policy with economic policy—"green jobs." "Green Jobs," the new buzzwords of politicians, are touted by supporters as promising environmental sustainability and economic prosperity. Others believe these policies are environmentally irrelevant and will lead to economic disaster. Underlying this debate are urgent issues such as climate change, with some models predicting potentially "catastrophic and abrupt"[1] consequences of inaction, indicating that a greener future is an important priority. Likewise, the worst recession since the Great Depression has created the need for new jobs. Supporters argue that green jobs are the "holy grail" which will lead to environmental sustainability and economic prosperity.

The state of Ohio is following countless states, cities, and nations in the chase for green energy. Boosters argue that Ohio possesses unique advantages not held elsewhere, though boosters in the other locales believe they too hold the competitive advantage in being the clean energy capital of the world. Can we all win or will only a few lucky jurisdictions capture most of the prize? Most likely, only a few will win. According to a recent *Columbus Dispatch* report[2], between 2007 and 2010, Ohio invested $2.6 billion on advanced energy projects, with most on "clean coal" projects. In an environment of budget shortfalls in which every dollar counts, this massive investment should be evaluated for its potential payoff. Will it deliver the promised returns in large numbers of new jobs or will it be a failed government program that diverts our attention from more promising prospects?

Fortunately, before policies such as green job subsidies and cap and trade are enacted, there are valuable lessons to be learned from previous experience, as well as from the current state of America's energy industry. In this manner, this policy brief assesses current efforts to merge environmental policy with job creation efforts. To preview our findings, we conclude that the state's current efforts are unlikely to generate large numbers of new jobs. The overriding weakness for alternative energy to create jobs even in the short run is that virtually all alternative energy technologies are capital intensive, requiring relatively

Acknowledgements: We would like to thank Shibalee Majumdar, Tripti, Uprety, Ian Sheldon, and Heather Stephens for their valuable insights. Any mistakes should not be associated with them but are our own.

1. IPCC, 2007. http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch2s2-2-4.html
2. Hallett and Gearino, 2010. http://www.dispatch.com/live/content/local_news/stories/2010/05/16/what-color-ohios-economy.html?sid=101

few workers. While this gives us hope that eventually "green energy" can be competitive with fossil fuels, it illustrates why it will not be a major job creator. A future policy brief will discuss what we believe to be a more effective approach to leverage Ohio's assets in garnering a share of the green economy.

Significant Findings:

- Through a cap and trade program, the 1990 Clean Air Act significantly reduced acid rain caused by sulfur dioxide emissions with negligible impacts on employment suggesting similar methods of approaching greenhouse gas emissions would be effective and also would have small impacts on jobs.
- Subsidies to green jobs may reduce carbon emissions, but would also have minimal impacts on employment. Although green job growth has been impressive, its share of employment is too small to have a notable impact on unemployment.
- The job-creating potential of subsidies to green jobs will be further reduced by displacement effects—i.e., a larger green energy sector comes at the expense of employment in the fossil fuels industry, such as coal, as well as other industries that would be harmed from the higher taxes needed to fund the subsidies.
- We find that replacing 25% of our coal energy with wind energy would in fact reduce carbon emissions by over 450 tons, but it would also increase costs by approximately $22 billion. The short run changes in total employment would likely range between -0.012% and +0.068%. In either event, the change is so tiny it would not even be noticed.
- California has a decade long head start in green energy. This has not translated into a significant number of "green" jobs and its overall economy may even lag the nation in job growth.
- Although coal produces more carbon emissions than alternative energy sources, it is also significantly lower in cost. Thus, there are opportunity costs associated with not only the allocation of tax revenue but also replacing coal in terms of cost and productivity. These savings could be used to invest in alternative methods of creating jobs and alternative methods to reduce carbon emissions, including energy efficiency.
- Rather than subsidizing "green energy" projects, there are lower cost methods to create the jobs so desperately needed by unemployed Americans. Some of the lowest cost methods of creating jobs are increasing funding for construction of infrastructure and R&D for long-term growth.
- Likewise, there are lower cost methods to more efficiently reduce carbon emissions, including simple energy conservation. Commercial and residential building and appliance modernization are among the most economical methods of reducing carbon. Programs such as "cash for caulkers" may have more beneficial impacts on both job creation and reduction of carbon emissions than subsidies for alternative energy.

When all such opportunity costs are taken into account, our analysis suggests that the minimum cost method of reducing carbon emissions and creating jobs would be to separate environmental policy from employment policy. Thus, governments can create policies and allocate funds to effectively deal with both climate change and unemployment, but they should tackle them as separate issues. Keeping them together will likely lead to smaller gains for the environment without any net job creation benefits.

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Introduction

The consequences of climate change are uncertain, but have the potential to drastically affect not only our environment but also the economy. Cap and trade and green jobs proposals have helped bring about the confluence of policies addressing what are arguably the most significant problems of our time, global climate change and the global economic recession. These policies address environmental and economic challenges including the market's failure to price the increasing level greenhouse gas emissions, specifically carbon dioxide, and the high unemployment rates caused by the economic downturn. Although the natural long-term rate of unemployment is approximately 5%, the national unemployment rate is currently more than double that at 10.2**%** (March 2010) and states such as Ohio and Michigan have reached unemployment levels of 11.5% and 14.9%**,** respectively.[3]

Policymakers have promised that by discouraging fossil-fuel intensive industries and encouraging alternative energy industries through subsidies, jobs can be created to alleviate unemployment while promoting energy security and independence from carbon emitting fossil fuels. Illustrating this viewpoint, the U.S. Conference of Mayors released the following statement about investing in green jobs:

> "The economic advantages of the Green Economy include the macroeconomic benefits of investment in new technologies, greater productivity, improvements in the U.S. balance of trade, and increased real disposable income across the nation. They also include the microeconomic benefits of lower costs of doing business and reduced household energy expenditures. These advantages are manifested in job growth, income growth, and of course, a cleaner environment."[4]

In contrast, opponents of cap and trade and green job subsidies have promised that these policies would actually result in millions of lost jobs, reduced productivity, increased household energy expenditures, and a reduction in income and the competitive advantage of the U.S.[5]

We conclude that many of the claims on both sides are overstated or simply unfounded and ignore the opportunity costs of policies. Moreover, policies that address unemployment and climate change separately may be more efficient at creat-

3. US Bureau of Labor Statistics February 2010 http://www.google.com/publicdata?ds=usunemployment&met=unemployment_rate&idim=state:ST260000&dl=en&hl=en&q=michigan+unemployment+rate
4. US Conference of Mayors http://usmayors.org/pressreleases/uploads/GreenJobsReport.pdf
5. Republican Policy Committee http://rpc.senate.gov/public/_files/

ing jobs and reducing carbon emissions than policies that attempt to solve these problems simultaneously.

Below, we take each of these in turn. First we assess the impact of cap and trade policies on employment and the economy—concluding that the effects are likely to be rather minor. Then we examine the impact of alternative energy policies on employment and carbon emissions. We conclude that alternative energy production is likely to be one of the more expensive ways to reduce carbon emissions and it is unclear whether net job creation will be positive.

We then examine the example of California, which is decades ahead of the rest of the country in terms of adopting alternative energy and reducing energy consumption per capita. We find that despite having more than a one generation head start, California's green-job share of total employment remains below 1 percent and its overall economic performance in terms of total employment growth has lagged the national average. These findings do not suggest that movements to a green economy will be a major economic engine of growth.

We caution that this does not mean that California's environmental policies are not socially worthwhile because the positive environmental impact may be sufficient in itself to justify the policies. Yet, California's experience does suggest that merging environmental policy with economic policy will likely lead to disappointing outcomes in terms of its potential to fix unemployment.

Cap and Trade

Market forces do not provide firms with incentives to reduce carbon emissions. When firms have no direct costs associated with their amount of carbon emissions, firms will choose to produce more greenhouse gases than is desirable for society. This market failure or negative externality can be alleviated by imposing a cost on carbon emissions for firms. A quantity mechanism for imposing this cost works by capping the total amount of carbon that firms are allowed to emit and allowing firms to trade permits to emit certain levels of carbon; hence, the term "cap and trade." Capping carbon emissions promotes accountability of firms to society and promotes the sustainability of their industries.

Ultimately, these permits would be traded on a market with the market determining the price of the right to emit additional carbon. The permit price provides incentives for firms to innovate in order to reduce emissions and costs.[6] There are, however, implications of these policies for product markets and labor markets of the industries that are energy intensive. Figure 1 depicts the immediate consequences of implementing cap and trade. By capping emissions, the government is essentially increasing the costs of production, causing the product supply curve to shift in. The carbon quantity cap will therefore increase prices of fossil fuels and energy-intensive goods.

There could be other losses associated with a cap and trade policy, especially if the government does not accurately estimate the optimal quantity for society so that the total marginal costs correspond to the private marginal costs of the firms plus societal marginal costs. In the short term, the reduction in output decreases the total amount of inputs required for production, such as the number of workers. This shifts the demand curve for labor, causing a decrease in employment and a decrease in wages as shown below. Yet, we will argue that these effects will be modest at best.

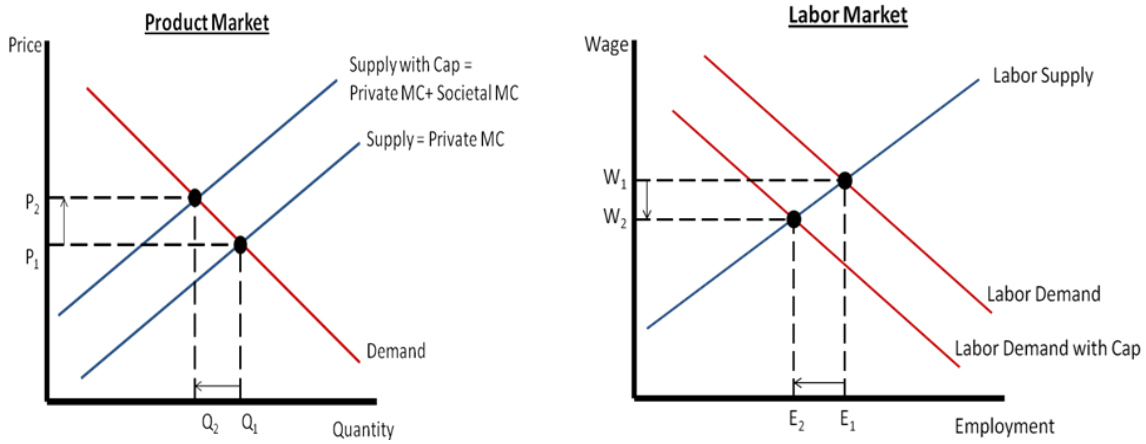


Figure 1: Short-run product and labor market implications of cap and trade

6. Krugman, 2010. http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all

The Size of Coal and Carbon Sectors:

At the macroeconomic level, the overall employment numbers in energy intensive industries is not large enough to have a significant negative impact on employment. For example, figure 2 shows the employment share of coal mining for Ohio and the U.S. Less than 0.05% of both Ohioans and Americans are employed in coal mining. Though there will be coal mining jobs in Ohio for generations to come, these figures illustrate that even under the most wildly pessimistic scenarios, only a relatively small share of the labor force would directly lose employment if coal mining was severely curtailed to reduce carbon emissions.

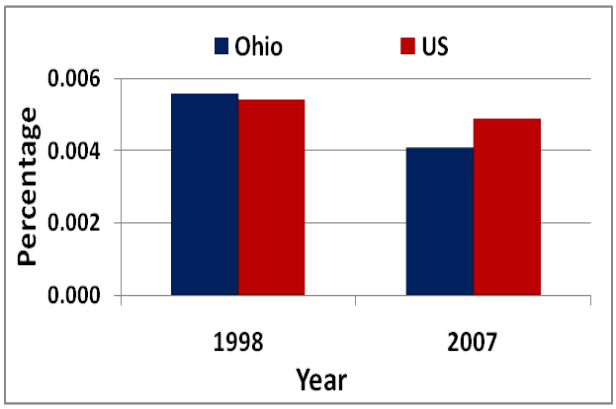


Figure 2: Employment share of coal mining

Long-run Impacts of Cap and Trade:

The critics of cap and trade policies are correct in that cap and trade will likely reduce productivity as firms make adjustments to reduce carbon emission—i.e., if it was such a good idea, firms would reduce carbon emissions voluntarily. However, will cap and trade produce a wholesale reduction in real wages and living standards? In a recent report, the Congressional Budget Office provides estimates of the economic impacts of cap and trade and they conclude that cap and trade would reduce after-tax income by only about 0.2% by 2020 (all else constant), rising to a loss of about 1.2% in 2050. By comparison, growth in a typical year should be about 2.5%, suggesting that cap and trade will have the effect of reducing living standards over the next 40 years, the equivalent of losing about 6 months of normal economic growth.[7]

In the long run after cap and trade policies are implemented, companies will find new ways of reducing emissions, thereby reducing costs, increasing profits, and further reducing any adverse employment effects of cap and trade. In addition, there should not be any major adverse employment effects across the entire economy. Given a natural unemployment rate in the U.S. economy of about 5%, along with a natural limitation on the number of people in the active labor force at any point in time, there is no way to permanently increase total employment beyond a fixed limit set by the size of the U.S. labor force.[8] The natural unemployment rate includes the frictional and structural unem-

7. The Congressional Budget Office (CBO) concludes that the cap-and trade provisions of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA), if implemented, would reduce gross domestic product (GDP) below what it would otherwise have been—by roughly ¼ percent to ¾ percent in 2020 and by between 1 percent and 3½ percent in 2050. By way of comparison, CBO projects that real (inflation-adjusted) GDP will be roughly two and a half times as large in 2050 as it is today, so those changes would be comparatively modest… The loss in purchasing power [due to higher prices households face] would be modest and would rise over time as the cap became more stringent and larger amounts of resources were dedicated to cutting emissions, accounting for 0.2 percent of after-tax income in 2020 and 1.2 percent in 2050. Source: U.S. Congressional Budget Office. The Economic Effects of Legislation to Reduce the Greenhouse-Gas Emissions http://www.cbo.gov/ftpdocs/105xx/doc10573/09-17-Greenhouse-Gas.pdf

8. This is a standard macroeconomic textbook argument about long-run growth, e.g. see Dornbusch and Fischer, 1990.

ployment that occurs even in a healthy expanding economy due to people moving and changing jobs for example.

According to the U.S. Bureau of Labor Statistics, there are about 154 million Americans in the active labor force, which means that in the long-run, only about 146.3 million Americans will be employed regardless of whether or not cap and trade is adopted (i.e., 5% or 7.7 million of the 154 million will be unemployed). That is, cap and trade will shift production and employment from energy-intensive industries to less energy-intensive industries, but long-run total employment will remain unchanged at approximately 146.3 million after long-term adjustments (which is why the CBO predicts very little change in real GDP or after-tax income). After-tax wage levels will only slightly decrease in the long run due to lower productivity (see Figure 3).

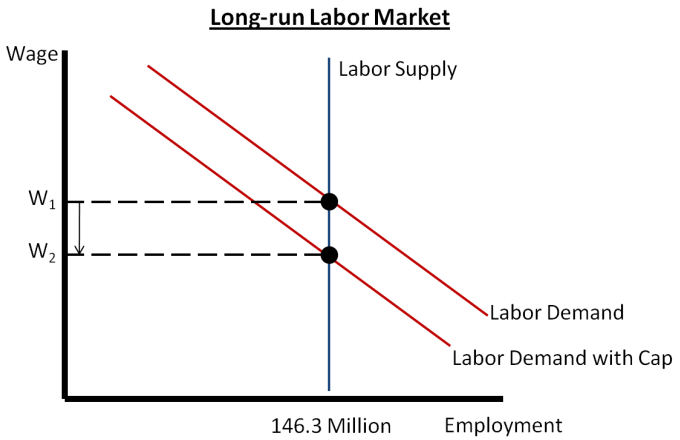


Figure 3: Long-run labor market implications of Cap and Trade

To further assess the short-run and long-run impacts of cap and trade, we can examine the results of past cap and trade programs. Specifically, Title IV of the 1990 Clean Air Act implemented a cap and trade program for sulfur dioxide in an effort to reduce the effects of acid rain. Figure 4 shows that cap and trade successfully reduced sulfate deposition. Sulfur dioxide concentrations in the atmosphere have decreased by as much as 50%. Due to higher costs for coal-fired electricity, many had feared that the coal mining industry would bear the largest burden of the cap and trade

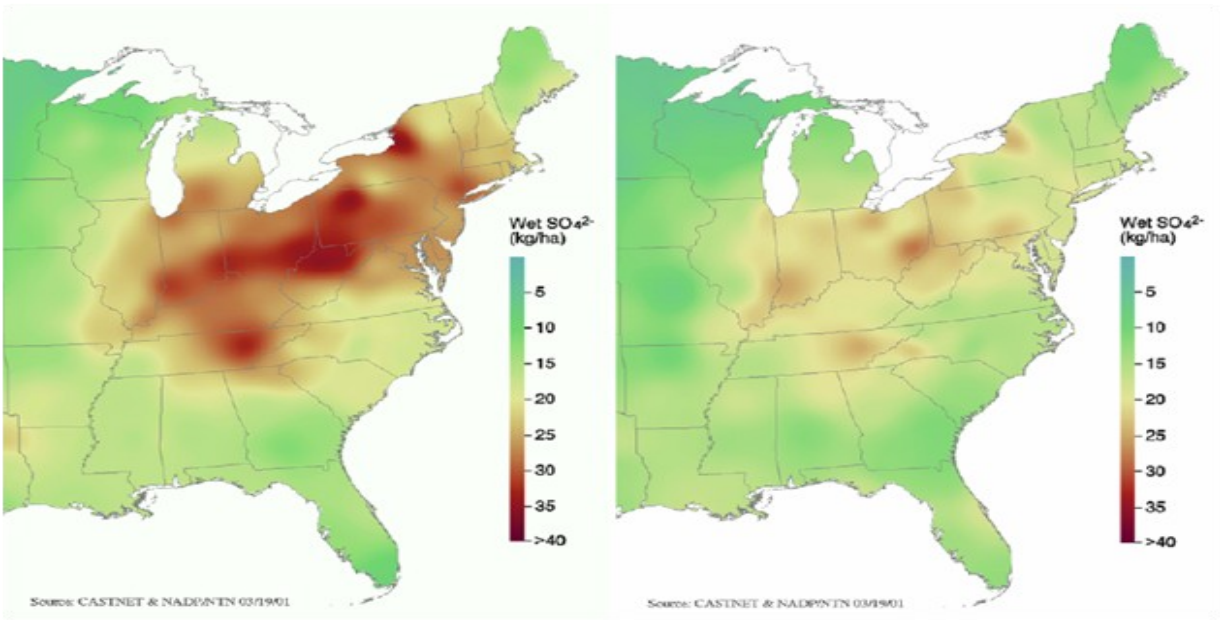
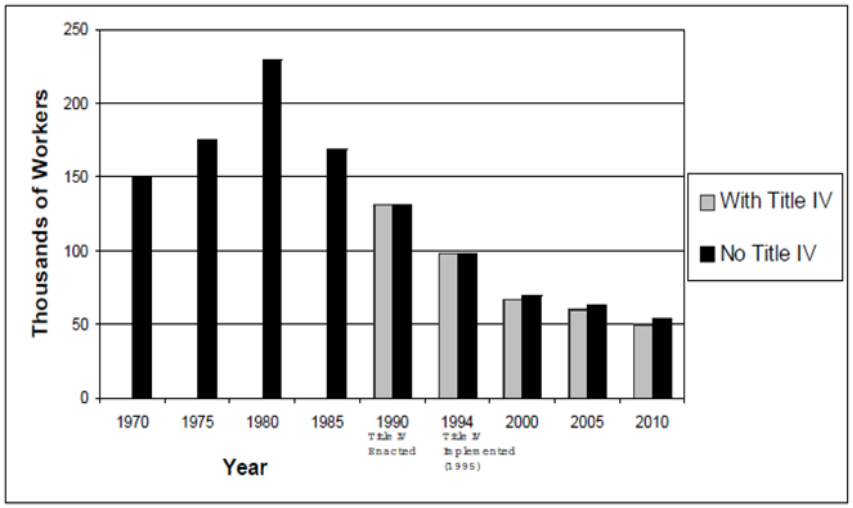


Figure 4: Sulfate deposition changes between the late 1980s and the late 1990s [10]

9. A. Denny Ellerman (MIT),2003 http://eurequa.univ-paris1.fr/S%E9minaires-GT-Eurequa/seminairePEN/pdf/Principaux/ExPostEllerman.pdf
10. Ibid.



Source: U.S. Department of Energy, Energy Information Administration (EIA) (2000). Energy Policy Act Transportation Rate Study: Final Report on Coal Transportation.

Figure 5: Coal mining employment changes with and without acid rain cap and trade [11]

program and experience significant losses in employment. However, instead of inflicting grievous economic harm, Figure 5 shows that the sharp reductions in pollution came without noticeable effects on jobs.

It is important to note that the initial 1990 estimates of the adverse employment impact on the coal industry were approximately double the updated estimates of the EPA's 2000 report.[12] Similarly, many feared cap and trade of sulfur dioxide would seriously harm manufacturing due to higher electricity costs. However, over the 1991-1998 period as cap and trade went into effect, U.S. and Ohio manufacturers, respectively, had job growth rates of 2.9% and 1.1%, which contrasts with the 3.2% and 3.9% declines over the 1998-2009 period (which began with the 1997-1998 Asian crisis). The point is that other factors are likely to have much stronger impacts on American manufacturers than cap and trade including international trade, productivity growth, and the business cycle.

Cap and Trade Summary:

Our overall conclusion is that past experience from the acid rain cap and trade program indicates that a carbon cap and trade system would be environmentally effective with minimal impacts on employment and the economy. There are also countries that have already established carbon cap and trade programs such as Australia, New Zealand, and members of the EU. Although it may be too early to estimate the impact carbon cap and trade programs have had on these countries, it appears that similar systems could be introduced in the U.S. without putting the country at a significant international trade disadvantage. Thus, our primary conclusion is that critics of cap and trade appear to have greatly overstated the adverse job loss impacts.

11. EPA. Impacts of the Acid Rain Program on Coal Industry Employment http://www.epa.gov/airmarkt/resource/docs/coalemployment.pdf
12. Ibid.

Green Jobs

Numerous countries have allocated a significant amount of government funds to subsidize green jobs with the dual goal of reducing carbon emissions and increasing employment. Proponents believe that subsidizing alternative energy will spur significant job creation and cultivate new centers of economic activity so desperately needed in areas with high unemployment such as Ohio and Michigan. For example, a recent Brookings Institution report stated, "America's national energy infrastructure—based primarily upon fossil fuels—must be updated and replaced with new technologies. At the same time, few regions in the nation are better equipped to deliver the necessary innovations than the troubled Great Lakes area."[13]

The race to green jobs appears to be another of a long line of economic development fads that governments have promoted. One problem with the green jobs fad (and economic development fads in general) is that with seemingly all 50 states, 3000-plus counties, and dozens of countries around the globe all chasing the same goal, it is unlikely that very many will succeed.[14]

Another problem with this trend is that as the favored industry changes with the latest fad, governments have historically been quick to respond with tax incentives and subsidies without any supporting research on the efficacy of such policies. Once subsidies are enacted, they are often much more difficult to remove, suggesting that policymakers should be careful before they act to fight free market trends. Finally, a related concern about economic development fads and associated government incentives is that by ignoring research on the economic and environmental consequences of these policies, many politicians ignore the opportunity costs of policies and potentially ignore more effective alternatives.

While there are reasons why jumping on the green jobs fad should be taken cautiously, most politicians have still taken the bait. For example, Michigan Governor Jennifer Granholm recently stated:

> By investing in our workforce, manufacturing infrastructure, and natural resources, we can make Michigan the state that helps end our nation's dependence on foreign oil and create good paying jobs in the process….Michigan is uniquely positioned to diversify its economy and create jobs by

13. The Brookings Institution policy brief (Duderstadt, Muro, and Rahman, 2010) focuses more on alternative energy research and development, which will likely have more long-run positive impacts on the region than unfocused efforts in alternative energy.

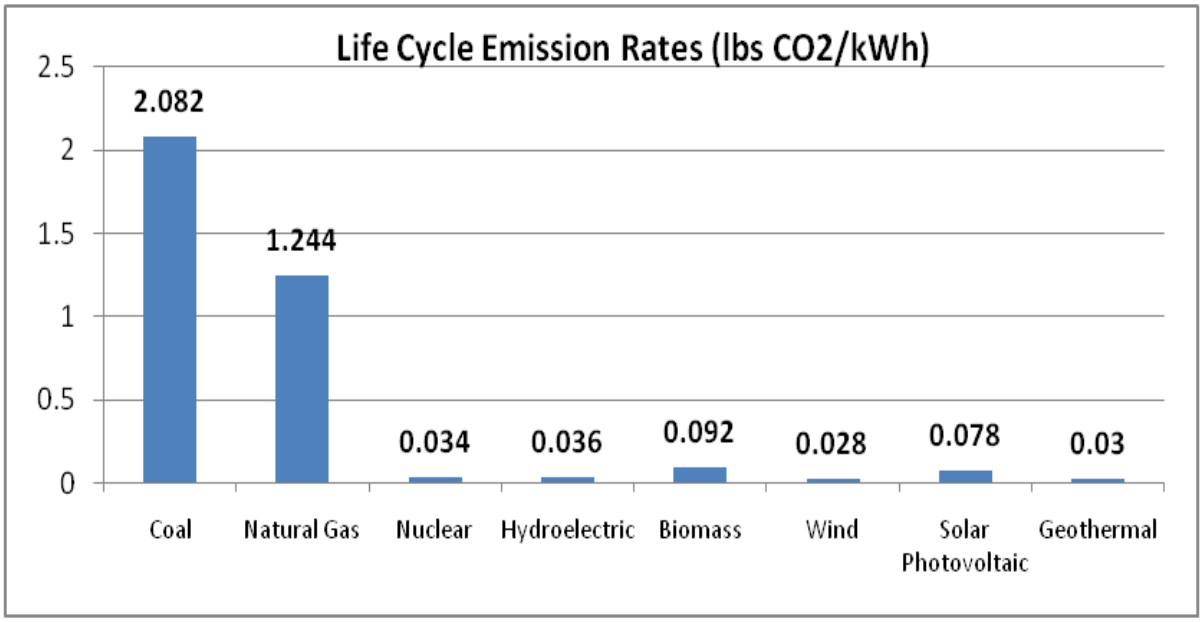
14.There is a long tradition of most states and counties trying to chase the same economic development goals and fads, most with very limited success. For example, in the 1980s and 1990s, there was a race for locations to create the "next Silicon Valley," most without success. This have been followed by later fads including the desire to create "clusters," hubs of biotechnology, medical science, centers for young urban professionals, and so on. In most cases, these efforts also failed. The point is that fads rarely succeed because they are frequently based on gut hunches and not supported by strong research.

growing the renewable energy sector.[15]

Many policymakers throughout the U.S. and the world have made similar statements regarding investment in the green energy industry, including Ohio Governor Ted Strickland. Thus, it is important to assess these claims. To do this, we must first analyze whether subsidizing green jobs would in fact be beneficial for the environment, resulting in less carbon emissions.

Figure 6 below shows that carbon emissions are indeed drastically reduced for alternative energy sources such as wind and solar, but carbon emissions can also be reduced using sources other than wind and solar. Natural gas emits substantially less carbon than coal as do nuclear, hydroelectric, geothermal and biomass sources of energy. Biomass includes ethanol and a wide range of energy products derived from plant and animal sources.

Other than the pressing climate challenges faced by the world, one of the reasons Governors Granholm and Strickland, along with many other policymakers, are looking for their jurisdictions to become the next center for green innovation is because of reports about growth trends in green jobs. At first glance, these trends seem quite promising. Yet, policymakers should be careful in evaluating these trends and making decisions on whether to invest based on fragmentary data. At this point in time, there is no standard government definition of a green job and comparable green job data from the U.S. Bureau of Labor Statistics will not be available until 2012. With no standard definition of a green job, there is a risk that the research from different sources will vary widely based solely on the definition used.



Note: Life cycle emissions rates include the total aggregated carbon emissions over the life cycle of the fuel, including extraction, production, distribution, and use.

Figure 6: Total carbon emissions per kWh generated by energy source [16]

15. Michigan.gov, 2009. http://www.michigan.gov/documents/nwlb/HTML_NWLB_Email_May19_09_278937_7.html
16. Meier, 2002. http://cpsenergy.com/files/STP_Univ_Wisc_energy%20_comparison.pdf

Likewise, in counting the number of new green jobs, there is also the risk of simply "reclassifying" current jobs as green to serve political goals—e.g., a long-term production worker making dishwashers could be reclassified as green if the company now makes new dishwashers that are modestly more energy efficient. With reclassification, no new jobs are created. With no official data, politicians may be quick to adopt numbers that fit their preconceived political conclusions.

For our purposes, we adopt The Pew Charitable Trusts definition of green energy jobs (which they call the "clean energy economy"). Though their definition may be broad, it serves our purposes in terms of creating a common benchmark across states.[17]

Figure 7 shows Pew's estimates of green energy job growth (or clean energy jobs) by state and for the U.S. as a whole. Pew wisely only counts jobs that are directly considered clean jobs to avoid exaggerations associated with indirect job creation. They find that green energy jobs grew 9.1% across the U.S. between 1998 to 2007, which compares to a 3.7% growth rate for the economy as a whole—though we caution that the 1998-

	CLEAN BUSINESSES 2007	CLEAN JOBS 2007	CLEAN JOB GROWTH 1998-2007	OVERALL JOB GROWTH 1998-2007	VENTURE CAPITAL 2006-2008 (thousands)
Alabama	799	7,849	2.2%	1.6%	$0
Alaska	350	2,140	9.4	15.7	0
Arizona	1,123	11,578	21.3	16.2	31,106
Arkansas	448	4,597	7.8	3.5	22,845
California	10,209	125,390	7.7	6.7	6,580,427
Colorado	1,778	17,008	18.2	8.2	622,401
Connecticut	857	10,147	7.0	-2.7	30,050
Delaware	211	2,368	-2.3	-8.9	3,342
District of Columbia	280	5,325	18.8	-7.1	89,877
Florida	3,831	31,122	7.9	22.4	116,980
Georgia	1,827	16,222	10.8	15.7	179,686
Hawaii	356	2,732	43.6	7.3	12,304
Idaho	428	4,517	126.1	13.8	27,890
Illinois	2,176	28,395	-2.5	-2.5	108,519
Indiana	1,268	17,298	17.9	-1.0	26,000
Iowa	729	7,702	26.1	3.6	149,237
Kansas	591	8,017	51.0	-0.3	13,275
Kentucky	778	9,308	10.0	3.6	0
Louisiana	995	10,641	19.5	3.0	0
Maine	725	6,000	22.7	3.3	0
Maryland	1,145	12,908	-2.4	1.3	323,996
Massachusetts	1,912	26,678	4.3	-4.4	1,278,462
Michigan	1,932	22,674	10.7	-3.6	55,099
Minnesota	1,206	19,994	11.9	1.9	49,938
Mississippi	454	3,200	24.8	3.6	30,384
Missouri	1,062	11,714	5.4	2.1	24,480
Montana	408	2,155	0.2%	12.7%	$0
Nebraska	368	5,292	108.6	-4.9	0
Nevada	511	3,641	28.8	26.5	19,804
New Hampshire	465	4,029	2.0	6.8	66,917
New Jersey	2,031	25,397	-9.6	-2.7	282,568
New Mexico	577	4,815	50.1	1.9	147,913
New York	3,323	34,363	-1.9	-2.6	209,590
North Carolina	1,783	16,997	15.3	6.4	82,571
North Dakota	137	2,112	30.9	9.4	0
Ohio	2,513	35,267	7.3	-2.2	74,224
Oklahoma	693	5,465	6.8	2.4	5,192
Oregon	1,613	19,340	50.7	7.5	70,002
Pennsylvania	2,934	38,763	-6.2	-3.1	232,897
Rhode Island	237	2,328	0.7	0.6	22,845
South Carolina	884	11,255	36.2	2.2	0
South Dakota	169	1,636	93.4	4.9	0
Tennessee	1,090	15,507	18.2	2.5	16,329
Texas	4,802	55,646	15.5	6.7	716,894
Utah	579	5,199	-12.4	10.8	26,957
Vermont	311	2,161	15.3	7.4	53,747
Virginia	1,446	16,907	6.0	6.6	70,828
Washington	2,008	17,013	0.5	1.3	635,109
West Virginia	332	3,065	-4.1	0.7	5,741
Wisconsin	1,294	15,089	-5.2	3.4	46,743
Wyoming	225	1,419	56.4	14.0	6,942
U.S. Total	68,203	770,385	9.1	3.7	12,570,110

NOTE: Venture capital values are adjusted for inflation and reported in 2008 dollars. See appendices for the complete data sets.
SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database and data from the Cleantech Group™ LLC; analysis by the Pew Center on the States and Collaborative Economics

Figure 7: Alternative energy job growth by state and overall[18]

17. The Pew definition is "A clean energy economy generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources." The Pew Charitable Trusts, 2009.
18. The Pew Charitable Trusts, 2009. http://www.pewcenteronthestates.org/uploadedFiles/

2007 period is characterized by sub-par job growth.

Figure 8 provides estimates of the job growth in just solar and wind energy generation for the US between 1998 and 2007. There is significantly more growth in solar and wind energy generation than for clean jobs in general. However, to put this in perspective, the average annual number of newly created jobs in clean energy over the nine year period respectively equaled 7,140 in an U.S. economy that currently has a labor force of approximately 154 million and gained 11.7 million total jobs during the same time period. By comparison, between December 1990 and December 2000, the U.S. economy added 23.4 million new jobs during the 1990s economic expansion and just during the months of April and May 2010, the U.S. economy created 290,000 and 431,000 nonfarm jobs, respectively.[19] Clearly, alternative energy appears to be at most an insignificant contributor to overall U.S. job growth.

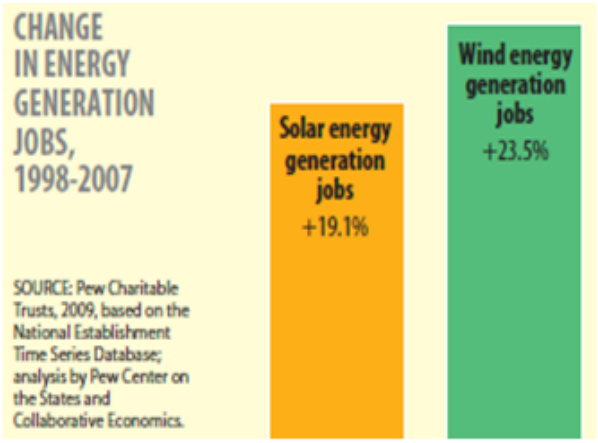
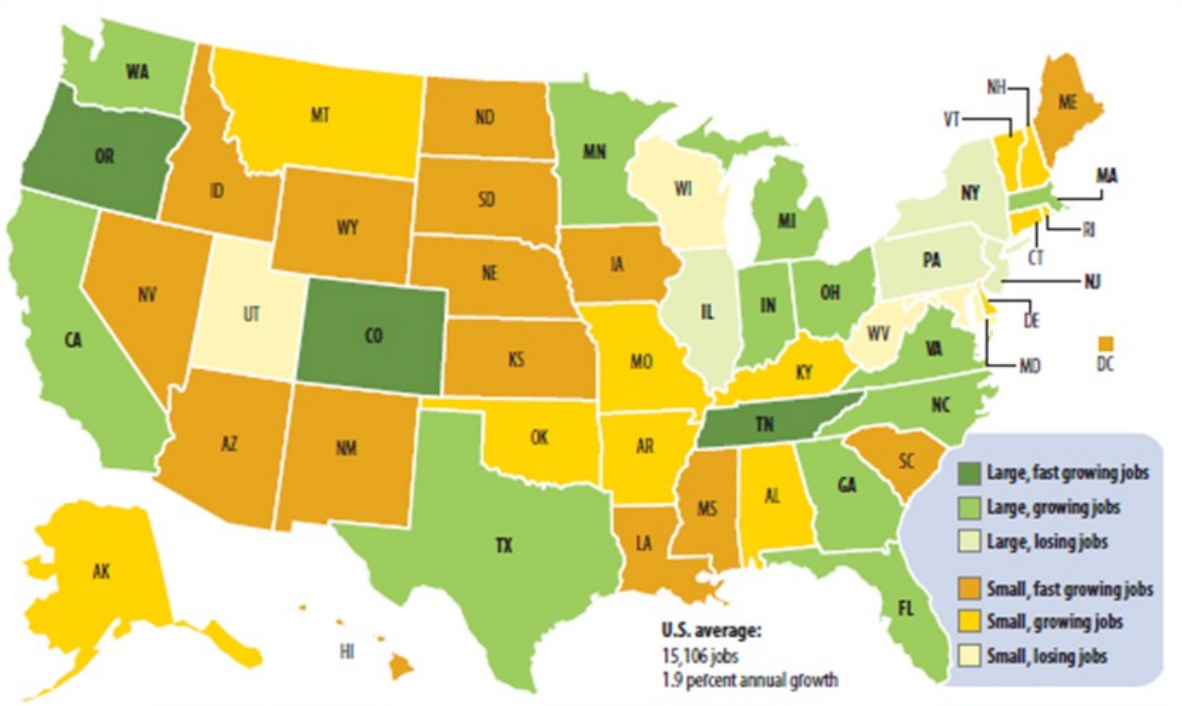


Figure 8: U.S. green energy job growth[20]

In Figure 9, we see the average annualized growth rates of green jobs for the U.S. and each state. Michigan and Ohio are classified as having "large growing jobs" meaning that their total number of green jobs exceeded the national average and has been growing by an average of 1 percent each year. However, predictions based on past growth may be inaccurate as an industry matures. Namely, as green energy firms become more efficient over time, less labor will be required for the same amount of output. As can be seen in figure 5, the historical trends in coal industry employment illustrate how growth rates decline as productivity growth increases. One would reasonably expect that green energy will be no different if it is to be a relatively low-cost alternative to fossil fuel energy in the long run.

Another concern with using figures on the growth rates of green energy is that even if these growth rates continue or even increase, the employment share of the green energy industry is simply not large enough to make a significant dent on unemployment in any reasonable timeframe. Figure 10 shows the employment share of green jobs across the country. Even a ten-fold increase in the share of green jobs in Ohio would only raise the green-job employment share of total employment to 5.6% (which would likely take generations to achieve and may never happen). The moral is that job growth needs to be on a much broader scale if it is to reduce unemployment.

19. US Bureau of Labor Statistics
20. The Pew Charitable Trusts, 2009.

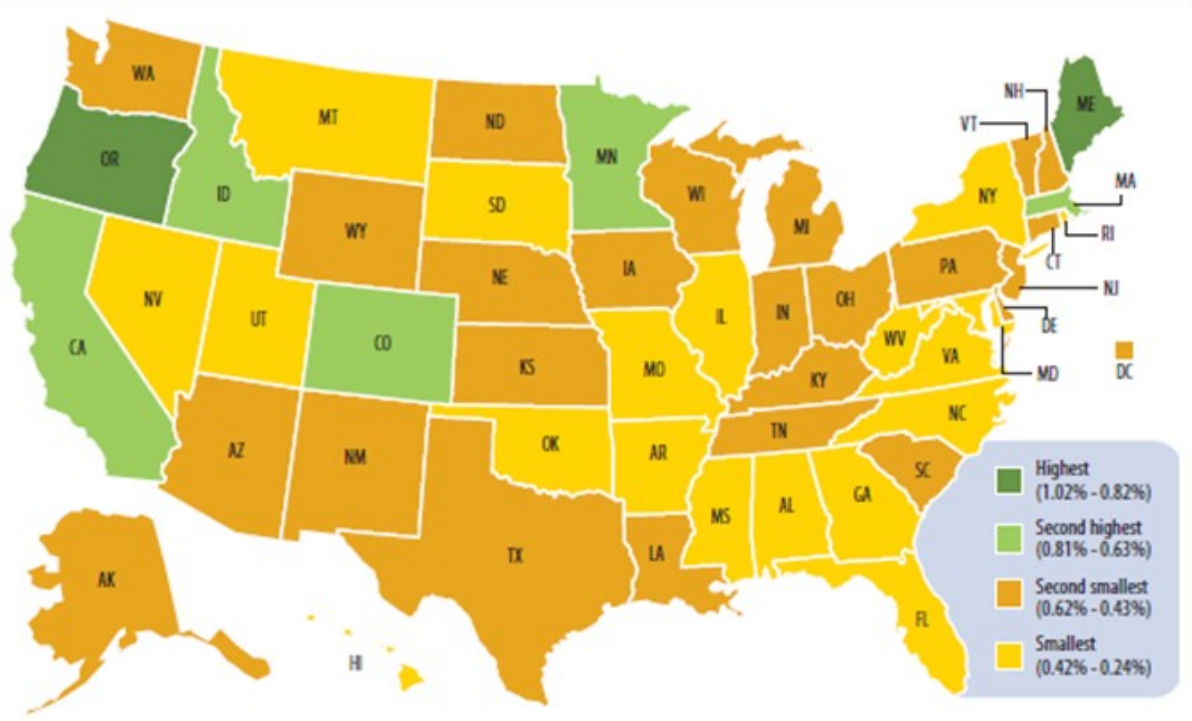


STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007	STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007	STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007
Alabama	7,849	0.31%	Kentucky	9,308	1.09%	North Dakota	2,112	3.17%
Alaska	2,140	1.14	Louisiana	10,641	2.06	Ohio	35,267	0.85
Arizona	11,578	2.19	Maine	6,000	2.34	Oklahoma	5,465	0.89
Arkansas	4,597	0.99	Maryland	12,908	–0.11	Oregon	19,340	4.77
California	125,390	0.88	Massachusetts	26,678	0.52	Pennsylvania	38,763	–0.48
Colorado	17,008	1.98	Michigan	22,674	1.20	Rhode Island	2,328	0.37
Connecticut	10,147	1.11	Minnesota	19,994	1.38	South Carolina	11,255	3.56
Delaware	2,368	0.23	Mississippi	3,200	2.57	South Dakota	1,636	7.89
District of Columbia	5,325	2.13	Missouri	11,714	0.71	Tennessee	15,507	2.14
Florida	31,122	0.90	Montana	2,155	0.15	Texas	55,646	1.70
Georgia	16,222	1.18	Nebraska	5,292	10.00	Utah	5,199	–1.31
Hawaii	2,732	4.29	Nevada	3,641	3.15	Vermont	2,161	1.69
Idaho	4,517	10.11	New Hampshire	4,029	0.44	Virginia	16,907	0.66
Illinois	28,395	–0.25	New Jersey	25,397	–1.08	Washington	17,013	0.23
Indiana	17,298	1.88	New Mexico	4,815	4.73	West Virginia	3,065	–0.36
Iowa	7,702	2.66	New York	34,363	–0.14	Wisconsin	15,089	–0.55
Kansas	8,017	4.74	North Carolina	16,997	1.62	Wyoming	1,419	5.16

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

Figure 9: Average annual growth rate of clean jobs [21]

21. The Pew Charitable Trusts, 2009.



	TOTAL JOBS	PERCENT CLEAN		TOTAL JOBS	PERCENT CLEAN		TOTAL JOBS	PERCENT CLEAN
Alabama	2,193,589	0.36%	Kentucky	2,069,602	0.45%	North Dakota	422,054	0.50%
Alaska	388,361	0.55	Louisiana	2,326,888	0.46	Ohio	6,304,302	0.56
Arizona	2,661,437	0.44	Maine	707,195	0.85	Oklahoma	1,784,492	0.31
Arkansas	1,366,809	0.34	Maryland	3,108,256	0.42	Oregon	1,902,294	1.02
California	17,556,872	0.71	Massachusetts	3,870,356	0.69	Pennsylvania	6,542,137	0.59
Colorado	2,668,069	0.64	Michigan	5,279,234	0.43	Rhode Island	549,754	0.42
Connecticut	2,150,723	0.47	Minnesota	3,143,012	0.64	South Carolina	2,059,151	0.55
Delaware	502,773	0.47	Mississippi	1,356,603	0.24	South Dakota	444,659	0.37
District of Columbia	1,021,958	0.52	Missouri	3,178,657	0.37	Tennessee	3,144,614	0.49
Florida	9,903,922	0.31	Montana	512,093	0.42	Texas	11,726,811	0.47
Georgia	4,955,677	0.33	Nebraska	1,038,673	0.51	Utah	1,291,211	0.40
Hawaii	651,894	0.42	Nevada	1,280,532	0.28	Vermont	365,646	0.59
Idaho	718,373	0.63	New Hampshire	735,051	0.55	Virginia	4,238,337	0.40
Illinois	6,792,326	0.42	New Jersey	4,957,892	0.51	Washington	3,098,042	0.55
Indiana	3,348,351	0.52	New Mexico	970,632	0.50	West Virginia	792,474	0.39
Iowa	1,800,264	0.43	New York	9,964,700	0.34	Wisconsin	3,150,000	0.48
Kansas	1,531,164	0.52	North Carolina	4,629,118	0.37	Wyoming	302,245	0.47

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

Figure 10: Employment share of the green energy industry [22]

22. The Pew Charitable Trusts, 2009.

Using U.S. Bureau of Labor Statisitcs data for Michigan and Ohio, we can calculate the total number of jobs that have been lost from the economy between 2000 and 2009 and the number of years it would take for green jobs to make up this loss (conservatively assuming this job loss does not continue). Figure 11 shows that even with the Pew clean job growth rates, green jobs alone simply cannot account for the jobs lost in Michigan and Ohio in a reasonable timeframe, let alone for the new jobs we need to create to keep up with the natural growth of the labor force.

In Ohio, it would take 331 years for green jobs to make up for the jobs which have been lost since 2000. In Michigan, the number is 303 years. These calculations assume that the current growth rate of green jobs will continue, which in the long run may be unrealistic. Though conservative, these estimates show that we cannot expect to fix unemployment in a reasonable amount of time with green jobs alone.

State	2000 Clean Jobs	2000 Total Jobs	2009 Total Jobs	2009-2000 Total Jobs Lost	Years to Make Up Current Job Loss
Ohio	33,413	5,624,600	5,073,600	551,000	**331**
Michigan	21,546	4,676,200	3,876,100	800,100	**303**

Note: Calculations use the Pew Research average annualized clean job growth for Ohio and Michigan at 0.85 and 1.2 percent, respectively. The "years to make up the current job loss" is calculated using the standard present value formula.

Figure 11: Years to Make Up for Current Job Losses

Mandates, Green Jobs, and the Rest of the Economy:

Regardless of how one cuts the data, green jobs will not be a significant component in reducing the very high levels of unemployment caused by the current recession. This leads to the question whether it is even possible that green job subsidies may actually **reduce** employment in the short-term? The answer to this question takes on added importance as record budget deficits mean that government expenditures to reduce current high-levels of unemployment should be conducted in the most cost-effective manner. Not just voters, but financial markets are wary of the high levels of government expenditures.

Green energy subsidies will lead to greater production of green energy. The increase in production in green energy will not only lead to more utilization of workers, but also physical capital. One concern is that alternative energy production is quite capital intensive, which means increases in production will lead to little increase in employment. For example, when driving by an ethanol plant or a wind farm, does one see capital investment (the ethanol plant or the wind turbines) or do they see scores of workers at the site? Normally, the answer is the capital investment stands out because neither technology employs very many workers relative to the capital investment.

Green subsidies may also have other indirect employment effects that may displace or even reduce employment. For example, more green energy production displaces jobs that would have existed in the fossil fuel industry. While there will be a reduction in pollution, including carbon emissions, subsidizing one industry usually only replaces currently-existing jobs with different jobs.

In addition, there are other displacement effects.[23] Government subsidies for green energy either require higher taxes or greater budget deficits that transfers funds from the private sector that could have created jobs across the broader economy.

To determine whether more jobs are created in green energy than are lost in brown energy, the labor intensity of each must be assessed. Green energy such as wind and solar are far more capital intensive than, for example, in the construction trades. This means that investing the same dollar amount in construction of infrastructure will create more jobs than if the money had been used to create green jobs. Differing energy sources also provide differing number of jobs in the production of energy. Figure 12 below shows the number of jobs required to produce a kWh for each energy source considered and thus is an approximation for the labor intensity of each energy source.

Certain energy sources require a smaller number of jobs to produce the same kWh because these energy sources are more efficient in producing energy. For example, a key reason America is addicted to coal-based electricity is its low cost without high labor demands. When energy is produced from more efficient sources in terms of jobs, this allows more people to work producing other goods, increasing the total number of goods or the GDP of the economy as a whole. Reallocating resources to produce energy from less efficient sources such as solar would therefore decrease efficiency and GDP, without any net-job creation.

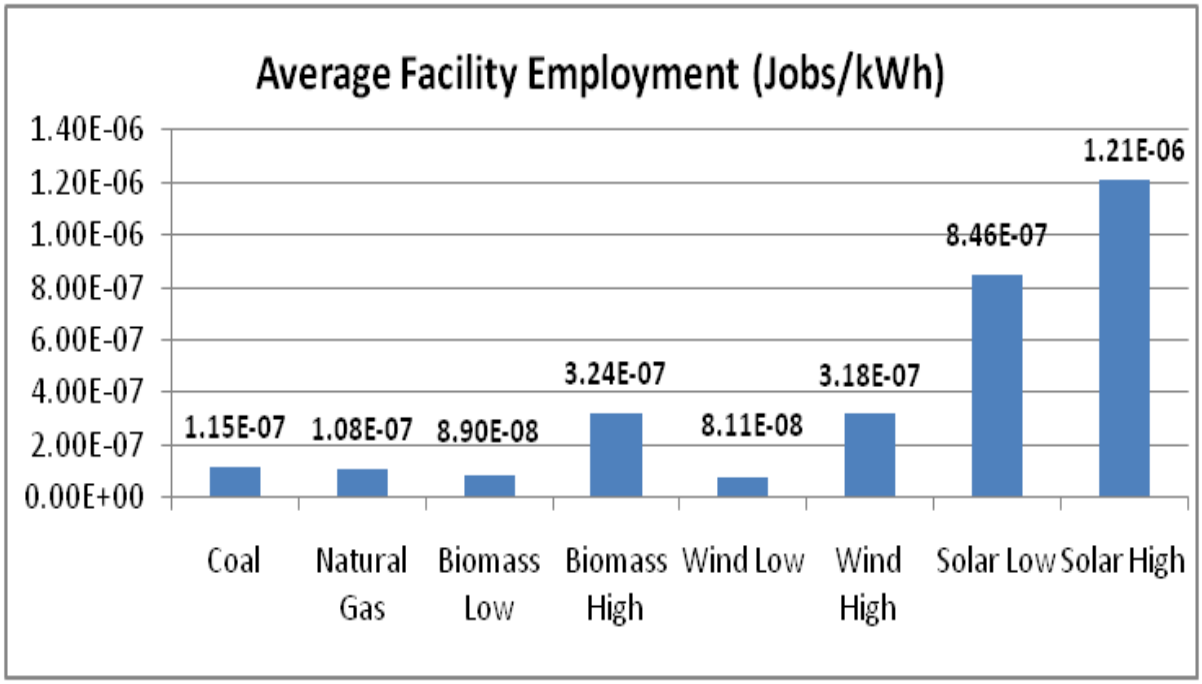
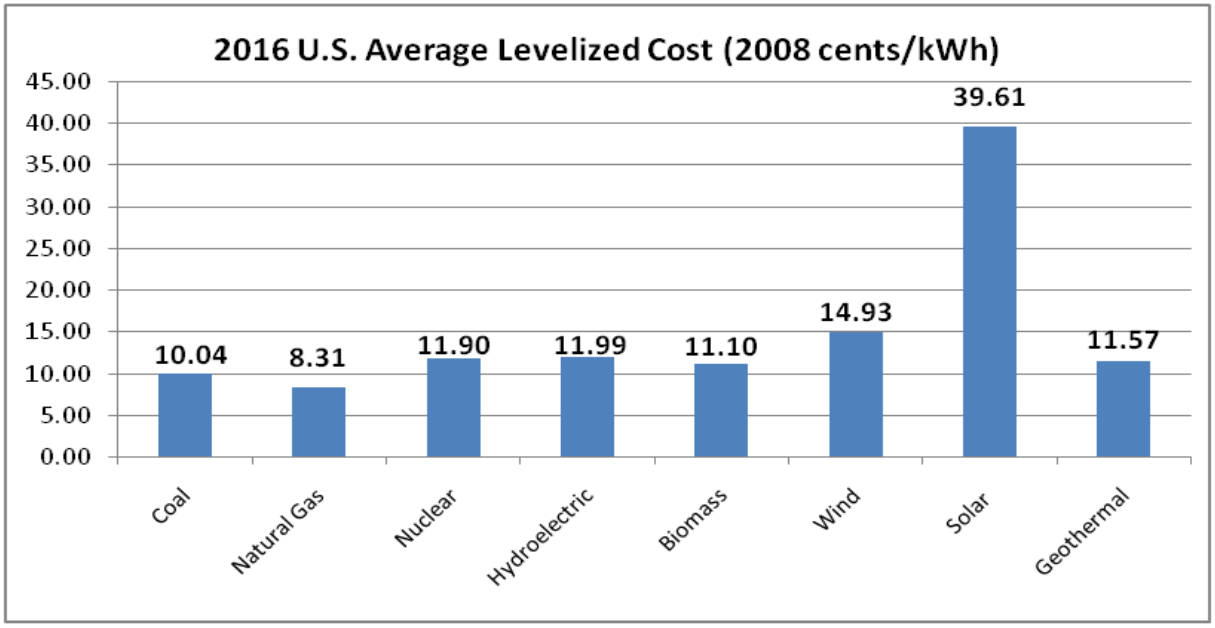


Figure 12: Estimates of the number of jobs required to produce a kWh by energy source[24]

23. There are other indirect effects such as the indirect jobs created by green energy in the construction of the turbines or in other industries that supply the sector. However, as green energy displaces fossil fuel production, there is the loss of the indirect jobs that supported the fossil fuel sector, producing very little net impact.
24. Kammen, et al., 2004. http://www.unep.org/civil_society/GCSF9/pdfs/karmen-energy-jobs.pdf

Figure 13 provides evidence of efficiency in terms of the cost to produce a kWh for each energy source. Using the lowest cost method of producing energy frees up resources to be spent on other goods increasing GDP, or alternatively, it could free up resources to be spent on different methods of decreasing carbon emissions. Coal is one of the lowest cost methods of producing a kWh, but it is not the cheapest. When the total costs (including building the facility, for example) are accounted for, natural gas becomes the cheapest method to generate a kWh (at least based on 2008 costs).



Note: The average levelized cost is the present value of all costs including building and operating the plants.

Figure 13: Energy production costs by energy source[25]

To better understand the difference in jobs, costs of production, and carbon emissions between energy sources, the effect of replacing just 25 percent of energy produced from coal with energy produced from wind is calculated below in figure 14 and in figure 15.

Figure 14 shows that there will be a significant decrease in carbon emissions from using wind. Yet, there is also a significant cost increase associated with using wind instead of coal, though this does not include the social benefits of reducing carbon emissions.[26] These increased costs in production will be

	2009 Total kWH	2009 Total Coal kWH	Changes in Total Emissions (lbs)	Total Annual Cost (Millions)	Total Cost Per Household (dollars/year)
US	3,951,117,000,000	1,764,486,000,000	-906,063,561,000	$21,571	$191.93
MI	101,642,000,000	67,822,000,000	-34,826,597,000	$829	$215.66
OH	135,949,000,000	113,824,000,000	-58,448,624,000	$1,391	$308.78

Figure 14: Cost Effects of Replacing 25 percent of coal with wind

25. US Department of Energy, 2010. http://www.eia.doe.gov/oiaf/aeo/pdf/2016levelized_costs_aeo2010.pdf

26. In the Spring of 2010, carbon was trading for $17.60 a ton (which was deemed low) in the EU "cap and trade" carbon markets (Kanter, 2010). Using this value, transferring 25% of our electrical generation from coal to wind leads to environmental gains worth $16.4 billion dollars for the U.S. as a whole from reduced carbon emissions.

	Total Coal Jobs Based on Total kWh	Employment Change (low)	Employment Change (high)	Employment Change Share (low)	Employment Change Share (high)
US	203,440	-15,107	89,634	-0.012%	0.068%
MI	7,820	-581	3,445	-0.015%	0.089%
OH	13,124	-975	5,782	-0.019%	0.114%

Figure 15: Labor Effects of Replacing 25 percent of coal with wind

seen by households in their electricity bills and in the energy-intensive products they purchase. For the typical U.S. household, their costs would increase by approximately $192 annually, while the increase would be about $309 annually for the typical Ohio household (because Ohio currently gets a higher percentage of its electricity from coal). Because of the differences in the production of wind energy across the country, the total number of jobs may actually decrease. However, the estimates in either direction are for net employment to change by no more than 0.1%. [27] Therefore, replacing coal with wind, currently the most viable energy alternative, would have very little direct impact on employment, though it would produce significant gains in reducing pollution. Thus, wind has potentially large benefits in terms of pollution reduction, but its likely impact on jobs is imperceptible.

Government Subsidies and Green Jobs:

Policymakers have been quick to encourage companies such as (say) Wal-Mart to create jobs by offering generous tax incentives. Yet, recent research suggests that oftentimes when public funds were used to subsidize Wal-Mart or any other firm, it resulted in a net loss of jobs.[28] Similar displacement effects occur for subsidizing green energy. Specifically, because tax dollars are taken from the private sector that could have been used elsewhere, the cost of each green job will be more than just the increase in production costs.

A range of "tax-expenditure" costs per green job created from across the US are provided below in figure 16. Not shown is one of the more expensive taxpayer subsidies, the DuPont plant in Circleville, Ohio.[29] The federal and Ohio state governments are reported to be contributing $50.7 million and $12 million, respectively, in subsidies for a net addition of 80 jobs. This totals $784,000 per new job, which has a very large opportunity cost by any measure. This means lost funding for infrastructure, education, health care, or lower taxes. In addition, taxes have to be higher to support these subsidies., further reducing employment in all sectors.

Even the lowest "tax-expenditure" subsidies have opportunity costs. Each dollar could

27. The number of jobs that wind energy creates depends on many factors. For example, wind turbines may be produced in the United States (e.g., in the Great Plains or in Ohio) or they may be produced in China or Europe due to lower costs.
28. A Wal-Mart may cause the closure or downsizing of other locally-owned businesses offsetting any direct employment gains. Aho, 2009. http://articles.moneycentral.msn.com/SavingandDebt/SaveMoney/the-price-of-wal-mart-coming-to-town.aspx?page=2
29.Gearino, 2010. http://www.dispatch.com/live/content/business/stories/2010/01/19/dupont.ART_ART_01-19-10_A8_BTGBH03.html

Company	City	State	Workers	Investment	Subsidies	Investment Per Worker	Subsidy Per Worker
Acciona Windpower	West Branch	Iowa	130	$23,000,000	$4,850,000	$176,923	$37,308
AE Polysilicon	Fairless Hills	Pennsylvania	145	$70,000,000	$8,200,000	$482,759	$56,552
Clipper Windpower	Cedar Rapids	Iowa	250	$50,000,000	$3,150,000	$200,000	$12,600
Evergreen Solar	Midland	Michigan	100	$55,000,000	$5,700,000	$550,000	$57,000
Evergreen Solar	Devens	Massachusetts	700	$165,000,000	$44,000,000	$235,714	$62,857
First Solar	Perrysburg	Ohio	834	$71,500,000	$20,960,000	$85,731	$25,132
Flabeg Solar	Findlay	Pennsylvania	300	$30,000,000	$9,000,000	$100,000	$30,000
Gamesa	Fairless Hills	Pennsylvania	509	$34,000,000	$3,930,000	$66,798	$7,721
Gamesa	Ebensburg	Pennsylvania	298	$50,000,000	$11,310,000	$167,785	$37,953
Heliovolt	Austin	Texas	168	$80,400,000	$1,600,000	$478,571	$9,524
LM Glasfiber	Grand Forks	North Dakota	900	$2,650,000	$7,800,000	$2,944	$8,667
LM Glasfiber	Little Rock	Arkansas	350	$95,000,000	$33,800,000	$271,429	$96,571
OptiSolar	Sacramento	California	1000	$500,000,000	$20,000,000	$500,000	$20,000
Sanyo Solar	Salem	Oregon	200	$80,000,000	$26,985,000	$400,000	$134,925
Schott Solar	Albuquerque	New Mexico	360	$105,000,000	$17,000,000	$291,667	$47,222
Siemens Power Generation	Fort Madison	Iowa	380	$43,000,000	$12,500,000	$113,158	$32,895
Solaicx	Portland	Oregon	66	$56,000,000	$21,500,000	$848,485	$325,758
Solar Wind	Hillsboro	Oregon	1000	$440,000,000	$41,000,000	$440,000	$41,000
Suniva	Norcross	Georgia	100	$75,000,000	$10,000,000	$750,000	$100,000
TPI Composites	Newton	Iowa	330	$56,000,000	$6,600,000	$169,697	$20,000
Trinity Structural Towers	Newton	Iowa	140	$21,000,000	$1,280,000	$150,000	$9,143
Trinity Structural Towers	Clinton	Illinois	140	$15,000,000	$2,000,000	$107,143	$14,286
United Solar Ovonic	Greenville	Michigan	400	$126,000,000	$37,000,000	$315,000	$92,500
United Solar Ovonic	Battle Creek	Michigan	350	$260,000,000	$96,900,000	$742,857	$276,857
Vestas Americas	Windsor	Colorado	420	$60,000,000	$1,100,000	$142,857	$2,619
Vestas Americas	Brighton	Colorado	1350	$290,000,000	$8,500,000	$214,815	$6,296
Vestas Americas	Pueblo	Colorado	450	$240,000,000	$23,800,000	$533,333	$52,889
Xunlight	Toledo	Ohio	160	$52,000,000	$14,900,000	$325,000	$93,125

Figure 16: Estimates of tax-expenditure costs per green job created through government subsidies[30]

have been spent on other methods of reducing carbon emissions or on other government programs.

Given the cost of these subsidies, it is important to understand how green jobs stack up in terms of their ability to reduce carbon and the cost effectiveness of the various carbon emissions reduction alternatives. Figure 17 provides a comparison of the costs of various carbon emissions reduction alternatives. Each alternative has a range of potential costs to reduce emissions by a ton. Some methods of reducing carbon actually save money. For example, the range for increasing the energy efficiency of U.S. automobiles is somewhere between a savings of $200 to a cost of $200 per ton of reduced carbon emissions.

30. Mattera, 2009. http://www.goodjobsfirst.org/pdf/gjfgreenjobsrpt.pdf

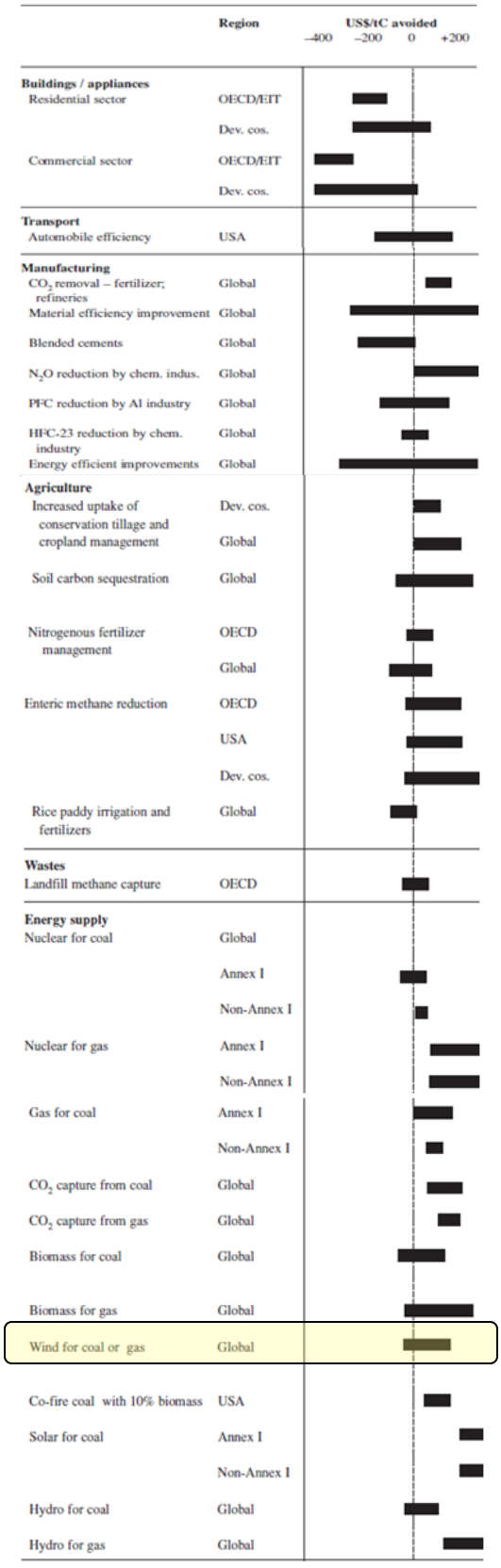


Figure 17: Comparison of costs per ton of carbon emissions reduction[31]

31. Moomaw, 2001. http://www.grida.no/climate/ipcc_tar/wg3/pdf/3.pdf

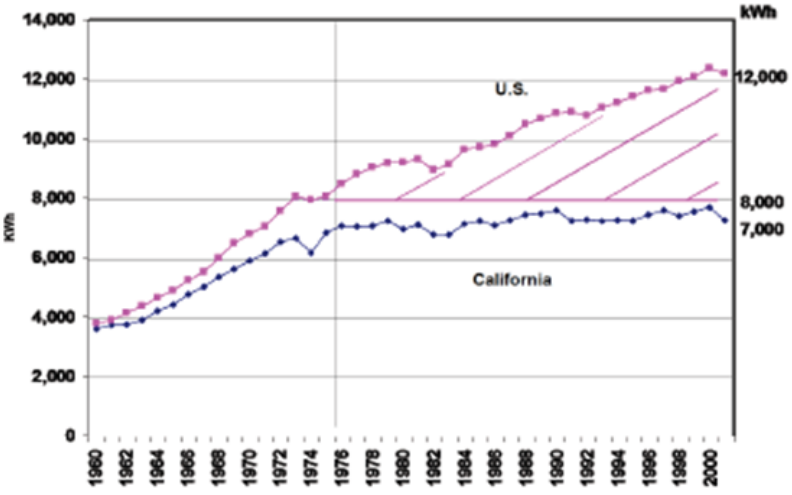
Estimates for the costs of a one ton reduction of carbon emissions by replacing coal or gas with wind can be directly compared to other emissions reduction methods. There are alternatives that not only cost less than replacing coal with wind but can actually save money such as residential and commercial modernization of buildings and appliances. Replacing coal with nuclear is also a lower cost method of reducing emissions; however, this does not account for other environmental implications such as waste removal. Moreover, the cost of substituting coal for wind does not include the deadweight loss associated with using subsidies to accomplish this—i.e., the losses in the aggregate economy due to increased taxes and resources being shifted out of high-valued uses to pay the tax.

California and the Green Economy:

As with cap and trade, there are lessons that can be learned from previous experience within the U.S. to determine the impact of green job subsidies. Specifically, California has been subsidizing alternative energy since the 1970s. For example, in 1999, California first offered tax credits for purchasing renewable energy and in 2002 developed mandates.[32] Throughout the 1980s, California established incentives for the construction and use of renewable energies and provided research and development funding. Arguably the most job creation in California's renewable energy industry has occurred as a result of the innovation from R&D and not through directly subsidizing jobs. The appendix provides a chart showing the number of patents and amount of venture capital in alternative energy innovations for each state. California far exceeds that of any other state, which means that they should capture many of the gains to this innovation.

Of course, this innovation has not come at a low cost as California has some of the most expensive electricity and gasoline prices in the country. In February 2010, the national average electricity cost per kWh was 9.52 cents, but it was 12.57 cents in California.[33] Possibly the most important outcome is that California has significantly reduced its per capita energy demand as shown below in figure 18.

The lower energy demand and the demand for energy saving products driving California's green economy is a direct result of



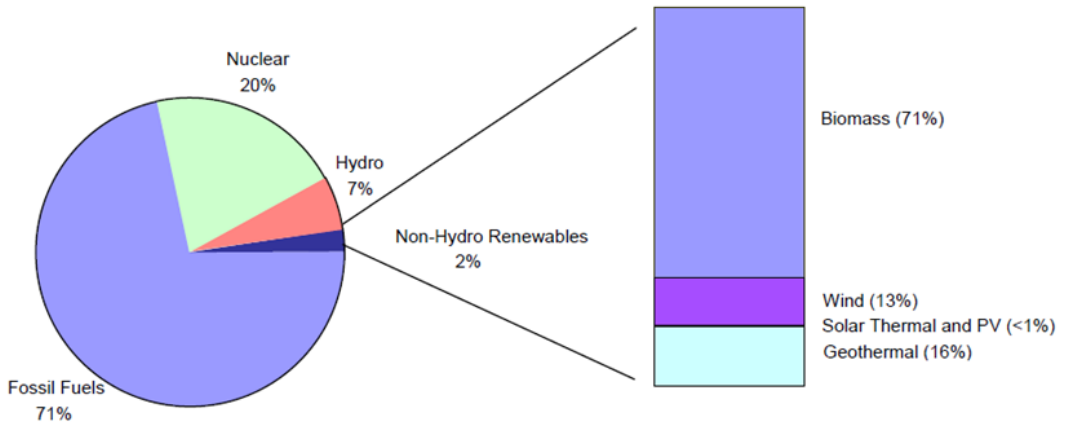
Source: Rosenfeld (2008)

Figure 18: Total per capita electricity use [34]

32. US Department of Energy, 2005. http://www.eia.doe.gov/cneaf/solar.renewables/page/non_hydro/nonhydrorenewablespaper_final.pdf#3.2
33. Department of Energy, 2010. http://www.eia.doe.gov/electricity/epm/table5_6_a.html
34. Roland-Holst, 2008. http://are.berkeley.edu/~dwrh/CERES_Web/Docs/UCB%20Energy%20Innovation%20and%20Job%20Creation%2010-20-08.pdf

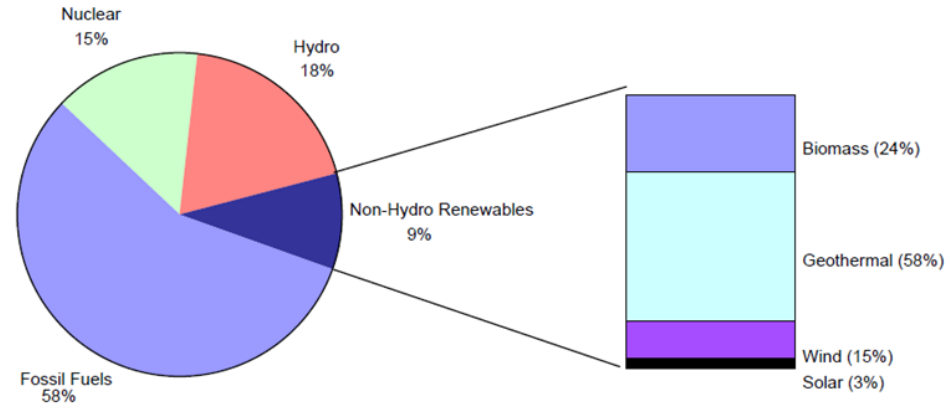
California's high energy costs. As fossil fuels become more expensive, firms and households will demand substitutes. Figure 19 and figure 20 provide a comparison of the U.S. and California in terms of their total energy composition by source. These figures show that California has lower per-capita energy consumption and greater intensity of non-hydropower renewable energy.

California's energy composition differs from the U.S., but how has this affected labor markets? There is very little conclusive evidence that California's green job initiatives have positively affected its economy. Using a benchmark of 100 in 1999, figure 21 shows how employment in California and the U.S. has evolved. From 1999, employment growth for California initially exceeded the national average then matched the national average, and in 2006 California's employment growth dropped below the national average. It is especially noteworthy that California's growth lagged the overall



Source: Energy Information Administration, Electric Power Annual 2003, December 2004, Table 1.1, http://www.eia.doe.gov/cneaf/electricity/epa.pdf and Electric Power Monthly, November 2004, Table 1.1.a, http://www.eia.doe.gov/cneaf/electricity/epm/epm.pdf, accessed December 15, 2004.

Figure 19: 2003 US electricity generation[35]



Source: California Energy Commission, "California Gross System Power for 2003," http://www.energy.ca.gov/electricity/gross_system_power.html, accessed August 12, 2004.

Figure 20: 2003 California electricity generation[36]

35. US Department of Energy, 2005. http://www.eia.doe.gov/cneaf/solar.renewables/page/non_hydro/nonhydrorenewablespaper_final.pdf#3.2
36. Ibid.

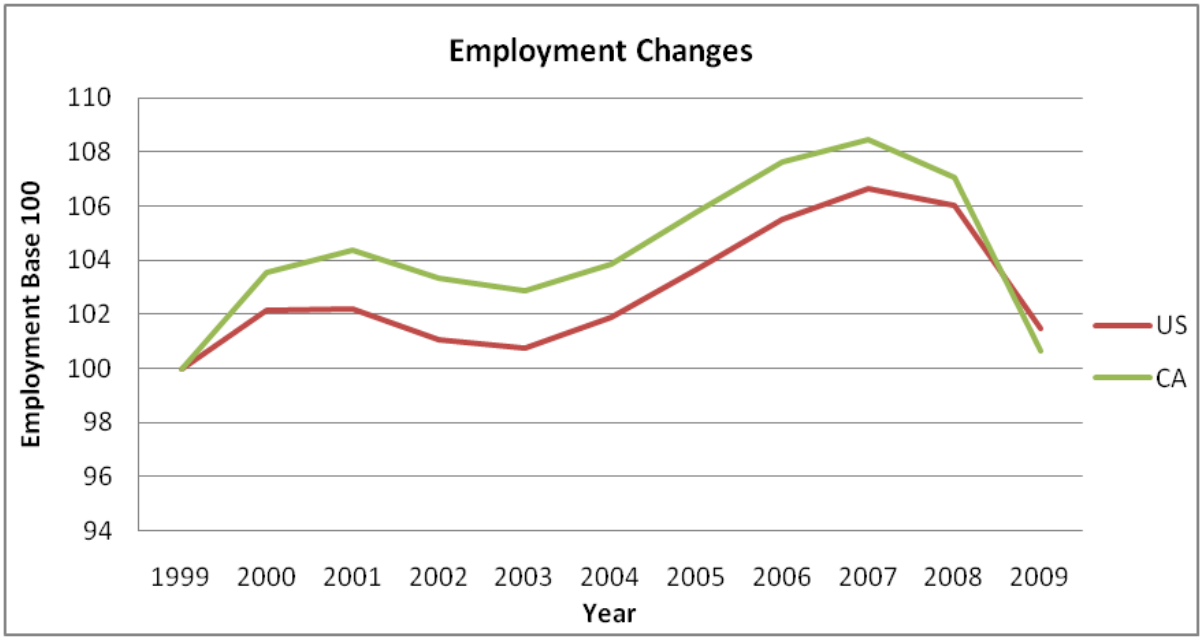


Figure 21: Changes in 100 Jobs from 1999-2009[37]

U.S. economy as fuel prices soared (post 2006), despite its greater reliance on alternative energy sources.

Since 1998, California's average annual job growth in clean energy, according to Figure 9, has been similar to Ohio's (approximately 0.88%) despite the greater emphasis on green energy in California. Although it has the largest number of clean energy jobs in the country, this still only accounts for 0.71 percent of the jobs in the state. Even with California's decade-long commitment to alternative fuels, green jobs still are too small of a share of the labor force to have a significant impact. In addition, there are still offsetting displacement effects elsewhere in the California economy that reduce net employment growth. The key point is that despite the fact that California has long been a leader in alternative energy, this has not translated into greater job growth (though California has considerably less pollution, which is socially worthwhile).

37. U.S. Bureau of Labor Statistics

Green Policies, Climate Changes, and New Jobs:

Separating Fact From Fiction

The Ohio State University

June 2010

Summary

Market forces do not provide incentive for firms and consumers to reduce their carbon emissions, causing emissions to be too high from society's point of view. The result is excessive carbon emissions, producing climate-change scenarios that have potentially catastrophic consequences. Thus, policymakers should set out to correct this externality through programs such as cap and trade and other programs that reduce carbon emissions.

The question becomes what is the most effective approach to reduce emissions at the lowest cost. In this heated debate, advocates on both sides of the debate make overstated claims about how certain policies will affect the economy and reduce carbon. With all of the exaggerated claims on both sides, policymakers tend to overlook the opportunity costs associated with their decisions. This policy brief aims to separate fact from fiction to describe the most effective ways to reduce carbon and assesses whether cap and trade policies and green-job policies lead to large changes in employment.

Previous experiences with cap and trade programs suggest that emissions can be drastically reduced. Contrary to the claims of many of its opponents, cap and trade should not drastically affect employment or GDP. Similarly, green job subsidies will not drastically affect labor markets and simply cannot correct record levels of unemployment as some proponents suggest. In fact, the deadweight loss (the loss in economic efficiency) and displacement affects associated with subsidies suggest that there may even be a short-term net job loss associated with this type of policy. The opportunity costs associated with green job subsidies include funding that could have created more jobs by investing in more labor intensive activities such as construction of infrastructure. It also includes funding that could have been used for more effective and efficient methods of reducing carbon emission. Finally, there are also opportunity costs elsewhere in society: the funds instead could have been used to reduce the budget deficit, improve healthcare, alleviate poverty, and lower taxes, just to name a few. All of these opportunity costs should be accounted for when creating new policies including the allocation of funds with the intention of creating green jobs.

The most important lesson is that policymakers should consider the most cost-effective means of both controlling greenhouse emissions and generating economic growth– and the answer may not lie in a sound-bite solution like "green jobs" that claims to tackle both. Controlling greenhouse emissions will require energy prices to more accurately reflect the true costs to society of carbon emissions. Once that happens, experience has shown that businesses and Americans can respond effectively and efficiently to the benefit of the environment and the economy. If further economic stimulus is needed along with targeted tax cuts aimed at job creation, policymakers should consider investments

in infrastructure, education, and research and development with higher long-term payoffs and fewer distortionary effects.

Our next policy brief will describe what we believe are more cost effective strategies of leveraging the movement toward clean energy, while also creating jobs.

Appendix

Exhibit E1. U.S. Clean Energy Patents, 1999-2008

State	Total Patents, 1999-2008
Alabama	26
Alaska	1
Arizona	178
Arkansas	8
California	1,401
Colorado	161
Connecticut	404
Delaware	43
District of Columbia	9
Florida	236
Georgia	256
Hawaii	16
Idaho	73
Illinois	297
Indiana	174
Iowa	46
Kansas	15
Kentucky	17
Louisiana	22
Maine	8
Maryland	134
Massachusetts	384
Michigan	749
Minnesota	218
Mississippi	3
Missouri	25
Montana	5
Nebraska	15
Nevada	71
New Hampshire	74
New Jersey	248
New Mexico	95
New York	909
North Carolina	179
North Dakota	5
Ohio	309
Oklahoma	36
Oregon	163
Pennsylvania	241
Rhode Island	51
South Carolina	49
South Dakota	4
Tennessee	47
Texas	414
Utah	47
Vermont	12
Virginia	68
Washington	195
West Virginia	14
Wisconsin	214
Wyoming	15
U.S. Total	8,384

SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

Exhibit E2. U.S. Clean Energy Venture Capital, 2006-2008

State	Venture Capital, 2006-2008
Alabama	$0
Alaska	$0
Arizona	$31,105,879
Arkansas	$22,844,701
California	$6,580,426,908
Colorado	$622,400,734
Connecticut	$30,050,286
Delaware	$3,342,057
District of Columbia	$89,877,117
Florida	$116,980,006
Georgia	$179,685,738
Hawaii	$12,303,914
Idaho	$27,890,265
Illinois	$108,519,023
Indiana	$26,000,000
Iowa	$149,237,274
Kansas	$13,274,882
Kentucky	$0
Louisiana	$0
Maine	$0
Maryland	$323,995,916
Massachusetts	$1,278,461,918
Michigan	$55,099,376
Minnesota	$49,937,944
Mississippi	$30,383,955
Missouri	$24,479,634
Montana	$0
Nebraska	$0
Nevada	$19,804,386
New Hampshire	$66,917,018
New Jersey	$282,567,651
New Mexico	$147,912,504
New York	$209,590,500
North Carolina	$82,570,734
North Dakota	$0
Ohio	$74,224,203
Oklahoma	$5,191,978
Oregon	$70,001,922
Pennsylvania	$232,897,084
Rhode Island	$22,844,701
South Carolina	$0
South Dakota	$0
Tennessee	$16,328,927
Texas	$716,894,200
Utah	$26,957,250
Vermont	$53,746,890
Virginia	$70,828,261
Washington	$635,108,739
West Virginia	$5,740,751
Wisconsin	$46,742,521
Wyoming	$6,941,813
U.S. Total	$12,570,109,562

SOURCE: Pew Charitable Trusts, 2009, based on data from The Cleantech Group™ LLC; analysis by Pew Center on the States and Collaborative Economics.

Figure 24: Venture Capital Comparison[38]

38. The Pew Charitable Trusts, 2009.

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