

A Good Environment for Jobs

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August 2012



ECONOMICS
FOR EQUITY &
ENVIRONMENT

www.e3network.org

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Executive Summary

The U.S economy is entering its fourth year of high unemployment. Job creation is a concern for every sitting public official and candidate for office, as well as for many families. While just about everyone would agree that protecting existing jobs and creating new jobs are critical steps towards lifting the economy out of its ongoing crisis, economists, politicians, and the public are far from unanimous about government’s best role in fostering what Presidential candidate Mitt Romney has called “an environment that is good for jobs.”

Arguments about job creation have been particularly important for opponents of environmental regulation. Jobs are destroyed in vast numbers, we have been told, when the Clean Air Act protects human health, when the environmental impacts of new pipelines are questioned, and when sensible safeguards are adopted to prevent another oil well blowout in the Gulf of Mexico. Can it really be the case that what’s good for the environment is always bad for jobs? Environmental protection also requires extensive investments that stimulate the economy and generate employment.

Often, politicians and industry officials pose a sharp dichotomy: protect the environment or protect jobs, as if these two goals were naturally and inevitably opposed to one another. Perhaps less frequently, advocates of “clean energy” development argue for the idea of a synergy: what is good for the environment is good for jobs, and vice versa. We surveyed the studies cited in stump speeches and news reports that estimate jobs lost or gained due to energy and environmental policies, exploring the type of investments that are projected to foster jobs growth and just how much confidence should be placed in these economic predictions. Across almost all studies we found a broadly consistent “big picture” result, accompanied by lots of questions and concerns about the accuracy of their smaller details. The big picture is this:

Jobs are created when investments are shifted out of fossil-fuel industries and into non-fossil-fuel industries, and jobs are destroyed when the opposite occurs. As a result, policies that support alternative energy and environmental protection are often very successful at increasing employment.

Table ES1 shows both our own estimates of full-time equivalent and part- and full-time jobs per \$1 million ratios using IMPLAN 2009 data and the estimates found in the literature (The range of ratios across categories of industries is shown in parentheses. Category-level results as well as a detailed, replicable methodology for these estimates are reported in an appendix.) The same \$1 million results in twice as many jobs when spent in non-fossil-fuel sectors than it does in fossil-fuel industries.

Table ES1: Comparing Total Job Impact Ratios

	FTE		Part- and Full-Time	
	IMPLAN 2009	Survey of Literature	IMPLAN 2009	Survey of Literature
All sectors	16.0	--	17.5	17.3
Fossil-fuel sectors	8.1 (6.5 - 18.0)	5.2 - 11.5	8.2 (6.6 - 18.3)	6.5 - 23.2
Non-fossil-fuel sectors	16.5 (7.8 - 28.0)	7.0 - 66.2	18.1 (7.9 - 32.3)	4.5 - 32.2

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The quality of a job estimate calculated in this way, of course, rests on the underlying accuracy of both the expected number of jobs per dollar of spending in a given industry and the predictions about how the policy will change spending in each sector. In Box ES1 we have assigned letter grades for the overall quality of the job estimates in our survey, based upon the percentage of studies among the group reviewed that “passed” each criterion.

Box ES1: A Checklist for High-Quality Job Impact Studies

Getting Jobs Ratios Right:

- ✓ Does the study include direct, indirect, and induced spending? **B-**
- ✓ Does the study adequately explain the source of the job ratios? **F**

Measuring Jobs in Full-Time Equivalents:

- ✓ Does the study explain what it means by a “job?” (That is, does it distinguish between full-time equivalent and part-time plus full-time jobs?) **F**
- ✓ If the study clearly uses part-time plus full-time jobs, does it explain why? **F**

New Losses and Gains in Spending:

- ✓ Does the study make it clear whether job estimates are cumulative or for a single year? **C**
- ✓ Does the study use new spending net of a baseline in the absence of the policy change (as opposed gross spending)? **B+**
- ✓ If the study clearly uses spending net of a baseline, does it look at the difference between the policy and its most likely alternative? **F**

The Finer Details:

- ✓ Most job studies base their results on a very simple estimation method. Does the study discuss what may have been missed from its analysis? **F**

As an example of these recommended practices, we applied our jobs per dollar estimates to an existing study of the spending needed to eliminate coal from U.S. electricity production (Keith et al. 2010). Our analysis and our review of other recent studies agree: shifting spending from fossil-fuel to non-fossil-fuel industries would lead to an increase in total employment. Hidden in the total number of net jobs that would be created, however, are real layoffs of fossil-fuel industry workers. Retraining workers with specialized, fossil-fuel-based skills should be a cost component of every “green” energy policy.

Our review of the literature further suggests that job impact estimates need to be treated with caution. We found a few excellent high-quality job studies, but many more studies failed to make the grade due to questionable methodological choices or a failure to clearly document the assumptions, data sources, and procedures used.

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There is no reliable evidence for the argument that regulations in general, or environmental regulations in particular, are uniquely bad for employment. Many regulations require that one kind of investment be replaced with another, resulting in job losses in some areas and job gains in others. Careful analysis, avoiding the errors described in this report, is required to determine the net effect of any one regulation. The one consistent pattern that emerges from the literature on jobs and the environment, however, suggests that many regulations will lead to net job creation: clean energy alternatives create more jobs than the fossil fuels that they replace.

1. Introduction

As we recover from this recession, the transition to clean energy has the potential to grow our economy and create millions of jobs - but only if we accelerate that transition. Only if we seize the moment.

– President Barack Obama, June 15, 2010¹

[T]he U.S. economy is not struggling for lack of government spending. It is struggling for lack of competitiveness. Instead of President Obama's doomed strategy of creating jobs that are good for the environment, we need a strategy to create an environment that is good for jobs.

– Former Governor Mitt Romney, October 24, 2011²

The U.S economy is entering its fourth year with unemployment above 8 percent. We have not seen this level of joblessness since 1984 (and during the early-1980s recession, it lasted just over two years). Job creation is a concern for every sitting public official and candidate for office, as well as for many families.³ While just about everyone would agree that protecting existing jobs and creating new jobs are critical steps towards lifting the economy out of its ongoing crisis, economists, politicians, and the public are far from unanimous about government's best role in fostering "an environment that is good for jobs."

Arguments about job creation have been particularly important for opponents of environmental regulation. Jobs are destroyed in vast numbers, we have been told, when the Clean Air Act protects human health, when the environmental impacts of new pipelines are questioned, and when sensible safeguards are adopted to prevent another oil well blowout in the Gulf of Mexico. Can it really be the case that what's good for the environment is always bad for jobs? Environmental protection also requires extensive investments that stimulate the economy and generate employment.

To find out what kinds of investments are projected to foster jobs growth and just how much confidence should be placed in these economic predictions, we surveyed the studies behind the estimates of jobs lost or gained by energy and environmental policies heard in stump speeches and news reports. As described in this paper, we found a broadly consistent "big picture" result across almost all studies, and a lot of questions and concerns about the accuracy of their smaller details. The big picture is this:

¹ Obama (2010).

² Romney: Believe in America website, <http://www.mittromney.com/blogs/mitts-view/2011/10/we-need-environment-jobs>.

³ U.S. Bureau of Labor Statistics (2012) Seasonal Unemployment Rate, 16 years and over, Series Id: LNS14000000. The unemployment rate has exceeded 8 percent since February 2009; in the post-World War II period, it also exceeded 8 percent from November 1981 through December 1984; January through December 1975.

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Jobs are created when investments are shifted out of fossil-fuel industries and into non-fossil-fuel industries, and jobs are destroyed when the opposite occurs. As a result, policies that support alternative energy and environmental protection are often very successful at increasing employment.

Perspectives on how government policies can impact employment differ in at least two important ways: First, can government spending and other active public policies increase employment, or should the government concentrate on removing all fetters to a free marketplace, and staying out of the way of private sector job creation? And second, if government should play a role in stimulating or guiding job creation, what types of policies and investments are the most desirable?

This paper focuses on the second issue. Briefly on the first: the most important economic limitation to government job creation is unfortunately irrelevant in the near future. When we are at or close to full employment (very low unemployment), government spending can compete with and “crowd out” private sector employment; in the extreme, there is no way to create a net increase in jobs if everyone is already employed. The flip side of this argument is more in evidence today – when large numbers of people are out of work, government spending can create jobs for the unemployed, without crowding out any private sector activity. Of course, those who dispute this view, maintaining that government intervention always harms the private sector, will conclude that government spending reduces employment, now and forever. The analysis presented here begins with an acceptance of a key aspect of Keynesian macroeconomics: when unemployment is high, government spending is important, and maybe even essential, to job stimulus.

It has been well documented that insufficient investment has led to significant deterioration of U.S. infrastructure. The United States’ aging stock of levees, dams, bridges, roads, electric transmission lines and power plants is widely regarded as both a national security risk and a drag on economic productivity.⁴ The country’s energy systems received a D+ in the American Society of Civil Engineers’ *2009 Report Card for America’s Infrastructure*, and have been a key focus of federal strategic planning under both the Bush and Obama administrations.⁵ Indeed, the National Energy Policy Development Group – led by Vice President Dick Cheney – concluded that, “One of the greatest energy challenges facing America is the need to use 21st century technology to improve America’s aging energy infrastructure,” noting the crucial role of public safety and environmental protection in federal energy policy.⁶

From the Keystone Pipeline to drilling in the Gulf of Mexico, investments in energy infrastructure and their potential environmental impacts have also been at the forefront of public debate. Many political candidates and industry groups (petrochemical, nuclear, renewable, etc.) have made strong claims regarding the potential for specific energy and other related environmental policies to either create or destroy jobs. Often, politicians and industry officials pose a sharp dichotomy: protect the environment or protect jobs, as if these two goals were

⁴ FEMA Strategic Foresight Initiative (2011); U.S. Government Accounting Office (2008); The Urban Land Institute and Ernst & Young (2010)

⁵ American Society of Civil Engineers (2011); National Energy Policy Development Group (2001); Obama (2012).

⁶ National Energy Policy Development Group (2001, p.7-1).

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naturally and inevitably opposed to one another. Perhaps less frequently, advocates of “clean energy” development argue for the idea of a synergy: what is good for the environment is good for jobs, and vice versa.

We looked at a broad range of recent studies that examine the job impacts of U.S. energy and environmental policies, asking both, How do these studies estimate the number of jobs likely to be generated by a particular public policy? And, what kinds of policies are likely to get the biggest “bang for our buck” (in terms of job creation) – those fostering renewable energy production, or those building up our existing fossil-fuel-based energy infrastructure?

While there is more than one acceptable method for estimating job impacts from public policy, the field is clearly dominated by input-output studies – which account not just for direct employment due to purchases in a given industry but also for jobs indirectly created by the resulting business-to-business transactions and (often) employees’ consumer purchases. Section 2 provides a detailed checklist of the standards these studies need to meet in order to provide high-quality job estimates.

One important difference among the input-output job impact studies that we reviewed brings into question the *accuracy* of their results (how close they come to a true or correct prediction of future job impacts) , or, at the very least, their *precision* (how similar are the results of multiple studies of the same public policy). Across the 36 estimates reviewed, we found surprisingly large differences in the expected jobs per dollar impact assigned to each economic sector. To these studies’ credit, however, we also identified a consistent pattern among their job per dollar ratios: \$1 million generates fewer jobs when spent in fossil-fuel industries than it does when spent in non-fossil-fuel sectors. Section 3 summarizes the results of this review of the literature and – with the hope of inspiring greater consistency in future studies – also presents a clear, well-documented, and entirely replicable method for producing jobs per dollar ratios by economic sector. As an example of the good practices set out in Sections 2, these newly minted jobs per dollar estimates are then applied in Section 4 to an existing study of the expenditures necessary to eliminate coal from U.S. electricity production.

Finally, Section 5 draws on the information presented in this paper to address our second key research question: What kinds of environmental public policies lead to the most job creation? The evidence is clear: Clean energy investment, which moves spending from fossil-fuel to non-fossil-fuel industries, creates jobs.

2. From Energy Spending to Energy Jobs

What makes for a good jobs study? Estimates of the number of jobs that will be created or destroyed by a particular public policy are an increasingly common feature of political discourse. This is particularly true for the debate on energy spending, and of environmental policy more generally. Most of the jobs estimates reported in the news are based on a simple recipe, called input-output jobs analysis:

- Start with the dollars of spending that the policy is expected to either generate or take away;
- Break those dollars out into the economic sectors where they will be spent (for example, mining, construction, manufactures, or agriculture);
- Multiply each sector's dollars by its expected jobs to dollars ratio (which includes the effects of additional rounds of job creation as businesses buy inputs from other sectors and employees spend their paychecks); and then,
- Add up the resulting jobs gained or lost.

The quality of a job estimate calculated in this way, of course, rests on the underlying accuracy of both the expected number of jobs per dollar of spending in a given industry and the predictions about how the policy will change spending in each sector. Box 1 summarizes, and the

Box 1: A Checklist for High-Quality Job Impact Studies

Getting Jobs Ratios Right:

- ✓ Does the study include direct, indirect, and induced spending? **B-** (29/36)
- ✓ Does the study adequately explain the source of the job ratios? **F** (21/36)

Measuring Jobs in Full-Time Equivalent:

- ✓ Does the study explain what it means by a "job?" (That is, does it distinguish between full-time equivalent and part-time plus full-time jobs?) **F** (18/36)
- ✓ If the study clearly uses part-time plus full-time jobs, does it explain why? **F** (0/9)

New Losses and Gains in Spending:

- ✓ Does the study make it clear whether job estimates are cumulative or for a single year? **C** (27/36)
- ✓ Does the study use new spending net of a baseline in the absence of the policy change (as opposed gross spending)? **B+** (32/36)
- ✓ If the study clearly uses spending net of a baseline, does it look at the difference between the policy and its most likely alternative? **F** (12/32)

The Finer Details:

- ✓ Most job studies base their results on a very simple estimation method. Does the study discuss what may have been missed from its analysis? **F** (13/36)

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following sections treat in more detail, a checklist of quality controls for job estimates. The checklist also includes letter grades based on the percentage of studies that “passed” each criterion (for example, 29 out of 36 estimates included direct, indirect, and induced effect, for a grade of 81 percent, or a B-).

Getting Jobs Ratios Right

The assumed relationship between spending and job creation is one of the most important components of any estimate of employment impacts from energy and environmental policies. The most common method for *ex ante* analysis – how many jobs will a proposed policy create – predicts economy-wide impacts by applying “multipliers” to the expected new spending in each economic sector. The result is a ratio of jobs per \$1 million of spending for:

- *Direct employment* – spending in a given sector results in additional jobs in that same sector.
- *Indirect employment* – spending in one sector causes a far-reaching web of business-to-business transactions as each sector makes purchases in other sectors; the result is additional jobs in those inter-related sectors.
- *Induced employment* – new employees spend their paychecks in sectors throughout the economy; the result is additional jobs in sectors that produce consumer goods and services, and the sectors that supply consumer industries, and so on.

Decreases in spending would have the opposite effect, with jobs lost in the direct and indirect sectors and additional losses of induced employment due to reductions in consumer spending from laid-off employees. A full accounting of the job effects of a particular policy sums up direct, indirect, and induced changes in employment.

Job ratios for specific sectors, and their underlying methods, data sources, and assumptions, differ greatly from one job impact study to the next. Section 3 below explores these differences and presents a clear, easily replicable methodology for producing job ratios by industry category. (Appendix A includes a more detailed discussion of the methods used to estimate job impacts.)

Measuring Jobs in Full-Time Equivalents

Job impact studies also differ in their definition of a “job.” Some studies count every part- and full-time position as a job, while others convert jobs into full-time equivalency (FTE), where one job is the equivalent of one person working full-time for one year. Unless everyone works full-time, the headcount of part- and full-time jobs will always be higher than FTE jobs for the same amount of spending. IMPLAN – a commonly used source of economic data that breaks down U.S. business activity into over 400 sectors – estimates that the relationship between these very different meanings of a “job” range from 69 to 99 FTE jobs for each 100 part- and full-time jobs, depending on the economic sector.⁷

At a minimum, a high-quality job impact study should make it clear whether the estimated jobs lost or gained are FTE jobs or part- and full-time jobs; as reported in Appendix A, numerous

⁷ “Convert_IMPLAN440_Employment_to_FTE_and_Income_to_EC,” Minnesota IMPLAN Group, Inc. (2012). This spreadsheet includes a discussion of the IMPLAN method of calculating these conversion factors.

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studies fail to document this key definition. Furthermore, unless there are compelling reasons for adding part-time together with full-time jobs, the FTE approach has a number of clear advantages: headcount estimates can have the effect of obscuring the share of part-time jobs generated by new spending; any transition between full and part-time workers would also be masked; and FTE job impacts are more readily comparable across different studies, giving the study's results a greater applicability in the policy arena.

New Losses and Gains in Spending

Good job estimates also depend on predictions about changes to energy or other environmental spending as a result of a public policy. For higher or lower spending to accurately translate into jobs gained or lost a few critical quality controls need to be in place:

- *Annual spending needs to be clearly differentiated from cumulative spending.* If spending isn't reported *by year* (2015 spending, 2016 spending, etc.) then it should be *by a range of years* (spending from 2015 through 2020). This makes it easier to compare results across studies and helps to avoid the misuse of estimated job impacts in secondary publications. When industry groups, politicians, or journalists misinterpret a study's estimate of cumulative jobs over several years or decades as the impact of a single year's spending, it can lead to a proliferation of misinformation.
- *Changes in spending caused by a public policy must be reported net of a baseline scenario.* Basing job estimates on gross spending overestimates the economic impact of public policies. For example, the total number of jobs directly and indirectly created by the fossil-fuel industry is a good measure of the number of jobs that would be lost if the industry vanished and nothing replaced it; it is a very bad measure of the job impacts of any particular policy that causes small changes in the size of the industry. A high-quality job impact study should clearly lay out the terms of its baseline scenario of economic activity *without the policy change*.
- *In many cases, spending used in job impact studies should be the difference between the public policy being studied and an alternative policy.* The impact of many public policies is best understood not as the difference between doing something (the policy) and doing nothing (the baseline), but rather as the difference in the impacts of one policy option as compared to its most likely alternative. This may take the form of a richer, more complex understanding of what it means to estimate baseline conditions. The most basic baseline scenarios may simply project current conditions forward with some accounting for expected changes in national output or the overall size of the labor force. A better baseline presents the most likely spending scenario in the event that the public policy under study is not implemented.

As in all of the steps needed to produce job impact estimates, careful documentation of definitions, methods, and data sources is critical to high-quality spending predictions. Section 4 provides an example of doing this right.

The Finer Details

A high-quality impact study gets the job ratios right, uses full-time job equivalents, and estimates jobs lost from new spending (net of a baseline or likely alternative). But a thorough analysis would go much further to account for a broader set of macroeconomic effects. This is not to

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discourage the use of “basic” job estimation techniques: such studies can be produced quickly and inexpensively to give a ballpark figure that is useful as a gauge of the size and direction (i.e., job losses or job gains) of employment impacts. Simpler methods, such as input-output analysis, however, may benefit from some additional discussion of the macroeconomic effects that they leave out.

More complicated methods of analysis, such as computable general equilibrium models, provide a more thorough representation of the complex macroeconomic effects caused by any change in government spending or regulation of the private sector. These interactions may include the effects of price and income elasticities (or the ways in which changes in consumption or production effect prices and incomes), changes to imports and exports, the role of U.S. fossil-fuel supply and demand in the international market, learning curves (with experience, new technologies become less expensive to produce), and increasing costs of extracting finite fossil-fuel resources. Such studies are more time consuming and more expensive to conduct, and often rely on unexamined and unreported assumptions about market-clearing mechanisms and elasticities.

Neither input-output analysis nor computable general equilibrium models are perfect windows into the future. Rather, they are alternative ways of imagining a likely future. Most policy impact analyses will use the basic, back-of-the envelope method described in the recipe above. A high-quality study will also address – however briefly – the mostly likely effects of the macroeconomic interactions not captured by this simple method of impact analysis.

3. Job Impacts of Policy Choices

Changes to energy spending result in jobs lost or gained, not just in energy sectors but throughout the economy. The total job impact depends on what industries are impacted by public policy. We surveyed 36 recent estimates of the job impacts of environmental policies to compare and contrast the ratios of jobs per \$1 million of spending used in the literature (the full results of this survey are reported in Appendix A). These studies assessed the employment impacts of a range of public policies, including: recent EPA regulations such as the Mercury and Air Toxics Standard for utilities, and the Clean Air Transport Rule; federal policies regarding the development of fossil fuel resources, such as offshore oil fields, shale gas fields, and the Keystone XL Pipeline; and federal and state renewable portfolio standards.

For each study reviewed, we took note of its methods of estimation, data sources, key modeling assumptions, and replicability (was it well-documented enough that someone could repeat its methods and expect to achieve identical results). A recent study by the Institute for Policy Integrity provides a similar, overlapping, review of this literature, but focuses on the role of employment impact studies in policymaking, arguing that such studies should complement, but not replace, cost-benefit analyses and calling for more rigor and transparency when choosing analytical methods and making modeling assumptions (Livermore et al. 2012).

Table 1 displays a summary of the range of “total” – including direct, indirect, and induced employment – job effects per \$1 million found in our survey of recent studies.⁸

Table 1: Total Job Impact Ratios from Survey of Literature

Industry	FTE	Part- and Full-Time
Average: all industries	--	17.3
Household Consumption	7.0 - 17.0	18.4
Petroleum sectors	5.2 - 11.5	6.5 - 23.2
Renewables	13.3 - 13.7	8.9 - 19.0
Energy efficiency / retrofit	11.4 - 66.2	16.5 - 18.1
Energy infrastructure	12.5 - 40.0	5.4 - 26.7
General utilities	--	6.1 - 20.0
Manufacturing	--	11.6 - 24.8
Construction	--	15.6 - 25.8
Government	--	21.0 - 26.5
Agriculture / Forestry	--	9.9 - 26.9
Other mining	--	10.3 - 13.5
Trade / Services	--	4.5 - 32.2

Source: See Appendix A for data sources. The summary presented in this table includes only “total” job impact ratios that include direct, indirect and induced effects.

⁸ Studies that did not include all three types of employment effects – direct, indirect, and induced – are excluded from this summary, but included in Appendix A. Where no information was offered to indicate which kinds of jobs are being discussed, we have made the assumption that “jobs” are part- and full-time jobs.

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In the FTE results, there is both a wide range of estimates within each industry category and a broad pattern in the differences between: 1) fossil-fuel sectors; 2) non-fossil-fuel energy, construction and manufacturing sectors; and 3) other services. This pattern is less obvious in the non-FTE-based estimates, which do not have standardized units that could be compared across industries. Within and across the FTE-based studies surveyed we found that fossil-fuel sectors generate fewer jobs per \$1 million of spending than do non-fossil-fuel energy, construction, and manufacturing sectors, and that other services have the highest jobs ratios overall.⁹

Table 2 displays our own estimates of FTE and part- and full-time jobs per \$1 million ratios based on IMPLAN 2009 data for the United States. (We provide results for 20 categories of economic sectors as well as a detailed, replicable methodology for these estimates in Appendix B.) Using data from this well-known source, the same \$1 million results in twice as many jobs when spent in non-fossil-fuel sectors than it does in fossil-fuel industries. Because the fossil-fuel industries are so small, representing just 5.2 percent of U.S. GDP and 0.7 percent of U.S. employment, the average non-fossil-fuel sector jobs to \$1 million ratio is very similar to that of the all-sector average. Overall, the job impact ratios obtained from IMPLAN 2009 fall within the range of those used elsewhere in the literature.

Table 2: Comparing Total Job Impact Ratios

	FTE		Part- and Full-Time	
	IMPLAN 2009	Survey of Literature	IMPLAN 2009	Survey of Literature
All sectors	16.0	--	17.5	17.3
Fossil-fuel sectors	8.1 (6.5 - 18.0)	5.2 - 11.5	8.2 (6.6 - 18.3)	6.5 - 23.2
Non-fossil-fuel sectors	16.5 (7.8 - 28.0)	7.0 - 66.2	18.1 (7.9 - 32.3)	4.5 - 32.2

Source: See Appendices A and B for methodology and source notes. Values in parentheses are the range across categories of economic sectors. The summary presented in this table includes only "total" job impacts ratios that include direct, indirect and induced effects.

The total job impact ratios, shown by industry category in Table 3, range from 6.5 FTE jobs per \$1 million of spending on petroleum refineries to 28.0 FTE jobs per \$1 million of spending on forestry and fishing related activities. Even within the fossil-fuel-based grouping there is a wide variation in ratios, ranging up to 18.0 FTE jobs for each \$1 million in the support activities for oil and gas operations category.

The wide range of jobs per \$1 million ratios, for both fossil-fuel sectors and non-fossil-fuel sectors, suggests that the employment impacts of a specific policy are very sensitive to the types of investments under consideration. The labor intensity (jobs per dollar) of an industry in and of itself is captured by its impact on direct employment. Some industries are notably more labor intensive than others. Despite having similar indirect impacts through suppliers and employees' downstream consumption, when the fossil-fuel industries are compared to all other sectors they have a relatively low impact on direct employment. This difference in direct employment drives much of the variation in job impact ratios.

⁹ Although not quite as clear, this pattern is found within the non-FTE studies as well. A lone exception in the studies surveyed was Watzman (2011), whose implied jobs ratios were two to three times higher for fossil fuel investments than for renewable energy investments. See Appendix A for more detail.

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Table 3: FTE Employment Effect Ratios from IMPLAN 2009 Data

Category	Direct	Indirect	Induced	Total
All sectors	6.3	3.6	6.1	16.0
Fossil-fuel sectors	0.8	3.4	3.9	8.1
Petroleum refineries	0.1	3.3	3.2	6.5
Natural gas utilities	0.6	3.1	3.5	7.3
Drilling oil and gas wells	1.0	4.3	4.3	9.7
Extraction of oil and natural gas	2.2	3.3	5.4	10.8
Mining coal	3.1	3.8	5.8	12.7
Support activities for oil and gas operations	4.8	5.1	8.1	18.0
Non-fossil-fuel sectors	6.6	3.6	6.3	16.5
Real estate and rental and leasing	5.5	2.4	2.5	10.3
Electric utilities	1.5	2.4	3.9	7.8
Mining, except petroleum, and support activities	2.9	3.0	4.4	10.3
Manufacturing, except petroleum refineries	2.2	4.9	5.3	12.4
Information, finance and insurance	3.6	4.2	6.0	13.9
Water and sewage utilities	4.8	3.4	6.3	14.5
Wholesale trade, transportation and warehousing	5.6	3.6	6.4	15.6
Professional, scientific, and technical services	7.3	3.2	7.9	18.4
Government	9.7	1.0	8.0	18.6
Farms	7.3	6.4	5.4	19.1
Construction	7.7	4.5	7.4	19.6
Retail trade	14.5	1.4	5.9	21.7
Other services, except government	10.7	3.6	7.2	21.5
Forestry, fishing, and related activities	16.2	4.2	7.6	28.0

Source: Authors' calculation based on IMPLAN 2009 data for the United States. See Appendix B for methodology and data sources.

4. Jobs in “A Future without Coal and Nuclear”

In this section we assess the employment effects of a transition to a coal-free energy sector, providing an illustrative example of the practices recommended in previous sections. Using expenditure estimates for two disparate energy industry investment paths, developed by researchers at Synapse Energy Economics (Keith et al. 2010), we calculate the net employment impacts of a transition to a cleaner, coal-free economy by 2050. Box 2 shows how our analysis (based on that of Synapse) conforms to the checklist presenting above in Box 1.

Box 2: A Checklist for Jobs in “A Future without Coal and Nuclear”

Getting Jobs Ratios Right:

- ✓ Our study includes direct, indirect, and induced spending.
- ✓ Our study carefully explains the source of the job ratios.

Measuring Jobs in Full-Time Equivalent:

- ✓ Our study explains what it means by a “job.”
- ✓ Our study uses full-time equivalent jobs.

New Losses and Gains in Spending:

- ✓ Our study makes it clear whether its job estimates are cumulative or for a single year.
- ✓ Our study uses new spending net of a baseline in the absence of the policy change.
- ✓ Our study looks at the difference between the policy and its most likely alternative.

The Finer Details:

- ✓ Our job study, like most, bases its results on a very simple estimation method; it does, however, discuss the effects that have been left out.

In the “business-as-usual” baseline scenario, investments in coal, natural gas, and nuclear power generation facilities are the primary means of expanding generation capacity to meet projected future demand for electricity. The alternative “transition” scenario gradually reduces spending on coal-fired facilities, eliminating all use of coal to generate electricity by 2050.

The transition scenario further assumes no new nuclear power, and limited use of natural gas, ultimately reducing year 2050 transition scenario expenditures on natural gas and nuclear to 50 percent of year 2050 baseline spending. To replace the steep decline in nuclear and fossil-fuel electricity generation, large investments in energy efficiency, renewable energy generation, and infrastructure upgrades are needed to meet projected energy demand. One result is an 82 percent reduction in electric utilities’ carbon dioxide emissions. Another result is a major realignment of energy investment. Table 4 shows a summary of the net difference between transition and baseline scenario energy industry spending, including annual spending at ten-year intervals. Over the forty-year time period there is a cumulative increase of \$81 billion in spending (an average of about \$2 billion per year), driven to a great extent by energy efficiency expenditures.

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Table 4: Annual Change in Spending, Transition Scenario Net of Baseline (million 2009 US\$)

Sector	2020	2030	2040	2050	Total 2010-2050
Coal	-21,593	-46,017	-72,562	-98,056	-1,892,000
Natural gas	6,750	-18,317	-48,659	-77,021	-987,365
Nuclear	-5,875	-11,663	-22,700	-39,348	-599,120
Geothermal	1,182	3,360	5,746	7,400	139,880
Biomass	1,964	5,173	14,022	23,772	330,450
CSP	1,490	3,210	4,520	4,729	115,845
PV distributed	1,870	4,909	5,532	7,442	160,320
PV central	1,126	2,568	3,192	4,515	91,435
LFG/WWT gas	587	749	998	1,034	28,510
Wind	11,469	21,095	24,860	32,696	737,720
Wind integration costs	330	1,600	2,900	3,900	67,800
Energy efficiency	14,000	48,000	79,000	110,000	1,960,000
Incremental transmission	800	1,600	2,300	3,100	62,500
Avoided emission control	-4,500	-4,500	-4,500	0	-135,000
Net spending per year:	9,600	11,767	-5,351	-15,837	80,975

Source: Authors' calculations based on Synapse Energy Economics (Keith et al. 2010) data.

Table 5: FTE Job Impacts, Transition Scenario Net of Baseline

Sector	2020	2030	2040	2050	Total 2010-2050
Coal	-248,497	-529,573	-835,059	-1,128,449	-21,773,530
Natural gas	61,621	-167,216	-444,208	-703,125	-9,013,659
Nuclear	-93,850	-186,310	-362,619	-628,561	-9,570,594
Geothermal	19,005	54,024	92,388	118,982	2,249,077
Biomass	41,834	110,188	298,676	506,356	7,038,754
CSP	23,957	51,612	72,675	76,036	1,862,627
PV distributed	30,067	78,930	88,947	119,657	2,577,724
PV central	18,105	41,290	51,323	72,595	1,470,148
LFG/WWT gas	9,438	12,043	16,046	16,625	458,401
Wind	184,406	339,178	399,714	525,706	11,861,518
Wind integration costs	5,783	28,041	50,824	68,350	1,188,236
Energy efficiency	245,358	841,229	1,384,522	1,927,816	34,350,173
Incremental transmission	14,020	28,041	40,309	54,329	1,095,350
Avoided emission control	-86,456	-86,456	-86,456	0	-2,593,682
Net job impact by year:	224,792	615,021	767,083	1,026,317	21,200,544

Source: Authors' calculation based on Synapse Energy Economics (Keith et al. 2010) and IMPLAN 2009 data for the United States. See Appendices B and C for methodology and data sources. Table 5 uses Weighting Scheme #1, see Appendix Table C1.

Our IMPLAN 2009 FTE job impact ratios (including direct, indirect, and induced impacts) for each sector, as described in Section 3 above, were then applied to the annual changes in spending from Table 4. The results are displayed in Table 5, showing that a transition away from a coal-

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based energy sector would result in the creation of over 21 million net FTE jobs from 2010 to 2050, or an average of a little more than half a million jobs in each year.

When compared to the cumulative change in net spending, cumulative net job gains are relatively large. This is because relatively less spending occurs in fossil-fuel industries in the transition scenario, and these industries have lower job impact ratios. Although increased spending on energy efficiency barely offsets reduced spending on coal, the employment gains from energy efficiency expenditures swamp the job losses from reduced reliance on coal, because energy efficiency spending has a much larger employment impact per million dollars.¹⁰

Although there are net job gains for the economy as a whole, employment gains are not ubiquitous—there are important job losses within the coal, natural gas, and nuclear energy industries. Communities heavily dependent upon coal-related industries would be especially hard hit by the changing spending patterns of the proposed policy, and efforts to assist these communities would be an important component of the policy's implementation that is not addressed in Synapse cost estimates. These efforts might include retooling and retraining the workforce and developing alternative economic opportunities.

One limitation of an input-output jobs analysis like this one is its inability to capture the policy's impact on important macroeconomic effects such as changes in prices and the progress of technology. It is clear that such a policy, resulting in an economy-wide shift in the electricity generation technology, would have some impact on prices. The net economic impact of this change, however, is not as obvious. On the one hand, moving towards cleaner energy would increase the cost of electricity generation and create a drag on the economy. On the other, the policy's emphasis on energy efficiency would reduce energy costs for consumers and businesses and result in economic stimulus.

Technological advance would also play an important role in determining the policy's net economic impact. Improvements in renewable energy technology may reduce the cost of generation, mitigating any increase in electricity prices. Firms will also adapt to higher prices, making changes to their production process that may lead to a net gain or net loss of jobs. Moving to a more intensive method of analysis, such as a computable general equilibrium model, would allow for the inclusion of these impacts but would introduce other concerns, such as the accuracy of the price and income elasticities modeled.

¹⁰ Appendix C explores the potential sensitivity of these job estimates to changes in the assumed distribution of spending across specific industrial categories. Very similar results using an alternative weighting scheme suggest that these job impacts are robust to changes in the weighting of economic sectors.

5. The Bottom Line

Our analysis and our review of other recent analyses agree: shifting spending from fossil-fuel to non-fossil-fuel industries would lead to an increase in total employment. Hidden in the total number of net jobs that would be created, however, are real layoffs of fossil-fuel industry workers. From the perspective the U.S. economy as a whole, environmental investments appear to be a clear winner. From the perspective of some individual workers, incomes would be lost and, in some cases (such as coal mining), their skills may not make them attractive candidates for the new jobs being created. Retraining workers with specialized, fossil-fuel-based skills should be a cost component of every “green” energy policy.

Our review of the literature also suggests that job impact estimates need to be treated with some caution. We found a few excellent high-quality job studies in terms of our four criteria:

- Getting jobs ratios right
- Measuring jobs in full-time equivalents
- Calculating net losses and gains in spending; and
- Using appropriate macroeconomic methods

But many more studies failed to make the grade either in terms of questionable methodological choices, or a failure to clearly document the procedures followed and data sources and assumptions used. Our demonstration of using these best practices – starting from an existing study of costs of eliminating coal from the U.S. electricity production by 2050 – supports the broad finding of this literature as a whole: clean energy investment makes for a good environment for jobs.

There is no reliable evidence for the argument that regulations in general, or environmental regulations in particular, are uniquely bad for employment. Many regulations require that one kind of investment be replaced with another, resulting in job losses in some areas and job gains in others. Careful analysis, avoiding the errors described in this report, is required to determine the net effect of any one regulation. The one consistent pattern that emerges from the literature on jobs and the environment, however, suggests that many regulations will lead to net job creation: clean energy alternatives create more jobs than the fossil fuels that they replace.

Appendix A: Survey of Job Impact Ratios

This survey included 36 estimates of the job impacts of environment and energy related policies, including the Gulf of Mexico deepwater drilling moratorium, the development of the Keystone XL Pipeline, the so-called ‘train-wreck’ of multiple new regulatory requirements facing coal plants, expanded development of the Marcellus Shale (i.e., “fracking” in natural gas production, in the northeastern United States), and the implementation of national and state level Renewable Portfolio Standards. These studies vary in their definition of jobs (part- and full-time versus full-time equivalency) and in their inclusion or exclusion of direct, indirect, and induced employment effects. These effects are typically generated using input-output tables, varying by industry, the geographic scope of analysis, and the input-output model used (two of the most common models are IMPLAN and the Bureau of Economic Analysis’ RIMS II model).

Table A1 displays jobs per \$1 million ratios obtained from studies that clearly report FTE employment.

Table A1: FTE Job Impacts per \$1 million, Survey of Literature

Industry	Cicchetti (2011)	Houser, Mohan, and Heilmayr (2009)	Howland et al (2009)	Mason (2009)	Mason (2010)	Perryman Group (2010)	Pollin et al (2008)	Pollin, Wicks-Lim, and Garrett-Peltier (2009)	Pollin, Heintz, and Garrett-Peltier (2009)	Weinstein (2010)
Petroleum sectors										
Oil industry							5.4			
Oil / Natural gas				10.4	10.42				5.2	11.5
Petroleum refining				7.9						
Oil / Natural gas / Coal								5.3		
Coal									6.9	
Household consumption		7.0					17.0			
Renewables										
Investment: new generation										
Solar									13.7	
Wind									13.3	
Energy efficiency / Retrofit										
Green recovery		30.1					20.0			
Investment: clean-energy								16.7		
Building retrofits		25.1 - 25.3	45.7 - 66.2						16.7	
Investment: pollution controls	11.4									
Energy infrastructure										
Smart grid									12.5	
Battery R&D		22.5								
Smart meter		40.0								
Mass transit / Freight rail*		34.5							22.3	
Transport/Communication		25.0								
CCS pilot projects		28.5								
Keystone Pipeline construction						5.7				
Analysis characteristics:										
FTE jobs?	Yes	Yes	Yes	Yes	Yes	Yes	Yes ^a	Yes ^a	Yes ^a	Yes ^b
Job years?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Direct+Indirect+Induced?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jobs ratio: implied or reported?	Implied	Both	Reported	Reported	Reported	Implied	Implied	Reported	Reported	Implied
^a Personal communication with Heidi Garrett-Peltier, March 2012										
^b Personal communication with Bud Weinstein, March 2012										
* 90/10 split										

Source: Cicchetti (2011), calculated Table 7 on page 46, and page 49; Houser et al (2009), calculated from page 1 and Table 2; Howland et al (2009), Table ES2, page 4; Mason (2009), Table A3, page 28; Mason (2010), page 18; Perryman Group (2010), calculated from page 4; Pollin et al (2008), page 10; Pollin, Wicks-Lim and Garrett-Peltier (2009), Figure 1; Pollin, Heintz and Garrett-Peltier (2009), Table 5; Weinstein (2010), calculated from Table 2 and page 5.

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Table A2a: Part- and Full-Time Job Impacts, Survey of Literature

Industry	ACEEE (2011)	Apollo Alliance (2004)	Bezdek et al (2008)	Bivens (2003)	Considine et al (2009)	IHS Global Insight (2010)	Inter-Agency Economic Report (2010)	Lopez et al (2010)	PA Consulting (2009)
Average	17.3								
Petroleum sectors									
Oil / Natural gas				8.6			11.1		
Oil / Natural gas extraction									
Petroleum refining				7.5					
Coal / Coal mining				6.5					
Construction related: coal									
Construction related: gas									
Drilling wells: shale gas					12.6 - 17.1				
Operations related: coal									
Operations related: gas									
Natural gas distribution									
General utilities									
Energy	9.9								
Electric utilities									
Gas utilities									
Industrial boiler owners						15.5 - 16.4			
Mass transit/Freight rail		7.1 - 7.5							
Transport / Communication		7.7							
Transport / Utilities									
Energy Infrastructure									
Brownfield redevelopment		6.0							
Hydrogen fuel cell R&D		6.2							
Nuclear construction									
Water and Wastewater		5.4						20.0 - 26.7	
Renewables									
Construction related: solar									
Construction related: wind									
Operations related: solar									
Operations related: wind									
Renewables		19.0							
Biomass		8.9							
Environmental protection			16.5 - 18.1						
Household consumption									
Manufacturing	13.8								
Metal durables									
Construction	20.3			15.6					
Building retrofits		25.8							
Residential									
Commercial									
Other									
Government	21.0								
Ag / Resource extraction									
Commerical logging							9.9, 11.3		
Agriculture									
Agriculture / Forestry				20.3			10.9, 12.9		
Other mining									
Trade / Services									
Wholesale trade									
Retail									
Trade / Services	18.8								
Services									
Scientific R&D		4.5 - 6.7							
Finance		12.6							
Analysis characteristics:									
FTE jobs?	No	**	**	**	**	No	**	No	**
Job years?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Direct+Indirect+Induced?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jobs ratio: implied or reported?	Reported	Implied	Implied	Reported	Implied	Implied	Implied	Reported	Implied
** Could not be determined from source									

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Table A2b: Part- and Full-Time Job Impacts, Survey of Literature

Industry	Price Waterhouse Cooper (2011)	Public Policy Institute (2011)	Quest (2011b)	Quest (2011a)	Scott et al (2002)	Scott et al (2002)	Scott et al (2008)	Scott et al (2008)	Solan et al (2010)	Urbanchuck (2009)
Average										
Petroleum sectors										
Oil / Natural gas	8.5		9.9 - 10.7	8.9						
Oil / Natural gas extraction					7.0	10.3	9.1	13.1		
Petroleum refining					7.1	11.8 - 13.0				10.1
Coal / Coal mining							9.9	9.7		
Construction related: coal										
Construction related: gas										
Drilling wells: shale gas		23.2								
Operations related: coal										
Operations related: gas										
Natural gas distribution							7.1	14.3		12.5
General utilities										
Energy										
Electric utilities					9.5	9.2	6.1	6.5		11.6
Gas utilities					7.4	14.7				
Industrial boiler owners										
Mass transit/Freight rail										16.6
Transport / Communication					16.4	13.5 - 20.0				
Transport / Utilities							15.9	17.5		
Energy Infrastructure										
Brownfield redevelopment										
Hydrogen fuel cell R&D										
Nuclear construction									13.9	
Water and Wastewater					14.0	25.9				16.0
Renewables										
Construction related: solar										
Construction related: wind										
Operations related: solar										
Operations related: wind										
Renewables										
Biomass										
Environmental protection										
Household consumption										18.4
Manufacturing										
							11.6	13.8		
Metal durables					17.3	13.1 - 24.8				
Construction										
Building retrofits					21.0		18.3	17.0		
Residential										
Commercial										
Other										
Government										
					26.5	21.7				
Ag / Resource extraction										
Commerical logging										
Agriculture					26.9	26.6				19.1
Agriculture / Forestry							24.1	14.0		
Other mining					13.5	10.3	11.1	10.9		
Trade / Services										
Wholesale trade							11.5	12.6		18.3
Retail					32.2	23.6	25.0	25.1		
Trade / Services										
Services							15.4	18.0		
Scientific R&D										21.7
Finance					10.1	16.6	11.1	11.4		
Analysis characteristics:										
FTE jobs?	No	**	No	No	**	**	No ^c	No ^c	No	**
Job years?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Direct+Indirect+Induced?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jobs ratio: implied or reported?	Implied	Implied	Implied	Reported	Reported	Reported	Reported	Reported	Implied	Reported
^c Personal communication with Michael J. Scott, March 2012										
** Could not be determined from source										

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Table A2c: Part- and Full-Time Job Impacts, Survey of Literature

Industry	Boyce and Riddle (2010)	EPA (2011)	Heintz et al (2011)	Huntington (2009)	Sterzinger and Svrcek (2004)	Sterzinger and Svrcek (2005)	Watzman (2011)
Fossil fuels							
Oil / Natural gas	3.7						
Natural gas				2.1			
Coal	4.9			3.7			
Operations related: coal							8.3
Operations related: gas							3.9
Construction related: coal							8.3
Construction related: gas							7.2
Renewables							
Construction related: solar						1.8	3.3
Construction related: wind					3.7		1.0
Operations related: solar							2.1
Operations related: wind							1.0
Biomass	12.4			1.8 - 6.5			
Solar	9.8			3.2 - 4.5			
Wind	9.5			1.6 - 6.4			
Energy efficiency / Retrofit							
Building retrofits	11.9						
Investment: pollution controls		5.9	3.5				
Annual operating: pollution controls		3.8					
Investment: new generation			3.1				
Energy infrastructure							
Smart grid	8.9						
Mass transit / Freight rail**	15.9						
Analysis characteristics:							
FTE jobs?	Yes	Yes	Yes	**	Yes	Yes	**
Job years?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Direct+Indirect+Induced	No Induced	Direct Only	Direct Only	Direct Only	Direct Only	Direct Only	**
Jobs ratio: implied or reported?	Reported	Implied	Implied	Reported	Implied	Implied	Implied

** Could not be determined from the publication

Source: ACEEE (N.d.), Figure 1; Apollo Alliance (2004), calculated from Tables A to D.8; Bezdek et al (2008), calculated from Table 3, page 72; Bivens (2003), Table 9; Considine et al (2009), calculated from page ii and pages 23-25; Inter-Agency Report (2010), calculated from Table 2, page 11, and employment impact estimates on page 13; Lopez et al (2010), Table A1; PA Consulting (2009), page 11; Price Waterhouse Cooper (2011), calculated from Table E-1; Public Policy Institute (2011), calculated from pages 15-17; Quest (2011a), footnotes 2 and 3, citing Quest (2011b); Quest (2011b), Figures 11 and 12; Scott et al (2002), Table 4.1, pages 4.2-4.5; Scott et al (2008), Table 1, page 2286; Solan et al (2010), calculated from Table 10 and pages 30-33; Urbanchuk (2009), Appendix Table 1, page 12; Boyce and Riddle (2010), Table 6, page 12; EPA (2011), calculated from Table 8-6 and Table 9-6; Heintz et al (2011), calculated from Table 2, page 11; Huntington (2009), 2001; Sterzinger and Svrcek (2004), calculated from page 46; Sterzinger and Svrcek (2005), calculated from page 18; Watzman (2011), estimated from slide 20.

Table A2a and A2b include jobs ratios both for studies using part-time and full-time employment estimates and those that did not document their treatment of part-time employment. Tables A2c shows studies – using both the FTE and headcount methods – that present only direct, or direct and indirect effects.

We have maintained the original sector classifications as defined by the studies themselves. Where necessary, implied job impact ratios were calculated using a study’s expenditure assumptions and the resulting estimates of employment effects. With the exception of Watzman (2011), the studies reviewed indicate that spending in the fossil-fuel sectors has relatively low employment impacts as compared to non-fossil-fuel sectors. This is particularly true of the FTE-based studies, although the pattern is still apparent within individual non-FTE studies.

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Alternatively, the employment impacts of energy policies can be measured in terms of jobs per unit of additional energy generation capacity. Research conducted by the Energy and Resources Group at the University of California, Berkeley indicates that investments in new fossil-fuel generation generate fewer jobs than low-carbon and renewable energy alternatives (Wei et al. 2010). This finding is corroborated by several other studies that take this approach, supporting the more general finding that fossil-fuel based energy investments have relatively low employment effects (Black & Veatch 2010; Huntington 2009; Roland-Holst and Kahrl 2009). If renewables are more expensive per kwh, however, then they create more jobs per kilowatt-hours even if the jobs per dollar ratio were the same in every industry – a potentially important limitation to this method of analysis.

Appendix B: Job Impact Ratio Methodology and Data Sources

For this study, IMPLAN’s 440 sectors were mapped into 20 categories, including six single-sector fossil-fuel categories: extraction of oil and natural gas; mining coal; drilling oil and gas wells; support activities for oil and gas operations; natural gas utilities; and fossil-fuel refineries (see Table B1 which also displays each category’s associated NAICs codes).¹¹

Table B1: Industry Map

Category*	NAICS code	IMPLAN codes
Farms	111, 112	1-14
Forestry, fishing, and related activities	113, 114, 115	15-19
Extraction of oil and natural gas	211	20
Mining coal	212100	21
Mining, except petroleum, and support activities	212 (excludes 212100), 21311A	22-27,30
Drilling oil and gas wells	213111	28
Support activities for oil and gas operations	21311B	29
Electric utilities	221100	31
Natural gas utilities	221200	32
Water and sewage utilities	221300	33
Construction	230	34-40
Manufacturing, except petroleum refineries	311-339 (except 324110)	41-114,116-318
Petroleum refineries	324110	115
Wholesale trade, transportation and warehousing	420, 48,49	319,332-340
Retail trade	4A0	320-331
Government	491, S00 (excludes S00800)	427-432,437-440
Information, finance and insurance	51, 52	341-359
Real estate and rental and leasing	53	360-366
Professional, scientific, and technical services	54	367-380
Other services, except government	55, 56, 61, 62, 71, 72, 81	381-425
* Excludes IMPLAN sectors: 361, 426, and 433-436		

In IMPLAN databases, “employment” refers to total part-time, full-time and temporary jobs. To account for differences in the number of hours worked, employment can be converted to “full-time equivalent,” or “FTE,” employment using IMPLAN’s sector-specific conversion factors.¹² For clarity, in this report, full-time equivalent employment is always referred to as “FTE” employment. Table B2 displays each category’s 2009 output and FTE employment for the United States as a whole.¹³ Fossil-fuel sectors represented 5.2 percent of all U.S. output in 2009, and 0.7 percent of U.S. FTE employment. A final column in Table B2 shows single-sector categories ranked by the total FTE employment effect (the sum of direct, indirect, and induced effects) per \$1 million of output from the lowest ratio (in the sectors included here, petroleum refineries) to the highest (support activities for oil and gas operations).

¹¹ IMPLAN to NAICS mapping based on “2007_IMPLAN_Sector_Scheme.xls,” Minnesota IMPLAN Group, Inc. (2012).

¹² “Convert_IMPLAN440_Employment_to_FTE_and_Income_to_EC,” Minnesota IMPLAN Group, Inc. (2012). This spreadsheet includes a discussion of the IMPLAN method of calculating these conversion factors.

¹³ IMPLAN 2009, United States, “StudyAreaIndustryData” Table, columns “Output” and “Employment,” and “Convert_IMPLAN440_Employment_to_FTE_and_Income_to_EC,” Minnesota IMPLAN Group, Inc. (2012). Employment data are multiplied, sector by sector, by FTE conversion factors to estimate FTE employment.

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Appendix Table B2: Output and Employment by Category

Category	Output (10 ⁶ \$)	Output Share	FTE Employment	FTE Employment Share	Sector Rank*
All sectors	24,123,371		151,806,056		
Fossil-fuel sectors	1,256,438	5.2%	1,059,032	0.7%	
Petroleum refineries	699,919	2.9%	74,403	0.0%	6
Natural gas utilities	182,788	0.8%	111,278	0.1%	12
Drilling oil and gas wells	76,543	0.3%	77,622	0.1%	30
Extraction of oil and natural gas	218,328	0.9%	471,165	0.3%	55
Mining coal	32,410	0.1%	102,052	0.1%	134
Support activities for oil and gas operations	46,451	0.2%	222,511	0.1%	300
Non-fossil-fuel sectors	22,866,932	94.8%	150,747,024	99.3%	
Real estate and rental and leasing	1,343,547	5.6%	7,336,460	4.8%	
Electric utilities	271,209	1.1%	409,344	0.3%	17
Mining, except petroleum, and support activities	52,905	0.2%	155,082	0.1%	
Manufacturing, except petroleum refineries	5,191,447	21.5%	11,622,939	7.7%	
Information, finance and insurance	3,135,009	13.0%	11,352,777	7.5%	
Water and sewage utilities	10,053	0.0%	47,888	0.0%	218
Wholesale trade, transportation and warehousing	1,937,632	8.0%	10,886,334	7.2%	
Professional, scientific, and technical services	1,561,764	6.5%	11,446,008	7.5%	
Government	2,115,810	8.8%	20,498,609	13.5%	
Farms	303,058	1.3%	2,203,942	1.5%	
Construction	1,216,251	5.0%	9,408,941	6.2%	
Retail trade	1,050,317	4.4%	15,182,807	10.0%	
Other services, except government	4,634,195	19.2%	49,488,939	32.6%	
Forestry, fishing, and related activities	43,735	0.2%	706,953	0.5%	
* FTE job impact per \$1 million in spending, where a lower rank indicates a lower jobs per dollar ratio.					

For context, Table B3 shows output, FTE employment, and ranking by total FTE job impact per \$1 million for the IMPLAN sectors with the ten lowest and ten highest ranks. For the ten lowest ranking sectors, total FTE employment to output ratios range from 3.9 to 7.0 jobs per \$1 million; for the ten highest, these ratios range from 30.9 to 53.0.¹⁴

¹⁴ IMPLAN 2009, United States, “ReportsMultipliersEmployment” Table, columns “DirectEffects,” “IndirectEffects,” and “InducedEffects,” and “Convert_IMPLAN440_Employment_to_FTE_and_Income_to_EC,” Minnesota IMPLAN Group, Inc. (2012). Part- and full-time employment effects are multiplied, sector by sector, by FTE conversion factors to estimate FTE employment effects. Category averages are output weighted.

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Appendix Table B3: Output and Employment by Sector (highest and lowest ten sectors)

Sector	Output (10 ⁶ \$)	Output Share	FTE Employment	FTE Employment Share	Sector Rank*
Lessors of nonfinancial intangible assets	159,092	0.7%	55,403	0.0%	1
Tobacco product manufacturing	44,632	0.2%	18,607	0.0%	2
Distilleries	8,164	0.0%	7,290	0.0%	3
Primary smelting and refining of copper	9,255	0.0%	1,853	0.0%	4
Mining gold, silver, and other metal ore	16,030	0.1%	20,572	0.0%	5
Petroleum refineries	699,919	2.9%	74,403	0.0%	6
All other petroleum and coal products manufacturing	7,772	0.0%	5,018	0.0%	7
Electronic computer manufacturing	121,620	0.5%	88,414	0.1%	8
Flavoring syrup and concentrate manufacturing	30,285	0.1%	9,416	0.0%	9
Asphalt paving mixture and block manufacturing	15,037	0.1%	13,029	0.0%	10
Community food, housing, and other relief services, ...	31,291	0.1%	606,908	0.4%	425
Retail Stores - Miscellaneous	57,812	0.2%	1,353,321	0.9%	426
Other Federal Government enterprises	8,330	0.0%	78,834	0.1%	427
Child day care services	43,943	0.2%	1,033,077	0.7%	428
Individual and family services	64,119	0.3%	1,533,667	1.0%	429
Fitness and recreational sports centers	18,628	0.1%	446,611	0.3%	430
Car washes	7,462	0.0%	195,567	0.1%	431
Support activities for agriculture and forestry	18,402	0.1%	513,897	0.3%	432
Performing arts companies	13,811	0.1%	398,410	0.3%	433
State and local government passenger transit	14,750	0.1%	237,645	0.2%	434

* From lowest to highest FTE employment per \$1 million

As discussed in the main body of this white paper, some researchers report part and full-time employment effects (as opposed to full-time equivalent effects). Table B4 displays IMPLAN 2009 average part- and full-time employment effects per \$1 million which, among these 20 categories, range from 6.6 to 32.3.¹⁵ In general, fossil-fuel categories' total job impact ratios are little changed by a conversion from part- and full-time to FTE jobs. In contrast, many non-fossil-fuel categories – and especially service-based categories – employ a noticeable share of part-time workers.

¹⁵ The methodology for calculated part- and full-time job impacts is identical to that use to calculated FTE employment effects with one exception: the part- and full-time calculations leave out the FTE conversion factors.

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Appendix Table B4: Average Part- and Full-Time Employment/\$1 Million by Category

Category	Direct	Indirect	Induced	Total
All sectors	7.0	3.8	6.7	17.5
Fossil-fuel sectors	0.9	3.4	4.0	8.2
Petroleum refineries	0.1	3.3	3.2	6.6
Natural gas utilities	0.6	3.2	3.6	7.3
Drilling oil and gas wells	1.0	4.4	4.4	9.8
Extraction of oil and natural gas	2.2	3.3	5.5	11.0
Mining coal	3.2	3.8	5.9	12.9
Support activities for oil and gas operations	4.9	5.2	8.2	18.3
Non-fossil-fuel sectors	7.4	3.8	6.8	18.1
Real estate and rental and leasing	6.0	2.6	2.7	11.4
Electric utilities	1.5	2.4	4.0	7.9
Mining, except petroleum, and support activities	3.0	3.0	4.5	10.5
Manufacturing, except petroleum refineries	2.3	5.0	5.4	12.7
Information, finance and insurance	3.8	4.4	6.3	14.5
Water and sewage utilities	4.8	3.5	6.4	14.7
Wholesale trade, transportation and warehousing	5.9	3.7	6.8	16.4
Professional, scientific, and technical services	7.8	3.4	8.4	19.5
Government	11.8	1.0	9.6	22.4
Farms	8.5	7.5	6.3	22.3
Construction	8.1	4.8	7.7	20.6
Retail trade	16.8	1.6	6.9	25.3
Other services, except government	12.3	4.1	8.1	24.5
Forestry, fishing, and related activities	18.7	4.9	8.8	32.3

Appendix C: Employment Estimates Methodology

Employment effects of Synapse’s (Keith et al. 2010) proposed transition away from coal and nuclear were based on their estimates for the net spending required by each technology in the energy industry. Two scenarios were discussed in the Synapse report: a “business-as-usual” case that forecasts spending on technologies given a continuing reliance on coal, natural gas, and nuclear sources of energy; and a “transition” case that eliminates coal, reduces natural gas use, builds no new nuclear capacity, and emphasizes demand-side management and renewable power sources. These spending estimates are presented in ten-year increments, beginning in 2010 and ending in 2050. The difference in spending between these two scenarios – essentially, the spending on the transition case net of baseline spending – is then used to estimate the net job impacts of a transition away from coal and nuclear.

To calculate the employment effect of this net spending we estimated appropriate job impact ratios for each technology. Using sector-specific ratios developed from IMPLAN data (as described in Appendix B), we develop two weighting schemes (see Table C1). The first – used in the main text of this paper – allocates spending to industrial sectors based on our best judgment of these sectors relative importance to each technology, a method inspired and loosely based on the Political Economy Research Institute’s analysis of spending in the energy sector (Pollin, Wicks-Lim, et al. 2009).

The second scheme simply uses the average IMPLAN 2009 job impact ratios for fossil-fuel and non-fossil-fuel groupings of 8.1 and 16.5 FTE jobs per \$1 million, as appropriate. For both weighting schemes, these spending shares were then applied to the respective industry-level employment effect ratios and aggregated, resulting in technology-specific job impact ratios. Results from the second weighting scheme were quite similar to those from the first, demonstrating the model’s insensitivity to variations in the sector weights used for each technology.

The technology-specific job impact ratios were then applied to Synapse’s net change in spending on each technology. To estimate cumulative job impacts we assumed a linear trend in the change in spending between the beginning and end of each decade (2010 to 2020, 2020 to 2030, etc.). Table C2 displays the resulting employment effect when the second, simpler weighting scheme is used, and is directly comparable to Table 5 in the body of the white paper. The use of an alternative weighting scheme does not impact the conclusion qualitatively, nor does it have a large impact on the magnitude of the estimated effect – there is still a large net gain in employment.

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Appendix Table C2: FTE Employment Effect in Synapse 2010, Weighting Scheme #2

	2020	2030	2040	2050	Total 2010-2050
Coal	-248,497	-529,573	-835,059	-1,128,449	-21,773,530
Natural gas	54,989	-149,221	-396,405	-627,459	-8,043,659
Nuclear	-96,696	-191,959	-373,616	-647,622	-9,860,819
Geothermal	19,454	55,302	94,572	121,795	2,302,262
Biomass	32,325	85,142	230,786	391,260	5,438,823
CSP	24,524	52,833	74,394	77,834	1,906,674
PV distributed	30,778	80,796	91,050	122,487	2,638,681
PV central	18,533	42,266	52,537	74,312	1,504,914
LFG/WWT gas	9,661	12,328	16,426	17,018	469,241
Wind	188,766	347,199	409,167	538,138	12,142,014
Wind integration costs	5,431	26,334	47,731	64,189	1,115,909
Energy efficiency	230,424	790,024	1,300,248	1,810,472	32,259,323
Incremental transmission	13,167	26,334	37,855	51,022	1,028,677
Avoided emission control	-74,065	-74,065	-74,065	0	-2,221,943
Net job impact by year:	208,796	573,740	675,622	864,998	18,906,568

Source: Authors' calculation based on Synapse Energy Economics (Keith et al. 2010) and IMPLAN 2009 data for the United States. See Appendix A for methodology and data sources.

References

American Council for an Energy-Efficient Economy (n.d.). “How Does Energy Efficiency Create Jobs?” Available at <http://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>.

Apollo Alliance (2004). *New Energy for America*. The Institute for America’s Future and The Center on Wisconsin Strategy. Available at http://cows.org/joel/pdf/a_150.pdf.

Bezdek, R.H., Wendling, R.M. and DiPerna, P. (2008). “Environmental protection, the economy, and jobs: National and regional analyses.” *Journal of Environmental Management* 86(1), 63–79.

Bivens, J. (2003). *Updated Employment Multipliers for the U.S. Economy*. No. 268. Washington, D.C.: Economic Policy Institute. Available at http://www.epi.org/page/-/old/workingpapers/epi_wp_268.pdf.

Black & Veatch (2010). *Assessment of a 15 Percent Pennsylvania Alternative Energy Portfolio Standard*. 165599. Available at http://pennfuture.org/UserFiles/File/Legislation/HB80SB92_Report201001.pdf.

Boyce, J.K. and Riddle, M.E. (2010). *CLEAR Economics: State-Level Impacts of the Carbon Limits and Energy for America’s Renewal Act on Family Incomes and Jobs*. Amherst, MA: Political Economy Research Institute, University of Massachusetts, Amherst. Available at <http://www.peri.umass.edu/236/hash/863fdbde6e/publication/403/>.

Cicchetti, C.J. (2011). *Why EPA’s Mercury and Air Toxics Rule is Good for the Economy and America’s Workforce*. Navigant Consulting and the Clean Air Council. Available at http://www.cleanair.org/sites/default/files/MercuryRuleEconomicsReport_1.pdf.

Considine, T., Watson, R., Entler, R. and Sparks, J. (2009). *An Emerging Giant: Prospects and Economic Impacts of Developing the Marcellus Shale Natural Gas Play*. Pennsylvania State University. Available at <http://www.alleghenyconference.org/PDFs/PELMisc/PSUStudyMarcellusShale072409.pdf>.

Elliott, R.N., Gold, R. and Hayes, S. (2011). *Avoiding a Train Wreck: Replacing Old Coal Plants with Energy Efficiency*. ACEEE.

EPA (2011). *Regulatory Impact Analysis of the Proposed Toxics Rule*. Available at <http://www.epa.gov/ttnecas1/regdata/RIAs/ToxicsRuleRIA.pdf>.

FEMA Strategic Foresight Initiative (2011). *Critical Infrastructure: Long-term Trends and Drivers and Their Implications for Emergency Management*. Washington, D.C.: Federal Emergency Management Agency. Available at http://www.fema.gov/pdf/about/programs/oppa/critical_infrastructure_paper.pdf.

Heintz, J., Garrett-Peltier, H. and Zipperer, B. (2011). *New Jobs - Cleaner Air: Employment Effects Under Planned Changes to the EPA’s Air Pollution Rules*. Amherst, MA: Political Economy Research Institute and Ceres. Available at <http://www.ceres.org/resources/reports/new-jobs-cleaner-air>.

A Good Environment for Jobs

Houser, T., Mohan, S. and Heilmayr, R. (2009). *A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination*. PB09-3. Washington, D.C.: Peterson Institute for International Economics and World Resources Institute. Available at http://pdf.wri.org/green_global_recovery.pdf.

Howland, J., Murrow, D., Petraglia, L. and Comings, T. (2009). *Energy Efficiency: Engine of Economic Growth*. Rockport, ME: Environment Northeast and Economic Development Research Group, Inc. Available at http://www.environmentne.org/public/resources/pdf/ENE_EnergyEfficiencyEngineofEconomicGrowth_FINAL.pdf.

Huntington, H.G. (2009). "Creating Jobs With 'Green' Power Sources." *USAEE Dialogue* 17(1).

Inter-Agency Economic Report (2010). *Estimating the Economic Effects of the Deepwater Drilling Moratorium on the Gulf Coast Economy*. U.S. Department of Commerce. Available at <http://www.esa.doc.gov/sites/default/files/reports/documents/drillingmoratorium.pdf>.

Keith, G., Biewald, B., Takahashi, K., Napoleon, A., Hughes, N., Mancinelli, L. and Brandt, E. (2010). *Beyond Business as Usual: Investigating a Future without Coal and Nuclear Power in the U.S.* Cambridge, MA: Synapse Energy Economics Inc. Available at <http://www.synapse-energy.com/Downloads/SynapseReport.2010-05.CSI.Beyond-Business-as-Usual.10-002.pdf>.

Livermore, M.A., Piennar, E. and Schwartz, J.A. (2012). *The Regulatory Red Herring: The Role of Job Impact Analyses in Environmental Policy Debates*. New York, NY: Institute for Policy Integrity. Available at http://policyintegrity.org/files/publications/Regulatory_Red_Herring.pdf.

Lopez, R.A., Deepak, J., Zhu, C., Gunther, P. and Carstensen, F. (2010). *Economic Impacts of Connecticut's Agricultural Industry*. The University of Connecticut Department of Agricultural and Resource Economics and The Connecticut Center for Economic Analysis. Available at <http://www.ct.gov/dep/lib/dep/forestry/economicimpacts.pdf>.

Mason, J.R. (2010). *The Economic Cost of a Moratorium on Offshore Oil and Gas Exploration to the Gulf Region*. Louisiana State University. Available at <http://www.noia.org/website/download.asp?id=40016>.

Mason, J.R. (2009). *The Economic Contribution of Increased Offshore Oil Exploration and Production to Regional and National Economies*. American Energy Alliance. Available at http://www.americanenergyalliance.org/images/aea_offshore_updated_final.pdf.

Minnesota IMPLAN Group Inc. (2012). "IMPLAN System." Available at <http://www.implan.com>.

National Energy Policy Development Group (2001). *National Energy Policy*. Washington, D.C.: U.S Government Printing Office. Available at <http://www.ne.doe.gov/pdfFiles/nationalEnergyPolicy.pdf>.

Obama, B. (2012). "Remarks of President Barack Obama – As Prepared for Delivery: State of the Union Address: 'An America Built to Last'." Available at http://www.c-span.org/uploadedFiles/Content/The_Administration/State_of_the_Union/SOTU-2012.pdf.

A Good Environment for Jobs

Obama, B. (2010). "Remarks by the President to the nation on the BP Oil Spill." Available at <http://www.whitehouse.gov/the-press-office/remarks-president-nation-bp-oil-spill>.

PA Consulting Group (2009). *Sudden Impact: An Assessment of Short-Term Economic Impacts of Water and Wastewater Construction Projects in the United States*. Arlington, VA: Clean Water Council. Available at http://www.nuca.com/files/public/CWC_Sudden_Impact_Report_FINAL.pdf.

Perryman Group (2010). *The Impact of Developing the Keystone XL Pipeline Project on Business Activity in the US*. Available at <http://www.perrymangroup.com/reports/TransCanada.pdf>.

Pollin, R., Garrett-Peltier, H., Heintz, J. and Scharber, H. (2008). *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*. Amherst, MA: Political Economy Research Institute and the Center for American Progress. Available at http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/peri_report.pdf.

Pollin, R., Heintz, J. and Garrett-Peltier, H. (2009). *The Economic Benefits of Investing in Clean Energy*. Washington, DC: Center for American Progress and Political Economy Research Institute, University of Massachusetts, Amherst. Available at http://www.americanprogress.org/issues/2009/06/clean_energy.html.

Pollin, R., Wicks-Lim, J. and Garrett-Peltier, H. (2009). *Green Prosperity: How Clean Energy Policies Can Fight Poverty and Raise Living Standards in the United States*. Prepared under commission from the Natural Resources Defense Council and Green For All. Amherst, MA: Political Economy Research Institute, University of Massachusetts, Amherst. Available at http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/green_economics/green_prosperity/Green_Prosperty.pdf.

PricewaterhouseCoopers LLP (2011). *The Economic Impacts of the Oil and Natural Gas Industry on the U.S. Economy in 2009: Employment, Labor Income, and Value Added*. Available at http://www.api.org/policy/americatowork/upload/EconomicImpacts_of_Industry_on_US_Economy_in_2009.pdf.

Public Policy Institute (2011). *Drilling for Jobs: What the Marcellus Shale could mean for New York*. Available at <http://www.ppynys.org/reports/2011/Drilling-for-jobs-what-marcellus-shale-could-mean-for-NY.pdf>.

Quest Offshore Resources, Inc. (2011a). *The State of the Offshore U.S. Oil and Gas Industry*.

Quest Offshore Resources, Inc. (2011b). *United States Gulf of Mexico Oil and Natural Gas Industry Economic Impact Analysis*.

Roland-Holst, D. and Kahrl, F. (2009). *Energy Pathways for the California Economy*. 0903241. University of California, Berkeley. Available at http://are.berkeley.edu/~dwrh/CERES_Web/Docs/energy%20pathways%20final%20report.pdf.

A Good Environment for Jobs

Scott, M.J., Roop, J.M. and Schultz, R.W. (2002). *ImBuild II: Impact of Technologies on Energy Efficiency Programs*. 13926. Richland, WA: Pacific Northwest National Laboratory. Available at http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13926.pdf.

Scott, M.J., Roop, J.M., Schultz, R.W., Anderson, D.M. and Cort, K.A. (2008). “The impact of DOE building technology energy efficiency programs on U.S. employment, income, and investment.” *Energy Economics* 30(5), 2283–2301. DOI: 10.1016/j.eneco.2007.09.001.

Solan, D., Black, G., Louis, M., et al. (2010). *Economic and Employment Impacts of Small Modular Nuclear Reactors*. Boise, ID: Energy Policy Institute and Center for Advanced Energy Studies. Available at <http://epi.boisestate.edu/media/3494/economic%20and%20employment%20impacts%20of%20smrs.pdf>.

Sterzinger, G. and Svrcek, M. (2005). *Solar PV Development: Location of Economic Activity*. Renewable Energy Policy Project. Available at <http://www.repp.org/articles/static/1/binaries/SolarLocator.pdf>.

Sterzinger, G. and Svrcek, M. (2004). *Wind Turbine Development: Location of Manufacturing Activity*. Renewable Energy Policy Project. Available at <http://www.repp.org/articles/static/1/binaries/WindLocator.pdf>.

U.S. Bureau of Labor Statistics (2012). “Labor Force Statistics from the Current Population Survey.” Available at <http://www.bls.gov/data/>.

U.S. Government Accounting Office (2008). *Physical Infrastructure: Challenges and Investment Options for the Nation’s Infrastructure*. Washington, D.C. Available at <http://www.gao.gov/new.items/d08763t.pdf>.

Urban Land Institute and Ernst & Young (2010). *Infrastructure 2010: Investment Imperative*. Washington, D.C.: The Urban Land Institute.

Urbanchuk, J.M. (2009). *Contribution of the Ethanol Industry to the Economy of the United States*. Renewable Fuels Association. Available at http://www.wicornpro.org/library_pdfs/LECGEconomicImpactReport1.pdf.

Watzman, B. (2011). *Coal 2011: Challenges & Opportunities*. National Mining Association. Available at http://www.easterncoalcouncil.net/2011-Presentations/BRUCE%20WATZMAN_%20Presentation.pdf.

Wei, M., Patadia, S. and Kammen, D.M. (2010). “Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?” *Energy Policy* 38(2), 919–31. DOI: 10.1016/j.enpol.2009.10.044.

Weinstein, B.L. (2010). *The Economic and Fiscal Consequences of the Drop in Shallow-Water Drilling Permits: Impacts on the Gulf Coast and the Nation*. Dallas, TX: Maguire Energy Institute. Available at

A Good Environment for Jobs

<http://pressdocs.cox.smu.edu/maguire/Maguire%20Institute%20Shallow%20Water%20Report%209-10.pdf>