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HEADWATERS ECONOMICS

Green Jobs Metrics

A Guide to Efforts to Quantify the Green Economy

June 2012

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ABOUT HEADWATERS ECONOMICS

Headwaters Economics is an independent, nonprofit research group whose mission is to improve community development and land management decisions in the West.

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CONTENTS

INTRODUCTION

Economic claims about various energy strategies today are receiving considerable media attention. Many policymakers and interest groups promote energy policies and projects in terms of "simple" job creation numbers. However, job creation estimates and projections are anything but simple. There are risks associated with uninformed use of employment data, and a number of media outlets are devoting energy and time to debunking jobs claims, much as *The Washington Post* did with the Keystone XL Pipeline debate.[1]

This paper offers an overview of efforts to quantify the national green economy in terms of job creation from two perspectives. First, we review leading studies that have documented the size and growth rates of the green economy to date to provide a synopsis of methods and data sources, and to assess how easily such studies could be reproduced. Second, we discuss the practice of projecting future green job creation. We provide a brief review of methods used to forecast employment from clean energy policies and projects, and offer a framework for thinking critically about employment projections and their use in policy analysis.

The Executive Summary provides key points about measuring the green economy and projecting green job growth, and offers points of consideration. The Closing Thoughts section looks at future methods and approaches to effectively measure the Green Economy. References to cited materials as well as other employment studies are provided at the end of the document.

The goal of this paper is to encourage precision and credibility in public discussions of the performance of the green economy. We approach this goal by offering a concise guide to and discussion of the various approaches to measuring the green economy that have emerged over the past decade.[2] All of these studies have charted unique paths over the hurdle presented by an absence of standard definitions and datasets describing the green economy. For this reason, the studies vary in their findings and can be difficult to compare.

This report discusses the green economy as a whole because energy-related jobs are typically placed under the umbrella of green jobs. As researchers have taken different approaches to defining segments of the green economy, one report's clean energy sector may not be exactly the same as another's in terms of what firms and occupations are included. We believe that reviewing the methodological choices that have been made in describing the broader green economy is a constructive way to think through approaches to analyzing links between energy policy and employment.

In taking a synthetic approach to green jobs literature, we parallel an important conversation taking place through a variety of professional economic forums. In 2010, Congress directed the Bureau of Labor Statistics (BLS) to develop and initiate a system for tracking green jobs. In developing its approach, the BLS sought input from a number of academic, government, and private sector economists and other analysts on green employment metrics. Methodology chapters of prominent white papers on the green economy also contain important discussions about the pros and cons of datasets and survey methods.[3] But because the methodology chapters are typically offered as an appendix written in a manner targeting a small community of analysts and economists, few consumers of green economy statistics are likely to be aware of the key discussions taking place in them. The purpose of this brief is not to supplant these important antecedents, but rather to summarize and discuss them in a form accessible for policymakers, the media, and advocates.

EXECUTIVE SUMMARY

The goal of this paper is to encourage precision and credibility in public discussions of the green economy and projections for future job creation in this sector. The push to evaluate clean energy policies in terms of employment numbers has prompted a flurry of activity directed at developing effective metrics. This study reviews several recent reports that have developed creative and analytically sound approaches to measuring green economic performance in the late 1990s and the 2000s. It also discusses the more recent Bureau of Labor Statistics (BLS) program that will allow reproducible, rigorous evaluations of the impacts of energy policies on employment trends from 2010 forward at the state and national level.

Despite these major accomplishments, there continue to be a number of cautions for tracking employment trends in the green economy or projecting future job growth.

ABOUT DEVELOPED ANALYTICAL METHODS

- Trend data is critical to describe growth and decline in sectors of the economy, like green jobs or its subsectors like clean energy. The BLS has laid the groundwork for the collection of trend data moving forward from 2010. For the pivotal period from the early 1990s through 2009, there are several important efforts by private research groups, but they will not be compatible with BLS analysis going forward.

- Accurate trend data and data for sub-state geographies have been and will continue to be highly expensive to procure. While the BLS methodology could be deployed at metropolitan or county scales, this is not currently a planned effort by the BLS.

- Comparability is a big issue. The use of different datasets and definitions of the green economy in studies to date significantly limits the opportunity to synthesize existing studies into a broad analysis of trends. Some of the differences in the ways scholars have defined the green economy are relatively insignificant in that they are semantic or show up in different categorizations of green jobs. Others are more fundamental, such as the decision to include or exclude the nuclear industry from the definition of “green.”

- Projections of future job growth are most trustworthy when they reflect a range of possible scenarios and when they are populated with data and assumptions that are appropriate to a specific industry and geography.

WHAT STUDIES SAY ABOUT GREEN JOBS SO FAR

- As measured—in terms of green products, rather than green process employment—the green economy has a small share of total jobs in the United States. According to the BLS, green goods and services jobs totaled 3.1 million in 2010 (2.5 percent of total employment); according to Brookings-Battelle, comprised 2.7 million jobs in 2010. Other recent studies have found that the share is less, partly because they considered only private-sector jobs.

- The national studies discussed here likely underestimate the green economy because they focus on the production of goods and services and exclude “process” jobs—jobs focused on the adoption of energy-saving or otherwise “environmental” behaviors by corporations or individuals. These studies also exclude advocacy or education jobs that are not directly related to

the development of a green product or service. When the BLS releases green "process" employment data it could add significantly to the total number of green jobs.

- Those studies that present historical trends in the performance of different sectors agree that renewable energy and energy efficiency sector employment trends stand out for their explosive growth, while they remain a small share of overall green jobs. This is a further argument for the importance of collecting trend data using strict definitions of green economy categories to enable comparisons over the long-term.

- Studies find that most green jobs are in the states with the largest economies: California, New York and Texas. Studies differ as to which states lead the nation in terms of the share of all jobs in the state that are green jobs, though two studies place Virginia and Washington, D.C. in the top five.

- The emphasis on showcasing manufacturing opportunities within the clean energy economy should not come at the expense of recognizing the significant opportunities associated with green jobs services and the public sector.

PROJECTING JOB GROWTH IN THE GREEN ECONOMY

Projections for future green economy-related employment numbers—often the topic of debate in the media and in political campaigns—are fraught with uncertainty and complications. A number of private companies offer estimates of future "green jobs," but because they use proprietary models, it is difficult to measure the accuracy of their estimations.

- A number of techniques are used in economic forecasting such as rules of thumb, expert judgment, extrapolation, leading indicators, surveys, time-series models, and econometric models.

- Validation is an important feature in economic forecasting, which makes the use of rules of thumb and expert judgment less trustworthy techniques. Even "experts" can be wrong and have difficulty considering all of the variables that influence future job growth. Extrapolation models sometimes work, especially for short time horizons, but depend on the assumption that the recent trend in job growth will continue at a similar pace and scale. Numerous variables—such as fluctuations in the marketplace, new technologies, the price of competing products, changes in supply and demand, or altered government policies—make it difficult to predict future growth on past history.

- The advantage of time-series and econometric models is that they attempt to mimic the complexities of the marketplace and policy arena through a large number of variables and equations. This complexity also makes the models more difficult to understand, and to discern whether certain "best guesses" and assumptions driving the models are valid.

- One way to hedge against possible errors is to forecast a range of possible outcomes that depend on a variety of different economic conditions, such as low-, medium-, and high-growth scenarios, or by varying which conditions are assumed to hold. Scenarios, coupled with explicit statements of the model's assumptions, can provide a level of transparency that is often lacking in jobs growth projections.

- Researchers seeking to document specifically the number of jobs or businesses in green economic sectors rightly exclude indirect employment. Nonetheless, many growth projections utilize such an approach. The reliability of models that use multipliers varies depending on the data and assumptions they use. It can be helpful to explain if the model was calibrated with local information, if the model has realistic assumptions regarding supply and demand, and most importantly, how the multipliers for a particular industry compare to those from other sectors.

I. MEASUREMENTS OF THE GREEN ECONOMY

CHALLENGES IN MEASURING THE GREEN ECONOMY

A factor contributing to confusion about the performance of the green economy is the absence of a long-term, established dataset tracking employment in the green economy and its sectors over time. Examples of such datasets for other industries include data maintained by the U.S. Department of Commerce and the U.S. Department of Labor's Bureau of Labor Statistics (BLS). The quality of these data sources hinges on both on their geographic scope and on the use of consistent and transparent methodologies over time. In addition, these datasets and the methodologies informing them are publicly-available free of charge. Key elements of their methodological consistency are the classification systems used to track industries and occupations.

Job estimates rely on a number of different data sources and, depending on which source is used, they can vary considerably. Each dataset uses different methods (for example, some count the self-employed and agriculture, while others do not) and because of this, the exact number of people employed in any one industry depends to some extent on the dataset used. Because variability exists, federal employment statistics are often less suited for exact measures and instead are more useful for showing long-term trends, comparing relative size of sectors, and discerning patterns of one industry relative to the rest of the economy.

One of the challenges with using past records of federally published data is that, before 2000, a different industrial classification system was used, making long-term comparisons difficult for some industries (see full discussion page 14-15). Beginning in 2000, the North American Industry Classification System (NAICS) has been in use, which groups 1,170 establishments according to single economic concept, the *process* used.[4] Importantly, NAICS recognizes 358 new industries, 250 of which are services-producing industries. Many new high-tech developments, such as fiber optic cable manufacturing, satellite communications, and the production of software did not exist when the predecessor to NAICS, the Standard Industrial Classification (SIC) system, was developed.

Existing classification systems do not currently address "green jobs" as a unique category or set of categories. New and emerging business activities may or may not comport well with existing classification codes used in current employment datasets. While all enterprises and activities within some industry codes could be considered wholly green, many other industry codes will have a mix of enterprises: some of which are green, some of which are not. Recent and current research efforts are focused on building a complete list of codes of industries that are "fully" green (meaning that any job and any enterprise classified under the code fits the definition of a green job) and, in the case of enterprises with a mix of activities, figuring out the ratio of green jobs to other jobs.

The absence of a specific classification system also presents challenges for other important sectors of the economy, for example travel and tourism. To respond to the need to track this important component of the economy, different institutions have developed approaches that work well to estimate travel and tourism-related economic activity, particularly when used together in combinations adapted to the reporting requirements of the project at hand.[5] Over the long-term, it is highly possible that the best approach to tracking the green economy will use a similar model (i.e., a combination of strategic, efficient approaches built on existing data collection programs rather than trying to devise a single, systematic new program that can provide explicit accuracy at a number of temporal and geographic scales).

BUREAU OF LABOR STATISTICS GREEN JOBS PROJECT

In response to the growing policy emphasis on "green jobs," in 2010 Congress ordered the Bureau of Labor Statistics (BLS) to initiate an effort to produce employment data for industry sectors that produce green goods and services. According to the BLS web site, "[t]he goal of the BLS green jobs initiative is to develop information on (1) the number of and trend over time in green jobs, (2) the industrial, occupational, and geographic distribution of the jobs, and (3) the wages of the workers in these jobs."[6]

The BLS has developed a green jobs definition and an associated list of qualifying industrial activities. The agency has also developed methodologies for conducting surveys to begin to collect green jobs data by a two-pronged approach, focusing on "Green Goods and Services" (GGS; an output approach) and green process jobs (an input approach) as distinct. The relevance of this is that previous studies have excluded green process jobs due to difficulties in acquiring accurate data, meaning that they underestimate green employment, possibly by a large margin.

The BLS data collection effort began in mid-2011, and an initial report of Green Goods and Services data for the year 2010 was released on March 22, 2012. BLS will also estimate the occupational employment as well as wages for establishments identified in future releases.

In summary, estimates of jobs in businesses that produce goods or services that benefit the environment or conserve natural resources (the "output approach") consist of:

- The GGS survey, which will produce data on the number of jobs related to the production of green goods and services, total and by industry (using NAICS), for the U.S., states, and the District of Columbia.

- The expanded Occupational Employment Statistics (OES) surveys, which will result in estimates of employment and wages (using Standard Occupational Classification [SOC]) for the same scope of industries (the same NAICS codes) and geography.

In addition to Green Goods and Services, the BLS will describe Green Process jobs. The agency has identified four categories of jobs where workers' duties involve making their establishments' production processes more environmentally friendly or use fewer resources: (1) Energy from renewable sources, (2) Energy efficiency, (3) Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse, and (4) Natural resources conservation.

BLS has developed an employer survey to test the feasibility of estimating the number of jobs in which workers' duties involve making their establishments' production processes more environmentally friendly or use fewer resources. Once this survey is complete, BLS will propose a methodology to the Federal Register.

This method will result in data on the number of wage and salary jobs related to use of environmentally friendly production processes. Data will be employment and wages by detailed 2010 SOC occupation, for the nation and by Census region. It will include agricultural workers, but not the self-employed.

The benefits of the BLS initiative effort will be enormous—the methods behind it have received extensive feedback from experts and the public, and the BLS is a trusted source of information that provides data to the public free of charge and in a consistent format, year to year. The primary limits of the dataset are the lack of retrospective data as well as the lack of county-specific data. As with any federal initiative, particularly one tied so closely to a particular administration's platform, there is a risk of the loss of funding for this mandate in the future.

EXISTING STUDIES AND THE BLS APPROACH COMPARED

Despite the absence of an established public dataset tallying green jobs within specific industrial sectors, researchers have analyzed the number of green jobs and employment growth rates for the U.S., states, and cities in a number of studies. Prior to the publication of BLS data, the most recent leading national studies to date included studies conducted by the Pew Charitable Trusts with Collaborative Economics in 2009, Department of Commerce in 2010, and the Brookings Institute's Metropolitan Policy Program with Battelle Technology Partnership in 2011.[7] Several online bibliographies and reviews of green economy studies are available—our discussion is limited to a few representative efforts.[8]

KEY FINDINGS ON THE GREEN ECONOMY

Three recent studies that have addressed the national green economy rigorously and the initial data release of BLS Green Goods and Services (GGS) are summarized briefly here.

SCOPE & APPROACH

In 2009, Pew Charitable Trusts with California-based Collaborative Economics released "The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America." Their report provided data on the size and rate of growth of the clean energy economy for the 50 states and the country as a whole from 1998 to 2007. In addition to tracking establishment and employment numbers for states by sector of the green economy, the report also focused on measures of activity such as venture capital, public investment and patents.

The Economics and Statistics Administration of the U.S. Department of Commerce published an analysis of the national green economy in April 2010. Entitled, "Measuring the Green Economy," the study reports on the size and composition of the green economy at the national level, reporting on data from the 2007 Economic Census.

The Brookings Institute's Metropolitan Policy Program worked with Battelle Technology Partnership Practice to create national and regional green jobs assessment: "Sizing the Clean Economy," published in June 2011. The report provides detailed tallies for the years 2003 to 2010 of the size and rate of growth of the green economy at national and state levels. It is the only report to date to generate data at the municipal and county level for the entire country (the report focuses on metropolitan areas but the data could be parsed by county geography according to the authors). An important contribution of the Brookings-Battelle study is its ability to address the recession years of 2008 and 2009, during which the green economy faced serious challenges.

In addition to tracking the number of green economy establishments and the jobs and exports associated with them, the report also developed information on occupations and wages for the green economy and as compared to the whole U.S. economy. The report discussion focuses on comparative metropolitan area performance and on policy issues affecting the performance of the green economy.

In March 2011, as noted earlier, the BLS released data on total employment in Green Goods and Services in 2010 for states and the nation. The data are derived through sample-based surveys of business and government establishments that report whether they produce green goods and services, and the percentage of revenue or employment associated with those green goods and services. The data are reported by conventional categories: private versus government, and by major industrial sector (e.g., construction, education and health, etc.). This is in contrast to other studies that offered breakdowns by type of green industry or product.

MEASUREMENTS & DESCRIPTIONS

Size of the National Green Economy

Pew-Collaborative Economics tallied the green economy at 770,385 jobs in 2007—or one-half percent of all private-sector U.S. jobs.

The Department of Commerce study found that the green economy comprised between one to two percent of total business activity in 2007. The estimated jobs ranged from 1.8 to 2.2 million, or 1.5 to 1.9 percent of all private-sector jobs in the U.S. in 2007.

Brookings-Battelle counted 2.7 million green economy jobs in 2010, or two percent of all U.S. employment.

The Bureau of Labor Statistics measured the size of the national GGS economy at 3.1 million jobs in 2010, around 2.5 percent of total employment. This release covers only output-based jobs (making it comparable to other studies described here). The agency plans to release data on process-based jobs data later in 2012.

Composition of the Green Economy

Studies differ in their approaches to breaking down national numbers by categories. Pew focused on the categories within their definitions of the green economy (see page 10 for definitions), while the BLS March 2011 release reports numbers only according to existing industry codes. Brookings-Battelle and the Department of Commerce studies offered a combination of both approaches.

The Pew-Collaborative Economics report emphasized the dominant role of their "Conservation and Pollution Mitigation" category, which comprised 65 percent of all green economy jobs in 2007 according to their findings. Similarly, the Department of Commerce study found that energy conservation, resource conservation and pollution control comprised between 80 and 90 percent of green business activity (measured in terms of shipments and receipts).

The studies documented a range of jobs in renewable energy: 89,000 in 2007 according to Pew-Collaborative Economics; between 36,000 and 44,000 in 2007 according to the Department of Commerce, and 138,364 in 2010 according to Brookings-Battelle. Major differences in the ways researchers approached the energy efficiency sector make it difficult to compare numbers for this arena in the larger clean energy field.

Brookings-Battelle reported that the green economy is manufacturing-intensive, with 26 percent of all green jobs in their study involved in manufacturing, versus nine percent of the broader economy (in 2010). The Department of Commerce study found that 13 percent of green business activity in 2007 (again, measured in shipments and receipts) was in manufacturing.

BLS reports that the GGS economy primarily comprises manufacturing (14.8%); construction (11.9%); and professional, scientific, and technical services (11.2%), although the largest employment relative to overall industry sector size is in utilities (nearly 12 percent of all private employment in utilities).

Rates of Growth

Trend data is necessary to discuss rates of growth, making the Pew-Collaborative Economics and the Brookings-Battelle approaches especially important. (The BLS survey will provide annual data going forward from 2010 but not retrospective data.) Pew-Collaborative Economics reported a 9.1 percent

growth rate from 1995 to 2007 (a faster rate than the national average of all jobs—3.7%), while the Brookings-Battelle study found the green economy lagged the national economy from 2003 to 2010 (3.4 compared to 4.2% growth). It makes no sense to compare their findings because the time periods are different and neither study shares annual data. However, both studies point out that clean technology jobs in renewable energy and energy efficiency tended to have explosive growth rates and tended to outperform national job growth by significant measures.

Wages in the Green Economy

Brookings-Battelle is the only study that analyzes wages, asserting that wages in the clean economy were on average 13 percent higher than in the whole U.S. economy. The study emphasizes that this is because more green economy jobs are in better paying industries that utilize occupations that are on average better paid than other occupations in the economy. The study observes that 69 percent of all green jobs are "green collar" with wages that fall within 20 percentage points of the national median wage, versus the U.S. economy in which 43 percent of jobs fall into the same cohort.

BLS will deliver wage data for GGS and process employment with future releases. The first release of this type of information is expected in July of 2012.

Regional Performance

Pew-Collaborative Economics, Brookings-Battelle, and BLS all provide state-level data. Both of the studies and BLS found that California, New York, and Texas led the nation in terms of total green jobs. This is in keeping with the relative size of their economies compared to the U.S. economy as a whole. As a share of all jobs, the studies came to different conclusions. The Pew-Collaborative Economics findings pointed to Oregon, Maine, California, Colorado, and Massachusetts having the largest share based on the study's very conservative approach to tallying green jobs. While not exactly parallel, Brookings-Battelle and the BLS GGS study had more concurrence. Brookings-Battelle identified Alaska, Oregon, the District of Columbia, Montana, and Virginia as states in which green jobs had the strongest foothold as a share of employment in the state. BLS found that the states in which GGS jobs commanded the largest share of total jobs were Virginia, District of Columbia, Idaho, Alaska, Maryland, and Montana (Oregon was in sixth place in the BLS study).

TOP STATES IN THE GREEN ECONOMY BY GREEN JOBS AS SHARE OF ALL JOBS IN STATE

Report	Pew-Collaborative Economics (2007 data)	Brookings-Battelle (2010 data)	Bureau of Labor Statistics (2010 data)
Top 5 States	Oregon (1.02%) Maine (0.85%) California (0.71%) Massachusetts (0.69%) Minnesota, Colorado (0.64%)	Alaska (4.7%) Oregon (3.4%) District of Columbia (3.1%) Montana (3.1%) Vermont (3.0%)	Vermont (4.4%) District of Columbia (3.9%) Idaho (3.7%) Alaska, Maryland (3.6%) Montana (3.5%)

The Brookings-Battelle study is unique in providing performance measures for the green economy in the 100 largest U.S. metropolitan areas. San Francisco, Washington D.C., Philadelphia, Atlanta, New York, and Chicago are the top performing areas in terms of the most clean energy jobs in 2010. (New York and Chicago tied for fifth place.)

METHODS AND DATA SOURCES

This rest of this section focuses on the methods used in these studies, how they compare with the BLS green jobs project, and resulting differences in what we can learn from them.

DEFINITIONS OF "GREEN JOBS" AND/OR "CLEAN ECONOMY"

Defining the clean economy is the first step in any attempt to assess its size. The exact definitions are reproduced in the text box on this page.

Each of the definitions reflects a slightly different resolution of the problem of delimiting green economic activity. Is green economic activity limited to clean technologies? Is there a basic distinction between a company making clean products, its supplier, and the company institutionalizing green behaviors while building or selling otherwise undistinguished products? Does the green economy include education and advocacy? Is nuclear energy green? Are biofuels "clean"?

DEFINITIONS

Pew-Collaborative Economics: "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."

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U.S. Department of Commerce: "Products or services … whose predominant function serves one or both of the following goals:
Conserve Energy and Other Natural Resources: This includes products or services that conserve energy to reduce fossil fuel use and promote water, raw material, land, and species and ecosystem conservation; or
Reduce Pollution: This includes products or services that provide clean energy or prevent, treat, reduce, control or measure environmental damage to air, water and soil. The remediation, abatement, removal, transportation, or storage of waste and contaminants also are considered to reduce pollution." (U.S. Department of Commerce, 2010: 5-6)

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Brookings-Battelle: "The clean economy is economic activity—measured in terms of establishments[1] and the jobs associated with them—that produces goods and services with an environmental benefit or adds value to such products using skills or technologies that are uniquely applied to those products."

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BLS Green Jobs Project: "Green jobs are either: (A) Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources. (B) Jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources."

The three major national published studies summarized here chose to exclude "process" jobs and have attempted to focus on actual goods and services. BLS maintains this distinction, but has plans to address process activities specifically in a separate study. As for particular sectors, such as the nuclear industry or mass transit, the studies take different approaches for both conceptual and practical reasons, described further below.

A related discretionary step in this data analysis involves the creation of an internal categorization of the green economy specific to the report. Most studies use categories with detailed segments, which may or may link directly to industry codes. The broader categories show up in report summaries and can lead to confusion.

The difference in the ways researchers parsed the green economy—major categories are shown in the table below—range from minor differences in choice of words to major differences in definition. For example, according to the Pew-Collaborative Economics system, water efficiency products are "conservation and pollution mitigation," while Brookings-Battelle sorted it into energy and resource efficiency. This limits the potential for comparing information across studies. This could be resolved with the implementation of a standard definition going forward, although there are some limits depending on the dataset used or establishments and employments as discussed below.

CATEGORIES IN THE GREEN ECONOMY

Report	Pew-Collaborative Economics	Department of Commerce	Brookings-Battelle	Bureau of Labor Statistics
Green Economy Categories	Conservation and Pollution Mitigation Environmentally Friendly Production Training and Support Clean Energy Energy Efficiency	Resource Conservation Environmental Assessment Energy Conservation Renewable/Alternative Energy Pollution Control	Agricultural and Natural Resources Conservation Education and Compliance Energy and Resource Efficiency Greenhouse Gas Reduction, Environmental Management and Recycling Renewable Energy	Energy from renewable resources Energy efficiency Pollution mitigation Organic agriculture Governmental and regulatory administration

MATCHING DEFINITIONS TO DATASETS

With a working definition in hand, the next step involves determining the products and services and/or processes that meet the definition. For example, products associated with the green economy could be things like solar heaters or compost, while processes might include heating equipment manufacturing.

There are two major systems that classify industries by assigning to activities and products a set of generic codes that make data analysis possible: the Standard Industrial Classification system (SIC) and the North American Industrial Classification System (NAICS). While the federal bureaus have adopted NAICS as the preferred categorization of the U.S. economy, SIC remains in use and is the default hierarchy in the leading private source of data on U.S. businesses, Dun and Bradstreet.[9] There are important conceptual differences between the two methods (see previous discussion), but practically speaking researchers choosing a set of industry codes to parse their definition of the green economy may be influenced by which dataset on the economy they plan to mine for employment numbers.

Whatever the hierarchy, researchers conducting green economy surveys evaluate industry codes as to their merits for inclusion in the green economy. This involves testing their definition and in some cases engaging in thoughtful interpretation of it. For example, Brookings-Battelle defends its decision, in contrast to Pew-Collaborative Economics, to include the nuclear-energy industry (adding perhaps 75,000 more jobs to its database) based on a comparison of life-cycle socio-environmental damages of different technologies conducted by the European Commission.

For the Department of Commerce study, analysts evaluated more than 22,000 individual product and service codes—six-digit NAICS codes further refined by unique product codes—to determine those which could be considered green.[10] They then analyzed data collected in the 2007 Economic Census according to those product codes and their related six-digit NAICS categories. Economic census employment data are not available by product code. In order to determine a relationship between the

product and service code and the broader six-digit codes by which employment data are reported, Economics and Statistics Administration researchers used the product or service's share of the total NAICS code shipments and receipts as a proxy. (They assumed share of green shipments/receipts equaled the share of green employment at NAICS industry level. To our knowledge, this assumption has not been tested.)[11]

Both the Pew-Collaborative Economics and the Brookings-Battelle taxonomies are based on the SIC system. An initial list of eight-digit SIC codes for industries that fall fully within the definition of the green economy was developed by Pew-Collaborative Economics. The list was expanded in a subsequent study and further updated by Brookings-Battelle. Using this list (of 222 SIC codes), Brookings could obtain trend data for each industry code on the number of establishments, their employees, and locations through the National Establishment Time Series NETS database.

In addition to deploying an expanded list of SIC codes for industries "fully" within the clean economy, Brookings-Battelle undertook a major effort to expand their dataset to recognize the many industries partly within their definition of clean energy. Researchers manually gathered firm names provided by a variety of lists—membership lists for business and industry organizations, recipients of clean economy venture capital, inventors of patented products, certifications, and more. Brookings vetted the lists and then added any missing firms to their study's dataset, assigning them a relevant SIC code and obtaining establishment information from the NETS database. This effort yielded 31 percent of the total establishments and 51 percent of the number of jobs included in the Brookings-Battelle study.

Unfortunately, the Brookings-Battelle methodology does not document the additional SIC codes (for the "partial" clean energy sectors), nor the share of the total employment in the 8-digit sector commanded by the firms the researchers validated for inclusion in the clean energy dataset. What this means is that reproducing the study would involve a similar manual update of the dataset based on aggregating and cleaning data from membership lists and other informal data sources.[12]

BLS OFFERS A STANDARD DATASET

BLS has identified 333 detailed industries (at the 6-digit NAICS level) where green goods and services are classified. They consist of five categories: (1) Energy from renewable sources, (2) Energy efficiency, (3) Pollution reduction, removal, greenhouse gas reduction, and recycling and reuse, (4) Natural resource conservation, (5) Environmental compliance, education and training, and public awareness. (Note these are the same as the Brookings-Battelle study.)[13]

Using this industry set, BLS will conduct an annual survey (the Green Goods and Services [GGS] survey, as described on Page 6) to estimate whether establishments are producing goods or services that benefit the environment or conserve resources. From the survey, BLS estimates the number of green jobs for each NAICS industry category. No single industry receives the "green" label; rather, "green jobs" are estimated to exist in different proportions in different sectors.

SELECTING & ANALYZING DATASETS

A major difference between the Pew-Collaborative Economics and Brookings-Battelle studies and those conducted by public agencies such as the U.S. Department of Commerce involves selecting a dataset for analysis.

The 2010 U.S. Department of Commerce study reports national information based on the Census Bureau's 2007 Economic Census. Conducted every five years, the Economic Census is based on a mail

survey sent to every business "with at least one paid employee and significant production within their industry area." (U.S. Department of Commerce, 2010. Appendix 2: 1)

The five-year intervals of the Economic Census make it difficult to evaluate trends in industry performance. In addition, changes in definitions of product codes between census years can make it impossible to compare certain categories from year to year. The Department of Commerce green jobs study did not evaluate sub-national trends.

Rather than using free, public data, both Pew and Brookings turned to the National Establishment Times Series database. NETS is based on data collected and maintained by the credit reporting agency Dun and Bradstreet. NETS is considered by many the best available dataset on establishment-level jobs information. However, access is an issue: NETS means committing to tens or hundreds of thousands of dollars in up-front fees for data acquisition and in annual update fees.[14]

Experts have compared NETS to public sources of establishment and employment data, and report high correlation, with some exceptions.[15] One major advantage of the NETS approach is that data reporting is not constrained by non-disclosure agreements that are common practice in government surveys. Non-disclosure agreements can limit the accuracy of data when a small number of businesses are involved—typically because the sector or the geographic area is small. In other words, researching using NETS may have access to data that would otherwise be blocked by non-disclosure agreements in public datasets. On the other hand, it is possible to use a systematic approach to develop estimates for non-disclosed data that can effectively handle data gaps in public datasets. In our experience in most comparative analyses, the accessibility advantages of using public versus proprietary data far outweigh the disadvantages arising from non-disclosure issues associated with small employment sectors in small geographies.

The Pew-Collaborative Economics and the Brookings-Battelle reports took different approaches to the NETS database in terms of including public sector employment—excluded by Pew-Collaborative Economics and included by Brookings-Battelle.[16] This is one source of the difference in size between the two studies' estimates. Public Mass Transit accounted for 350,000 jobs in 2010 in the Brookings-Battelle database, a number that is close to half of the number of total green jobs tallied in the Pew-Collaborative Economics database. Pew-Collaborative Economics also excluded public sector conservation and regulation and nuclear energy (as noted above).

II. PROJECTING JOB GROWTH IN THE GREEN ECONOMY

All of the studies described above had the advantage of hindsight. In contrast, the energy-related employment numbers are often the topic of debate in the media. In political campaigns, projections are fraught with even more uncertainty and complications simply because the future is unpredictable.[17] The discussion below reviews the techniques available for forecasting job growth with a specific discussion of input/output modeling.

FORECASTING METHODS

A number of techniques are used in economic forecasting. These include making use of rules of thumb, expert judgment, extrapolation, leading indicators, surveys, time-series models, and econometric models. A number of private companies offer estimates of future "green jobs," but because they use proprietary models, it is difficult to estimate the accuracy of their estimations.

Validation is an important feature in economic forecasting, which makes the use of rules of thumb and expert judgment less trustworthy techniques. Even "experts" can be wrong and have difficulty considering all of the variables that influence future job growth. Extrapolation models sometimes work, especially for short time horizons, but depend on the assumption that the recent trend in job growth will continue at a similar pace and scale. Fluctuations in the marketplace, the arrival of new technologies, international currency exchange rates, the price of competing products, changes in supply and demand, and the existence or elimination of government policies are all examples of variables that make it difficult to predict future growth on past history.

Many forecasting models make use of time-series models and econometric models that are based on equations that model the behavior of a number of groups that may influence the industry, including consumers, producers, investors, and state and federal government. The advantage of these models is that they are more complex and realistic because they attempt to mimic the complexities of the marketplace and policy arena through a large number of variables and equations. This complexity also makes the models more difficult to understand, and to discern whether certain "best guesses" and assumptions driving the models are valid. For example, a common feature in econometric models is to assume a level of rationality in decision-making on the part of economic agents (consumers, elected officials, etc.). However, economies are often faced with sudden and often unanticipated shocks, like recessions, the emergence of new technologies and scientific discoveries, and rapidly changing government policies (some of which may make sense for political and strategic reasons, but are irrational from an economic development perspective).

One way to hedge against possible errors is to forecast a range of possible outcomes that depend on a variety of different economic conditions, such as low-, medium-, and high-growth scenarios, or by varying which conditions are assumed to hold. For example, one could forecast a range of future "green" jobs that depends on the assumption of national policies to subsidize particular industries through, for example, tax breaks or federal investment in new technologies. Or, a range of jobs could be forecasted based on a range of prices for competing products; for example, rising oil prices may make alternative fuels relatively more affordable, driving up demand for products such as wind turbines. Using a range of assumptions and possible outcomes is one way to admit and highlight the inaccuracies of forecasting the future, while at the same time stating explicitly the assumptions in the model.

IMPACT MODELING

Researchers seeking to document specifically the number of jobs or businesses in the clean energy sector rightly exclude indirect employment.[18] Nonetheless, many reports of green job creation will utilize such an approach. There are some basic principles to keep in mind when evaluating claims that address secondary or indirect jobs or dollars.

Economic impact models, such as input/output models (for example, the IMPLAN software can be used to conduct impact analysis) are designed to measure inter-industry relationships, including "multipliers" that are used show how a change in one industry can have a ripple effect through other sectors. For example, one new "green" manufacturing job (in the production of wind turbines, for example) may affect other industries, such as suppliers to the manufacturing plant (for example, suppliers of gears and electronic components used in wind turbines). The expenditures of these workers in turn influence other sectors (for example, purchases by manufacturing plant workers in the local grocery store).

Economic forecasting should not be confused with impact modeling. Impact modeling is useful for understanding the ripple effect of a potential "green" job in other sectors of the economy, but first a forecast is needed of the number of new "green" jobs. In other words, impact analysis follows forecasting.

The reliability of input/output models (I/O), like forecast models, varies depending on the data and assumptions they use. I/O models like IMPLAN have a number of built-in parameters based on national data collected by the software developers. A proper use of I/O model to describe the impact of a project(s) in a given geography is to validate these estimates with information specific to the study geography, often gathered through interviews and surveys. Similarly, depending on the industry, it is critical to calibrate the economic assumptions in the model with industry-specific and geographically accurate information with regard to market dynamics.

QUESTIONS TO ASK OF JOBS FORECASTS

Here are a few simple questions to consider when evaluating a model of job growth:

Was the model calibrated with local information?

Does the model have realistic assumptions, or a range of scenarios regarding supply and demand—and the complex influence of changes in prices, technologies, preferences and laws (among many other factors)?

How do the multipliers for a particular industry compare to those from other sectors?

CLOSING THOUGHTS

Several important questions going forward concern the value of further investment in expensive private data in order to enable continued monitoring of pre-2010 trends and at smaller geographic scales, or to rely on publicly-available data from the Bureau of Labor Statistics or on a combination of these approaches.

A hybrid approach is likely the optimal future for green jobs analysis. While data for economic sectors such as health care and mining are relatively well defined and reliable—and have been for decades at a variety of geographic scales such as cities, counties, states, and the nation—emerging economic activity such as green jobs can defy simple categorization and must be teased out as a share of other industrial categories.

A comparable example is the difficulty of measuring travel and tourism activity. This sector has no single or simple appropriate industrial codes to track employment. As a result, a variety of approaches and datasets have evolved to track this sector, and—depending on the area and trend that needs to be described—these different tools can be deployed in unique combination to create a reliable profile of travel and tourism dynamics.

For tracking green jobs, the more analytical approaches such as the Pew-Collaborative Economics and the Brookings-Battelle reports are critical because they also address other measures of economic activity such as investments and patents. By considering these multiple data sources, these approaches can look for constellations of activities and trends that signify growth, overcoming some of the data barriers related to the lack of a single, standardized source of data on industry employment trends.

Even with a continuation of the current level of private sector analysis, Peters et al. (2011) express concern that failure to further refine and standardize green jobs assessments could result in the implementation of "poorly thought-out policies."[19] This is one of the reasons why the green jobs methods developed by the Bureau of Labor Statistics are significant. As long as the BLS maintains a long-term commitment to replicate the methodology over time, it will eventually deliver a publicly-available, consistent long-term dataset that will set a high standard for green jobs tracking. County- and metropolitan area-level data would significantly add to the value of this dataset.

In the meantime, however, the policy and financial investment focused on advancing the clean energy economy will be carefully scrutinized by critics and boosters alike. This is a good argument for continuing to invest in analysis of multiple datasets—both private and public—to help document green job trends at multiple scales, as well as for deploying job creation estimates in the most careful, defensible manner possible.

RESOURCES

SELECTED REFERENCES

This bibliography is organized into two sections: Measurements of the Green Economy and Analysis of Policies that Affect the Green Economy.

MEASUREMENTS OF THE GREEN ECONOMY

Becker, R. A., & Shadbegian, R. J. (2009). Environmental Products Manufacturing: A Look inside the Green Industry. *The B.E. Journal of Economic Analysis & Policy*, *9*(1).

Chapple, K., & Hutson, M. (2010). *Innovating the Green Economy in California Regions*.

Collaborative Economics. (2008). *California Green Innovation Index*. Palo Alto: Next 10.

Collaborative Economics. (2009). *2009 California Green Innovation Index*. Palo Alto: Next 10.

Colorado Department of Labor and Employment. (2011). *Interim Report on Green Jobs in the Colorado Economy*. http://lmigateway.coworkforce.com/lmigateway/admin/gsipub/htmlarea/uploads/GreenJobsSurveyReport.pdf.

Department of Employment and Economic Development Labor Market Information Office. (2011). *Minnesota's Emerging Green Economy: Green Jobs Report 2011*. http://www.positivelyminnesota.com/Data_Publications/Data/LMI/PDFs/Final_Green_Jobs_-_Dec_2011/MN_Green_Jobs_Report_2011.pdf.

Idaho Department of Labor. (2010). *Idaho Green Jobs Survey 2010*. http://lmi.idaho.gov/Portals/13/Research%20Projects/Green/Idaho_Green_Jobs_Survey_2010_FINAL.pdf.

Knutsen, K., Wikstrom, K., Goldberg, M., & Wright, S. (2010). *Building the Clean Energy Economy: A Study on Jobs and Economic Development of Clean Energy in Utah.*

Michigan Department of Energy, L. & E. G. (2010). *Michigan Green Jobs Report: A Regional Analysis*. http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest//Michigan-Regional-Green-Jobs.pdf.

Muro, M., Rothwell, J., & Saha, D. (2011). *Sizing The Clean Economy: A National And Regional Green Jobs Assessment*.

New York State Department of Labor. (2009). *New York State's Clean Energy Industry: Labor Market and Workforce Intelligence*. http://www.labor.state.ny.us/workforcenypartners/PDFs/NYS%20Clean%20Energy%20Jobs%20Report%20FINAL%2005-27-09.pdf.

Oregon Employment Department. (2012). *The Greening of Oregon's Workforce: Jobs, Wages, and Training*. http://www.qualityinfo.org/pubs/green/greening.pdf.

Peters, D. J., Eathington, L., & Swenson, D. (2011). *An Exploration of Green Job Policies, Theoretical Underpinnings, Measurement Approaches, and Job Growth Expectations*. Iowa State University.

Pew Charitable Trusts. (2009). *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America*.

Sinclair-Desgagné, B. (2008). The Environmental Goods and Services Industry. *International Review of Environmental and Resource Economics*, *2*(1), 69–99.

State of Oregon Employment Department. (2010). *Oregon's Renewable Energy Production and Generation Sector*. http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/Oregons-Renewable-Energy-Production-and-Generation-Sector.pdf.

U.S. Department of Commerce. (2010). *Measuring the Green Economy*.

U.S. Department of Commerce. (2010). *Measuring the Green Economy Appendix 2: Methodology*.

U.S. International Trade Administration, O. of E. and E. I. (2010). *Environmental Technologies Industries: 2010 Industry Assessment*.

ANALYSIS OF POLICIES THAT AFFECT THE GREEN ECONOMY

American Energy Innovation Council. (2010). *A Business Plan for America's Energy Future*.

Anderberg, M. (2008). *Green Collar Workers and Other Mythical Creatures*. http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/TX-Green-Collar-Workers.pdf.

Economic Opportunity Studies. (2009). *How Many Workers Does the Weatherization Assistance Program Employ Now? What Jobs Will the Recovery Act Offer?*

Ellingson, M., Hunter, L., Lung, R. B., Carey, K., & Plunkett, E. (2010). *Compendium of Best Practices: Sharing Local and State Successes in Energy Efficiency and Renewable Energy from the United States*. Washington: Alliance to Save Energy, American Council on Renewable Energy, and Renewable Energy and Efficiency Partnership.

Hayward, S. F., Muro, M., Nordhaus, T., & Shellenberger, M. M. (2010). *Post-Partisan Power: How a Limited and Direct Approach to Energy Innovation Can Deliver Clean, Cheap Energy, Economic Productivity and National Prosperity*. Oakland: Breakthrough Institute.

Hendricks, B., Kaufman, L., Berlin, K., Humble, M., Hundt, R., Kragie, A., et al. (2010). *Cutting the Cost of Clean Energy 1.0: Toward a Clean Energy Deployment Plan for Jobs, Security, and Broad-Based Economic Growth in 2011*. Washington: Center for American Progress and Coalition for Green Capital.

Mills, K. G., Reynolds, E. B., & Reamer, A. (2008). *Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economies*. Washington: Brookings Institution.

Muro, M., & Fikri, K. (2011). *Job Creation on a Budget: How Regional Industry Clusters Can Add Jobs, Bolster Entrepreneurship, and Spark Innovation*. Washington: Brookings Institution.

Muro, M., & Katz, B. (2010). *The New 'Cluster Moment:' How Regional Innovation Clusters Can Foster the Next Economy*. Washington: Brookings Institution.

Muro, M., & Rahman, S. (2010). *Centers of Invention. Leveraging the Mountain West Innovation Complex for Energy System Transformation*. Washington: Brookings Institution / The Hamilton Project.

Roland-Holst, D., Kahrl, F., Khanna, M., & Bakka, J. (2009). *Clean Energy and Climate Policy for U.S. Growth and Job Creation*.

Schwer, R. K., & Riddel, M. (2004). *The Potential Economic Impact of Constructing and Operating Solar Power Generation Facilities in Nevada*.

Washington State Department of Community, T. and E. D. (2009). *Washington State's Green Economy: A Strategic Framework.* http://www.ecy.wa.gov/climatechange/CTEDdocs/GreenEconomy_StrategicFramework.pdf.

Wei, M., Patadia, S., & 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*, 919–931.

Worldwatch Institute. (2008). *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World*. Washington.

ENDNOTES

[1] "Keystone pipeline claims: a bipartisan fumble." Published online at The Fact Checker blog of the Washington Post, 12/14/2011. http://www.washingtonpost.com/blogs/fact-checker/post/keystone-pipeline-jobs-claims-a-bipartisan-fumble/2011/12/13/gIQAwxFisO_blog.html .

[2] Employment and establishment metrics are of course only one approach to sizing and tracking the performance of the green economy. Few comprehensive reports rely on only these measures. Other metrics include tracking the amount of venture capital invested in particular sectors, looking at the rate of successful patents of new technology, and the amount of public investment achieved in different states and cities. This brief focuses on employment metrics.

[3] See for example: Peters, D. J., Eathington, L., & Swenson, D. (2011). *An Exploration of Green Job Policies, Theoretical Underpinnings, Measurement Approaches, and Job Growth Expectations*. Iowa State University. Appendix B: Methodology in Pew Charitable Trusts. (2009). *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America.* Rothwell, J., Grueber, M., Horowitz, M., & Muro, M. (2011). *Methodological Appendix for Sizing the Clean Economy: A National and Regional Green Jobs Assessment*. Metropolitan Policy Program at Brookings.

[4] Because the classification systems changed, some industries are "backward compatible," which means you can plot long-term trends that span the SIC and NAICS years, while with others this is not advised. In addition, while the new NAICS system more accurately reflects the full diversity of the "services" sectors and incorporates the existence of industries that did not exist not that long ago, it does mean that "long-term" trends for many newer, high-tech sectors start in the year 2000. For example, lumber manufacturing is the same under SIC and NAICS because the primary activity of a lumber mill (the activity is the manufacture and sale of lumber, under SIC) is the same as the process (milling lumber, under NAICS). In contrast, a plastics injection company that produced primarily hulls for boats, it would be classified as a "boat manufacturer" under SIC, even though it may also have made other products. Under NAICS, a company like this would be classified by its production process, such as "plastics injection molding manufacturing." Numerous other examples exist.

[5] Easily accessible data from the Department of Commerce can be used to understand growth trends in sectors likely to be associated with travel and tourism. More detailed, in-depth analysis is still required to develop absolute measures of the size of travel and tourism at a given point in time and in a given geography. Headwaters Economics maintains a free, downloadable software that runs in Excel to allows users to create custom economic profiles for county, state, and national geographies for a variety of industries and other features of the economy. The various approaches to measuring travel and tourism employment are discussed in the EPS-HDT chapter, Travel and Tourism. See: http://headwaterseconomics.org/tools/eps-hdt .

[6] The BLS program is described on the web site: http://www.bls.gov/home.htm#frn .

[7] Muro, M., Rothwell, J., & Saha, D. (2011). Sizing The Clean Economy: A National and Regional Green Jobs Assessment; Pew Charitable Trusts. (2009). The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America; U.S. Department of Commerce. (2010). Measuring the Green Economy.

[8] The California Employment Development Department, Labor Market Information Division is maintaining an index of green economy studies with summaries at the time of writing. The index is available online: http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/Green-Digest-Index.pdf. States that have robust green economy analytical programs include California, Michigan, and Washington.

[9] In the most basic terms, the distinction between the two systems is that the SIC focuses on *what* is made or sold while NAICS bases categories on *how* the product is produced. This allows NAICS to capture and describe the growing role of services in the U.S. economy. The following excerpt from Headwaters Economics' EPS-HDT provides some context: For over sixty years, starting in the 1930s, the Standard Industrial Classification (SIC) system has served as the structure for the collection, aggregation, presentation, and analysis of the U.S. economy. Under SIC, which employed a four-digit coding structure, an industry consists of a group of establishments primarily engaged in producing or handling the same product or group of products or in rendering the same services. As the U.S. economy shifted from a primary emphasis on manufacturing to a more complex services economy, SIC became less useful as a tool for describing the economy's changing industrial composition. The North American Industry Classification System (NAICS), developed using a production-oriented conceptual framework, groups establishments into industries based on the activity in which they are primarily engaged. NAICS uses a six-digit hierarchical coding system to classify all economic activity into twenty industry sectors. Five sectors are mainly goods-producing sectors and fifteen are entirely services-producing sectors.

County Business Patterns started organizing their data using NAICS in 1998, Census in 2000, and Bureau of Economic Analysis Regional Economic Information System in 2001. Because the methods underlying SIC and NAICS are fundamentally different (what was sold vs. how it was produced), NAICS is not backward compatible with SIC. There are a few circumstances where it is acceptable to show uninterrupted trends across the SIC-NAICS discontinuity. Total personal income, total labor income, and non-labor income can all be plotted continuously without a problem. In addition, a few industries can also be plotted without a break, though this is not the case for services.

[10] The Economics and Statistics Administration (ESA) provides the following example. "[T]he six-digit NAICS code 333414—heating equipment (except warm air furnaces) manufacturing—includes 21 product lines. One of the product lines is "solar energy collectors" (product code 33414A136) which ESA analysts determined fit the definition of a green product." U.S. Dept. of Commerce, Economics and Statistics Administration, 2010. "Measuring the Green Economy: Appendix 2": 1. In this evaluation, researchers at the ESA used both a narrow and a more liberal approach to whether a product line fit their own definition. Narrow yielded 497 product codes, more liberal 732.

[11] U.S. Department of Commerce, 2010. Appendix 2, page 2.

[12] In addition, to avoid over-counting, Brookings-Battelle researchers relied on detailed company information to include in their database only the specific establishments directly engaged in the clean economy supply chain and not those selling supplies to non-green sectors of the economy.

[13] The list of industries is available here: http://www.bls.gov/green/final_green_def_8242010_pub.pdf.

[14] Licenses last two years, with a national dataset currently priced at $200,000—although pricing is less for the acquisition of data limited by sector and or geography. Annual updates can cost as much as the original license fee or may be discounted, depending on the package purchased.
[15] A weakness of NETS may be its data on the size of public sector organizations. This is discussed in Rothwell et al. 2011: 32.
[16] See above.
[17] This discussion does not address a thoughtful point made by David Peters and his Iowa State University colleagues about the problem of job forecasts—opportunity cost. That is, few job projections attempt to model job losses associated with policy transitions.
[18] From Brookings-Battelle Methodology Appendix: "It warrants noting that industry studies often take a different approach than the one here. Industry studies and those produced by consulting firms will often include something called "indirect" jobs as part of the clean economy or sector of interest. The analysts admit that these jobs are not directly involved in producing for the sector of interest, but they argue that they are created indirectly through the spending of workers and companies in the clean economy. By this logic, law firms with clean economy clients would be part of the clean economy; computer manufacturers who sell to clean economy producers would be indirectly involved; so would restaurants that serve clean economy employees on their lunch breaks, and so on. As implied by these examples, if adopted, this procedure would have greatly increased the number of jobs deemed part of the clean economy. Yet, it would have been illogical and inaccurate. Every job is an indirect job from the perspective of another industry. For every firm with clean economy clients, there is a firm or consumer that buys from the clean economy. Advocates of the clean economy would hardly want to say that a percentage of solar panel manufacturers are really part of the fossil fuel industry because they buy gasoline to ship their products. For these reasons, only suppliers who make products unique to the clean economy are counted."
[19] Specifically, they write: "[M]any state and local leaders, in the absence of policy and definitional precision, may have highly inflated expectations about the economic development potential of green jobs and industries. … [M]any are urgently adopting green industry development activities, especially as they allow capitalizing on current federal incentives, and in the absence of reliable information, they may be implementing poorly-thought-out policies." (Peters et al., 2011: 45)