

Tracking Jobs in Clean Industries in New England

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Interest in “clean industries” as a source of economic development—especially as a potential source of jobs—is growing. Such industries may include products and services used to store and conserve energy, produce energy from renewable and low-carbon sources, treat waste, and conserve and manage water and other natural resources.

However, tracking jobs in clean industries—often called “green jobs”—is difficult because, unlike the high-technology sector, the clean-industries sector lacks a standard definition of which industries the sector actually comprises. This article explores four definitions of the sector: two defined by measures developed by analysts at highly respected institutions, and two defined by measures we created based on widely used databases. We use these definitions to analyze the composition and concentration of jobs in clean industries in New England and each state in the region and compare these figures with the national average. In doing so we show how the findings vary with the definition of the clean-industries sector.

Despite these differences among the various approaches, our investigation shows that New England as a whole—as well as some individual states in the region—has fairly strong concentrations of clean-industries jobs relative to the national average. If we extrapolate from recent trends, the comparison suggests that the region has the potential for job growth in several clean industries. However, measuring such growth—and the success of policies designed to promote it—will remain challenging without a standard definition of the sector.

Four Definitions of “Clean Industries”

There are inherent difficulties in estimating the number of jobs in clean industries. All four approaches documented here define the sector and the industries it comprises and then measure the total number

of jobs at firms and business establishments—units of larger firms whose headquarters may be located outside the region—in these industries. This means that defining the sector narrowly is likely to underestimate the number of clean jobs, while defining it broadly is likely to overestimate the number of jobs because the definition includes industries unrelated to the provision of renewable energy, the conservation of nonrenewable energy, and other clean activities. In this article we consider a range of definitions.

In *The Clean Energy Economy* (2009), analysts at the Pew Charitable Trusts identify five industry categories in the sector and 16 industry segments in the categories, which they track from 1998 to 2007.¹ The categories include clean energy, energy efficiency, environmentally friendly production, conservation & pollution mitigation, and training & support (See Table 1). The Pew report has drawn significant media coverage.² However, the analysis is proprietary, making it difficult to fully replicate and update the approach.

In *Sizing the Clean Economy* (2011), analysts at the Brookings Institution define clean industries in greater detail and more transparently. They identify five general categories as well as 39 industry segments in the sector, which they track from 2003 to 2010.³ The broad categories include energy & resource efficiency, agricultural & natural resources conservation, renewable energy, education & compliance, and greenhouse gas reduction, environmental management, & recycling (see Table 1).

The third definition of clean industries we explore is the most expansive: it includes industries that have been cited for clean activity by the Pew and Brookings analysts, and by analysts at the University of California at Berkeley, and that also have potential for growth (see Table 1). We base this definition on

Table 1. Four Definitions of “Clean Industries”

An appendix at Indicator’s website provides more detail on all four definitions of clean industries:
<http://www.bostonfed.org/economic/need/index.htm>

Source	Includes
PEW (“clean energy”)	Clean energy; Energy efficiency; Environmentally friendly production; Conservation & pollution mitigation; Training & support
Brookings (“clean economy”)	Energy & resource efficiency; Agricultural & natural resources conservation; Renewable energy; Education & compliance; Greenhouse gas reduction, environmental management, & recycling
NAICS (broad measure of clean industries)	Electric power generation, transmission & distribution; Utility system construction; Ventilation, heating, air-conditioning, & commercial refrigeration equipment manufacturing; Engine, turbine, & power transmission equipment manufacturing; Navigational, measuring, electromedical, & control instruments manufacturing; Electric lighting equipment manufacturing; Other electrical equipment & component manufacturing; Architectural, engineering, & related services; Management, scientific, & technical consulting services; Scientific research & development services; Other professional, scientific, & technical services
NETS (energy services and research)	Electric power generation, transmission, & services; Energy conservation & management; Energy engineering & architectural services; Energy conservation & building products; Other

the North American Industrial Classification System (NAICS). Analysts from Moody’s Analytics helped us finalize the list of industries and track data on employment in these industries using data from the U.S. Bureau of Labor Statistics (BLS), which bases its figures on NAICS.⁴ These BLS data are available through 2009.

The final definition of the clean-industries sector we consider is the narrowest of the four: it encompasses business establishments in energy services and research industries that Berkeley analysts included in a 2010 research paper on the green economy (see Table 1).⁵ We drew information on employment at business establishments in these industries from the National Establishment Time-Series Database (NETS).⁶ NETS data are available through 2009.

We used 2007 data from all these sources for most of our analysis, because 2007 was the last year included in the Pew report. Where available, more recent data appear in an appendix to this report, posted on the *New England Economic Indicators* website: <http://www.bostonfed.org/economic/need/index.htm>.

Where the Clean-Industries Jobs Are

The distribution of clean-industries jobs varies with the definition of the sector. Under the Pew approach, conservation & pollution mitigation accounts for well over one-half of all employment in clean industries, in both the region and the nation (see Figure 1). The region records the strongest concentration of clean-industries jobs relative to the nation in training & support (10.2 percent versus 6.8 percent).⁷ The

region also has a higher concentration of jobs in both energy efficiency and clean energy relative to the nation, under the Pew approach.

Under the Brookings definition, well over one-third of all clean-industries jobs are in greenhouse gas reduction, environmental management, & recycling, in both New England and the nation (see Figure 2). The education & compliance industry provides the second-largest share of clean-industries jobs. The region records the strongest concentration of jobs relative to the nation in agricultural & natural resources conservation (10.0 percent versus 4.8 percent), under the Brookings approach.

According to the NAICS definition, the largest share of clean-industries jobs occurs in architectural, engineering, & related services, in both New England and the nation: 22.3 percent and 27.0 percent, respectively (see Figure 3). The region records the highest concentration of clean jobs relative to the nation in navigational, measuring, electromedical, & control instruments manufacturing (15.9 percent versus 8.4 percent) and in scientific research & development services (16.3 percent versus 11.3 percent) under the NAICS definition.

According to the NETS definition, a large majority of clean-industries jobs occurs in electric power generation, transmission, & services in both the region and the nation (see Figure 4). However, the share of regional jobs in that industry trails the national share (73.6 percent versus 82.5 percent). The region records the highest concentration of clean-industries

Figure 1. - Share of Total Jobs in Various Clean-Industry Categories, under the Pew Definition, 2007

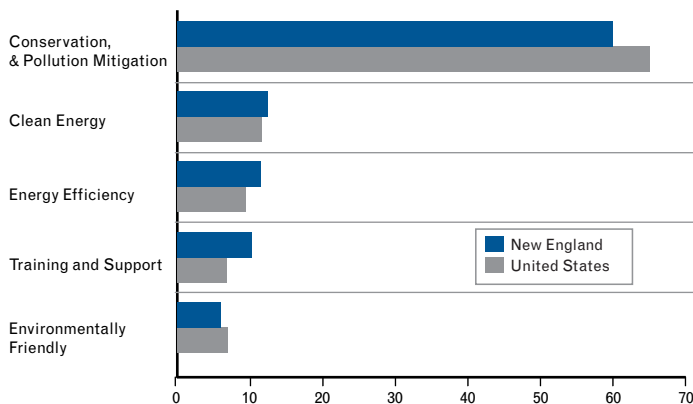


Figure 2 - Share of Total Jobs in Various Clean-Industry Categories, under the Brookings Definition, 2007

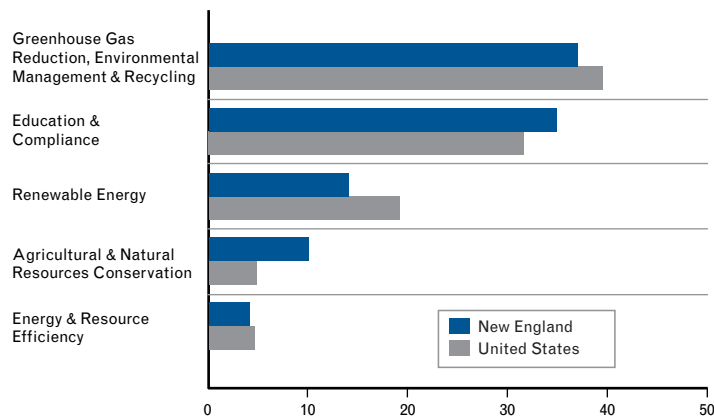
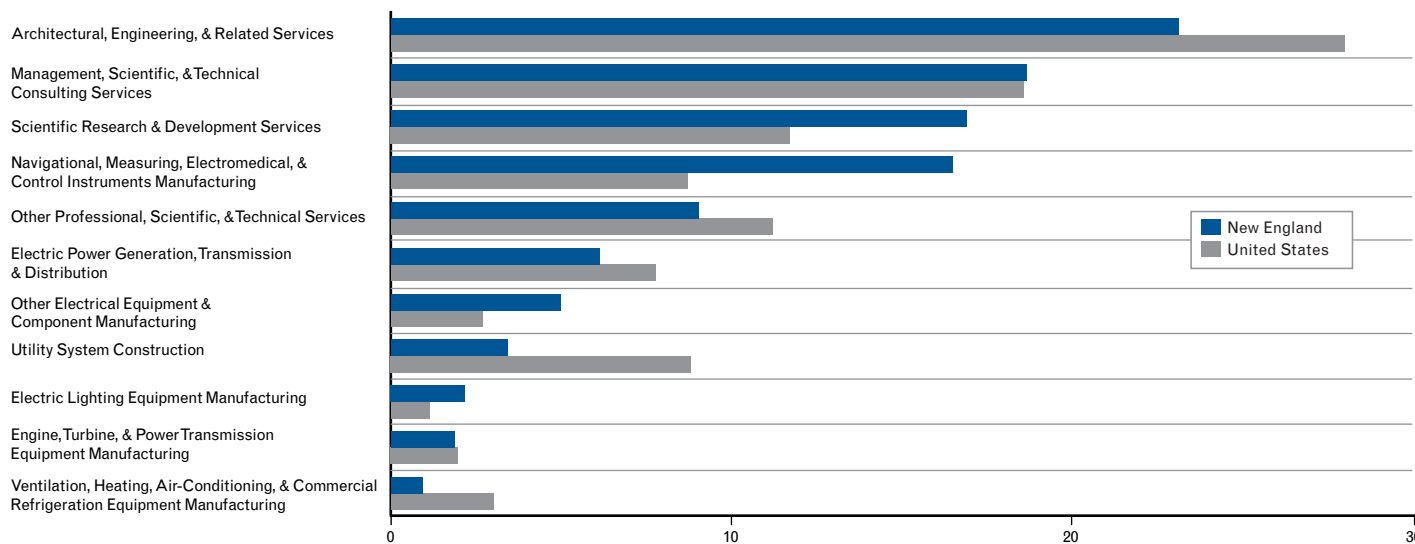


Figure 3. Share of Total Jobs in Various Clean Industries, under the NAICS Definition, 2007



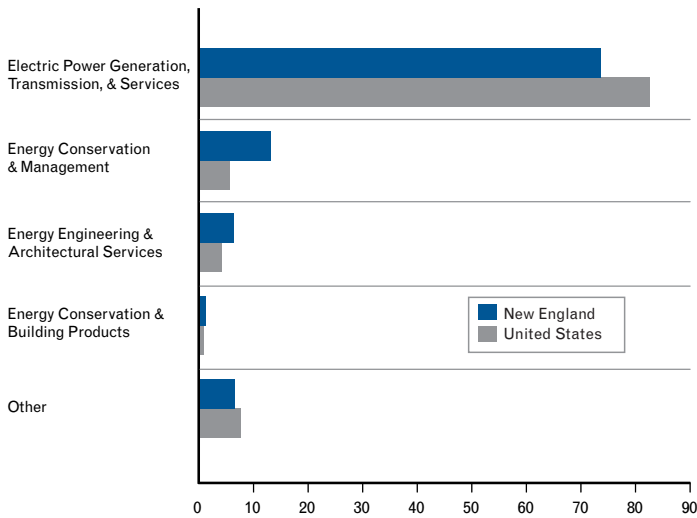
jobs relative to the nation in energy conservation & management (12.9 percent versus 5.4 percent). The region also has a higher concentration of jobs in energy engineering & architectural services and energy conservation & building products than the nation.

The total number of jobs in clean industries in New England varies widely with the definition of the sector (see Table 2). In 2007, this total ranges from 12,418 under the NETS definition to 310,900 under the NAICS definition. Similarly, the number of clean-industries jobs in each state in the region varies with the definition. Under the NAICS measure, Massachusetts had 177,860 clean-industries jobs in 2007, but under the NETS measure, the state had just 3,905 jobs (see Figure 5). (For changes in job totals over time under the four definitions, see Table A5 in the online appendix.)

The share of clean-industries jobs in total employment is a better measure of the relative strength of the sector than are the raw employment numbers. As with the raw numbers, the share of clean-industries jobs in New England varies with the definition of the sector, ranging from 0.2 percent under the NETS definition to 4.4 percent under the NAICS definition (see Figure 6). The Pew and Brookings estimates are in between, at 0.7 percent and 1.8 percent of total employment, respectively. The four definitions appear in the same order when ranking the national share of employment devoted to clean industries, ranging from 0.2 percent to 3.9 percent.

How does the percentage of clean-industries jobs in New England compare with the national average? Under the Pew and NAICS definitions, the region's share of clean-industries jobs in total employment is higher than the national share. Under the Brookings and NETS definitions, the regional share is virtually the same as the national average.

Figure 4. - Share of Total Jobs in Various Clean Industries, under the NETS Definition, 2007



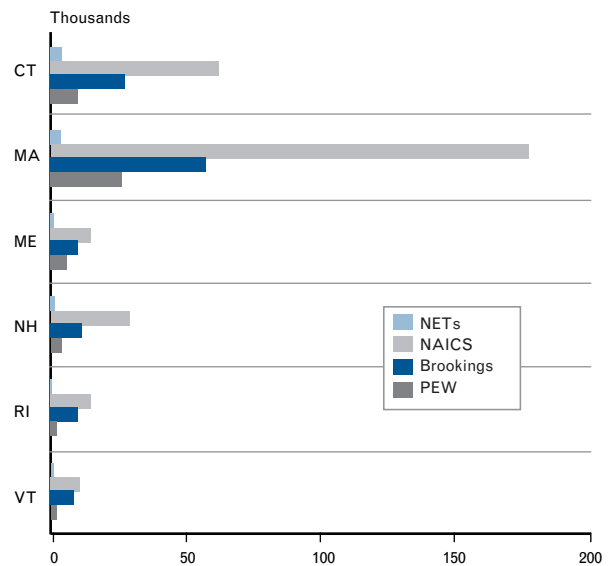
Clean-Industries Jobs as a Share of Total Employment: New England States

We can also use the four definitions to compare the share of clean-industries jobs in each New England state with the national average. According to the Pew analysis, all the New England states except Rhode Island have concentrations of clean-industries jobs at or above the national average of 0.6 percent (see Figure 6).⁸ At 0.5 percent, Rhode Island’s share of these jobs lags the national average slightly, with the state’s share of clean-industries jobs lower than the national average in all five of Pew’s clean-industries categories. (That is, Rhode Island is not particularly weak or strong in any one category.)

According to the Pew analysts, Maine has the highest concentration of clean-industries jobs among the New England states (1.0 percent of total employment). This ranking reflects Maine’s relatively high concentration of jobs related to energy efficiency, which account for 40 percent of Pew’s clean-industries jobs in this state.

According to the Brookings analysts, Vermont has the highest share of clean-industries jobs in the region (2.8 percent)—and this share is substantially higher than the national average. Vermont’s high concentration reflects the state’s relatively high

Figure 5. - Number of Jobs in Clean Industries in the New England States, 2007



percentage of jobs in organic food & farming, conservation, and waste management & treatment. All the other New England states have shares of clean-industries jobs closer to the national average under this measure, with Rhode Island and New Hampshire above the national average, and Massachusetts, Maine, and Connecticut slightly below the national average.

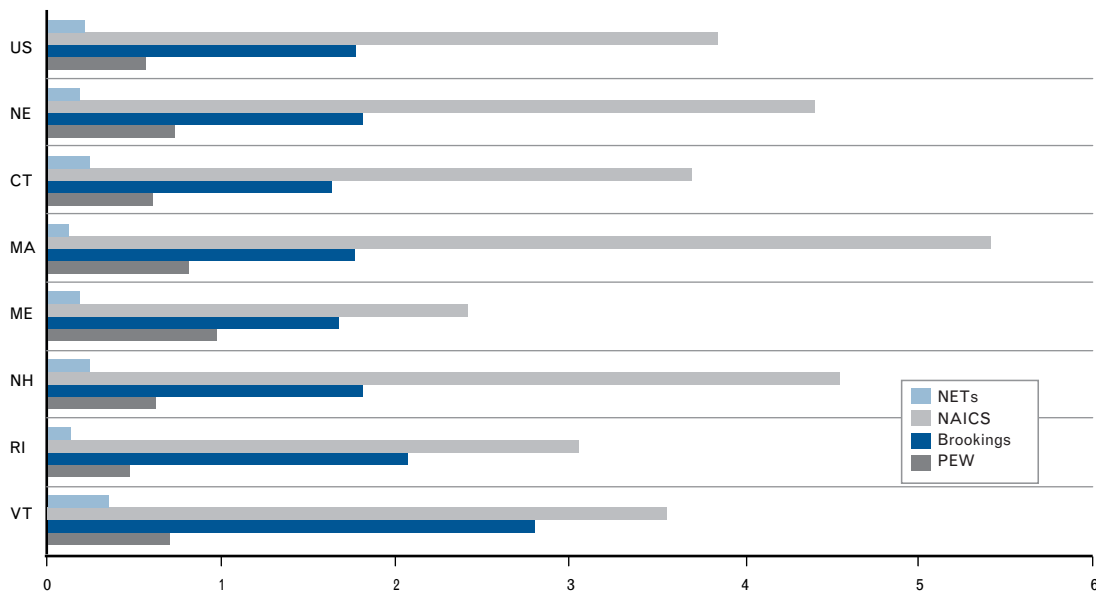
Under the NAICS-based definition, Massachusetts has the highest concentration of clean-industries jobs in the region (5.4 percent). This high concentration reflects the state’s strong position in scientific research & development services, and architectural, engineering, & related services. With clean industries representing only 2.4 percent of total employment, Maine lags considerably behind the other New England states under the NAICS definition. This reflects a relatively weak position in several of the state’s manufacturing-based clean industries, which are more heavily represented in the NAICS-based measure than in the other measures.

Under the NETS-based definition, Vermont again has the highest share of clean-industries jobs in the region (0.4 percent). Vermont’s strength reflects the fact that local producers of electricity provide a high share of the state’s power. In fact, the amount of electricity these producers generate is nearly one-third higher than total retail sales

Table 2. Total Jobs in Clean Industries, New England and the Nation, 2007

	PEW	Brookings	NAICS	NETS
New England	51,343	126,275	310,900	12,418
United States	765,060	2,418,207	5,261,130	282,467

**Figure 6. - Clean-Industries Jobs as a Share of Total Employment:
New England and the Nation, 2007**



in the state, so Vermont’s electricity producers are net exporters.⁹ The state’s two largest employers under the NETS definition are both in industry segments that encompass electricity generation, including nuclear power (see the online appendix). Massachusetts, by contrast, is an electricity importer and the only state in the region where retail electricity sales are higher than net electricity generation. This contributes to the state’s having one of the lowest shares (0.1 percent) of NETS clean-industries jobs in New England.

Is Employment in Clean Industries Growing?

We can further use the four definitions to examine the growth of employment in clean industries. The challenge here is that the Brookings analysts used data that begin in 2003, while the other three definitions are based on data that begin in 1998.

Annual total employment growth in the nation and New England averaged 1.0 percent and 0.5, respectively, from 1998 to 2007, and 0.7 and 0.5 percent, respectively, from 2003 to 2007. It is important to keep in mind the lower growth in the latter period when comparing figures from Brookings with those under the other definitions.

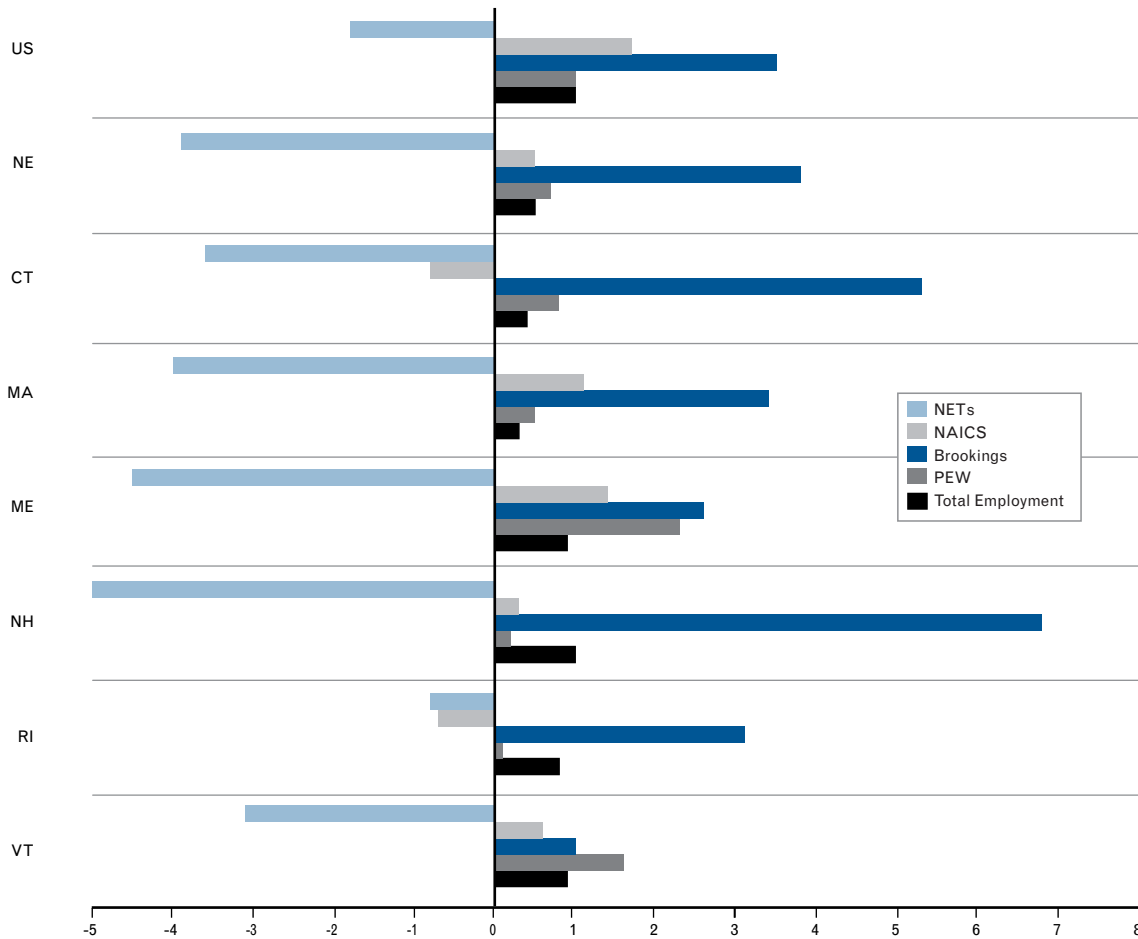
The Pew analysts found that clean-industries employment grew faster in the nation than in New England (1.0 percent versus 0.7 percent annual aver-

age from 1998 to 2007). Clean-industries employment growth was the same as overall employment growth nationally (1.0 percent), but was somewhat faster than overall employment growth in the region (0.7 percent compared to 0.5 percent).

Among the New England states, Maine and Vermont had the highest employment growth in Pew-defined clean industries from 1998 to 2007. These two states have been among the most active in the nation in tackling climate change and spurring the development of clean industries, through efforts such as state climate adaptation plans and public benefit funds, which are used to support investments in clean energy. These policies may have proved especially beneficial in boosting the share of clean-industries jobs in these states because of their relatively small initial employment base in this sector.¹⁰

As with the Pew definition, employment in NAICS-defined clean industries grew faster in the nation than in New England from 1998 to 2007 (1.7 versus 0.5 percent annual average). Clean-industries employment grew more slowly in Massachusetts, Maine, New Hampshire, and Vermont than in the nation, and actually declined in Connecticut and Rhode Island. These drops could reflect the overall weakness of the industrial and high-tech sectors in the latter two states, rather than a shortcoming in clean industries in particular.

Figure 7. - Annual Average Percent Changes in Clean-Industries Jobs and Total Employment: New England and the Nation, 1998–2007



Notes: The figures represent average annual changes from 1998 to 2007, except for the Brookings figures, which represent average annual changes from 2003 to 2007. Growth rates in total employment from 2003 to 2007 were 0.7 percent in the nation, 0.5 percent in New England, 0.0 percent in Connecticut, 0.1 percent in Massachusetts, 1.6 percent in Maine, 1.2 percent in New Hampshire, 1.4 percent in Rhode Island, and 1.2 percent in Vermont.

In contrast to the Pew analysis, the NAICS definition shows clean-industries employment rising as a share of overall employment nationwide, but maintaining a constant share of overall employment in the New England region from 1998 to 2007. Massachusetts and Maine were the only two New England states where the NAICS definition indicates that clean industries gained employment share during this period.

According to the NETS definition, clean-industries employment declined in the nation, and even more dramatically in New England from 1998 to 2007 (-1.8 percent versus -3.9 percent annual average). The decline in the NETS measure employment in the nation and region could reflect energy conservation and efficiency efforts coupled with industry downsizing and measures to improve productivity, with the sharper decline in the region reflecting lower population growth and greater energy conser-

vation and energy efficiency effort in New England than the national average. The more modest decline in Rhode Island could partly reflect the fact that the state began with the lowest share of clean-industries jobs in 1998, according to this definition.

Under the Brookings definition, with the more limited time frame, employment in clean industries grew faster than total employment in both New England and the nation from 2003 to 2007 (see Figure 7). However, employment in clean industries grew faster in New England than in the nation (3.8 percent versus 3.5 percent, as an annual average during that time), while total employment grew more slowly in New England than nationally (0.5 percent versus 0.7 percent).

New Hampshire saw the most significant job growth in clean industries in the region, according to Brookings, averaging 6.8 percent annually from 2003 to 2007—well above the U.S. average (3.5 percent).

New Hampshire's relatively rapid growth occurred in regulation & compliance and renewable energy. The rise in regulation & compliance may reflect New Hampshire's adoption of policies designed to combat climate change, although other states in the region have also enacted such legislation. Connecticut's growth in Brookings-defined clean industries (an average of 5.3 percent per year) also exceeded the U.S. rate of growth by a substantial margin.

After 2007, overall economic conditions deteriorated during the Great Recession. Total annual employment fell for three consecutive years, both nationally and in New England, with the steepest declines occurring between 2008 and 2009. How did clean industries weather this downturn?

The three available sources differ in their answers.¹¹ Under two of the three definitions, clean industries fared better than other sectors of the economy. Clean industries fared worse than overall employment only under the narrow NETS definition, with clean-industries' shares of total employment declining from 2007 to 2009 in the nation and New England.

The Brookings analysis shows more jobs in clean industries in 2010 than in 2007 nationally, in New England, and in each New England state except Rhode Island. Brookings definition clean-industries shares also rose in the nation and in all of the New England states, including Rhode Island.

The NAICS-based analysis generally shows net decreases in clean-industries employment from 2007 to 2009. The only exception is a slight increase in clean-industries jobs in Massachusetts. However, clean-industries shares of total employment rose in the nation, New England, and all states in the region except Connecticut and New Hampshire from 2007 to 2009. This means that clean industries fared better than other sectors of the economy during this period under the NAICS definition.

Conclusion

This investigation shows that the level, concentration, and growth of jobs in clean industries in New England vary significantly with the definition of the sector. Considered together, the four measures suggest that clean industries account for anywhere from 0.2 percent to more than 4 percent of jobs today. If the general patterns of the 1990s and 2000s continue, these industries have good potential to provide more employment in the future—particularly in segments other than the energy supply industry.

Promising areas include scientific research & development services, measurement & control instruments manufacturing, energy conservation & management, and agriculture & natural resources conservation. Taken together, this analysis also suggests that Vermont, Maine, and Massachusetts have the strongest clean industries in the region, while Rhode Island lags the other New England states in this arena. State policymakers may want to consider these strengths, weaknesses, and opportunities when designing their economic development strategies.

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The views expressed in this report are those of the authors and do not necessarily represent positions of the Federal Reserve Bank of Boston or the Federal Reserve System.

Endnotes

- 1 Pew Charitable Trusts, *The Clean Energy Economy*, Washington, DC, 2009. Online at http://www.Pewcenteronthestates.org/uploaded-Files/Clean_Economy_Report_Web.pdf.
- 2 See “Greening the Rustbelt,” *Economist*, August 13, 2009; Michael Burnham, “Green Sector Jobs ‘Poised for Explosive Growth,’ Study Says,” *New York Times*, June 10, 2009; “New Map: The Economics of Clean Energy in 50 States,” Washington, DC, Center for American Progress, online at http://www.americanprogress.org/issues/2009/10/50_state_energy.html; Jim Tankersley and Don Lee, “China Takes Lead in Clean Tech Investment,” *Los Angeles Times*, March 25, 2010; Dan Shapley, “The Five Best Cities for Green Jobs,” *Huffington Post*, March 18, 2010, online at http://www.huffingtonpost.com/2010/01/11/the-5-best-cities-for-gre_n_415133.html; and Ron Pernick, *The Clean Tech Market Authority*, *Clean Tech Job Trends*, October 2009.
- 3 Mark Muro and Jonathan Rothwell, *Sizing the Clean Economy: A National and Regional Green Jobs Assessment*, Washington, DC: Brookings Institution, 2011, online at http://www.brookings.edu/metro/Clean_Economy.aspx. For citations, see Jack Spencer, “Media Loves ‘Green Jobs,’” July 31, 2011, online at <http://www.michiganconfidential.com/15486>; Douglas McIntyre, “Where the Green Jobs Are Growing in the U.S.,” *MSNBC*, July 21, 2011, online at <http://www.msnbc.msn.com/id/43774081/ns/business-going-green/t/where-green-jobs-are-growing-us>; and “American Cities with the Fastest Green Jobs Growth,” *FoxBusiness*, July 15, 2011, online at <http://www.foxbusiness.com/markets/2011/07/15/american-cities-with-fastest-green-jobs-growth/>.
- 4 For more on NAICS, see <http://www.census.gov/eos/www/naics/>. For more on Moody’s Analytics, see <http://www.moody.com/Pages/atc003.aspx>.
- 5 Karen Chapple, Cynthia Kroll, T. William Lester, and Sergio Montero, *Innovation in the Green Economy: The Mix of Innovation, Industries, and Regions in an Emerging Industry*. Paper presented to the annual conference of the Industry Studies Association, Chicago, May 7, 2010. Online at <http://www.industrystudies.pitt.edu/chicago10/2010%20Papers/Kroll%20-%20InnovationGreen.pdf>.
- 6 Analysts can purchase information from NETS, a private database created by Walls and Associates and Dun and Bradstreet. See <http://you-reconomy.org/nets/NETSDatabaseDescription.pdf>.
- 7 Training & support are jobs, businesses, and investments that provide specialized services to the other four Pew categories in the clean energy economy. Examples of jobs include financial analysts and consultants specializing in clean-industries investments; lawyers and paralegals providing legal services to the sector; and vocational teacher training new workers for the clean energy economy. All figures in the text and figures are rounded to one decimal place.
- 8 The figures presented here on Pew jobs as a percent of total employment differ slightly from those in *The Clean Energy Economy*. This is because we relied on figures for total 2007 employment from Moody’s Analytics that reflect recent revisions from the U.S. Bureau of Labor Statistics. Thus the clean-industry shares of total employment in this report are generally lower than those in the Pew report.
- 9 U.S. Energy Information Administration. http://www.eia.gov/cneaf/electricity/st_profiles/e_profiles_sum.html.
- 10 See Pew Center on Global Climate Change, *U.S. Climate Policy Maps*, March 2011. Online at http://www.Pewclimate.org/what_s_being_done/in_the_states/state_action_maps.cfm.
- 11 The Appendix includes data on clean-industries’ performance during the Great Recession, from 2007 to 2010, under the Brookings, NAICS, and NETS definitions. Data under the Pew definition are available only from 1998 to 2007. See <http://www.bostonfed.org/economic/need/index.htm>.

Appendix: Tracking Jobs in Clean Industries in New England

Supplemental materials for the article written and published in the Q3 2011 edition of New England Economic Indicators. Article written by Ross Gittel, James R. Carter Professor at the University of New Hampshire's Whittemore School of Business and Economics and former visiting scholar with the New England Public Policy Center, and Josh Stillwagon, Ph.D. Candidate in Economics, University of New Hampshire.

A. Four Definitions of Clean Industries: Discussion and Data

The Pew definition

Analysts at the Pew Charitable Trusts worked with Collaborative Economics, a consulting firm based in Silicon Valley, to construct their definition of clean industries, and to collect and analyze data.¹ The researchers relied primarily on the National Establishment Time Series (NETS) database for employment data, because it provides the most detailed information at the level of business establishments, also known as business units, which may be parts of larger companies.

The researchers selected business establishments by industry, as defined by their 8-digit Standard Industrial Code (SIC). After identifying establishments and their associated employment levels in 16 industry segments, the analysts condensed these segments into five broader categories (see Table A1). The methodology is proprietary, so the list of industries in each segment is not publicly available by SIC code.

Table A1. Clean industries according to the Pew definition

Category	Industry Segment
Clean energy	Energy generation, energy transmission, and energy storage
Energy Efficiency	Energy efficiency
Environmentally Friendly Production	Transportation, manufacturing/industrial, construction, agriculture, energy production, and materials
Conservation & Pollution Mitigation	Air & environment, recycling & waste, and water & wastewater
Training & Support	Business services, finance/investment, and research & advocacy

¹ Pew Charitable Trusts, *The Clean Energy Economy*, Washington, DC, 2009. Online at http://www.Pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf.

The Brookings definition

The Brookings Institution analysts worked with Battelle Technology Partnership Practice, a firm based in Cleveland, to build a database of “clean economy” establishments and employment.² Like the Pew analysts, the Brookings researchers used 8-digit SICs to identify clean industries that fit their definition.³ The Brookings analysts included 39 industry segments composed of 8-digit SIC industries and grouped the segments into five categories (see Table A2). The researchers then identified establishments and employment levels within each segment.

The Brookings definition focuses on industries whose products and services have environmental benefits, such as managing natural resources—including energy, air, and water—for greater efficiency and conservation.. This definition, unlike the one used by the Pew researchers, does not include establishments that conduct themselves in an environmentally friendly manner by such means as adopting internal environmental goals, making processes more environmentally responsible, or even contributing to knowledge about environmental challenges.

In addition, the Brookings analysts include only establishments that make products or provide services focused exclusively on the “clean economy,” rather than including establishments that make products and provide services used in a broad range of industries. This definition therefore leaves out jobs at firms that serve clean industries but do not focus exclusively on these industries.

The Brookings analysts used the NETS and Dun & Bradstreet databases to compile employment figures at the establishment level.⁴

² Mark Muro and Jonathan Rothwell, *Sizing the Clean Economy: A National and Regional Green Jobs Assessment*, Washington, DC: Brookings Institution, 2011, Online at http://www.brookings.edu/metro/Clean_Economy.aspx.

³ The Brookings analysts also included some specific firms outside these industries that they considered part of the clean economy.

⁴ The names of the specific firms in the Brookings database are not available, because of the analysts’ agreement with their data providers.

Table A2. Clean industries according to the Brookings definition

Industry Category	Segments	Standard Industrial Code (by code and industry name)
Agricultural & Natural Resources Conservation		
	Conservation	1810103 - Mats, pre-seeded: soil erosion, growing of, 8510102 - Reforestation services, 35890300 - Sewage and water treatment equipment, 38220000 - Environmental controls, 49520000 - Sewerage systems, 49590302 - Environmental cleanup services, 50399912 - Soil erosion control fabrics, 86419903 - Environmental protection organization, 87310301 - Energy research, 87489905 - Environmental consultant, 89990703 - Natural resource preservation service
	Organic food & farming	86419903 - Environmental protection organization
	Sustainable forestry products	8510102 - Reforestation services, 86419903 - Environmental protection organization
Education & Compliance		
	Regulation & compliance	38220000 - Environmental controls, 81110208 - Environmental law, 86419903 - Environmental protection organization, 87349911 - Water testing laboratory, 87449904 - Environmental remediation, 89990703 - Natural resource preservation service
	Training	86419903 - Environmental protection organization, 87489905 - Environmental consultant
Energy & Resource Efficiency		
	Appliances	17310202 - Energy management controls, 50740200 - Heating equipment (hydronic)
	Battery technologies	35890306 - Water treatment equipment industrial, 36210116 - Storage battery chargers, motor and engine generator type, 36290107 - Thermo-electric generators, 36919902 - Batteries rechargeable, 87119906 - Energy conservation engineering, 87310301 - Energy research
	Electric vehicle technologies	37110104 - Cars, electric, assembly of, 87310301 - Energy research
	Energy-saving building materials	17310203 - Environmental system control installation, 17420203 - Insulation, buildings, 17990208 - Insulation of pipes and boilers, 24930400 - Insulation and roofing material, reconstituted wood, 28999928 - Insulating compounds, 32110302 - Insulating glass, sealed units, 32310401 - Insulating glass: made from purchased glass, 34430304 - Economizers (boilers), 38220000 - Environmental controls, 50330200 - Insulation materials, 50740208 - Heating equipment and panels, solar, 52110300 - Insulation and energy conservation products, 87119906 - Energy conservation engineering, 87489904 - Energy conservation consultant
	Energy-saving consumer products	17310202 - Energy management controls, 17420203 - Insulation, buildings, 36410106 - Lamps, fluorescent, electric, 36459905 - Fluorescent lighting fixtures, residential, 38290218 - Solarimeters, 87310301 - Energy research
	Fuel cells	36290102 - Electrochemical generators (fuel cells), 36749901 - Fuel cells, solid state, 87310301 - Energy research

Green architecture and construction services	17310203 - Environmental system control installation, 17420203 - Insulation, buildings, 87110101 - Pollution control engineering, 87489904 - Energy conservation consultant
HVAC & building control systems	16290505 - Waste water and sewage treatment plant construction, 17310202 - Energy management controls, 35640101 - Air cleaning systems, 36130210 - Regulators, power, 38220000 - Environmental controls, 38260700 - Instruments measuring thermal properties, 50330200 - Insulation materials, 50740200 - Heating equipment (hydronic), 50840704 - Meters, consumption registering, 76990304 - Thermostat repair, 87110403 - Heating and ventilation engineering, 87310301 - Energy research
Lighting	17310202 - Energy management controls, 36410106 - Lamps, fluorescent, electric, 36469904 - Fluorescent lighting fixtures, commercial
Professional energy services	17310203 - Environmental system control installation, 52110301 - Energy conservation products, 87119906 - Energy conservation engineering, 87310301 - Energy research, 87489904 - Energy conservation consultant
Public mass transit	40119902 - Interurban railways, 41110000 - Local and suburban transit, 41190000 - Local passenger transportation, nec, 41310000 - Intercity and rural bus transportation, 41739901 - Bus terminal operation, 44890000 - Water passenger transportation, 47299901 - Carpool/vanpool arrangement, 47890200 - Passenger train services
Smart grid	17310202 - Energy management controls, 36130210 - Regulators, power, 36290101 - Battery chargers, rectifying or nonrotating, 73899931 - Meter readers, remote, 87119906 - Energy conservation engineering, 87310301 - Energy research, 87489904 - Energy conservation consultant
Water efficient products	35890306 - Water treatment equipment, industrial, 35999919 - Water leak detectors, 38240117 - Water meters, 38250303 - Current measuring equipment, nec, 50740102 - Water purification equipment, 50930200 - Metal scrap and waste materials, 73899931 - Meter readers, remote
Greenhouse Gas Reduction, Environmental Management, & Recycling	
Air and water purification technologies	17310203-Environmental system control installation, 28999948 -Water treating compounds, 35640101-Air Cleaning Systems, 35890304- Water Filters and softners Household type, 38229904-Electric air cleaner controls automatic, 50740102- Water purification equipment, 86419903- Environmental protection organization, 87349911 -Water testing laboratory
Carbon storage & management	13110201 - Coal Gasification
Green building materials	17420203 - Insulation, buildings, 52110302 - Insulation material, building
Green chemical products	28210401 - Carbohydrate plastics, 28739901 - Fertilizers: natural (organic), except compost, 50939905 - Oil, waste
Green consumer products	28759901 - Compost, 35999919 - Water leak detectors, 49539905 -Recycling, waste materials, 49590302 - Environmental cleanup services, 50399912 - Soil erosion control fabrics, 50939905 - Oil, waste, 87489905 - Environmental consultant
Nuclear energy	87310301 - Energy research

Pollution reduction	17310203 - Environmental system control installation, 17969906 - Pollution control equipment installation, 38220000 - Environmental controls, 38269907 - Environmental testing equipment, 50840706 - Pollution control equipment, air (environmental), 73890201 - Air pollution measuring service, 86419903 - Environmental protection organization, 87110101 - Pollution control engineering
Professional environmental services	8510102 - Reforestation services, 17310203 - Environmental system control installation, 28999928 - Insulating compounds, 38220000 - Environmental controls, 73890201 - Air pollution measuring service, 86419903 - Environmental protection organization, 87110101 - Pollution control engineering, 87310302 - Environmental research, 87489905 - Environmental consultant, 89990703 - Natural resource preservation service
Recycled-content products	24930400 - Insulation and roofing material, reconstituted wood, 28759901 - Compost, 28999928 - Insulating compounds, 38220000 - Environmental controls, 49539905 - Recycling, waste materials, 50330200 - Insulation materials, 50930105 - Waste paper, 87310301 - Energy research
Recycling & reuse	8510102 - Reforestation services, 16290505 - Waste water and sewage treatment plant construction, 28759901 - Compost, 35599937 - Recycling machinery, 35890306 - Water treatment equipment, industrial, 36919902 - Batteries, rechargeable, 49539905 - Recycling, waste materials, 49590302 - Environmental cleanup services, 50849914 - Recycling machinery and equipment, 50939905 - Oil, Waste, 52110302 - Insulation material, building, 86419903 - Environmental protection organization, 87310301 - Energy research, 87489905 - Environmental consultant, 89990703 - Natural resource preservation service
Remediation	17310202 - Energy management controls, 17990801 - Asbestos removal and encapsulation, 35899901 - Asbestos removal equipment, 49530102 - Chemical detoxification, 49590302 - Environmental cleanup services, 86419903 - Environmental protection organization, 87340301 - Hazardous waste testing, 87449904 - Environmental remediation, 87489905 - Environmental consultant
Waste management & treatment	8510102 - Reforestation services, 16290505 - Waste water and sewage treatment plant construction, 17310203 - Environmental system control installation, 28999948 - Water treating compounds, 35890306 - Water treatment equipment, industrial, 38230506 - Water quality monitoring and control systems, 49520000 - Sewerage systems, 49590302 - Environmental cleanup services, 50750103 - Air pollution control equipment and supplies, 86419903 - Environmental protection organization, 87349911 - Water testing laboratory, 87489905 - Environmental consultant
Renewable Energy	
Biofuels/biomass	17310202 - Energy management controls, 17990208 - Insulation of pipes and boilers, 28690104 - Ethyl alcohol ethanol, 28999948 - Water treating compounds, 87310301 - Energy research, 87489904 - Energy conservation consultant, 89990703 - Natural resource preservation service
Geothermal	17819901 - Geothermal drilling, 50740208 - Heating equipment and panels, solar,
Hydropower	35110207 - Wheels, water
Renewable energy services	17310101 - Cogeneration specialization, 87119906 - Energy conservation engineering, 87310301 - Energy research, 87489904 - Energy conservation consultant

Solar photovoltaic	17110403 - Solar energy contractor, 17310202 - Energy management controls, 34339904 - Solar heaters and collectors, 36740306 - Solar cells, 36919902 - Batteries, rechargeable, 38290218 - Solarimeters, 50740208 - Heating equipment and panels, solar, 52110303 - Solar heating equipment, 87119906 - Energy conservation engineering, 87310301 - Energy research, 87489904 - Energy conservation consultant
Solar thermal	17110403 - Solar energy contractor, 34339904 - Solar heaters and collectors, 50740208 - Heating equipment and panels, solar, 52110303 - Solar heating equipment, 87310301 - Energy research, 87489904 - Energy conservation consultant
Waste-to-energy	17310202 - Energy management controls, 49539905 - Recycling, waste materials, 52110301 - Energy conservation products, 87310301 - Energy research
Wave/ocean power	17310202 - Energy management controls, 87310301 - Energy research
Wind	17110403 - Solar energy contractor, 17310202 - Energy management controls, 35239906 - Windmills for pumping water, agricultural, 36219909 - Windmills, electric generating, 38220304 - Temperature sensors for motor windings, 50740208 - Heating equipment and panels, solar, 50840706 - Pollution control equipment, air (environmental), 52110300 - Insulation and energy conservation products, 87310301 - Energy research, 87489904 - Energy conservation consultant, 89990703 - Natural resource preservation service

The NAICS definition

We constructed this broad definition based on the North American Industry Classification System (NAICS), selecting clean industries at the 4-digit level (see Table A3). We included 11 industries that had significant activity in providing products and services used to store and conserve energy, produce energy from renewable and low-carbon sources, treat waste, and conserve and manage water and other natural resources.

We determined that industries had significant activity in these areas if Pew, Brookings or University of California -Berkeley analysts in a 2010 research paper included the industries in their definitions.⁵ We selected the final list of industries in consultation with Moody's Analytics, which provided employment data for the New England states and the nation from the U.S. Bureau of Labor Statistics (BLS).⁶ The BLS collects data at the establishment level whenever possible, using the primary NAICS activity of each establishment to designate its industry.

Table A3: Clean industries according to the NAICS definition and their codes

Industry Description	NAICS Code
Electric power generation, transmission, & distribution	2211
Utility system construction	2371
Ventilation, heating, air-conditioning, & commercial refrigeration equipment manufacturing	3334
Engine, turbine, & power transmission equipment manufacturing	3336
Navigational, measuring, electromedical, & control instruments manufacturing	3345
Electric lighting equipment manufacturing	3351
Other electrical equipment & component manufacturing	3359
Architectural, engineering, & related services	5413
Management, scientific, & technical consulting services	5416
Scientific research & development services	5417
Other professional, scientific, & technical services	5419

⁵ Karen Chapple, Cynthia Kroll, T. William Lester, and Sergio Montero, *Innovation in the Green Economy: The Mix of Innovation, Industries, and Regions in an Emerging Industry*. Paper presented to the annual conference of the Industry Studies Association, Chicago, May 7, 2010. Online at <http://www.industrystudies.pitt.edu/chicago10/2010%20Papers/Kroll%20-%20InnovationGreen.pdf>.

⁶ For more on NAICS, see <http://www.census.gov/eos/www/naics/>. For more on Moody's Analytics, see <http://www.moody.com/Pages/atc003.aspx>.

The NETS definition

Our fourth definition focuses on energy research and services. We based this definition on the 8-digit SIC industries that analysts at the University of California at Berkeley included in *Innovation in the Green Economy*, a 2010 research paper.⁷

We used the 2011 NETS database to identify employment at the business establishment level in these industries.⁸ The NETS database provides more detailed information on jobs at the level of the business establishment than is available in public sources. Collecting data at this level—rather than at the firm level—allows us to identify the number of clean-industries jobs more precisely. The use of SICs allows us to identify more detailed segments than the NAICS codes allow. We found a total of 596 clean industries related to energy research and services, although many provide few jobs.

Table A4 shows the top five industry segments by employment for each New England state, according to this definition of clean industries. The table also shows the industry group under which each segment appears in the NETS database. (Figure 4 in the main article focuses on these groups.)

⁷ Karen Chapple, Cynthia Kroll, T. William Lester, and Sergio Montero, *Innovation in the Green Economy: The Mix of Innovation, Industries, and Regions in an Emerging Industry*. Paper presented to the annual conference of the Industry Studies Association, Chicago, May 7, 2010. Online at <http://www.industrystudies.pitt.edu/chicago10/2010%20Papers/Kroll%20-%20InnovationGreen.pdf>.

⁸ Analysts can purchase information from NETS, a private database created by Wall and Associates and Dun & Bradstreet. See <http://youreconomy.org/nets/NETSDatabaseDescription.pdf>.

Table A4. The Top-five clean industries in the NETS definition, and their SIC codes

Connecticut		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119902	Generation, electric power	Electrical power transmission & services
87489904	Energy conservation consulting	Energy conservation & management
87119906	Energy conservation engineering	Energy engineering & architectural services
52110301	Energy conservation products	Energy conservation & building materials
49319901	Cogeneration of electric power	Electrical power transmission & services
Massachusetts		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119902	Generation, electric power	Electrical power transmission & services
87489904	Energy conservation consulting	Energy conservation & management
49119901	Distribution, electric power	Electrical power transmission & services
49119908	Hydroelectric power generation	Electrical power transmission & services
87119906	Energy conservation engineering	Engineering and architectural services
Maine		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119902	Generation, electric power	Electrical power transmission & services
49119901	Distribution, electric power	Electrical power transmission & services
49530000	Refuse systems	Other
87119906	Energy conservation engineering	Energy engineering & architectural services
49119903	Transmission, electric power	Electrical power transmission & services
New Hampshire		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119906	Nuclear electric power generation	Electrical power transmission & services
49119902	Generation, electric power	Electrical power transmission & services
49119907	Fossil fuel electrical power generation	Electrical power transmission & services
87489904	Energy conservation consulting	Energy conservation & management
87110000	Engineering services	Energy engineering & architectural services
Rhode Island		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119902	Generation, electric power	Electrical power transmission & services
87489904	Energy conservation consulting	Energy conservation & management
87110403	Heating and ventilation engineering	Energy engineering & architectural services
87119906	Energy conservation engineering	Energy engineering & architectural services
76990304	Thermostat repair	Other

Vermont		
<i>SIC</i>	<i>Industry Segment</i>	<i>Industry Group</i>
49119902	Generation, electric power	Electrical power transmission & services
49119906	Nuclear electric power generation	Electrical power transmission & services
87489904	Energy conservation consulting	Energy conservation & management
49110000	Electric services	Electrical power transmission & services
49119901	Distribution, electric power	Electrical power transmission & services

B. Changes in Clean Industries Jobs over Time

Table A5 provides data on the total number of clean-industries jobs and share of total employment in clean industries over time under the four definitions for the nation, the region, and each of the New England states.

Table A5. Total Number of Clean-Industries Jobs over Time

Pew:

	US	NE	CT	MA	ME	NH	RI	VT
1998	701,668	48,088	9,484	25,580	4,888	3,950	2,311	1,875
1999	721,836	47,503	9,677	24,604	5,010	3,882	2,476	1,854
2000	734,571	45,309	8,814	23,842	5,005	3,478	2,437	1,733
2001	751,572	47,924	10,715	24,057	5,006	3,368	2,879	1,899
2002	777,995	50,291	11,287	24,742	5,364	3,887	2,982	2,029
2003	759,374	50,706	10,976	25,220	5,719	3,850	2,822	2,119
2004	747,825	50,133	11,248	24,444	5,827	3,741	2,800	2,073
2005	738,037	50,208	11,203	24,630	5,754	3,959	2,529	2,133
2006	753,295	50,850	10,052	26,381	5,805	4,045	2,401	2,166
2007	765,060	51,343	10,147	26,678	6,000	4,029	2,328	2,161

Brookings:

	US	NE	CT	MA	ME	NH	RI	VT
2003	2,110,208	108,720	22,541	50,598	9,298	8,971	9,017	8,295
2007	2,418,207	126,275	27,728	57,753	10,304	11,667	10,192	8,631
2010	2,675,545	137,360	29,751	63,523	12,212	12,886	9,563	9,425

NAICS (Total number of clean-industries jobs over time):

	US	NE	CT	MA	ME	NH	RI	VT
1990	4,154,590	290,570	69,540	151,940	14,250	26,920	17,510	10,410
1991	4,077,170	272,270	66,100	143,540	13,080	24,280	16,030	9,240
1992	4,031,620	266,960	64,840	140,220	12,900	23,980	15,710	9,310
1993	4,048,790	267,130	64,210	140,830	13,010	24,410	15,120	9,550
1994	4,096,750	270,910	64,110	143,750	12,830	25,070	15,510	9,640
1995	4,176,450	272,960	63,800	144,880	12,900	26,150	15,470	9,760
1996	4,237,250	278,200	64,680	149,770	12,670	26,630	14,930	9,520
1997	4,356,380	286,260	66,180	154,580	12,700	27,510	15,330	9,960
1998	4,515,640	297,020	67,490	161,410	13,200	28,480	16,060	10,380
1999	4,633,270	298,740	67,110	163,120	14,100	27,690	16,090	10,630
2000	4,817,960	308,090	68,390	169,520	14,160	28,080	16,940	11,000
2001	4,854,100	310,830	66,670	173,400	14,370	28,030	16,940	11,420
2002	4,719,800	301,640	65,350	169,220	14,200	26,460	15,870	10,540
2003	4,637,900	292,450	62,360	164,540	14,030	26,090	15,400	10,030
2004	4,716,660	292,780	62,250	163,780	14,160	26,930	15,420	10,240
2005	4,908,090	297,610	62,230	168,260	14,060	27,400	15,170	10,490
2006	5,115,220	303,390	61,670	172,910	14,230	28,700	15,170	10,710
2007	5,261,130	310,900	62,750	177,860	14,910	29,370	15,040	10,970
2008	5,363,680	319,370	63,900	184,440	15,550	29,320	15,010	11,150
2009	5,061,230	304,930	59,770	178,030	14,710	27,420	14,230	10,770

NETs (Total number of clean-industries jobs over time):

	US	NE	CT	MA	ME	NH	RI	VT
1990	349,518	24,041	9,326	8,693	1,884	1,842	1,027	1,269
1991	350,138	24,453	9,144	8,635	1,829	2,722	842	1,281
1992	346,729	23,229	9,353	7,254	1,748	2,744	842	1,288
1993	354,051	21,681	9,097	5,881	1,653	2,796	833	1,421
1994	352,994	21,563	8,906	6,154	1,652	2,606	815	1,430
1995	354,143	20,934	8,466	6,096	1,649	2,565	766	1,392
1996	329,983	18,014	5,826	5,671	1,778	2,551	792	1,396
1997	334,898	17,807	5,880	5,694	1,696	2,447	722	1,368
1998	332,402	17,636	5,726	5,658	1,693	2,455	677	1,427
1999	330,064	17,447	5,787	4,811	2,276	2,459	677	1,437
2000	342,892	18,009	6,919	4,988	1,568	2,479	672	1,383
2001	336,487	18,611	6,989	6,437	1,480	1,657	673	1,375

2002	353,507	20,323	8,717	6,371	1,568	1,650	639	1,378
2003	328,646	22,761	11,382	6,275	1,659	1,543	633	1,269
2004	310,904	14,698	5,066	4,461	1,677	1,557	647	1,290
2005	305,251	14,254	4,731	4,350	1,691	1,541	633	1,308
2006	307,405	14,283	5,398	4,087	1,571	1,543	631	1,053
2007	282,467	12,418	4,148	3,905	1,123	1,542	632	1,068
2008	267,367	10,815	3,057	3,523	1,130	1,528	660	917
2009	254,701	10,514	2,947	3,481	1,017	1,536	603	930

Total Employment Figures used in Calculations

	US	NE	CT	MA	ME	NH	RI	VT
1990	108,980,761	6,363,342	1,619,667	2,988,200	535,233	508,458	454,075	257,708
1991	107,718,072	6,050,508	1,557,142	2,824,417	513,492	482,175	424,150	249,133
1992	108,294,640	5,998,467	1,526,200	2,798,183	511,792	487,017	424,092	251,183
1993	110,397,058	6,083,334	1,531,067	2,843,075	519,308	502,500	429,967	257,417
1994	113,522,758	6,203,000	1,543,650	2,906,483	531,625	523,175	434,083	263,983
1995	116,462,257	6,328,658	1,561,558	2,980,009	538,150	539,800	438,917	270,225
1996	118,933,450	6,433,791	1,582,433	3,039,350	542,500	553,683	440,708	275,117
1997	122,075,209	6,574,959	1,607,617	3,113,900	553,733	570,283	450,008	279,417
1998	125,322,536	6,728,508	1,643,392	3,183,833	569,183	589,075	457,983	285,042
1999	128,148,582	6,860,867	1,669,083	3,242,567	586,342	605,842	465,467	291,567
2000	131,094,356	7,023,216	1,693,192	3,328,933	603,525	622,075	476,792	298,700
2001	130,930,500	7,036,275	1,681,100	3,339,250	608,200	627,217	478,417	302,092
2002	129,570,372	6,927,366	1,664,867	3,259,008	606,458	618,300	479,417	299,317
2003	129,083,866	6,850,592	1,644,525	3,198,300	606,667	617,742	484,192	299,167
2004	130,622,965	6,874,942	1,649,842	3,194,758	611,667	627,325	488,408	302,942
2005	132,894,158	6,918,075	1,662,058	3,211,525	611,667	636,325	491,000	305,500
2006	135,132,041	6,983,366	1,680,525	3,245,367	614,608	641,950	493,233	307,683
2007	136,671,108	7,043,242	1,698,142	3,280,384	617,758	645,983	492,642	308,333
2008	136,090,367	7,041,909	1,699,033	3,290,250	617,283	646,133	481,992	307,217
2009	129,927,913	6,776,942	1,627,658	3,173,817	595,117	624,308	459,042	297,000
2010	129,822,172	6,767,734	1,608,958	3,186,709	592,833	623,042	458,783	297,408

Percent of Total Employment for the Four Measures

Pew:

	US	NE	CT	MA	ME	NH	RI	VT
1998	0.56%	0.71%	0.58%	0.80%	0.86%	0.67%	0.50%	0.66%
1999	0.56%	0.69%	0.58%	0.76%	0.85%	0.64%	0.53%	0.64%
2000	0.56%	0.65%	0.52%	0.72%	0.83%	0.56%	0.51%	0.58%
2001	0.57%	0.68%	0.64%	0.72%	0.82%	0.54%	0.60%	0.63%
2002	0.60%	0.73%	0.68%	0.76%	0.88%	0.63%	0.62%	0.68%
2003	0.59%	0.74%	0.67%	0.79%	0.94%	0.62%	0.58%	0.71%
2004	0.57%	0.73%	0.68%	0.77%	0.95%	0.60%	0.57%	0.68%
2005	0.56%	0.73%	0.67%	0.77%	0.94%	0.62%	0.52%	0.70%
2006	0.56%	0.73%	0.60%	0.81%	0.94%	0.63%	0.49%	0.70%
2007	0.56%	0.73%	0.60%	0.81%	0.97%	0.62%	0.47%	0.70%

Brookings:

	US	NE	CT	MA	ME	NH	RI	VT
2003	1.63%	1.59%	1.37%	1.58%	1.53%	1.45%	1.86%	2.77%
2007	1.77%	1.79%	1.63%	1.76%	1.67%	1.81%	2.07%	2.80%
2010	2.06%	2.03%	1.85%	1.99%	2.06%	2.07%	2.08%	3.17%

NAICS:

	US	NE	CT	MA	ME	NH	RI	VT
1990	3.81%	4.57%	4.29%	5.08%	2.66%	5.29%	3.86%	4.04%
1991	3.79%	4.50%	4.24%	5.08%	2.55%	5.04%	3.78%	3.71%
1992	3.72%	4.45%	4.25%	5.01%	2.52%	4.92%	3.70%	3.71%
1993	3.67%	4.39%	4.19%	4.95%	2.51%	4.86%	3.52%	3.71%
1994	3.61%	4.37%	4.15%	4.95%	2.41%	4.79%	3.57%	3.65%
1995	3.59%	4.31%	4.09%	4.86%	2.40%	4.84%	3.52%	3.61%
1996	3.56%	4.32%	4.09%	4.93%	2.34%	4.81%	3.39%	3.46%
1997	3.57%	4.35%	4.12%	4.96%	2.29%	4.82%	3.41%	3.56%
1998	3.60%	4.41%	4.11%	5.07%	2.32%	4.83%	3.51%	3.64%
1999	3.62%	4.35%	4.02%	5.03%	2.40%	4.57%	3.46%	3.65%
2000	3.68%	4.39%	4.04%	5.09%	2.35%	4.51%	3.55%	3.68%
2001	3.71%	4.42%	3.97%	5.19%	2.36%	4.47%	3.54%	3.78%
2002	3.64%	4.35%	3.93%	5.19%	2.34%	4.28%	3.31%	3.52%
2003	3.59%	4.27%	3.79%	5.14%	2.31%	4.22%	3.18%	3.35%

2004	3.61%	4.26%	3.77%	5.13%	2.31%	4.29%	3.16%	3.38%
2005	3.69%	4.30%	3.74%	5.24%	2.30%	4.31%	3.09%	3.43%
2006	3.79%	4.34%	3.67%	5.33%	2.32%	4.47%	3.08%	3.48%
2007	3.85%	4.41%	3.70%	5.42%	2.41%	4.55%	3.05%	3.56%
2008	3.94%	4.54%	3.76%	5.61%	2.52%	4.54%	3.11%	3.63%
2009	3.90%	4.50%	3.67%	5.61%	2.47%	4.39%	3.10%	3.63%

NETS:

	US	NE	CT	MA	ME	NH	RI	VT
1990	0.32%	0.38%	0.58%	0.29%	0.35%	0.36%	0.23%	0.49%
1991	0.33%	0.40%	0.59%	0.31%	0.36%	0.56%	0.20%	0.51%
1992	0.32%	0.39%	0.61%	0.26%	0.34%	0.56%	0.20%	0.51%
1993	0.32%	0.36%	0.59%	0.21%	0.32%	0.56%	0.19%	0.55%
1994	0.31%	0.35%	0.58%	0.21%	0.31%	0.50%	0.19%	0.54%
1995	0.30%	0.33%	0.54%	0.20%	0.31%	0.48%	0.17%	0.52%
1996	0.28%	0.28%	0.37%	0.19%	0.33%	0.46%	0.18%	0.51%
1997	0.27%	0.27%	0.37%	0.18%	0.31%	0.43%	0.16%	0.49%
1998	0.27%	0.26%	0.35%	0.18%	0.30%	0.42%	0.15%	0.50%
1999	0.26%	0.25%	0.35%	0.15%	0.39%	0.41%	0.15%	0.49%
2000	0.26%	0.26%	0.41%	0.15%	0.26%	0.40%	0.14%	0.46%
2001	0.26%	0.26%	0.42%	0.19%	0.24%	0.26%	0.14%	0.46%
2002	0.27%	0.29%	0.52%	0.20%	0.26%	0.27%	0.13%	0.46%
2003	0.25%	0.33%	0.69%	0.20%	0.27%	0.25%	0.13%	0.42%
2004	0.24%	0.21%	0.31%	0.14%	0.27%	0.25%	0.13%	0.43%
2005	0.23%	0.21%	0.28%	0.14%	0.28%	0.24%	0.13%	0.43%
2006	0.23%	0.20%	0.32%	0.13%	0.26%	0.24%	0.13%	0.34%
2007	0.21%	0.18%	0.24%	0.12%	0.18%	0.24%	0.13%	0.35%
2008	0.20%	0.15%	0.18%	0.11%	0.18%	0.24%	0.14%	0.30%
2009	0.20%	0.16%	0.18%	0.11%	0.17%	0.25%	0.13%	0.31%

Addendum: New Green Jobs Estimate and Methodology

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The 2011: Q3 edition of *New England Economic Indicators* featured an article by Ross Gittell and Josh Stillwagon, titled “Tracking Jobs in Clean Industries in New England,” that provided a review of the various measures of jobs in clean industries—often called “green jobs.” Since the article’s publication the Bureau of Labor Statistics (BLS) has released its own estimates of green jobs.¹ The following addendum provides a brief comparison of the green jobs estimate and methodology released by the BLS to those found in the Gittell and Stillwagon (G & S) article published in our Indicators series.

Overview of Definitions and Methods

The new BLS estimates are the first of a pair of BLS estimates related to green jobs. The current release only considers output-based jobs, which are defined as “producing goods or providing services that benefit the environment or conserve natural resources.”² Using this definition, the BLS identified 333 potentially green industries (out of the 1,193) in the 2007 North American Industry Classification System (NAICS). These 333 industries cover approximately 20 percent of the nation’s employment. The BLS used a sample of 120,000 firms from within these industries to develop its estimates.

One of the major difficulties in developing accurate green jobs estimates is deciding how to handle firms that do not solely produce green goods (for instance, a traditional home builder that also offers weatherization services). In order to address this issue, the BLS asked firms to estimate the percentage of their revenue generated by green activities. The BLS then apportioned the firm’s total employment using this share. For example, if a firm reported that it generated 25 percent of its revenue from green services and employed 200 people, 50 of those employees counted towards the green jobs estimates. As will be discussed in more detail later, this technique/

approach is the greatest strength of the BLS methodology over other methodologies.

The G & S piece relies on four separate definitions of green jobs. The first is the definition established by The Pew Charitable Trusts (Pew). Pew first began by identifying companies receiving venture capital funds designed to support investment in the environment and clean energy technology. This list was supplemented with a list of companies from “green business directories, press coverage, published articles, and databases of government incentive programs for renewable energy.” Using the Standard Industry Classification System (SIC) codes associated with these identified businesses, Pew researchers developed estimates of the number of workers at similarly classified firms. This list was then supplemented using automated Internet searches. Since Pew only considered wholly green SIC codes and wholly green firms, no apportioning strategy was adopted. Pew acknowledges that this lack of apportionment may render their estimates conservative.

The Brookings Institution (Brookings) was responsible for the second definition used by G & S. Brookings built off the SIC codes used by Pew and supplemented these with codes selected by researchers at the University of California at Berkeley. Brookings also supplemented its list with additional companies by using “member lists, certifications, grantees, and other sources.” Brookings attempted to perform an apportioning strategy similar to the one used by the BLS, but the shares which Brookings used to apportion employment were developed on an ad hoc basis and were based on company documents, as available.

The next two definitions were developed by G & S. The first, referred to as the NAICS definition, was developed in conjunction with Moody’s Analytics. It includes 11 industries that had “significant activ-

Table 1. Comparison of Green Jobs Estimates by Various Methodologies

Definition and Latest Year:	Pew 2007	Brookings 2010	NAICS 2009	NETS 2009	BLS 2010
United States	765,060	2,675,545	5,061,230	254,701	3,100,000
New England	51,343	137,360	304,930	10,514	168,749
Connecticut	10,147	29,751	59,770	2,947	39,207
Maine	6,000	12,212	14,710	1,017	13,925
Massachusetts	26,678	63,523	178,030	3,481	79,307
New Hampshire	4,029	12,886	27,420	1,536	11,502
Rhode Island	2,328	9,563	14,230	603	11,924
Vermont	2,161	9,425	10,770	930	12,884

Source: Tracking Jobs in Clean Industries in New England, and U.S. Bureau of Labor Statistics Green Goods and Services press release, March 22nd.

ity in providing products and services used to store and conserve energy, produce energy from renewable and low-carbon sources, treat waste, and conserve and manage water and other natural resources.”³ These codes were then used to derive estimates based on BLS employment data. The second definition, the National Establishment Time-Series Database (NETS) definition, is based on a list developed by researchers at Berkeley (mentioned earlier). Using this set of industries, G & S were able to develop estimates using NETS data. The methodological appendix describing these two definitions does not indicate that G & S used an apportioning strategy.

Comparison and Conclusion

In developing reliable estimates of green jobs, one of the most crucial parts of the process is the ability to apportion jobs within firms that are not completely “green.” Without this ability, researchers are forced to decide between a restrictive definition of green industries by only counting industries that are wholly green, or risk counting jobs that do not support conservation or the environment. A large amount of the variance in estimates can be explained by different tolerances for these types of errors and the use of methods to minimize such errors. The BLS methodology has a unique advantage in this context. The number of industries considered potentially green by the BLS was far larger than the number considered by the NAICS definition proposed by G & S.⁴ However, because the BLS has the ability to apportion jobs, it can afford to cast a wider net without worrying that it will count nongreen jobs as green.

ing each methodology. Nationally, it is apparent that the BLS’s estimates are substantially larger than many of the other estimates, with only the NAICS definition producing higher estimates. It is interesting to note that despite the significantly wider range of industries considered by the BLS, their estimates are lower than those derived under the NAICS definition. The relative smallness of the BLS estimates, notwithstanding the NAICS’ narrower set of industries under consideration, is evidence of the importance of industry selection as well as the ability to apportion jobs.

Comparison of state-level estimates reveals that these differences can be even more pronounced at the state level. As an example, the NAICS methodology produces national employment estimates from 2009 that are 1.6 times larger than the BLS estimates from 2010. The same comparison across the New England states showed that the BLS measure ranged from 0.8 times the size of the NAICS measure in Vermont to 2.4 times the NAICS measure in New Hampshire. In addition, the NAICS estimates for green employment in Massachusetts comprised 58 percent of the green employment in New England, while under the BLS definition this share is closer to 46 percent. It is not completely clear what drives these state level differences, but it is likely related to a relatively high in-state concentration of industries considered green by the NAICS definition.⁵ (Table 1. Comparison of Green Jobs Estimates by Various Methodologies)

Table 1 provides the latest available estimates for the New England states, the region, and the nation us-

Endnotes

¹ For more information regarding the BLS press release, see <http://www.bls.gov/ggs/>. While no historical data is available, new output-based estimates are expected to be released every quarter.

² The second set of estimates, which are slated to be released by early July, will cover process-based jobs. These are jobs “in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources.” The BLS intends to release at least one more year of estimates under this program. Additional estimates detailing wages and employment at the occupation level are expected to be released in September.

³ The word “industries” is used interchangeably to refer to differing levels of details. The NAICS definition captures 11 industries at the 4-digit level, and thus 63 industries at the 6-digit level. The BLS definition captured 333 industries at the 6-digit level. Of the 63 industries considered green in the NAICS methodology, the BLS only counted 38 as green.

⁴ Unfortunately, it is only possible to directly compare the NAICS definition to the BLS methodology because the other definitions use SIC codes.

⁵ In addition to state-level aggregate green employment estimates, the BLS also produces private sector industry level estimates. Please see tables 4, 5, and 6, <http://www.bls.gov/news.release/ggqcew.toc.htm>.