

U.S. Metro Economies

Green Jobs in U.S. Metro Areas
October 2008

Current and Potential Green Jobs in the U.S. Economy

Prepared for:

**The United States
Conference of Mayors
and the Mayors Climate
Protection Center**

Prepared by:



THE UNITED STATES CONFERENCE OF MAYORS





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INTRODUCTION

Dwindling natural resources, growing global demand for energy, climate change – these issues are irrevocably altering our global economy. In this report, the U.S. Conference of Mayors and Global Insight have examined the economic benefits of the 'Green Economy' - that part of economic activity which is devoted to the reduction of fossil fuels, the increase of energy efficiency, and the curtailment of greenhouse gas emissions. The greening of the U.S. economy, of the global economy, is not a dismantling of the past, but a new step forward – the next step in a continuous process of economic growth and transformation that began with industrialization and led us through the high-tech revolution.

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

The remainder of the Introduction presents the background for our research of Green Jobs. In the second section we establish a current count of Green Jobs in the U.S. economy as well as their distribution across metropolitan areas. The third section outlines areas of potential future growth. In the fourth section we forecast potential growth under a set of specific scenarios. The fifth section concludes.

OIL AND GAS CONSUMPTION

As is well known, the United States has a thirst for oil that well exceeds its production. In 1970, when domestic oil production peaked, net imports of foreign oil supplied 21% of total consumption in the United States. By 2007, that figure had risen to 59%, and Global Insight forecasts the import share of consumption to rise to 65% by 2030, unless measures are taken to decrease America's dependence on foreign sources of oil.

The primary driver behind our ever-increasing demand for foreign oil is the transportation sector, namely cars and trucks. According to the Energy Information Administration (EIA) the transportation sector consumed 69% of total petroleum products in 2007.¹ Global Insight estimates that the transportation sector consumed a combined 179 billion gallons of petroleum-based fuels in 2007, and demand for all petroleum products is forecast to grow 7.7% by 2030. That increased demand, combined with lower domestic production, is expected to result in a 27% increase in daily petroleum imports by 2030 over 2007 levels. The transportation sector also accounted for 33% of CO₂ emissions in 2007.

Our increased reliance on foreign oil has led to significant debate on topics such as energy security, foreign policy, and financial stability related to the widening trade deficit. Combining Global Insight's oil import forecast with our expectations for crude oil prices, we are currently forecasting an average outflow of \$240 billion per year, measured in 2006 dollars, to

¹ Annual Energy Review. Energy Information Administration. U.S. Department of Energy. 2007.

pay for imported oil through the year 2030.² That \$240 billion dollars, or 2.3% of Gross Domestic Product, acts very much as a tax on the U.S. economy. Indeed, it is worse than a tax - for the money flows out of the country, not to be re-invested in areas such as health care, education, or infrastructure.

ELECTRICITY DEMAND

Energy demand outside of the transportation sector is also growing, as the population increases and energy-dependent appliances continue to be ever more integrated into homes and businesses. The residential and commercial construction sectors, which use energy for heating and cooling buildings and homes, and electricity for lighting and appliances, are major sources of consumption.

Global Insight projects that by 2030, more than 36 million new homes and 20 billion square feet of commercial building space will be constructed to accommodate new demand and replace older structures. This new construction will generate net additional demand of 790 billion kilowatt hours of electricity by 2030, equivalent to 465 million barrels of oil. Electricity expenditures in 2030 for those net additions are expected to be \$120 billion.

Electricity generation can also have a negative effect on health conditions. Pollution caused by "dirty" power plants (namely, coal-generated utilities), car and truck congestion, and energy-intensive manufacturing plants, all have adverse health effects on the population.

A GREENER ECONOMY

Scientists have almost universally accepted that global climate change is a reality. As a result, many nations are making concerted efforts to reduce the buildup of carbon dioxide (CO₂) and other GHG emissions either by reducing the use of fossil fuels or by finding ways to prevent emissions from entering the atmosphere. While the United States accounts for only 5% of the world's population, it accounts for 20% of worldwide energy usage and 20% of global CO₂ emissions. Becoming a greener economy will enable the U.S. to transition to a lower carbon economy, a step in the direction of preventing the adverse effects of global warming as well as improving public health and stabilizing energy expenditures. It will also create a significant number of new jobs.³


Global Insight has calculated the current total number of Green Jobs in the U.S. across several broad industries. These are industries that have high growth potential as the U.S. becomes a greener economy. We have also calculated potential growth under assumptions for the future of renewable electricity generation, increased energy efficiency for residential and commercial buildings, and increased usage of renewable fuels by the transportation sector.

This data has been broken out at both the national and the metro level. Metropolitan economies are the engines of U.S. economic growth; if investment in green industries is to successfully transform the U.S. economy, it must happen at the metropolitan and local level.

² The average outflow estimate is highly sensitive to expected future oil prices and would be higher if measured in nominal dollars.

³ In this report we project potential job growth of moving toward a lower carbon economy but do not provide a calculation of greenhouse gas reduction.

This investment is critical to our competitiveness in the global economy, to our living standards, indeed, to our future. These investments carry macroeconomic benefits as well – they create jobs, increase productivity, and generate income that creates further jobs. It is a virtuous cycle, an investment that has real returns for both the short and the long term.



CURRENT GREEN JOBS

To construct a count of Green Jobs in the United States we have identified to the finest precision possible the number of workers employed in green activities. We define these as: any activity that generates electricity using renewable or nuclear fuels, agriculture jobs supplying corn or soy for transportation fuel, manufacturing jobs producing goods used in renewable power generation, equipment dealers and wholesalers specializing in renewable energy or energy-efficiency products, construction and installation of energy and pollution management systems, government administration of environmental programs, and supporting jobs in the engineering, legal, research and consulting fields. A full list of the chosen sectors is included in the Appendix.

Green Jobs by Major Category - U.S. Total	
Renewable Power Generation	127,246
Agriculture and Forestry	57,546
Construction & Systems Installation	8,741
Manufacturing	60,699
Equipment Dealers & Wholesalers	6,205
Engineering, Legal, Research & Consulting	418,715
Government Administration	71,900
Total	751,051

U.S. CONFERENCE OF MAYORS – GLOBAL INSIGHT GREEN JOBS INDEX

We estimate that as of 2006 there were just more than 750,000 Green Jobs in the U.S. economy.⁴ More than half of existing jobs were in Engineering, Legal, Research and Consulting, revealing the importance of these indirect jobs to the Green Economy. The second largest category was Renewable Power Generation, with more than 127,000 jobs. Agriculture and Forestry provided a significant contribution of 57,500 jobs.⁵

Green Jobs in 2006 were distributed across the country. Approximately 85% were located in metropolitan areas while the remaining 15% were in non-metropolitan counties. The table to the right reveals the metropolitan areas with the highest numbers of Green Jobs. It is not surprising that the highest ranking areas are some of the largest metropolitan economies in the country, especially considering that over half of the country's Green Jobs are in the engineering, legal, research, and consulting category. These top-ten areas account for 23% of total Green Jobs in the United States.

Top Ten Metropolitan Areas	
MSA	Green Jobs 2006
New York	25,021
Wash DC	24,287
Houston	21,250
Los Angeles	20,136
Boston	19,799
Chicago	16,120
Philadelphia	14,379
San Francisco	13,848
San Diego	11,663
Pittsburgh	9,627

⁴ Data is from the National Establishment Time Series (NETS) database by Walls & Associates. Renewable Power Generation Jobs are not available in NETS. Green Jobs 2006 totals for Metropolitan areas include all categories except Renewable Power Generation.

⁵ We did not include all Corn and Soy Farming jobs in the United States. Approximately 23% of U.S. grown corn is used for ethanol and 16% of soy for biodiesel. We used those shares to scale down the contribution of those sectors.

GREEN JOB POTENTIAL GROWTH

In this section, we examine the fundamental changes to the U.S. economy that are likely to drive future growth in Green Jobs. For renewable resources, the two key areas are in electricity generation and transportation fuels. These two sectors currently use vast amounts of fossil fuels and accordingly are responsible for the bulk of greenhouse gas generation. In addition to using cleaner fuels, there are significant gains to be made in our existing infrastructure by making it more energy efficient. Jobs engaged in developing new technologies to increase energy efficiency and usage of renewable resources, and jobs that install existing technologies, are considered Green Jobs.

RENEWABLE POWER GENERATION - STATUS AND POTENTIAL

Increasing concerns about global warming have brought significant attention to the electric power generation sector. The Environmental Protection Agency estimates that in 2006 electricity generation was responsible for 41% of carbon dioxide emissions in the United States. The sector is a heavy consumer of fossil fuels, using coal to generate approximately half of all electricity in the country. Fortunately, there are a range of alternatives to fossil fuel-based electricity, whose technologies have already made them economically competitive, or are expected to be competitive in the near future. The EIA estimates the electric power sector generated 4,006 billion kilowatt hours of electricity in 2007. Of that total, just 319 billion (8.0%) was generated from renewable sources. The nuclear power industry also created a significant amount of non-fossil fuel power, generating 806 billion kilowatt hours. Of the renewable resources, hydroelectric power was by far the largest contributor. Wind energy, though small in magnitude, was the fastest growing from the previous year.

Wind Power

Wind energy is currently the fastest growing alternative energy source in the country. The EIA of the U.S. Department of Energy estimates that net generation in 2007 was 32.1 billion kilowatt-hours (kWh), a 21% increase from one-year earlier and a near five-fold increase since the start of the decade. Wind generation in 2007 was enough to power more than 2.9 million homes. According to estimates from the American Wind Energy Association (AWEA), 2008 will be another record year. The rapid pace of investment has continued, leading to a 45% increase in capacity, and net generation from wind energy is expected to increase significantly in 2008. This rapid investment has led to an increased share of electricity generation, and it now accounts for 10% of renewa-

U.S. Wind Energy Potential - Top 20 States Billions of Kilowatt Hours Annually			
North Dakota	1,210	Colorado	481
Texas	1,190	New Mexico	435
Kansas	1,070	Idaho	73
South Dakota	1,030	Michigan	65
Montana	1,020	New York	62
Nebraska	868	Illinois	61
Wyoming	747	California	59
Oklahoma	725	Wisconsin	58
Minnesota	657	Maine	56
Iowa	551	Missouri	52

Source: American Wind Energy Assn.

ble electricity generation. In terms of total energy generation for the U.S., though, it maintains an extremely low share, generating just 0.8% of the total in 2007.

Wind energy is growing quickly, but in the U.S. the industry has tapped less than one-half of a percent of wind's potential generation. The AWEA estimates total potential generation at 10,777 billion kWh annually, more than 2.5 times the net amount of electricity generated in the U.S in 2007. Regionally, the highest potential lies in the northern and western parts of the country. North Dakota is ranked highest with 1,210 billion kWh of potential. The four highest ranked states (North Dakota, Texas, Kansas, and South Dakota) are estimated to have a total potential of 4,500 billion kWh, enough to power the entire country. Although the preponderance of wind power potential is in northern and western states, there are some opportunities further east. Maine, New York, and Michigan are also on the list of top-twenty states.

Solar Power

Solar power is an alternative energy source providing opportunity for massive job growth and significantly decreased reliance on fossil fuels, especially in electricity generation. The basic technology has existed for decades, but widespread adoption has not occurred mostly because of high generation costs relative to fossil fuel-based power. Recent advances, however, combined with rising fossil fuel prices have dramatically reduced the average cost per kilowatt hour of generating solar electricity, making it more competitive. Federal and state tax incentives along with regulatory changes have also prompted increased investment.

Solar power can be harnessed in several ways. The two most popular are photovoltaic devices that convert the sun's energy directly to electricity, and solar thermal devices, which concentrate the sun's rays to produce heat, usually for living space or water. In 2007, approximately 606 million kWh were generated from photovoltaic and thermal devices, enough to power nearly 55,000 homes. That is 23% higher than in the year 2000. Investment in new solar capacity surged 21% in 2007, according to estimates from the EIA. Despite the rapid investment in solar technology, it remains an extremely small part of the overall generation infrastructure, generating just 0.2% of alternative-based electricity in 2007.

There is tremendous potential for solar power across the country. Implementation options vary from large centralized generation fields to smaller scale units for neighborhoods or individual homes. The most intense and reliable solar energy is in the southwest, but most areas receive enough sunlight for solar power to be economically

Annual Shipments of Photovoltaic Cells and Modules (Peak Kilowatts)				
Year	U.S. Production	Domestic	Exports	Imports
1997	46,354	12,561	33,793	1,853
1998	50,562	15,069	35,493	1,931
1999	76,787	21,225	55,562	4,784
2000	88,221	19,838	68,382	8,821
2001	97,666	36,310	61,356	10,204
2002	112,090	45,313	66,778	7,297
2003	109,357	48,664	60,693	9,731
2004	181,116	78,346	102,770	47,703
2005	226,916	134,465	92,451	90,981
2006	337,268	206,511	130,757	173,977

Source: EIA Annual Photovoltaic Module/Cell Manufacturers Survey

viable. As with other technologies, potential job growth is available to any city that is able to attract manufacturing firms in the industry. Production within the United States has surged over the past 10 years; in 1997, domestic producers shipped photovoltaic devices totaling 46,354 peak kilowatts of capacity. That year there were more than 1,700 direct employees in the industry. By 2006, production had reached 337,268 peak kilowatts of capacity, a more than seven-fold increase, and employment had risen to 4,000 jobs. The industry actually supports many additional manufacturing jobs, as the end-product producers purchase raw materials and intermediate goods from suppliers. In order for solar energy to attain a more prominent role in domestic energy production, both employment and production would need to increase dramatically.

Hydropower

Hydropower is the largest, most established alternative energy source in the United States, and there is potential for further growth. In 2007, hydroelectric sources generated 246 billion kWh of electricity, enough to power more than 22 million homes. Net generation in 2007 accounted for 77% of alternative net electricity generation and 6.1% of U.S. net electricity generation.

Despite the already large contribution of hydropower to the national electricity infrastructure, there is significant room for it to expand. In a 2006 study, the U.S. Department of Energy identified feasible available potential hydropower projects that would double net generation by this highly efficient and clean source. The best known hydropower projects are massive dams that can power hundreds of thousands of homes; these 'Large Hydro' installations account for just 8% of plants but 80% of hydro power. The greatest future potential, though, is in 'Small Hydro' projects, with capacities ranging from 1 MW to 30 MW. Locations for potential hydropower projects are spread across the country. The DOE indicates that if all potential projects were built, 33 states would more than double their hydropower generation and 41 states would see increases of more than 50%.

Geothermal Power

Geothermal energy is another energy source that is poised to grow and create jobs as our alternative energy infrastructure is further developed. This technology taps into heat and steam in the earth's crust and either uses them directly or to produce electricity. The industry began contributing to the national energy infrastructure in the 1960s and showed rapid gains over the next two decades. From 1970 to 1980, net generation of geothermal electricity increased by a factor of ten. Over the next ten years, net generation tripled. After 1990 though, the industry hit a plateau and then declined as existing plants either lost well pressure or shut down and investment dollars for new projects were diverted to other technologies. In 2007, geothermal sources yielded net generation of 14.9 billion kWh, enough to power 1.3 million homes. That equaled about 4.7% of all renewable generation. There is ample room for expansion of geothermal energy. An assessment by the U.S. Geological Survey concluded that total geothermal potential might as much as ten times higher than current installed capacity.⁶

⁶ USGS Circular 790. Assessment of Geothermal Resources of the United States. 1979.

Biomass Power

Biomass is another group of technologies where additional investment and jobs will help to develop the nation's alternative energy infrastructure. Biomass includes perhaps the oldest form of human energy production, the burning of wood products, which is considered a renewable form of energy because of the short time needed to re-grow the energy source relative to fossil fuels. The modern biomass industry has moved far beyond merely burning logs taken from felled trees; it uses wood waste and other byproducts, including agricultural byproducts, ethanol, paper pellets, used railroad ties, sludge wood, solid byproducts, and old utility poles. Several waste products are also used in biomass, including landfill gas, digester gas, municipal solid waste, and methane.

Much of the biomass used in our economy is used to generate electricity. In 2007, net generation by the biomass electric power sector was 25 billion kWh, enough to power 2.3 million homes. But that figure accounts for less than half of electricity generation from this power source, because it only includes the power sector. Firms in the industrial sector recognize the benefits of capturing the power of waste products and have developed an extensive biomass infrastructure to generate power for their own use. Combining the electric power and industrial sectors (and a small contribution from the commercial sector), net generation from biomass sources totaled more than 55 billion kWh, or the equivalent of electricity for more than 5 million homes.

ENERGY EFFICIENCY – STATUS AND POTENTIAL

Energy Efficiency Standards

Efforts to increase energy efficiency in residential and commercial buildings have great potential to generate new employment opportunities in the rapidly expanding Green Economy. These structures account for a significant portion of total energy consumption in the United States, and dedicated initiatives to improve energy efficiency could significantly impact total electricity consumption.

One of the most comprehensive sets of guidelines, among others, for green building construction and renovation is the United States Green Building Council's LEED® (Leadership in *Energy* and Environmental Design) rating system. Since its initial launch in early 2000, LEED® has quickly emerged as one of the most widely-recognized green building standards in the United States.⁷ The U.S. Green Building Council (USGBC) has also expanded its oversight into the residential sector with a January 2008 release of LEED® for Homes™. The two rating systems feature several overlapping categories that address site selection, material selection, interior environmental quality, and several others. For our analysis, applications of LEED® construction will refer to the category entitled "energy and atmosphere", which focuses directly on energy efficiency in buildings.

⁷ "The Costs and Financial Benefits of Green Building," Report to California's Sustainable Building Task Force, October 2003, pp. 4-6.

Energy Star Program Key Indicators, 2000 and 2006 ⁸			
	Indicator	2000	2006
Qualified Products	Products Sold*	600 million	2 billion+
	Product Categories	40	50+
	Product Models	11,000	40,000
	Public Awareness	40%	68%
	Retailers (partners)	25	900
New Homes	New Homes Built*	25,000	725,000
	Home Builders (partners)	1,600	3,500
Commercial Buildings	Buildings Rated*	4,200	30,000
	Buildings Labeled*	545	3,200
Annual Results	Energy Saved (kWh)	62 billion	170 billion
	Net Savings (USD)	\$5 billion	\$14 billion

* Cumulative Results Since 1992 Program Inception

Within the LEED® energy and atmosphere certification category, many of the criteria are based on guidelines established by the Environmental Protection Agency's Energy Star® program. The primary goal of Energy Star® is to promote the use of energy-efficient products and building practices by providing good information for consumers and business owners about the available energy efficiency strategies.⁹ Energy Star® also provides funding to get new green technologies off the ground.

Energy Efficiency Implementation

Research has shown that both green and conventional construction projects are being bid and worked on by similar contractors, implying that green construction work does not require specialized workers.¹⁰ Instead, one of the key differences between green and conventional renovations is generally the materials used in the process. One problem that currently exists in the industry, however, is a knowledge gap across many contracting firms. Some firms are not fully aware of some green construction techniques or the wide variety of modern materials that can be used in a given renovation project. This makes them unable to effectively educate customers about the energy efficient building options that are available.¹¹ Despite these current limitations, we should not expect to see a new industry populated by a new breed of "green construction workers." As green building technology becomes increasingly popular—due to advocacy programs like Energy Star® — traditional contractors will develop their skill sets and expand their knowledge bases in ways that will allow them to transform large numbers of ordinary buildings into some of the most energy efficient in the world. The existing stock of energy inefficient buildings offers an opportunity to reduce total electricity demand and create jobs for these workers.

⁸ "Energy Star and Other Climate Protection Partnerships, 2006 Annual Report," Environmental Protection Agency (EPA), September 2007, Table 9.

⁹ "Energy Star®—The Power To Protect the Environment Through Energy Efficiency," Environmental Protection Agency (EPA), August 2003, pp. 1-2.

¹⁰ "Job Opportunities for the Green Economy: A State-by-State Picture of Occupations that Gain from Green Investments," Political Economy Research Institute, June 2008.

¹¹ Sigalle Rosner, "Job Implications in Los Angeles' Green Building Sector", University of California at Los Angeles, May 2006.

RENEWABLE TRANSPORTATION FUELS

Transportation Sector Emissions

The U.S. transportation sector has garnered a significant amount of attention recently for several reasons. Like the electricity generation sector, it uses a significant amount of fossil fuels, resulting in greenhouse gas emissions. In fact, the EPA estimates the transportation sector generated 33% of total carbon dioxide emissions in 2007. Total CO₂ emissions in the sector have increased 16% since 1995, and 25% since 1990. Another concern is the source of the energy. The vast majority of transportation fuels are derived from petroleum, a commodity that is increasingly imported from abroad.

Renewable Fuels

The private market and legislators at all levels are increasingly turning to alternative fuels for the transportation sector, specifically to ethanol and biodiesel. National and state energy policies have encouraged increased usage of ethanol blended with gasoline in recent years. That, combined with rising petroleum prices making biofuels more economically palatable, has led

U.S. Motor Fuels Production			
Year	Ethanol (Million Gals)	Gasoline (Million Gals)	Ethanol Share (%)
1997	30,674	2,826,051	1.09
1998	33,453	2,880,521	1.16
1999	34,881	2,895,989	1.20
2000	38,627	2,910,056	1.33
2001	42,028	2,928,050	1.44
2002	50,956	2,986,747	1.71
2003	66,772	2,990,949	2.23
2004	81,009	3,025,128	2.68
2005	92,961	3,035,889	3.06
2006	116,294	3,052,754	3.81
2007	155,263	3,050,614	5.09

Source: EIA

to dramatic growth in their usage. In 1997, ethanol made up just 1.09% of the total gasoline pool. By 2007, that had increased to 5.09%. Ethanol can be produced from any feedstock that has plentiful natural sugars or starch that can be easily converted into sugars. In the United States most ethanol is produced from corn, but other feedstocks are used internationally in rapidly expanding ethanol markets such as Brazil (sugar cane) and Europe (sugar beets). Biodiesel is similar in nature to ethanol, in that it is a fuel substitute derived from crops. Current production and usage is on a much smaller scale in the United States. In the U.S., the predominant feedstock for biodiesel is soybean oil, but in Europe the primary feedstock is rapeseed and sunflower oil, while in Malaysia biodiesel is produced from palm oil. Both ethanol and biodiesel production are growing rapidly in the United States, with heavy investment in both types of facilities in recent years.¹²

Our estimates of potential Green Jobs in the transportation sector are derived from increased production of renewable fuels. There are potentially many more Green Jobs that would result from research, development, and production of new vehicle engine types, reengineered transportation systems, and other changes as policies and investments seek to reduce dependency on imported oil and fossil fuels. These and other changes are not addressed in this report.

¹² We acknowledge there is debate over whether corn-based ethanol and soy-based biodiesel should be considered Green Jobs due to high energy and water usage in the production of crops. We consider them as alternative fuels here because of their ability to reduce reliance on fossil fuels.

GREEN JOBS FORECAST

In order to forecast potential Green Jobs, we've created three separate categories (Renewable Power Generation, Residential and Commercial Retrofitting, and Renewable Transportation Fuels) and performed three forecasts of direct jobs under various scenarios. We then projected indirect jobs in the support categories and combined the results. This overall U.S.-level forecast is then distributed to metropolitan areas according to existing shares of Green Jobs. The MSA-level forecast, then, should not be viewed as our projection of what *will* happen. It shows the growth of new Green Jobs that would occur in metropolitan areas if the current distribution were to remain proportionally unchanged. We fully expect, however, that as with high-technology jobs, metropolitan areas will compete with each other in order to draw the maximum number of Green Jobs to their economies.

RENEWABLE POWER GENERATION

There are efforts at both the federal and state levels to increase the use of renewable resources in electricity generation, and those efforts are the motivation for our scenario here. There are 24 states plus the District of Columbia that have enacted Renewable Portfolio Standards (RPS) mandating a specific share of electricity that must be generated from renewable resources by a certain date. Additionally, there are four states with nonbinding goals for the adoption of renewable energy sources. No two states are quite the same, though, and federal legislators have attempted to pass legislation that would provide a nationwide mandate. Our scenario construction here is similar in nature to federal legislation proposed in 2007 and 2008, but with higher RPS standards and a longer time frame.

Total Power Generation and Renewable Share (Million Kilowatt Hours)				
	2008	2018	2028	2038
Total Net Generation	4,147,850	4,650,350	5,094,400	5,437,350
Total Renewable	124,350	668,550	1,385,050	2,175,000
Wind	38,850	225,200	441,050	652,500
Solar	700	41,300	181,250	435,000
Hydropower*	13,650	67,950	139,650	217,500
Geothermal	15,100	74,150	146,050	217,500
Biomass	56,050	259,950	477,050	652,500
Renewable Share	3%	14%	27%	40%

* Incremental Hydropower added since January 1, 2001

Scenario

The forecast for total net generation comes from the Global Insight Energy Group. Over the 30-year forecast period, total net generation is expected to increase approximately 30% over the 2008 level. In our scenario, we assume 40% of electricity generated in the United States must come from alternative resources. Qualifying alternative resources are wind, solar, geothermal, biomass, and incremental hydropower.¹³ That last resource is defined as hydropower generation capacity added since January 1, 2001, via increased efficiency at

¹³ Nuclear power generation jobs are included in the count of current Green Jobs but are not included in our projection scenario.

existing infrastructure or by investing in new infrastructure. We also assume a distribution among resources within renewable generation. The table above shows our assumed distribution and the total generation from each resource under our assumptions. The distribution by resource is: Wind 30%, Solar 20%, Incremental Hydropower 10%, Geothermal 10%, and Biomass 30%. The trajectory to achieve 40% by the year 2038 is linear, and in the early years closely resembles the paths proposed in federal legislation in 2007 and 2008.

To achieve this increased generation from alternative resources there is clearly a need for increased infrastructure, which in turn will create Green Jobs. The manufacture of necessary materials, construction of facilities, and ongoing operations and management of the infrastructure will all require workers. For each resource, we use two coefficients (manufacturing and construction) that are in terms of "jobs per megawatt hour of newly installed capacity" and a third coefficient (operations) that is in terms of "jobs per megawatt hour of total installed capacity". Green Jobs are created by additions to the infrastructure and by the operation of that infrastructure.¹⁴

Green Jobs Created

For each alternative resource type, there are jobs created in manufacturing the necessary materials, construction of new facilities, and operation and maintenance (O&M) of those facilities. As discussed above, some areas of the country have an advantage for a specific resource type due to more intense sunlight, wind, flowing water, or access to geothermal heat. So construction and O&M jobs will depend on the site of installation. But Green Jobs in the manufacture of materials can be created in any location that is able to draw firms and investment.

The bulk of jobs related to *wind* infrastructure will come in the manufacturing of equipment. The technology of wind electricity is relatively new, but the manufacturing base for its production is very similar to past products. Every state in the country has firms and a labor force with experience making products similar to the blades, gearboxes, brakes, hubs, cooling fans, couplings, drives, cases, bearings, generators, towers and sensors that make up a wind tower. These jobs fall into the familiar durable manufacturing sectors of plastics and rubber, primary metals, fabricated metal products, machinery, computer and electronic products, and electrical equipment. Cities across the country have the capacity to attract job growth in these important manufacturing sectors along the nation's path to a new energy infrastructure.

Many potential manufacturing jobs in the *solar* industry are high tech jobs in the Semiconductor and Related Devices subsector. Nearly one-quarter of existing jobs in this sector are in California, but many other states have a significant presence too. But solar infrastructure also requires components from more traditional sectors such plastics and rubber, fabricated metal products, and electrical equipment. In a national move to develop a larger solar ener-

¹⁴ Coefficients are derived from:

"The Work That Goes Into Renewable Energy". Renewable Energy Project (REPP). November 2001. No. 13.

"Geothermal Industry Employment: Survey Results and Analysis". Geothermal Energy Assn. September 2005.

"California Renewable Technology Market and Benefits Assessment". Electric Power Research Institute (EPRI). November 2001. Report 1001193.

"Solar Manufacturing Activities". Energy Information Administration (EIA). October 2007. Tables 2.17-2.29

gy infrastructure many cities would have the opportunity for job growth across several sectors.

As with other technologies, increased investment in *hydropower* will generate jobs not just in locations where new infrastructure is installed, but also in cities and towns that are best able to attract manufacturing firms to build the necessary generators, turbines, rotors, blades, and other associated parts.

The vast majority of potential *geothermal* sites are in the western part of the country, and most of the potential associated jobs would be created on-site and are similar to existing fossil fuel industry jobs. These include contractors, construction, drilling equipment operators, excavators, and surveyors. But associated manufacturing jobs making mechanical equipment, drilling equipment, and primary metal suppliers could be located anywhere in the country. Also, an expansion of geothermal infrastructure would create jobs for architects, designers, structural engineers, and environmental services consultants that do not need to be located on-site.

Many of the new jobs created by growth in the *biomass* sector would be in waste management, to recover usable wood and waste products as well as in the harvesting and manufacture of raw fuels such as agriculture byproducts as fuels. Additionally there would be manufacturing and construction jobs for new generating facilities and the retrofitting of existing generation facilities for biomass use. Landfills, discarded wood products, and industrial waste are not limited to any particular region, and the generators to burn the fuel can be built anywhere. Biomass thus has the potential to bring Green Jobs to any city in the country.

RESIDENTIAL AND COMMERCIAL RETROFITTING

The next component of our study addresses the potential job growth associated with energy efficiency improvements for residential and commercial buildings. We assume that these efficiency gains will be implemented through a series of building renovations during the forecast period that will incorporate new energy efficient features into existing structures. We do not include the potential job implications of energy efficiency efforts in construction of new green buildings.

Scenario

We assume a reduction of energy consumption by the current stock of residential and commercial structures by 35% over the next three decades. Other research has established that such a reduction is technically feasible. In the forecast, this reduction is distributed in identical increments for each year. This works out to incremental reductions in total annual energy consumption for residential and commercial buildings of approximately 1.2% per year.

Green Jobs Created

In order to translate the implied energy savings into a forecast for job creation, we use coefficients that establish a quantitative relationship between the amount of electricity

saved (in millions of kilowatt-hours) and the resulting number of jobs that would be created in the process.¹⁵ We use these coefficients in conjunction with the energy savings levels dictated by our 35% reduction assumption to project the number of jobs created when the energy efficiency guidelines are implemented. These jobs include the manufacture of necessary products as well as their installation. Retrofitting jobs can encompass a wide variety of different tasks, ranging from the relatively minor to the most complex. Forecasts driven by energy savings are able to incorporate the diversity of renovation jobs that can be done, even accounting for the possibility that efficiency gains could be achieved through a series of varying incremental improvements made over time on individual houses.

In our scenario, reducing current annual energy consumption levels of residential and commercial buildings by 35% over the next 30 years will result in incremental energy savings of more than 32,000 million kilowatt-hours each year. These savings will be divided almost equally across the residential and commercial sectors, with 51% allocated to the former and 49% allocated to the latter. Meanwhile, achieving these annual energy efficiency goals will require nearly 81,000 Green Jobs, approximately 36,000 in the residential sector and 45,000 in commercial.

Power Usage by Current Residential and Commercial Sectors (Million Kilowatt Hours)				
	2008	2018	2028	2038
Power Usage by Sector				
Residential	1,397,250	1,245,450	1,076,850	908,200
Commercial	1,348,150	1,201,700	1,039,000	876,300
Reduction				
Residential		-11%	-23%	-35%
Commercial		-11%	-23%	-35%

Given the nature of building retrofitting work, we believe that the specialty trade contractor component of the construction sector will ultimately benefit the most from these new employment opportunities. Many of the workers required to complete the renovation work and installations of efficiency upgrades fall under the classifications of the traditional construction trades that comprise this category. Ultimately, increasing demand for green building work can be expected to generate new employment opportunities for electricians, HVAC technicians, carpenters, plumbers, roofers, laborers, and insulation workers, among others. Increased demand for green retrofitting work will simultaneously stimulate demand for green building materials, providing additional sources of job gains in associated manufacturing industries.

RENEWABLE TRANSPORTATION FUELS

In an effort to use cleaner fuels and to reduce reliance on foreign petroleum, both the private market and legislators are attempting to increase usage of plant based products such as ethanol and biodiesel. Our forecast is motivated by the expectation that the private market and legislators will continue to push the U.S. transportation sector toward higher usage of non-petroleum fuels.

¹⁵ Coefficients are derived from: "The Size of the U.S. Energy Efficiency Market: Generating a More Complete Picture," American Council for an Energy-Efficient Economy, May 2008, Appendix A.

New Renewable Transportation Fuel Production Cars & Light Trucks (Million Gallons)			
	2018	2028	2038
Total Fuels	149,500	143,500	142,000
Alternative Fuels	34,500	41,000	42,500
Alternative Fuel Share	23%	29%	30%

Scenario

In our scenario we assume that ethanol and biodiesel increase their contribution to transportation fuels during the forecast period. Specifically, we assume that 30% of gasoline and diesel demand for passenger cars and light trucks is satisfied by an alternative by the year 2038. The table above shows total production of both fuels under this assumption in that year.¹⁶ The trajectory of implementation includes consideration of current federal legislation which mandates usage of 36 billion gallons of alternative fuel by the year 2022. Our scenario includes a rapid expansion of production in the early portion of the forecast period and slower growth thereafter to reach the 30% mark by the year 2038.

Green Jobs Created

To achieve this significant increase in the production of alternative fuels, the United States would need to invest heavily in new infrastructure and also greatly expand production of the crops that serve as feedstocks for the fuels. Both, of course, would create new Green Jobs. To estimate the total number of Green Jobs, we apply two coefficients; the first coefficient is an estimate of the number of manufacturing and construction jobs required to build each marginal addition to the ethanol and biodiesel infrastructure. The second coefficient is an estimate of the number of jobs required to grow the feedstocks and operate the facilities for the increased production of the fuels.¹⁷

INDIRECT JOBS

It is clear that the engineering, legal, research, and consulting positions play a major role in the Green Economy, as they account for 56% of current Green Jobs. They have also grown faster than direct Green Jobs since 1990, expanding 52%, compared with 38% growth in direct jobs.

In projecting potential future Green Jobs, though, we remain conservative. Although these indirect jobs have historically grown faster, we do not project them to do the same under our scenarios. This is because we do not expect that each marginal electricity generation job will require another environmental lawyer, for example, and not every retrofitting position will require commensurate growth in research or consulting. Thus, we conservatively project

¹⁶ Our expected total transportation fuel demand comes from a separate Global Insight Inc. forecast

¹⁷ Coefficients are derived from:

"Contribution of the Ethanol Industry to the Economy of the United States". Renewable Fuels Assn. (RFA). February 2008.

a single indirect job added for every two direct jobs in the future, well below the historical pattern.¹⁸

FORECAST RESULTS

Our projections reveal that there is great potential for Green Job growth in the U.S. economy. Under our chosen scenarios, renewable power generation would lead to the generation of more than 1.2 million jobs. The trajectory of job growth is similar to the assumed path of electricity generation. There is relatively smooth growth as the manufacturing sector expands in response to demand for generation equipment, the construction sector expands to install the new equipment, and more jobs are created to operate and maintain the new infrastructure. The 30-year project to retrofit our existing residential and commercial building stock would generate nearly 81,000 jobs. These jobs would retrofit a small percentage of the existing residential and commercial stock of buildings each year and dramatically reduce their energy requirements over the 30-year forecast period.

The push to greatly increase use of alternative transportation fuels would generate nearly 1.5 million new Green Jobs in the U.S. economy. The trajectory of growth for these jobs follows a similar path to the expansion of renewable fuel production, with faster growth in the early forecast period to reach the federal mandate and slower growth thereafter. And the associated growth in engineering, legal, research and consulting positions would be more than 1.4 million new jobs. Overall, we estimate there is the potential for 4.2 million new Green Jobs to be added to the U.S. economy.

Potential New Green Jobs 2038 - U.S. Total			
	2018	2028	2038
Renewable Power Generation	407,200	802,000	1,236,800
Residential & Commercial Retrofitting	81,000	81,000	81,000
Renewable Transportation Fuels	1,205,700	1,437,700	1,492,000
Engineering, Legal, Research & Consulting	846,900	1,160,300	1,404,900
Total	2,540,800	3,481,000	4,214,700

The potential growth in Green Jobs is significant in that it could be the fastest growing segment of the United States economy over the next several decades and dramatically increase its share of total employment. The current count of 750,000 jobs amounts to less than one-half of a percent of total current jobs. The generation of 4.2 million new Green Jobs would more than quintuple the total count and could provide as much as 10% of new job growth over the next 30 years.

It is important to recognize these forecast results depend heavily on our chosen scenarios. Altering any of the assumptions regarding the share of electricity to be generated from alternative resources, the extent of retrofitting, or the share of transportation fuels from renewable sources would obviously change the results.

At the metropolitan level, our analysis shows that there is great potential for Green Job growth in regional economies. The Appendix Tables show the number of new Green Jobs

¹⁸ Government Administration jobs are included in the current count of Green Jobs but are not a source of growth in our projections.

that would be attributed to each metropolitan area assuming that all growth occurs in metro areas and that the current distribution remains unchanged. This should not be interpreted as a forecast for each individual metro; one of the promising aspects of Green Jobs is that the vast majority of them are not restricted to any specific location, so cities and their metro areas across the country can and are expected to compete to attract this job growth.

CONCLUSION

The United States is clearly heading toward a new era in terms of its energy policy, energy infrastructure, and energy-based economy. Elected officials at all levels of government and private markets are both gearing up for massive investments in new alternative fuel technologies and in increased energy efficiency. There are many Green Jobs in our economy already, but that figure stands to grow tremendously over the coming years due to market forces, legislation, and local initiatives, or some combination thereof. The vast majority of Green Jobs are not location dependent, so future Green Jobs will be located in cities and metropolitan areas that are currently the most attractive for investment, or in areas that actively increase their attractiveness relative to competing areas. The good news is that traditional industries continue to be replaced by new opportunities, and we have only just begun to tap into many of them.

APPENDIX

Standard Industrial Classification 8-Digit Codes Used

Renewable Power Generation	Manufacturing
Hydroelectric	Wet corn milling
Nuclear	Corn milling by-products
Other Renewable	Gluten feed and meal
Agriculture and Forestry	Soybean and Vegetable oil mills
Corn Farming	Lecithin, soybean
Soybean Farming	Soybean flour, grits, oil, cake, meal, or powder
Forestry and Reforestation services	Soybean protein concentrates and isolates
Forest management services	Hydrogen
Forest management plans, preparation of	Ethyl alcohol, ethanol
Timber cruising, estimating, and valuation services	Solar heaters and collectors
Engineering, Legal, Research & Consulting	Turbines and turbine generator set units, complete
Environmental law	Gas turbine generator set units, complete
Environmental protection organization	Hydraulic turbine generator set units, complete
Pollution control engineering	Steam turbine generator set units, complete
Building construction consultant	Turbines and turbine generator sets and parts
Heating and ventilation engineering	Gas turbines, mechanical drive
Electrical or electronic engineering	Hydraulic turbines
Energy conservation engineering	Steam engines and turbines
Agricultural and Biological research	Turbo-generators
Biotechnical research, commercial	Wheels, water
Natural resource research	Windmills for pumping water, agricultural
Energy research	Windmills, electric generating
Environmental research	Light emitting diodes
Materials mgmt. consultant	Solar Cells and Photovoltaic devices, solid state
Productivity improvement consultant	Fuel cells, solid state
Environmental remediation	Hydrogen ion equipment, colorimetric
Energy conservation consultant	Environmental controls and testing equipment
Environmental consultant	Solarimeters
Earth science services	Construction & Systems Installation
Geological and Geophysical consultant	Solar energy contractor
Recycling, waste materials	Energy management controls
Environmental cleanup services	Environmental system control installation
Natural resource preservation service	Pollution control equipment installation
Government Administration	Equipment Dealers & Wholesalers
Environmental health program administration	Heating equipment and panels, solar
Environmental agencies	Air pollution control equipment and supplies
Air pollution control agency	Pollution control equipment, air (environmental)
Environmental protection agency	Pollution control equipment, water (environmental)
Environmental quality and control agency	Solar heating equipment

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Alaska		
Anchorage, AK	1,271	10,058
Fairbanks, AK	270	2,138
Alabama		
Anniston-Oxford, AL	119	944
Auburn-Opelika, AL	246	1,949
Birmingham-Hoover, AL	1,970	15,589
Columbus, GA-AL	377	2,986
Decatur, AL	171	1,350
Dothan, AL	65	511
Florence-Muscle Shoals, AL	720	5,695
Gadsden, AL	57	455
Huntsville, AL	2,358	18,654
Mobile, AL	453	3,584
Montgomery, AL	1,341	10,609
Tuscaloosa, AL	214	1,694
Arkansas		
Fayetteville-Springdale-Rogers, AR-MO	247	1,956
Fort Smith, AR-OK	183	1,450
Hot Springs, AR	263	2,085
Jonesboro, AR	54	424
Little Rock-North Little Rock, AR	1,319	10,438
Memphis, TN-MS-AR	1,075	8,507
Pine Bluff, AR	37	291
Texarkana, TX-Texarkana, AR	560	4,430
Arizona		
Flagstaff, AZ	337	2,668
Lake Havasu, AZ	74	587
Phoenix-Mesa-Scottsdale, AZ	3,887	30,753

¹⁹ The New Through 2038 column should not be viewed as our projection of where new Green Jobs *will* be located. It shows the locations of new Green Jobs that would occur if the current distribution were to remain proportionally unchanged. We fully expect that local areas will compete with each other in order to draw the maximum number of Green Jobs to their economies.

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Prescott, AZ	181	1,430
Tucson, AZ	1,310	10,365
Yuma, AZ	52	414
California		
Bakersfield, CA	913	7,222
Chico, CA	237	1,872
El Centro, CA	44	347
Fresno, CA	1,053	8,332
Hanford-Corcoran, CA	14	113
Los Angeles-Long Beach-Santa Ana, CA	20,136	159,321
Madera, CA	58	461
Merced, CA	40	314
Modesto, CA	417	3,303
Napa, CA	239	1,891
Oxnard-Thousand Oaks-Ventura, CA	2,477	19,596
Redding, CA	434	3,434
Riverside-San Bernardino-Ontario, CA	4,224	33,425
Santa Barbara-Santa Maria, CA	777	6,145
Sacramento--Arden-Arcade--Roseville, CA	8,236	65,162
Santa Cruz-Watsonville, CA	813	6,434
San Diego-Carlsbad-San Marcos, CA	11,663	92,285
San Jose-Sunnyvale-Santa Clara, CA	3,810	30,147
Salinas, CA	441	3,493
San Luis Obispo-Paso Robles, CA	446	3,528
Santa Rosa-Petaluma, CA	619	4,897
San Francisco-Oakland-Fremont, CA	13,848	109,570
Stockton, CA	461	3,649
Vallejo-Fairfield, CA	533	4,218
Visalia-Porterville, CA	522	4,128
Yuba City, CA	132	1,044
Colorado		
Boulder, CO	2,402	19,003
Colorado Springs, CO	570	4,511
Denver-Aurora, CO	6,644	52,568
Fort Collins-Loveland, CO	617	4,882
Greeley, CO	272	2,149

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Grand Junction, CO	185	1,462
Pueblo, CO	99	780
Connecticut		
Bridgeport-Stamford-Norwalk, CT	803	6,354
Hartford-West Hartford-East Hartford, CT	8,019	63,448
New Haven-Milford, CT	1,348	10,668
Norwich-New London, CT	485	3,841
District of Columbia		
Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	24,287	192,165
Delaware		
Dover, DE	753	5,957
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	14,379	113,772
Florida		
Cape Coral-Fort Myers, FL	677	5,359
Deltona-Daytona Beach-Ormond Beach, FL	512	4,051
Fort Walton Beach-Crestview-Destin, FL	91	718
Gainesville, FL	632	4,999
Jacksonville, FL	2,091	16,547
Lakeland, FL	429	3,397
Miami-Fort Lauderdale-Miami Beach, FL	6,717	53,145
Naples-Marco Island, FL	280	2,214
Ocala, FL	269	2,132
Orlando-Kissimmee, FL	2,855	22,588
Palm Coast, FL	131	1,037
Palm Bay-Melbourne-Titusville, FL	581	4,600
Panama City-Lynn Haven, FL	212	1,677
Pensacola-Ferry Pass-Brent, FL	936	7,410
Port St. Lucie-Fort Pierce, FL	536	4,239
Punta Gorda, FL	156	1,231
Sarasota-Bradenton-Venice, FL	670	5,303
Tallahassee, FL	568	4,491
Tampa-St. Petersburg-Clearwater, FL	2,935	23,225
Vero Beach, FL	91	719

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Georgia		
Albany, GA	178	1,406
Athens-Clarke County, GA	557	4,411
Atlanta-Sandy Springs-Marietta, GA	7,354	58,186
Augusta-Richmond County, GA-SC	4,461	35,295
Brunswick, GA	90	714
Chattanooga, TN-GA	672	5,313
Columbus, GA-AL	377	2,986
Dalton, GA	137	1,084
Gainesville, GA	139	1,102
Hinesville-Fort Stewart, GA	21	166
Macon, GA	257	2,033
Rome, GA	108	852
Savannah, GA	479	3,793
Valdosta, GA	251	1,988
Warner Robins, GA	90	714
Hawaii		
Honolulu, HI	2,022	15,997
Iowa		
Ames, IA	264	2,089
Cedar Rapids, IA	654	5,176
Davenport-Moline-Rock Island, IA-IL	586	4,638
Des Moines, IA	1,489	11,784
Dubuque, IA	148	1,173
Iowa City, IA	402	3,179
Omaha-Council Bluffs, NE-IA	1,337	10,582
Sioux City, IA-NE-SD	331	2,619
Waterloo-Cedar Falls, IA	405	3,202
Idaho		
Boise City-Nampa, ID	1,962	15,521
Coeur d'Alene, ID	251	1,984
Idaho Falls, ID	417	3,300
Lewiston, ID-WA	70	556
Logan, UT-ID	369	2,919
Pocatello, ID	117	928

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Illinois		
Bloomington-Normal, IL	265	2,094
Champaign-Urbana, IL	965	7,637
Chicago-Naperville-Joliet, IL-IN-WI (MSA)	16,120	127,545
Danville, IL	99	787
Davenport-Moline-Rock Island, IA-IL	586	4,638
Decatur, IL	1,902	15,048
Kankakee-Bradley, IL	441	3,492
Peoria, IL	2,221	17,573
Rockford, IL	280	2,213
Springfield, IL	1,880	14,874
St. Louis, MO-IL	3,436	27,190
Indiana		
Anderson, IN	138	1,091
Bloomington, IN	313	2,475
Chicago-Naperville-Joliet, IL-IN-WI (MSA)	16,120	127,545
Cincinnati-Middletown, OH-KY-IN	4,221	33,398
Columbus, IN	55	432
Elkhart-Goshen, IN	214	1,696
Evansville, IN-KY	574	4,540
Fort Wayne, IN	437	3,461
Indianapolis, IN	8,909	70,491
Kokomo, IN	381	3,012
Lafayette, IN	931	7,365
Louisville, KY-IN	1,827	14,456
Michigan City-La Porte, IN	143	1,131
Muncie, IN	62	494
South Bend-Mishawaka, IN-MI	405	3,205
Terre Haute, IN	197	1,562
Kansas		
Kansas City, MO-KS	2,522	19,953
Lawrence, KS	176	1,395
St. Joseph, MO-KS	388	3,073
Topeka, KS	213	1,683
Wichita, KS	669	5,295

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Kentucky		
Bowling Green, KY	135	1,064
Cincinnati-Middletown, OH-KY-IN	4,221	33,398
Clarksville, TN-KY	259	2,051
Elizabethtown, KY	113	897
Evansville, IN-KY	574	4,540
Huntington-Ashland, WV-KY-OH	314	2,487
Lexington-Fayette, KY	643	5,088
Louisville, KY-IN	1,827	14,456
Owensboro, KY	424	3,355
Louisiana		
Alexandria, LA	150	1,191
Baton Rouge, LA	3,470	27,458
Houma-Bayou Cane-Thibodaux, LA	156	1,233
Lake Charles, LA	250	1,975
Lafayette, LA	589	4,659
Monroe, LA	126	994
New Orleans-Metairie-Kenner, LA	1,514	11,981
Shreveport-Bossier City, LA	396	3,136
Massachusetts		
Barnstable Town, MA	1,680	13,293
Boston-Cambridge-Quincy, MA-NH (MSA)	19,799	156,660
Pittsfield, MA	405	3,208
Providence-New Bedford-Fall River, RI-MA	1,961	15,517
Springfield, MA	901	7,129
Worcester, MA	2,090	16,537
Maryland		
Baltimore-Towson, MD	5,910	46,763
Cumberland, MD-WV	24	186
Hagerstown-Martinsburg, MD-WV	116	920
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	14,379	113,772
Salisbury, MD	83	653
Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	24,287	192,165
<i>Sum of Metro Area</i>		

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Maine		
Bangor, ME	458	3,623
Lewiston-Auburn, ME	157	1,246
Portland-South Portland-Biddeford, ME	954	7,545
Michigan		
Ann Arbor, MI	1,288	10,193
Battle Creek, MI	66	525
Bay City, MI	137	1,086
Detroit-Warren-Livonia, MI	4,884	38,642
Flint, MI	345	2,731
Grand Rapids-Wyoming, MI	655	5,184
Holland-Grand Haven, MI	1,189	9,408
Jackson, MI	172	1,364
Kalamazoo-Portage, MI	431	3,410
Lansing-East Lansing, MI	1,835	14,522
Monroe, MI	102	807
Muskegon-Norton Shores, MI	64	509
Niles-Benton Harbor, MI	884	6,992
Saginaw-Saginaw Township North, MI	157	1,241
South Bend-Mishawaka, IN-MI	405	3,205
Minnesota		
Duluth, MN-WI	472	3,734
Fargo, ND-MN	251	1,989
Grand Forks, ND-MN	573	4,531
La Crosse, WI-MN	291	2,301
Minneapolis-St. Paul-Bloomington, MN-WI	4,811	38,063
Rochester, MN	309	2,445
St. Cloud, MN	318	2,519
Missouri		
Columbia, MO	190	1,505
Fayetteville-Springdale-Rogers, AR-MO	247	1,956
Jefferson City, MO	2,080	16,458
Joplin, MO	154	1,215
Kansas City, MO-KS	2,522	19,953
Springfield, MO	300	2,371

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
St. Joseph, MO-KS	388	3,073
St. Louis, MO-IL	3,436	27,190
Mississippi		
Gulfport-Biloxi, MS	268	2,122
Hattiesburg, MS	158	1,252
Jackson, MS	803	6,355
Memphis, TN-MS-AR	1,075	8,507
Pascagoula, MS	92	727
Montana		
Billings, MT	262	2,073
Great Falls, MT	148	1,171
Missoula, MT	572	4,526
North Carolina		
Asheville, NC	452	3,574
Burlington, NC	82	649
Charlotte-Gastonia-Concord, NC-SC	1,932	15,285
Durham, NC	5,645	44,663
Fayetteville, NC	157	1,245
Goldsboro, NC	105	828
Greensboro-High Point, NC	764	6,044
Greenville, NC	158	1,246
Hickory-Lenoir-Morganton, NC	206	1,630
Jacksonville, NC	28	219
Raleigh-Cary, NC	3,315	26,226
Rocky Mount, NC	166	1,315
Virginia Beach-Norfolk-Newport News, VA-NC	2,164	17,126
Wilmington, NC	297	2,353
Winston-Salem, NC	867	6,857
North Dakota		
Bismarck, ND	237	1,878
Fargo, ND-MN	251	1,989
Grand Forks, ND-MN	573	4,531
Nebraska		

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Lincoln, NE	926	7,325
Omaha-Council Bluffs, NE-IA	1,337	10,582
Sioux City, IA-NE-SD	331	2,619
New Hampshire		
Boston-Cambridge-Quincy, MA-NH (MSA)	19,799	156,660
Manchester-Nashua, NH	486	3,843
New Jersey		
Allentown-Bethlehem-Easton, PA-NJ	1,110	8,781
Atlantic City, NJ	281	2,227
New York-Nrthrn New Jersey-Lng Islnd, NY-NJ-PA (MSA)	25,021	197,971
Ocean City, NJ	76	601
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	14,379	113,772
Trenton-Ewing, NJ	8,788	69,535
Vineland-Millville-Bridgeton, NJ	127	1,008
New Mexico		
Albuquerque, NM	2,297	18,177
Farmington, NM	92	726
Las Cruces, NM	354	2,802
Santa Fe, NM	1,269	10,044
Nevada		
Carson City, NV	187	1,480
Las Vegas-Paradise, NV	2,126	16,821
Reno-Sparks, NV	679	5,372
New York		
Albany-Schenectady-Troy, NY	9,567	75,694
Binghamton, NY	330	2,607
Buffalo-Niagara Falls, NY	2,017	15,959
Elmira, NY	52	411
Glens Falls, NY	224	1,774
Ithaca, NY	454	3,589
Kingston, NY	271	2,145
New York-Nrthrn New Jersey-Lng Islnd, NY-NJ-PA (MSA)	25,021	197,971
Poughkeepsie-Newburgh-Middletown, NY	1,001	7,918

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Rochester, NY	1,909	15,108
Syracuse, NY	1,344	10,634
Utica-Rome, NY	220	1,738
Ohio		
Akron, OH	947	7,496
Canton-Massillon, OH	634	5,019
Cincinnati-Middletown, OH-KY-IN	4,221	33,398
Cleveland-Elyria-Mentor, OH	2,952	23,357
Columbus, OH	3,938	31,163
Dayton, OH	1,180	9,334
Huntington-Ashland, WV-KY-OH	314	2,487
Lima, OH	225	1,777
Mansfield, OH	146	1,156
Parkersburg-Marietta-Vienna, WV-OH	113	896
Sandusky, OH	52	410
Springfield, OH	84	662
Toledo, OH	1,298	10,272
Weirton-Steubenville, WV-OH	47	369
Wheeling, WV-OH	277	2,194
Youngstown-Warren-Boardman, OH-PA	456	3,604
Oklahoma		
Fort Smith, AR-OK	183	1,450
Lawton, OK	28	222
Oklahoma City, OK	2,016	15,951
Tulsa, OK	1,190	9,416
Oregon		
Bend, OR	642	5,080
Corvallis, OR	783	6,198
Eugene-Springfield, OR	993	7,853
Medford, OR	1,109	8,775
Portland-Vancouver-Beaverton, OR-WA	6,714	53,122
Salem, OR	1,815	14,360
Pennsylvania		
Allentown-Bethlehem-Easton, PA-NJ	1,110	8,781

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Altoona, PA	63	500
Erie, PA	360	2,850
Harrisburg-Carlisle, PA	1,898	15,021
Johnstown, PA	100	792
Lancaster, PA	433	3,429
Lebanon, PA	130	1,031
New York-Nrthrn New Jersey-Lng Islnd, NY-NJ-PA (MSA)	25,021	197,971
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	14,379	113,772
Pittsburgh, PA	9,627	76,174
Reading, PA	473	3,741
Scranton--Wilkes-Barre, PA	400	3,162
State College, PA	167	1,324
Williamsport, PA	79	626
York-Hanover, PA	899	7,111
Youngstown-Warren-Boardman, OH-PA	456	3,604
Rhode Island		
Providence-New Bedford-Fall River, RI-MA	1,961	15,517
South Carolina		
Anderson, SC	154	1,216
Augusta-Richmond County, GA-SC	4,461	35,295
Charleston-North Charleston, SC	1,775	14,044
Charlotte-Gastonia-Concord, NC-SC	1,932	15,285
Columbia, SC	2,155	17,049
Florence, SC	278	2,198
Greenville, SC	3,954	31,287
Myrtle Beach-Conway-North Myrtle Beach, SC	230	1,819
Spartanburg, SC	144	1,138
Sumter, SC	169	1,335
South Dakota		
Rapid City, SD	185	1,463
Sioux City, IA-NE-SD	331	2,619
Sioux Falls, SD	354	2,800
Tennessee		
Chattanooga, TN-GA	672	5,313

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Clarksville, TN-KY	259	2,051
Cleveland, TN	40	319
Jackson, TN	25	197
Johnson City, TN	444	3,515
Kingsport-Bristol-Bristol, TN-VA	214	1,691
Knoxville, TN	6,755	53,450
Memphis, TN-MS-AR	1,075	8,507
Morristown, TN	318	2,515
Nashville-Davidson--Murfreesboro, TN-AR	3,250	25,712
Texas		
Abilene, TX	116	920
Amarillo, TX	405	3,201
Austin-Round Rock, TX	6,059	47,937
Beaumont-Port Arthur, TX	747	5,912
Brownsville-Harlingen, TX	238	1,885
College Station-Bryan, TX	2,520	19,941
Corpus Christi, TX	654	5,178
Dallas-Fort Worth-Arlington, TX	8,851	70,029
El Paso, TX	707	5,597
Houston-Sugar Land-Baytown, TX	21,250	168,136
Killeen-Temple-Fort Hood, TX	139	1,102
Laredo, TX	184	1,456
Longview, TX	537	4,249
Lubbock, TX	305	2,410
McAllen-Edinburg-Mission, TX	470	3,716
Midland, TX	284	2,247
Odessa, TX	227	1,796
San Angelo, TX	135	1,068
San Antonio, TX	2,220	17,565
Sherman-Denison, TX	54	426
Texarkana, TX-Texarkana, AR	560	4,430
Tyler, TX	306	2,421
Victoria, TX	38	304
Waco, TX	164	1,299
Wichita Falls, TX	74	586
Utah		

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Logan, UT-ID	369	2,919
Ogden-Clearfield, UT	603	4,774
Provo-Orem, UT	354	2,799
Salt Lake City, UT	3,040	24,053
St. George, UT	26	208
Virginia		
Blacksburg-Christiansburg-Radford, VA	313	2,477
Charlottesville, VA	263	2,083
Danville, VA	25	201
Harrisonburg, VA	178	1,411
Kingsport-Bristol-Bristol, TN-VA	214	1,691
Lynchburg, VA	1,600	12,659
Richmond, VA	1,952	15,443
Roanoke, VA	465	3,679
Virginia Beach-Norfolk-Newport News, VA-NC	2,164	17,126
Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	24,287	192,165
Winchester, VA-WV	55	439
Vermont		
Burlington-South Burlington, VT	586	4,637
Washington		
Bellingham, WA	317	2,506
Bremerton-Silverdale, WA	272	2,154
Kennewick-Richland-Pasco, WA	979	7,750
Lewiston, ID-WA	70	556
Longview, WA	521	4,122
Mount Vernon-Anacortes, WA	229	1,813
Olympia, WA	630	4,988
Portland-Vancouver-Beaverton, OR-WA	6,714	53,122
Seattle-Tacoma-Bellevue, WA	6,257	49,510
Spokane, WA	648	5,128
Wenatchee, WA	131	1,037
Yakima, WA	470	3,718
Wisconsin		
Appleton, WI	299	2,369

Current and Potential Green Jobs by Metropolitan Area¹⁹

	Existing 2006	New Through 2038
Chicago-Naperville-Joliet, IL-IN-WI (MSA)	16,120	127,545
Duluth, MN-WI	472	3,734
Eau Claire, WI	224	1,772
Fond du Lac, WI	89	706
Green Bay, WI	637	5,041
Janesville, WI	146	1,153
La Crosse, WI-MN	291	2,301
Madison, WI	3,016	23,861
Milwaukee-Waukesha-West Allis, WI	1,979	15,662
Minneapolis-St. Paul-Bloomington, MN-WI	4,811	38,063
Oshkosh-Neenah, WI	213	1,682
Racine, WI	99	785
Sheboygan, WI	160	1,267
Wausau, WI	155	1,223
West Virginia		
Charleston, WV	548	4,333
Cumberland, MD-WV	24	186
Hagerstown-Martinsburg, MD-WV	116	920
Huntington-Ashland, WV-KY-OH	314	2,487
Morgantown, WV	240	1,903
Parkersburg-Marietta-Vienna, WV-OH	113	896
Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	24,287	192,165
Weirton-Steubenville, WV-OH	47	369
Wheeling, WV-OH	277	2,194
Winchester, VA-WV	55	439
Wyoming		
Casper, WY	196	1,551
Cheyenne, WY	198	1,564

Top 100 Current and Potential Green Jobs Ranked by Metropolitan Area

		Existing 2006	New Through 2038
1	New York-Nrthrn New Jersey-Lng Islnd, NY-NJ-PA (MSA)	25,021	197,971
2	Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	24,287	192,165
3	Houston-Sugar Land-Baytown, TX	21,250	168,136
4	Los Angeles-Long Beach-Santa Ana, CA	20,136	159,321
5	Boston-Cambridge-Quincy, MA-NH (MSA)	19,799	156,660
6	Chicago-Naperville-Joliet, IL-IN-WI (MSA)	16,120	127,545
7	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	14,379	113,772
8	San Francisco-Oakland-Fremont, CA	13,848	109,570
9	San Diego-Carlsbad-San Marcos, CA	11,663	92,285
10	Pittsburgh, PA	9,627	76,174
11	Albany-Schenectady-Troy, NY	9,567	75,694
12	Indianapolis, IN	8,909	70,491
13	Dallas-Fort Worth-Arlington, TX	8,851	70,029
14	Trenton-Ewing, NJ	8,788	69,535
15	Sacramento--Arden-Arcade--Roseville, CA	8,236	65,162
16	Hartford-West Hartford-East Hartford, CT	8,019	63,448
17	Atlanta-Sandy Springs-Marietta, GA	7,354	58,186
18	Knoxville, TN	6,755	53,450
19	Miami-Fort Lauderdale-Miami Beach, FL	6,717	53,145
20	Portland-Vancouver-Beaverton, OR-WA	6,714	53,122
21	Denver-Aurora, CO	6,644	52,568
22	Seattle-Tacoma-Bellevue, WA	6,257	49,510
23	Austin-Round Rock, TX	6,059	47,937
24	Baltimore-Towson, MD	5,910	46,763
25	Durham, NC	5,645	44,663
26	Detroit-Warren-Livonia, MI	4,884	38,642
27	Minneapolis-St. Paul-Bloomington, MN-WI	4,811	38,063
28	Augusta-Richmond County, GA-SC	4,461	35,295
29	Riverside-San Bernardino-Ontario, CA	4,224	33,425
30	Cincinnati-Middletown, OH-KY-IN	4,221	33,398
31	Greenville, SC	3,954	31,287
32	Columbus, OH	3,938	31,163
33	Phoenix-Mesa-Scottsdale, AZ	3,887	30,753
34	San Jose-Sunnyvale-Santa Clara, CA	3,810	30,147
35	Baton Rouge, LA	3,470	27,458
36	St. Louis, MO-IL	3,436	27,190
37	Raleigh-Cary, NC	3,315	26,226
38	Nashville-Davidson--Murfreesboro, TN-AR	3,250	25,712
39	Salt Lake City, UT	3,040	24,053
40	Madison, WI	3,016	23,861

Top 100 Current and Potential Green Jobs Ranked by Metropolitan Area

		Existing 2006	New Through 2038
41	Cleveland-Elyria-Mentor, OH	2,952	23,357
42	Tampa-St. Petersburg-Clearwater, FL	2,935	23,225
43	Orlando-Kissimmee, FL	2,855	22,588
44	Kansas City, MO-KS	2,522	19,953
45	College Station-Bryan, TX	2,520	19,941
46	Oxnard-Thousand Oaks-Ventura, CA	2,477	19,596
47	Boulder, CO	2,402	19,003
48	Huntsville, AL	2,358	18,654
49	Albuquerque, NM	2,297	18,177
50	Peoria, IL	2,221	17,573
51	San Antonio, TX	2,220	17,565
52	Virginia Beach-Norfolk-Newport News, VA-NC	2,164	17,126
53	Columbia, SC	2,155	17,049
54	Las Vegas-Paradise, NV	2,126	16,821
55	Jacksonville, FL	2,091	16,547
56	Worcester, MA	2,090	16,537
57	Jefferson City, MO	2,080	16,458
58	Honolulu, HI	2,022	15,997
59	Buffalo-Niagara Falls, NY	2,017	15,959
60	Oklahoma City, OK	2,016	15,951
61	Milwaukee-Waukesha-West Allis, WI	1,979	15,662
62	Birmingham-Hoover, AL	1,970	15,589
63	Boise City-Nampa, ID	1,962	15,521
64	Providence-New Bedford-Fall River, RI-MA	1,961	15,517
65	Richmond, VA	1,952	15,443
66	Charlotte-Gastonia-Concord, NC-SC	1,932	15,285
67	Rochester, NY	1,909	15,108
68	Decatur, IL	1,902	15,048
69	Harrisburg-Carlisle, PA	1,898	15,021
70	Springfield, IL	1,880	14,874
71	Lansing-East Lansing, MI	1,835	14,522
72	Louisville, KY-IN	1,827	14,456
73	Salem, OR	1,815	14,360
74	Charleston-North Charleston, SC	1,775	14,044
75	Barnstable Town, MA	1,680	13,293
76	Lynchburg, VA	1,600	12,659
77	New Orleans-Metairie-Kenner, LA	1,514	11,981
78	Des Moines, IA	1,489	11,784
79	New Haven-Milford, CT	1,348	10,668
80	Syracuse, NY	1,344	10,634

Top 100 Current and Potential Green Jobs Ranked by Metropolitan Area

		Existing 2006	New Through 2038
81	Montgomery, AL	1,341	10,609
82	Omaha-Council Bluffs, NE-IA	1,337	10,582
83	Little Rock-North Little Rock, AR	1,319	10,438
84	Tucson, AZ	1,310	10,365
85	Toledo, OH	1,298	10,272
86	Ann Arbor, MI	1,288	10,193
87	Anchorage, AK	1,271	10,058
88	Santa Fe, NM	1,269	10,044
89	Tulsa, OK	1,190	9,416
90	Holland-Grand Haven, MI	1,189	9,408
91	Dayton, OH	1,180	9,334
92	Allentown-Bethlehem-Easton, PA-NJ	1,110	8,781
93	Medford, OR	1,109	8,775
94	Memphis, TN-MS-AR	1,075	8,507
95	Fresno, CA	1,053	8,332
96	Poughkeepsie-Newburgh-Middletown, NY	1,001	7,918
97	Eugene-Springfield, OR	993	7,853
98	Kennewick-Richland-Pasco, WA	979	7,750
99	Champaign-Urbana, IL	965	7,637
100	Portland-South Portland-Biddeford, ME	954	7,545



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