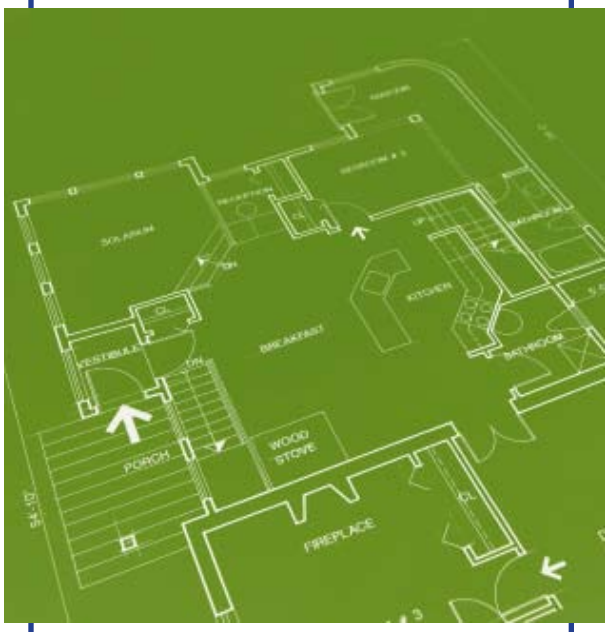
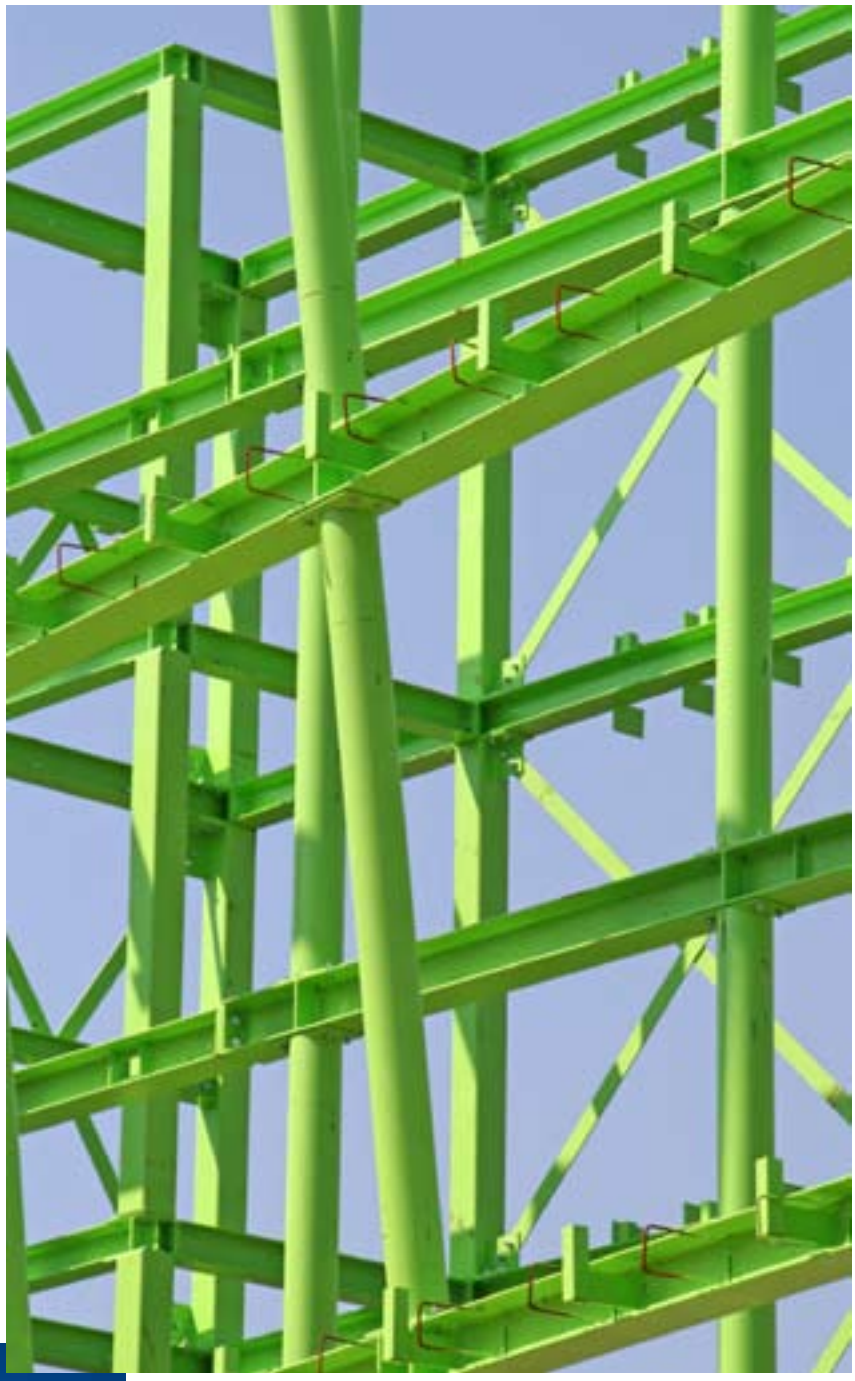
Buffalo Niagara

Where Industry



Creates Energy



A comprehensive report on the green economy & Western New York's alternative-energy manufacturing potential

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Keith W. Rabin, President, July 2009

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BUFFALO NIAGARA:
WHERE INDUSTRY CREATES ENERGY

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Buffalo Niagara:

Where Industry Creates Energy

Foreword

The U.S. Conference of Mayors estimated in 2006 that the number of green jobs in the Buffalo Niagara region of Western New York (Buffalo Niagara*) could rise from an estimated 2,017 in 2006 to 15,959 in 2038. Recent trends and developments, however, indicate growth will be much faster as nations come to understand the accelerating importance of green energy. These technologies promote energy independence, lessen environmental degradation and stimulate demand during an increasingly severe global slowdown. Even more vital, they constitute the only means to provide the resources needed to sustain development and growth in consumption in the emerging markets that are likely to drive global growth in the 21st century.

This report attempts to define the green economy and to examine opportunities for job creation with an emphasis on manufacturing opportunities in Buffalo Niagara.

The renewable-energy industry is usually divided into five main sectors: wind, solar, hydro, biomass and geothermal. Some analysts also incorporate nuclear power within a wider category of alternative energy. What these sectors have in common is that they all produce energy, on a large and small scale. There are also non-energy producing sectors that have potential to create jobs. This includes the smart grid and energy storage, transportation, green building and solid waste management.

To generate jobs in the new green economy it is important to look—not only at the technologies—but also at related equipment and component manufacturing across entire supply and value chains. A value chain encompasses the steps needed to create related products and the materials, products, people and services needed in the process. The resulting end products—in particular those that promote diversification toward cleaner energy sources—create a demand for goods and services. This will create additional job possibilities in a multiplier effect across each link of the chain.

This report attempts to define the green economy and to examine opportunities for job creation with an emphasis on manufacturing opportunities in Buffalo Niagara.

Buffalo Niagara offers a number of advantages to business-creating green jobs. Its industrial capacity, proximity to Canada and highly populated Northeast and Midwest U.S. markets, Great Lakes location, transportation infrastructure and capacity, cost structure, academic excellence, labor force and manufacturing heritage all provide distinct advantages to green companies.

By matching the needs of the green economy to the region's assets, opportunities for job growth can be identified. These opportunities can then be examined in terms of strengths, opportunities and the competitive landscape. This will help to define strategies that can attract new growth as well as the programmatic recommendations to position Buffalo Niagara as a desirable "Center for Excellence" where "Industry Creates Energy."

Bringing new green jobs to, and increasing economic activity within, Buffalo Niagara will position the region to participate in the development of the new green and renewable energy products that will increasingly drive economic growth in the years to come.

**For the purposes of this study, Buffalo Niagara is defined as comprising the eight counties of western New York, including Allegany, Chautauqua, Cattaraugus, Erie, Genesee, Niagara, Orleans and Wyoming. The U.S. Conference of Mayors report cited, however, defines the region as Allegany, Chautauqua, Erie and Niagara counties.*

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Executive Summary

BUFFALO NIAGARA: WHERE INDUSTRY CREATES ENERGY

By KWR International, Inc.
for Buffalo Niagara Enterprise
July 2009

RENEWABLE ENERGY WILL BE A KEY DRIVER OF GROWTH IN THE 21ST CENTURY

Buffalo Niagara stands at the threshold of a major opportunity to apply its industrial capacity within the renewable energy sectors that will increasingly drive global economic growth in coming decades. With its diverse manufacturing heritage and skilled work force, the region can become a key asset in U.S. efforts to expand its competitive presence in emerging green industries and technologies. This will create thousands of new jobs and position the region as a laboratory for the rejuvenation of America's rust belt cities. This opportunity builds off the region's existing strengths to help create a transformative and supporting business environment where "Industry Creates Energy."

For more than 20 years, there have been proponents for a new "green" economy who advocate less out of environmental concern than as a trigger for an economic transformation that could rival the industrial and technology revolutions of the late 19th and 20th centuries. The high volatility of fossil fuel costs, excessive reliance on energy sources in politically insecure areas of the world and environmental issues, such as climate change, are all increasing interest in this sector.

The economic collapse of 2008 is accelerating this trend. U.S. and foreign governments—on national as well as state and local levels—are pledging unprecedented public spending on green jobs and technologies to drive innovation and stimulate economic activity during troubled times. This promises a leveraging effect beyond the actual investment—providing incentives and helping green technologies to gain the scale and improvements needed to increase usage and commercial viability. In some ways the benefits can be compared to those obtained from the NASA space program of the 1960-1970s, which also could not be, at least initially, justified on economic factors alone.

While some are skeptical, even critical of the transformative nature of the green jobs movement, the magnitude of global government spending being proposed (nearly 1 trillion dollars in the U.S. alone) means this is a phenomenon that cannot be ignored. For this reason, cities and regions across the U.S. and Canada are now defining the role they can play in the accelerating transformation toward a new green economy.

GREEN JOBS ARE LARGELY IN MANUFACTURING, TRADE & RELATED SERVICE INDUSTRIES

While research and development in alternate energy technologies plays a part in green job creation, an equally important part is the repurposing of existing manufacturing techniques and skills to the creation of products required in the new green economy.

A University of California-Berkeley report that reviewed 13 studies examining the impact of renewable energy on job creation found renewable energy and efficiency improvements create twice as many jobs per unit of energy and per dollar

invested than traditional fossil fuel-based generating technologies. The Center for American Progress, a think tank that has supplied a number of President Barack Obama's top administration officials, said "These jobs are impossible to offshore. Making buildings more energy efficient, constructing mass transit lines, installing solar panels and wind turbines, expanding public green space, growing and refining biofuels—all this work must take place right here in America, in both urban and rural areas."

For example, large turbines that harness wind energy call for technical expertise from sheet metal workers, machinists, engineers, mechanics, welders, millwrights, construction workers and maintenance people as well as sales, management and administrative support. Because energy costs are anticipated to remain volatile and rise higher over time, the need for conservation also creates a market for energy efficiency. This necessitates new construction and retrofits, which require architects, engineers, roofers, insulators, carpenters, inspectors, truck drivers and other support services.

Green jobs, therefore, require exactly the skills and facilities that have been idled in Buffalo Niagara.

GOVERNMENT STIMULUS TO ACCELERATE DEVELOPMENT OF GREEN JOBS & INDUSTRIES

At the start of 2009, the Obama administration and the U.S. government authorized the spending of more than $150 billion in renewable energy to enhance U.S. competitiveness in these emerging growth sectors and to create or retain up to 5 million green jobs in an economy that had plunged into a serious worldwide recession.

Buffalo Niagara has the potential to capture a significant portion of the green jobs and development activities that result from major government investments, which stimulate further private sector investment in technologies, goods and services. These investments are driven by the need to preserve the environment and provide an alternative to U.S. dependence on fossil fuels.

STARTING POINT FOR MOST GREEN INDUSTRIES IS GENERATION OF RENEWABLE ENERGY

There are five main renewable-energy generation sectors:

•Wind is the most rapidly growing renewable-energy source and the most recognizable. Naturally occurring wind currents are used to spin wind turbines to generate power.

While some are skeptical, even critical of the transformative nature of the green jobs movement, the magnitude of global government spending being proposed (nearly 1 trillion dollars in the U.S. alone) means this is a phenomenon that cannot be ignored.

•Solar is energy collected from sunlight used to generate electricity via photovoltaic cells. The cells can be in large arrays for supplying power to the national grid, or in small rooftop units that power just one building.

•Hydropower is where flowing water is used to spin turbines connected to generators. Niagara Falls and Hoover Dam are well known hydro-energy projects, but there is strong interest in hydrokinetic energy, which uses river flows and coastal currents to spin submerged turbines to create energy.

•Geothermal is power generated by geysers fueled by heat located deep within the earth's core. Geothermal heat pumps can also be used in small-scale residential and commercial buildings.

•Biomass is energy created by burning organic waste, using methane gas generated from landfills or even harnessing energy produced by algae. Biomass includes alternative fuel creation such as ethanol for use in vehicles.

•Nuclear energy is created by nuclear fission within a nuclear reactor. Nuclear is not usually classified as a renewable or alternative energy source, even though it does not rely on fossil fuels. It stands apart largely because of perceived environmental concerns.

The renewable energy industry also encompasses sectors that are not energy producing, including:

•Energy Transmission and Storage: The use of renewable energy will increase the need to replace America's aging electrical distribution system with a "smart grid" that combines alternative and fossil fuel energies to deliver consistently and efficiently to meet peak demands. Since some renewable energy sources such as wind and solar are intermittent, the smart grid also requires new methods of bulk energy storage.

•Green Buildings: The creation of energy-efficient buildings will be required in the new green economy

since energy costs are expected to rise. Energy efficient buildings reduce overall demand and the detrimental impacts on the environment that accompany nearly all types of energy generation. The industry creates good jobs with relatively short vocational training and in particular can provide job opportunities in the poverty pockets of American cities. As more and more communities across the nation revise building codes to require that rehabilitation and new construction incorporate energy conservation, an immediate demand is created that generates new jobs.

•Transportation: America is moving rapidly toward alternative (nonpetroleum) fuel vehicles. These include biofuels (ethanol, methanol and other fuels made from plants oil or animal fat); compressed natural gas; electricity stored in batteries and hydrogen fuel cells.

•Waste Remediation/Recycling: Effective control of the generation, storage, treatment, recycling and reuse, transport, recovery and disposal of hazardous wastes is of paramount importance for sustainable development. New industries are being developed around this need as well as new opportunities for traditional manufacturing.

BUFFALO NIAGARA CAN PROVIDE CAPACITY ACROSS SECTORS IN RENEWABLE ENERGY

Buffalo Niagara is defined as New York's westernmost counties: Allegany, Chautauqua, Cattaraugus, Erie, Genesee, Niagara, Orleans and Wyoming.

The key job-creation opportunities for the region are found in the supply and value chain of all renewable energy sectors. In fact, it is the region's unique ability to participate in the development, design and manufacture of component parts across all sectors that gives it a potential competitive edge in attracting green economy jobs.

The supply chain in renewable energy can be significant. Wind energy, for example, uses large turbines with over 8,000 component parts. Buffalo Niagara already has in its counties established firms and skilled workers with experience in 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.

In both the academic and private sectors, the region also has ongoing programs that are related, directly or indirectly, to the research and development required to advance the technologies and design the products needed in a green economy.

Solar energy, as another example, is a little less manufacturing intensive, but it still covers nearly 25 individual manufacturing sectors in its component parts. Photovoltaic cells—the primary component—require a high grade of silicone being produced in Buffalo Niagara.

Similar patterns can be found in almost all of the sectors examined as part of this study.

The region also has direct renewable-energy generation possibilities worth noting:

•Large-scale wind energy generation is viable in Buffalo Niagara. Various parts of the region receive wind forces strong enough to be viable for commercial production and supply to the grid. These areas exist on and off the shores of Lakes Erie and Ontario and as well as in some rural inland areas. Since some wind turbine components are large and difficult to transport, the development of the region's wind energy generation potential can also yield advantages in attracting component parts manufacturing firms. In addition, there is a core base of manufacturing in the region that has the potential to add on capacity for production of wind component parts.

•Buffalo Niagara also has potential for solar energy generation. Given current technology, large solar arrays that feed the grid are not feasible, but solar arrays that feed defined areas through a micro grid are possible. A potential also exists for the use of solar energy in individual homes and buildings, since despite its winter reputation, Buffalo has more than adequate solar days to take advantage of such systems.

•Hydropower has long contributed to the success of Buffalo Niagara due to the proximity of Niagara

Falls. The Niagara River holds potential for additional hydrokinetic energy by using the river's swift currents to turn submerged turbines. There are both technical and ecological issues surrounding the development of the technology, but it could prove to be a very viable alternate energy resource for the region.

In addition, Buffalo Niagara offers a number of advantages to businesses seeking to compete in the emerging green economy. Buffalo Niagara's access to population centers, proximity to Canada, Great Lakes location and transportation infrastructure all represent significant advantages to companies seeking access to raw materials, industrial inputs and speed to market. In particular its proximity to Toronto and Southern Ontario holds potential for the region to benefit from green initiatives for private sector expansion that are being implemented by the national and provincial governments of Canada as well as those in the U.S.

The existing manufacturing base, existing facilities and skilled work force can be the foundation for companies seeking to commercialize the products that will drive growth in coming decades. The region already has a significant number of companies who manufacture components that are similar to those required in the supply chain of alternative energy production. There are also companies in the region that have a significant presence in all aspects of various types of renewable energy and related fields.

In both the academic and private sectors, the region also has ongoing programs that are related, directly or indirectly, to the research and development required to advance the technologies and design the products needed in a green economy. A primary strength is the UB School of Engineering, the second largest in New York, since the growth of a green economy demands highly qualified engineers in all sectors.

It is not any single attribute, quality or resource that makes Buffalo Niagara competitive in the new green economy, but rather the sum of all these factors. Clearly, future economic growth is likely to be driven in part by an ability to integrate a range of competing renewable and traditional sources.

With its ability to reach across energy sectors, Buffalo Niagara can be a place where ideas, research and products can be tested across energy sectors, making the region a laboratory and launching ground for new processes and an incubator for companies developing new products.

BUFFALO NIAGARA'S INDUSTRIAL BASE IS MORE DIVERSE & BALANCED THAN COMPETING REGIONS

There are a multitude of locations that can demonstrate strength within individual sectors, but few locations can demonstrate the same across-the-board competitiveness as Buffalo Niagara. Using manufacturing sector revenues to compare Buffalo Niagara to other localities, the scope of manufacturing diversity in the region becomes apparent. Buffalo Niagara's counties were compared to other locations in ten sectors using standard codes within the North American Industry Classification System (NAICS).

In almost every instance, manufacturing activity of the type required to produce component parts or services for renewable energy in these other locations was highly concentrated, with a small number of codes accounting for the vast majority of revenues generated.

This was true even in large markets, such as Dallas (where two codes related to Waste Management accounted for 57.4% of revenues) and Los Angeles (where four codes in Energy Transmission and Storage accounted for 66.5% of revenues), both of which might be assumed to have even greater diversity than Buffalo Niagara.

In comparison, few renewable energy-related manufacturing codes in Buffalo Niagara's case exceeded 12% of revenues, and only one in all ten sectors examined (Electric Power Generation in Energy Transmission and Storage) reached 14.1%. Buffalo Niagara clearly has a diverse and balanced industrial base. This provides it with a major advantage as it seeks to provide industrial capacity and ancillary services to firms seeking to manufacture equipment, components and other green and renewable energy-related products and services.

Buffalo Niagara's broad manufacturing capacity provides it with an opportunity to take a leading role in developing commercial applications for renewable energy and to become a component supplier in all aspects of renewable energy use and production. This capacity is growing in importance as the current economic turmoil is causing U.S. business, government and academia to more seriously face up to the problems of deindustrialization and to determine how best to reinvigorate manufacturing in the U.S.

While the ultimate success of this policy debate is still to be determined, Buffalo Niagara can establish itself as a model for the re-industrialization of America in the

new green economy and serve as a national laboratory for restoring manufacturing jobs. Success will at least partially be determined by its ability to establish itself as a North American center for the commercialization of green and renewable energy related products.

BUFFALO NIAGARA CAN BECOME A REGION WHERE 'INDUSTRY CREATES ENERGY'

By positioning Buffalo Niagara as a region where "Industry Creates Energy," the region can participate in a revitalized American economy, capitalizing on its historic industrial advantages to reclaim its manufacturing heritage and create new jobs.

This will not happen simply by inviting companies to set up new facilities. It will require substantial, proactive and concerted effort and leadership by business, government and academia on local, state and national levels. It will also require careful positioning and the development of wide networks with input from numerous additional entities in other locations worldwide.

There are some significant areas that require attention.

New York state has a reputation of being one of the worst states in the nation in which to conduct business. High taxes and fees with complicated laws and regulations are a disincentive to investment in the state. And while New York is a leader in energy incentives, no effort has been made to link these programs to traditional manufacturing incentive programs as they might apply to the alternative energy value chain.

These multiple state programs, plus multiple local incentive programs, create a bureaucratic obstacle course that keeps companies from accessing applicable incentives and making New York competitive with other states.

In addition, Buffalo Niagara does not have the "green image" that is important to green economy investors and entrepreneurs. The region at the local level has not formulated special incentives or programs that would foster green jobs, and there has been little follow-up on plans that called for green programs.

Building codes in most communities do not address issues of energy efficiency. Government building programs or companies receiving government assistance have not been required to address energy issues. The ideas of an active and enthusiastic environmental community have not been fully embraced by the region's established institutions in ways that generate actions and programs.

The region should help existing companies to retool, remarket and reinvent themselves as green economy companies.

SUCCESS IN THE GREEN ECONOMY REQUIRES CLEAR COMMITMENT, INTENSE EFFORT & COOPERATION

Buffalo Niagara must demonstrate a clear commitment to both developing a supporting business environment as well as to becoming a region dedicated to green technologies and practices. Buffalo Niagara's success in the new green economy will require intensive efforts and cooperation among the diverse group of constituencies that must contribute to the success of an initiative of this kind.

KWR International's research and conclusions in the main report lead to four major recommendations:

•Buffalo Niagara should consider the formation of a regionally based "Green Team" to facilitate and guarantee the region's participation in the new green economy. This Green Team should provide leadership and foster cooperation and commitment among all constituencies for the development of a consensus, guidelines and a green sustainability plan.

•Buffalo Niagara should position itself for a leadership role in the new green economy by developing the "soft" infrastructure that will complement the manufacturing infrastructure already in place. This will require initiatives by government, business, academia and the community as a whole in supporting green technologies and practices. The establishment of Buffalo's green identity is vital to the attraction of new investment and jobs.

•Buffalo Niagara should encourage its institutions, organizations and businesses to actively participate in the global dialogue on alternative energy production to establish a leadership role in green manufacturing processes and green jobs.

•Buffalo Niagara should develop an integrated green initiative for the regional coordination of planning and policy development, organization capabilities and program management. This will help to establish the foundation of

a credible action plan and agenda for the outreach and promotion that will generate new jobs and investment.

Also, the overall report makes a number of additional suggestions that can enhance the region's participation in a new green economy and green-job creation:

•The region should help existing companies to retool, remarket and reinvent themselves as green economy companies.

•The region has the ability to put together manufacturing sites and facilities that would reduce a manufacturer's carbon footprint in "low carbon energy zones." Niagara Falls hydropower could be used to supplement micro-grid systems of wind, solar and hydrokinetic generated power on brownfield sites to drastically reduce the pollutants used in the manufacture of a product.

•Buffalo Niagara should work with its educational institutions to develop new programs and adapt existing ones to the requirements of a new green economy. The region can seek out the development of overlapping technologies, in fields such as biomedical research, that might have application to alternative energy development.

•The region should package and market energy incentives with traditional manufacturing incentives and new federal programs, promoting them in the context of the region's strengths in the green economy. With many opportunities emerging at once, the region can distinguish itself by providing advisory and other support-type services to entrepreneurs and companies that can expand the region's growth in the new economy.

•Buffalo Niagara should accelerate its efforts to re-brand itself as a green community. It should enact code requirements that work with incentives for energy efficient buildings to immediately foster jobs in construction and retrofit as well as in meeting demand for the manufacture of energy efficient building products.

•Buffalo Niagara should aggressively examine and pursue green energy opportunities specific to its location on the Great Lakes and near Canada. It should pursue a binational partnership to develop the Great Lakes potential in wind and hydrokinetic energy in a sustainable, environmentally friendly manner. It should actively seek new green tech energy firms in Canada and offer assistance in developing products and manufacturing facilities to serve the United States market.

•Buffalo Niagara should develop a plan to utilize its proximity to Toronto to access international markets and seek foreign investments and partnerships with companies of the European Union and Asia that have established leadership roles in alternative energy development. It should develop a global marketing campaign as an outreach to alternative energy companies, building on the fame of Niagara Falls as one of the world's largest and oldest sources of sustainable energy.

The goal is to utilize the same strengths and attributes that led to Buffalo Niagara's original rise. These include access to water and hydroelectric power, a strategic position between the Northeast and Midwest and near Canada, a skilled workforce, established manufacturing capacity and industrial real estate.

This will provide the platform needed to attract the businesses, manufacturing and jobs that will be essential to building U.S. competitiveness in renewable energy. The renewable energy industry draws on the same strengths the region possesses and is an industry that is likely to constitute a primary source of global economic growth in coming decades.

Buffalo Niagara's ability to provide credible capacity in almost all alternative-energy solutions being proposed, the presence of one of the Northeast's largest public universities and a relatively low cost-structure are just a few of the many factors that provide the region with an ability to become a center of innovation and renewed manufacturing strength.

For this important transformation to happen, these recommendations and actions need to be placed into a cohesive structure, designed to address agreed-upon goals, needs and objectives. This is the only way to achieve real and sustainable results. Without an appropriate emphasis on policy, planning and strategic development, Buffalo Niagara could easily be left behind in an emerging green economy.

But with united and coordinated action, Buffalo Niagara has an unlimited potential to show the world how an old, declining manufacturing center can transform itself into a focal point within a new growth economy.

With new initiatives based on the generation of renewable energy, green practices and sound environmental policies, Buffalo Niagara can claim its rightful place as truly being a region where "Industry Creates Energy."

I THE NEW GREEN ECONOMY

For more than 20 years, there have been proponents of a new "green" economy who advocate less out of environmental concern than as a trigger for an economic transformation that could rival or surpass the industrial and technology revolutions of the late 19th and 20th centuries. The high volatility of fossil fuel costs, excessive reliance on energy sources in politically insecure areas, and environmental issues such as global warming are all increasing interest in this sector. This is dramatically expanding economic development opportunities in green businesses for cities and regions worldwide.

Increasing consumption in China, India and other emerging markets is also placing great strains on existing supplies of energy and natural resources. According to the World Wildlife Federation's Living Planet Report, "if everyone in the world lived like average Americans, we would need 5.3 planets to support us." This demonstrates that alternative energy is essential to addressing the financial and environmental consequences of this global rise in demand.

In a sense, the 2008 economic collapse is only accelerating this trend. U.S. and foreign governments—national and local—are pledging unprecedented public spending on green jobs and technologies to drive innovation and stimulate economic activity during these troubled times. This promises a leveraging effect beyond the actual investment, providing incentives and helping green technologies gain the scale and improvements needed to increase use and commercial viability.

While some are skeptical and even critical of the transformative nature of the green jobs movement, the magnitude of global government spending being proposed—nearly $1 trillion in the U.S. alone—means this phenomenon cannot be ignored. For this reason, cities and regions across the U.S. and Canada are now defining the role they can play in the accelerating transformation toward a new green economy.

Green Jobs

According to Joseph Romm, editor of Climate Change, "green jobs are commonly defined as living-wage career-track jobs that contribute to preserving or enhancing environmental quality." Their creation is usually associated with a transition from fossil-based fuels to low-carbon energy sources. While research and development in alternate-energy technologies plays a part in job creation, an equally important part is the repurposing of existing manufacturing techniques and skills to the creation of products required in the new green economy.

For example, large turbines that harness wind energy call not only for technical expertise, but also for sheet metal workers, machinists, engineers, mechanics, welders, millwrights, construction workers and maintenance people as well as sales, management and administrative support. Because energy costs are anticipated to remain volatile and rise over time, the need for conservation also creates a market for energy efficiency. This necessitates new construction and retrofits, which require architects, engineers, roofers, insulators, carpenters, inspectors, truck drivers and other support services.

The National Council for Advanced Manufacturing uses three categories to define of green jobs:

- existing jobs redirected toward efficiency and sustainability (renewable energy, resources efficiency, waste efficiency)
- jobs creating green or sustainable products (photovoltaic panels, wind turbines, recycled products, energy-efficient products, etc.)
- jobs enabled through sustainable manufacturing (materials recovery, reuse, remanufacturing, transportation efficiency).[1]

Green jobs, therefore, are largely manufacturing and trades jobs as well as those within related service industries. They require exactly the skills and facilities that have been idled in the Northeast's Rust Belt cities. Proponents argue green jobs can signal a revival of America's manufacturing economy and reinvigorate the nation's former centers of goods production.

Here again, current global economic deleveraging and restructuring of the banking sector—while painfully traumatic over the short term—is only likely to reinforce this trend. Over time it is likely to lead to a shift away from business and career strategies that focus primarily on financial engineering and services into those that seek growth and profitability through operational businesses, manufacturing and other more tangible pursuits.

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[1] *Green Jobs in Manufacturing: A Road Map for Progressively Green Solutions Through a Sustainable and Green Workforce. National Council for Advanced Manufacturing. December 2008.*

iStock photo

'Green jobs are commonly defined as living-wage career-track jobs that contribute to preserving or enhancing environmental quality.'

Joseph Romm
editor
Climate Change

Renewable Energy

According to a University of California-Berkeley report that reviewed 13 studies examining the impact of renewable energy on job creation "renewable energy and efficiency improvements create twice as many jobs per unit of energy and per dollar invested than traditional fossil fuel-based generating technologies. This is achieved by redirecting money previously spent on wasted energy, pollution and imported fuel toward advanced technology, modern infrastructure and skilled labor."

Because these jobs are labor-intensive and focused on transforming localities, they are difficult to outsource. A statement from the Center for American Progress, a think tank that has supplied a number of President Barack Obama's top cabinet-level officials, says "these jobs are impossible to offshore. Making buildings more energy efficient, constructing mass transit lines, installing solar panels and wind turbines, expanding public green space, growing and refining biofuels—all this work must take place right here in America, in both urban and rural areas. Moreover, deploying clean technologies and improving the efficiency of our energy infrastructure are local investments with a high level of domestic sourcing and large multiplier effect."[2]

Green jobs begin with new investment in alternative energy. Renewable energy—a term sometimes used interchangeably with "alternative energy"—refers to energy sources that can regenerate indefinitely without being depleted. They are an alternative to fossil fuels such as oil, coal and natural gas, which require millions of years to develop and therefore not considered "renewable."

Energy Generation Sectors

Given current technologies, the five most prevalent alternative energy sources are:

•**Solar**—Energy collected from sunlight is used to generate electricity via photovoltaic arrays. Though one of the most expensive forms of renewable energy, solar has great potential as technology continues to advance.

•**Wind**—Wind is the most rapidly growing source of renewable energy and the most recognizable. Naturally occurring wind currents are used to spin wind turbines to generate power.

•**Geothermal**—Power generated by geysers fueled by heat located deep within the earth's core. Geothermal heat pumps can also be used in residential and commercial buildings.

•**Hydropower**—Flowing water is used to spin turbines connected to generators. Niagara Falls and Hoover Dam are well-known hydro energy sources. There are, however, several smaller-scale hydroelectric systems, such as diversionary dams, tides, waves and river current.

•**Biomass**—Energy created by burning wood, wood waste, plants, animal or other organic waste and methane gas generated from landfills. In addition to energy creation, biomass refers to alternative fuel creation for transportation modes.

[2]*Fact Sheet: Green Jobs 101, Center for American Progress, December 2008.*

An additional sector that bears attention is nuclear energy. Nuclear is not usually classified as a renewable energy source, despite its lower carbon footprint and an emission of greenhouse gases lower than fossil fuels. Nuclear is not a part of the traditional "green energy" movement because of environmental concerns raised by opponents and the very real problem of disposal and storage of radioactive waste generated in the process.

Although the United States does not have an answer to the disposal problem, Energy Secretary Steven Chu has noted, "Nuclear is going to be part of our energy future. It has to be."

The Obama administration has indicated a willingness to proceed with new nuclear plant construction as part of a multifaceted plan to reduce dependence on nondomestic oil. Component manufacturing and construction activity for these new plants—projected to be 20 to 30 in the U.S. alone—is anticipated to yield significant job-creation in the years to come.

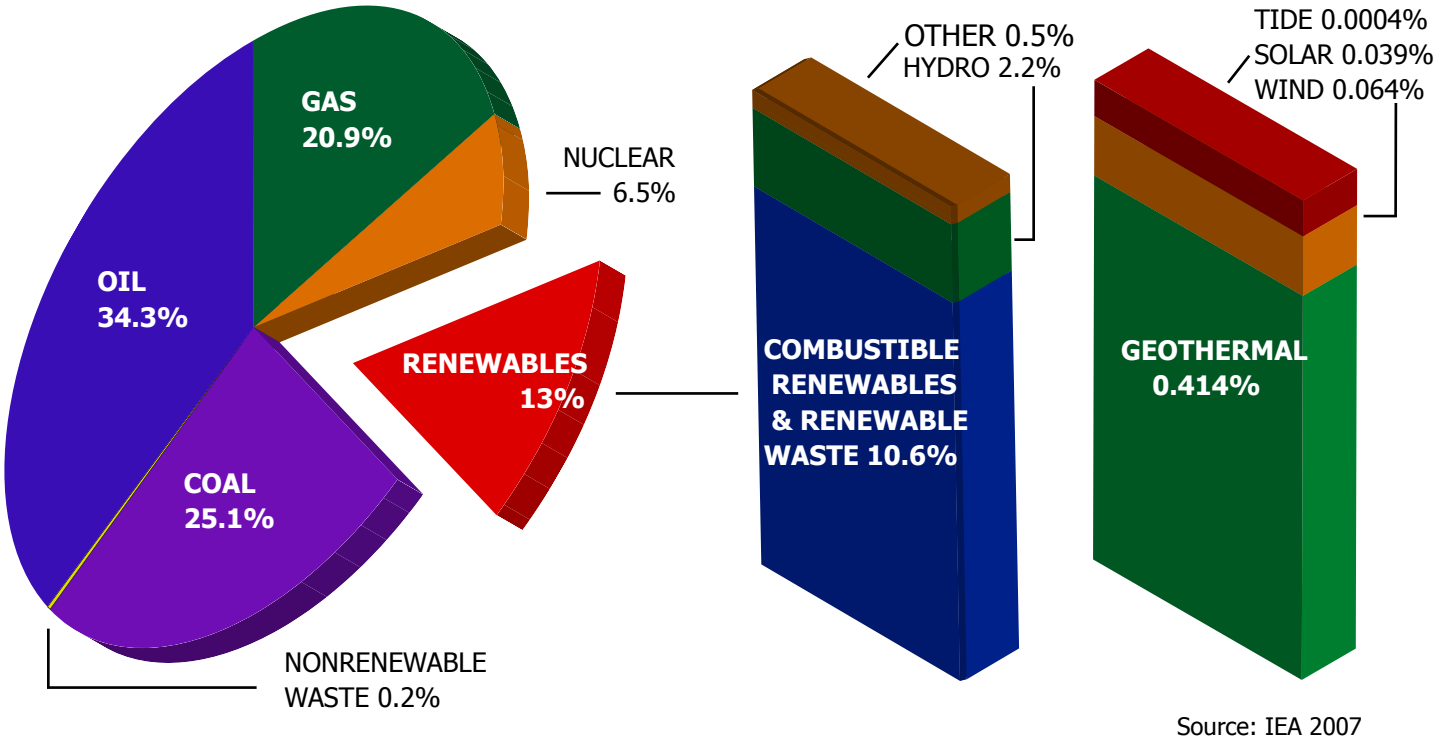
With the growing understanding that nuclear must be a factor in our alternate-energy infrastructure, there is an increasing need for specialized skills and capacity in manufacturing, construction and services.

II GREEN ECONOMY GROWTH SECTORS

The Value Chain of the Green Economy

The Duke University Center on Globalization, Governance and Competitiveness in a joint study with the AFL-CIO[3], determined it was possible to apply a "value chain" to alternative energy opportunities by expanding the more familiar supply chain approach with additional layers of information about how and where higher-value activities and industrial upgrading can occur. They determined manufacturing will play a vital role in green economy growth. This can be determined by breaking down each technology into its main materials and components; identifying the main components of the value chain and their respective end products and companies; and assessing the labor types required in the manufacturing process.

[3]*Carbon-Reducing Technologies and U.S. Jobs. Gary Gereffi, Kristen Dubay, Marcy Lowe. Center on Globalization, Governance and Competitiveness. Duke University. 2008.*



FUEL SHARE OF WORLD PRIMARY ENERGY SUPPLY

For example, many potential manufacturing jobs in the solar industry are high-tech jobs in the semiconductor and related devices subsector. Solar infrastructure also requires components from more traditional sectors such plastics and rubber, fabricated metal products and electrical equipment.

Additionally, the bulk of jobs related to wind infrastructure will come in equipment manufacturing. Wind electricity technology is relatively new, but its manufacturing base is similar to past products. Across America there are established firms and skilled workers 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.

While the vast majority of potential geothermal sites are in the western part of the country there are also ample opportunities in other parts of the U.S.—particularly smaller-scale installations—and most associated jobs would be created on site and are similar to existing fossil-fuel industry occupations. These include contractors, construction workers, drilling equipment operators, excavators and surveyors. But associated manufacturing jobs making mechanical equipment, drilling equipment and primary metal suppliers could be located in any region of the U.S. with the necessary transportation links and labor pool. In addition, an expansion of geothermal infrastructure would create jobs for architects, designers, structural engineers and environmental services consultants, as well as other alternative-energy technologies, sales, marketing finance and related service and administrative functions.

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

Growth in the biomass sector will center on alternative fuel production and waste management. In rural areas, this will mean harvesting and manufacturing agricultural products and recovering wood and waste products. In urban areas, manufacturing and construction jobs will be created for new conversion and generating facilities and the retrofitting of existing generation facilities for biomass use. Urban areas with facilities for transporting bulk commodities that are closer to population centers that constitute the primary end-users will have an advantage through lower logistical costs.

Nuclear power also offers significant potential and high-value jobs given the precision required in the fabrication of components and the scarcity of activity. The World Nuclear Organization estimates there are 374 new reactors being planned or proposed globally with 33 of these to be located in the U.S., where there has been little or no activity in recent decades.

The renewable-energy industry also holds job-creating sectors not specifically energy producing, including:

•Energy Transmission and Storage: The electrical grid system in the U.S. is outdated and there is an urgent need to incorporate today's distributed-energy technologies and renewable energy into what is being called a "smart grid." A smart grid will determine peak and down times and allow the integration of multiple energy sources and distribute the load to meet demands. This is essential to allow use of renewable energy where required natural inputs are distant from the urban centers that have the highest demand. In addition, the ability to store bulk energy for use at higher demand times is a vital part of the renewable-energy supply chain. In particular, wind and solar are not consistent suppliers of energy as the required natural inputs are not available at all times. Therefore energy generated at peak times needs to be stored for use during down times. Competitive technologies are now emerging, which will create opportunities in both the scientific and manufacturing sectors.

•Green Buildings: Whether in new construction or in retrofitting, the creation of energy-efficient environments is an important part of the renewable energy field. Energy conservation helps the environment and reduces long-term energy costs for the owner. Creating green buildings is the fastest stimulus for the economy since projects can be undertaken almost immediately. It creates good-paying jobs with relatively short vocational training and can provide job opportunities in impoverished urban areas. The drive toward energy efficiency increases demand for insulation, energy-efficient windows, general building materials and energy-efficient appliances. Subsidies and incentives for green buildings make practical the installation of small-scale renewable energy systems (solar, wind, geothermal), which can create excess energy that is sold back to the grid.

•Transportation: America is now acknowledging the real

need for alternative (nonpetroleum) fuel vehicles and electric and hybrid automobiles are gaining greater acceptance. Biofuels (ethanol, methanol and other fuels made from plant oil or animal fat); compressed natural gas; and hydrogen fuel cells are all being developed as viable replacements for fossil fuels. The need for mobile energy storage and networks of charging stations will also provide manufacturing opportunities as the underlying technologies and systems are developed.

•Solid Waste Management: Effective control of the generation, storage, treatment, recycling and reuse, transport, recovery and disposal of hazardous waste has become a major worldwide concern. New industries are emerging around this growing industry as well as new opportunities to adapt traditional manufacturing for use in this sector.

Potential Green Economy Job Creation

Alternative energies become economically viable at grid parity—the price point at which alternative energy-generated electricity can be produced at a competitive price with traditional energy sources such as fossil fuels and nuclear. In nations where fossil fuels are less accessible and alternative fuels are more subsidized, building wind, solar and geothermal power plants and installations are price competitive with fossil-fuel facilities.

While this is not currently the case in the U.S., policymakers are increasingly willing to subsidize development of these technologies. This is due to fears over "peak oil" and long-term supply of traditional fossil fuels, as well as climate change, environmental consequences, price volatility, the need to raise consumption in emerging markets and transfer of wealth to potentially unstable parts of the world. The hope is that, over time, technology will improve and demand will rise, resulting in lower costs and economies of scale. Subsidies can then be reduced, as market mechanisms prove sufficient on their own.

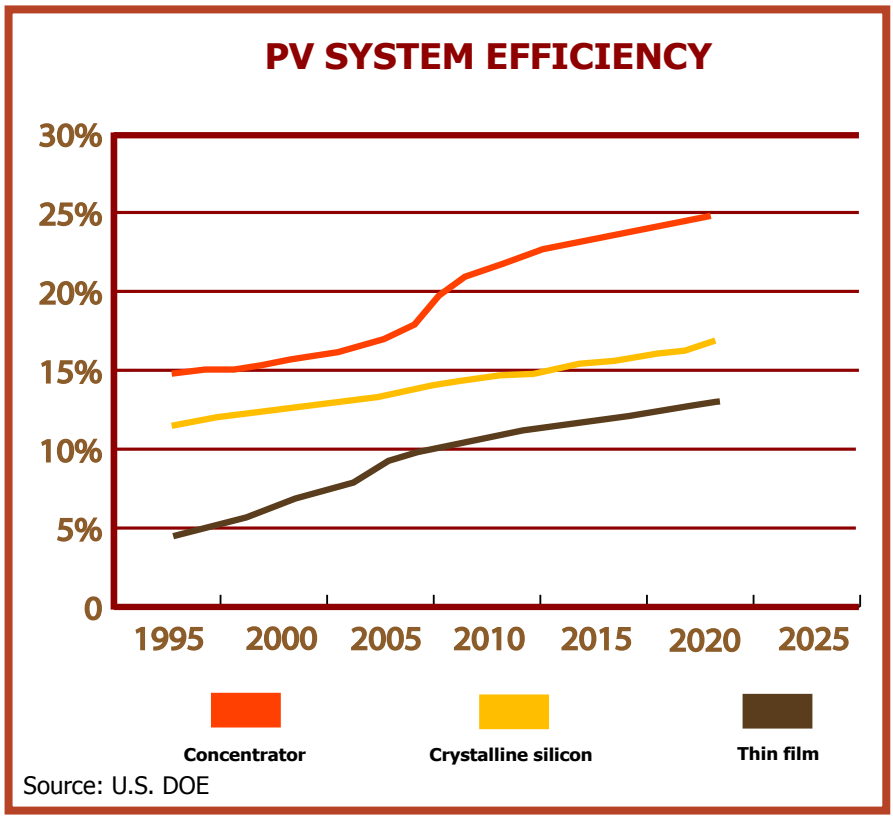
As a result, job creation in the new green economy will be driven—at least in the near term—by government policy. U.S. policy subsidizes fossil fuels in a number of ways at the federal level, but this is forecast to change in favor of alternative energies.

In Germany, government policies have made renewable energy sources competitive with fossil fuels. Increased demand and high environmental awareness among consumers, has allowed Germany to use its engineering and manufacturing capabilities to become a leader in domestic renewable energy usage and in the design and manufacture of wind and solar systems.

iStock photo

Japan is also making significant investments in the green economy, not only to curb global warming and achieve greater energy security, but also to create new sources of economic growth. As a result, Japan has initiated programs to provide interest-free loans to investors in environment-related fields. It is also promoting the purchase of vehicles with low carbon dioxide emissions,

[4]*Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy. Robert Pollin, Heidi Garrett-Peltier, James Heintz, Helen Scharber. Center for American Progress. September 2008.*



Source: U.S. DOE

and energy-efficient housing.

U.S. energy subsidies come largely through tax policy. A September 2008 report by the Center for American Progress,[4] authored by the Political Economy Research Institute at the University of Massachusetts-Amherst, examined the impact of a $100 billion fiscal stimulus with additional credit stimulus. They projected a federal loan guarantee program to boost private-sector investment in energy efficiency and renewable energy. Most of the federal spending would be in the form of public infrastructure investments in public-building retrofits, public transportation, and smart-grid systems. These investments are to be funded through public funds, tax credits, and loan guarantees, with an emphasis on spurring private-sector investment.

The report found a potential to create 2 million new jobs in two years by investing in six energy-efficiency and renewable-energy strategies:

•Retrofitting buildings to improve energy efficiency
•Expanding mass transit and freight rail
•Building "smart" electrical grid transmission systems
•Wind power
•Solar power
•Next-generation biofuel

New York's share of such a program would be $7.1 billion, based on combining its population and gross domestic product, and net job creation through a green economic recovery program would be 131,991 jobs, based on June 2008 unemployment figures.

II-B GREEN ECONOMY ENERGY SECTORS

A government report showed that in 2007, for the first time, nonhydroelectric renewable energy, led by wind power, was the leading source of new U.S. electric-generating capacity.[5] The U.S. Energy Information Administration (EIA) also stated for the first time ever, renewable energy sources accounted for the largest portion of capacity additions. Renewable energy sources, excluding hydroelectric generation, produced a net generation that grew by 9% as compared to 10.5% growth in 2006. Renewable energy accounted for 2.5% or 105 million megawatts of total net generation in 2007. This marks the fourth consecutive year in which the share of total net generation by renewable energy has increased.

With the Obama administration taking immediate action to incentivize the renewable industry, there can be no doubt growth is about to accelerate. This diversity is important. Unlike the adoption of hydrocarbons in the 19th century, which dominated energy use for more than 100 years, renewable energy is likely to be characterized by a range of different technologies, supplemented by effective storage devices and localized delivery systems distributed through a wide-reaching national or even internationally functional smart grid.

The following section examines the characteristics of the five major alternative energy sectors as well as nuclear power. It also looks at several of the nonenergy generating sectors of renewable energy that may have job creating potential for the region.

SOLAR

Solar power has become a key component of the energy mix in Germany, Japan and Spain. It is also expand ing rapidly in the U.S., growing by an annual rate exceeding 20% over the last decade. Solar is the use of

[5]*Electric Power Annual 2007, U.S. Energy Information Administration December 2008.*

photovoltaic (PV) cells and thermal-array power plants to convert sunlight into electricity. PV solar is practical in small applications, including individual structures.

Sector Overview

Although solar has been the fastest-growing segment in the alternative energy chain, today's financial conditions have altered growth predictions for the industry. It is expensive; especially given the current economic climate, low oil prices and the reluctance of investors. As a result, many solar projects, particularly large-scale facilities, have been scaled back. Nevertheless, the U.S. continues to have considerable growth potential and is becoming a more significant solar market.[6]

New technologies, however, continue to be developed. These include thin-film PV, nanotechnology, low-cost semiconductor alternatives to poly silicon and the improvement of concentrating solar-power systems. This will provide multiple opportunities for growth and entrepreneurship. For example, green building, new or retrofit, residential or commercial, is becoming both required and increasingly desirable—and solar energy is an important factor in achieving green-building goals.

Backed by major government incentive programs, an economic study by Navigant Consulting Inc., forecast that direct, indirect and induced activity will support 440,000 jobs, increasing domestic investment in the solar industry to $232 billion by 2016.[7] California, Florida, Arizona, New Mexico, Nevada, New Jersey, Massachusetts, New York, Oregon and Washington expect to see substantial growth from solar-energy manufacturing and installation jobs.

TECHNOLOGIES

There are three main technologies in the sector:

•Photovoltaic (PV) systems are used primarily to power homes connected to the grid. PV systems use semiconductor materials that convert sunlight into electricity with the most widely used systems using crystal silicon cells. Polycrystalline cells, also used in installations, are cheaper to produce, but not as effective in converting energy. A third type of PV, thin-film technology, makes it easier to mass-produce thin cells and is gaining market share. Both cells and film are installed in flat-panel collectors used primarily for small-scale distributed power generation.

•Solar Thermal (ST) systems collect the sun's energy in the form of thermal or heat energy as opposed to electrical energy. Domestic hot-water heating and swimming-pool heating are the primary uses.

•Concentrated Solar Power Systems (CSP) are those in which collectors are used in large-scale operations to supply power to the grid. This system uses mirrors to concentrate sunlight on a focal point. This magnifies the heat to power electricity-generating turbines. These systems are large in scale and generally not suited to northern climates using current technology, given the number of sun days available. In sunny areas such as the Southwest, thermal energy can be created equivalent to conventional fossil fuel power plants.

MARKET OPPORTUNITIES

Solar technology is dynamic, and the key to long-term success is reducing costs so the technology can exist without incentives. Therefore, research and development is critical to making solar cells cheaper and more efficient. This includes new architectural designs such as the use of nanotechnology to create new, more efficient silicon nano-crystals, and new materials to substitute for silicon, which can be limited in supply.

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[6] *"Industry Leaders Forecast Dramatic Growth in the U.S. Solar Market by 2016 with Extension of Credit," Solar Energy Industries Association, Oct. 3, 2008.*

[7] *Navigant Consulting Solar Outlook, December 2008.*

Jobs created in the solar energy sector include:

Solar Power Electrical Engineers, Electricians, Industrial Machinery Mechanics, Welders, Metal Fabricators, Electrical Equipment Assemblers, Equipment Operators, Installation Helpers, Laborers, Construction Managers, Silicon Feedstock Processing.

Support functions: R&D, Design, Financial, Legal, Administrative, System Resellers, Distributors and Installers, Accountants, Engineers, Computer Analysts, Clerks, Factory Workers, Truck Drivers and Mechanics.

Major companies in the sector:

Solar Cells: Sharp—Japan: Q-Cells—Germany; Suntech—China; Motech—Taiwan; Kyocera—Japan; SunPower—Philippines; First Solar—U.S.; Gintech—Taiwan; E-Ton—Taiwan; Deutsche Cell/Shell—Germany; JA Solar—China; and Sanyo—Japan.

The industry is active in large- and small-scale installations and uses. Its technology segments include:

•Alternative (nonsilicon-based) thin-film PV technologies
•On-grid applications (in which solar power supplements electricity obtained from the utility network)
•Consumer PV markets include installations for use in residential grid-tie systems, water pumping, RV and marine applications, and remote home systems
•Industrial PV markets include the employment of PV technology in communications, oil and gas industries, traffic safety, railroads, lighting systems, rural development, and installations in commercial grid-tie systems, and defense-related applications for the government
•Solar nanotech (tiny solar cells printed on flexible, very thin light-retaining materials, bypassing the cost of silicon production). Nano Market's projections indicate that printed PV could be a $1 billion market by 2011
•Hybrid power systems incorporating PVs with other power sources, generators, fuel cells and batteries
•Rooftop solar for home heating and electric generation

RAW MATERIALS

Silicon is the primary raw material used in the solar energy sector. This includes: poly silicon, a silicon raw material which is melted and recast to remove impurities; ingot, the cast silicon stabilized in its polycrystalline form; monocrystalline silicon; amorphous silicon; and polycrystalline silicon, an important raw material for solar cells also used to make semiconductor wafers.

Over the past few years, the ability to secure a stable supply of poly silicon has been a decisive factor for market share and competitiveness among solar-cell makers. This constraint has eased, however, more recently, as economic conditions have lowered demand for large solar panels and greater supply of poly silicon has become available.

PROCESSING & COMPONENT MANUFACTURING

EIA data shows that in 2007, 60 manufacturers and/or importers were active in manufacturing, importing or exporting solar thermal collectors, a significant increase from the 44 companies operating in 2006. In 2007, 72% (10.9 million square feet) of all solar-thermal collectors were manufactured in California, New Jersey, Florida, Pennsylvania and Connecticut, and 62% (9.4 million square feet) of the total were shipped from California and New Jersey alone. Imports of solar-thermal collectors totaled 3.9 million square feet in 2007. These imports originated from seven foreign countries including China, Israel, Germany, Turkey, the UK, Canada and Australia.

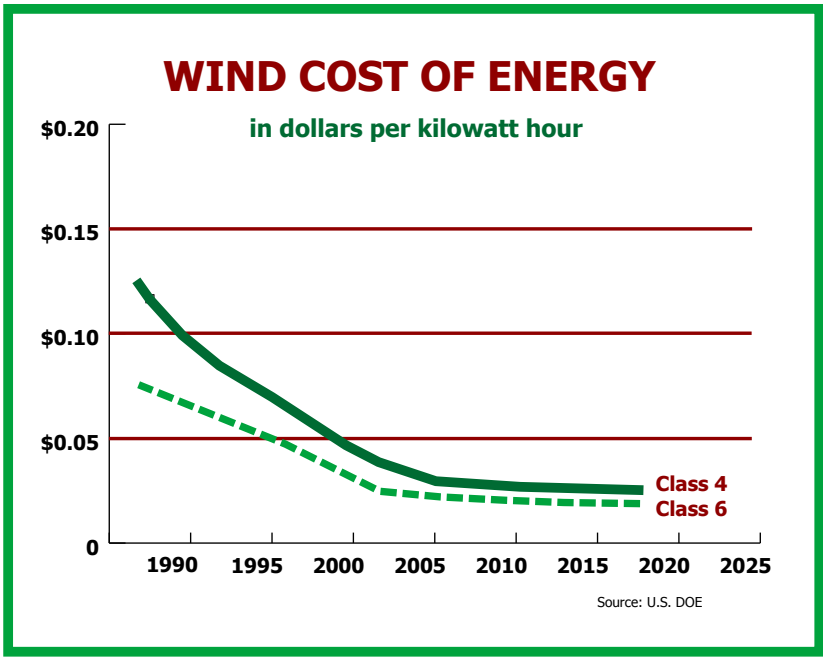
Major North American Industry Classification System (NAICS) solar industry codes

221119	Other Electric Power Generation
221122	Electric Power Distribution
237130	Power/Comm. Line/Related Structures Const
238220	Plumbing, Heating, & A/C Contractors
325211	Encapsulant
326113	Rear Layer
326299	Fuel cells, solid-state
327211	Top Surface
331316	Aluminum Extruded Product Mfg
331421	Copper Rolling, Drawing & Extruding
332311	Prefabricated Metal Building/Component Mfg
332312	Fabricated Structural Metal Manufacturing
332322	Sheet Metal Work Manufacturing
332410	Power Boiler/Heat Exchanger Mfg
332999	All Other Misc. Fab Metal Product Mfg
333412	Industrial/Commercial fans/blowers
333414	Heating Equip (except Warm Air Furnace) Mfg
333415	HVAC & Comm./Indust. Refrig. Equip Mfg
333613	Power Transmission Equip
333911	Pump/Pumping Equip Mfg
333912	Air/Gas Compressor Mfg
334112	Computer Storage Device Mfg
334413	Solar Cells
334418	Printed Circuits & Electronics Assemblies
334513	Instruments for Measure, Display & Control
334515	Meter
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution & Specialty Transformer Mfg
335312	Motor & Generator
335313	Circuit Breakers & Fusers
335314	Relay & Industrial Control
335911	Storage Batteries
335931	Electrical Connections
335999	Charge Controller
423720	Plumbing/Heating Equip Merchandise / Wholesalers
541310	Architectural services
541330	Engineering Design Services
541690	Energy Consulting Services
541710	R&D in Physical, Engineering & Life Sciences

WIND

In January 2009, the American Wind Energy Association released data showing that more wind power was installed in the United States in 2008 than ever before. More than 8,300 megawatts of newly installed wind-energy capacity is enough to provide power to more than 2 million average homes. This was more than a 50% jump from 2007.[8]

The association listed the top five states, in terms of wind power generating capacity, as Texas, Iowa, California, Minnesota and Washington. The industry had 85,000 workers in 2008, up 35,000 from 2007—a 70% increase.



Sector Overview

Electricity generated from wind turbines has grown continuously in the U.S. over the past 20 years. While in the past wind electricity was most widely utilized in Germany and Denmark, the U.S. has recently become the world's largest wind-power producer. Although there can be community resistance due to the aesthetics of wind farms, wind power can be an effective driver of economic development. Wind energy boosts the local tax base, provides direct benefits to land owners (often in rural areas), and creates jobs in the production supply chain for wind turbines and related goods. New York ranks 15th in the country for wind power potential, and an estimated 10% of the state's energy needs could be produced by utilizing land-based wind power, with additional opportunities in offshore wind farms.

TECHNOLOGIES

The majority of wind turbines can be placed into two categories: horizontal-axis turbines or vertical-axis turbines, each describing blade orientation. Individual wind turbines can be used to generate power for individual homes or buildings. On a larger scale, they can be installed in groups as a major energy source.

Utility-scale wind turbines range from those producing 100 kilowatts to those generating several megawatts. The largest turbines are the most effective and cost-efficient. Utility-wind turbines are grouped together to form wind farms and supply bulk power to a grid.

Smaller turbines producing less than 100 kilowatts are available for residential and commercial use. They are often used in conjunction with diesel generators, batteries, and photovoltaic systems to make hybrid systems. They are usually used in areas where access to a power grid is not available.

MARKET OPPORTUNITIES

Large- and small-scale wind-turbine production is predicted to offer great job-growth opportunities. For the past ten years, sales have grown approximately 29% annually. The small wind turbine market grew 14% and experienced $42 million in sales in 2007. Even before the new push by the federal government, the projected U.S. market for wind turbine components and systems was expected to reach $60.9 billion by 2013.

Wind turbine production involves the manufacture of many component parts using traditional technologies. As with most alternative-energy applications, the benefits of using underlying technologies such as wind within a local market extends far beyond the actual energy derived. That is because firms with a presence in the sector—whether in research and development, equipment and component manufacturing or services possess a platform that enhances their awareness and ability to test, utilize and showcase their products. This helps to promote innovation and to create local stakeholders and interest groups. which facilitates the search for labor, involvement and support from local

[8]*Fact Sheet: Another Record Year for New Wind Installations. American Wind Energy Association. January 2009.*

governments, industry, academic institutions and community organizations. In a multiplier effect, it also affects the availability of raw materials and existence of service providers.

Worldwide wind-generation capacity through wind farms will reach more than 160 gigawatts by 2010. The U.S. Department of Energy (DOE) predicts wind will be able to satisfy 20% of the country's electricity needs by 2030, if not sooner. The minimum average wind speed for wind turbines to work efficiently is 9 mph for small wind turbines and 13 mph for large-scale utility turbines.

There may also be additional opportunities in offshore wind. Despite its small size, Denmark produces 13% of its energy from wind, accomplishing this through offshore wind farms. Wind speeds offshore are generally 20% higher than onshore, allowing for great efficiency. Offshore wind turbines also last longer; a typical onshore wind turbine has a 30-year life span, compared to 55 years for one offshore.

Retail small-wind systems are another opportunity area. The installation of small-wind systems on micro and other power grids tripled in 2007 to 1,292 units. Thousands of additional units exist in areas that lack utility power. Small-wind systems are affordable for many residential and commercial customers and require less wind resources and larger systems.

Many states, including New York, have net-metering rules that require utility companies to pay small turbine owners credit for power they contribute to the grid. This substantially offsets the cost of the initial installation.

RAW MATERIALS

The raw materials in wind installations are relatively common plastics and metals. The tower is constructed in steel, either in a steel lattice tower similar to electrical towers or a steel tubular tower. The housing, which contains the major components such as the gearbox, is made of fiberglass. Generator and electric controls are made primarily of steel and copper.

The turbine's blades can be made from a number of materials such as fiberglass with a hollow core, lightweight wood and aluminum.

Major NAICS codes for the wind energy sector

221119	Other Electric Power Generation
221122	Electric Power Distribution
237130	Power/Communications Line/Const
326199	All Other Plastics Product Manufacturing
326299	Fuel cells, solid-state
331316	Aluminum Extruded Product Mfg
331421	Copper Rolling, Drawing, & Extruding
331511	Iron Foundries
332111	Iron & Steel Mills
332112	Nonferrous Forging
332312	Fabricated Structural Metal
332313	Plate Work Manufacturing
332322	Sheet Metal Work Manufacturing
332911	Industrial Valve Manufacturing
332999	All Other Misc Fab Metal Product Mfg
333412	Industrial & Commercial fans & blowers
333611	Turbines, & Turbine Generators, & Turbine Generator Sets
333612	Speed Changer, Industrial
333613	Power Transmission Equip
333912	Air/Gas Compressor Mfg
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments Mfg for Measure, Display & Control
334515	Meter Mfg for Measuring, Testing Electricity & Signals
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution, & Specialty Transformer Manufacturing
335312	Motors & Generators
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay & Industrial Control
335911	Storage Battery
335931	Electrical Connections
335999	Electronic Equipment & Components, NEC
541310	Architectural services
541330	Engineering Design Services
541620	Environmental Consulting Services
541690	Energy Consulting Services
541710	R&D in Physical, Engineering, and Life Sciences

Jobs created in the wind energy sector

Wind Turbine Production—Environmental Engineers, Iron and Steel Workers, Machine Assemblers, Machine Tool Operators, Mechanical Engineers, Operations Managers, Quality Control Technicians, Lathe Operators, Industrial Engineer, Industrial Machinery Mechanic, Welders, Tool and Die Maker, Grinding Operator, Materials Handler, Maintenance Worker, Millwrights, Sheet Metal Workers, Machinists, Electrical Equipment Assemblers, Construction Equipment Operators, Industrial Truck Drivers, Industrial Production Managers, First-Line Production, Supervisors Accountants, Engineers, Computer Analysts, Clerks, Factory Workers, Truck Drivers and Mechanics.

Wind Farm Operations—Wind Field Technician, Wind Energy Forecasting and Resource Assessment, Wind Plant Monitoring Technician, Wind Data Analyst, Site Prospector, Wind Plant Administrator, Site Supervisor, Senior Property Agent, Senior Risk Management Analyst.

Major companies in the sector

Wind Turbine Manufacturing: General Electric Energy—(U.S.—New York State) Manufacturing facilities in U.S., Germany, China, Spain, and Canada; Vestas—Denmark; Siemens—Germany; Gamesa—Germany; Mitsubishi Power Systems—United States

Wind Farms: FPL Energy—United States and Canada; Babock and Brown—United States, Germany, France, Australia; Iberdrola—Spain, United States (planning new operations in New York State); Horizon-EdP—Portugal, United States, South America.

Freerange photo

PROCESSING & COMPONENT MANUFACTURING

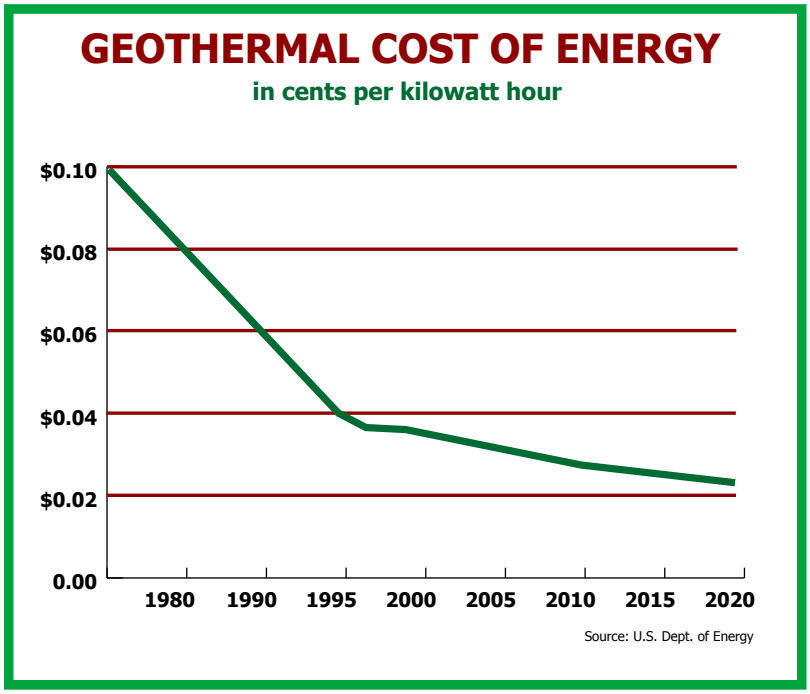
There are approximately 8,000 components in a wind turbine. The majority of components, however, are not unique to wind turbines and are commonly manufactured. They fit into twelve major NAICS codes for the manufacturing processes. Major components include:

•Anemometer: Measures the wind speed and transmits wind speed data to the controller
• Blades: Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate
•Brake: Can be applied mechanically, electrically or hydraulically to stop the rotor in emergencies
•Controller: Starts the machine at wind speeds of about 8 to 16 mph and shuts off the machine at about 55 mph. Turbines do not operate at above about 55 mph because they might be damaged by the high winds
•Gearbox: Gears connect the low-speed to the high-speed shaft and increase rotational speeds from about 30-60 rotations per minute (rpm) to about 1,000-1,800 rpm, the speed required by most generators to produce electricity. The gearbox is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower speeds and don't need gearboxes
•Generator: Usually off-the-shelf induction generator producing 60-cycle AC
•High-speed shaft: Drives the generator
•Low-speed shaft: The rotor turns the low-speed shaft at about 30-60 rpm
•Nacelle: The nacelle sits atop the tower and contains a gearbox, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on
•Pitch: Blades are turned, or pitched, out of the wind to control rotor speed and keep rotor from turning in winds that are too high or low to produce electricity.
•Rotor: The blades and the hub
•Tower: Made from tubular steel, concrete, or steel lattice. As wind speed increases with height, taller towers capture more energy and generate more electricity
•Wind vane: Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind
•Yaw drive: Upwind turbines face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes
•Yaw motor: Powers the yaw drive

GEOTHERMAL

The U.S. leads the world in electric-power generation from geothermal energy. According to the EIA, geothermal energy in 2005 generated approximately 0.36% of U.S. annual electricity generation. Geothermal power generation is concentrated in seven western U.S. states with capacity rated at 2,957 megawatts, with an additional 3,959 megawatts of new capacity planned. Alaska, Arizona, California, Colorado, Florida, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming have projects under consideration or development.

EIA also reports geothermal heat-pump installations have been growing at an annual rate of 15%, with more than 600,000 units installed in the U.S. in 2005. Every year in the U.S., 50,000 to 60,000 new units are installed—the largest growth in the world. This smaller-scale geothermal-energy form is found throughout the country.



Sector Overview

Geothermal energy uses the heat within the earth as an energy source, providing a reliable resource at a stable price. It is an energy source that generates electricity while producing minimal emissions and negative environmental impact. With only a small emission of carbon dioxide, geothermal provides an ability to meet renewable portfolio standards. Geothermal also has the capability to provide heat for agricultural, industrial, commercial and space-heating applications.

Most large-scale geothermal resources are in remote or rural areas, which in the western U.S. tends to be federal or state land. This often leads to legal challenges in developing projects, which makes leasing difficult when dealing with land and environmental requirements, as well as historical and cultural conflicts.

Geothermal has some similarities to the oil industry. The two sectors compete for many of the same resources in drilling equipment, capital, political support and skills. As in oil, there is great risk in drilling and exploration. Therefore, tax credits and other incentives are vital. There is only a 20% success rate for discovering new, untapped resources and 80% in areas where wells are already producing geothermal resources. Geothermal development has an average cost structure of $3.5 million per megawatt.

TECHNOLOGIES

Geothermal energy is considered a renewable resource because the heat emanating from the earth's interior is essentially limitless. Geothermal energy can be used for electricity production, direct-use purposes, and home and commercial-building heating. To develop electricity from geothermal resources, wells are drilled to release natural hot water or steam. This is known as a geothermal reservoir. The reservoir collects many feet below the groundwater table. Wells bring the geothermal liquid to the surface, where it is converted at a power plant into electricity.

A geothermal reservoir is the most common technology type for electricity generation. Wells are drilled more than a mile deep into underground reservoirs that can tap into steam and very hot water capable of powering turbines. For commercial generation, reservoirs need to be more than 150° C—or 302° F—to be efficient.

Dry-steam plants directly use hydrothermal fluids to turn turbines. This type of system requires a natural heat flow close enough to the earth's surface to bring steam or hot water to the earth's surface. Examples are the geysers in Imperial Valley and Yellowstone.

Flash-steam plants are the most common type of geothermal power plants. To drive turbines, they use flashed steam, which is created as high-pressure hot water at temperatures greater than 182° C is pulled into lower-pressure tanks.

Major NAICS codes for manufacturing processes in the geothermal sector

211111	Hydroelectric Power Generation
221119	Other Electric Power Generation
221122	Electric Power Distribution
221330	Steam & Air-Conditioning Supply
237130	Power/Comm Line/Related Structures Const
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel
331421	Copper Rolling, Drawing, & Extruding
331511	Iron Foundries
332111	Iron & Steel Mills
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332996	Fabricated Pipe & Pipe Fitting Mfg
332410	Power Boiler/Heat Exchanger Mfg
332420	Metal Tank (Heavy Gauge) Mfg
332911	Industrial Valve Mfg
332999	All Other Misc Fab Metal Product Mfg
333132	Oil/Gas Field Machinery & Equipment Mfg
333412	Industrial & Commercial fans & blowers
333415	A\C & Warm-Air Heating Equipment & Commercial & Industrial Refrigeration Equipment Mfg
333611	Turbines/Turbine Generators, & Turbine Generator Sets
333612	Speed Changer, Industrial
333613	Power Transmission Equip
333911	Pump & Pumping Equipment Mfg
333912	Air & Gas Compressor Mfg
333923	Overhead Traveling Crane, Hoist, & Monorail System Mfg
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334515	Meter (Instrument Mfg for Measuring & Testing Electricity & Signals)
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution, & Specialty Transformer Mfg
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay & Industrial Control
335931	Electrical Connections
335999	Charge Controller
532410	Construction, Mining & Forestry Machinery & Equip Rental/Leasing

Binary-cycle plants use a secondary fluid, which has a much a lower boiling point, to drive the turbines. These plants use the more moderate temperature water to turn the secondary fluid into a vapor. The geothermal water and working fluid are kept in a closed-loop system to ensure there is no contact.

Direct-use systems utilize geothermal reservoirs found a couple of miles or more beneath the earth's surface. A modern direct-use system drills a hole into a reservoir to access a constant stream of water. This system is composed of piping, a heat exchanger, controls and a disposal system that gets rid of the cold water.

MARKET OPPORTUNITIES

According to the Geothermal Energy Association, geothermal power has increased 20% in 2008 with a capacity of 2,957 megawatts. The AFL-CIO and the Renewable Energy Policy Project estimate that between 2003 and 2013, the sector could create upward of 19,000 manufacturing jobs from renewable industries. In 2008, there were 97 new geothermal power projects in 13 states creating nearly 7,000 jobs.

An EIA projection of growth for the U.S. geothermal industry predicts 2,455 megawatts of new geothermal power will be produced by 2026. Plant construction typically takes from approximately 17 to 33 months and generates 3.1 person-years of work per megawatt. For example, a 50-megawatt plant may require up to 33 months of construction and employ up to 160 workers.

The direct utilization of geothermal energy includes heating pools and spas, greenhouses and aquaculture facilities, space heating and district heating, snow melting, agricultural drying, industrial applications and ground-source heat pumps, the largest application, which encompasses 59% of geothermal energy use. The second largest direct use is in aquaculture.

In addition to the manufacturing of equipment and components, other opportunities in the sector include: providing support services in drilling capacity, data/information technology and power-generation equipment; design, manufacturing, installation and testing a system's air-conditioning and heat-pump components; and securing access to drilling

equipment needed to develop potential resources and maintain speed.

RAW MATERIALS

Geothermal resources range from shallow ground to hot water and rocks several miles below the earth's surface, and even further down to the extremely hot molten rock called magma. Wells more than a mile deep can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for a variety of uses.

The biggest potential for geothermal energy applications in electricity production is in the Western States, primarily in California, Nevada, Idaho and Oregon. Small-scale geothermal direct heat pumps, however, are feasible in most areas of the United States.

In 2006 the National Renewable Energy Laboratory (NREL) released a report that estimates domestic geothermal resources. The report estimates 26,000 megawatts of geothermal power could be developed by 2015, with direct use and heat pumps contributing another 20,000 megawatts of thermal energy. The report suggests by 2025 more than 100,000 megawatts of geothermal power could be in production, with direct use and heat pumps adding another 70,000 megawatts of thermal energy.[9]

PROCESSING & COMPONENT MANUFACTURING

Geothermal installations offer a number of manufacturing opportunities, both in location (drilling) and energy operations. Geothermal heat pumps use a high-pressure refrigerant to move heat between the earth and the heat pump. These systems can be closed where water and an antifreeze solution is circulated through the loop to extract heat from the earth. Alternatively in an open-loop system, water is drawn from a well as a heat sink and then returned to a drainage field. These loops are designed in vertical or horizontal shapes.

Additional special heat pump features can be added to change speed and multiple-speed blowers. This provides an ability to improve comfort and efficiency. Furthermore, there are features that make it possible to produce hot water.

[9]*Geothermal—The Energy Under Our Feet: Resource Estimates for the United States, Bruce D. Green and R. Gerald Nix, National Renewable Energy Laboratory, November 2006.*

Jobs created in the geothermal sector:

Business operations specialist, welders, cutters, testers and sorters, mechanics, pipe/steamfitters, plumbers, machinists, carpenters, construction equipment operators, computer/IT managers, software engineers, computer programmers, environmental engineers, drillers, excavators, surveyors, architects/designers, geologists, hydrologists, electricians, and geophysicists.

Also, hydraulic engineers, civil engineers, mechanical engineer, structural engineers, database administrators, HVAC technicians/contractors, food-processors, aquaculturists, horticulturists, resort managers, spa developers, researchers, government employees, lawyers, accounting and bookkeeping clerks, auditors, general manager, plant manager, maintenance supervisors, janitors and cleaners, purchasing managers, lab managers, technicians, ecologists, truck and tractor drivers, security guards, payroll and timekeeping clerks, inspectors, shipping and receiving clerks, assemblers, sales representatives, biochemists, research and design, sheet-metal workers, metal fabricators, industrial production managers, industrial machinery, training and development specialist, tool and die makers, customer service representatives, laborers, environmental science technicians, mechanical drafters, first-line supervisors, team assemblers, and administrative assistants.

Major companies in the sector

FHP Manufacturing—Florida; Water Furnace International—Indiana; ECONAR Energy Systems—Minnesota; Climate Master—Oklahoma; SPX Cooling Technologies Inc.—Kansas; Metex Corporation—New Jersey; 101 Pipe and Casing—Wisconsin; PowerChem Technology—Nevada; and Mafi-Trench Company—California.

In 2008, Google invested $6.25 million into Altarock Energy and $4 million into Potter Drilling to further develop geothermal technologies, which are already centered in Google's home base of northern California.

In addition, Chevron has invested over $100 million to develop operations in Indonesia. Other investors in the geothermal sector include Berkshire Hathway, United Technologies and Ortmat.

HYDROPOWER

Hydropower accounts for about one-sixth of world's electricity supply and is a proven and well-tested technology. At present, modern hydropower plants allow an energy-efficiency conversion process of more than 90%. Hydropower is already the nation's oldest and largest renewable-energy source, providing nearly 10% of total U.S. electricity and two-thirds of all renewable output. The worldwide installed hydroelectric capacity has increased from around 723,000 megawatts in 2001 to around 857,000 megawatts.

Sector Overview

Hydropower, or hydroelectricity, comes from the energy created by falling or moving water turning the blades of a turbine connected to generators that convert energy into electricity. A hydropower facility's capacity to produce electricity depends on the volume of water flowing through a turbine and the height (called the "head") from which the water falls. The greater the flow and height, the more electricity is produced.

Globally, hydropower now represents 19% of total electricity production. Hydropower produces more than 95,000 megawatts of electricity annually, enough to meet the needs of about 35 million residential customers in California, New York, Ohio, Pennsylvania and Texas.

China, which leads in hydroelectric production as well as installed capacity, is followed by Canada, Brazil and the U.S., which has more installed capacity than Canada or Brazil, but still produces less electricity. Many large-scale hydropower projects have been criticized for environmental concerns including altering wildlife habitats, hindering fish migration, and negatively impacting water quality and flow patterns. As a result of increased environmental regulation, the National Hydropower Association forecasts a decline in large-scale hydropower use in the U.S. through 2020.

New technologies are emerging, however, in small-scale hydropower using hydrokinetic energy, in which the force of water generated by flowing rivers, tides and currents is used to power turbines.

TECHNOLOGIES

There are several types of turbines used for hydropower, categorized by their ability and the technology used to convert water flow into electricity. Companies are consistently working to improve current models with an emphasis on addressing efficiency as well as environmental concerns. Three primary types of turbines are used in producing hydropower: The Kaplan turbine, used in low-head sites, is a propeller-type turbine with adjustable blades; Pelton turbines, employed in high-head sites, use the impulse of water falling in buckets; and Francis turbines, the most common type, are used in heads ranging from 10 meters to several hundred.

Hydrokinetic and ocean-wave technologies include: horizontal-axis (reaction) turbines; cross-flow (helical) turbines; open-center turbines; ducted turbines; Rotech Tidal Turbines; VA Tech; Point Absorbers; Aqua Energy; Ocean Power Technology; Attenuators; Ocean Power Delivery Pelamis; Oscillating Terminators and Overtopping Wave.

MARKET OPPORTUNITIES

Large and small hydropower systems offer opportunities in manufacturing. Turbines, for example, are an integral part of any hydropower installation. Facilities also require automated control systems and safety systems. Each installation must be individually designed, installed and tested. Because it is a mature industry, component parts are needed for maintenance and upgrade of existing operations.

Large-scale hydropower projects usually involve large dams that require a major investment and often run into environmental concerns, but the subsector "small hydro power" uses small diversionary dams to run turbines that generate 30 megawatts or less. These systems have low visibility and due to their small-scale can be easily mass-produced. Unlike solar and wind, water flows are constant and produced energy is non-intermittent.

Also known as hydrokinetic power systems, small hydro is gaining greater attention as the technology matures and gains greater commercial viability. Submerged or partially submerged turbines, usually in an array, are placed in rivers with strong currents or large bodies of water with strong tides. The water current is converted directly into electricity.

Advances in materials, structures, power generation and microelectronics have only recently made hydrokinetic generation commercially viable. Advocates point to its efficient use of natural resources in a way that is minimally invasive to the environment. Unlike small hydro dams, hydrokinetic installations can be established quickly with less on-site construction.

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Hydropower is already the nation's oldest and largest renewable energy source, providing nearly 10% of total U.S. electricity and two-thirds of all renewable output.

PROCESSING & COMPONENT MANUFACTURING

Manufactured component parts required in the hydropower industry include: turbines, brakes, controllers, gearboxes, generators, shafts, rotors, casings, automated control systems and safety systems.

Major NAICS codes for manufacturing processes in the hydropower sector

211111	Hydroelectric Power Generation
221119	Other Electric Power Generation
221122	Electric Power Distribution
237130	Power/Communications Line/ Related Structure Const
331210	Iron/Steel Pipe/Tube Mfg
331421	from Purchased Steel Copper Rolling, Drawing & Extruding
331511	Iron Foundries
332111	Iron & Steel Mills
332996	Fabricated Pipe & Pipe Fitting Mfg
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332911	Industrial Valve
332999	All Other Misc Fab Metal Product Mfg
333415	Air-Con/Warm Air Heating Equip. & Comm/Indust Refrig Equip Mfg
333611	Turbines & Turbine Generators
333612	Speed Changer, Industrial
333613	Power Transmission Equip
333911	Pump/Pumping Equip Mfg
333923	Overhead Traveling Crane, Hoist & Monorail System Mfg
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334515	Meter (Instrument Mfg for Measuring/Testing Electricity & Signals)
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution & Specialty Transformer Mfg
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay & Industrial Control
335931	Electrical Connections
335999	Charge Controller
423720	Plumbing/Heating Equip Merch/Wholesalers
541310	Architectural services
541330	Engineering Design Services
541380	Testing Laboratories
541620	Environmental Consulting Svcs
541690	Energy Consulting Services
541710	R& D in Physical, Engineering, & Life Sciences

Representative jobs in the hydropower sector:

Biophysicists; Clerical; Business Operations Specialists; Civil Engineers; Computer & IT Managers; Computer Programmers; Software Engineers; Construction Equipment Operators; Construction Managers; Database Administrators; Electrical & Electronic Equipment Assemblers; Electricians; Engineering Managers; Environmental Engineers; Environmental Science Technicians; Employment, Recruitment, & Placement Specialists; Industrial Engineers; Industrial Machinery Mechanics; Industrial Production Managers; Inspectors, Testers, & Sorters; Janitors & Cleaners; Laborers; Machinists; Mechanical Engineers; Metal Fabricators; Payroll & Timekeeping Clerks; Plumbers, Pipefitters, & Steamfitters; Purchasing Agents; Research & Design; Sales Representatives; Security Guards; Sheet Metal Workers; Shipping Clerks; Surveyors; Tool & Die Makers; Training & Development Specialists; Truck Drivers; Welders; Accountants; Engineers; & Computer Analysts.

Major companies in the sector:

American Hydro Energy Corp.—Pennsylvania; Bourne Energy—California; Water Wall Turbine & Blue Energy International—British Columbia; Clark Machine—Ontario; Brookfield Renewable Power—Ontario; Dependable Turbines Ltd.—British Columbia; eTurbines Inc.—Texas; Hydro Green Energy—Texas; Hydro West Group—Washington; Rentricity—New York; James Leffel and Co.—Ohio; UEK Corp.—Maryland; and United Hydro Services—Minnesota

BIOMASS

Biomass is one of the world's fastest-growing electricity sources. Drawing on a mature technology, the biomass sector is well-positioned to continue expanding its share of primary energy and electricity production as it gains popular acceptance. The U.S. National Energy Laboratory has calculated the biomass industry creates, on average, 4.9 jobs for every megawatt of power produced.

Sector overview

Biomass is any organic material from plants or animals converted to electricity or fuel. Processing biomass as an energy source emits less greenhouse gas than fossil fuels, and biomass is abundantly available in the United States. Biomass does, however, require energy—usually carbon based—for processing. The industry has also been criticized for diverting crop production from food-crop acreage, usually sugar and corn, thereby contributing to the current rise in food prices.

Biomass material comes from plants and includes: sugar cane and sugar beets (energy stored as simple sugars); corn and other grains (energy stored as starches); or cellulosic biomass (energy stored as complex sugar polymers). Cellulosic biomass is under consideration for bioethanol production and includes: agricultural residues such as the stalks, leaves, and husks of corn plants; forestry wastes (chips and sawdust, dead trees, and tree pruning); municipal solid waste (household garbage and paper products); food processing, industrial wastes and "energy crops" (fast-growing trees and grasses) developed and planted solely for biofuel production.

Agriculture and forestry residues, especially residues from paper mills, are the most common biomass resources used for generating electricity and power. Use of liquid transportation fuels such as ethanol and biodiesel, currently derived primarily from agricultural crops, is also steadily increasing.

MARKET OPPORTUNITIES

In December 2008, President Bush signed the Energy Independence and Security Act. This calls for U.S. production of renewable fuels to reach 36 billion gallons a year—nearly five times current levels—by 2022.

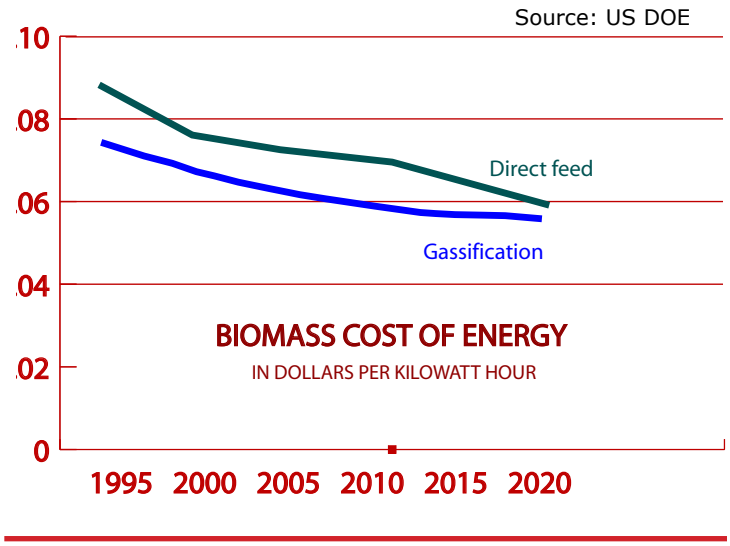
Biomass is the only renewable energy that can be directly substituted for petroleum-based transportation fuels, which account for one-third of U.S carbon dioxide emissions. In 2008, America planned to divert 18% of its grain output for ethanol, chiefly to break its dependency on oil imports.

Biofuel production has accelerated over the last five years, spurred in part by a U.S. drive to produce corn-derived ethanol as an alternative to petrol. Sugar cane and maize, for example, are turned into bioethanol, a gasoline substitute, while rapeseed and palm oil are made into biodiesel. New technology may open the way for the use of nonedible grain stalks to make ethanol, but for now the only biofuel crop that genuinely pays its way is sugar cane, which has proved particularly successful in Brazil.

The potential also exists to produce other fuels, includ-

ing higher alcohols, "green" gasoline and diesel, and aviation fuels produced by enzymatic and microbial and/or catalytic processing of biomass. Significant issues of feasibility, cost and scalability remain, but such advanced biofuels would have numerous advantages such as having energy content comparable to current petroleum-based fuels and easier integration into the existing fuel infrastructure.

Although research and development on cellulosic ethanol has made progress in reducing estimated conversion costs, production costs remain too high for biomass fuels to compete in the marketplace. Transformational breakthroughs in basic and applied science will be necessary to make plant-based biofuels economically viable.



In November 2008, the International Energy Agency predicted renewable energy would overtake natural gas to become the second-largest source of power generation worldwide within two years.

TECHNOLOGIES

Biomass can be burned directly or converted to a gaseous fuel or oil to generate electricity. Major types of biopower systems include direct-fired, co-firing, gasification, anaerobic digestion and pyrolysis.

Biomass can be converted directly into liquid fuels (biofuels) for transportation needs (cars, trucks, buses, airplanes and trains). The two most common types of biofuels are ethanol and biodiesel. Ethanol, used mostly as a fuel additive, is an alcohol made by fermenting any biomass high in carbohydrates (starches, sugars or celluloses) through a process similar to brewing beer. Biodiesel is made by combining alcohol (usually methanol) with vegetable oil, animal fat or recycled cooking greases and can be used as a renewable alternative fuel for diesel engines.

Decaying biomass produces methane, a gas that can be used as an energy source. In landfills, wells can be drilled to release methane from the decaying organic matter. Then pipes from each well carry the gas to a central point where it is filtered and cleaned before burning. Methane also can be produced through a process called anaerobic digestion. This involves using bacteria to decompose organic matter in the absence of oxygen. Gasification systems use high temperatures and an oxygen-starved environment to convert biomass into a gas that runs a turbine.

In addition to gas, liquid fuels can be produced from biomass through a process called pyrolysis, which occurs when biomass is heated in the absence of oxygen. The biomass then turns into a liquid called pyrolysis oil that can be burned like petroleum to generate electricity.

RAW MATERIALS

Any plant-derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, animal wastes, municipal wastes, and other waste materials constituting sources of renewable energy. Examples of materials used thus far are:

- Soybeans, oilseed crops including winter canola and sunflowers, sugar cane and sugar beets and corn
- Agricultural residues (leftover material from crops, such as the stalks, leaves, and husks of corn plants)
- Forestry wastes (chips and sawdust, dead trees, and tree pruning)
- Municipal solid waste (household garbage and paper products)
- Food processing and other industrial wastes (black liquor, a paper manufacturing byproduct)
- Energy crops (fast-growing trees and grasses) developed just for this purpose

The Department of Energy (DOE) suggests U.S. agricultural and forest resources (grasses, wood chips) can provide enough cellulosic ethanol (60 billion gallons a year) to displace about 30% of our current gasoline consumption by 2030.

At the end of 2008, the DOE announced it will invest up to $200 million over the next six years to support pilot- and demonstration-scale bio-refineries that use

Major NAICS codes for manufacturing processes in the biomass sector

111110	Soybean Farming
111120	Oilseed (except Soybean) Farming
111150	Corn Farming
111199	All Other Grain Farming
111998	All Other Miscellaneous Crop Farming
113210	Forest Nurseries/Gathering Forest Prod
115114	Postharvest Crop Activities (except Cotton Ginning)
115115	Farm Labor Contractors/Crew Leaders
115310	Support Activities for Forestry
221122	Electric Power Distribution
236210	Industrial Building Construction
237130	Power/Comm Line/ Related Structures Const
321113	Sawmills
321999	All Other Miscellaneous Wood Product Mfg
322110	Pulp Mills
322121	Paper (except Newsprint) Mills
322299	Fuel cell forms, cardboard, & All Other Converted Paper Product Mfg
324110	Petroleum Refineries
324199	All Other Petroleum & Coal Products Mfg
325193	Ethyl Alcohol Mfg
325199	All Other Basic Organic Chemical Mfg
325211	Encapsulant
327993	Mineral Wool Mfg
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel
331421	Copper Rolling, Drawing, & Extruding
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332410	Power Boiler/Heat Exchanger Mfg
332420	Metal Tank (Heavy Gauge) Mfg
332911	Industrial Valve Mfg
332999	All Other Misc Fab Metal Product Mfg
333120	Construction Machinery Mfg
333210	Sawmill & Woodworking Machinery Mfg
333291	Paper Industry Machinery Mfg
333298	All Other Industrial Machinery Mfg
333411	Air Purification Equipment Mfg
333412	Industrial/Commercial fans/blowers
333414	Heating Equip (except Warm Air/Furnace) Mfg
333415	Air-Con/Warm Air Heating Equip. & Comm./Indust. Refrig. Equip. Mfg.
333611	Turbines, & Turbine Generators, & Turbine Generator Sets
333612	Speed Changer, Industrial
333613	Power Transmission Equip
333911	Pump/Pumping Equip. Mfg
333912	Air/Gas Compressor Mfg
333922	Conveyor/Conveying Equipment Mfg
333923	Overhead Traveling Crane, Hoist, & Monorail System Mfg
333995	Fluid Power Cylinder/Actuator Mfg
333997	Scale/Balance (ex Laboratory) Mfg
333999	All Other Misc. Gen. Purpose Mach. Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334515	Meter (Instrument Mfg for Measuring/Testing Electricity & Signals)
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution, & Specialty Transformer Mfg
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay & Industrial Control
335931	Electrical Connections
336399	All Other Motor Vehicle Parts Mfg
336510	Railroad Rolling Stock Mfg
423720	Plumbing/Heating Equip. Merch./Wholesalers
423930	Recyclable Material Merchant Wholesalers
532412	Construction, Mining & Forestry Machinery & Equip. Rental & Leasing
541310	Architectural services
541330	Engineering Design Services
541380	Testing Laboratories
541620	Envir. Consulting Svcs
541690	Energy Consulting Services
541710	R& D in Physical, Engineering, & Life Sciences
562111	Solid Waste Collection
562212	Solid Waste Land fill
562213	Solid Waste Combustors & Incinerators
562219	Other Nonhazardous Waste Treatment & Disposal
562910	Remediation Services
562920	Materials Recovery Facilities

feedstock such as algae or produce advanced biofuels. This adds to the more than $1 billion already committed to government research, development and the demonstration of cellulosic biofuels technology.

PROCESSING & COMPONENT MANUFACTURING

Bioenergy requires many manufactured components due to the complex processes used in chemical conversion and refinement. The supply chain stages are feedstock production, feedstock logistics, conversion, distribution and end-use.

Storage tanks, mills, valves, pipes, pumps, motors, heaters, filtration systems, agitators, distillation columns, turbines, centrifuges and laboratory/analytical equipment are all part of the refining process. Farm machinery is used in biomass production, and truck and rail transport are required for both the raw material and finished product. The basic production categories are biomass characterization; thermochemical and biochemical biomass conversion technologies; bio-based product development; biomass process engineering and analysis; and the manufacture of boiler units and storage tanks.

As an example, the 2005 Renewable Energy Policy Project (REPP) report concluded the development of biomass steam-generator technology, generating 8,700 megawatts of energy, would involve, on a national basis, 12,447 firms, $5,885 billion and create 37,053 new full-time equivalent jobs. In New York, 1,605 firms would be involved in creating 2,683 new biomass jobs and receive $465 million of investment in manufacturing components to supply this emerging industry.

Representative jobs in the biomass sector:

Jobs created in the biomass sector include: Harvesters, Collectors, Logistics Industry Workers, Pre-processing Workers, Chemical Engineers, Chemists, Chemical Equipment Operators, Chemical Technicians, Mixing and Blending Machine Operators, Agricultural Workers, Industrial Truck Drivers, Farm Product Purchasers, Agricultural and Forestry Supervisors and Laborers, Agricultural Inspectors, Accountants, Lawyers, Office Clerks, Human Resource Managers, Cashiers, and Retail Sales Persons.

Major companies in the sector:

Major companies in the biomass sector include: Axens—France; Ballestra—Italy; BioDiesel International—Australia; BioDiesel Industries—U.S; Coskata—U.S; DuPont Danisco Cellulosic Ethanol—U.S; Ekoil—Ukraine; Energia—Netherlands; Lurgi—U.S; Renewable Energy Group—U.S; Sapphire Energy—U.S.

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NUCLEAR

Although the U.S. was once the leader of commercial nuclear power generation, concerns over plant safety has caused nuclear to become a "not in my backyard" industry. However, growing worldwide awareness and concerns about climate change have made noncarbon-based power generation essential and nuclear power advocates, and now even Patrick Moore, a co-founder of Greenpeace, and Stewart Brand, founder of "The Whole Earth Catalog" advocate for nuclear expansion.[10] That is due to improved safety, better reactor technology and the belief nuclear can deliver far more capacity with much lower subsidies than other alternative-energy applications at present. In addition, some analysts point out there has never been a worker fatality in a U.S. nuclear plant, whereas 41 workers and 16 members of the public have died from wind-related incidents.[11] As a result, the U.S. and many other countries are reconsidering nuclear power's advantages.

Sector Overview

The Nuclear Energy Institute says nuclear plants provide almost 20% of the nation's electricity. With 104 operating nuclear reactors (35 boiling-water reactors and 69 pressurized-water reactors) the U.S. has more reactors than any other country.

The U.S. has not opened a new nuclear power plant since Tennessee's Watts Bar 1 in June 1996, and the last construction on a new plant began on the River Bend facility in Louisiana in 1977. As result, there has been an erosion of the country's industrial infrastructure to build nuclear plants with domestic components. That is expected to change if the federal government proceeds with plans to authorize the construction of up to 20 or more new nuclear facilities starting in 2009 or 2010.

The DOE's Office of Nuclear Energy, Science and Technology is also pursuing the development of next-generation nuclear energy systems known as Generation IV. Two concepts being explored are sodium-cooled fast reactors and very-high temperature reactors, with technology advancing more quickly on the high-temperature concept.

If this new push for nuclear energy as a supplement to other renewable energies takes place, the U.S. industrial nuclear industry will once again experience growth. This will require a need to re-establish forging production, heavy manufacturing, specialized pipe manufacturing, mining, fuel services and the training of necessary skilled labor. Irrespective of this development, the World Nuclear Association reports in addition to the 436 reactors now operating in 30 economies including Taiwan, there are also 43 new reactors under construction and 374 new facilities planned or proposed over the next 15 years.

The American Society of Mechanical Engineers (AMSE) nuclear accreditation known as N stamp is required for any manufacturer supplying nuclear components. The N Stamp certifies the authorized vendor has produced commercial, nuclear-grade components in accordance with the ASME Boiler and Pressure Vessel Nuclear Codes and Standards. This applies to both design and fabrication of components. Few U.S. companies have N Stamp certification for industrial equipment that can be used in new-generation reactors.

N Stamp accredited nuclear engineer facilities have declined in the U.S. from 440 in the mid-1980s to nearly half that over the next two decades. This trend has started to slightly reverse; as of mid-2008, 225 facilities were accredited to make commercial-grade nuclear components.

OPPORTUNITIES

New nuclear plants are built with very large, often called "heavy," nuclear components. At one time, U.S. companies led the world in manufacturing this equipment. Today Japan Steel Works is the world's sole supplier of the ultra-heavy large forgings that are essential in most commercial reactors. These forgings can weigh more than 600 tons, and are used to manufacture large reactor pressure vessels, steam generators and other reactor components. Nuclear plants also require other types of traditional "heavy industry" components, including reactor pressure vessels, heat exchangers, reinforced steel, specialty concrete parts, steel decking, electrical conduit and control cables.

The Clean and Safe Energy Coalition (CASEnergy Coalition), a nonprofit advocacy group for nuclear power, says building new nuclear plants in the U.S. will create a substantial number of jobs in component-part manufacturing. With its need for heavy manufacturing—cast concrete

[10] *"Going Nuclear: A Green makes the Case," by Patrick Moore, Washington Post, April 16, 2006.*

[11] *"Wind Power: More Dangerous Than Nuclear?" by David Masters, www.fairhome.co.uk, February 23, 2009.*

and forged steel—as well as light manufactured parts, the coalition estimates 400 to 700 workers would be needed in the manufacturing supply chain to produce reinforced steel, pipes, cables, pumps, fasteners, insulation, valves and other items needed for new nuclear reactors.

There is a severe shortage of nuclear engineers, radiation technicians, and quality-control and quality-assurance workers. As a result, a new generation will need to be trained in relevant technologies and skills.

PROCESSING & COMPONENT MANUFACTURING

The nuclear supply chain requires firms qualified to provide major components such as steam generators, pressurizers, special engines, tubing, insulation, forgings, nuclear-qualified pipe, pumps, valves, and flanges, concrete, sheet metal, and cable. Assembling all of these inputs into a working nuclear plant will require skilled laborers, including carpenters, sheet-metal workers, and concrete finishers.

Representative jobs in the nuclear sector:

Electrical Technicians, Mechanical Technicians, Reactor Operators, Iron Workers, Millwrights, Insulators, Heavy Equipment Operators, Carpenters, Skilled Laborers, Sheet-Metal Workers, Concrete Finishers, Maintenance Technicians, Radiation Protection Experts, Chemistry Technicians, Plumbers, Nuclear Engineers, Radiation Technicians, Quality Control Instrumentation and Control Technicians, and Quality Assurance Workers Accountants, Engineers, Computer Analysts, Clerks, Factory Workers, Truck Drivers and Mechanics.

Companies in this sector:

Major companies in the nuclear energy sector include: Dominion Resources—Virginia; General Electric—New York; Exelon—Illinois; Cameco Corp.—Canada; U.SEC Inc.—Maryland ; Westinghouse—Pennsylvania; Mitsubishi Heavy Industries—Japan; Toshiba Plant Systems and Services Co.—Japan; Babcock and Wilcox—Virginia; Northrop-Gruman—Virginia; Chicago Bridge and Iron—Chicago; Duke Energy—North Carolina; Iberdola—Spain; Entergy—Mississippi; China National Nuclear Corporation—China; Areva—France; Japan Atomic Power Co.—Japan; United States Enrichment Co.—Kentucky; and UniStar—Maryland.

Babcock and Wilcox Nuclear Power Generation Group (formerly BWX Technologies), a McDermott International subsidiary, specializes in the management of nuclear materials, facilities, and technologies and has been the main N-stamp accredited manufacturer of nuclear power generation components in the U.S. It is the top North American steam generator producer and currently the sole U.S. manufacturing facility for large pressure vessels. In 2006 it entered an agreement with Areva to produce components for UniStar at its Mount Vernon, Indiana plant. Its' Canadian associate has provided nuclear services, steam generators and reactor vessel closure heads to companies worldwide.

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General Electric is also a major supplier of nuclear equipment. Westinghouse, a group company of Toshiba Corporation, is a leading supplier of nuclear plant products and technologies. Northrop-Grumman is planning by 2012 to start producing nuclear grade steel-alloy components such as reactor pressure vessels, steam generators and pressurizers based on designs by French company Areva.

Major NAICS codes for nuclear sector manufacturing processes

221113	Nuclear Electric Power Generation
221122	Electric Power Distribution
237130	Power/Communication Line/Related Const
325188	All Other Basic Inorganic Chemical Mfg
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel
331421	Copper Rolling, Drawing, & Extruding
331511	Iron Foundries
332111	Iron & Steel Mills
332112	Piping & Pressure Vessel Components, Pipets, Nuclear Fitting, Vesselet, Nozzelet
332311	Prefabricated Metal Building/Component Mfg
332312	Fabricated Structural Metal Manufacturing
332313	Plate Work Manufacturing
332322	Sheet Metal Work Manufacturing
332410	Power Boiler/Heat Exchanger Mfg
332420	Metal Tank (Heavy Gauge) Manufacturing
332911	Industrial Valve Manufacturing
332996	Fabricated Pipe & Pipe Fitting Manufacturing
332999	All Other Misc Fab Metal Product Mfg
333120	Construction Machinery Mfg
333298	All Other Industrial Machinery Manufacturing
333613	Power Transmission Equip
333911	Pump/Pumping Equip Mfg
333923	Overhead Traveling Crane, Hoist, & Monorail System Manufacturing
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334515	Meter (Instrument Mfg for Measuring/Testing Electricity & Signals)
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution, & Specialty Transformer Manufacturing
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay & Industrial Control
335931	Electrical Connections
335999	Charge Controller
541310	Architectural services
541330	Engineering Services
541380	Testing Laboratories
541620	Envir Consulting Svcs
541690	Energy Consulting Services
541710	R&D in Physical, Engineering, & Life Sciences
562112	Hazardous Waste Collection
562211	Hazardous Waste Treatment & Disposal
562910	Remediation Services

II-C OTHER GREEN ECONOMY SECTORS

In addition to the direct-renewable energy-generation sectors, other complex industry sectors are an integral part of the Green Economy. Each involves manufacturing, engineering, construction, research, technical training, services and investment. These sectors also have the potential for major growth in construction and the production of equipment and component parts.

ENERGY TRANSMISSION & STORAGE

All the generators of renewable energy, to different degrees, require storage systems for excess energy created during peak output periods for use during off-peak periods. This energy needs to be transported from the point of transmission to a distribution system that delivers it as needed to the end-user. The current transmission/distribution system—called "the grid"—dates back to Thomas Edison's time and evolved with little overall planning over a century. It is based on a system where the point of energy generation, usually a fossil-fuel facility, is near the major population center it is designed to serve.

Because it is frequently dependent on geographical natural resources, which can be costly to transport, a move to renewable energy will require energy created to be moved from areas far removed from major cities. It will need to take up the excess capacity generated in small-scale community energy generation and from within "microgrids" and combine it with energy from large-scale renewable and fossil-energy generators to smoothly deliver electricity wherever it is needed. For efficient delivery, it will require that multiple points of generation communicate with many points of consumption in a structure called a "smart grid."

THE SMART GRID

The smart grid, when funded and built, is envisioned as a means to provide affordable, clean, efficient and abundant electric power connecting the entire U.S. using emerging power distribution technologies. Early in 2009, Congress allocated $11 billion for the development and implementation of smart grid technologies. Some experts, however, estimate the cost of rewiring the whole nation into a smart grid could be more than $3 trillion.

An Information Technology and Innovation Foundation report prepared for the Obama administration transition

team showed a $10 billion smart grid investment would create 239,000 jobs with 140,500 in small business.[12]

GridWise Alliance is a consortium of electricity industry stakeholders that includes such technology powerhouses as Cisco Systems, IBM, Google, General Electric, Hewlett-Packard and SAP, as well as makers of smart meters, demand-response systems and other smart grid devices and services. The alliance estimates up to 280,000 new jobs can be created directly from the deployment of smart grid technologies with approximately 119,000 of those jobs in the manufacturing supply chain.[13]

In addition to traditional steel girders and wiring, the smart grid will require in-home energy devices that provide information and control consumption. Advanced Metering Infastructure (AMI), which creates a network between advanced meters and utility business systems, will maintain two-way communication with the grid to allow consumers to participate in demand-response programs and to feed excess energy back into the grid from individual energy-generating systems. Communication systems will be required to transmit the data. Automated distribution systems—circuit breakers, regulators, reclosers—will be required to run the system efficiently. Additionally, meter data-management systems will be needed to collect and share the gathered data across the national grid's multiple power sources.

The grid will also require considerable back office utility systems and equipment to analyze the data for customer-information systems, outage-management systems, net-metering applications, field work force management and asset-management systems.

MICROGRID OPPORTUNITIES

An emerging market opportunity may lie in microgrids—sometimes called distributed energy or community-energy systems. In a microgrid, one or more relatively small energy generators (up to 10,000 kilowatts) are joined together in a smart-distribution system covering a surrounding geographic area. A microgrid could include a small wind turbine, solar panels, geothermal pump or even small hydro power and join them together, distributing electricity to a campus, industry, neighborhood or community. A microgrid can interact with the main grid as a single entity—rather than individual sources—to sell excess energy or buy supplemental energy as required. A microgrid can also be designed, with sufficient sources to operate independently of the main grid to supply its users with the cheapest energy available at peak times from its multiple sources, which is especially useful in remote locations. Microgrids offer a number of benefits:

- Ability to use multiple sources of renewable energy, or combine them with traditional energy sources from the main grid
- Reduced stress on the main grid
- Less lost energy in transmission due to adjacency of source and end-user
- Reliability through ability to operate independently of main grid in national emergencies, brownouts or power failures
- Smart distribution controlled by end-users
- Ability to sell excess energy as a single entity

A microgrid in an industrial park, for example, could provide its companies with 100% renewable energy, thereby lowering the carbon footprint of a manufactured product. As renewable energy reaches price parity with carbon-based fuels, microgrid systems may also be able to provide cheaper electricity.

A microgrid could also be a significant draw for companies who want to guarantee they will have no power interruptions to critical functions (i.e. server farms). According to a study by the Rand Corporation and the Electric Power Research Institute, outages cost American businesses as much as $100 billion per year. Microgrids require the same basic components as a large grid but on a much smaller scale.

BULK ENERGY STORAGE

Early in 2009, Congress allocated $2 billion for energy-storage research and development. Large-scale energy storage is essential to wide-scale use of renewable energy and the "smart grid" can adjust variable levels of demand. Although hydro, bioenergy and geothermal tends to deliver a constant and consistent energy flow, wind and solar generate power only when the wind blows or the sun shines. This necessitates an ability to store energy for use when generation is not taking place.

Exactly the best way to do this has not been determined, and most likely a mix of different technologies will be

[12] *"The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America,"Information Technology and Innovation Foundation (ITIF) January 2009.*

[13] *The U.S. Smart Grid Revolution: KEMA's Perspectives for Job Creation, Report for GridWise, KEMA Consulting, January 2008.*

used. Some of them are surprisingly mechanical in nature and will require manufactured component parts.[14]

Pumped hydroelectric is one means of bulk-energy storage. This requires large reservoirs where water is released over a dam with turbines during peak daytime demand when prices are high. The water would then be pumped back into the reservoir at night when prices are low. Flywheels can also be used to store energy, taking energy in when it is wound up and releasing it a later time.

Another bulk energy storage system uses energy generated to produce compressed air stored in a large, usually underground, chamber. This would then be released to turn turbine-generating electricity based on demand. Both pumped hydro and compressed air are often limited by geographic and geological constraints. In addition, hydrogen fuel cells are under development for large-scale use. They would use a renewable energy source to split water into hydrogen and oxygen that can then be recombined in a process that generates energy.

Other researchers are looking at various types of batteries, notably lithium-based. These could be manufactured to hold large-scale energy. The development of super-capacitors and super-conducting magnets are also being looked at as possible bulk-energy storage systems.

[14] *"Efforts turn to storage for renewable energy," By Carolyn Y. Johnson, Boston Globe, Sept. 1, 2008.*

To operate with the greatest efficiency, microgrid systems also require energy storage. They may be able to utilize flywheel, battery or cell technologies at lower cost than a large-scale grid.

These systems require construction and equipment that will yield opportunities for the manufacture of component parts. New York is considered a leader, along with California, in energy storage. The state, through New York State Energy Research and Development Authority (NYSERDA) has partnered with Sandia National Laboratories and the DOE in demonstration projects for flywheel and substation battery storage technologies.

PROCESSING & COMPONENT MANUFACTURING

Smart grid development involves adding new pipes and wires. It also includes design, construction, equipment, and labor. Equipment and material will be required for upgrades to aging transmission and distribution lines.

Smart grid implementation will stimulate accelerated growth for: raw materials providers; meter manufacturers; substation equipment makers; network and server equipment manufacturers; intelligent transmission and distribution automation device makers; communications system providers and software system providers; smart thermostat makers; and smart appliance manufacturers.

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Representative jobs in the ETS sector:

Project Managers; Contracts Administrators; Resource Managers; Vendor Managers; Test & Verification Specialists; Regulatory Compliance Officers; Grid Component Installers; Laborers; Line Workers; Metering Specialists; IT Software Specialists; System Planners & Engineers; Filed Technical Support Specialists; Residential Commercial Meter Building Installers & Grid Operators; Accountants; Engineers; Computer Analysts; Clerks; Factory Workers; & Truck Drivers.

Major companies in the smart grid sector:

General Electric and Landis+Gyr—New York; Itron—Washington; Sensus Metering Systems—North Carolina; Silver Springs Networks, Google and eMeter—California; GridPoint—Virginia; Comverge—New Jersey; Trilliant—California; Tendril—Colorado.

Almost all major U.S. utilities will be a part of smart-grid development. Utilities leading in the field include: Southern California Edison, PG & E, Xcel Energy, Austin Energy, Sempra, Oncor and San Diego Gas and Electric.

Major companies in the sector include: Beacon Power Corp.—Massachusetts; Xcel Energy—Minnesota; CAES Development—Ohio; GridPoint—Virginia; BYD Co.—China; VRB Power Systems—Canada; NGK Insulators & Sumitomo Electric Industries Ltd.—Japan.

Major NAICS codes for manufacturing processes in the Energy Transmission and Storage industry sector

221119	Other Electric Power Generation
221122	Electric Power Distribution
237130	Power/Communications Line/ Related Structures Const
331421	Copper Rolling, Drawing & Extruding
332111	Iron & Steel Mills
332112	Nonferrous Forging
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332911	Industrial Valve Mfg
332999	All Other Misc Fabricated Metal Product Mfg
333415	Air-Con/Warm Air Heating Equip & Comm/Industrial Refrigeration Equip Mfg
333613	Power Transmission Equip
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334512	Automatic Environmental Control Mfg for
334513	Residential, Commercial, & Appliance Use Instruments/Related Products Mfg for Measure, Display &Control
334515	Meter (Instrument Mfg for Measuring & Testing Electricity &Electrical Signals)
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution, & Specialty Transformer Mfg
335312	Motor & Generator Mfg
335313	Switch gear/Switchboard Apparatus Mfg
335314	Relay/Industrial Control Mfg
335911	Storage Batteries
335931	Electrical Connections
541310	Architectural services
541330	Engineering Design Services
541380	Testing Laboratories
541618	Utilities Mgt Consulting Svcs
541620	Environmental Consulting Services
541690	Energy Consulting Services
541710	R&D in Physical, Engineering, & Life Sciences

GREEN BUILDINGS

Residential and commercial buildings account for nearly 40% of U.S. energy consumption, and green-building and retrofitting technologies make it possible to reduce this percentage by making buildings use energy more efficiently. Energy efficiency pays for itself in the long run by reducing energy costs. At the same time it creates high-quality permanent jobs. In addition to being extremely cost-effective to the consumer, energy efficiency and green building/retrofitting is highly marketable to green consumers, as many scientists and environmentalists believe energy-efficient products and sustainable buildings are the least expensive and most plausible way to combat global warming.

TECHNOLOGIES

Energy-efficiency technologies can be applied on residential and commercial levels. Many of the technologies are the same but will exist on larger scales in commercial buildings. The primary aspect of green building is the "whole-building approach," where the house is viewed as an integrated system with each component working together to maximize energy efficiency. The technologies employed to achieve energy efficiency include appliances, building envelope, lighting and water heating. All of these aspects differ in scale and approach depending on factors such as climate and residential versus commercial buildings.

APPLIANCES

Products that have earned an Energy Star meet strict guidelines set by the EPA and DOE on energy efficiency and household products, ranging from toasters to computers have been approved by Energy Star. The main energy-using appliances in the home are clothes washers, dishwashers, refrigerators and freezers, and room air conditioners. Smart appliances are not only energy efficient, but also have the ability to communicate with a smart grid system to run at periods of low demand and least cost. In fact, plugging a smart appliance into a smart grid will be the equivalent of connecting a computer to the Internet, since both systems exchange information.

The U.S. appliance industry is relatively mature, with three dominant companies; Whirlpool, General Electric, and Sweden's Electrolux all produce full lines of major household appliances for cooking, refrigeration and laundry. Haier from China is also rising as an emerg-

ing competitor. In addition, Panasonic/Matsushita and Hitachi are moving to introduce environmentally friendly and green appliances and over time, given the trend toward integration and a whole-building approach, we are likely to see firms such as Apple and Microsoft moving to upgrade the importance of IT-oriented solutions. For example, cell phones can be used to regulate heating and lighting and to check on conditions in the home or office. In fact, Google has already entered the field with the introduction of a home energy-monitoring service.

U.S. manufacturing exports of appliances have steadily decreased in recent decades, and the majority of large appliances are now produced in other countries since the market is driven by price and there are economies of scale to overseas production. This could change with high energy and transport prices or government incentives for energy-efficient appliance production. The appliances sector creates local jobs in sales, installation and service.

BUILDINGS

The term "building envelope" describes the separation between a building's interior and exterior parts, and includes the foundation, roof, walls, doors and windows. By building or improving on the building envelope with energy-efficient materials, home-heating cost is lowered and less energy is used. Caulking and weather strips are the most common and least expensive energy retrofits. These are the least durable parts and have to be replaced whenever necessary to ensure there are no leaks. The next most obvious elements are windows and doors. Buildings built in earlier times when energy was less expensive are inefficient, and the windows and doors need to be updated to more energy-efficient models. Last of all, ventilation mechanisms need to be properly maintained and insulated.

New technologies such as plastic honeycomb vents, masonry sealers, wall flashings, control vents and new sealants improve energy efficiency and durability of ventilation systems.

The cost of lighting in the United States amounts to 22% of the total electricity generated in the country. As an aspect of energy-efficient building, different technologies reduce the amount of energy used for lights. Design innovations also seek to take advantage of natural sunlight, reduce heat generated by light to lower air-conditioning costs and automate lights so they are only on when necessary. Incandescent bulbs have been most commonly used due to their low costs, but they are inefficient at converting electricity compared to more expensive fluorescent, LED, and high-intensity discharge lights, which contribute to lower electric bills in the long run. Other technologies include improved fixtures, dimmer switches to use less electricity when less light is needed, and occupancy sensors, which turn off lights when nobody is in a room.

The DOE says water heating accounts for 14% of household electricity costs. This large expense to consumers is often wasted as warm water sits unused in a tank. There are many approaches to green water heating, one of the more popular being tankless water heaters that heat water as it is needed instead of storing it. Solar water heating systems are another option. Combination approaches aim to combine various aspects of a building's water and space heating.

Other aspects of the building-envelope approach include designs that take advantage of natural resources, automated systems to efficiently control utilities in a house and energy-producing components such as PV panels included as part of the building.

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), provides a suite of standards for environmentally sustainable construction. In the United States and in a number of other countries around the world, LEED certification is the recognized standard for measuring building sustainability. It is designed to promote design and construction practices that increase profitability, while reducing the negative environmental impacts of buildings and improving occupant health and well-being.

In overall commercial-building ratings, the highest category are distinguished as Silver, Gold and Platinum. Different versions of the rating system are available for specific project types:

•LEED for New Construction: Includes major renovations (the most commonly applied-for certification)
•LEED for Existing Buildings
•LEED for Commercial Interiors: fit-outs by tenants
•LEED for Core and Shell: total building minus tenant improvements
•LEED for Homes
•LEED for Neighborhood Development
•LEED for Schools: Recognizes the unique nature of the design and construction of K-12 schools
•LEED for Retail: Consists of two rating systems, one

based on New Construction and Major Renovations version 2.2. and the other track based on LEED for Commercial Interiors version 2.0.

OPPORTUNITIES & OUTLOOK FOR SECTOR

Studies at the beginning of 2009 indicate despite world economic problems, green building could be one of the growing bright spots for the American economy. The USGBC believes this is due to the emphasis U.S. national recovery plans are placing on green jobs and infrastructure as well as the desire of consumers and businesses to cut energy and operating costs in their homes and commercial facilities.

"The future of our built environment clearly centers on energy efficiency, water reduction, systems that encourage cleaner indoor air, the use of recycled and more sustainably developed materials, and communities that coexist with their environments," USBGC President and CEO Rick Fedrizzi said in a Jan. 13 press release.

Turner Construction, one of America's largest green builders, conducted a study and survey at the end of 2008 called "Green Building Barometer" and found, despite current financing difficulties, two-thirds of professionals in commercial real estate would still build green, with 64% indicating overall lower operating costs in existing green buildings.

USBGC also points to a 2008 McGraw-Hill Construction survey showing interest in green homes reaches even to lower-income workers. The survey indicated 70% of potential home buyers were inclined to buy a green home, and that preference was 78% for those earning less than $50,000 per year.

McGraw-Hill Construction's Green Outlook 2009 report "Trends Driving Change" stated while green buildings are now 10% to 12% of the current commercial and institutional market, this could rise as high as 25% by 2013. If that were to happen, the total green building market including residential could reach more than $100 billion, more than double 2008's figures.

A survey of commercial building owners jointly funded by Incisive Media's Real Estate Forum and GlobeSt.com, the Building Owners and Managers Association (BOMA) International and USGBC indicated 45% were making plans to invest in sustainability and efficiency in their existing properties during 2009.

Freerange photo

Jobs in the Green Building sector:

Green building and retrofitting is done not by specialists but by traditional workers such as plumbers, electricians and roofers trained in new green technologies. Manufacturing of green appliances, roofing, insulation, etc. is often done in preexisting factories that employ new technologies. The main area of green building that requires manufacturing unique to the industry is PV panel production.

To obtain LEED certification, however, the work force must be be properly trained in techniques like ratings, placement, installation and maintenance. Green building professionals, through the LEED Accredited Professional Exam, are enabled to facilitate building ratings with various LEED systems. The Green Building Certification Institute administers the accreditation and many community colleges now provide courses to prepare candidates for LEED certification exams.

The manufacture of energy-efficient appliances and materials could greatly increase U.S. manufacturing and to create more manufacturing and factory-based jobs. In 2006, the energy-efficiency industry created 8 million jobs, with more than 50% in manufacturing. Second and third place were recycling and construction.

Jobs in the sector include: Construction Laborers, Sheet-Metal Workers, Electricians, Heating/Air Conditioning Installers, Carpenters, Cement Masons and Concrete Finishers, Hazardous Materials Removal Workers, Plumbers, Boilermakers, HVAC System Engineers, Construction Equipment Operators, Roofers, Insulation Workers, Carpenter Helpers, Industrial Truck Drivers, Construction Equipment Operators, Accountants, Lawyers, Office Clerks, Hu-

man Resource Managers, Cashiers, Retail Salespersons, Construction Managers, Accountants, Lawyers, Clerical Workers and Building Inspectors.

Major companies in the Green Building sector

It is hard to identify major companies in the field of green building because most construction firms are localized or extremely specialized in a specific aspect of green building. In the manufacturing field, there are a number of companies that produce energy efficient appliances as well as building components. Not surprisingly, the major players in the energy efficient appliances industry are the same companies that have been major players in the appliance industry for years.

GE Consumer and Industrial is General Electric's appliance branch and is one of the largest suppliers of appliances in the world. Their main factory in the United States is Appliance Park located in Kentucky.

Major NAICS codes for manufacturing processes in the Green Building sector

221122	Electric Power Distribution
236115	New Single Family Housing Const/
236116	New Multifamily Housing Const
236117	New Housing - (spec) operative builders
236118	Residential Remodelers
236210	Industrial Building Construction
236220	Comm/Instit Building Construction
237130	Power/Comm Line/Related Structures Const
238220	Plumbing, Heating, & Air-Conditioning Contractors
321999	All Other Miscellaneous Wood Product Mfg
326199	All Other Plastics Product Mfg
327211	Top Surface
327993	Mineral Wool Mfg
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel
331421	Copper Rolling, Drawing, & Extruding
332111	Iron & Steel Mills
332311	Prefabricated Metal Building/Component Mfg
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332999	All Other Misc Fab Metal Product Mfg
333120	Construction Machinery Mfg
333411	Air Purification Equipment Mfg
333412	Industrial/Commercial fans/blowers
333415	Air-Con/Warm Air Heating Equip & Comm/Indust Refrig Equip Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334512	Automatic Environmental Control Mfg for Residential, Commercial, & Appliance Use
334513	Instruments/Related Products Mfg for Measure, Display & Control
334515	Meter (Instrument Mfg for Measuring & Testing Electricity & Electrical Signals)
334519	Other Measuring/Controlling Device Mfg
335110	Electric Lamp Bulb/Parts
335121	Resid Electric Light Fixtures
335122	Commercial, Industrial, Instit Lighting Fixtures
335129	Other Lighting Equipment (floodlights, street lights)
335221	Household Cooking Appliance
335228	Other Major Household Appliances
335311	Power, Dist, Spec Transformers
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus
335314	Relay & Industrial Control
335911	Storage Battery
335912	Primary Battery
335931	Electrical Connections
335999	Charge Controller
423720	Plumbing/Heating Equip Merch/Wholesalers
532412	Construction, Mining, & Forestry Machinery & Equipment Rental & Leasing
541310	Architectural services
541330	Engineering Services
541350	Building Inspection Services
541380	Testing Laboratories
541420	Indust Design Svcs (Energy Effic)
541618	Utilities Mgt Consulting Svcs
541620	Envir Consulting Svcs
541690	Energy Consulting Services
541710	R & D in Physical, Engineering, & Life Sciences
562111	Solid Waste Collection
562119	Other Waste Collection
562212	Solid Waste Land fill
562213	Solid Waste Combustors & Incinerators
562219	Other Nonhazardous Waste Treatment & Disposal
562910	Remediation Services
562920	Materials Recovery Facil
562991	Septic Tank & Related Svcs
562998	All Other Misc Waste Mgt Svcs

Whirlpool has many factories to produce products for the brand as well as subsidiaries such as Maytag and KitchenAid. Their major United States factories are located in Ohio, Indiana, Arkansas, and Michigan.

Haier (China) is also emerging as a full line appliance manufacturer, and Matsushita and Hitachi (Japan) are dedicating substantial resources to the development and manufacturing of smart appliances.

Major players in the manufacturing of energy efficient CFL and LED light bulbs include: Maxlite—New Jersey; Phillips—Netherlands; and General Electric—New York.

Other significant companies in the green building sector include: Turner Construction Co.—New York; Homasote Co.—New Jersey; iCrete—California; Plyboo—California; Relfectix—Indiana; Radiant Floor Company—Vermont.

Freerange photo

TRANSPORTATION

Alternative fuel options for auto and mass transit include electric energy or batteries, ethanol or alcohol fuels, biodiesel, and natural gas. Biodiesel and natural gas are the most mature and available technologies. Ethanol is now being produced and added to the fossil fuel supply. Electric energy is now being used in hybrid automobiles and the auto industry's goal is to develop all-electric vehicles. Furthermore, new materials, such as plastics, specialty metals, thermoelectric materials and a range of other technologies, materials and devices are being developed to reduce vehicle weight and to otherwise allow increased energy and other efficiencies.[15]

Technologies & opportunities

The development and production of sophisticated rechargeable secondary batteries and accumulators are needed for the new "green vehicle" industry. Current battery systems remain a significant barrier to widespread adoption of electric vehicles. Vehicles demand batteries that are lightweight, provide bursts of high power and offer a long life. As demonstrated by the many new offerings from major auto manufacturers shown at the recent 2009 Detroit Automobile Show, the surge toward electric vehicles also appears to be jumpstarting investments in U.S. advanced-battery R&D and production.

According to an annual global survey[16] by KPMG LLP, over the next five years automotive manufacturers are expected to intensely focus investment on new models, products and technologies to satisfy consumer demand for fuel-efficient, affordable cars. Asked to rate the importance of automotive product innovations over the next five years, forecasters rated hybrid systems, fuel-cell technology, advanced materials and electric and battery technology at the top of their wish list.

Stressing the need for energy independence as well as the desire for the U.S. to maintain its technological leadership, American auto executives have warned that without homegrown suppliers, the country could become as dependent on Asian-made batteries as it is on oil from the Middle East and elsewhere. Smaller,

[15] *"New Material to Improve Gas Mileage in Automobiles," The AZo Journal of Materials Online, www.azom.com Oct. 10, 2008.*

[16] *"Momentum: KMPG's Global Auto Executive Survey 2009, KMPG International, December 2008.*

more advanced lithium-ion batteries are now becoming the gold standard for car companies and electric and hybrid cars are being designed—and soon will be in production—that look, feel and handle much like standard gas vehicles. However, these batteries are mostly Asian-made, though some of the technology has been developed in the U.S. in government labs, universities and by firms such as 3M and General Electric.[17]

Fuel cells are another important component in advanced electrical energy storage. Vehicles based on this technology are expected to have a great advantage over battery-powered electric vehicles. They eliminate charging time, allow a wide range of speeds, and operate as long as fuel is supplied. Fuel cells use a chemical reaction, rather than combustion to produce electricity. They are more efficient, environmentally-preferable, and have fewer moving parts. They are also more reliable and easier and cheaper to maintain.

For the near term at least, biofuels will be an important way to reduce emissions and dependence on fossil fuels. Clean diesel technology offers up to 40% savings over conventional fuel while reducing greenhouse gas emissions by about 20% compared to gasoline. Manufacturers with diesel products in their 2009 lines include Volkswagen, Mercedes-Benz, Audi and BMW. Chrysler, Ford, GM, Honda, Mitsubishi, Nissan and Subaru have also indicated they intend to introduce clean diesel engines in their light-duty cars and trucks.

Ultra-low sulfur diesel (ULSD) and biodiesel can be used in diesel vehicles. ULSD contains significantly less sulfur than traditional diesel fuel and can be safely used in all vehicles. Biodiesel, created from feed stocks, can also be used in diesel vehicles when mixed with conventional diesel fuel in low percentages. An additional transportation manufacturing opportunity is in high-speed rail. Intercity high-speed rail at speeds of up 150 mph—can be expected to generate significant numbers of construction and manufacturing jobs in building track and rolling stock. Early in 2009, Congress allocated $9.3 billion for intercity rail projects.

PROCESSING & COMPONENT MANUFACTURING

Processing and component manufacturing is similar to some aspects of energy storage and biomass energy.

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[17] *"Detroit Goes for Electric Cars but Will Drivers?" by Bill Vlasic, The New York Times, Jan. 10, 2009.*

Jobs in the Transportation sector include:

Civil Engineers, Rail Track Layers, Electricians, Welders, Metal Fabricators, Engine Assemblers, Production Helpers, Bus Drivers, First-Line Transportation Supervisors, Dispatchers Energy-Efficient Automobiles Computer Software Engineers, Electrical Engineers, Engineering Technicians, Welders, Transportation Equipment Painters, Metal Fabricators, Computer-Controlled Machine Operators, Engine Assemblers, Production Helpers, Logistics Industry Workers, Chemical Engineers, Chemists, Chemical Equipment Operators, Chemical Technicians, Mixing and Blending Machine Operators and Operations Managers.

Major companies in the sector:

For electric battery production, energy-efficient transportation development will be a global competition among some of the world's largest companies. Nissan and Japanese electronics giant NEC plan to invest $115 million over the next three years to make advanced lithium-ion batteries. For electric vehicles, Toyota, partnering with Matsushita Electric, will invest nearly $700 million to do the same. MidAmerican Energy, (controlled by Warren Buffett's Berkshire Hathaway) has invested $230 million for a 10% stake in China's car and battery maker BYD. General Motors will establish its own lithium-ion battery pack manufacturing facility.

Biodiesel and other biofuels are oriented toward domestic production. Major companies include: ADM—Illinois; Cargill—Minnesota; Lake Erie Biofuels—Pennsylvania; Renewable Energy Group—Iowa; Peach State Labs—Georgia; and Peter Cremer North America—Ohio.

Major NAICS codes for manufacturing processes in the green Transportation sector

326299	Fuel cells, solid-state
327993	Mineral Wool Mfg
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel
331421	Copper Rolling, Drawing & Extruding
331511	Iron Foundries
332111	Iron & Steel Mills
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332996	Fabricated Pipe & Pipe Fitting Mfg
332410	Power Boiler/Heat Exchanger Mfg
332420	Metal Tank (Heavy Gauge) Mfg
332911	Industrial Valve Mfg
332999	All Other Misc Fab Metal Product Mfg
333411	Air Purification Equipment Mfg
333412	Industrial/Commercial fans/blowers
333414	Heating Equip (except Warm Air Furnace) Mfg
333415	Air-Con/Warm Air Heating Equip & Comm/Indust Refrig Equip Mfg
333911	Pump/Pumping Equip Mfg
333912	Air/Gas Compressor Mfg
333922	Conveyor/Conveying Equipment Mfg
333923	Overhead Traveling Crane, Hoist, & Monorail System Mfg
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334519	Other Measuring/Controlling Device Mfg
335311	Power, Distribution & Specialty Transformer Mfg
335312	Motor & Generator
335313	Switch gear/Switchboard Apparatus Mfg
335911	Storage Battery
335912	Primary Battery
335931	Electrical Connections
335999	Charge Controller
336111	Automobile Mfg
336112	Light Truck & Utility Vehicle Mfg
336399	All Other Motor Vehicle Parts Mfg
336510	Railroad Rolling Stock Mfg
541330	Engineering Design Services
541690	Energy Consulting Services
541710	R&D in Physical, Engineering & Life Sciences

SOLID WASTE MANAGEMENT

The U.S. Environmental Protection Agency (EPA) collectively refers to waste remediation and recycling as Integrated Solid Waste Management (ISWM). Major components include waste prevention, recycling and composting, and combustion and disposal in properly designed, constructed and managed landfills. Remediation and disposal can also encompass the capping, isolation or maintenance of permanently contaminated sites, the removal of hazardous material from a contaminated site for industrial reuse (brownfields), or the development and implementation of technologies that isolate and contain byproducts of manufacturing or energy production.

Sector overview

Growing awareness of the need to reduce waste and to promote the recovery and reuse of discarded materials is driving industry growth. Broad sectors of particular importance include automotive waste (e.g., tires), oil recycling, the plastics industry, the electrical/electronics industry and all industries within the packaging chain. In addition, carbon sequestration and the rehabilitation of former industrial facilities have become important components in environmental remediation.

The industry is constantly researching and developing new "green technologies" to improve disposal methods such as incineration, waste separation, recycling, chemical and effluent treatment and waste monitoring. Generally, the European Union countries are considered leaders in waste reduction, recovery and reuse of discarded materials.

Toxic substances in environment-generated manufacturing processes or even home use of chemicals are termed hazardous wastes. Ideally, hazardous wastes are reused or recycled. If this is not possible, hazardous waste is safely contained while it is stored, transported and properly disposed to prevent accidental release into the environment. Typical methods of hazardous-waste storage and disposal include surface impoundments (storage in lined ponds), high-temperature incineration (controlled burning), municipal and hazardous-waste landfills (burying in the ground), and deep-well injection (pumping into underground wells). More promising methods focus on minimizing waste, reusing and recycling chemicals, finding less hazardous alternatives and using innovative treatment technologies.

The EPA states U.S. recycling facilities constitute a $160 billion-a-year industry that processes more than 600 million tons materials annually, creating 1.5 million jobs.[18]

Market opportunities

Remediation activity can be on- or off-site. This generally falls into the classification of biological, physical/chemical, electrical, thermal and biological. All of these techniques generate manufacturing opportunities: containment vessels, liners, incinerators, drilling equipment, specialized transport, soil-treatment machinery and earth-moving equipment are a few of many items typically required in hazardous-waste remediation.

Waste management increasingly depends on new technology, such as computers to plot the most efficient waste collection routes and GPS to track equipment. More sophisticated materials-handling equipment is being used to move waste, such as large dumpsters that can be loaded and unloaded by one person, or front-end loaders that automatically weigh the contents. Landfills design and operation, dictated by a vast numbers of regulations and restrictions, is a complicated engineering task involving the latest technologies.

Brownfields

It is estimated the U.S. has more than 450,000 brownfields, properties where expansion, redevelopment or reuse is stymied by the presence of a hazardous substance, pollutant or contaminant. Working with communities and states, the EPA provides grants to clean up and reuse the property, often for manufacturing or commercial use or as a public space.

The EPA provides grants for assessments, technical assistance, cleanups and job training. The agency says it has leveraged more than $6.5 billion in brownfields cleanup and redevelopment funding from the private and public sectors, creating approximately 25,000 new jobs. Unlike other types of land revitalization programs, brownfields create additional jobs by reuse of the property and returning it to local taxation.

Brownfields can be well-suited to alternative-energy reuse. In some cases, more intense land use is impractical because of weak market conditions or contamination makes redevelopment with commercial buildings impractical. However, wind farms and solar fields can be developed on sites that may not work for other uses. Flexible regulatory approaches allow productive alternative-energy uses of contaminated property. For example, a wind farm or solar field might be allowed as a surface use of property that is impractical to clean up for more job-intensive uses.

Waste management increasingly depends on new technology . . .

One area of opportunity is the redevelopment of brownfield sites as alternative or renewable energy production facilities. The "Brightfields" program, a DOE initiative, specifically promotes the redevelopment of brownfields to use solar technology to generate both clean energy and revenue for the community.

Carbon sequestration

Another market opportunity is carbon sequestration—or carbon capture and storage—a process by which carbon dioxide is captured at its source—such as power plants or industrial processes—and subsequently stored in nonatmospheric reservoirs such as depleted oil and gas reservoirs, unusable coal seams, deep saline formations, or lakes and oceans. The long-term storage of carbon dioxide is a relatively untried process and a number of different technologies are being researched to accomplish this process.

If a successful and commercially viable process is developed, carbon sequestration could reduce factory air pollution by as much as 80%, according to some experts in the industry. This is the essential component of "clean coal," the burning of coal to capture emissions and therefore create a more eco-friendly fossil fuel, which the U.S. has in abundance.

According to the DOE, present technology sequestration costs are in the range of $100 to $300 per ton of carbon emissions avoided. The goal of the program is to reduce the cost of carbon sequestration to $10 or less per net ton of carbon emissions avoided by 2015.

An important industry segment is asbestos removal and disposal. Asbestos, which is hazardous when inhaled, was used in a wide variety of building materials and building components during the 20th century. The widest use occurred from 1940 to 1975 and many buildings of that era now have to undertake asbestos removal before renovation or demolition.

[18] *U.S. Recycling Economic Information, study for U.S. Environmental Protection Agency/National Recycling Coalition by R. W. Beck Inc. July 2001.*

Recycling

Recycling, the process of making something old and used into something of value, prevents wasting useful materials, reduces the need for new raw materials, and potentially reduces energy usage and the need for land -filling and its potential pollution-associated problems. The major recyclable materials are metal, paper, plastic, glass, textiles and electronics.

A major benefit of recycling is that is takes less energy to produce recycled material than "virgin" material. This lowers materials costs for paper and steel mills, iron foundries, plastics converters, computer manufacturers, composters, and wood-product manufacturers. The National Recycling Coalition estimates there are 56,000 recycling processing facilities in the U.S.

According to the Steel Recycling Institute, the North American steel industry annually uses millions of tons of steel scrap from recycled cans, automobiles, appliances, construction materials and other steel products. Due to environmental, energy and landfill concerns, more communities are operating recycling programs that include steel cans and some recycle appliances. Nucor Steel for example has made recycling an essential part of its business strategy.

The U.S. Council for Automotive Research says cars are the most recycled consumer product in terms of percent and volume. More than 95% of all end-of-life vehicles go through a market-driven recycling infrastructure.

Rapid technological change, low cost and short product cycles have made electronic waste one of the fastest growing waste problems. This includes computers, televisions, entertainment devices, mobile phones and other electronics. They represent about 70% of toxic heavy metals found in landfills.

The EPA estimates, at best, only about 18% of electronic waste is recycled. Some electronics contain valuable recyclables, although removing them can be difficult due to toxicity. Possible solutions include curbside pick-off and buyback programs and magnetic separation at resource recovery facilities. Many environmental advocates favor legislation that would make manufacturers responsible for taking back their products at end of life.

More and more states and local governments are mandating waste-reduction programs, such as prohibiting the disposal of yard wastes and newspaper, which contribute 50% of the material placed in landfills. California leads this effort with a 50% waste-diversion law. In addition, its jurisdictions are creating new waste-handling infrastructures to include curbside recycling, material recovery facilities and composting operations.

Major NAICS codes for the Solid Waste Management industry

236210	Industrial Building Construction
331421	Copper Rolling, Drawing, & Extruding
332312	Fabricated Structural Metal Mfg
332322	Sheet Metal Work Mfg
332420	Metal Tank (Heavy Gauge) Mfg
332911	Industrial Valve Mfg
332999	All Other Misc Fab Metal Product Mfg
333120	Construction Machinery Mfg
333298	All Other Industrial Machinery Mfg
333411	Air Purification Equipment Mfg
333922	Conveyor/Conveying Equipment Mfg
333923	Overhead Traveling Crane, Hoist, & Monorail System Mfg
333995	Fluid Power Cylinder/Actuator Mfg
334112	Computer Storage Device Mfg
334418	Printed circuits & electronics assemblies
334513	Instruments/Related Products Mfg for Measure, Display & Control
334519	Other Measuring/Controlling Device Mfg
335312	Motor & Generator Mfg
335314	Relay/Industrial Control Mfg
335931	Electrical Connections
423930	Recyclable Material Merchant Wholesalers
541310	Architectural services
541330	Engineering Services
541380	Testing Laboratories
541620	Env Consulting Services
541690	Energy Consulting Services
541710	R&D in Physical, Engineering, & Life Sciences
562111	Solid Waste Collection
562112	Hazardous Waste Collection
562119	Other Waste Collection
562211	Hazardous Waste Treatment & Disposal
562212	Solid Waste Landfill
562219	Other Nonhazardous Waste Treatment & Disposal
562910	Remediation Services
562920	Materials Recovery Facil
562991	Septic Tank & Related Svcs
562998	All Other Misc Waste Mgt Services

Jobs in Solid Waste Management include:

Environmental Scientists and Specialists, Environmental Engineers, Construction Managers, Registered Geologists, Registered Asbestos and Lead Consultants, Electrical Engineers, Mechanical Engineers, Hazardous Materials Workers, Water and Liquid Waste Treatment Plant Operators, Environmental Science Protection Technicians, Refuse and Recyclable Material Collectors, Environmental Engineering Technicians, Accountants, Computer Technicians, Clerks, Factory Workers, Truck Drivers, and Mechanics.

Major companies in the sector:
Waste Management, with annual revenues of $13.9 billion, is the undisputed world leader in nearly all facets of waste treatment, including low-level nuclear, chemical and asbestos cleanup, and daily garbage removal, waste reduction and recycling. Republic Services is now the second-largest waste company in the U.S., with approximate annual revenues of $9 billion. Republic was the third largest but jumped to second when in late 2008 it acquired the second largest company Allied Waste Services. Allied, in turn, had recently completed acquisition of a major competitor, Browning Ferris Industries. The companies' pre-merger names are still widely used.

Major companies in the waste management sector include: Waste Management—Texas; Republic Services—Florida; Veolia Environmental Services North America Corp.—Illinois; Covanta Holding Corp.—New Jersey; Safety Clean Systems—Texas; Waste Connections—California.

Recycling as a sub-sector of waste management has many large, medium and small companies dealing with specific types of materials for recycling. There are a number of startup ventures seeking to commercialize new technologies. Innovative recycling companies include Green Fuel Technologies—Massachusetts; Electronic Recyclers—California; Ze Gen—Massachusetts; Eco2 Plastics—California and Harsco Corp.—Pennsylvania.

Freerange photo

III BUFFALO NIAGARA & THE GREEN ECONOMY

Buffalo Niagara has inherent strengths that provide it with the potential to become a major player in the new green economy. Its industrial strengths allow the region to make a contribution to nearly every sector of the new green economy and an opportunity exists to position Buffalo Niagara as a center for manufacturing components used in renewable-energy industries. In some instances, the region can also be viable as a generator of alternative electric energy. Truly it can become a place "Where Industry Creates Energy."

The Renewable Energy Policy Project (REPP)—a coalition of the Sierra Club and the United Steelworkers—issued a report in 2007 showing that more than 10,000 new jobs could be located in Buffalo Niagara in just four of the main energy sectors. Their analysis Allegany, Erie, Niagara and Chautauqua counties showed the greatest growth could occur in manufacturing components for wind, solar, biofuel and geothermal.

While the opportunity is great, there are weaknesses that must be addressed. Regional leadership will need to consider strengths and opportunities, as well as threats and weaknesses, and work on them constructively in a very competitive environment. Regions, states and nations will all be seeking to carve out their own role in a green revolution that could be every bit as significant as the manufacturing revolution that built Buffalo Niagara more than 100 years ago.

Buffalo Niagara's Strengths

GEOGRAPHIC LOCATION

Buffalo Niagara is uniquely situated to serve the Northeast's major population centers while receiving goods and materials from the Midwest—the same role it played in its growth at the beginning of the 20th century. The region is defined as an eight-county area in western New York consisting of Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans and Wyoming counties.

Buffalo Niagara is 500 miles from 41% of the U.S. population and 59% of Canada's population. It is midway between New York City and Chicago as well as Toronto and Pittsburgh. It also a part of the Golden Horseshoe, a nearly continuous metro area that covers Toronto, Hamilton, and St. Catherines in Ontario, and Niagara Falls, Buffalo, Batavia and Rochester in New York.

In many renewable-energy sectors, most notably wind, solar and biofuels, there are distinct advantages to proximity in the manufacture of component parts for renewable-energy facilities, since components and raw materials can be difficult or costly to transport.

The region's rural areas have the potential to supply biostock, including timber resources, and wind resources for direct energy generation. The region posesses abundant hydropower and is also in the major Northeast grid corridor, which allows energy generated there to be easily transmitted to major population centers. Buffalo NIagara is also close to major metropolitan areas where older commercial buildings and housing will need retrofitting for energy efficiency as cheap energy becomes less available.

THE GREAT LAKES

Buffalo Niagara's access to two of the Great Lakes, Erie and Ontario, may prove to be its greatest attraction in growing renewable-energy jobs. The lakes provide maritime access for the transport of raw materials and manufactured goods, and abundant fresh water for

JOB CREATION IN FOUR WESTERN NEW YORK COUNTIES

COUNTY	FIRMS	WIND	SOLAR	GEOTHERMAL	BIOFUELS	TOTALS
Allegany	12	722	72	1315	1433	3542
Erie	167	2002	482	635	1157	4276
Niagara	50	1460	16	128	113	1717
Chautauqua	22	543	914	2078	2733	917
TOTALS	251	4727	914	2078	2733	10452

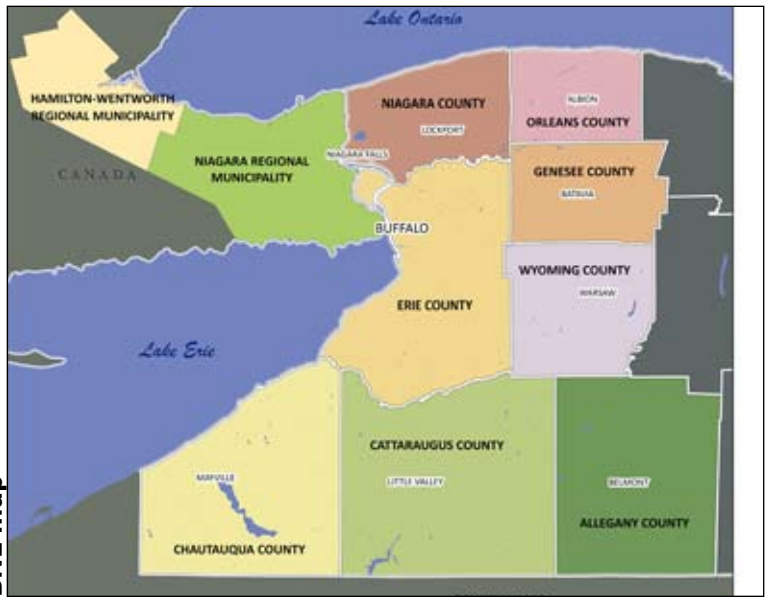
Source: Renewable Energy Policy Project

manufacturing processes.

The Great Lakes, in particular the western shores of Lake Erie, have been shown to be excellent for the development of wind-energy generation with onshore and offshore facilities. Lake currents, tides and Niagara River currents are being studied as potential new sources of hydrokinetic power as they flow toward Niagara Falls, one of the largest and oldest renewable-energy generators in the world.

INTERNATIONAL TRADE

Canadian and U.S. entrepreneurs will be pursuing business opportunities related to renewable energies as their governments stimulate new investment. Canada has historically had a concern for the environment and has taken an aggressive approach to fostering renewable energy technologies.



BNE map

Since Buffalo Niagara is only 90 minutes by car from Toronto, Canada's financial hub and investment center, companies can maintain corporate offices in Toronto while managing U.S. production facilities. Buffalo Niagara's manufacturing and distribution facilities allow Canadian companies easier access to the much larger American market.

Canadian-U.S. trade is well established in Buffalo Niagara, with $57 billion worth of goods crossing local borders annually or $156 million each day. The region has eight international ports of entry (four motor vehicle, three rail, one water). Buffalo Niagara has experience and a successful track record in providing assistance to Canadian companies seeking U.S. facilities.

The Canadian government is expected to make renewable-energy investments comparable in scale to those being made to stimulate the U.S. economy. Shared energy resources, such as wind, water and grid access, can potentially foster joint ventures and mutually beneficial agreements. Since global-energy firms often maintain a presence in Toronto as they seek to enter that nation's market, Buffalo Niagara entrepreneurs have potentially greater opportunities for global partnerships and investment.

TRANSPORTATION

Buffalo Niagara is a transportation hub, providing first-class freight transport by land, sea and air. In a Logistics Today magazine study, the Buffalo region ranked 30th out of 362 U.S. metropolitan areas in being a "logistics friendly" city. The analysis ranked Buffalo industry access as 81st among all cities, comparable to Phoenix, Daytona Beach, Fla., and Greensboro, N.C. Since local infrastructure was planned during an earlier age when the region supported a larger population and industrial base, it now operates under capacity. While this strains the budgets needed to maintain these networks, companies operating in the region are able to operate more efficiently with fewer delays and logistical constraints.

Air: Buffalo-Niagara International Airport ranks 72nd of all U.S. airports in terms of cargo landed weight with almost 317 million pounds per year. Niagara Falls International Airport handled more than 50 million pounds, placing it 115th in the rankings. The Niagara Falls airport has a 10,000-foot runway—the state's third largest—capable of handling the world's largest cargo planes.

Highway: The region's highway freight system is composed of: Interstates 90, 190 and 290; Interstate 990; Interstate 86; U.S. 219; Route 400; Queen Elizabeth Way; and Ontario Route 405. There are four highway border crossings to Canada.

Rail: Four of the seven U.S. Class I Railroads operate in this region including CSX Transportation (CSX), Norfolk Southern (NS), Canadian Pacific Railway (CP) and Canadian National Railway (CN). One Class II (or regional) railroad and three Class III (or short line) railroads also operate here. Several major freight yards provide large intermodal and bulk distribution facilities.

Water: Buffalo Niagara's principal waterborne commerce center is the Port of Buffalo. It consists of 28 terminals including the three terminals of Gateway Trade Center. The Welland Canal, a westerly part of the St. Lawrence Seaway, is 27 miles long and connects Lake Erie and Lake Ontario, which provides access to the Port of Toronto. The Erie Canal provides barge traffic through upstate New York to the Hudson River and the Port of New York.

LOW COST OF LIVING

One factor that makes Buffalo Niagara attractive for renewable-energy job-creating projects and expanded manufacturing operations is its low cost of living, which, at $53,000 per average household, is just below the national average. Buffalo Niagara compares favorably to other Rust Belt areas where costs are higher than the national average (Detroit—9% higher; Cleveland —5% higher). The low cost of living for employees can translate directly into lower labor costs.

Housing stock is affordable and has held value. The 2008 real estate bubble burst has had minimal impact on the region, and the median regional home price is just over $100,000.

MANUFACTURING BASE

Buffalo Niagara has a large, vibrant economy with a particular focus on manufacturing. Manufacturers of such hard goods as transportation equipment, machinery and fabricated metal products are the region's most important export income-generating industries. Many products manufactured in the region are required for renewable-energy development, and the firms that make them are often among the largest employers in their respective counties. Manufacturing operations in the eight-county area include:

ALLEGANY COUNTY: Dresser-Rand Co. (turbines); Alstron Power (air cleaning and purifying equipment); Vesuvius High Tech Ceramics (industrial ceramics products); Baldwin's Forest Products (lumber); P M Research Inc. (industrial coil machinery); Genesee Metal Products (structural steel) Deming Electro Plating Corp. (metal finishers).

CATTARAUGUS COUNTY: Alcas Corp. (cutlery); AVX (electronic equipment); Cooper Power Systems (electric equipment); Gowanda Electronics (electronic coil and transformers); Cytec Industries (chemicals); Mazza Sheet Metal and OSM Corp. (sheet-metal fabrication).

One factor that makes Buffalo Niagara attractive for renewable energy job-creating projects and expanded manufacturing operations is its low cost of living.

CHAUTAUQUA COUNTY: Cummins Engine (diesel engines); MRC Bearing (ball and roller bearings) Truck-Lite (vehicle safety lighting); Valeo Engine Cooling (engine cooling systems); Carborundum/Monfrax Fused (cast refractories); Hope's Architectural Products (steel and aluminum windows); Crawford Furniture (wood furniture); Jamestown Metal Products (laboratory furniture); Weber-Knapp (specialty metal products); Monfrax Inc. (refractories); Blackstone (sheet-metal fabrication); Dunkirk Specialty Steel (bar, rod and wire specialty steel).

ERIE COUNTY: GM Powertrain (auto parts); Ford Motor Co. (automotive stampings); Praxair Inc. (industrial gases); Dunlop Tire Corp. (tires); DuPont (chemicals); Luvata Buffalo (brass manufacturing); Cameron Compression (air and gas compressors); Strippit Inc. (punching and shearing machinery); PCB Piezotronics Inc.; Invitorgen (biological products); ISG Lackawanna (galvanizing).

GENESEE COUNTY: United States Gypsum (gypsum products); Graham Corp. (vacuum equipment and systems); Batavia Metal Products (metal goods); Byron Enterprises Inc. (grain-handling equipment); Liberty Pumps (pumps); Summit Lubricants (lubricants); Strong Force and Fabrication (forgings); Pinnacle Manufacturing (aluminum die castings).

NIAGARA COUNTY: Delphi Thermal and Interior (auto radiators); Kadmea (machinery); DuPont (industrial inorganic chemicals); Sherwood Valve (valves); Vishay Thin Film (semiconductors and resistors); Precious Plate (plating); Olin Chlor-Alkali Products (inorganic chemicals); Tam Ceramics (zirconium); Snyder Industries (gears and gear cutting); Diversified Manufacturing Inc. (machine shops); Metal Cladding (powder coatings); Delroyd Worm Gears (industrial drives and gears); Sherwood (valves); Confer Plastics (molded plastics) Tulip (molded plastics); Stollberg Inc. (flux manufacturers).

ORLEANS COUNTY: Bruner International (brakes);

Many products manufactured in the region are of the type required for the development of renewable energies, and these firms are often among the largest employers in their respective counties.

Freerange photo

Saint-Gobain Technical Fabrics (tire cord and fabrics); Trek Inc. (electrostatic equipment); BMP America (textile converting); Empire Coating (metal finishers); Stand ex AirDistribution Products (duct and duct fittings); Penasck (sheet metal fabrication); Phinney Tool and Die Co. (tool-and-die makers); Monroe Electronics (measuring instruments); F and H Metal Finishing (metal finishing).

WYOMING COUNTY: Markim Tubing (steel pipe and tubes); Koike Aronson (welding equipment); Foamex (foam plastics); Steel and O'Brien Manufacturing (machine shops); SMD (semiconductors and related devices); Hilec LLC, (noncurrent-carrying devices); Farrant Screw Machine (screw machine products); Vimco Manufacturing (lighting fixtures); Burt Tool and Die Co. (machine shops).

WORK FORCE

Buffalo Niagara has a well-deserved reputation for a hardworking, educated and affordable work force. More than 1.5 million people live in the region, which ranks 18th in the U.S. for work-force education. More than 37% of Buffalo Niagara residents have at least an associates degree, compared to 38% for all of New York, and 34% for the U.S. High school graduates comprise more than 86% of the region's population.

Losses in manufacturing employment have accelerated over the last three years, particularly in transportation-component manufacturing, creating a skilled labor surplus. Blue-collar jobs comprise 41.5% of the work force. Manufacturing comprises 16% of the total work force or 105,000 workers, with 4% working in construction. The region has the sixth-highest employment concentration of machinery jobs out of the 50 largest U.S. metro areas.

RESEARCH & EDUCATION

Buffalo Niagara has a strong base of universities and colleges and the EPA named UB as one of its Top 10 College and University Green Power Partners. Many are involved in research and development and have training programs related to renewable energies. Neighboring Rochester further strengthens Buffalo Niagara's capabilities, along with the strategic alliances of the Centers for Excellence in the State University of New York system. Together with southern Ontario, Buffalo Niagara hosts more than 60 colleges and universities with an enrollment of more than 300,000 students.

Engineers are absolutely critical to renewable energy, from design and construction to operations and maintenance. The University at Buffalo possesses the second-largest engineering program in New York and offers degrees in all major fields of engineering through the School of Engineering and Applied Sciences (SEAS), which is ranked in the top 15% of America's 300 engineering programs. In 2011, UB will open a new $61 million building for engineering and applied sciences that will house research projects on energy-battery storage and renewable-energy technologies. Their programs include:

•The Center for Excellence in Global Enterprise Manage-

ment delivers leading-edge research driven by industrial need with results that have immediate practical impact

•The Center for Unified Biometrics is focused on advancing the fundamental science of biometrics and providing key enabling technologies to build engineered systems

•The Center for Integrated Waste Management coordinates research and technology development in the areas of toxic substances and hazardous wastes

•The Energy Systems Institute focuses on the development of mechanisms to predict failure in electronic systems

•The Great Lakes Program's mission is to develop, evaluate, and synthesize scientific and technical knowledge on the Great Lakes Ecosystem in support of public education and policy formation

•The New York State Center for Engineering Design and Industrial Innovation carries out research to develop state-of-the-art simulation techniques and tools for the design of products, complex systems, and scientific applications. The school also conducts research in energy systems, microelectronics, photonics, molecular transformations, chemical-systems engineering, nanotechnology, and advanced polymeric, electronic and optical materials. Its energy-systems research includes batteries, electrochemical power, power electronics, power packaging and plasma processing

•UB's Environmental and Development Clinic has researched Great Lakes offshore wind turbines and water-anchored kinetic turbines. Its Environment and Society Institute (ESI) promotes interdisciplinary research on environmental problems important to the regional community and functions as an environmental clearinghouse for the UB community and the general public

•The UB Center for Industrial Effectiveness (TCIE) is a major regional resource for industrial manufacturing firms, offering technical assistance in advanced manufacturing, business-system improvements, and product testing and development. TCIE assists in management strategy and provides corporate training in ISO certification and Six Sigma processes.

The center also matches product development requirements with faculty members doing research in a related field, and through the New York State Center for Engineering Design and Industrial Innovation, provides access to virtual-reality systems, prototyping, finite-element analysis, and complex modeling and animation. They also help companies access university testing labs for quality assurance or material analysis and identify funding support and grant assistance for productivity improvements and work force training.

Insyte Consulting is a private, nonprofit organization that works with Buffalo Niagara manufacturers to provide assistance in process improvement, marketing and business planning, quality system implementation, information-technology support, and new technology application. They also provide access to financial assistance that help develop new technology processes and products in Buffalo Niagara.

In the region's southern section, Alfred University conducts photonics research and related solar-sector training programs. The Rochester Institute of Technology hosts the Advanced Fuel Cell Research Laboratory and is one of only four Hydrogen Technology Learning Centers.

The region has four community colleges and a two-year technical school. All have successfully partnered with business and industry in work force development programs to create skills training based on needs.

In early 2009, Buffalo and Niagara Falls made plans to use federal economic stimulus money on green projects. Buffalo is implementing a $2.7 million plan to make energy-conservation improvements in 30 city-owned buildings and has a long-term strategy to spend $25 million on energy conservation in 145 other city buildings.

GREEN ECONOMY SYNERGIES

An important element in renewable energy sector growth can be the synergies that develop between companies, organizations, governments and educational institutions.

Shared goals, ideas, technologies and needs can create new alliances and synergies that in turn provide leverage and momentum and serve to attract outside interest and investment. Even component-part manufacturers can find such synergies alluring because they assist in attracting talent and making contacts that facilitate entry into new markets. It is therefore useful to frequently assess the region's ties to the various renewable-energy sectors and to use them in regional marketing-development efforts.

QUALITATIVE & QUANTITATIVE RESEARCH METHODOLOGY

In addition to analyzing a range of qualitative factors, KWR International also reviewed a number of quantitative factors. Basic data, unless otherwise indicated, was taken from the Hoover's corporate database. This included:

Intra-Buffalo Niagara NAICS Analysis

Relevant industry codes were identified for each sector across all eight Buffalo Niagara counties. In contrast to the usual practice of simply counting the number of firms in each NAICS code, KWR International also calculated aggregate revenues generated. This approach provides a more accurate assessment as firms can vary dramatically in size, and potential synergies depend on the number of corporate partners available and their cumulative economic muscle.

It should be emphasized, however, that the revenue and firm analysis should be considered relative, rather than absolute, indicators. That is because most firms do not release revenues by NAICS code, and databases such as Hoover's therefore include the total revenue figure for each company in each NAICS code in which that firm operates. Therefore, when one is measuring across multiple codes, each firm is counted every time they appear in a code, inflating both revenues and the stated firm count. The effect can be meaningful, especially when including companies that operate in multiple NAICS codes or have particularly large group revenues distributed across two or more NAICS groups.

While the highlighted NAICS codes are important to each of the covered renewable-energy sectors, this does not mean the firms who report the code are necessarily active in the sector. For example, Buffalo Niagara has 87 firms in Fabricated Structural Metal, but that does not mean these firms are active in wind-energy manufacturing, which relies on this input, or that fabricated structural metal accounts for more than a minor portion of revenues in some of the firms that were included.

That said, since there are many overlapping technologies and manufacturing processes, it is possible in many cases for firms already active in these areas to expand into renewable-energy sectors that make use of the input. In other words, even if many of these firms are not involved in renewable sectors at present or primarily dedicated to a particular code, they do have the technical capacity and should be seen as an indicator of Buffalo Niagara's underlying potential.

An important element in renewable energy sector growth can be the synergies that develop between companies, organizations, governments and educational institutions.

Nonetheless, given that revenue breakdowns by NAICS code are not available at this time, a revenue analysis is the best available tool for measuring the aggregate economic strength of regional revenues in each area. While not providing an absolute indicator, this does represent a significant improvement over previous methodologies in accurately identifying and assessing trends and relative relationships between counties, sectors and other locations competing in these NAICS activity areas.

To provide an example of the issues highlighted above, consider the biomass segment, a diverse category including more NAICS codes than any other area analyzed within this study. In the number of firm's analysis, biomass accounts for 3.97% of firms. This reflects some of the double-counting noted, which results in the inflation noted above, though not nearly as large as in the revenues analysis, which amounts to an astounding 76.09% of total revenues. This clearly is not the actual economic contribution of biomass within the Buffalo Niagara region, though given these factors affect all counties, it does allow for a meaningful assessment of the relationship between different counties and the overall regional strengths and weaknesses depicted in the following sections.

Total Buffalo Niagara Revenue/Firms with NAICS Codes Demonstrating Statistical Error

Additionally, to discern how individual counties rated compared to their underlying potential, KWR International also compared the percent contribution of each county to overall Buffalo Niagara economic activity and to specific-renewable energy sectors. For purposes of the analysis, KWR assumed the two numbers should be the same: If a county contributed 10% of total number of firms in Buffalo Niagara, it should also contribute 10% of total firms in wind energy in the region, and this was designated as our "forecast." Similarly, if a county contributed 20% of total revenues in Buffalo Niagara, the forecast was that it would also contribute 20% of revenues in wind energy in the region. A county that contributed more than the expected amount, whether

Total Buffalo Niagara Revenue/Firms with NAICS Codes Demonstrating Statistical Error											
	Total	Solar	Wind	Hydro	Geo	Bio	Nuclear	ETS	Bldg	Waste	Trans
Firms (total)	72,377	2,351	1,611	1,643	1,739	2,874	1,629	1,536	5,920	1,722	1,411
Total Rev. (mil)	$35,151	$19,121	$20,440	$25,547	$25,732	$26,748	$23,265	$16,359	$20,094	$17,087	$21,296
% BN Firms	100.0	3.30	2.23	2.27	2.40	3.97	2.25	2.12	8.18	2.38	1.95
% BN Rev	100.0	54.40	58.15	72.68	73.20	76.09	66.19	46.54	57.16	48.61	60.58

in number of firms or revenues, was counted as "overweight" in that renewable-energy area. A county that contributed less than the expected amount was considered "underweight." Weighting was expressed as a percent of the expected contribution, with par being 100%, underweight being any percent under 100%, and overweight being any percent over 100%.

For example, Erie County contributes approximately 70% of all economic activity in the Buffalo Niagara region but accounts for 95% of all solar activity. Therefore Erie County is overweight in solar and rated at 135% (i.e. its 95% contribution to solar is 135% of its expected 70% contribution). Conversely, Niagara County contributes over 10% of the region's economic activity but less than 1% of its solar activity. As a result, it is underweight in solar and rated as having at about 9% of what might be expected.

While this calculation is helpful, it should again be emphasized that it must be considered within the perspective of the inflation highlighted above. The reason for this is one would expect Erie County, with the region's most firms and revenues, to be more subject to this inflation than rural counties. Therefore, the calculated overweights should be qualitatively discounted to some extent.

Comparative Analysis: To discern how Buffalo Niagara compared to potential competing locations, KWR International also moved to identify other locations that possessed competing firms. This was done by examining the industry directory on greenjobs.com along with other sources. Given Buffalo Niagara is composed of eight counties and located in the Northeast, which possesses different population and demographic and geographic characteristics than other areas of the country, it was difficult to determine the optimal comparison method. Nevertheless, attempts were made to pick areas that had multiple firms and relevance to the Buffalo Niagara region.

For example, Evergreen Solar, Konarka Technologies and Spire Corporation were all located in Middlesex County, Mass., SunEdison (which bills itself as North America's largest solar energy service provider) is located in Prince Georges County, Md., and Energy Conversion Devices and United Solar Ovonic were located in Oakland County, Mich. For this reason, these three counties were selected for a Solar-sector comparison with Buffalo Niagara's eight counties, with similar adjustments made for population size and the other factors noted in the Intra-Buffalo analysis above, in addition to demographic factors.

It should be noted it would have been far easier to select three locations on the basis of their potential competitiveness with Buffalo Niagara itself. For example one could have chosen cities such as Toledo, Cleveland, Pittsburgh and others that share Buffalo's industrial past. This methodology was not selected on purpose; the goal of this report is to attract companies seeking to establish manufacturing operations in renewable energy-related sectors. These entities are not limited to Buffalo Niagara and direct competitors but rather to the entire spectrum of potential sites. For this reason, it was deemed preferable to choose locations that had already achieved a measure of success in the sectors under examination.

While this is also a subjective method of comparison and should not be taken as a precise statistical comparison of Buffalo Niagara to all locations within the United States, it does also allow for a number of insightful comparisons and conclusions.

Intra-Sectoral Comparison: After conducting the intra-regional and comparative analyses outlined above, steps were also taken to analyze Buffalo Niagara's competitiveness across different sectors. This was done to discern commonalities, strengths and weaknesses, as well as overlapping codes and other factors of concern.

SOLAR SECTOR

Although Buffalo Niagara is not considered a prime area for grid-scale solar-energy facilities, it does have many factors that could play an important part in boosting the region's importance. This is particularly true in the manufacturing of smaller PV and solar-thermal installations. The region also has research and development companies and solar technology facilities.

Buffalo has an image as a cold and snowy city, but it has more sunny days from May through September than any Northeast city and total snowfalls significantly less than other upstate New York cities. Weather reputation is not a good barometer of potential, especially in solar. Germany, which has a climate similar to the Northeast, leads the world in solar-power production.

Globe Metallurgical in Niagara Falls, a division of Globe Specialty, is investing $60 million in a high-grade silicon-products manufacturing facility. Globe will have capabilities to produce about 30,000 tons of metallurgical-grade silicon annually. The scarcity of premium solar-grade silicon has been one of the impediments to the industry's development. As part of its agreement with the state, 25% of Globe's upgraded metallurgical-grade silicon production from its Niagara Falls facility will be available annually at discounts up to 15% for local companies. This will be used to attract new solar-panel manufacturers to New York. Eligibility and allocations depend on the size and scope of the project.[19]

Two other large Buffalo companies are also important in the industry. Praxair, Inc. a global Fortune 500 company manufactures and distributes industrial gases that are an important part of the solar supply chain and also produces liquid hydrogen, an important alternative fuel source. DuPont is a leading materials supplier to the PV Industry.

The region also has a strong metal-manufacturing base, and major companies producing solar-energy components including glass, solar cells and other manufactured components. Canrom Photovoltaics in Niagara Falls is a manufacturer of solar cells, systems, and related products for home, industrial, and custom uses. Canrom is also developing its own line of thin-film solar electric modules.

In Depew, National Solar Technologies develops and manufactures off-the-shelf and custom products for solar and wind energy power sources and solar lighting systems. Solar Liberty Energy Systems Inc. is one of the largest commercial and residential solar-system design and installation companies in North America.

Buffalo has an image a cold and snowy city, but it has in fact more sunny days from May through September than any city in the Northeast . . .

Conserval, in Buffalo, provides thermal heating products, an efficient way to solar heat large buildings. The DOE considers their patented Solar Wall to be as "in the top 2% of energy-related inventions."[20]

The University at Buffalo has a number of advanced engineering and research programs with applications to solar. In particular, the Integrated Nanostructured Systems Strategic Initiative uses new approaches for fabricating inorganic nonmaterial that may play a role in creating more efficient solar cells. Alfred University conducts state-of-the-art photonics research and related work force training programs. The university is a leader in ceramic research. This is key to developing solid-oxide fuel cells and the university works closely with nearby Corning Inc.

The American Solar Energy Society held its 2009 conference in Buffalo in May. This conference is the largest and most inclusive solar and renewable energy conference held in the United States with more than 5,000 attendees. It brought the sectors' major companies to the region and provided an opportunity to showcase the region and allowed local companies to exhibit products that can be part of the solar-energy chain.

BUFFALO NIAGARA SOLAR NAICS VALUE CHAIN ANALYSIS

The Buffalo Niagara Solar Value Chain table analyzes all NAICS codes that account for over 2%.

When one analyzes this distribution by the number of firms in each NAICS code, it would appear that Plumbing, Heating and Air-Conditioning Contractors are the strongest with 37% of the total, followed by Engineering Design, Energy Consulting and Architectural Service,

[19] *"Niagara Falls: Old Plant Gains New Life," Rick Forgione. Niagara Gazette. May 20, 2008.*

[20] *"Inventions and Innovation Program," U.S. Department of Energy. Lisa Barnett, Program Manager. December 2001.*

Buffalo Niagara Solar NAICS Value Chain Analysis

SOLAR	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Solar BN Rev Frcst Based on All	$341	$817	$1,278	$13,430	$571	$1,991	$314	$379	$19,121
Actual Revenues Based on Model	$21	$660	$289	$17,213	$87	$809	$31	$12	$19,121
Actual Revenues/Forecast Revenues	6.1%	80.8%	22.6%	128.2%	15.3%	40.6%	9.9%	3.0%	100.0%

All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Solar BN Firm Frcst Based on All	64	129	249	1,428	99	302	55	65	2,391
Actual Firms Based on Model	53	112	205	1,535	97	293	52	44	2,391
Actual Firms / Forecast Firms	83.4%	86.7%	82.2%	107.5%	98.3%	97.0%	94.1%	67.9%	100.0%

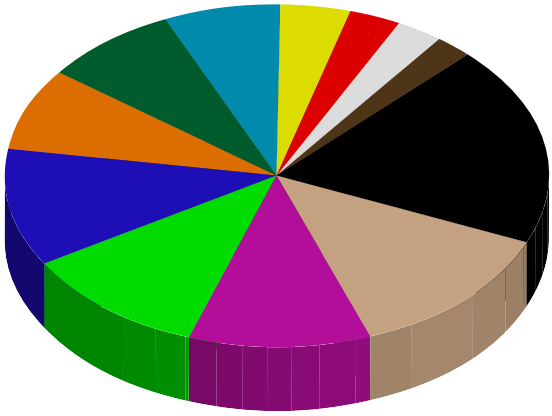
SOLAR - Major NAICS Codes - Revenues		Major Segments - Revenue									
NAICS	Solar Industry Segment Name	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total	% Total
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	12.9%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	11.2%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	10.9%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	10.7%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	8.0%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	7.9%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	7.5%
238220	Plumbing, Heating & AC Contractors	2	16	36	684	19	38	5	5	805	4.2%
423720	Plumbing/Heating Equip. Merch./Wholesalers	3	1	21	455	11	91	0	1	582	3.0%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.6%
335312	Motor and Generator	0	300	0	146	0	0	0	0	447	2.3%
	Total Other	9	328	126	2,828	30	252	19	3	3,595	18.8%
Total Revenues Solar ($ Millions)		**$21**	**$660**	**$289**	**$17,213**	**$87**	**$809**	**$31**	**$12**	**$19,121**	
Total Solar Revenues % to Total		**0.1%**	**3.5%**	**1.5%**	**90.0%**	**0.5%**	**4.2%**	**0.2%**	**0.1%**	**100.0%**	

SOLAR - Major NAICS Codes - Firms		Major Segments - Number of Firms									
NAICS	Solar Industry Segment Name	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total	% Total
238220	Plumbing, Heating & AC Contractors	21	50	90	521	50	114	27	19	892	37.3%
541330	Engineering Design Services	6	16	15	230	8	46	5	6	332	13.9%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	10.5%
541310	Architectural services	2	0	11	115	1	10	1	3	143	6.0%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	4.6%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	3.2%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	3.1%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	2.5%
221119	Other Electric Power Generation	2	6	11	15	3	11	1	1	50	2.1%
	Total Other	6	22	29	262	15	55	8	7	404	16.9%
Total Firms Solar		**53**	**112**	**205**	**1,535**	**97**	**293**	**52**	**44**	**2,391**	
Total Firms % to Total		**2.2%**	**4.7%**	**8.6%**	**64.2%**	**4.1%**	**12.3%**	**2.2%**	**1.8%**	**100.0%**	

Freerange photo

Solar NAICS Industries Distribution in BN Region

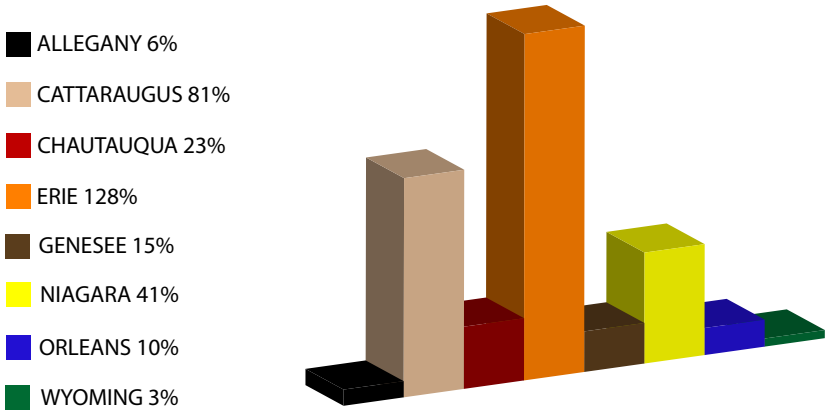
(Revenue per NAICS code)



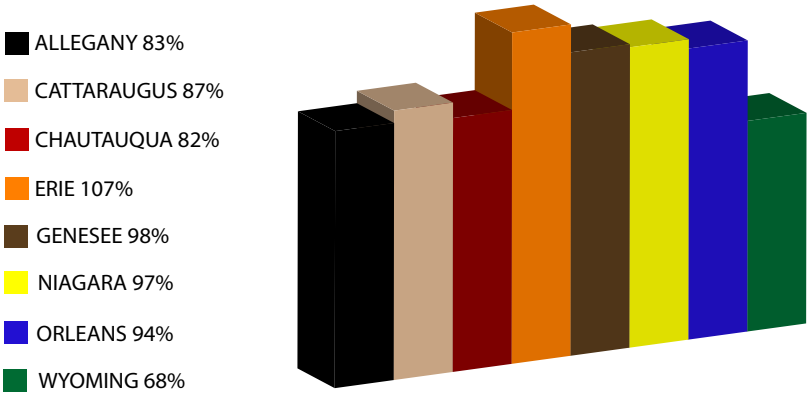
19%	Total other	11%	Other measuring/ controlling device mfg	4%	Plumbing, heating & AC contractors
13%	Electric power distribution	8%	Sheet metal work mfg	3%	Plumbing/heating equip merch/wholesalers
11%	Instr/related prod mfg for measuring, display & control	8%	Fabricated structural metal mfg	3%	Energy consulting services
11%	Pump/pump priming equipment mfg	7%	All other misc fab. metal product mfg	2%	Motor and generator

SOLAR PERFORMANCE OF BN COUNTIES

Actual Revenues/Forecasted Revenues



Actual Firms/Forecasted Firms



which account for about 30% collectively.

When examined using revenues, however, one can see a more even distribution with four NAICS codes registering more than 10% each of total revenues, including Electric Power Distribution (12.9%), Instruments/Related Products Mfg for Measure, Display and Control (11.2%), Pump/Pumping Equip Mfg (10.9%) and Other Measuring/ Controlling Device Mfg (10.7%). Three other codes registered over 5% with the others at lower amounts.

As with most sectors, economic activity is centered in Erie County, which accounted for 70.2% of total revenues and more than 90% of solar revenues. When we divide solar revenues over what would be forecasted if it had generated the same 70.2% share, we can say for the purposes of this analysis it is generating 128.2% over what would be expected. When one conducts the same analysis in terms of the number or solar firms, Erie generates a smaller but still positive 107.5%. The other counties combined generated less than 50% of the solar revenues that would be anticipated if they had performed on level with their share of total revenues, with the exception of Cattaraugus, which generated just over 80%. When measured in terms of the number of firms in each county, the totals were more positive. Genesee, Niagara and Orleans all achieved over 90%, and the rest over 80%, with the exception of Wyoming, which generated only 67.9%.

WIND SECTOR

The hundreds of mechanical parts that go into wind-turbine operations match Buffalo Niagara's traditional manufacturing base of metal and plastic manufacturing. In addition, the region has the capacity to generate wind energy in large quantities. The REPP coalition estimated that 124 Buffalo Niagara manufacturing companies have the potential to produce component parts for the wind industry.

For this reason, wind-farm installation and operation offers potential, in respect to the tangible production of alternative

Buffalo Niagara Wind NAICS Value Chain Analysis

WIND	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Wind BN Rev Frcst Based on All	$365	$874	$1,366	$14,357	$610	$2,128	$336	$405	$20,440
Actual Revenues Based on Model	$67	$931	$225	$18,256	$150	$748	$44	$19	$20,440
Actual Revenues/Forecast Revenues	18.3%	106.6%	16.5%	127.2%	24.6%	35.2%	13.1%	4.6%	100.0%

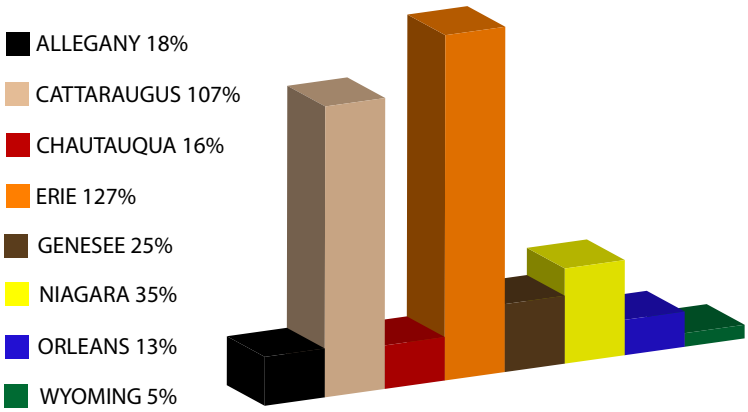
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Wind BN Firm Frcst Based on All	43	87	168	962	66	204	37	44	1,611
Actual Firms Based on Model	32	61	128	1,087	52	201	29	21	1,611
Actual Firms / Forecast Firms	74.8%	70.1%	76.2%	113.0%	78.2%	98.8%	77.9%	48.1%	100.0%

WIND - Major NAICS Codes - Revenues		**Major Segments - Revenue**									
NAICS	**Wind Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	12.1%
333995	Fluid Power Cylinder/Actuator Mfg	0	0	0	2,096	86	16	0	0	2,198	10.8%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	10.5%
332911	Industrial Valve Manufacturing	0	0	0	1,934	6	138	0	0	2,079	10.2%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	10.0%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	7.5%
332312	Fabricated Structural Metal	0	1	31	1,438	1	33	0	1	1,505	7.4%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	7.0%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.4%
335312	Motors and Generators	0	300	0	146	0	0	0	0	447	2.2%
326199	All Other Plastics Product Manufacturing	0	1	16	297	7	62	18	0	401	2.0%
	Total Other	61	615	103	2,617	29	242	19	16	3,702	18.1%
Total Revenues Wind ($ Millions)		**$67**	**$931**	**$225**	**$18,256**	**$150**	**$748**	**$44**	**$19**	**$20,440**	
Total Wind Revenues % to Total		**0.3%**	**4.6%**	**1.1%**	**89.3%**	**0.7%**	**3.7%**	**0.2%**	**0.1%**	**100.0%**	

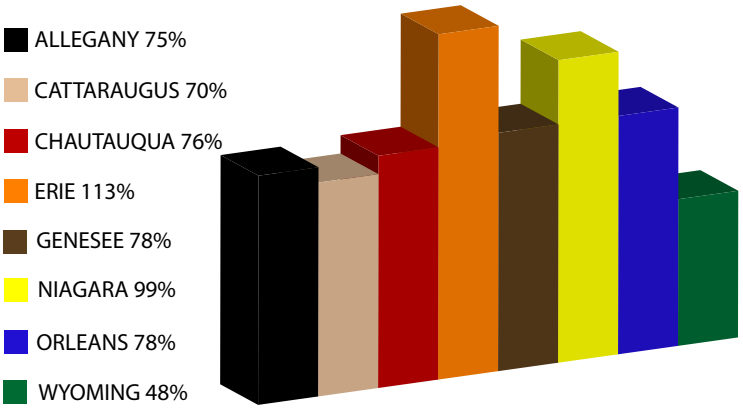
WIND - Major NAICS Codes - Firms		**Major Segments - Number of Firms**									
NAICS	**Wind Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
541330	Engineering Design Services	6	16	15	230	8	46	5	6	332	20.6%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	15.6%
541310	Architectural services	2	0	11	115	1	10	1	3	143	8.9%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	6.8%
326199	All Other Plastics Product Manufacturing	0	2	9	60	6	12	2	0	91	5.6%
331511	Iron Foundries	0	2	9	60	6	12	2	0	91	5.6%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	4.7%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.7%
221119	Other Electric Power Generation	2	6	11	15	3	11	1	1	50	3.1%
332313	Plate Work Manufacturing	1	0	4	18	0	9	0	1	33	2.0%
	Total Other	6	19	30	254	11	44	8	3	375	23.3%
Total Firms Wind		**32**	**61**	**128**	**1,087**	**52**	**201**	**29**	**21**	**1,611**	
Total Firms % to Total		**2.0%**	**3.8%**	**7.9%**	**67.5%**	**3.2%**	**12.5%**	**1.8%**	**1.3%**	**100.0%**	

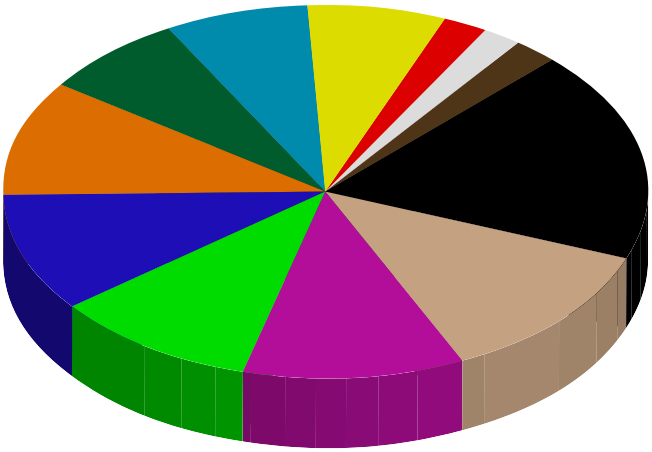
WIND PERFORMANCE OF BUFFALO NIAGARA COUNTIES

Actual Revenues/Forecasted Revenues



Actual Firms/Forecasted Firms





Wind NAICS Industries Distribution in Buffalo Niagara Region

Revenue per NAICS code

18%	Total other	10%	Industrial Valve Mfg	7%	All Other Misc Fab Metal Product Mfg
12%	Electric power distribution	10%	Other Measuring/ Controlling Device Mfg	2%	Energy Consulting Service
11%	Fluid Power Cylinder/ Actuator Mfg	7%	Sheet Metal Work Mfg	2%	Motor & Generator
10%	Instr/Related Prod Mfg for Measure, Display & Control	7%	Fabricated Structural Metal	2%	All Other Plastics Product Mfg

energy as well as to position Buffalo Niagara as a region truly committed to this technology. The DOE has rated sections of the Lake Erie and Lake Ontario shorelines as good to excellent for wind-energy generation. Some of the region's rural areas have also proven to be commercially viable.

A Buffalo landmark after just a few years of operation, Steel Winds is a 20-megawatt wind turbine project on Lake Erie's shore. The project, developed by Niagara Wind Power and BQ Energy, spent more than $40 million to develop the eight windmills that rise over 400 feet on a brownfield site. There are plans to expand as demand increases.

Noble Environmental Power, a Connecticut wind-energy company operates 67 wind turbines in Wyoming County. Mounted on 265-foot towers, they generate 100 megawatts of electricity that is fed into the national power grid. The company is exploring additional wind farms in Allegany and Cattaraugus counties.

Massachusetts' First Wind, Ireland's Artricity, Inc. and Spain's Iberdola have also shown interest in the region's rural areas. Empire State Wind Energy LLC of Oneida, formed by Buffalo Sabres owner Thomas Golisano, is exploring possible turbine sites in western New York.

Lake Effect Energy of Buffalo develops responsible and commercially viable wind-power projects for western New York. Lorax Energy Systems in Webster, is the North American distributor for the Fuhrländer Wind Turbine, which builds state-of-the-art turbines. Frey Electric in Tonawanda, N.Y., does wind-turbine-to-generator installations for large-scale wind farms.

A local citizen's organization, the Wind Action Group and UB Law School's Environmental and Development Clinic advocate the development of offshore wind turbines on the Great Lakes. Their 2008 report[21] claims offshore wind facilities on Erie and Ontario could produce at least 8,200 megawatts of power, which would put it close to the 2,253-megawatt Robert Moses Niagara Power Plant at Niagara Falls. As yet, there are no U.S. offshore wind facilities, but those in Europe generate 1,000 megawatts of power.

This citizens' initiative is partly responsible for the New York Power Authority (NYPA) decision in April 2009 to spend more than $1 billion to develop offshore wind power consisting of 25 to 40 turbines on Lake Erie and Lake Ontario, with the energy generated to be utilized in western New York. To facilitate private-sector participation and partnerships, NYPA is offering 20-year power-purchase agreements, along with other incentives, and anticipates completion by 2014.

BUFFALO NIAGARA WIND NAICS VALUE CHAIN ANALYSIS

The Buffalo Niagara Wind Value Chain table analyzes all NAICS codes that account for over 2%.

The table above summarizes the Buffalo Niagara Solar Value Chain by breaking down, both in terms of revenues and firms. A more detailed breakdown is included below and in minor NAICS table in the appendix.

[21] *"Offshore Wind's Role in Developing a Wind Energy Industry in Western New York," Environment and Development Clinic at University at Buffalo Law School for the Wind Action Group, Robert Shaw, May 2007.*

Buffalo Niagara Hydropower NAICS Value Chain Analysis

HYDROPOWER	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Hydropower BN Rev Frcst Based on All	$456	$1,092	$1,707	$17,944	$763	$2,660	$420	$506	$25,547
Actual Revenues Based on Model	$18	$652	$243	$23,506	$143	$915	$27	$45	$25,547
Actual Revenues/Forecast Revenues	3.9%	59.7%	14.2%	131.0%	18.7%	34.4%	6.3%	9.0%	100.0%
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Hydropower BN Firm Frcst Based on Al	44	89	171	981	68	208	38	45	1,643
Actual Firms Based on Model	35	70	134	1,112	51	185	32	24	1,643
Actual Firms / Forecast Firms	80.2%	78.9%	78.2%	113.3%	75.2%	89.1%	84.3%	53.9%	100.0%

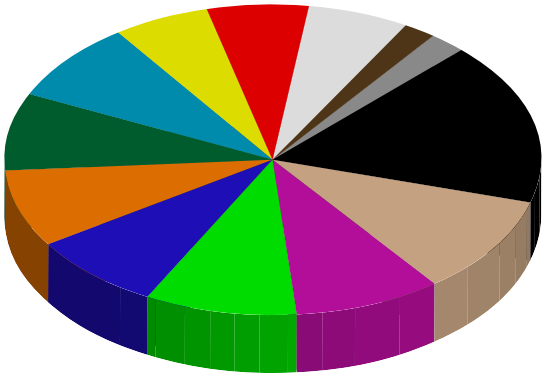
	HYDROPOWER - Major NAICS Codes - Revenues	**Major Segments - Revenue**									
NAICS	**Hydropower Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	9.6%
211111	Hydroelectric Power Generation	0	14	3	2,402	0	0	0	0	2,419	9.5%
333995	Fluid Power Cylinder/Actuator Mfg	0	0	0	2,096	86	16	0	0	2,198	8.6%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	8.4%
332911	Industrial Valve	0	0	0	1,934	6	138	0	0	2,079	8.1%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	8.1%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	8.0%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	6.0%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	5.9%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	5.6%
333923	Ovrhd Travling Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	2.5%
423720	Plumbing/Heating Equip. Merch./Wholesalers	3	1	21	455	11	91	0	1	582	2.3%
	Total Other	10	625	118	3,141	13	470	21	43	4,440	17.4%
Total Revenues Hydropower ($ Millions)		**$18**	**$652**	**$243**	**$23,506**	**$143**	**$915**	**$27**	**$45**	**$25,547**	
Total Hydropower Revenues % to Total		**0.1%**	**2.6%**	**1.0%**	**92.0%**	**0.6%**	**3.6%**	**0.1%**	**0.2%**	**100.0%**	

	HYDROPOWER - Major NAICS Codes - Firms	**Major Segments - Number of Firms**									
NAICS	**Hdropower - Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
541330	Engineering Design Services	6	16	15	230	8	46	5	6	332	20.2%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	15.3%
541310	Architectural services	2	0	11	115	1	10	1	3	143	8.7%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	6.7%
331511	Iron Foundries	0	2	9	60	6	12	2	0	91	5.5%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	4.6%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	4.5%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.6%
541380	Testing Laboratories	2	1	3	44	0	6	1	2	59	3.6%
221119	Other Electric Power Generation	2	6	11	15	3	11	1	1	50	3.0%
	Total Other	7	27	36	256	13	43	12	4	398	24.2%
Total Firms Hydropower		**35**	**70**	**134**	**1,112**	**51**	**185**	**32**	**24**	**1,643**	
Total Firms % to Total		**2.1%**	**4.3%**	**8.2%**	**67.7%**	**3.1%**	**11.3%**	**1.9%**	**1.5%**	**100.0%**	

When one analyzes the Wind Value Chain in terms of the number of firms, Engineering Design and Energy Consulting Services assume the largest share at 20.6% and 15.6% respectively, followed by Architectural Services at 8.9%. Only three other categories generated firm shares over 5% including Other Measuring/Controlling Device Mfg (6.8%), Iron Foundries (5.6%) and All Other Plastics Product Manufacturing (5.6%) respectively.

When measured in terms of revenues, Electric Power Distribution (12.1%), Fluid Power Cylinder/Actuator Mfg (10.8%), Instruments/Related Products Mfg for Measure, Display & Control (10.5%), Industrial Valve Manufacturing (10.2%) and Other Measuring/Controlling Device Mfg (10%) generated over 10% of wind revenues. Sheet Metal Work Manufacturing, Fabricated Structural Metal, All Other Misc. Fabricated Metal Product Manufacturing all generated between 5-10 % in revenues and all others below this amount.

As with solar, economic activity is centered in Erie County, even when one adjusts for populations differences. It accounted for 89.3% of revenues in the selected wind-related NAICS codes. When we divide these revenues over what would be forecasted if it had generated the same 70.2% share, we can say for the purposes of this analysis it is generating 127% over what would be expected. That is only a 1% difference from the previous solar analysis. When one conducts the same analysis in terms of the number or wind-related firms, Erie generates 113% above capacity. All of the other counties generated less than 50% of anticipated wind-related revenues, again with



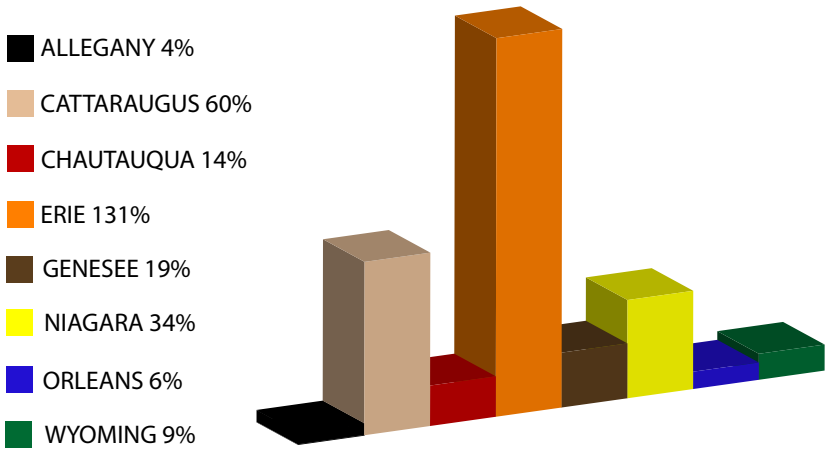
Hydropower NAICS Industries Distribution in Buffalo Niagara Region

Revenue per NAICS code

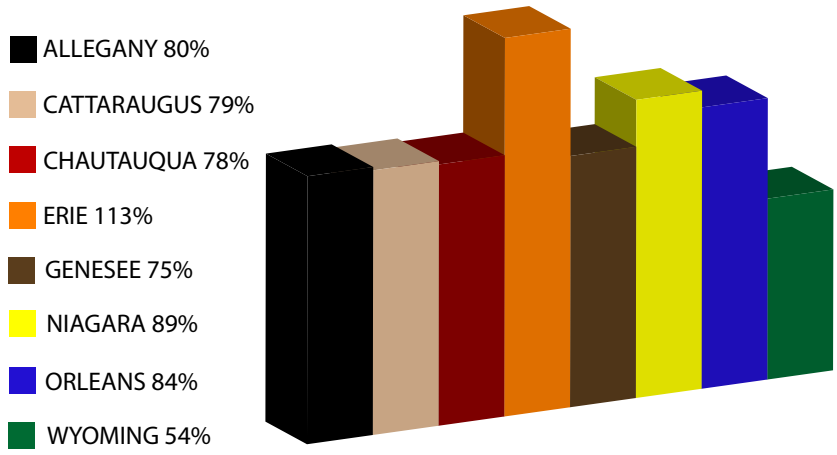
17%	Total Other	8%	Industrial Valve	6%	Fabricated Structural Metal Mfg
10%	Electric Power Distribution	8%	Pump/Pumping Equip Mfg	6%	All Other Misc Fab Metal Product Mfg
9%	Hydroelectric Power Generation	8%	Other Measuring/ Controlling Device Mfg	2%	Ovrhd Traveling Crane, Hoist & Monorail Sys Mfg
9%	Fluid Power Cylinder/ Actuator Mfg	6%	Sheet Metal Work Mfg	2%	Plumbing/Heating Equip Merch/Wholesalers
8%	Instr/Related Prod Mfg for Measure, Display & Control				

HYDROPOWER PERFORMANCE OF BUFFALO NIAGARA COUNTIES

Actual Revenues/Forecasted Revenues



Actual Firms/Forecasted Firms



the exception of Cattaraugus, though in this case also generated a positive number of variance of 107%. When measured in terms of the number of firms in each county the totals were again more positive, with Niagara generating 99% of anticipated firms. All of the other counties registered between 70-80%, again with the exception of Wyoming, which generated only 48%.

HYDROPOWER SECTOR

Due largely to Niagara Falls, New York produces more hydropower than any state east of the Mississippi. The Niagara project, located about 4 1/2 miles downstream from Niagara Falls, houses two main facilities: the Robert Moses Plant, with 13 turbines, and the Lewiston Pump-Generating Plant, with 12 pump-turbines. Between the two, there are storage bays capable of holding 740 million gallons of water; behind the Lewiston plant, sits a 1,900-acre reservoir.

NYPA is America's largest state-owned public power enterprise and links their work in energy production to more than 400,000 jobs statewide. The authority sells electricity generated at its Niagara Power Project to several businesses in western New York and has plans to move into wind-energy production.

Their hydropower is classified as replacement or expansion power and is delivered through an arrangement with National Grid, the utility company supplying electricity in the area.

Since 2003, industrial allocations of Niagara hydropower are distributed based on an advisory panel's recommendations. Critics have argued that more power should go the region where it is generated and say too much of the current regional allocation goes to "old industries" that are unlikely to expand or generate new jobs. The authority's programs for extending low-cost power to new or expanding industries are under review.

Although Niagara hydropower is considered to be at capacity given current technology, there is strong interest in using the Niagara River as a source of hydrokinetic power in locations upstream and downstream from the Falls. Free Flow Power Corp., a Massachusetts firm, has filed for permits to place 875 hydro turbines in the Niagara River in a 17-mile stretch from the Peace Bridge in Buffalo to Grand Island.

Hydro Green Energy, a Texas firm, has also filed for permits to place 90 hydro turbines in the river between the Rainbow Bridge in Niagara Falls and the Lewiston-Queenston Bridge. Hydrokinetic operations may also be able to tap the power of the tides in the region's two Great Lakes.

BUFFALO NIAGARA HYDROPOWER NAICS VALUE CHAIN ANALYSIS

The Buffalo Niagara Hydropower Value Chain table analyzes all NAICS codes that account for over 2%.

No individual NAICS code accounts for more than 10% of hydropower revenues in Buffalo Niagara, though seven register more than 8% including Electric Power Distribution (9.6%), Hydroelectric Power Generation (9.5%), Fluid Power Cylinder/Actuator Mfg (8.6%), Instruments/Related Products Mfg for Measure, Display and Control (8.4%), Pump/Pumping Equip Mfg (8.1%), Industrial Valve (8.1%) and Other Measuring/Controlling Device Mfg (8%) respectively.

Three others, Sheet Metal Work Manufacturing (6%), Fabricated Structural Metal Manufacturing (5.9%) and All Other Misc. Fab. Metal Product Mfg (5.6%), registered over 5%, with the rest below. As with wind and solar, economic activity remains centered in Erie County, which accounted for about 67.7% of total firms and almost 92% of total revenues.

When measuring the percentages of total firms operating in hydropower against total firms in their respective county, which in essence corrects for population differences, Erie again is operating at 131% above what would be expected in terms of revenues and 113% in terms of the number of firms.

Cattaraugus was the only county operating over 50% of anticipated revenues at 60%, followed by Niagara at 34% and the rest under 20%, or in the case of Allegany, Orleans and Wyoming, registering barely visible performance on the bar graph.

GEOTHERMAL SECTOR

Buffalo Niagara does not have the natural resources for large-scale geothermal power generation, although geothermal heat pumps are practical in many areas, especially in the eastern and southern areas of the region.

In Buffalo Niagara there are several equipment and component manufacturers that focus on the smaller-scale geothermal industry. In addition, several school districts and high-heat users such as dairies have installed or are considering geothermal systems.

Cal Research Inc. in Ransomville, a geothermal energy system components and steam calorimetry instruments supplier, and Caster Drilling Enterprises, a specialist in the design and installation of geothermal systems for residential and commercial use, provide services that include well-field design, loop-field installation, excavation, test-well drilling and thermal conductivity testing.

Phoenix Geothermal Services in Auburn is a designer, developer, and reseller of geothermal heating systems; e-Vanhee of Rochester is a full design, install-and-service company specializing in geothermal systems.Two large architectural preservation projects chose geothermal systems in recent renovations: Frank Lloyd Wright's Darwin Martin house and Babeville, an art/performance space in the former Asbury Delaware Church.

The Southern Tier West Regional Planning and Development Board, in cooperation with the New York State Energy Research and Development Corporation, has studied possible geothermal applications in the southern portion of Buffalo Niagara. A new $2 million geothermal heat system for the Salamanca City Central School District came online in 2008.

BUFFALO NIAGARA GEOTHERMAL NAICS VALUE CHAIN ANALYSIS

The Buffalo Niagara Geothermal Value Chain table analyzes all NAICS codes that account for over 2%.

No individual NAICS code accounts for more than 10% of Geothermal revenues in Buffalo Niagara, though as with Hydro, seven register more than 8% including Electric Power Distribution (9.6%), Hydroelectric

Buffalo Niagara Geothermal NAICS Value Chain Analysis

GEOTHERMAL	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Geothermal BN Rev Frcst Based on All	$460	$1,100	$1,719	$18,073	$768	$2,679	$423	$510	$25,732
Actual Revenues Based on Model	$15	$953	$248	$23,392	$164	$887	$27	$46	$25,732
Actual Revenues/Forecast Revenues	3.2%	86.7%	14.4%	129.4%	21.4%	33.1%	6.3%	9.1%	100.0%
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Geothermal BN Firm Frcst Based on Al	46	94	181	1,039	72	220	40	47	1,739
Actual Firms Based on Model	36	66	145	1,169	57	206	32	28	1,739
Actual Firms / Forecast Firms	77.9%	70.3%	79.9%	112.5%	79.4%	93.8%	79.6%	59.4%	100.0%

	GEOTHERMAL - Major NAICS Codes - Revenues	**Major Segments - Revenue**									
NAICS	**Geothermal Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	9.6%
211111	Hydroelectric Power Generation	0	14	3	2,402	0	0	0	0	2,419	9.4%
333995	Fluid Power Cylinder/Actuator Mfg	0	0	0	2,096	86	16	0	0	2,198	8.5%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	8.3%
332911	Industrial Valve Manufacturing	0	0	0	1,934	6	138	0	0	2,079	8.1%
333911	Pump and Pumping Equipment Manufacturing	0	0	0	1,934	6	138	0	0	2,079	8.1%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	8.0%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	6.0%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	5.9%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	5.5%
333923	Ovrhd Trvlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	2.5%
	Total Other	10	926	144	3,483	46	533	21	44	5,207	20.2%
Total Revenues Geothermal ($ Millions)		**$15**	**$953**	**$248**	**$23,392**	**$164**	**$887**	**$27**	**$46**	**$25,732**	
Total Geothermal Revenues % to Total		**0.1%**	**3.7%**	**1.0%**	**90.9%**	**0.6%**	**3.4%**	**0.1%**	**0.2%**	**100.0%**	

	GEOTHERMAL - Major NAICS Codes - Firms	**Major Segments - Number of Firms**									
NAICS	**Geothermal Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
541330	Engineering Design Services	6	16	15	230	8	46	5	6	332	19.1%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	14.4%
541310	Architectural services	2	0	11	115	1	10	1	3	143	8.2%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	6.3%
331511	Iron Foundries	0	2	9	60	6	12	2	0	91	5.2%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	4.4%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	4.3%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.4%
541380	Testing Laboratories	2	1	3	44	0	6	1	2	59	3.4%
221119	Other Electric Power Generation	2	6	11	15	3	11	1	1	50	2.9%
532412	Constr, Ming, & Forstry Mach & Equip Rtl & Lsg	0	0	6	17	3	7	0	2	35	2.0%
	Total Other	8	23	41	296	16	57	12	6	459	26.4%
Total Firms Geothermal		**36**	**66**	**145**	**1,169**	**57**	**206**	**32**	**28**	**1,739**	
Total Firms % to Total		**2.1%**	**3.8%**	**8.3%**	**67.2%**	**3.3%**	**11.8%**	**1.8%**	**1.6%**	**100.0%**	

Power Generation (9.4%), Fluid Power Cylinder/Actuator Mfg (8.5%), Instruments/Related Products Mfg for Measure, Display and Control (8.3%), Pump/Pumping Equip Mfg (8.1%), Industrial Valve (8.1%) and Other Measuring/Controlling Device Mfg (8.08%) respectively. Three others, Sheet Metal Work Manufacturing (6%), Fabricated Structural Metal Manufacturing (5.9%) and All Other Misc. Fab Metal Product Mfg (5.5%), registered more than 5%.

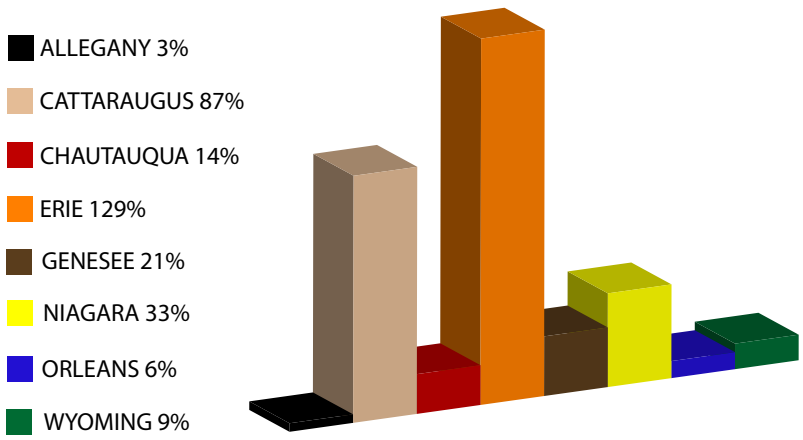
As with the previous categories, economic activity remains centered in Erie County, which accounted for 67.2% of total firms and almost 90.9% of total Geothermal revenues.

When measuring the percentages of total firms operating in Geothermal against total firms in their respective county, which in essence corrects for population differences, Erie operates at 129% above what would be expected in terms of revenues and 113% in terms of the number of firms.

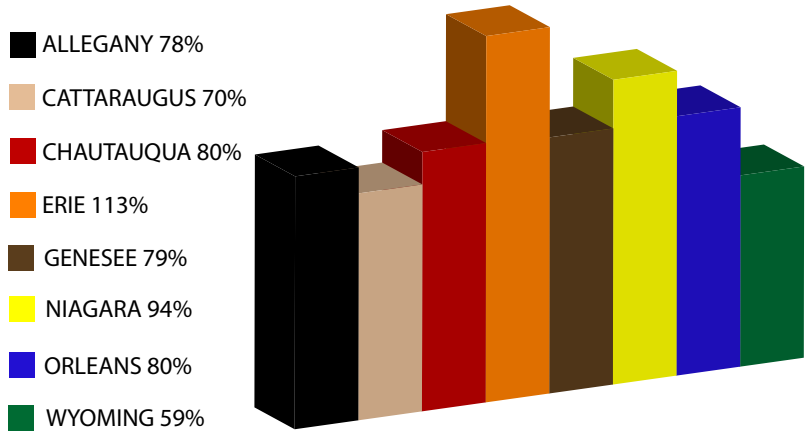
As in the other categories, Cattaraugus came closest to meeting the revenues that would be anticipated if Geothermal were to follow the total revenue distribution, though only reaching 87%. This was followed by Niagara at 33%, Genesee at 21% and Chautauqua at 14%, with all of the others registering under 10%.

GEOTHERMAL PERFORMANCE OF BUFFALO NIAGARA COUNTIES

Actual Revenues/Forecasted Revenues

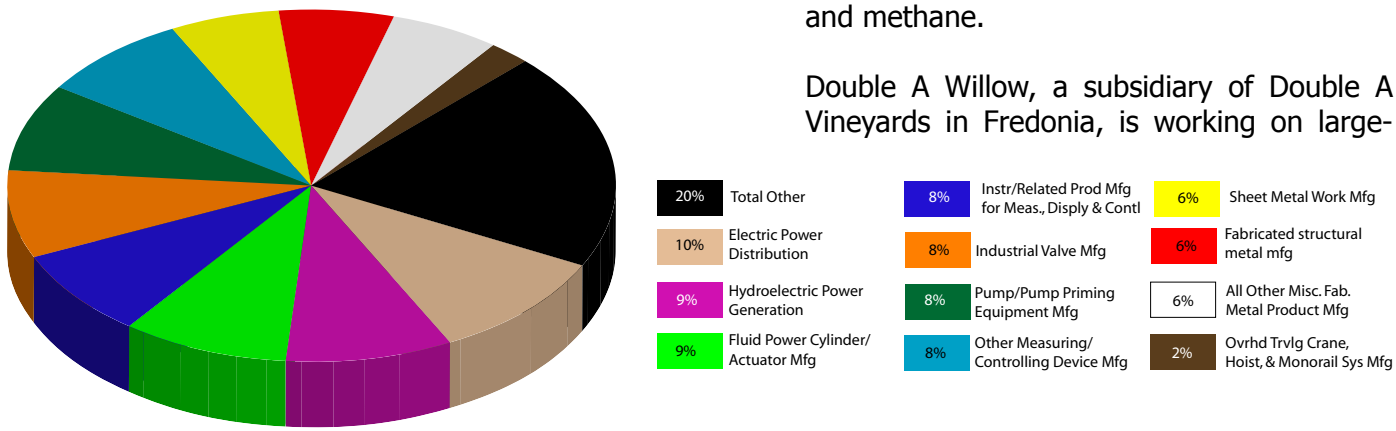


Actual Firms/Forecasted Firms



Geothermal NAICS Industries Distribution in BN Region

(Revenue per NAICS code)



BIOMASS

Biomass and biofuel operations generally require bulk transport, an advantage offered by Buffalo Niagara in its highway, rail and shipping systems. The component parts of the industry in general match the profile of the region's traditional manufacturing base. Plans are being made to reuse Buffalo's abandoned grain elevators as bulk storage for biofuel production.

RiverWright is a Buffalo company with plans to produce 110 million gallons of ethanol yearly in a facility on the Buffalo River. A group of area investors has purchased the 18-acre plot of land near the Ohio Street lift bridge and plan an $80-million-dollar project. The plant will utilize an 80,000-square-foot production facility and four grain elevators well as rail lines for distribution. The facility plans to bring in its biostock from the Midwest via lake freighter.

Northern Ethanol LLC in late 2008 announced plans to spend $245 million on a 70-acre site in Niagara Falls for an ethanol-producing plant. The company, a subsidiary of Toronto-based Northern Ethanol Inc., says production will include 108 million gallons of ethanol per year from 37 million bushels of corn.

Buffalo's NanoDynamics Energy received a grant from the DOE's biomass research program and developed a process to fabricate a single tubular cell capable of generating more than 20 watts. The cells were tested and assessed for performance on a variety of fuels, including hydrogen, methane and biogas. The company has a DOE contract to develop a 400-watt solid-oxide fuel cell designed to operate on a variety of fuels, including hydrogen and methane.

Double A Willow, a subsidiary of Double A Vineyards in Fredonia, is working on large-

Buffalo Niagara Biomass NAICS Value Chain Analysis

BIOMASS & BIOFUEL	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Biomass BN Rev Frcst Based on All	$478	$1,143	$1,787	$18,787	$798	$2,785	$440	$530	$26,748
Actual Revenue Based on Model	$92	$1,047	$342	$23,646	$336	$998	$216	$72	$26,748
Actual Revenues/Forecast Revenues	19.3%	91.6%	19.1%	125.9%	42.1%	35.8%	49.1%	13.6%	100.0%
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Biomass BN Firm Frcst Based on All	76	155	300	1,717	119	363	66	78	2,874
Actual Firms Based on Model	103	164	289	1,439	207	394	142	136	2,874
Actual Firms / Forecast Firms	134.9%	105.7%	96.4%	83.8%	174.6%	108.5%	213.8%	174.7%	100.0%

BIOMASS & BIOFUEL - Major NAICS - Revenues		Major Segments - Revenue									
NAICS	Biomass & Biofuel Industry Segment Name	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total	% Total
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	9.2%
333995	Fluid Power Cylinder/Actuator Mfg	0	0	0	2,096	86	16	0	0	2,198	8.2%
332911	Industrial Valve Manufacturing	0	0	0	2,031	86	31	0	0	2,148	8.0%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	8.0%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	7.8%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	7.7%
336399	All Other Motor Vehicle Parts Mfg	0	0	32	1,599	0	5	0	0	1,636	6.1%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	5.7%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	5.6%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	5.3%
333923	Ovrhd Trvlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	2.4%
423720	Plumbing/Heating Equip. Merch./Wholesalers	3	1	21	455	11	91	0	1	582	2.2%
	Total Other	85	1,033	188	3,987	126	656	210	70	6,354	23.8%
Total Revenues Biomass & Biofuel ($ Millions)		**$92**	**$1,047**	**$342**	**$23,646**	**$336**	**$998**	**$216**	**$72**	**$26,748**	
Total Biomass & Biofuel Revenues % to Total		**0.3%**	**3.9%**	**1.3%**	**88.4%**	**1.3%**	**3.7%**	**0.8%**	**0.3%**	**100.0%**	

BIOMASS & BIOFUEL - Major NAICS - Firms		Major Segments - Number of Firms									
NAICS	Biomass & Biofuel Industry Segment Name	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total	% Total
111998	All Other Miscellaneous Crop Farming	26	39	82	87	85	69	51	58	497	17.3%
541330	Engineering Design Services	6	16	15	230	8	46	5	6	332	11.6%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	8.7%
111150	Corn Farming	16	17	22	33	38	18	26	31	201	7.0%
541310	Architectural services	2	0	11	115	1	10	1	3	143	5.0%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	3.8%
236210	Industrial Building Construction	5	6	6	42	3	19	0	4	85	3.0%
423930	Recyclable Material Merchant Wholesalers	3	1	8	43	2	14	1	4	76	2.6%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	2.6%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	2.1%
541380	Testing Laboratories	2	1	3	44	0	6	1	2	59	2.1%
321999	All Other Miscellaneous Wood Product Mfg	2	7	15	25	2	7	0	0	58	2.0%
	Total Other	26	61	88	485	51	148	47	21	927	32.3%
Total Firms Biomass & Biofuel		**103**	**164**	**289**	**1,439**	**207**	**394**	**142**	**136**	**2,874**	
Total Firms % to Total		**3.6%**	**5.7%**	**10.1%**	**50.1%**	**7.2%**	**13.7%**	**4.9%**	**4.7%**	**100.0%**	

scale development of shrub willow, a high-yield, fast-growing and durable plant that serves as a biomass energy source.

Laidlaw Energy Group is developing a clean-wood biomass-fueled power plant in Ellicottville which uses a wood gasification system to handle various types of wood biomass fuel. Schutte Buffalo Hammermill LLC manufactures size-reduction equipment for a variety of industries, including alternative energy and recycling. Hebler Corp. makes renewable energy systems, including biomass gasification systems.

Buffalo Niagara Biomass NAICS Value Chain Analysis

The Buffalo Niagara Biomass Value Chain table analyzes all NAICS codes that account for over 2%.

Given the diversity of technologies and inputs into the biomass/biofuel sector, some of which are only tangentially involved (i.e., motor-vehicle parts), there are more relevant NAICS codes here than within any other area examined. With that in mind, economic activity was focused on seven areas, each of which accounted for

more than 6% of revenues generated, including Electric Power Distribution (9.2%), Fluid Power Cylinder/Actuator Manufacturing (8.2%), Industrial Valve Manufacturing (8%), Instruments/Related Products Mfg for Measure, Display and Control (8%), Pump/Pumping Equipment Manufacturing (7.8%), Other Measuring/Controlling Device Manufacturing (7.7%), and All Other Motor Vehicle Parts Manufacturing (6.1%). Perhaps more illustrative is the fact that of the 76 NAICS Biomass-related codes identified, 55 registered less than 1% each in terms of revenue share generated.

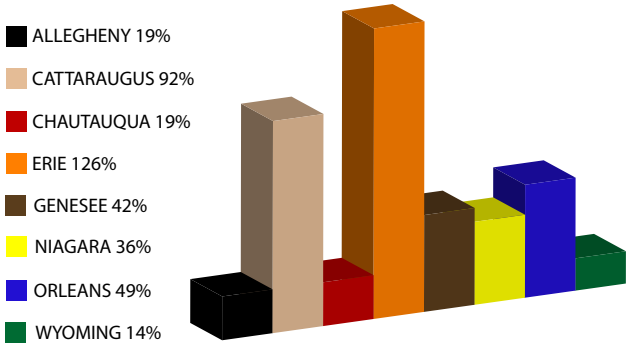
When viewed in terms of the number of firms, All Other Miscellaneous Crop Farming registered the largest contribution at 17.3%, followed by Engineering Design Services (11.6%). No other category registered more than 10% in terms of number of firms identified.

One might expect Erie County to be less dominant in biomass-related firms given the inclusion of agriculture in this category, and one can see both differences and similarities in this distribution when compared to other sectors. While Erie registered 88.4% of revenues and 50.1% of firms identified—in terms of population-adjusted potential, one sees Erie operating at 126% of anticipated revenues—which is similar to other sectors, but only 84% when looking at the number of firms.

The other counties registered a similar distribution when looked at in terms of revenues, with Cattaraugus registering 92% of anticipated revenues and all others below 50%. Due to the importance of agriculture, however, the comparative analysis of different counties revealed a totally different distribution when measured in terms of the number of firms. This included an extremely high 214% for Orleans, 175% for Wyoming and 175% for Genesee, and all other registering higher than Erie, which registered the lowest ranking.

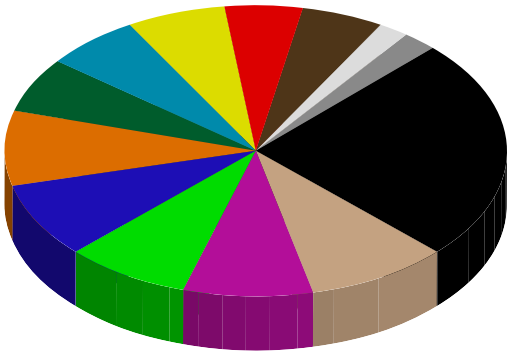
BIOMASS & BIOFUEL PERFORMANCE OF BUFFALO NIAGARA COUNTIES

Actual Revenues/Forecasted Revenues

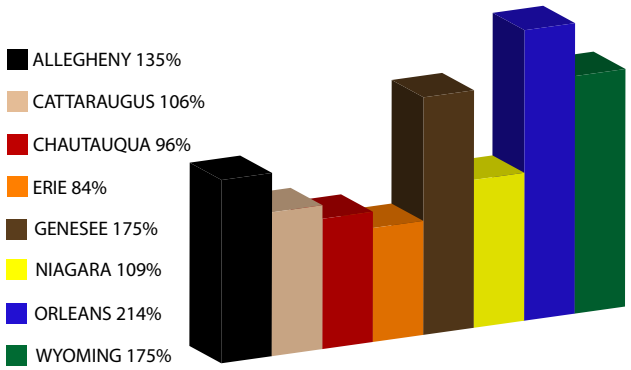


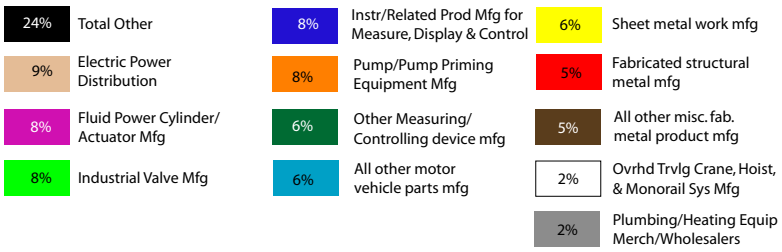
Biomass NAICS Industries Distribution in BN Region

(Revenue per NAICS code)



Actual Firms/Forecasted Firms





NUCLEAR

Buffalo Niagara has no operating nuclear facilities but is home to the West Valley Reprocessing Plant, which has done important research work in nuclear waste transportation and storage. It was a private-sector operation for the reprocessing of spent nuclear fuel rods, and from 1966 to 1972, approximately 660,000 gallons of highly radioactive waste accumulated in underground waste tanks as a result. The company decided the plant was not economically viable and abandoned operations. For the last 21 years, state and federal governments have undertaken nuclear remediation activities with controversies over funding, responsibility and safety. The most successful process to date has been the "vitrification" of liquid high-level radioactive waste, which solidifies the waste into glass-like logs transported by rail to nuclear depositories. Although an apparent liability, West Valley does draw experts in the nuclear field and employs dozens of nuclear engineers and technicians. In addition, Buffalo Niagara has idle heavy-industry plants, notably steel, that may be appropriate for making the large component parts required for a revived nuclear industry.

Buffalo Niagara Nuclear NAICS Value Chain Analysis

The Buffalo Niagara Nuclear Value Chain table analyzes all NAICS codes that account for over 2%.

Nuclear analysis is potentially even more misleading than the other categories given the high degree of precision and need for certification involved. While "Electric Power Distribution", "Sheet Metal Work Manufacturing" and the various consulting service categories appear in many of the sectors, it is fair to say the majority of firms included have no actual involvement with nuclear energy. One can usually get beyond this by stating that transforming their production into the category is feasible given it involves similar expertise, though that is unlikely with Nuclear.

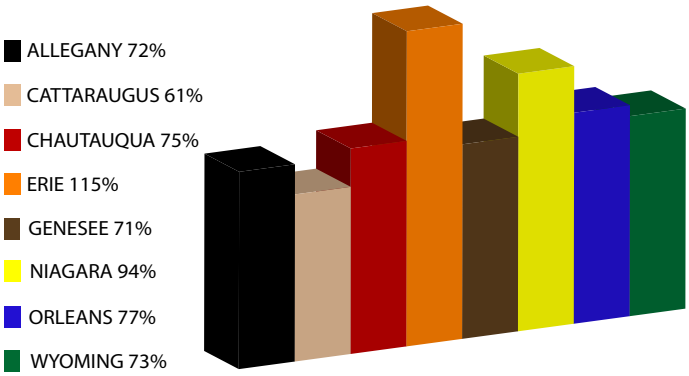
That is because this is far more of a "heavy industry," and the average sheet-metal firm, while potentially able to make wind turbine components or other light industry and consumer applications, is not going to be have the capacity and skills to obtain the certification needed to produce for a nuclear plant. On the other hand, those that do are likely to face far less competition and enjoy higher margins.

In any case, here too Electric Power Distribution (10.6%) enjoyed the highest share of Nuclear-related NAICS codes, followed by Fluid Power Cylinder/Actuator Mfg (9.4%), Industrial Valves (9.2%), Instruments/Related Products Mfg for Measure, Display and Control (9.2%), Pump/Pumping Equip Mfg (8.9%), and Other Measuring/Controlling Device Mfg (8.3%) respectively. Sheet Metal Work Mfg (6.6%), Fabricated Structural Metal Mfg (6.5%) and All Other Misc Fab Metal Product Mfg (6.1%), registered over 5%.

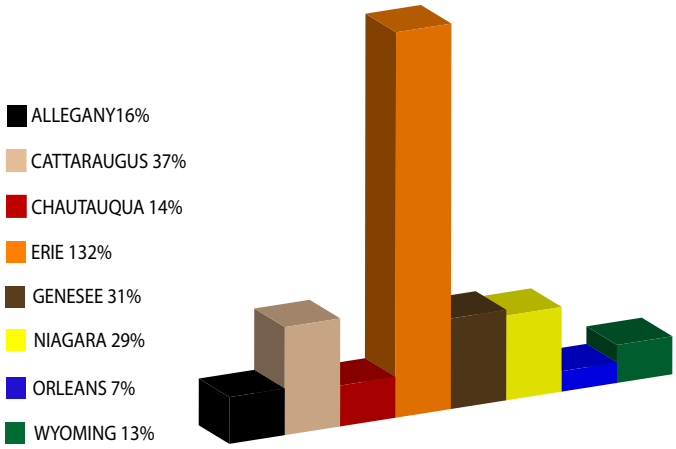
As with prior categories, economic activity remains centered in Erie County, which accounted for about 92.9% of total revenues and 68.4% of total firms. When measuring the percentages of total revenues or firms operating in Nuclear-related NAICS codes against total revenues or firms in their respective county, which in essence corrects for population differences, Erie is operating at 132% above what would be expected in terms of anticipated revenues and 115% in terms of the number of firms. This was followed by Cattaraugus (37%), Genesee (31%) and Niagara (30%) in terms of revenues with all the other counties registering under 20%. When examining the number of firms Niagara came in second after Erie at 94% and all other counties ranging from 60-80%.

Nuclear Performance of BN Counties

Actual Firms/Forecasted Firms



Actual Revenues/Forecasted Revenues



Buffalo Niagara Nuclear NAICS Value Chain Analysis

NUCLEAR	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Nuclear BN Rev Frcst Based on All	$415	$994	$1,555	$16,341	$694	$2,423	$382	$461	$23,265
Actual Revenues Based on Model	$67	$372	$216	$21,609	$215	$701	$25	$60	$23,265
Actual Revenues/Forecast Revenues	16.1%	37.4%	13.9%	132.2%	31.0%	28.9%	6.6%	13.0%	100.0%

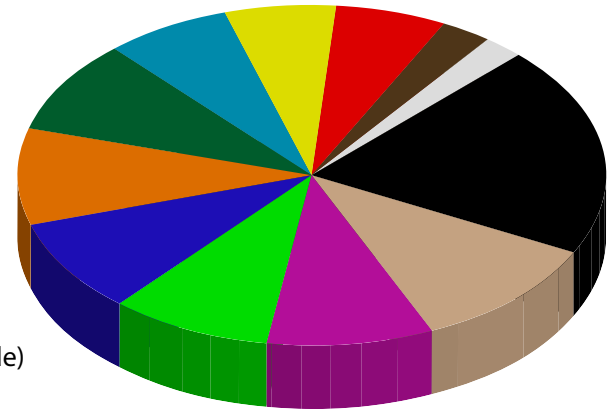
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Nuclear BN Firm Frcst Based on All	43	88	170	973	67	206	38	44	1,629
Actual Firms Based on Model	31	54	127	1,115	48	193	29	32	1,629
Actual Firms / Forecast Firms	71.6%	61.4%	74.7%	114.6%	71.4%	93.8%	77.0%	72.5%	100.0%

	NUCLEAR - Major NAICS Codes - Revenues	**Major Segments - Revenue**									
NAICS	**Nuclear Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	10.6%
333995	Fluid Power Cylinder/Actuator Mfg	0	0	0	2,096	86	16	0	0	2,198	9.4%
332911	Industrial Valve Manufacturing	0	0	0	2,031	86	31	0	0	2,148	9.2%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	9.2%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	8.9%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	8.8%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	6.6%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	6.5%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	6.1%
333923	Ovrhd Trvlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	2.7%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.1%
	Total Other	61	356	109	3,751	15	226	19	57	4,595	19.7%
Total Revenues Nuclear ($ Millions)		**$67**	**$372**	**$216**	**$21,609**	**$215**	**$701**	**$25**	**$60**	**$23,265**	
Total Nuclear Revenues % to Total		**0.3%**	**1.6%**	**0.9%**	**92.9%**	**0.9%**	**3.0%**	**0.1%**	**0.3%**	**100.0%**	

	NUCLEAR - Major NAICS Codes - Firms	**Major Segments - Number of Firms**									
NAICS	**Nuclear Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
541330	Engineering Services	6	15	15	230	8	46	5	6	331	20.3%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	15.4%
541310	Architectural services	2	0	11	115	1	10	1	3	143	8.8%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	6.8%
331511	Iron Foundries	0	2	9	60	6	12	2	0	91	5.6%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	4.5%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.6%
541380	Testing Laboratories	2	1	3	44	0	6	1	2	59	3.6%
332313	Plate Work Manufacturing	1	0	4	18	0	9	0	1	33	2.0%
	Total Other	7	19	38	318	14	59	11	12	478	29.3%
Total Firms Nuclear		**31**	**54**	**127**	**1,115**	**48**	**193**	**29**	**32**	**1,629**	
Total Firms % to Total		**1.9%**	**3.3%**	**7.8%**	**68.4%**	**2.9%**	**11.8%**	**1.8%**	**2.0%**	**100.0%**	

Nuclear NAICS Industries Distribution in BN Region

(Revenue per NAICS code)



20%	Total other	9%	Instr/Related Prod Mfg for Measure, Display & Control	6%	Fabricated Structural Metal Mfg
11%	Electric power distribution	9%	Pump/Pumping Equip. Mfg	6%	All Other Misc. Fab. Metal Product Mfg
9%	Fluid Power Cylinder/ Actuator Mfg	9%	Other Measuring/ Controlling Device Mfg	3%	Overhead Trvlg Crane, Hoist, & Monorail Sys Mfg
9%	Industrial Valve Mfg	7%	Sheet Metal Work Mfg	2%	Energy consulting services

Buffalo Niagara ETS NAICS Value Chain Analysis

ENERGY TRANSMISSION STORAGE	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
ETS BN Rev Frcst Based on All	$292	$699	$1,093	$11,490	$488	$1,703	$269	$324	$16,359
Actual Revenues Based on Model	$20	$941	$224	$14,492	$54	$580	$44	$5	$16,359
Actual Revenues/Forecast Revenues	6.9%	134.5%	20.5%	126.1%	11.0%	34.1%	16.3%	1.5%	100.0%

All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
ETS BN Firm Frcst Based on All	41	83	160	917	63	194	36	42	1,536
Actual Firms Based on Model	32	60	121	1,046	50	179	27	21	1,536
Actual Firms / Forecast Firms	78.4%	72.3%	75.5%	114.0%	78.9%	92.2%	76.0%	50.5%	100.0%

		Major Segments - Revenue									
NAICS	**Energy Trans Storage Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	15.1%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	13.1%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	12.6%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	9.4%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	9.2%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	8.7%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	3.0%
335312	Motor and Generator	0	300	0	146	0	0	0	0	447	2.7%
326199	All Other Plastics Product Mfg	0	1	16	297	7	62	18	0	401	2.4%
335311	Power, Distribution, & Specialty Transformer Mfg	6	0	0	368	0	0	0	0	374	2.3%
541330	Engineering Design Services	1	2	2	331	3	13	2	2	355	2.2%
333912	Air/Gas Compressor Mfg	0	300	1	7	17	8	0	0	333	2.0%
335999	Charge Controller	0	0	1	330	0	0	0	0	332	2.0%
334418	Printed circuits and electronics assemblies	0	0	0	319	0	0	0	0	320	2.0%
	Total Other	8	322	98	1,528	5	206	17	0	2,184	13.4%
Total Revenues Energy Trans Storage ($ Millions)		**$20**	**$941**	**$224**	**$14,492**	**$54**	**$580**	**$44**	**$5**	**$16,359**	
Total Energy Trans Storage Revenues % to Total		**0.1%**	**5.7%**	**1.4%**	**88.6%**	**0.3%**	**3.5%**	**0.3%**	**0.0%**	**100.0%**	

	ETS - Major NAICS Codes - Firms	Major Segments - Number of Firms									
NAICS	**Energy Trans Storage Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
541330	Engineering Design Services	6	15	15	230	8	46	5	6	331	21.5%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	16.3%
541310	Architectural services	2	0	11	115	1	10	1	3	143	9.3%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	7.2%
326199	All Other Plastics Product Mfg	0	2	9	60	6	12	2	0	91	5.9%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	4.9%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	4.8%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.8%
221119	Other Electric Power Generation	2	6	11	15	3	11	1	1	50	3.3%
326299	Fuel cells, solid-state	0	1	1	21	0	6	0	1	30	2.0%
335999	Charge Controller	1	1	4	18	2	4	0	0	30	2.0%
	Total Other	5	17	21	195	10	33	8	2	291	18.9%
Total Firms Energy Trans Storage		**32**	**60**	**121**	**1,046**	**50**	**179**	**27**	**21**	**1,536**	
Total Firms % to Total		**2.1%**	**3.9%**	**7.9%**	**68.1%**	**3.3%**	**11.7%**	**1.8%**	**1.4%**	**100.0%**	

ENERGY TRANSMISSION & STORAGE

Buffalo Niagara has an existing manufacturing, technology and research base to support the development, production and distribution of renewable-energy storage components and systems.

Energy Curtailment Specialists (ECS) has grown from a two-person operation in 2001 to become North America's largest private demand-response provider offering turnkey, administrative and à la carte demand services.

Demand response works like the smart grid and is the action of end-users lowering their demand for power in order to help balance supply and demand on the grid. ECS makes the arrangements with utilities, and their end-user customers receive incentive payments for lowering electrical consumption at peak times.

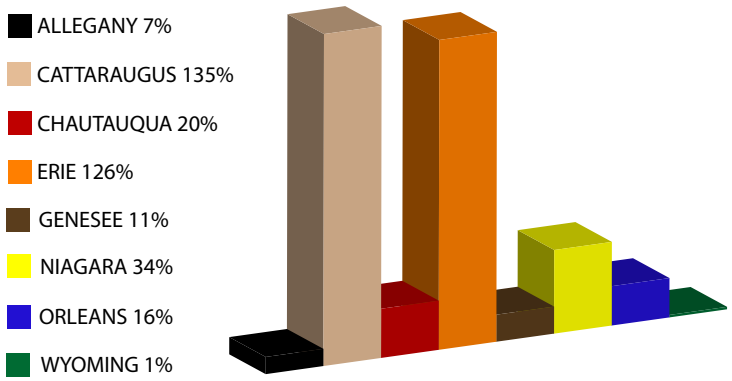
The company, which operates in 24 states including New York, Pennsylvania, New Jersey, Maryland and Ohio, has recently expanded into Canada with several large clients in southern Ontario.

UB's Integrated Nanostructured Systems is researching the enabling technology for future generations of energy storage by developing batteries for the electric and plug-in hybrid-vehicle markets.

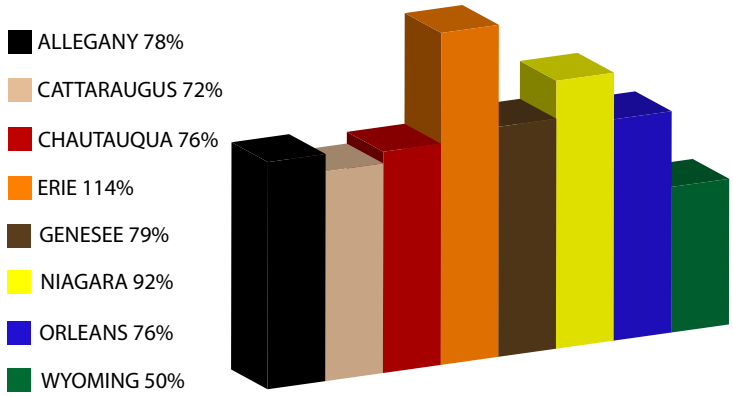
NanoDynamics Inc's energy division manufactures products, devices, and systems for the portable power and energy generation markets including a solid oxide fuel cell. ENrG Inc., also in Buffalo, specializes in technologies for fuel cells and gas separation.

ETS PERFORMANCE OF BUFFALO NIAGARA COUNTIES

Actual Revenues/Forecasted Revenues

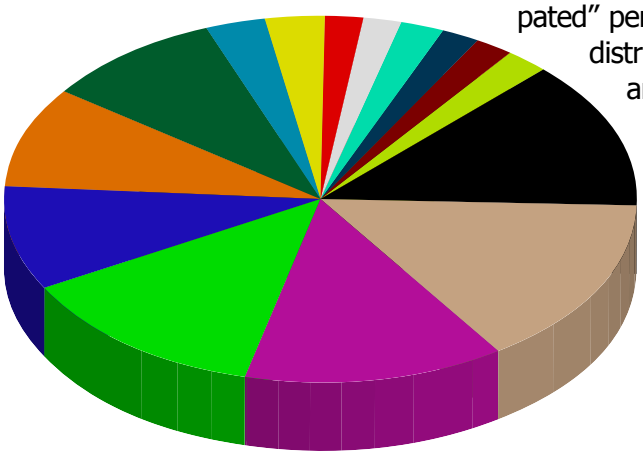


Actual Firms/Forecasted Firms



ETS NAICS Industries Distribution in Buffalo Niagara Region

Revenue per NAICS code



13%	Total other	9%	Fabricated Structural Metal Mfg	2%	Power, Distr, & Specialty Transformer Mfg
15%	Electric power distribution	9%	All Other Misc Fab Metal Product Mfg	2%	Engeneering Design Services
13%	Instr/Related Prod Mfg for Measure, Display & Control	3%	Energy Consulting Services	2%	Air/Gas Compressor Mfg
13%	Other Measuring/ Controlling Device Mfg	3%	Motor & Generator	2%	Charge Controller
9%	Sheet Metal Work Mfg	2%	All Other Plastics Product Mfg	2%	Printed Circuits & Electronics Assemblies

Dresser-Rand, the largest global supplier of turbine rotating equipment solutions to the worldwide oil and gas, chemical, petrochemical and process industries, is currently investing $14.7 million to build a new state-of-the-art technology center in Olean.

The Buffalo Niagara ETS Value Chain table analyzes all NAICS codes that account for over 2%.

Three NAICS codes, Electric Power Distribution (15.1%), Instruments/Related Products Mfg for Measure, Display & Control (13.1%) and Other Measuring/Controlling Device Mfg (12.6%) accounts for just over 40% of Energy Transmission and Storage – related NAICS codes in Buffalo Niagara, followed by Sheet Metal Work Manufacturing (9.4%), Fabricated Structural Metal Manufacturing (9.20%) and All Other Miscellaneous Fabricated Metal Product Manufacturing (8.7%) with no other NAICS code registering over 3.1%. Similar to other sectors, when measured in terms of the number of firms, activity is dominated by services, with Engineering Design Services accounting for 21.5%, though it is again important to emphasize that this includes all engineering design services, most of which have nothing to do with renewable energy or the transmission or storage.

When measuring the actual performance of the individual Buffalo Niagara counties against their "anticipated" performance if they followed the same distribution as seen in total revenues and firms, Cattaraugus County comes out the highest at 135%, given its strong showing in Turbines, Compressors, Motors and Generators. This, however, is one of the more notable instances of double-counting between NAICS codes, given many firms that make turbines also make motors, etc.

As a result it is important to use these indicators as a basis for comparison while understanding they are subject to the statistical limitations of the model and available data. Erie, which dominated in all other sectors, came in second at 126%, while the other counties ranged from 1% to 34% of anticipated revenues. When measured in the number of firms, Erie again dominates at 114%.

Buffalo Niagara Green Building NAICS Value Chain Analysis

GREEN BUILDING	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Green Bldg BN Rev Frcst Based on All	$359	$859	$1,343	$14,113	$600	$2,092	$330	$398	$20,094
Actual Revenues Based on Model	$146	$448	$362	$17,914	$134	$940	$62	$88	$20,094
Actual Revenues/Forecast Revenues	40.8%	52.1%	27.0%	126.9%	22.4%	44.9%	18.7%	22.1%	100.0%
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Green Bldg Firm Frcst Based on All	157	320	617	3,536	244	748	137	160	5,920
Actual Firms Based on Model	122	295	558	3,678	213	774	140	140	5,920
Actual Firms /Forecast Firms	77.6%	92.3%	90.4%	104.0%	87.2%	103.5%	102.3%	87.3%	100.0%

GREEN BUILDING - Major NAICS Codes - Revenu		Major Segments - Revenue									
NAICS	**Green Building Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
221122	Electric Power Distribution	$0	$0	$17	$2,448	$0	$0	$0	$0	$2,464	12.3%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	10.6%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	10.2%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	7.6%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	7.5%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	7.1%
236220	Comm./Instit. Building Construction	1	37	58	637	19	109	1	15	878	4.4%
238220	Plumbing, Heating, and AC Contractors	2	16	36	684	19	38	5	5	805	4.0%
423720	Plumbing/Heating Equip. Merch./Wholesalers	3	1	21	455	11	91	0	1	582	2.9%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.5%
236115	New Single Family Housing Const/	7	15	30	362	9	50	6	12	491	2.4%
335312	Motor and Generator	0	300	0	146	0	0	0	0	447	2.2%
541618	Utilities Mgt Consulting Svcs	1	1	6	388	19	3	1	1	421	2.1%
326199	All Other Plastics Product Mfg	0	1	16	297	7	62	18	0	401	2.0%
	Total Other	126	62	89	3,778	29	296	24	52	4,455	22.2%
Total Green Building Revenues ($ Millions)		**$146**	**$448**	**$362**	**$17,914**	**$134**	**$940**	**$62**	**$88**	**$20,094**	
Total Green Building Revenues % to Total		**0.7%**	**2.2%**	**1.8%**	**89.2%**	**0.7%**	**4.7%**	**0.3%**	**0.4%**	**100.0%**	

GREEN BUILDING - Major NAICS Codes - Frims		Major Segments - Firms									
NAICS	**Green Building Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
236115	New Single Family Housing Const/	28	80	128	717	40	174	42	39	1,248	21.1%
238220	Plumbing, Heating, and AC Contractors	21	50	90	521	50	114	27	19	892	15.1%
236118	Residential Remodelers	5	27	55	433	24	70	18	11	643	10.9%
541618	Utilities Mgt Consulting Svcs	5	12	36	376	7	67	9	7	519	8.8%
236220	Comm./Instit. Building Construction	6	23	38	265	21	63	5	17	438	7.4%
541330	Engineering Services	6	16	15	230	8	46	5	6	332	5.6%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	4.2%
236116	New Multifamily Housing Const.	7	17	35	101	7	40	4	10	221	3.7%
541310	Architectural services	2	0	11	115	1	10	1	3	143	2.4%
	Total Other	33	61	135	746	51	159	24	24	1,233	20.8%
Total Firms Green Building		**122**	**295**	**558**	**3,678**	**213**	**774**	**140**	**140**	**5,920**	
Total Firms % to Total		**2.1%**	**5.0%**	**9.4%**	**62.1%**	**3.6%**	**13.1%**	**2.4%**	**2.4%**	**100.0%**	

GREEN BUILDINGS

Buffalo is quickly gaining ground in green building. The amount of green construction and LEED certified buildings advanced rapidly in 2008 with more green construction on the drawing board. The area's major developers and builders, including Ciminelli Development, Uniland Development and McGuire Development all had major LEED projects at the end of 2008. The most prominent were the $137 million federal courthouse being built in Buffalo's downtown and the $35.5 million Buffalo State College Burchfield Penney Art Center.

Buffalo has received national attention less for building construction than for innovative deconstruction. Buffalo nonprofit ReUse has been featured in national publications for an ambitious program to salvage and resell materials from among the city's 10,000 blighted or abandoned houses. ReUse employs inner-city youth and gives them valuable job skills in the building trades for possible future employment.

In 2004, UB, by committing to LEED Gold standards for all new buildings. adopted high-performance guidelines to direct a new construction and renovation design process that prioritizes energy efficiency.

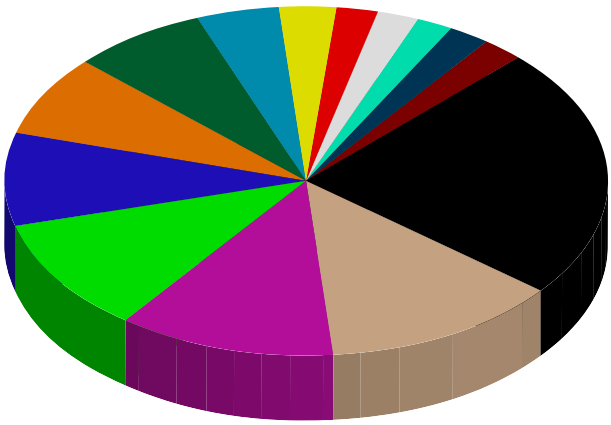
Buffalo Niagara Green Building NAICS Value Chain Analysis

The Buffalo Niagara Green Building Value Chain table analyzes all NAICS codes that account for over 2%.

Given the Green Building sector's diversity, which ranges from design and construction of new buildings, building renovation, introductions of energy efficiency, the development of green appliances and other consumer and industrial products, there are more relevant NAICS codes here than in any other sector examined in this report except for Biomass. Similar to the other areas, the largest code is Electric Power Generation (12.3%).

Green Building NAICS Industries Distribution in BN Region

Revenue per NAICS code



It is followed by Instruments/Related Products Mfg for Measure, Display and Control (10.6%) and Other Measuring/ Controlling Device Mfg (10.2%). Other significant codes include Sheet Metal Work Manufacturing (7.6%), Fabricated Structural Metal Manufacturing (7.5%) and All Other Misc. Fabricated Metal Product Manufacturing (7.1%). As with Biomass, many are quite small, with 40 out of the 63 NAICS codes registering under 1% of total revenues.

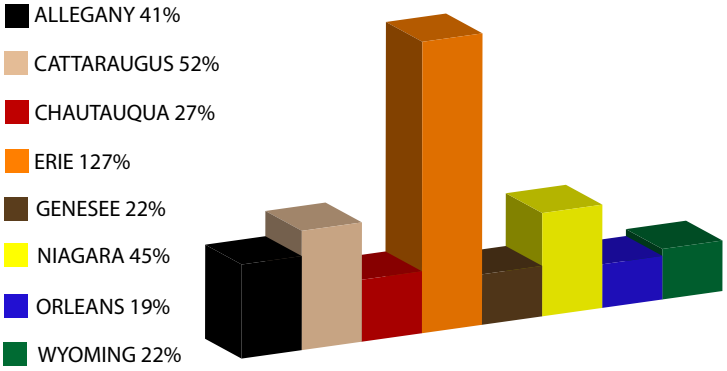
22%	Total other	7%	Fabricated Structural Metal Mfg	2%	Energy Consulting Services
12%	Electric power distribution	7%	All Other Misc Fab Metal Product Mfg	2%	New Single-family Housing Const
11%	Instr/Related Prod Mfg for Measure, Display & Control	4%	Comm/Institutional Building Const	2%	Motor & Generator
10%	Other Measuring/ Controlling Device Mfg	4%	Plumbing/Heating & AC Contractors	2%	Utilities Mgt Consulting Services
8%	Sheet Metal Work Mfg	3%	Plumbing/Heating & Equip Merch Wholesalers	2%	All Other Plastics Product Mfg

More than twice as many firms were identified for Green Buildings (5,920) than the next largest sub-sector, Biomass (2,874) demonstrating the decentralized nature of Green Building activity as well as the importance of service firms. For example, there were 1248 New Single Housing Construction firms (21.1%) identified, followed by Plumbing, Heating, and Air-Conditioning Contractors (15.1%) and Residential Remodelers (10.9%).

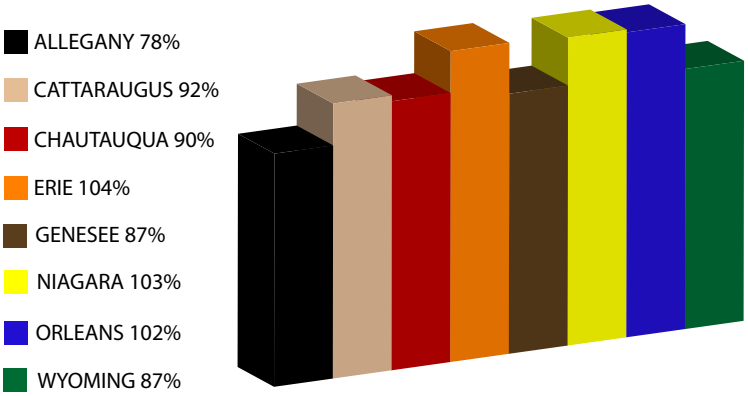
While Erie County dominates Green Building economic activity — as it does in most of the areas studied in terms of revenues — and registers the highest in terms of actual versus anticipated revenues (104%), it does so by a far smaller amount than in the other sectors analyzed. The other counties registered between 78-103% While not as strong as Biomass, this is stronger than the other sub-sectors, and reflects the far more localized nature of this industry and the difficulties of including only Green Building related equipment and components rather than the services of local construction.

GREEN BUILDING PERFORMANCE OF BN COUNTIES

Actual Revenues/Forecasted Revenues



Actual Firms/Forecasted Firms



Buffalo Niagara Transportation NAICS Value Chain Analysis

TRANSPORTATION	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Transportation BN Rev Frcst Based on Al	$380	$910	$1,423	$14,958	$636	$2,217	$350	$422	$21,296
Actual Revenues Based on Model	$16	$627	$179	$19,576	$148	$695	$10	$44	$21,296
Actual Revenues/Forecast Revenues	4.2%	68.9%	12.6%	130.9%	23.3%	31.3%	2.9%	10.5%	100.0%

All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Transportation Firm Frcst Based on All	37	76	147	843	58	178	33	38	1,411
Actual Firms Based on Model	24	54	105	960	46	176	25	21	1,411
Actual Firms /Forecast Firms	64.0%	70.9%	71.3%	113.9%	79.0%	98.7%	76.7%	54.9%	100.0%

	TRANSPORTATION - Major NAICS - Revenues	**Major Segments - Revenue**									
NAICS	**Transportation Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
333995	Fluid Power Cylinder/Actuator Mfg	$0	$0	$0	$2,096	$86	$16	$0	$0	$2,198	10.3%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	10.0%
332911	Industrial Valve Manufacturing	0	0	0	1,934	6	138	0	0	2,079	9.8%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	9.8%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	9.6%
336399	All Other Motor Vehicle Parts Mfg	0	0	32	1,599	0	5	0	0	1,636	7.7%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	7.2%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	7.1%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	6.7%
333923	Ovrgd Trvlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	3.0%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.3%
335312	Motor and Generator	0	300	0	146	0	0	0	0	447	2.1%
	Total Other	10	312	58	2,517	28	107	3	41	3,076	14.4%
Total Revenues Transportation ($ Millions)		**$16**	**$627**	**$179**	**$19,576**	**$148**	**$695**	**$10**	**$44**	**$21,296**	
Total Trasnportation Revenues % to Total		**0.1%**	**2.9%**	**0.8%**	**91.9%**	**0.7%**	**3.3%**	**0.0%**	**0.2%**	**100.0%**	

	TRANSPORTATION - Major NAICS - Revenues	**Major Segments - Revenue**									
NAICS	**Transportation Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
333995	Fluid Power Cylinder/Actuator Mfg	$0	$0	$0	$2,096	$86	$16	$0	$0	$2,198	10.3%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	10.0%
332911	Industrial Valve Manufacturing	0	0	0	1,934	6	138	0	0	2,079	9.8%
333911	Pump/Pumping Equip. Mfg	0	0	0	1,934	6	138	0	0	2,079	9.8%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	9.6%
336399	All Other Motor Vehicle Parts Mfg	0	0	32	1,599	0	5	0	0	1,636	7.7%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	7.2%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	7.1%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	6.7%
333923	Ovrgd Trvlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	3.0%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.3%
335312	Motor and Generator	0	300	0	146	0	0	0	0	447	2.1%
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Total Revenues Transportation ($ Millions)		**$16**	**$627**	**$179**	**$19,576**	**$148**	**$695**	**$10**	**$44**	**$21,296**	
Total Trasnportation Revenues % to Total		**0.1%**	**2.9%**	**0.8%**	**91.9%**	**0.7%**	**3.3%**	**0.0%**	**0.2%**	**100.0%**	

Freerange photo

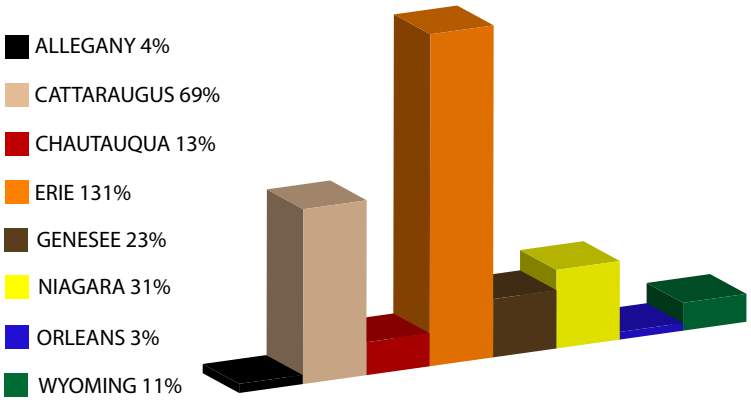
TRANSPORTATION

In 2009, Gov. David Patterson announced the creation of a consortium on hybrid electric batteries and energy-storage technologies to advance the development of technology for plug-in hybrid electric vehicles. The creation of a New York Energy Policy Institute to coordinate the knowledge base and expertise of New York's higher education institutions will bring important research and technical support to the consortium. Buffalo Niagara's companies and universities are expected to play a role as plans develop.

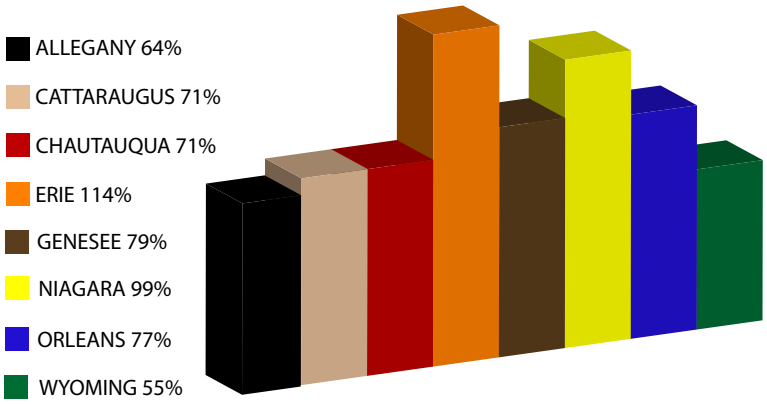
Buffalo-based ENrG Inc., through a licensing agreement with Corning, will produce thin ceramic membranes for solid-oxide fuel cells used for auxiliary power units

TRANSPORTATION PERFORMANCE OF BUFFALO NIAGARA COUNTIES

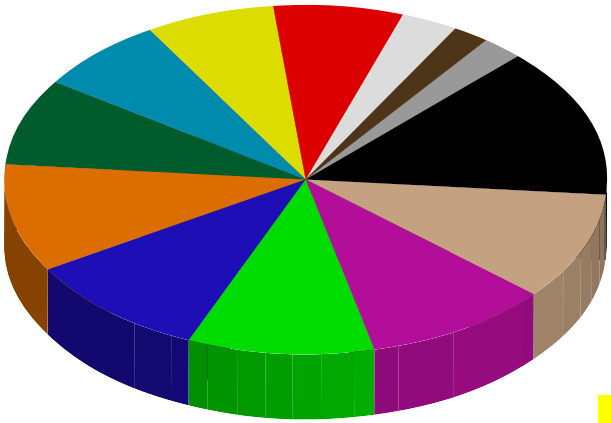
Actual Revenues/Forecasted Revenues



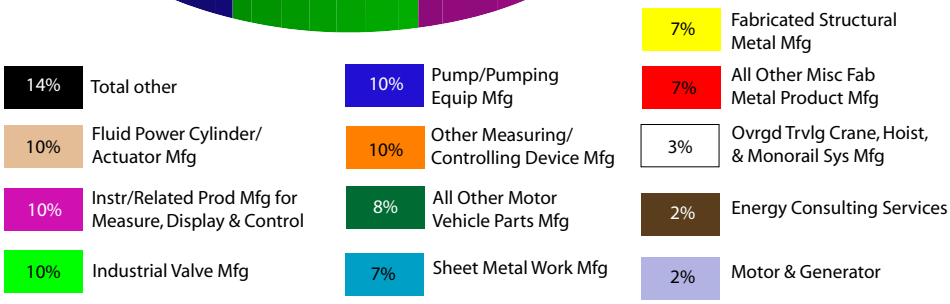
Actual Firms/Forecasted Firms



Transportation NAICS Industries Distribution in Buffalo Niagara Region



Revenue per NAICS code



in vehicles. Other applications include the military, when power is needed in remote locations. The cells use a hard, nonporous ceramic compound as the electrolyte and operate at 1,800° F.

Delphi Corp., a major automotive supplier with plants in Buffalo Niagara, maintains a fuel cell research and development center at the Rochester Institute of Technology. It received a $2.7 million grant from the Department of Defense in 2008. GM invested $31 million 2008 in its Tonawanda Powertrain Engine Plant to upgrade the current Ecotec 2.2-liter engines to make them E85 (ethanol) capable and improve emissions. Cummins Inc., Jamestown, employs 1,300 in the manufacture of diesel engines. Ashland Advanced Materials, Niagara Falls, is establishing a plant to produce carbon and graphite products that will support the manufacturing of lithium batteries for hybrid-electric vehicles.

Buffalo Niagara Transportation NAICS Value Chain Analysis

The Buffalo Niagara Transportation Value Chain table analyzes all NAICS codes that account for over 2%.

Primary NAICS codes in Transportation include Fluid Power Cylinder/Actuator Manufacturing (10.3%), Instruments/Related Products Mfg for Measure, Display and Control (10%), Industrial Valve Manufacturing (9.8%), and Other Measuring/Controlling Device Mfg (9.6%), All Other Motor Vehicle Parts Mfg (7.7%), Sheet Metal Work Manufacturing (7.2%) and Fabricated Structural Metal Manufacturing (7.1%) are also significant.

When measured by the number of firms, Transportation is, not surprisingly, dominated by Engineering Design and Energy Consulting Services, which account for just over 41%, though it is likely only a small minority of these firms are active in the Renewable Transportation sector.

When looked at in terms of anticipated versus actual revenues or firms, Transportation showed a typical distribution with Erie registering 131% in terms of revenues and 114% in terms of firms. The other counties ranged from 3%-69% in terms of revenues and 54.93%-98.73% in terms of firms.

Buffalo Niagara Solid Waste Management NAICS Value Chain Analysis

SOLID WASTE	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total
All Sector BN Revenue (Millions $)	$628	$1,502	$2,349	$24,689	$1,049	$3,660	$578	$696	$35,151
% Total Revenues	1.8%	4.3%	6.7%	70.2%	3.0%	10.4%	1.6%	2.0%	100.0%
Solid Waste BN Rev Frcst Based on All	$305	$730	$1,142	$12,001	$510	$1,779	$281	$338	$17,087
Actual Revenues Based on Model	$74	$371	$140	$15,697	$208	$577	$11	$10	$17,087
Actual Revenues/Forecast Revenues	24.3%	50.8%	12.3%	130.8%	40.7%	32.4%	3.8%	2.8%	100.0%
All Sector BN Firms (Total)	1,923	3,909	7,549	43,232	2,986	9,144	1,673	1,961	72,377
% Total Firms	2.7%	5.4%	10.4%	59.7%	4.1%	12.6%	2.3%	2.7%	100.0%
Solid Waste Firm Frcst Based on All	46	93	180	1,029	71	218	40	47	1,722
Actual Firms Based on Model	48	68	146	1,133	51	215	28	33	1,722
Actual Firms /Forecast Firms	104.9%	73.1%	81.3%	110.2%	71.8%	98.8%	70.3%	70.7%	100.0%

	SOLID WASTE - Major NAICS Codes - Revenues	**Major Segments - Revenue**									
NAICS	**Solid Waste Industry Segment Name**	**Al**	**Ca**	**Ch**	**Er**	**Ge**	**Ni**	**Or**	**Wy**	**Total**	**% Total**
333995	Fluid Power Cylinder/Actuator Mfg	$0	$0	$0	$2,096	$86	$16	$0	$0	$2,198	12.9%
332911	Industrial Valve Manufacturing	0	0	0	2,031	86	31	0	0	2,148	12.6%
334513	Instr/Related Prod Mfg for Meas., Disply & Contl	0	0	13	2,122	0	0	2	0	2,137	12.5%
334519	Other Measuring/Controlling Device Mfg	0	3	0	2,038	0	12	0	0	2,054	12.0%
332322	Sheet Metal Work Manufacturing	2	8	39	1,464	1	16	3	1	1,532	9.0%
332312	Fabricated Structural Metal Manufacturing	0	1	31	1,438	1	33	0	1	1,505	8.8%
332999	All Other Misc. Fab. Metal Product Mfg	3	2	0	1,403	18	1	0	0	1,426	8.3%
333923	Ovrhd Travlg Crane, Hoist, & Monorail Sys Mfg	0	0	0	632	0	0	0	0	632	3.7%
541690	Energy Consulting Services	2	2	6	254	2	228	1	1	496	2.9%
335312	Motor and Generator Mfg	0	300	0	146	0	0	0	0	447	2.6%
541330	Engineering Services	1	2	2	331	3	13	2	2	355	2.1%
	Total Other	68	53	49	1,743	11	228	2	5	2,158	12.6%
Total Revenues Solid Waste ($ Milions)		**$74**	**$371**	**$140**	**$15,697**	**$208**	**$577**	**$11**	**$10**	**$17,087**	
Total Solid Waste Revenues % to Total		**0.4%**	**2.2%**	**0.8%**	**91.9%**	**1.2%**	**3.4%**	**0.1%**	**0.1%**	**100.0%**	

	SOLID WASTE - Major NAICS Codes - Firms	Major Segments - Number of firms									
NAICS	Solid Waste Industry Segment Name	Al	Ca	Ch	Er	Ge	Ni	Or	Wy	Total	% Total
541330	Engineering Services	6	16	15	230	8	46	5	6	332	19.3%
541690	Energy Consulting Services	9	9	15	174	4	31	5	4	251	14.6%
541310	Architectural services	2	0	11	115	1	10	1	3	143	8.3%
334519	Other Measuring/Controlling Device Mfg	2	4	12	67	9	12	2	2	110	6.4%
236210	Industrial Building Construction	5	6	6	42	3	19	0	4	85	4.9%
423930	Recyclable Material Merchant Wholesalers	3	1	8	43	2	14	1	4	76	4.4%
541712	R&D in Physical, Engineering, and Life Sciences	3	1	2	62	1	6	1	0	76	4.4%
332312	Fabricated Structural Metal Manufacturing	1	2	10	57	3	0	0	1	74	4.3%
562991	Septic Tank & Related Svcs	5	3	11	23	1	13	2	2	60	3.5%
332322	Sheet Metal Work Manufacturing	1	2	10	32	3	8	2	1	59	3.4%
541380	Testing Laboratories	2	1	3	44	0	6	1	2	59	3.4%
562920	Materials Recovery Facil.	4	2	5	23	3	11	2	0	50	2.9%
	Total Other	5	21	38	221	13	39	6	4	347	20.2%
Total Firms Solid Waste		48	68	146	1,133	51	215	28	33	1,722	
Total Firms % to Total		2.8%	3.9%	8.5%	65.8%	3.0%	12.5%	1.6%	1.9%	100.0%	

SOLID WASTE MANAGEMENT

As part of its industrial heritage, Buffalo Niagara has many sites suitable for brownfield development. A number of sites are planned and "shovel ready" but have not proceeded for lack of government funding. Brownfields can be well-suited to renewable-energy reuse. In some cases, more intense land use is impractical because of weak market conditions or contamination may make commercial redevelopment difficult. However, wind farms and solar fields can be developed on sites that may not work for other uses. The Steel Winds site in Lackawanna is considered one the nation's best examples of brownfield use for renewable energy.

Bethlehem Steel has pledged $5 million to help prepare 1,150 unused acres of its former plant adjacent to Steel Winds. The money will also go to 1,200-acres in the South Buffalo Redevelopment Area for light and heavy industries, distribution businesses, and recreational uses. Erie County has committed $1 million to upgrade infrastructure. The South Buffalo Redevelopment Area will develop an area of 3 million square feet at a cost of $45 to $65 million. It is estimated this development will create 4,500 to 10,500 new jobs.

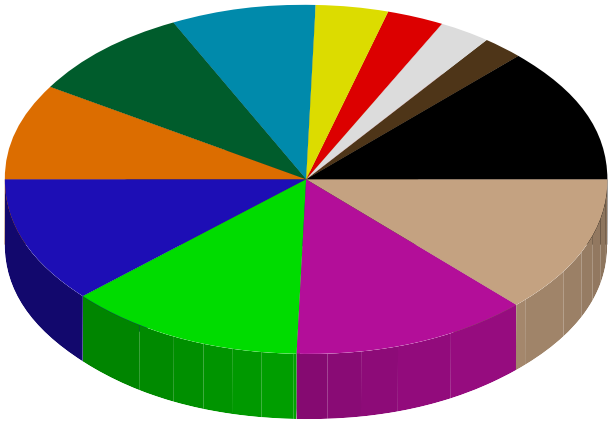
Sevenson Environmental Co. has its headquarters in Niagara Falls and is one of the country's leading environmental cleanup contractors. The principal shop, yard and maintenance facilities are in Niagara Falls with other offices in Pittsburgh, Philadelphia, Chicago, Los Angeles and Buffalo, which is the site of Sevenson's

full-service environmental testing and treatability study laboratory. Sevenson Environmental Services treats contaminated water, clean soil and contaminated buildings, focusing on hazardous waste remediation. Since working on the Love Canal cleanup in 1979, Sevenson has provided remediation services for more than 1,200 projects. It also decontaminates, demolishes, and closes facilities.

Ecology and Environment Inc. of Lancaster is a leading global environmental consulting firm working in environmental issues ranging from mitigating environmental damage to fighting global climate change. Founded in 1970, the company has completed more than 35,000 projects in 83 countries.

Solid Waste NAICS Industries Distribution in BN Region

(Revenue per NAICS code)



13%	Total Other	12%	Other Measuring/ Controlling Device Mfg	4%	Ovrhd Trvlg Crane, Hoist, & Monorail Sys Mfg
13%	Fluid Power Cylinder/ Actuator Mfg	9%	Sheet Metal Work Mfg	3%	Energy Consulting Services
13%	Industrial Valve Mfg	9%	Fabricated Structural Metal Mfg	3%	Motor & Generator Mfg
13%	Instr/Related Prod Mfg for Measure, Display & Control	8%	All Other Misc. Fab. Metal Product Mfg	2%	Engineering Services

Buffalo Niagara Solid Waste Management NAICS Value Chain Analysis

The Buffalo Niagara Solid Waste Management Value Chain table analyzes all NAICS codes that account for over 2%.

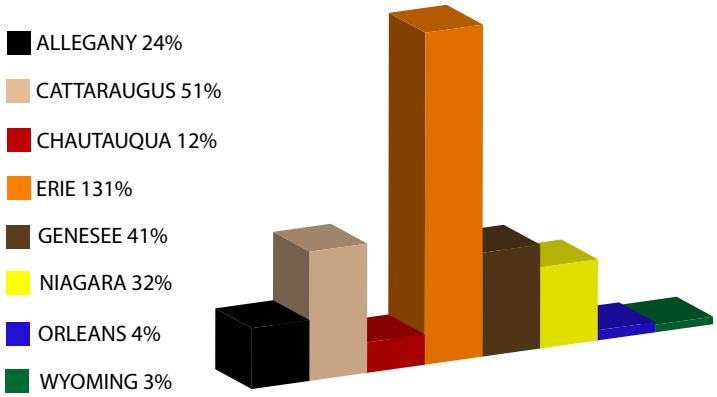
The primary NAICS codes in Solid Waste Management within Buffalo Niagara include Fluid Power Cylinder/Actuator Mfg (12.9%), Industrial Valve Mfg (12.6%), Instruments/Related Products Mfg for Measure, Display and Control (12.5%), and Other Measuring/Controlling Device Mfg (12%). Metal Work Mfg (9%) and Fabricated Structural Metal Mfg (8.8%) are also significant.

When measured in terms of the number of firms, Solid Waste Management is, again, not surprisingly, dominated by Engineering Design and Energy Consulting Services; they account for about 34%, though it is likely only a small minority of these firms are active in this sector.

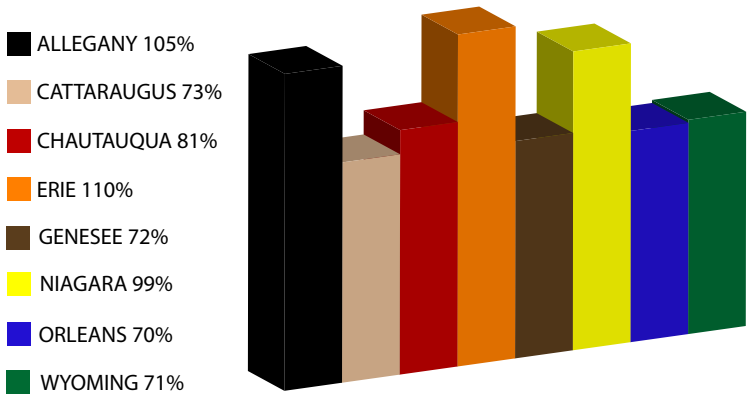
When looked at in terms of anticipated versus actual revenues or firms, Solid Waste showed a typical distribution with Erie registering 131% in terms of revenues and 110% in terms of firms. The other counties ranged from 3%-51% in terms of revenues and 70%-105% in terms of firms.

SOLID WASTE PERFORMANCE OF BN COUNTIES

Actual Revenues/Forecasted Revenues



Actual Firms/Forecasted Firms



LEADING BUFFALO NIAGARA CROSS-SECTOR INDUSTRIES IN RENEWABLE ENERGY

NAICS	Description	Bio	Hydro	ETS	Geo	Bldg	Grid	Nuke	Solar	Trans	Waste	Wind
221122	Electric Power Distribution	■	■	■	■	■	■	■	■			■
331421	Copper Rolling, Drawing & Extruding	■	■	■	■	■	■	■	■	■	■	■
332312	Fabricated Structural Metal Mfg	■	■	■	■	■	■	■	■	■	■	■
332322	Sheet Metal Work Mfg	■	■	■	■	■	■	■	■	■	■	■
332999	Other Misc Fab Metal Product Mfg	■	■	■	■	■	■	■	■	■	■	■
333415	AC/Warm-Air Heating & Refrig Equip Mfg	■	■		■	■	■		■	■		
333613	Power Trans Equip	■	■	■	■		■	■	■			■
334112	Computer Storage Device Mfg	■	■	■	■	■	■	■	■	■	■	■
334513	Instr Mfg for Measure, Display Control	■	■	■	■	■	■	■	■	■	■	■
334515	Meter	■	■	■	■	■	■	■	■			■
334519	Other Measuring/Control Device Mfg	■	■	■	■	■	■	■	■	■	■	■
335311	Power, Dist & Specialty Transformer Mfg	■	■	■	■	■	■	■	■	■		■
335312	Motor and Generator	■	■	■	■	■	■	■	■	■	■	■
335313	Switchgear/Switchboard Apparatus Mfg	■	■	■	■	■	■	■	■	■		■
335314	Relay & Industrial Control	■	■	■	■	■	■	■	■		■	■
335931	Electrical Connections	■	■	■	■	■	■	■	■	■	■	■
335999	Charge Controllers		■	■	■	■		■	■	■		■
541310	Architectural Svcs	■	■	■	■	■	■	■	■		■	■
541330	Engineering Design Svcs	■	■	■	■	■	■	■	■	■	■	■
541380	Testing Laboratories	■	■	■	■	■	■	■			■	
541620	Envir. Consulting Svcs	■	■	■	■	■	■	■			■	■
541690	Energy Consulting Svcs	■	■	■	■	■	■	■	■	■	■	■

Note: Colored boxes indicate NAICS codes where Buffalo Niagara possesses strength and that are relevant across different sectors. Blank boxes indicates little or no NAICS activity in targeted sector.

Buffalo Niagara is in a unique position to recruit and to interact with growing Canadian firms in the renewable energy sectors.

BUFFALO NIAGARA WEAKNESSES

Buffalo Niagara is in a highly competitive position to create new green jobs, but there are also regional weaknesses that must be recognized and addressed to make it competitive with other areas.

The most important weakness revolves around Buffalo's reputation, or lack thereof, as a green community. Despite its many strengths and achievements, intangible factors can often tip the scale against a community when site location decisions are being made. This need for a "green consciousness" makes it a unique challenge for professionals in economic development, since factors that were never previously considered part of the job creation/attraction effort can become quite important. In many instances, the region, thorough cooperative efforts, has the ability to eliminate or lessen the impact of these and other weaknesses. Those involved in business development can take a leadership role in fostering business, community and other alliances to address these issues.

Location

The region's northern climate makes it less suitable for some types of energy generation, given current technology. The region is also not in a competitive position for large-scale solar and geothermal installations that would supply the grid. However, smaller-scale projects for residential, commercial building and community use have already proven to be viable.

General Economic Conditions

With unemployment rates running from 8 to 10%, the Buffalo Niagara economy is weak. Nonmanufacturing jobs failed to rebound after the 2001 economic downturn, and more layoffs are anticipated due to the weak national economy. One-third of Buffalo area residents have incomes below the poverty level, making the metro region the second poorest in the nation. Salaries are 8% below the national average.

With a multitude of state and local taxes and fees, New York has also been ranked as the second-most expensive state in which to do business. Government is duplicative and overlapping. Although Niagara Falls generates some of the cheapest power in the nation, Buffalo Niagara's overall energy costs are high. Hydropower, which along with other renewable energies, could significantly lower a company's carbon footprint but is allocated only to new and expanding businesses through a cumbersome and lengthy application process.

Government Initiatives

Government initiatives can be extremely important in building the green economy. Buffalo's current $1 billion school construction project, for example, set no green standards. Government projects that require green standards—as well as projects receiving government assistance—can have an immediate job-creating impact on the local economy.

Other cities have shown when government leads the way, new business opportunities are created and the region gets attention among those looking to invest in the green economy.

None of the region's municipalities have a full-time employee charged with implementing green initiatives, although it is becoming a common practice around the country. There are few active government programs that support decreasing waste by increasing recycling, encouraging local purchases, composting programs

As the home of one of the world's largest hydropower projects and with the marketing advantage of instant identification, Buffalo Niagara should find opportunities in hydropower.

Freerange photo

and incentivizing residents to reduce waste. Green standards and requirements for building and construction have not been made a part of planning, zoning or building-code requirements in most communities.

Programs that encourage carpooling, biking, walking, mass transit and hybrid/biodiesel technologies in public transportation have been only intermittent, usually appearing when gas prices rise and then disappearing as they fall. Only a handful of local governments are taking any initiative to "green" their vehicle fleets.

Setting standards, creating examples, actively creating events around green issues can substantially increase a community's visibility and green profile. Green companies want to be in green communities to attract the green talent necessary to their success.

Plan Implementation

The region has prepared and adopted a number of plans that would facilitate green-job growth. In many instances, however, the plans have not been implemented or remained in the public eye. Chief among these plans is the Framework for Regional Growth adopted by Erie and Niagara counties. Key elements of this plan that would impact the green economy are:

Sustainable Neighborhoods: Improving the livability of urban neighborhoods and create more compact, pedestrian-friendly and energy-efficient communities.

Improved Mobility and Access: Build interstate and cross-border connectivity, strengthen alternative transportation, and enhance the livability of neighborhoods through greater transit use, walking, ride-sharing, and more efficient commuting patterns.

Energy-Efficient Systems and Services: Maximize the use of existing infrastructure and facilities, improve the competitive position of underused land and buildings, and promote the reuse of brownfields.

Conserved Natural and Cultural Assets: Includes efforts to encourage the conservation and protection of the region's most sensitive natural systems: lake fronts and escarpment; rivers, creeks, and streams; wetlands and floodplains; and forested lands recognized as regionally significant resources worthy of protection and conservation.

In Buffalo's Comprehensive Plan, "The Queen City in the 21st Century," there is an emphasis on creating a city that is "a prosperous green regional center providing livable communities for all its citizens."

The plan directly calls for: reducing energy consumption, land and other nonrenewable resources; minimizing the waste of materials, water and other resources; and reducing greenhouse gasses to alleviate climate change. Buffalo's mayor signed the U.S. Mayors Climate Protection Agreement, pledging to reduce greenhouse gas emissions by 7% (from 1990's level) by 2012.

Although these and other plans have been adopted, implementation has been lacking, according to community activists promoting their own recommended sustainable community policies.

Local Assistance

New business incentives have historically come from the state or through the region's Industrial Development Agencies, which provide tax incentives and financing. Many regions are rethinking the incentives offered to place a new emphasis on green-job growth. In some areas, energy-efficiency standards are required on projects receiving assistance, or certain, more favorable incentives are given to green-job producers.

Many areas are considering becoming green-energy producers. By building or financing alternative-energy sources on brownfields or in industrial parks and buildings serving multiple tenants, localities can offer companies a smaller carbon footprint in the manufacturing and production processes, making them more competitive. Some communities have envisioned an energy-district microgrid of combined solar and wind facilities with excess energy generated in the initial phases being sold to local utilities.

As a condition of tax breaks or financing, some jurisdictions are also considering a requirement that new developments meet LEED standards. There are also a few creating a percentage "buy local" requirement to foster green jobs in meeting the LEED goals.

At two recent green job conferences held in Buffalo in 2008, the number one complaint of established businesses and entrepreneurs was the lack of a one-stop information source on green jobs and renewable energy. NYSERDA administers more than 30 different programs with some directed to large energy generators and others to small residential installations.

Some apply to wind but not to solar, to solar but not to wind and a host of variations in other renewable-energy categories. Some of the programs have deadlines for application funding rounds, and some are underfunded and not functioning since allocations have been depleted. NYSERDA's commercial and business programs are not directly tied to information on standard manufacturing incentives and vice versa.

Another missing element identified at these conferences was information on how manufacturers could take advantage of renewable-energy opportunities. As the federal government pushes renewable-energy development, there could be opportunities for substantial job creation if existing manufacturers could identify or retool to meet market demand.

BUFFALO NIAGARA OPPORTUNITIES

Green Community

Businesses creating green jobs have shown a strong tendency to incorporate environmental sustainability as part of their corporate culture. In addition, communities with a strong green orientation are more likely to generate entrepreneurs to participate in the green economy as well as to convince existing companies to look at possible new opportunities stemming from the move to alternative energies.

Even as other Rust Belt cities such as Cleveland have emerged on green cities listings, Buffalo Niagara has yet to capitalize on its potential as a model green post-industrial triumph. Cleveland, for example, initiated a Sustainability Program in 2005. The program staff collaborates with a steering committee made up of environmental organizations that enhances bicycle programs, promotes green-building development, energy-saving efforts, waste reduction and renewable-energy opportunities.

Some cities with reputations for poor environmental quality, such as Chattanooga, Tenn., which had the nation's lowest air quality, have turned around their images by investing in green initiatives. Chattanooga focused on healthy waterfront development and locally manufactured hybrid electric vehicles and electric buses used in downtown transportation.

Milwaukee leaders formed a "green team" that brought together residents, businesses, government agencies, academic institutions and nonprofits. The collective worked on key environmental issues such as smart energy, storm-water management and green jobs. An outgrowth of this collaborative was the formation of a sustainability office.

Popular Science ranked its Top 50 Green Cities in 2008, using Census Bureau data and the National Geographic Society's Green Guide, which collected survey data and government statistics for American cities of more than 100,000 people in more than 30 categories, including air quality, electricity use and transportation.

Cities score points for drawing their energy from renewable sources, as well as for offering incentives for residents to invest in their own power sources, such as roof-mounted solar panels. High scores also go to cities whose commuters take public transportation or carpools, which improves air quality. Cities also earn

REGIONAL ORGANIZATIONS FOCUSED ON GREEN BUSINESS IN THE BUFFALO-NIAGARA REGION

BUFFALO'S GREEN GOLD INITIATIVE

BUFFALO'S
Green Gold
DEVELOPMENT
CORPORATION

Assisting and attracting businesses that solve environmental problems with their products or services

Mission

Green Gold is a collaborative visionary project to recast the image and the reality of the local economy. Our vision is based on the precept that the Earth cannot sustain current lifestyles and overall consumption and production patterns. As long as this is the case, there will be environmental problems in need of sustainable solutions. Businesses that offer solutions to those problems will prosper and provide an abundance of jobs, if marketed properly.

Programs/Actions

•Research on the environmental industry within the local economy and labor force
•Assistance for local companies
•Working with the school board and its Environmental Advisory Council
•Develop annual national conference
•Implement a national marketing strategy that identifies Buffalo as "the place to be" for environmental entrepreneurs.

UPSTATE GREEN BUSINESS NETWORK

Mission

The Upstate Green Business Network (UGBN) is a network of businesses, institutions, and organizations that share a mutual concern for the state of our environment. The UGBN has two chapters: Rochester Chapter and the Buffalo/Niagara Chapter.

Programs/Actions

•Promote good environmental management by integrating environmental criteria in business decisions, resulting in increased profitability and competitiveness.
•Membership includes regionally based companies, ranging from large manufacturers to small, service-oriented businesses.
•Provide a forum to make connections with peers and see green business practices.

APOLLO ALLIANCE (BUFFALO CHAPTER)

Mission

The alliance is a coalition of business, labor, environmental, and community leaders working to catalyze a clean-energy revolution in America to reduce our nation's dependence on foreign oil, cut carbon emissions that are destabilizing our climate, and expand opportunities for American businesses and workers.

Programs/Actions

•Inspired by the vision and technological achievements of the Apollo space program
•Promote policies and initiatives to speed investment in clean-energy technology and energy efficiency
•Put millions to work in a new generation of well-paid, green-collar jobs
•Make America a global leader in clean-energy products and services.

REGIONAL ORGANIZATIONS FOCUSED ON GREEN BUSINESS IN THE BUFFALO-NIAGARA REGION

BUFFALO FIRST

Mission

Buffalo First, an affiliate of the Business for Local Living Economies (BALLE), is a local advocacy group that works to build long-term economic empowerment and community self-reliance through local business ownership, economic justice, cultural diversity and economic stewardship.

Programs/Actions

- Promote the growth and development of community-based business
- Encourage local purchasing by customers and businesses
- Create opportunities for business leaders to network and share best practices
- Devise strategies for underemployed to become actively engaged in the economy
- Advocate public policies that strengthen independent local businesses, promote economic equity and protect the environment

ENVIRONMENTAL BUSINESS ASSOCIATION

Mission

EBA of New York State is the not-for-profit trade association dedicated to supporting the growth of the environmental industry in New York State. Specifically, we help to promote and serve the industry sectors of Climate Change, Greening Communities, Energy and WALCE (Water-Agriculture-Land Use-Conservation-Environmental).

Programs/Actions

- Stimulates business development, awareness and growth opportunities through networking, services and educational seminars
- Information clearinghouse for market, regulatory, technical and financial information
- Coordinates effective partnerships with business, research, government and not-for-profit organizations
- Serves as voice to inform government and business leaders about needs and economic opportunities of the environmental industry
- Assists in policy development that protects the environment and promotes a strong economy

points for the number of LEED-certified buildings as well as for green space, such as public parks and nature preserves. Recycling programs are also considered.

In the Popular Science ranking, Syracuse ranked 17th for renewable-sources use, including hydropower, for electricity, and green living. Rochester ranked 27th, with high marks for green space and recycling initiatives.

Sustainlane, the "people-powered sustainability guide" benchmarks the performance of the top 50 U.S. cities in 16 urban-sustainability areas, including air quality, innovation, commuting, local food and agriculture. The list reveals "which cities are increasingly self-sufficient, prepared for the unexpected and taking steps toward preserving and enhancing their quality of life."

Their top five cities are: Portland, Ore.; San Francisco; Seattle; Chicago; and New York. The list includes potential Buffalo Niagara competitors such as: Cleveland (16); Columbus, Ohio (30); Detroit (31); Charlotte, N.C. (35); and Indianapolis (44). Their ranking factors included bicycle accessibility, higher-density downtown development, light rail and public transit, government participation in the green movement, renewable-energy use, and neighborhood groups creating livable spaces.

However, opportunities exist to reverse Buffalo's reputation and rankings. In a 2008 survey, more than 170 organizations were identified as working in environmental issues in the region. The momentum for a green business movement is well under way with major collaborative initiatives such as WNY Environmental Alliance, Buffalo First, Green Gold Development Corp., Upstate Green Business Network and the Apollo Alliance presence in the region.

Local governments can establish sustainability offices and find a model at UB, which has been a leader in the Green Campus movement and has had an Energy Officer on staff since 1982. Its Green Office has focused on providing tools and programs including climate action and green-building design guides with free access as well as a focus on greening the university through reducing energy consumption. The Green Office has saved UB more than $10 million a year in energy costs.

Niagara Falls has recently made a commitment to make itself a green city by actively, and successfully, working to recruit new green industries to take over idled plants. They are also working on measures to green-fuel the city fleet.

To create a unified green movement in the WNY region, the WNY Environmental Alliance was formed in 2008. The alliance reaches out to the 170-plus groups working in the environment across all sectors to coordinate efforts. To centralize the environmental groups' voice, the alliance is creating the WNY GreenTable, a virtual meeting place for organizations, businesses, government agencies and community members to share information and promote green practices in the region.

Marketing Buffalo-Niagara as a green center for residents and businesses is already in motion. Buffalo Niagara Convention and Visitors Bureau has started the Green Hospitality Initiative. They have begun to work with hospitality partners to review current environmental practices and to establish a more comprehensive green plan for industry. Under this program, the regional hospitality industry will look to improve in the areas of waste management, energy savings, food production and disposal, water savings, environmentally safe cleaning products, paints and office practices.

In "Defining the Green Economy," a study conducted at the Center for Community Innovation at University of California-Berkeley, researchers reviewed 25 recent reports that assessed the effect of regional green movements on the economy. The report concluded stakeholders in local economic development have an opportunity to shape their green economy through policy. But intervention will be most effective if it builds upon local strengths and chooses appropriate policies to meet local goals. According to the report:

"Is the economic development goal job generation and retention? Cities and states should consider enacting policies such as green-building standards with provisions for local purchasing and hiring. Local quality of life? Cities might stimulate consumption through green-building policies, support for open space amenities and technical assistance for retailers. Job quality? Local governments might look to sectors that have traditionally provided well-paying, career-track jobs, with established job training programs and relationships with unions, such as utilities and transportation. Innovation, with a long-term horizon for outcomes? Incentivizing the clean tech sector with funding for R&D and technical assistance for startups may be the best approach, particularly at the state level."

The report concluded: "New green standards, regulations, incentives, technical assistance and marketing programs can help spur the green economy, but they will not actually create local economic development in

the absence of supporting policies. Local purchasing and hiring requirements, labor standards, and claw-back provisions will need to be part of the green economic development package if green policies are to have an impact on the economy and equity as well as the environment—and if they are to support local sustainability."

CANADA

Buffalo Niagara is in a unique position to recruit and to interact with Canadian renewable-energy firms. As noted previously, the region's proximity to the metro Toronto area allows Canadian companies to manage cross-border manufacturing and distribution facilities that service the larger American market. It should also be noted as Canada's business and financial center, Toronto also houses representatives from numerous governments, multinational corporations and other potentially useful entities from around the world. While Buffalo Niagara has recognized the potential of Canadians firms and other Toronto-based entities to do business in the U.S.—and attracted some of these firms with some success—the opportunities in renewable energy can give those efforts stronger focus.

Wind

A 2007 report by The Delphi Group and Garrad Hassan Canada Inc. interviewed key executives from major international large wind turbine and component manufacturers in order to gain some perspective on manufacturing and innovation opportunities that exist within the North American supply chain.

The firms, primarily Canadian, stated their location preferences for establishing manufacturing operations were generally as follows:

•Close to the Canada-U.S. border, with extra consideration for proximity to U.S. wind projects.
•Close to suppliers (which are also generally located close to major markets) and heavy industry capabilities
•Close to water transport routes and rail transport infrastructure
•Somewhere with good truck transport logistics
•Somewhere with a good skilled labor pool

Overall, it was felt the most important factor is that the location lead to cost-competitive operations. All firms interviewed agreed if a location does not make sense in terms of market potential, access to customers, access to a skilled labor pool and logistics, there is no point in manufacturing incentives. "If a location has poor access to suppliers, poor shipping logistics, or is far from the wind market or customers (OEM assemblers), significantly higher operating costs will be incurred compared to locations with better characteristics. Assuming the above conditions are satisfied (which is clearly the case in respect to Buffalo Niagara), and a manufacturer is considering two similar locations, manufacturing incentives do become of interest," the report concluded. Companies expressed the most interest in help with infrastructure investments, hiring and training, tax reductions, low-cost financing, export support and introduction to the American market.

The manufacture of the larger components on the American side of the border to serve American customers makes sense logistically. Opportunities might include the manufacture of gearboxes, large bearings, rotor hubs and shaft forgings

The Canadian study looked at component manufacturers for wind, but their findings could also apply to other renewable-energy sectors. In addition to wind, Canada offers strong potential for component manufacturing and new technology development in solar and hydro.

Solar

With a major supplier of photovoltaic-grade silicon located in Niagara Falls—and its ready availability of product at a discount—there are immense opportunities in photovoltaic production in Buffalo Niagara. Photovoltaic (PV) technologies are used in a variety of applications, ranging from large-scale solar utility plants and remote industrial power systems to roof-mounted residential power units, small battery chargers and power sources for consumer electronics.

Canada is particularly strong in the active solar thermal field and provides a broad range of technology products that might be recruited for manufacturing operations in Buffalo Niagara as a way to enter the U.S. market. As renewable energy is increasingly incentivized, it will be more appealing to American homeowners in the northeast as a means of cutting long-term energy costs.

Canadian developed and manufactured solar thermal field opportunities may include:

•**Solar collectors** for domestic and commercial water heating
•**Turnkey solar heating systems** for various commer-

Renewable-Energy Programs At Area Universities

UNIVERSITY AT BUFFALO (SUNY)

UB photo

■ Past programs such as the Brownfield's and Environmental Restoration Training resulted in 70% job placement for those that completed the rigorous eight-week training. (Research/Education)

■ Developing techniques to produce hydrogen from coal using nanoparticles (Research)

■ Developing new more practical photovoltaic technologies. (Research)

■ Examining the use of chemical systems to convert solar energy to chemical energy (Research)

■ Department of Mechanical and Aerospace Engineering does extensive research in Fluids and Thermal Sciences that can be applied to the development of fuel cells. (Research)

■ Department of Civil, Structural, and Environmental Engineering offers a B.S. Program in Environmental Engineering (Education)

■ Center for Integrated Waste Management provides research and education in a number of "green" fields. Most recently they received an Empire State Development Grant to pursue research and education in tire recycling.

CANISIUS COLLEGE	■ Undergraduate program in Environmental Science that covers environmental consulting, environmental regulation and monitoring, environmental conservation, environmental health sciences. (Education)
GENESEE COMMUNITY COLLEGE	■ Associate degree programs in environmental studies.
NIAGARA COMMUNITY COLLEGE	■ Programs in natural resources, conservation, electrical technology, and engineering science.
ERIE COMMUNITY COLLEGE	■ Noncredit training in building analysis, envelope training, heating and cooling, weatherization, energy auditing
ALFRED UNIVERSITY	■ Bachelor degree programs in environmental studies and geology.
FINGER LAKES COMMUNITY COLLEGE	■ Associate degree programs in natural resources conservation and environmental studies.

Notable Associate Degree and Certificate Programs

SCHOOL	PROGRAM INFORMATION
SAN JUAN COLLEGE	■ Renewable Energy Programs offered as one-year certificate program and A.A.S ■ Concentration in Photovoltaic System Design and Installation
COCONINO COMMUNITY COLLEGE	■ Alternative Energy Technology associates degree. Courses in architectural drafting, construction safety, house wiring, solar home design, photovoltaics and wind power.
LANE COMMUNITY COLLEGE	■ Renewable Energy Technician associates degree. Addresses residential and commercial energy efficiency, as well as solar energy and renewable energy systems installations.
SOUTHEAST MICHIGAN COMMUNITY COLLEGE CONSORTIUM	■ Partnership between nine community colleges and local industry partners. ■ Associate degree and certificate programs in construction and manufacturing. Formed to address future shortage of workers for advanced manufacturing and alternate energy. Program started with three-year $2.l million grant from U.S. Department of Labor.
COLUMBIA GORGE COMMUNITY COLLEGE	■ Renewable Energy Training Program one-year certificate or two-year A.A.S. prepares students for careers in hydro-generation, wind-generation, automated manufacturing, and engineering technicians. PPM Energy (major wind turbine manufacturer) providing $50,000 year for three years to establish program, also receives funding from U.S. Department of Labor program designed with many members of wind and renewable-energy industry.

cial, industrial, institutional and residential applications
•**Solar air collectors** for space heating and ventilation applications
•**Solar air-heating systems** for crop drying and other industrial applications
•**Solar pool-heating systems** for residential, commercial and institutional applications
•**Solar water heaters** for year-round use, even under extreme cold weather conditions.

Hydropower

As home to one of the world's largest hydropower projects and with a marketing advantage of instant identification, Buffalo Niagara should find opportunities in hydropower. Also, smaller-scale hydrokinetic power, which takes advantage of tides and water currents, is gathering more and more attention.

New York has taken a leadership role in testing this new technology, and synergies can be established with Canada, which has world-class expertise in hydropower project design and construction due to its vast water resources. Nearly two-thirds of the power produced in Canada is hydropower.

Notable Colleges with Bachelors, Masters and Ph.D. Programs

Oregon Institute of Technology

RESEARCH: Renewable Energy Center conducts research in photovoltaic power systems, ground-source heating systems, fuel-cell systems, wind, biomass and integrated systems.n Concentration in Photovoltaic System Design and Installation.

PROGRAM INFO: B.S. in Renewable Energy Engineering. First degree of its kind in North America when created. Renewable energy specific courses in photovoltaics, energy management and auditing, wind power, biofuels, renewable-energy transportation systems, green building and fuel cells. Resources of Geo-Heat center available to individuals, organizations, and companies pursuing geothermal development.

Appalachian State University

RESEARCH: Appstate Energy Center research grant program encourages new projects. A new Research Institute for Environment, Energy, and Economics was recently announced to further enhance research in these

PROGRAM INFO: B.S. in Renewable Energy Engineering. First degree of its kind in North America when created. Renewable energy specific courses in photovoltaics, energy management and auditing, wind power, biofuels, renewable-energy transportation systems, green building and fuel cells. Resources of Geo-Heat center available to individuals, organizations, and companies pursuing geothermal development.

Arizona State University

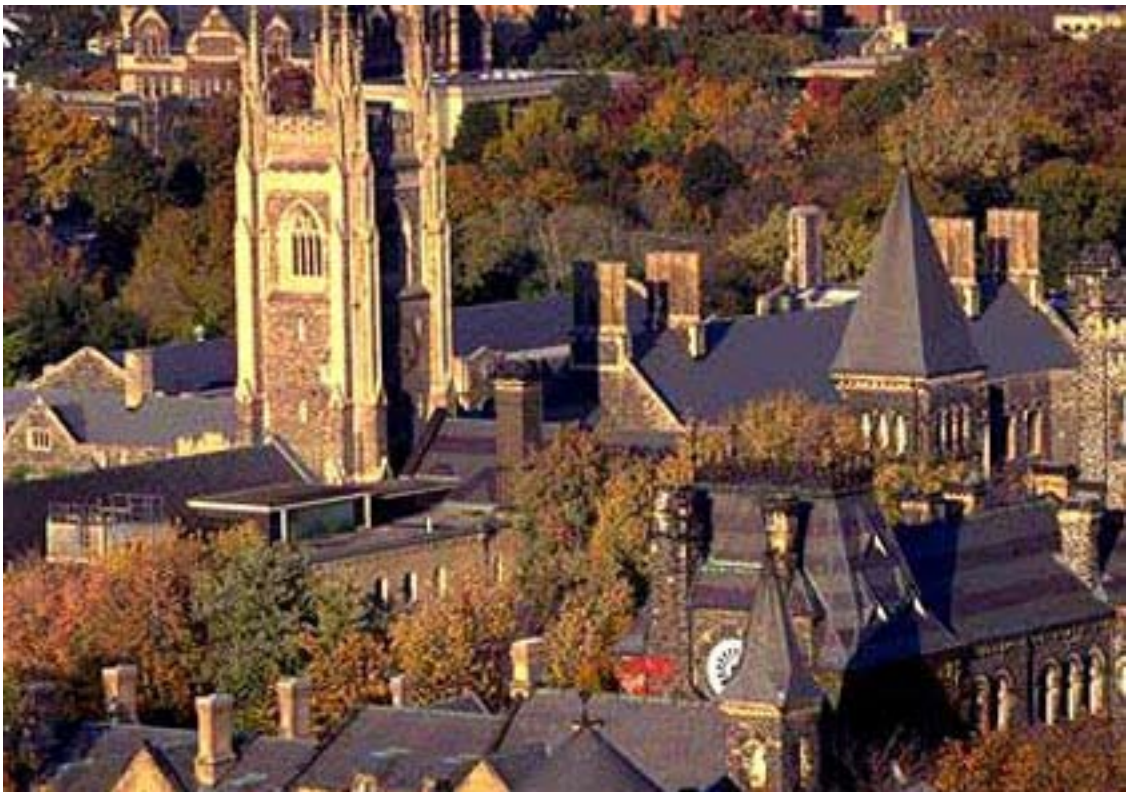
RESEARCH: Biodesign Institute focuses on energy and the environment. Current research includes a new type of microbal biofuel and creating biohydrogen energy.

PROGRAM INFO: College of Technology and Innovation offers B.S. In Electronics Engineering Technology and M.S. In Technology with concentration in alternative energy Focus on renewable energy through ocean, wind, solar, geothermal, and biomass sources.

Engineering programs also incorporate alternative-energy technologies. ASU's School of Sustainability offers B.A., B.S., M.A., M.S., and Ph.D. programs.

The National Science Foundation awarded the Electronic Systems Department at the Polytechnic campus a $900,000 grant to develop energy programs and courses in conjunction with Arizona and Texas community colleges.

Freerange photo



University of Toronto photo

St. George Campus of the University of Toronto is pictured here. Its Centre for Environment offers B.A. and B.S. programs in areas such as environmental policy, environment and society, and environmental sciences.

Opportunities in hydropower could include:
•Manufacturing of different type water turbines such as Pelton, Turgo, Francis and Propeller/Kaplan turbines
•Automated hydropower control and safety systems
•Modular powerhouse automation
•Design and construction of hydropower stations
•Computer modeling and simulation tools for hydraulic turbines

EDUCATION

As the renewable-energy industry continues to grow worldwide, there is an increasing need for specialized workers in the field. Many schools are taking notice of this and pursuing greater research in the field and offering degree and certification programs.

In the Buffalo-Niagara Region, initiatives toward a new green economy at the collegiate and vocational training levels exist but could be improved. UB was one of the nation's first schools to work toward a "green campus" and continues to pursue this goal by offering Environmental Studies degree programs and an Environmental Engineering degree as part of the School of Engineering.

Other area universities and community colleges offer associate and bachelor degrees in environmental studies, but little industry or job-specific training is available.

University Involvement in Buffalo Niagara

Across the border, the University of Toronto—Centre for Environment is located within the Faculty of Arts and Sciences, as well as the School of Graduate Studies. Core undergraduate B.A. and B.S. programs are available in areas such as environmental policy, environment and society, and environmental sciences.

In addition, collaborative programs are offered with departments such as geography, chemistry, earth sciences, psychology, philosophy and anthropology. A stand-alone professional Masters of Environmental Science is offered through the Centre's Scarborough campus.

Niagara College at Niagara-on-the-Lake is home to the Environment and Geomatics Centre which was founded in 1991 to provide leading-edge environmental education for full- and part-time students. The Centre trains students for professional roles in environmental management, ecological restoration, environmental assessment, geographic information systems management and environmental field and laboratory work.

Other models

The majority of colleges with successful progress in the alternative-energy field are, not surprisingly, located in areas where manufacturing, alternative energy and

sustainability have gained the most momentum.

In many cases, the schools were established with grants from organizations and companies in the alternative-energy field and from state and federal initiatives to increase alternative-energy sector growth and produce more jobs. As can be seen by the success of green industries in the states that are home to these schools, education at collegiate and vocational levels as well as outstanding research is necessary to promote green industry.

Notable Colleges and Universities with Bachelor, Masters, and Ph.D. Programs

While Buffalo Niagara colleges and universities possess many research and development programs that have applicability to renewable-energy development and the environment, few are aimed specifically at the sector. This is true even though many of these schools have advanced engineering and design programs that are required at virtually all levels of the renewable-energy supply and value chain. In addition, these schools have major research programs in biotechnology and nanotechnology where spin-offs into renewable-energy phases are possible. It also has robust, two-year colleges providing skills training that are integral to supply-chain development. Specific research and design centers are located at other universities in upstate New York and southern Ontario making cooperative partnerships feasible. While Buffalo Niagara has an outstanding educational base, it can still be improved and better positioned to meet the needs of the new green economy.

State Incentives

New York's renewable-energy-specific incentive programs are highly competitive with other states and can offer Buffalo Niagara opportunities to attract new business when marketed to target companies. In most surveys, New York ranks in the Top 10 of the states who have programs to aggressively pursue renewable energy and energy conservation. They include:

Green Building Tax Credit: Can be applied to corporate, personal-income, insurance-corporation, and banking-corporation taxes. It's for owners and tenants of buildings and spaces that meet certain green standards and can be applied to up to $2 million per building. Eligibility can be met under six different categories: whole-building credit (building and all tenant spaces are green), base-building credit (green buildings with no tenant space), tenant-space credit (tenant space is green), fuel-cell credit, photovoltaic-module credit and green-refrigeration credit.

Other Personal Tax Credits: New York offers solar and fuel-cell technologies incentives as well as biodiesel purchased for space- and water-heating applications. The biodiesel incentive is paid as $0.01 per percentage of biodiesel in the fuel, up to $0.20 per gallon. Individuals can receive the solar and fuel-cell incentive by using solar-water heat, solar-space heat, photovoltaics or fuel cells. The tax credit counts as 25% of equipment and installation cost, up to $5,000 for solar applications, and 20% of the cost of equipment and installation for fuel cells.

Industry Recruitment/Support: The Clean Energy Business Growth and Development incentive has $6.4 million available for five rounds of funding for clean energy business projects. Accepted projects are eligible for up to 50% of the project cost, up to $200,000 per project. This incentive is not for research and development. The project must be commercial or near commercial, located in New York and within the service territories of participating utilities.

Energy Star: The Energy Star Home Builders incentive is aimed at those certified as Energy Star Builders. Building to Energy Star standards entitles them to a cash incentive of up to $1,500 for regular homes, $2,500 for display homes and $3,000 for model homes. The last incentive aims to increase the manufacture of renewable, clean and energy-efficient products in New York. It is limited to projects within the service territo-

According to Andrew Rudnick, President and CEO of the Buffalo Niagara Partnership, upstate lost 33% of its manufacturing jobs over the last decade. Prior to the current recession, upstate New York grew at 4% over the last 14 years while nationwide growth was at 23%.

ries of investor-owned utilities and for products dealing with clean-electricity production, energy efficiency and grid-connected electricity storage. The incentive provides increasing amounts of money for projects during three different stages of development, with a maximum total of $1.5 million per project. A total of $10 million is available under this program.

Production Incentive: The Anaerobic Digester Gas-to-Electricity Rebate and Performance Incentive is in place to encourage small-site electricity generation on site. There is $20.1 million available, up to $1 million per anaerobic digester gas system. It provides money to purchase and install systems as well as payments per kilowatt hour of electricity generated.

Tax Abatements and Exemptions: There is currently one property-tax abatement, two property-tax exemption incentives and a sales tax exemption. The tax abatement is eligible only in cities with a population of at least 1 million (New York City), and for buildings that use photovoltaic equipment. Owners can subtract expenditures from their PV systems from their total real property taxes, 8.75% of system expenditures for four years for systems built between 2008 and 2010, and 5% of system expenditures for four years for systems built between 2011 and 2012. The first tax exemption is for residential buildings (from single- to four-family dwellings) that undergo energy-conservation improvements. These buildings are exempt from real property tax to the extent improvements increase the home's value. The second exemption is a local option: local governments can choose whether or not to participate, and it is for commercial, residential, industrial and agricultural facilities that install solar, wind and biomass power systems. It works in the same way as the energy conservation improvements exemption. The owner is exempt from taxes on any increase in property value that occurs as a result of the installation of an eligible power system. The sales tax exemption is for various solar technologies used to provide heating, cooling, hot water and electricity. It has a local option for municipalities to grant an exception. However, if a city of more than 1 million wishes to do so, it must enact a specific resolution that appears in the state law.

State Grants: Can be received in New York for a variety of energy-efficiency projects. The Assisted Home Performance Program helps low-income families in improving their energy efficiency. Families that earn 80% of the median income are eligible for up to $5,000 or 50% of the cost of energy-efficiency improvements. This includes energy-efficient utilities, lighting, programmable thermostats and building insulation. The EmPower New York program, part of NYSERDA, is for families earning 60% or less of the median income and who are customers of participating utilities. The program budget is $49.4 million and provides energy-efficiency improvements at no cost to eligible participants. Eligibility is determined based on energy use and energy-saving potential. The final state grant incentive is for distributed generation as combined heat and power and is available to industrial, commercial, residential and institutional firms. Grants in the amount of $25 million are divided into three categories based on project size and location.

New York Energy $mart
Public Service Commission
NYSERDA

State Loans: The Energy $mart Loan Fund is available for a facility that is an electric distribution customer of the six investor-owned utilities. The loan is up to $20,000 for single- to four-family homes, $2.5 million for existing multifamily construction ($5,000 a unit),

National Grid has incentives for commercial and residential gas efficiency, commercial electric efficiency, and small to mid-size business efficiency.

and $1 million for all nonresidential borrowers. All facilities excluding single- to four-family family homes can be eligible for an additional $500,000 if they are registered for LEED certification.

The Home Performance with Energy Star Loan program provides loans for the total cost of a home performance improvement from $2,500 to $20,000 depending on the applicants credit score for single- to two-family family homes. To qualify for the loan, the house must first undergo a Comprehensive Home Assessment by a Building Performance Institute contractor.

State Rebate Programs: New York has many state rebate programs to encourage the installation and purchase of energy-efficient technologies. Under the Energy $mart Multifamily Performance program, newly constructed and existing multifamily and low-income houses are eligible for incentives that improve energy efficiency. Facilities must have at least five units, and the property must be publicly subsidized or at least 25% of residents must receive public assistance or make less than 80% of the median income. The Energy $mart New Construction program offers up to $850,000 for upstate residents and $1.65 million for Con Edison customers in rebates of up to 75% of the capital cost of purchasing and installing energy-efficient equipment.

The existing facilities rebate includes payments of up to $30,000 for already existing efficiency measures, and performance incentives based on energy-efficiency improvements. The remaining rebate programs are technology specific. The fuel-cell rebate offers up to $50,000 for the purchase and installation of small systems and $1 million for large systems. There are also additional performance rebates. The small-wind incentive offers rebates for 29 different wind-system models, and the rebate differs for each model and the height at which it is installed. The PV incentive program is for new installation of photovoltaic systems in all sectors. The rebate is for $4/W up to 5 kW, $4.50 for Energy Star homes and building-integrated PV systems. Energy $mart is also part of NYSERDA.

Utility Rebates: Offered to Long Island Power Association and National Grid customers. LIPA offers incentives for commercial construction, residential efficiency, solar and wind. National Grid has incentives for commercial and residential gas efficiency, commercial electric efficiency, and small to mid-size business efficiency. The LIPA commercial-construction rebate goes from $100,000 per building to $400,000, depending on whether the project is prescriptive (rebates on pre-qualified equipment), custom or whole-building. The LIPA residential-efficiency rebates are specific for energy-efficient utilities, such as $75 for a refrigerator and $250-600 for a split central air conditioner. The solar rebate is meant to account for approximately 50% of a photovoltaic system. The rebate is per watt and decreases after the first 10, 40, and 50 kW. The rates are also different for governments, schools and nonprofits. The wind-energy rebate is organized similarly and is meant to account for 60% of a wind system's costs. National Grid's commercial-energy incentive is for improving electricity efficiency through measures such as lighting, occupancy sensors and walk-in coolers. The rebate is for 75% of the additional cost of efficiency upgrades on schools and new buildings, 45% of the project cost for existing buildings, and 80% of installation cost for small businesses. Their commercial gas-efficiency incentive is for 50% of the project cost for custom projects, and $100 to $6,000 for heating rebates.

The residential gas-efficiency rebates are for up to $1,000 depending on equipment type. For weatherization improvements, the rebate is up to $750 and includes $10 per Energy Star window replacement, $50 for programmable thermostats, and $300 for eligible water heaters. The National Grid small to mid-size business energy-efficiency rebate is for businesses with an average energy use of 200 kilowatts or less per month. This rebate is for technologies such as lighting, thermostats and occupancy sensors and is paid as 70% of the project cost. The remainder can be paid through the customers electric bill over a period of up to 24 months with 0% interest or with a 15% discount if paid as a lump sum

NEW FEDERAL INCENTIVES

The federal government is taking an aggressive role in funding renewable energy that can create opportunities for new and existing companies in Buffalo Niagara. Additional funding and programs are expected throughout 2009.

The $787 billion American Recovery and Reinvestment Act passed by Congress in February 2009 provides for $463 billion in spending and $324 billion in tax cuts. It includes $16.8 billion for energy efficiency and renewable-energy projects and technologies, including $4.5 billion for energy research and development. New York will receive $126 million through the State Energy Program and $31 million in alternative-energy block grants.

The spending is to include $30 billion for the so-called smart-power grid, along with advanced battery technology and energy-efficiency initiatives. New provisions also include a investment tax credit for manufacturing facilities used to make components for renewable-energy production, advanced battery technologies and "next-generation green technologies." The act also allocates $400 million to establish the Advanced Research Projects Energy Agency and a $580 million program for the National Institute of Standards and Technology for technology innovation and manufacturing standards programs.

The stimulus bill extends wind power tax credits through 2012 and other renewable sources, including biomass, geothermal, hydropower, landfill gas, waste-to-energy and marine power, through 2013. Congress extended solar power tax credits by eight years in October.

Stimulus-bill provisions could help jump-start a new, multibillion-dollar industry in the United States for manufacturing advanced batteries for hybrids and electric vehicles and for storing energy from the electrical grid to enable widespread renewable-energy use. It sets aside $2 billion in grants for manufacturing advanced batteries, plus tax credits to cover 30% of the cost of a plant (up to $2.4 billion in total credits). This is in addition to $7.5 billion in loans authorized in a previous bill for manufacturing advanced technology for vehicles, which includes batteries. Employees for these factories could be trained as part of $500 million in funding for retraining workers for green jobs. There is also $16.8 billion going to energy efficiency and renewable energy, which will likely include money for battery research to bring down costs and improve performance.

A recent article in Technology Review notes that significant advances in battery materials, including the development of new lithium-ion models, have been made in the United States in the past few years. But advanced battery manufacturing is almost entirely done overseas, particularly in Asia. As a result, advanced battery start-ups here typically have their batteries made overseas, although economics may change that. According to Technology Review, "Now, with the push to rely more on renewable energy and less on fossil fuels, a market for advanced batteries is starting to develop in the United States. This, combined with incentive for manufacturers in the United States, could allow an advanced battery industry to develop in this country. "

'Now, with the push to rely more on renewable energy and less on fossil fuels, a market for advanced batteries is starting to develop in the United States.'

Technology Review
PUBLISHED BY MIT

BUFFALO NIAGARA THREATS

THE GLOBAL ECONOMY

Through the end of 2009 and perhaps even longer, the severe economic recession that began in 2008 will impinge and, in some cases, reverse growth projections for renewable-energy development. At the beginning of 2009, the Buffalo Niagara region saw several wind-farm projects placed on hold, a phenomenon taking place not just locally, but across America and worldwide.

Renewable energy, for the foreseeable future, will be driven by the availability of government incentives and access to capital. While the U.S. government has taken steps to extend and increase tax credits and other incentives, outside investors need to have sufficient profits to utilize them. Since major energy projects are funded through the syndication of these tax credits, or through conventional lenders that are curtailing or restricting their lending, it is difficult to project growth in the immediate future.

According to Business Week, the number of tax-equity investors that were big on renewable energy have dropped from more than 20 to less than six, with former key players such as Merrill Lynch and Lehman Brothers no longer in existence.

A February 2009 report on the solar industry by Lux Research predicted for 2009 the available production capacity for solar cells and modules will be twice the demand. They predict the market will shrink from $36 billion to $29 billion.

The report further suggests that while the oversupply will lead to company failures, it should also set the stage for the survivors' long-term growth.

"Silicon availability will become increasingly irrelevant as module players seek to cut inventory. But the resulting price reductions will flatten out by 2011, bringing solar closer to grid parity and enabling the market to grow to $70 billion," the report says.

Wind-energy trade groups are projecting declines of 30% to 50% in new-equipment installation. At the beginning of 2009, factories building parts for wind turbines were announcing layoffs in several regions of the U.S.

Biofuels and electric cars are being touted as taking a leadership role in developing the new green economy; however, the median age of U.S. automobiles has been rising for the last decade, according to the DOE, and with the drop in auto sales caused by unemployment and tight credit, the turnover rate will not improve soon.

Additionally, while it remains clear renewable energy is a long-term priority in transportation and other sectors, the decline of gasoline prices—down from a high of $4 a gallon in the summer of 2008—has decreased the immediacy and importance of this issue in the minds of both businesses and consumers.

Government spending on building weatherization should help builders and materials suppliers in the short term, but it remains to be seen if state and local governments will have the wherewithal to follow the federal government's lead in retrofitting government buildings for energy efficiency.

The federal government is spending a considerable amount of money in the development of a new smart grid system. That will be vital to carry electricity from remote renewable-energy facilities to population centers. But there is the accompanying problem of large-scale energy storage to compensate for downtimes in solar- and wind-energy production.

Remember that renewable-energy resources like wind and solar are transient, Energy Secretary Steven Chu said. "We don't have large-scale power storage yet."

Although renewable-energy firms are generally applauding the efforts of the federal government, they remain skeptical whether programs and funds can be delivered in time to save many companies. Chu has admitted the DOE does not have a good record in acting quickly but said plans were being implemented to streamline the process.

Some critics note that with renewable energy resources currently accounting for about 2% of U.S. power generation, the ability to take that to 10% in four years, as the administration is suggesting, seems unlikely.

They argue renewables may not be the panacea suggested. Still, with $150 billion in renewable energy spending already in the pipeline, and with more likely to follow, growth will inevitably happen at some point.

Some critics note that with renewable energy resources accounting for about 2% of U.S. power generation, the ability to take that to 10% in four years, as the administration is suggesting, seems unlikely. They argue renewables may not be the panacea suggested. Still, with $150 billion in renewable-energy spending already in the pipeline, and with more likely to follow, growth will inevitably happen at some point.

NEW YORK BUSINESS CLIMATE

While there are many advantages to doing business in New York State and in Buffalo Niagara, there are distinct disadvantages that may threaten the region's participation in the new green economy.

In 2008, the cable financial news channel CNBC ranked New York the most expensive state in the nation for costs of doing business. They cited New York's individual income tax, property taxes, business taxes, consumer taxes (gas, sales) and worker's compensation costs as major factors.

A Forbes magazine ranking of best states to do business ranked New York at 49 with only California keeping it from winning designation as last. Again, business costs were the main factor.

Still, New York ranks well in studies that examine quality of life, education and access to technology. The Information Technology and Innovation Foundation ranked New York as the ninth top state in the nation in terms of preparation for the "new economy," factoring things such as knowledge jobs, globalization, and transformation to the digital economy and technological innovation.

Unshackle Upstate, a bipartisan coalition of more than 70 upstate business and trade organizations representing upwards of 45,000 companies, has repeatedly called for tax reductions and fewer business regulations.

Business Facilities magazine ranked New York No. 10 in its list of the top 20 "Green states" based on the state's incentive and tax policies encouraging green energy and technology development.

But, according to Andrew Rudnick, president and CEO of the Buffalo Niagara Partnership, upstate lost 33% of its manufacturing jobs over the last decade. Prior to the current recession, upstate grew at 4% over the last 14 years while nationwide growth was at 23%. He and other business leaders have complained that young people are moving away for better job prospects with the number of young adults ages 25 to 34 dropping by a half million since 1990.

Unshackle Upstate, a bipartisan coalition of more than 70 upstate business and trade organizations representing upwards of 45,000 companies, has repeatedly called for tax reductions and fewer business regulations. They also advocate: repeal of the Wick's Law, which requires municipalities to hire multiple contractors for every building project; reform of the Taylor Law, which governs collective bargaining for all public employees; and elimination of Labor Law 240-241, or "Scaffold Law," which imposes absolute liability on New York's property owners and contractors for work-site injuries.

Kenneth Adams, president of the New York State Business Council, in testimony before the Joint Legislative Hearing on the Executive Budget in February 2009, said New York is losing its competitiveness to other states, with job growth lagging at about 60% of the national rate in the 2000s.

"Our job growth has lagged behind national trends for the past two decades; New Yorkers, especially the young and well-educated, continue to leave for better job opportunities in other states; New York's high cost of doing business—taxes, especially real property tax, energy costs, health-care costs and others—discourage new investments by existing business and smother entrepreneurs and the creation of new businesses and new jobs in emerging technology sectors," he said. "Because of our weak competitive position, New York has lagged significantly behind national trends in recovering from the last two recessions."

At the beginning of 2009, the New York State Association of Counties issued a dire alarm: "There are warning signs everywhere of the gathering storm we are about to confront. The state's population trends indicate that we are losing young families and have an aging population, an increasing percentage of whom are senior citizens on fixed incomes. The state exceeds all of the national percentages of people living in poverty. At the same time, we are losing private-sector jobs and business investments are on the decline. These challenges demonstrate clearly that New York State must fundamentally change the way it does business if the state is to prosper once more."

INCENTIVE CHANGES IN NEW YORK

Since so many green jobs are actually manufacturing jobs reinvented for a new green economy, overall incentives, not just those targeted to energy, are important to a region that hopes to bring in new component-part manufacturers that supply renewable-energy facilities. Gov. David Paterson has called for sweeping reforms of the state's economic development incentive programs, which are currently centered on Enterprise Zones originally formulated to give extra incentives to firms that located in the state's economically distressed areas. Over the years, the political process manipulated the number of zones created and stretched their boundary requirements until they became a patchwork quilt in every county. Boundaries were sometimes redrawn to entice a single project that was never completed, but the reconstructed boundaries remain in place.

Restricting a state's best incentives to a zoned area creates disadvantages for renewable-energy operations. Ideal locations—such as brownfield sites—are often not located in zones. Neither are the large tracts of rural land required for large-scale operations such as wind. And zone boundaries are unlikely to stretch into

NYSERDA New York State Energy Research and Development Authority

lakes and rivers, where incentives might be required to launch offshore wind and hydro-turbine projects.

In the wake of the bailouts of so many large financial institutions and the auto industry, there is a populist outcry against incentives that are often viewed as corporate welfare. Some are advocating that New York's state and local incentive grantors include strict "claw-back" provisions to take back the financial benefits of the incentives if job creation targets are not met. This would be a high risk for any company in the current uncertain economic situation, but it poses a greater risk for projects related to renewable energy. The demand for renewable-energy production will be directly tied to the point of price parity with carbon-based fuels, which is in turn tied to the fluctuating and unpredictable world oil markets. Strict clawback provisions that do not include special considerations for the renewable-energy field may completely negate the benefit of incentives in New York and Buffalo Niagara. That would be a double blow in light of the state's current low ranking as a place to do business.

An incentive for Buffalo Niagara may be New York and Pennsylvania's electricity-discount programs. In the renewable-energy sectors, products with the lowest possible carbon footprint are more competitive. Niagara Falls hydropower allocations, whether in component manufacture or as a supplement to actual renewable-energy generation, would significantly lower the product's carbon footprint. This low-cost hydropower is limited due to an allocation system, and starting at the end of 2009 NYPA will be reviewing the contracts of current users.

About 100 major companies benefit from this power, many of them older industrial factories unlikely to experience significant growth. For example, Olin and Occidental, two chemical firms in Niagara Falls, take up about 30% of the region's allocation. Critics argue that these older technology firms "hog" the power from new companies that could potentially grow more jobs for the future. Supporters say if the contracts are not renewed, the old plants, which still employ significant numbers, will close and fuel an already high unemployment rate. Still, the ability to add significant hydropower into a mix with other renewables is an opportunity open to very few other areas of North America.

The New York State Energy Research & Development Authority offers energy-targeted incentives.

The exception is Ontario, which is already passing an ambitious number of new incentives for renewable-energy production and research, including a $250 million fund for green technology research. This could make Ontario a major competitor with the region, but it is equally possible it could become a major partner if viewed as part of a larger Great Lakes-centered area for renewable energy growth. A major challenge will be finding new ways to turn Ontario, a potential competitor, into a renewable energy partner with Buffalo Niagara.

Even with changes, the process of obtaining incentives can be an obstacle. When a company requests assistance, the picture can quickly get confusing. In a new renewable-energy facility or even a new manufacturing building that will make components, it might be possible to combine industry-targeted incentives from the Empire State Development Corp. (ESDC), energy-targeted incentives from NYSERDA, a research grant from the New York State Foundation for Science, Technology and Innovation (NYSTAR), bond financing and tax exemptions from one of more than a dozen industrial-development agencies, tax breaks from local empire zone offices, a hydropower agreement with NYPA and a power purchase agreement with one of two local utilities. While there are facilitators and leaders to help "package the deal," it can be overwhelming and time-consuming for business.

COMPETITION WITH STATES AND REGIONS

As national policies change to stimulate new investment in a green economy, the competition for green jobs will become intense as states and regions compete for their share. To varying degrees each sector depends on market and financial incentives to achieve

price parity in competition with cheaper fossil fuel-based energy generation.

Going forward, state programs that narrow the gap between fossil-fuel energy prices and those of renewable energy will continue to play a major competitive role, as will programs that provide specific incentives to companies creating green jobs. To date, New York has played an aggressive role, but at the start of 2009, 46 states faced budget shortfalls totaling more than $350 billion and the range and extent of future state incentives in the months and years ahead remains uncertain.

Many states, including New York, are re-evaluating and restructuring incentive programs as current economic conditions force across-the-board spending cuts. Utility-company incentives are expected to play an increasingly important role as states trim incentive packages, and the federal government is expected to enact polices that would encourage utilities to aggressively pursue energy conservation and renewable-energy sources. States and regions that work aggressively to enhance the new benefits enacted at the federal level will be the likely winners in the race for the most new green jobs.

Energy-targeted incentives in the individual states fall into the categories of energy generation and energy efficiency. These in turn break down in each category to incentives that are direct—low-cost loans, tax reductions—and those that are regulatory—standards, requirements, net metering, feed-in-tariff systems. There are also programs that fund research and development or provide venture-capital startup.

As of early 2009, California had the most diverse mix of renewable energy and the most renewable electricity (excluding hydropower) of any state. When hydropower is included, Washington becomes the leading state.

Regional solar markets continue to solidify and expand, especially in the Southwest, West, Mid-Atlantic and Northeast. Public policy has played a critical role in solar-market development in these states. The Southeast, led by North Carolina and Florida, is beginning to emerge as a renewable-energy player with extensive marketing campaigns. According to the Interstate Renewable Energy Council, a handful of states—Massachusetts, Ohio and Pennsylvania—stood out among others in 2008 by establishing robust policies designed to promote renewable-energy growth.

Some regions rely simply on marketing rather special incentives or distinct advantages. Northwest Pennsylvania, which would include Erie, Pa., on Lake Erie, lists benefits that are very similar to those offered (with many other things) in Buffalo Niagara, including: the existence of more than 200 existing alternative-energy companies in northwest Pennsylvania; more than 70 potential component manufacturers for alternative-energy industry; large availability of suitable, inexpensive industrial sites; strategic location (within 300 miles of more than 100 million people); superior regional infrastructure (four interstate highways, 11 airports, an international airport, a port, and approximately 1,000 miles of rail); low transportation costs; well-developed R&D base in alternative energy (11 universities); and low work-force costs.

Indeed, there are so many different incentives, standards, energy goals and inducements being established, that companies want a set of national guidelines that would even out at least some of the myriad factors that have to be considered in a location decision. The most significant national standard would be a uniform feed-in-tariff, which provides a set price for the purchase of renewable energy entering the grid system. Some other states' major energy incentives include:

Oregon: Has been extremely effective in increasing renewable energy presence and is a leader in building a renewable-energy industry. Oregon offers 50% of construction costs in tax credits for a facility where renewable-energy equipment is manufactured. This has helped bring in seven international solar manufacturers in the last two years. Additionally, Oregon has programs to buy back energy from grid-connected solar and wind systems as well as property-tax exemptions for these systems, which encourages residents and businesses to utilize these technologies.

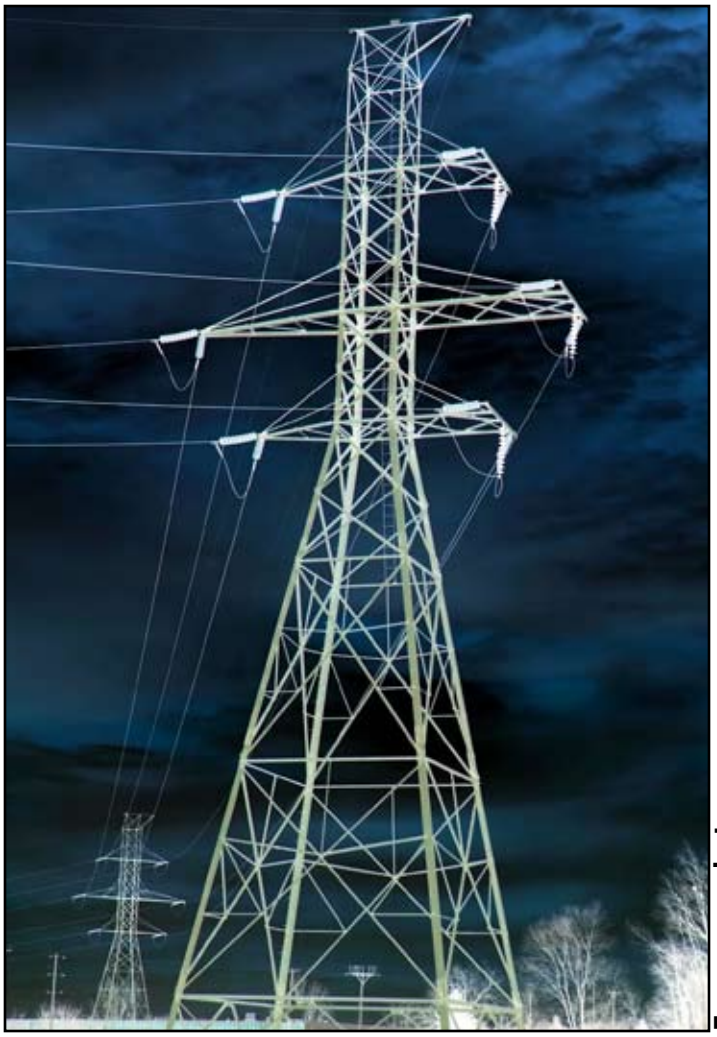
Pennsylvania: Has an ambitious renewable portfolio standard and has enacted incentives to support this. The goal is to have 18% of all energy created in state to come from alternative and renewable sources by 2021. So far, the focus has been on wind, geothermal and biofuel energy. Biodiesel producers are eligible for a 75-cent per-gallon subsidy capped at $1.9 million a year per producer to encourage the industry's growth. There is also a wind and geothermal incentive program, which pays manufacturers grants and loans based on the amount of jobs created as well as grants and loans for distribution projects. The state also supports innovation, and the Pennsylvania Energy Development Authority funds up to $1 million for advanced-energy projects in manufacturing and research.

California: Renewable-energy incentives are largely focused on solar energy due to the large amount of resources in the state. There are rebates on all types of solar systems, such as photovoltaic, solar-space heat, solar-thermal electric and solar water heating. Many utilities will buy back unused electricity generated from solar systems.

Massachusetts: Has a multifaceted approach to support renewable-energy endeavors and is currently one of the leaders of the country in renewable energy reforms. The Green Communities Act, passed in 2008, created a wide variety of new state incentives and support for renewable energy. Utility companies are required to enter 10- to 15-year contracts with renewable-energy developers to obtain funding for projects. Additionally, they are required to buy back excess energy, up to 2 megawatts, from customer's grid-connected wind-turbine and solar-energy systems. It also allows utility companies to own solar panels they install on customers' roofs. This will make meeting Gov. Deval Patrick's goal of 250 MW of installed solar power by 2017 much more feasible. The state also offers tax credits and reductions for approved renewable-energy systems, a sales tax exemption on the sale of solar, wind and geothermal systems, and an income-tax deduction on money earned from the sale or royalties of alternative-energy technologies.

Ohio: Renewable energy efforts are focused on wind, solar and biomass power, and the state has been referred to as "a potential hotbed for 'green collar' job creation," due to its manufacturing history and large amount of potential workers. It is second in the country for potential wind manufacturing and, in addition to financial incentives, recent tax reforms have been put in to place to support the industry. The state's Third Frontier Project has pledged to fund $1.6 billion over 10 years to improve cooperation between industry and academia to create a work force for a future boom in alternative energy. Ohio facilities used for energy conversion are exempt from sales, property and corporate franchise taxes. There are also many grants available for biomass, solar-water heat, photovoltaic and wind systems at the residential, government, corporate and multifamily residential levels.

Michigan: Focus is on the production aspect of renewable energy, including turbine manufacturing, solar-power development and biofuel generation. Businesses involved in research, manufacturing and alternative-energy development are eligible for tax credits. Michigan has also set up "Renewable Energy Renaissance Zones," and alternative-energy businesses located in these zones qualify for an abatement of the Michigan Business Tax, state education tax, property tax and certain local income taxes for up to 15 years. There are also property-tax exemptions for businesses that utilize renewable-energy technologies. The state also funds large-scale photovoltaic projects.



Freerange photo

Regions will need to constantly reassess the fast-changing market and incentives offered by states and regions that are in constant state of flux. The North Carolina Solar Center maintains an online Database of State Incentives for Renewable and Efficiency (dsireusa.org) and changes are so swift it is now updated daily.

It should also be remembered that incentives, while important in the renewable-energy field, are not by themselves enough to attract viable, competitive alternative-energy sources. As with other industries, factors such as access to capital and resources, labor and work-force needs, supply chains, end-market access and other market variables are weighed by companies in making alternative-energy site selections.

Renewable-Energy Standards in Selected States

A survey of energy incentives in six competing states showing New York has a competitive set of incentive programs as of March 2009.

STATE	NY	CA	PA	MA	OH	MI	OR
FINANCIAL INCENTIVES FOR RENEWABLE ENERGY							
Tax incentives							
Grants							
Loans							
Rebates							
Industry recruitment							
Bond Programs							
Production incentives							
FINANCIAL INCENTIVES FOR ENERGY EFFICIENCY							
Tax incentives							
Grants							
Loans							
Rebates							
Bond programs							
RULES, REGULATIONS FOR RENEWABLE ENERGY							
Renewable portfolio standards							
Net metering							
Interconnection standards							
RULES, REGULATIONS FOR ENERGY EFFICIENCY							
Standards for public buildings							
Building energy codes							

Source: Database of State Incentives for Renewables & Efficiency

IV COMPARATIVE ANALYSIS

To understand Buffalo Niagara in respect to its ability to attract manufacturing investment within the renewable-energy sectors targeted for this study, it is necessary not only to evaluate the capacity of the eight counties comprising the region, but to compare the region to potential competing locations.

This is problematic as each county has unique characteristics and strengths. Buffalo Niagara is also located between the Northeast and the Midwest, which has different demographic and geographic characteristics than other parts of the U.S. This makes it difficult to determine the best method of comparison. For example, it would not make sense to compare the Buffalo Metro Area to another Metro Area, as the Buffalo Metro Area or Erie County itself is not representative of the entire region. Similarly when one aggregates counties or compares the regions to another location of much larger size, the differences make it hard to perform meaningful comparisons.

Additionally, it is difficult to identify particular areas as points of comparison, or to decide whether it makes more sense to select large multinationals or larger firms, where renewable activities, while meaningful, account for only a small part of their revenues or smaller firms which specialize in the sector. Finally many firms do not advertise the locations of their production and sourcing facilities as well as the breakdown of products and revenues from a particular location. So, in some cases, one might select a location based upon a firm, which only has their corporate headquarters there rather than production facilities.

To overcome this problem, KWR International examined the industry directory on greenjobs.com along with other sources and moved to identify one or more firms within each of the targeted areas and then determined the counties in which they were located. Three counties were then chosen for each sector, based on their relevance to the Buffalo Niagara region, and the sector being evaluated. While some of these companies are large and some more local, the thinking was to provide a range of comparisons with different areas that had some presence in the sector.

As with the Intra-Buffalo Niagara analysis, there was the problem of double-counting, which introduces an almost exponential bias to the revenue numbers identified. This problem is the result of multi-line companies, which list themselves in several of the NAICS codes targeted. For example, if a $10 million firm competes in 10 NAICS codes, Hoover's lists them in each area with their full revenue number of $10 million. That would leave a total of $100 million, which is incorrect. Even if one moves to identify the duplications, it would be impossible to discern how to correct for this anomaly. These firms do compete in these different areas but release data only as a total and not per product. The only solution would be to approach each individually and obtain this data, which is usually, in any case, kept confidential.

Therefore, while not providing a direct comparison, given Buffalo Niagara is composed of eight different counties, which vary dramatically, this measure and methodology was selected as the most appropriate. Nevertheless, the findings here should not be interpreted as unbiased, given the data is highly influenced by the firm size and the county selected along with the underlying model's other limitations. Still, the commonalities and data discerned do allow for a number of insightful comparisons and conclusions.

SOLAR SECTOR

The three counties identified were: Middlesex County, Mass., in which Evergreen Solar, Konarka Technologies and Spire Corp. are located; Prince Georges County, Md., home to SunEdison (which bills itself as North America's largest solar energy service provider); and Oakland County, Mich., which contains Energy Conversion Devices and United Solar Ovonic. These three counties were compared with Buffalo Niagara's eight counties, with similar adjustments made for population size and the other factors noted in the preceding Intra-Buffalo analysis.

Buffalo Niagara possesses a larger population than these three areas but has the fewest firms per person, possibly due to the existence of larger employers. This finding holds with the exception of one county throughout this analysis for all sectors. Buffalo Niagara also has the lowest percentage of college-educated people and the most affordable housing.

The most competitive place for Solar appears to be Middlesex, which has a similar percentage of workers employed in manufacturing (6.5% compared to 7.6%

for Buffalo Niagara). When comparing the two, one can see they both have strengths in Measuring and Display/Control Instruments, though Middlesex is far stronger in Solar Cells, and all three are far stronger than Buffalo Niagara in Engineering Design Services.

The strongest-rated NAICS code in Prince Georges was Plumbing and Heating, while Oakland rated very high in Pumps and Pumping Equipment (where Buffalo Niagara rated half as high as Oakland), Charge Controllers and Top Surface. Buffalo Niagara, on the other hand, has strengths in various industrial processes and leads in several NAICS codes related to metal work.

In a pattern repeated in the great majority of comparisons undertaken as part of this analysis, Buffalo Niagara has a broader distribution of activity within the range of selected NAICS codes.

For example, more than 51% of revenues generated in Middlesex come from R&D and Engineering Design Services; Prince Georges generated more than 65% from Plumbing, Heating and Air Conditioning Contractors and 24.89% in Engineering Design Services. In addition, Oakland has three codes at near 20% each or 57% combined, including Top Surface, Pump/Pumping Equipment and Charge Controllers. On the other hand, Buffalo Niagara had only four codes over 10%, with none over 13%.

Solar Comparative Analysis—Demographic Information

COUNTY	MIDDLESEX	PRINCE GEORGES	OAKLAND	BN REGION
STATE	MASS.	MD.	MICH.	N.Y.
Population	1,465,396	801,515	1,194,156	1,591,708
Population as % of BN	92%	50%	75%	100%
Revenues as % of BN	659%	16%	185%	100%
Firms(Total)	88,892	49,067	96,036	72,377
# People per Firm	16.5	16.3	12.4	22.0
# People per Solar Firm	287	466	284	666
# People employed in Mfg	95,518	13,695	134,003	120,877
% People employed in Mfg	6.5%	1.7%	11.2%	7.6%
% College degree or above	43.7%	23.5%	36.0%	19.9%
Median House Value	$247,900	$145,600	$181,200	$88,213
Average House Value	$106,981	$158,368	$227,110	$78,094

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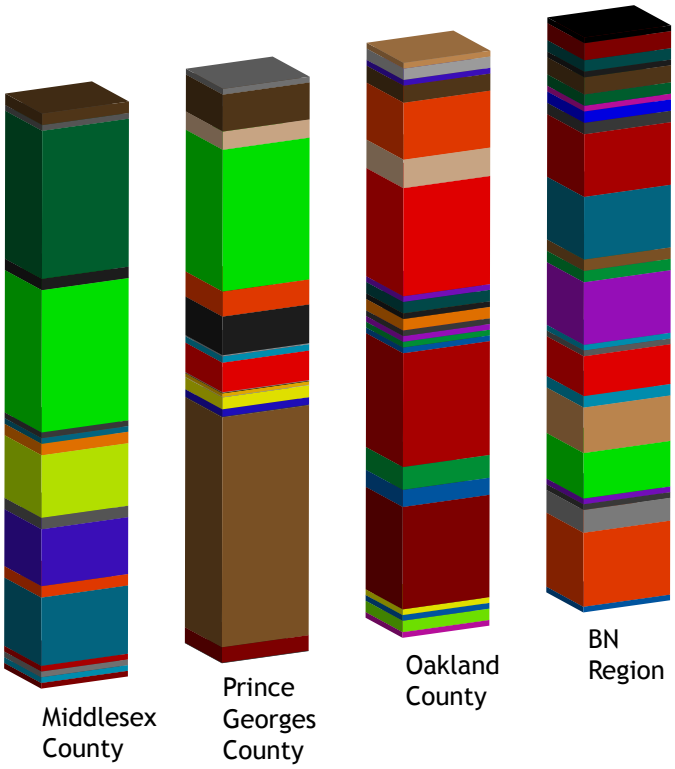
Solar NAICS Comparative Analysis—Revenues (In Millions $)

	COUNTY:	Middlesex		Prince Georges		Oakland		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
221119	Other Electric Power Generation	301	0.2	3	0.1	394	1.1	182	1.0
221122	Electric Power Distribution	1,058	0.8	0	0.0	15	0.0	2,464	12.9
237130	Power/Comm Line/Rel Structures Co	258	0.2	85	2.7	10	0.0	11	0.1
238220	Plumbing, Heating, & AC Contractor	1,016	0.8	1,270	40.4	553	1.6	805	4.2
325211	Encapsulant	40	0.0	5	0.1	204	0.6	105	0.5
326113	Rear Layer	53	0.0	0	0.0	147	0.4	13	0.1
326299	Fuel cells, solid-state	150	0.1	0	0.0	502	1.4	94	0.5
327211	Top Surface	7	0.0	1	0.0	6,403	18.1	5	0.0
331316	Aluminum Extruded Product Mfg	0	0.0	0	0.0	10	0.0	0	0.0
331421	Copper Rolling, Drawing, and Extru	1	0.0	0	0.0	6	0.0	127	0.7
332311	Prefabricated Metal Building/Comp	1	0.0	0	0.0	1,044	2.9	28	0.1
332312	Fabricated Structural Metal Mfg	108	0.1	42	1.3	121	0.3	1,505	7.9
332322	Sheet Metal Work Mfg	785	0.6	66	2.1	104	0.3	1,532	8.0
332410	Power Boiler/Heat Exchanger Mfg	4	0.0	0	0.0	10	0.0	312	1.6
332999	All Other Misc. Fab Metal Product	673	0.5	2	0.1	1,378	3.9	1,426	7.5
333412	Industrial/Commercial fans/blowers	531	0.4	0	0.0	67	0.2	21	0.1
333414	Heating Equip (ex. Warm Air Furnace	328	0.3	19	0.6	12	0.0	49	0.3
333415	AC/Wm Air Htg Eqp & Com/Ind Ref	30	0.0	3	0.1	68	0.2	109	0.6
333613	Power Transmission Equip	16	0.0	0	0.0	138	0.4	225	1.2
333911	Pump/Pumping Equip Mfg	9	0.0	0	0.0	6,929	19.6	2,079	10.9
333912	Air/Gas Compressor Mfg	35	0.0	0	0.0	12	0.0	333	1.7
334112	Computer Storage Device Mfg	15,635	12.4	0	0.0	263	0.7	1	0.0
334413	Solar Cells	2,553	2.0	3	0.1	372	1.1	8	0.0
334418	Printed circuits and electronics	208	0.2	0	0.0	223	0.6	320	1.7
334513	Instr/Reld Prod Mfg for Meas, Disp	12,601	10.0	165	5.2	390	1.1	2,137	11.2
334515	Meter	2,883	2.3	33	1.1	55	0.2	54	0.3
334519	Other Measuring/Controlling Device	13,331	10.6	0	0.0	533	1.5	2,054	10.7
335311	Power, Distrib & Specialty Transf	574	0.5	0	0.0	327	0.9	374	2.0
335312	Motor and Generator	156	0.1	0	0.0	786	2.2	447	2.3
335313	Circuit Breakers & Fuses	241	0.2	0	0.0	154	0.4	10	0.1
335314	Relay and Industrial Control	249	0.2	0	0.0	431	1.2	227	1.2
335911	Storage Batteries	10	0.0	0	0.0	36	0.1	1	0.0
335931	Electrical Connections	178	0.1	0	0.0	172	0.5	16	0.1
335999	Charge Controller	2,810	2.2	7	0.2	6,866	19.4	332	1.7
423720	Plumbing/Heating Equip Merch	638	0.5	215	6.8	176	0.5	582	3.0
541310	Architectural services	818	0.6	138	4.4	1,673	4.7	232	1.2
541330	Engineering Design Services	31,632	25.1	783	24.9	3,450	9.7	355	1.9
541690	Energy Consulting Services	2,801	2.2	101	3.2	913	2.6	496	2.6
541712	R&D	33,201	26.4	204	6.5	466	1.3	53	0.3
TOTAL REVENUES		$125,920	100%	$3,146	100%	$35,413	100%	$19,121	100%
% OF REVENUES: COUNTIES TO BN		659%		16%		185%			

Solar NAICS Comparative Analysis—Number of Firms

	COUNTY:	Middlesex		Prince Georges		Oakland		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
221119	Other Electric Power Generation	50	1.0	19	1.1	25	0.6	50	2.1
221122	Electric Power Distribution	13	0.3	0	0.0	3	0.1	8	0.3
237130	Power/Comm. Line/Rel Structures Co	16	0.3	14	0.8	13	0.3	15	0.6
238220	Plumbing, Heating, & AC Contractor	1,353	26.5	623	36.2	1,083	25.8	892	37.3
325211	Encapsulant	20	0.4	2	0.1	38	0.9	24	1.0
326113	Rear Layer	11	0.2	1	0.1	6	0.1	5	0.2
326299	Fuel cells, solid-state	12	0.2	3	0.2	30	0.7	30	1.3
327211	Top Surface	5	0.1	3	0.2	19	0.5	6	0.3
331316	Aluminum Extruded Product Mfg	0	0.0	0	0.0	2	0.0	1	0.0
331421	Copper Rolling, Drawing, and Extruding	2	0.0	0	0.0	2	0.0	5	0.2
332311	Prefabricated Metal Building/Comp	6	0.1	2	0.1	10	0.2	10	0.4
332312	Fabricated Structural Metal Mfg	45	0.9	13	0.8	47	1.1	74	3.1
332322	Sheet Metal Work Mfg	91	1.8	28	1.6	67	1.6	59	2.5
332410	Power Boiler/Heat Exchanger Mfg	4	0.1	0	0.0	4	0.1	12	0.5
332999	All Other Misc Fab Metal Product	32	0.6	11	0.6	33	0.8	29	1.2
333412	Industrial/Commercial fans/blowers	5	0.1	0	0.0	10	0.2	11	0.5
333414	Heating Equip (ex. Warm Air Furnace	10	0.2	2	0.1	6	0.1	8	0.3
333415	AC/Wm Air Htg Eqp & Com/Ind Ref Eq	22	0.4	7	0.4	24	0.6	31	1.3
333613	Power Transmission Equip	6	0.1	0	0.0	19	0.5	11	0.5
333911	Pump/Pumping Equip Mfg	9	0.2	0	0.0	12	0.3	12	0.5
333912	Air/Gas Compressor Mfg	10	0.2	0	0.0	5	0.1	14	0.6
334112	Computer Storage Device Mfg	25	0.5	2	0.1	19	0.5	5	0.2
334413	Solar Cells	130	2.5	8	0.5	37	0.9	10	0.4
334418	Printed circuits and electronics a	28	0.5	0	0.0	21	0.5	8	0.3
334513	Instr/Reld Prod Mfg for Meas, Disp	77	1.5	9	0.5	71	1.7	21	0.9
334515	Meter	68	1.3	7	0.4	24	0.6	16	0.7
334519	Other Measuring/Controlling Device	85	1.7	3	0.2	68	1.6	110	4.6
335311	Power, Distrib & Specialty Transf	15	0.3	3	0.2	16	0.4	8	0.3
335312	Motor and Generator	17	0.3	4	0.2	24	0.6	14	0.6
335313	Circuit Breakers & Fusers	15	0.3	0	0.0	34	0.8	10	0.4
335314	Relay and Industrial Control	29	0.6	3	0.2	71	1.7	24	1.0
335911	Storage Batteries	4	0.1	1	0.1	6	0.1	4	0.2
335931	Electrical Connections	17	0.3	1	0.1	6	0.1	12	0.5
335999	Charge Controller	72	1.4	17	1.0	47	1.1	30	1.3
423720	Plumbing/Heating Equip Merch./Who	94	1.8	36	2.1	96	2.3	10	0.4
541310	Architectural services	560	11.0	99	5.8	362	8.6	143	6.0
541330	Engineering Design Services	958	18.8	385	22.4	1,207	28.7	332	13.9
541690	Energy Consulting Services	614	12.0	288	16.7	446	10.6	251	10.5
541712	R&D	572	11.2	127	7.4	191	4.5	76	3.2
TOTAL FIRMS		5,102	100%	1,721	100%	4,204	100%	2,391	100%



Solar Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

Freerange photo

WIND SECTOR

The three counties identified were: Cleveland County, Okla., in which Bergey Windpower is located; Coconino County, Ariz., home to Southwest Windpower, the world's leading battery-charging wind turbine manufacturer; and Scott County, Minn., with Wind Turbine Industries Corp.

Buffalo Niagara possesses a much larger population than these areas, in part perhaps because it is composed of eight counties, possesses a major metro area, and appears to have more than twice as many firms and more than 15 times the revenues generated from these wind-related NAICS codes. Interestingly, even if one corrects for population within the limitations of this model, Buffalo Niagara seems to generate a higher amount of revenues from these selected wind-related NAICS codes than the other areas when measured on a per person basis. While there is diversity, in comparison with locations selected for solar and some of the other categories examined, it has more similar characteristics in terms of education and housing prices.

As with Solar, there does not appear to be any NAICS code that registers strongly in all of these locations, and identifying one particular characteristic absolutely essential to success from this data alone cannot be done. When measured on a percentage basis, Cleveland and Coconino counties appear notably stronger than Buffalo Niagara in terms of their allocation by percentage to Engineering Design and Energy Consulting Services and R&D. That may be indicative of Buffalo Niagara's diverse activity, which provides a broader range across the codes included within Wind. It should be emphasized, however, that even though the percentage is smaller, Buffalo Niagara has more activity in each of these areas than the three other areas combined.

For example, Cleveland County claims 108 firms with expertise in Engineering Design Services, which account for 52.4% of revenues in Wind-related codes, while Buffalo Niagara has 332 firms, which account for only 1.74% of revenues in the area. One can also look at Scott County, which generates 74.29% of its revenues from the activity of one firm, which makes Industrial and Commercial Fans and Blowers.

This illustrates the contribution a single firm can make to a region, particularly in a county with a small population. More important, for the purposes of this study is the wide diversity between NAICS codes seen in Buffalo Niagara within the Wind sector in comparison with competing locations, many of which are located in less accessible and more rural areas. Some of these locations are attracting a lot of attention, though lack the established industrial base that exists in Buffalo Niagara.

Wind NAICS Comparative Analysis—Demographic Information

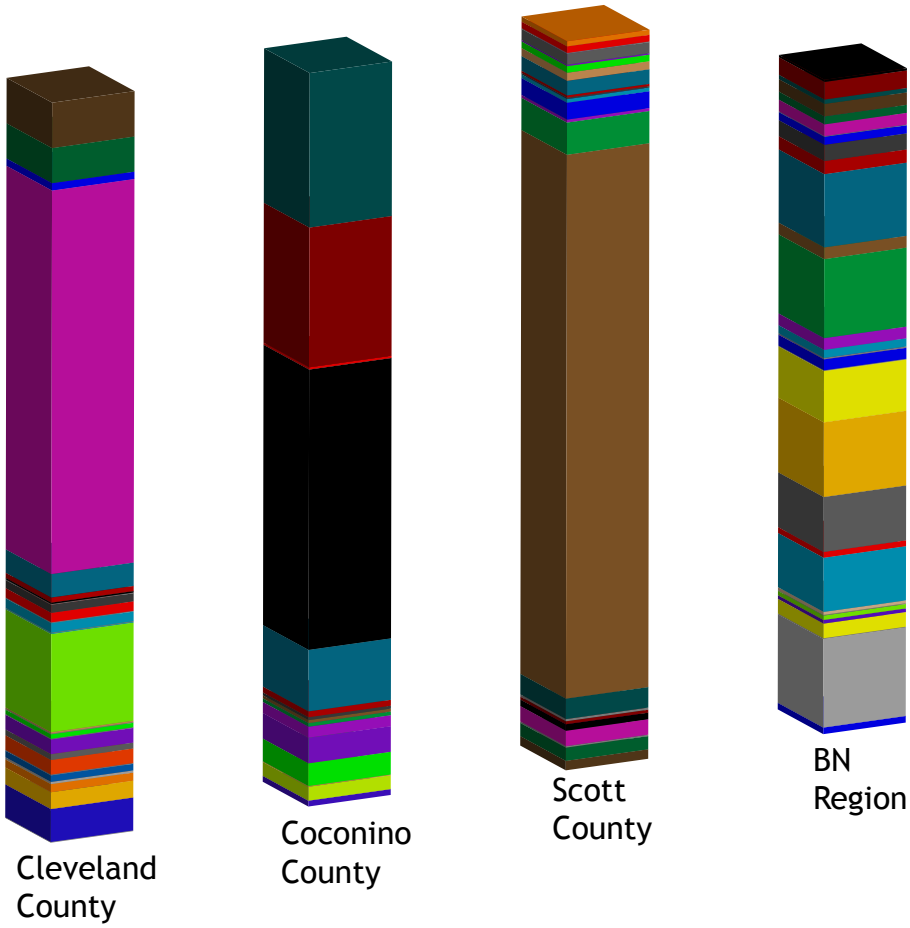
COUNTY	CLEVELAND	COCONINO	SCOTT	BN REGION
STATE	OKLA.	ARIZ.	MINN.	N.Y.
Population	208,016	116,320	89,498	1,591,708
Population as % of BN	13%	7%	6%	100%
Revenues as % of BN	2%	0%	4%	100%
Firms (Total)	12,744	8,715	8,809	72,377
# People per Firm	16.3	13.3	10.2	22.0
# People per Wind Firm	589	526	466	988
# People employed in Mfg	9,039	2,881	9,041	120,877
% People employed in Mfg	4.3%	2.5%	10.1%	7.6%
% College degree or above	23.4%	5.9%	14.3%	19.9%
Median House Value	$88,500	$142,500	$157,300	$88,213
Average House Value	$104,673	$104,673	$58,584	$78,094

Wind NAICS Comparative Analysis—Revenues (In Millions $)

NAICS	INDUSTRY SEGMENT	Cleveland		Coconino		Scott		BN Region	
		$$	%	$$	%	$$	%	$$	%
221119	Other Electric Power Generation	0	0.1	1	0.8	11	1.3	182	0.9
221122	Electric Power Distribution	22	4.5	0	0.0	15	1.8	2,464	12.1
237130	Power/Comm Line/Rel Structures Co	11	2.3	0	0.0	2	0.2	11	0.1
326199	All Other Plastics Product Mfg	6	1.1	0	0.0	17	2.1	401	2.0
326299	Fuel cells, solid-state	2	0.3	1	1.9	8	0.9	94	0.5
331316	Aluminum Extruded Product Mfg	0	0.0	0	0.0	0	0.0	0	0.0
331421	Copper Rolling, Drawing & Extruding	0	0.0	0	0.0	0	0.0	127	0.6
331511	Iron Foundries	0	0.0	0	0.0	0	0.0	2	0.0
332111	Iron & Steel Mills	4	0.9	0	0.1	0	0.0	22	0.1
332112	Nonferrous Forging	0	0.1	0	0.0	0	0.0	83	0.4
332312	Fabricated Structural Metal	10	2.0	2	3.1	4	0.4	1,505	7.4
332313	Plate Work Mfg	4	0.8	3	3.5	3	0.3	159	0.8
332322	Sheet Metal Work Mfg	10	2.0	0	0.0	22	2.8	1,532	7.5
332911	Industrial Valve Mfg	0	0.0	0	0.0	0	0.0	2,079	10.2
332999	All Other Misc Fab Metal Product	0	0.1	1	1.5	0	0.0	1,426	7.0
333412	Industrial & Commercial fans and	0	0.0	0	0.0	595	74.3	21	0.1
333611	Turbines, & Turb Generators	3	0.6	0	0.0	36	4.4	316	1.5
333612	Speed Changer, Industrial	1	0.1	0	0.0	4	0.4	32	0.2
333613	Power Transmission Equip	0	0.0	0	0.0	18	2.3	225	1.1
333912	Air/Gas Compressor Mfg	1	0.2	0	0.0	0	0.0	333	1.6
333995	Fluid Power Cylinder/Actuator Mfg	0	0.0	0	0.5	0	0.0	2,198	10.8
334112	Computer Storage Device Mfg	65	13.4	0	0.0	4	0.5	1	0.0
334418	Printed circuits & electronics	0	0.0	0	0.0	0	0.0	320	1.6
334513	Instr/Reld Prod Mfg for Meas, Disp	1	0.1	0	0.0	2	0.2	2,137	10.5
334515	Meter	0	0.1	0	0.4	0	0.0	54	0.3
334519	Other Measuring/Controlling Device	1	0.1	0	0.0	0	0.0	2,054	10.0
335311	Power, Distrib & Specialty Trans	7	1.3	0	0.0	2	0.3	374	1.8
335312	Motors & Generators	0	0.0	0	0.0	0	0.0	447	2.2
335313	Switchgear/Switchboard Apparatus M	0	0.0	0	0.0	0	0.0	10	0.0
335314	Relay & Industrial Control	5	1.1	0	0.4	16	2.0	227	1.1
335911	Storage Battery	1	0.1	0	0.0	0	0.0	1	0.0
335931	Electrical Connections	1	0.2	0	0.0	9	1.1	16	0.1
335999	Electronic Equipment & Component	3	0.7	1	0.8	7	0.9	332	1.6
541310	Architectural services	15	3.2	6	8.4	1	0.2	232	1.1
541330	Engineering Design Services	252	52.4	29	38.3	12	1.5	355	1.7
541620	Environmental Consulting Svcs	5	1.0	0	0.3	1	0.1	121	0.6
541690	Energy Consulting Services	23	4.8	14	19.1	7	0.9	496	2.4
541712	R&D	30	6.2	16	21.1	6	0.7	53	0.3
TOTAL REVENUES (IN MILLIONS)		$482	100%	$75	100%	$801	100%	$20,440	100%
% OF REVENUES: COUNTIES TO BN		2%		0%		4%			

Wind NAICS Comparative Analysis—Number of Firms

	COUNTY:	Cleveland		Coconino		Scott		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**		**#**		**#**		**#**	
221119	Other Electric Power Generation	3	0.8	8	3.6	5	2.6	50	3.1
221122	Electric Power Distribution	3	0.8	2	0.9	2	1.0	8	0.5
237130	Power/Comm Line/Rel Structures Co	8	2.3	0	0.0	1	0.5	15	0.9
326199	All Other Plastics Product Mfg	6	1.7	1	0.5	19	9.9	91	5.6
326299	Fuel cells, solid-state	2	0.6	2	0.9	3	1.6	30	1.9
331316	Aluminum Extruded Product Mfg	1	0.3	0	0.0	1	0.5	1	0.1
331421	Copper Rolling, Drawing & Extruding	0	0.0	0	0.0	0	0.0	5	0.3
331511	Iron Foundries	0	0.0	0	0.0	1	0.5	91	5.6
332111	Iron & Steel Mills	1	0.3	1	0.5	1	0.5	18	1.1
332112	Nonferrous Forging	1	0.3	0	0.0	0	0.0	5	0.3
332312	Fabricated Structural Metal	13	3.7	4	1.8	10	5.2	3	0.2
332313	Plate Work Manufacturing	3	0.8	2	0.9	3	1.6	33	2.0
332322	Sheet Metal Work Manufacturing	14	4.0	0	0.0	6	3.1	59	3.7
332911	Industrial Valve Manufacturing	3	0.8	0	0.0	0	0.0	25	1.6
332999	All Other Misc Fab Metal Product	4	1.1	4	1.8	2	1.0	29	1.8
333412	Industrial & Commercial fans and	0	0.0	0	0.0	1	0.5	5	0.3
333611	Turbines & Turb Generators	1	0.3	0	0.0	3	1.6	11	0.7
333612	Speed Changer, Industrial	1	0.3	0	0.0	1	0.5	10	0.6
333613	Power Transmission Equip	0	0.0	0	0.0	2	1.0	11	0.7
333912	Air/Gas Compressor Mfg	3	0.8	0	0.0	1	0.5	14	0.9
333995	Fluid Power Cylinder/Actuator Mfg	1	0.3	1	0.5	0	0.0	9	0.6
334112	Computer Storage Device Mfg	2	0.6	0	0.0	4	2.1	5	0.3
334418	Printed circuits & Electronics a	0	0.0	0	0.0	0	0.0	8	0.5
334513	Instr/Reld Prod Mfg for Meas, Disp	1	0.3	0	0.0	1	0.5	21	1.3
334515	Meter	2	0.6	2	0.9	0	0.0	16	1.0
334519	Other Measuring/Controlling Device	2	0.6	0	0.0	1	0.5	110	6.8
335311	Power, Distrib & Specialty Trans	2	0.6	0	0.0	2	1.0	8	0.5
335312	Motors & Generators	0	0.0	0	0.0	0	0.0	25	1.6
335313	Switchgear/Switchboard Apparatus	0	0.0	0	0.0	0	0.0	10	0.6
335314	Relay & Industrial Control	2	0.6	2	0.9	5	2.6	24	1.5
335911	Storage Battery	1	0.3	0	0.0	0	0.0	4	0.2
335931	Electrical Connections	3	0.8	0	0.0	1	0.5	12	0.7
335999	Electronic Equipment & Component	9	2.5	5	2.3	9	4.7	14	0.9
541310	Architectural services	52	14.7	31	14.0	13	6.8	143	8.9
541330	Engineering Design Services	108	30.6	65	29.4	44	22.9	332	20.6
541620	Environmental Consulting Svcs	10	2.8	4	1.8	4	2.1	29	1.8
541690	Energy Consulting Svcs	69	19.5	59	26.7	32	16.7	251	15.6
541712	R&D	22	6.2	28	12.7	14	7.3	76	4.7
TOTAL FIRMS		353	100%	221	100%	192	100%	1,611	100%



Wind Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

Freerange photo

GEOTHERMAL SECTOR

The three counties identified were: Oakland County, Mich., in which Geothermal Systems of Lapeer LLC is located, Middlesex County, N.J., which contains Metex Corp. and Fulton County, Ga., which includes Warren Environmental Equipment Co.

Buffalo Niagara is almost twice as large as Middlesex and Fulton Counties and about 33% larger than Oakland County in terms of population. Buffalo Niagara comes out second in terms of the number of people employed in manufacturing. Its median housing value and percent of college educated population is about half of these other locations.

While Buffalo Niagara is larger than these other locations in terms of population it is not necessarily the most competitive. Oakland County has about 75% of Buffalo Niagara's population, but 80% more firms within the selected geothermal-related NAICS codes and almost the same amount of revenues. Middlesex County has only half the population, 77% as many firms and 4.6 times as many revenues, while Fulton County — which appears to be the most competitive — also has about half the population with 57% more firms and 14.35 times as many revenues.

When looking at the range of NAICS codes, one can see a similar concentration as in other sectors in Oakland and Middlesex counties. The top three codes in these counties account for more than 50% of revenues, though Fulton County has a similar and perhaps even wider distribution than Buffalo Niagara.

Geothermal Comparative Analysis—Demographic Information

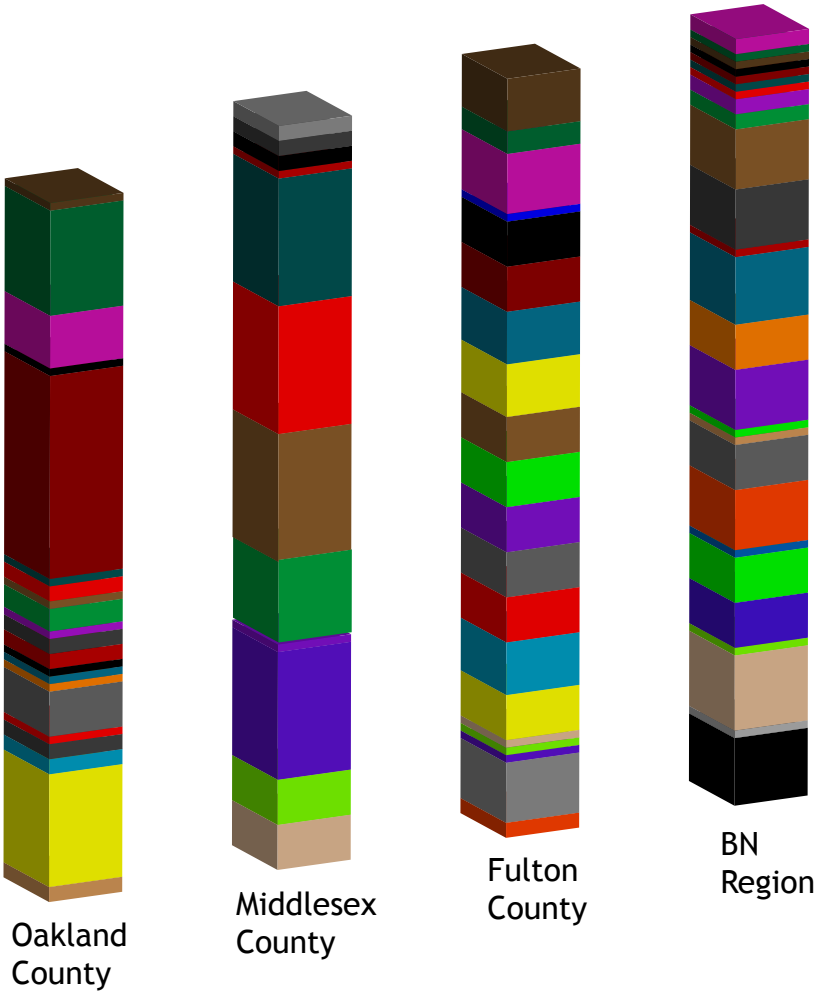
COUNTY STATE	OAKLAND MICH.	MIDDLESEX N.J.	FULTON GA.	BN REGION N.Y.
Population	1,194,156	750,162	816,006	1,591,708
Population as % of BN	75%	47%	51%	100%
Revenues as % of BN	98%	462%	1435%	100%
Firms(Total)	96,400	49,515	100,613	72,377
# People per Firm	12.4	15.2	8.1	22.0
# People per Geo Firm	379	556	299	915
# People employed in Mfg	134,003	50,728	32,951	120,877
% People employed in Mfg	11.2%	6.8%	4.0%	7.6%
% College degree or above	36.0%	30.4%	36.3%	19.9%
Median House Value	$181,200	$168,500	$180,700	$88,213
Average House Value	$227,110	$106,512	$247,633	$78,094

Geothermal NAICS Comparative Analysis—Revenues (In Millions $)

		Oakland		Middlesex		Fulton		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
211111	Hydroelectric Power Generation	0	0.0	1	0.0	24	0.0	2418.9	9.4
221119	Other Electric Power Generation	394	1.6	6,999	5.9	9,039	2.4	182	0.7
221122	Electric Power Distribution	15	0.1	193	0.2	27,586	7.5	2464.4	9.6
221330	Steam & Air-Conditioning Supply	1	0.0	0	0.0	0	0.0	0	0.0
237130	Power/Comm. Line/Rel Structures Co	10	0.0	260	0.2	35	0.0	11.3	0.0
331210	Iron/Steel Pipe/Tube Mfg frm Purch	32	0.1	0	0.0	2	0.0	46.5	0.2
331421	Copper Rolling, Drawing & Extruding	6	0.0	0	0.0	0	0.0	127	0.5
331511	Iron Foundries	3,802	15.1	1	0.0	1	0.0	1.6	0.0
332111	Iron & Steel Mills	397	1.6	7	0.0	1,859	0.5	27.5	0.1
332312	Fabricated Structural Metal Mfg	121	0.5	70	0.1	1,398	0.4	1505.3	5.9
332322	Sheet Metal Work Mfg	80	0.3	59	0.0	1,891	0.5	1532.3	6.0
332996	Fabricated Pipe & Pipe Fitting Mfg	437	1.7	7	0.0	1,862	0.5	97.1	0.4
332410	Power Boiler/Heat Exchanger Mfg	14	0.1	7,450	6.3	22,004	6.0	311.5	1.2
332420	Metal Tank (Heavy Gauge) Mfg	20	0.1	6	0.0	5	0.0	11	0.0
332911	Industrial Valve Mfg	136	0.5	20,199	17.0	23,895	6.5	2078.6	8.1
332999	All Other Misc. Fab. Metal Product	1,378	5.5	1,241	1.0	1,617	0.4	1425.9	5.5
333132	Oil/Gas Field Machinery & Equip	0	0.0	0	0.0	22,690	6.1	2.9	0.0
333412	Industrial & Commercial fans	69	0.3	14	0.0	1	0.0	21.1	0.1
333415	AC & WAH Equip & Cml & Indust Ref	70	0.3	12,602	10.6	1	0.0	108.8	0.4
333611	Turbines, & Turb Gen	24	0.1	5	0.0	22,018	6.0	316.3	1.2
333612	Speed Changer, Industrial	4	0.0	0	0.0	22,102	6.0	32.3	0.1
333613	Power Transmission Equip	138	0.5	24	0.0	116	0.0	225.4	0.9
333911	Pump & Pumping Equipment Mfg	28	0.1	20	0.0	4	0.0	2078.6	8.1
333912	Air & Gas Compressor Mfg	12	0.0	0	0.0	22,001	6.0	333.3	1.3
333923	Ovrhd Tvlg Crane, Hoist & Monorail	5	0.0	6	0.0	1	0.0	632.3	2.5
333995	Fluid Power Cylinder/Actuator Mfg	68	0.3	2	0.0	0	0.0	2197.9	8.5
334112	Computer Storage Device Mfg	263	1.0	1	0.0	13	0.0	1.3	0.0
334418	Printed circuits & electronics a	223	0.9	9	0.0	502	0.1	319.5	1.2
334513	Instr/Reld Prod Mfg for Meas, Disp	390	1.6	49	0.0	22,792	6.2	2136.8	8.3
334515	Meter	55	0.2	88	0.1	130	0.0	54	0.2
334519	Other Measuring/Controlling Device	533	2.1	20,225	17.0	23,946	6.5	2053.8	8.0
335311	Power, Distrib & Specialty Trans	327	1.3	8	0.0	25,821	7.0	373.5	1.5
335312	Motor & Generator	786	3.1	6	0.0	22,114	6.0	446.9	1.7
335313	Switchgear/Switchboard Apparatus	154	0.6	3	0.0	749	0.2	9.8	0.0
335314	Relay & Industrial Control	431	1.7	20,203	17.0	22,083	6.0	226.6	0.9
335931	Electrical Connections	172	0.7	20,203	17.0	2,029	0.5	15.7	0.1
335999	Charge Controller	6,866	27.3	72	0.1	29,306	7.9	331.9	1.3
532412	Constr, Mng, & Forstry Mach & Equip	243	1.0	327	0.3	234	0.1	81.1	0.3
541310	Architectural Services	1,673	6.7	173	0.1	1,034	0.3	231.6	0.9
541330	Engineering Design Services	3,450	13.7	770	0.6	10,901	3.0	355	1.4
541380	Testing Laboratories	340	1.4	2,556	2.2	618	0.2	234.8	0.9
541620	Environmental Consulting Svcs	597	2.4	202	0.2	372	0.1	120.7	0.5
541690	Energy Consulting Services	913	3.6	2,569	2.2	26,300	7.1	495.6	1.9
541712	R&D	466	1.9	2,145	1.8	90	0.0	53.2	0.2
TOTAL REVENUES (IN MILLIONS)		$25,141	100%	$118,772	100%	$369,188	100%	$25,732	100%
% OF REVENUES: COUNTIES TO BN		98%		462%		1,435%			

Geothermal NAICS Comparative Analysis—Number of Firms

	COUNTY:	Oakland		Middlesex		Fulton		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
211111	Hydroelectric Power Generation	4	0.1	6	0.4	4	0.1	18	1.0
221119	Other Electric Power Generation	25	0.8	37	2.7	68	2.5	50	2.9
221122	Electric Power Distribution	3	0.1	5	0.4	12	0.4	8	0.5
221330	Steam & Air-Conditioning Supply	1	0.0	0	0.0	2	0.1	0	0.0
237130	Power/Comm. Line/Rel Structures Co	13	0.4	9	0.7	20	0.7	15	0.9
331210	Iron/Steel Pipe/Tube Mfg frm Purch	4	0.1	1	0.1	2	0.1	7	0.4
331421	Copper Rolling, Drawing, & Extruding	2	0.1	2	0.1	2	0.1	5	0.3
331511	Iron Foundries	10	0.3	2	0.1	2	0.1	91	5.2
332111	Iron & Steel Mills	23	0.7	4	0.3	1	0.0	18	1.0
332312	Fabricated Structural Metal Mfg	47	1.5	22	1.6	23	0.8	74	4.3
332322	Sheet Metal Work Mfg	65	2.1	29	2.1	41	1.5	59	3.4
332996	Fabricated Pipe & Pipe Fitting	28	0.9	6	0.4	3	0.1	12	0.7
332410	Power Boiler/Heat Exchanger Mfg	4	0.1	2	0.1	4	0.1	12	0.7
332420	Metal Tank (Heavy Gauge) Mfg	4	0.1	1	0.1	2	0.1	4	0.2
332911	Industrial Valve Mfg	15	0.5	2	0.1	6	0.2	25	1.4
332999	All Other Misc. Fab. Metal Product	33	1.0	12	0.9	21	0.8	29	1.7
333132	Oil/Gas Field Machinery & Equip	3	0.1	0	0.0	2	0.1	3	0.2
333412	Industrial & Commercial Fans	10	0.3	4	0.3	5	0.2	11	0.6
333415	AC & WAH Equip & Cml & Indust Ref	22	0.7	15	1.1	11	0.4	31	1.8
333611	Turbines, & Turb Generators	5	0.2	2	0.1	7	0.3	10	0.6
333612	Speed Changer, Industrial	7	0.2	0	0.0	4	0.1	10	0.6
333613	Power Transmission Equip	19	0.6	3	0.2	7	0.3	11	0.6
333911	Pump & Pumping Equipment Manufactu	10	0.3	4	0.3	6	0.2	12	0.7
333912	Air & Gas Compressor Manufacturi	5	0.2	1	0.1	4	0.1	14	0.8
333923	Ovrhd Tvlg Crane, Hoist, & Monorai	6	0.2	1	0.1	3	0.1	7	0.4
333995	Fluid Power Cylinder/Actuator Mfg	11	0.3	1	0.1	3	0.1	9	0.5
334112	Computer Storage Device Mfg	19	0.6	4	0.3	9	0.3	5	0.3
334418	Printed circuits & electronics	21	0.7	7	0.5	9	0.3	8	0.5
334513	Instr/Reld Prod Mfg for Meas, Disp	71	2.3	11	0.8	19	0.7	21	1.2
334515	Meter	24	0.8	16	1.2	21	0.8	16	0.9
334519	Other Measuring/Controlling Device	68	2.2	14	1.0	20	0.7	110	6.3
335311	Power, Distrib & Specialty Transformer	16	0.5	9	0.7	9	0.3	8	0.5
335312	Motor & Generator	24	0.8	3	0.2	12	0.4	25	1.4
335313	Switchgear/Switchboard Apparatus	34	1.1	3	0.2	14	0.5	10	0.6
335314	Relay & Industrial Control	71	2.3	13	1.0	8	0.3	24	1.4
335931	Electrical Connections	6	0.2	6	0.4	5	0.2	12	0.7
335999	Charge Controller	47	1.5	33	2.4	55	2.0	30	1.7
532412	Constr, Mng, & Forstry Mach & Equip	37	1.2	19	1.4	22	0.8	35	2.0
541310	Architectural services	362	11.5	127	9.4	473	17.3	143	8.2
541330	Engineering Design Services	1,207	38.3	363	26.9	807	29.5	332	19.1
541380	Testing Laboratories	104	3.3	74	5.5	74	2.7	59	3.4
541620	Environmental Consulting Svcs	21	0.7	17	1.3	34	1.2	29	1.7
541690	Energy Consulting Svcs	446	14.2	278	20.6	659	24.1	251	14.4
541712	R&D	191	6.1	181	13.4	218	8.0	76	4.4
TOTAL FIRMS		3,148	100%	1,349	100%	2,733	100%	1,739	100%



Geothermal Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

iStock photo

HYDROPOWER SECTOR

The three counties identified were: York County, Pa., in which American Hydro Corp. is located; Harris County, Texas, with Hydro Green Energy and eTurbines; and Anne Arundel County, Md., home to UEK Corp.

Buffalo Niagara has a much larger population than York or Anne Arundel, though the difference is not as large as in the comparisons for Wind. On the other hand, Harris, located in the Houston metro area, has more than twice the population. Buffalo Niagara is second after York in terms of percent employed in manufacturing and has education levels and housing prices similar to York and Harris. Anne Arundel, near Washington, D.C., has higher housing prices and more college graduates.

In a pattern similar to the prior sectors, we can see Buffalo Niagara has a more diverse NAICS code distribution. While All Other Miscellaneous Fabricated Metal Product Manufacturing accounts for 55.74% of York, Hydroelectric Power Generation 61.76% of Harris, and Power and Communication Line and Related Structures and Engineering Design Services accounts for almost 58% of Anne Arundel County's total, no hydropower-related code in Buffalo Niagara accounts for more than 10%.

This provides further evidence of Buffalo Niagara's diversity of industrial capacity and is reflected in the distributions seen in the accompanying tables and graph.

Hydropower Comparative Analysis—Demographic Information

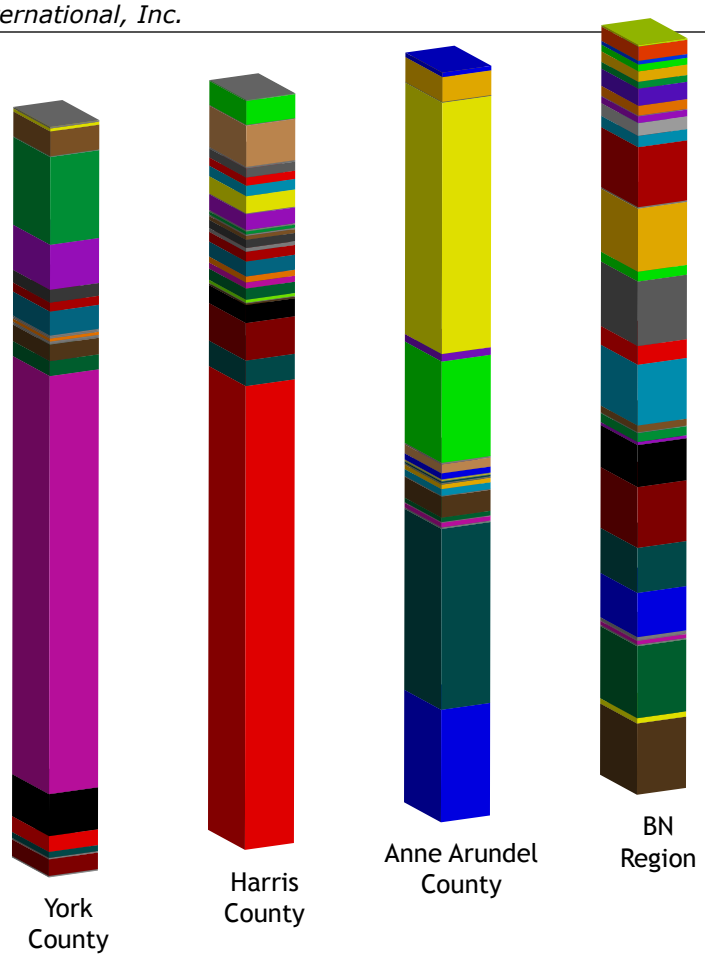
COUNTY STATE	YORK PA.	HARRIS TEXAS	ANNE ARUNDEL MD.	BN REGION N.Y.
Population	381,751	3,400,578	489,656	1,591,708
Population as % of BN	24%	214%	31%	100%
Revenues as % of BN	127%	701%	185%	100%
Firms (Total)	25,239	254,331	32,586	72,377
# People per Firm	15.1	13.4	15.0	22.0
# People per Hydro Firm	596	404	465	969
# People employed in Mfg	46,865	181,748	18,283	120,877
% People employed in Mfg	12.3%	5.3%	3.7%	7.6%
% College degree or above	16.5%	21.9%	28.1%	19.9%
Median House Value	$110,500	$87,000	$159,300	$88,213
Average House Value	$124,730	$123,482	$187,082	$78,094

Hydropower NAICS Comparative Analysis—Revenues (In Millions $)

	COUNTY:	York		Harris		Anne Arundel		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
211111	Hydroelectric Power Generation	0	0.0	372,522	61.8	0	0.0	2418.9	9.5
221119	Other Electric Power Generation	3	2.3	20,726	3.4	683	15.0	182	0.7
221122	Electric Power Distribution	0	0.0	30,132	5.0	0	0.0	2464.4	9.6
237130	Power/Comm Line/Related Const	8	0.9	14,435	2.4	1,093	24.1	11.3	0.0
331210	Iron/Steel Pipe/Tube Mfg Purchase	5	0.2	1,125	0.2	2	0.0	46.5	0.2
331421	Copper Rolling, Drawing & Extruding	0	0.3	1	0.0	7	0.2	127	0.5
331511	Iron Foundries	155	0.9	30	0.0	0	0.0	1.6	0.0
332111	Iron & Steel Mills	4	1.1	518	0.1	27	0.6	21.9	0.1
332996	Fabricated Pipe & Pipe Fitting Mfg	11	0.6	2,304	0.4	3	0.1	97.1	0.4
332312	Fabricated Structural Metal Mfg	55	4.4	9,006	1.5	25	0.6	1505.3	5.9
332322	Sheet Metal Work Mfg	150	4.7	4,707	0.8	126	2.8	1532.3	6.0
332911	Industrial Valve	404	0.6	5,112	0.8	0	0.0	2078.6	8.1
332999	All Other Misc Fab Metal Product Mfg	3,988	1.2	12,027	2.0	5	0.1	1425.9	5.6
333415	AC & WAH & Cml & Indust Ref Equip	140	2.3	7,733	1.3	41	0.9	108.8	0.4
333611	Turbines, Turbine Generators	154	0.2	2,867	0.5	1	0.0	316.3	1.2
333612	Speed Changer, Industrial	8	0.5	1	0.0	0	0.0	32.3	0.1
333613	Power Transmission Equip	2	0.3	103	0.0	29	0.6	225.4	0.9
333911	Pump/Pumping Equip. Mfg	0	0.3	6,578	1.1	3	0.1	2078.6	8.1
333923	Ovrhd Crane, Hoist, & Monorail	0	0.5	2,946	0.5	3	0.1	632.3	2.5
333995	Fluid Power Cylinder/Actuator Mfg	9	0.6	24	0.0	0	0.0	2197.9	8.6
334112	Computer Storage Device Mfg	0	0.6	103	0.0	0	0.0	1.3	0.0
334418	Printed circuits & electronics	17	0.8	33	0.0	7	0.2	319.5	1.3
334513	Instr/Reld Prod Mfg for Meas, Dispy	26	1.6	1,286	0.2	5	0.1	2136.8	8.4
334515	Meter	2	0.5	2,155	0.4	1	0.0	54	0.2
334519	Other Measuring/Controlling Device	3	0.3	1,216	0.2	3	0.1	2053.8	8.0
335311	Power, Distrib & Specialty Transform	0	0.2	12,868	2.1	6	0.1	373.5	1.5
335312	Motor & Generator	4	0.3	755	0.1	1	0.0	446.9	1.7
335313	Switchgear/Switchboard Mfg	12	0.9	13,926	2.3	37	0.8	9.8	0.0
335314	Relay & Industrial Control	13	1.4	8,317	1.4	55	1.2	226.6	0.9
335931	Electrical Connections	229	0.9	6,563	1.1	0	0.0	15.7	0.1
335999	Charge Controller	85	2.3	7,429	1.2	10	0.2	331.9	1.3
423720	Plumbing/Heating Equip Merch	121	5.3	577	0.1	612	13.5	582.3	2.3
541310	Architectural services	427	8.3	801	0.1	45	1.0	231.6	0.9
541330	Engineering Design Services	834	33.1	33,093	5.5	1,521	33.5	355	1.4
541380	Testing Laboratories	6	2.8	704	0.1	5	0.1	234.8	0.9
541620	Envir. Consulting Svcs	234	1.1	205	0.0	3	0.1	120.7	0.5
541690	Energy Consulting Services	29	13.9	19,577	3.2	151	3.3	495.6	1.9
541712	R&D	18	3.6	645	0.1	29	0.6	53.2	0.2
TOTAL REVENUES (IN MILLIONS)		$131,885	100%	$726,631	100%	$191,621	100.0	$103,642	100.0
% OF REVENUES: COUNTIES TO BN		127%		701%		185%			

Hydropower NAICS Comparative Analysis—Number of Firms

	COUNTY:	York		Harris		Anne Arundel		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
211111	Hydroelectric Power Generation	0	0.0	638	7.6	1	0.1	18	1.1
221119	Other Electric Power Generation	15	2.3	239	2.8	29	2.8	50	3.0
221122	Electric Power Distribution	0	0.0	47	0.6	0	0.0	8	0.5
237130	Power/Comm Line/Related Const	6	0.9	66	0.8	16	1.5	15	0.9
331210	Iron/Steel Pipe/Tube Mfg Purchase	1	0.2	62	0.7	1	0.1	7	0.4
331421	Copper Rolling, Drawing & Extruding	2	0.3	3	0.0	1	0.1	5	0.3
331511	Iron Foundries	6	0.9	18	0.2	0	0.0	91	5.5
332111	Iron & Steel Mills	7	1.1	45	0.5	2	0.2	18	1.1
332996	Fabricated Pipe & Pipe Fitting Mfg	4	0.6	120	1.4	1	0.1	12	0.7
332312	Fabricated Structural Metal Mfg	28	4.4	275	3.3	15	1.4	74	4.5
332322	Sheet Metal Work Mfg	30	4.7	204	2.4	17	1.6	59	3.6
332911	Industrial Valve	4	0.6	116	1.4	0	0.0	25	1.5
332999	All Other Misc Fab Metal Product Mfg	8	1.2	70	0.8	7	0.7	29	1.8
333415	AC & WAH & Cml & Indust Ref Equip	15	2.3	96	1.1	9	0.9	31	1.9
333611	Turbines, Turbine Generators	1	0.2	54	0.6	1	0.1	10	0.6
333612	Speed Changer, Industrial	3	0.5	5	0.1	0	0.0	10	0.6
333613	Power Transmission Equip	2	0.3	29	0.3	4	0.4	11	0.7
333911	Pump/Pumping Equip. Mfg	2	0.3	76	0.9	3	0.3	12	0.7
333923	Ovrhd Crane, Hoist, & Monorail	3	0.5	21	0.2	3	0.3	7	0.4
333995	Fluid Power Cylinder/Actuator Mfg	4	0.6	13	0.2	1	0.1	9	0.5
334112	Computer Storage Device Mfg	4	0.6	23	0.3	4	0.4	5	0.3
334418	Printed circuits & electronics	5	0.8	23	0.3	4	0.4	8	0.5
334513	Instr/Reld Prod Mfg for Meas, Dispy	10	1.6	133	1.6	6	0.6	21	1.3
334515	Meter	3	0.5	51	0.6	4	0.4	16	1.0
334519	Other Measuring/Controlling Device	2	0.3	133	1.6	7	0.7	110	6.7
335311	Power, Distrib & Specialty Transform	1	0.2	39	0.5	1	0.1	8	0.5
335312	Motor & Generator	2	0.3	45	0.5	3	0.3	14	0.9
335313	Switchgear/Switchboard Mfg	6	0.9	47	0.6	2	0.2	10	0.6
335314	Relay & Industrial Control	9	1.4	101	1.2	6	0.6	24	1.5
335931	Electrical Connections	6	0.9	18	0.2	0	0.0	12	0.7
335999	Charge Controller	15	2.3	139	1.7	15	1.4	14	0.9
423720	Plumbing/Heating Equip Merch	34	5.3	231	2.7	35	3.3	10	0.6
541310	Architectural services	53	8.3	734	8.7	122	11.6	143	8.7
541330	Engineering Design Services	212	33.1	2,449	29.1	409	38.9	332	20.2
541380	Testing Laboratories	18	2.8	249	3.0	20	1.9	59	3.6
541620	Envir. Consulting Svcs	7	1.1	107	1.3	16	1.5	29	1.8
541690	Energy Consulting Services	89	13.9	1,278	15.2	203	19.3	251	15.3
541712	R&D	23	3.6	410	4.9	84	8.0	76	4.6
TOTAL FIRMS		640	100.0	8,407	100.0	1,052	100.0	1,643	100.0



Hydropower Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

Freerange photo

BIOMASS SECTOR

The three counties identified were: Fulton County, Ga., where Sterling Planet Inc. is based; Marion County, Ind., with Earth-Solar Corp.; and St. Louis County, Mo., home to Anheuser Busch.

Buffalo Niagara is about twice as large as Fulton and Marion counties and substantially larger than St. Louis in population. Buffalo Niagara also has more people employed in manufacturing and is lowest in the number of college-educated population. Its median housing value is about half that of Fulton County and about 10 to 20% lower than Marion and St. Louis. While Buffalo Niagara has one of the of the highest people-to-firms ratios (21.99) of all areas included as part of this comparative analysis, it was surpassed here by St. Louis, which registered 34.87, the highest of any county targeted and due perhaps to the influence of a few large firms such as Anheuser Busch.

Biomass proved to be one of the more diverse sectors analyzed. None of the counties identified had extremely large concentrations within individual NAICS codes. To some extent, this may be due to the large number of codes included and because the codes in this sector tend to extend beyond the actual equipment to include inputs and the processes themselves. For this reason, it is hard to draw any strong conclusions other than Buffalo Niagara does have the capacity to compete in this area but is not realizing its potential. This is evidenced by the lower revenues generated in comparison with Fulton and St. Louis counties, both of which have lower populations.

Biomass Comparative Analysis—Demographic Information

COUNTY STATE	FULTON GA.	MARION IND.	ST. LOUIS MO.	BN REGION N.Y.
Population	816,006	860,454	1,016,315	1,591,708
Population as % of BN	51%	54%	64%	100%
Revenues as % of BN	1525%	69%	845%	100%
Firms (Total)	100,613	51,533	29,148	72,377
# People per Firm	8.1	16.7	34.9	22.0
# People per Biomass Firm	248	442	1,048	554
# People employed in Mfg	32,951	58,718	64,212	120,877
% People employed in Mfg	4.0%	6.8%	6.3%	7.6%
% College degree or above	36.3%	21.9%	32.5%	19.9%
Median House Value	$180,700	$99,000	$116,600	$88,213
Average House Value	$247,633	$119,208	$92,611	$78,094

Biomass NAICS Comparative Analysis—Revenues (In Millions $)

NAICS	INDUSTRY SEGMENT	Fulton		Marion		St. Louis		BN Region	
		$$	%	$$	%	$$	%	$$	%
111110	Soybean Farming	0	0.0	6	0.0	0	0.0	24.7	0.1
111120	Oilseed (except Soybean) Farming	0	0.0	0	0.0	0	0.0	0	0.0
111150	Corn Farming	0	0.0	41	0.2	0	0.0	71	0.3
111199	All Other Grain Farming	0	0.0	1	0.0	16,686	7.4	16.2	0.1
111998	All Other Miscellaneous Crop Farming	10	0.0	12	0.1	2	0.0	76.6	0.3
113210	Forest Nurseries/Gathering Forest Pr	0	0.0	0	0.0	0	0.0	0.3	0.0
115114	Postharvest Crop Activities	3	0.0	0	0.0	203	0.1	24.9	0.1
115115	Farm Labor Contractors	0	0.0	0	0.0	0	0.0	0.3	0.0
115310	Support Activities for Forestry	9	0.0	0	0.0	0	0.0	2.1	0.0
221122	Electric Power Distribution	27,586	6.8	1,692	9.1	11,698	5.2	2,464.4	9.2
236210	Industrial Building Construction	573	0.1	879	4.7	631	0.3	243.5	0.9
237130	Power/Comm. Line/Related Cons	35	0.0	8	0.0	2,215	1.0	11.3	0.0
321113	Sawmills	19,262	4.7	30	0.2	20	0.0	114.3	0.4
321999	All Other Misc Wood Product	20	0.0	7	0.0	10	0.0	132.1	0.5
322110	Pulp Mills	20,334	5.0	2	0.0	0	0.0	0.4	0.0
322121	Paper (except Newsprint) Mills	6,191	1.5	39	0.2	2	0.0	14.1	0.1
322299	Fuel cell forms, crdbd, Convd Ppr Pr	20,754	5.1	10	0.1	23	0.0	58.3	0.2
324110	Petroleum Refineries	13	0.0	1,639	8.8	173	0.1	29.4	0.1
324199	All Other Petroleum & Coal Products	180	0.0	2,489	13.4	187	0.1	25.9	0.1
325193	Ethyl Alcohol Mfg	11	0.0	0	0.0	0	0.0	1.2	0.0
325199	All Other Basic Organic Chemical Mfg	57	0.0	16	0.1	1,151	0.5	190.6	0.7
325211	Encapsulant	207	0.1	800	4.3	1,676	0.7	105	0.4
327993	Mineral Wool Mfg	15	0.0	0	0.0	0	0.0	3.9	0.0
331210	Iron/Steel Pipe/Tube Mfg from Purch	2	0.0	0	0.0	111	0.0	46.5	0.2
331421	Copper Rolling, Drawing, & Extrudi	0	0.0	0	0.0	0	0.0	127	0.5
332312	Fabricated Structural Metal Manufact	1,398	0.3	191	1.0	227	0.1	1505.3	5.6
332322	Sheet Metal Work Mfg	1,891	0.5	620	3.3	68	0.0	1532.3	5.7
332410	Power Boiler/Heat Exchanger Mfg	22,004	5.4	11	0.1	24,810	11.0	311.5	1.2
332420	Metal Tank (Heavy Gauge) Mfg	5	0.0	4	0.0	76	0.0	11	0.0
332911	Industrial Valve Mfg	23,895	5.9	85	0.5	24,810	11.0	2147.7	8.0
332999	All Other Misc. Fab. Metal Product	1,617	0.4	33	0.2	21	0.0	1425.9	5.3
333120	Construction Machinery Mfg	138	0.0	2	0.0	6	0.0	60	0.2
333210	Sawmill & Woodworking Mach Mfg	1	0.0	104	0.6	0	0.0	11.7	0.0
333291	Paper Industry Mach Mfg	259	0.1	1	0.0	1,992	0.9	1.8	0.0
333298	All Other Industrial Machinery Mfg	22,067	5.4	153	0.8	1,479	0.7	75.9	0.3
333411	Air Purification Equipment Mfg	12	0.0	0	0.0	0	0.0	11.8	0.0
333412	Industrial/Commercial fans/blowers	1	0.0	14	0.1	23	0.0	21.1	0.1
333414	Heating Equip (ex. Warm Air)	1,911	0.5	14	0.1	30	0.0	48.5	0.2
333415	AC & WAH Equip & Cml & Ind Ref Eq	1,929	0.5	36	0.2	70	0.0	108.8	0.4
333611	Turbines, & Turb Gentrs, & Turb Gen	22,018	5.4	0	0.0	0	0.0	316.3	1.2
333612	Speed Changer, Industrial	22,102	5.4	5	0.0	2	0.0	32.3	0.1
333613	Power Transmission Equip	116	0.0	5	0.0	1	0.0	225.4	0.8
333911	Pump/Pumping Equip Mfg	4	0.0	125	0.7	116	0.1	2078.6	7.8
333912	Air/Gas Compressor Mfg	22,001	5.4	139	0.7	19	0.0	333.3	1.2
333922	Conveyor/Conveying Equipment Mfg	84	0.0	79	0.4	2,026	0.9	32.8	0.1
333923	Ovrhd Tvlg Crane, Hoist & Monorail	1	0.0	6	0.0	0	0.0	632.3	2.4
333995	Fluid Power Cylinder/Actuator Mfg	0	0.0	81	0.4	24,807	11.0	2197.9	8.2
333997	Scale/Balance (ex Laboratory) Mfg	688	0.2	1	0.0	0	0.0	3.5	0.0
333999	All Other Misc Gen. Purpose Mach	69	0.0	53	0.3	80	0.0	113.6	0.4
334112	Computer Storage Device Mfg	13	0.0	0	0.0	3	0.0	1.3	0.0
334418	Printed circuits	502	0.1	42	0.2	2,399	1.1	319.5	1.2
334513	Instr/Reld Prod Mfg for Meas, Dispy	22,792	5.6	388	2.1	26,036	11.5	2136.8	8.0
334515	Meter				0.2	3	0.0		0.2

Continued on next page

Biomass NAICS Comparative Analysis—Revenues (In Millions $)

(Continued)

NAICS	INDUSTRY SEGMENT	COUNTY: Fulton $$	Fulton %	Marion $$	Marion %	St. Louis $$	St. Louis %	BN Region $$	BN Region %
334519	Other Measuring/Controlling Device	23,946	5.9	22	0.1	91	0.0	2,053.8	7.7
335311	Power, Distrib & Specialty Transform	25,821	6.3	50	0.3	24,808	11.0	373.5	1.4
335312	Motor & Generator	22,114	5.4	11	0.1	24,807	11.0	446.9	1.7
335313	Switchgear/Switchboard Mfg	749	0.2	1	0.0	2	0.0	9.8	0.0
335314	Relay and Industrial Control	22,083	5.4	120	0.6	24,812	11.0	226.6	0.8
335931	Electrical Connections	2,029	0.5	56	0.3	854	0.4	15.7	0.1
336399	All Other Motor Vehicle Parts Mfg	1,473	0.4	497	2.7	5	0.0	1,636.3	6.1
336510	Railroad Rolling Stock Mfg	7	0.0	0	0.0	3	0.0	16.7	0.1
423720	Plumbing/Heating Equip Merch	6,597	1.6	265	1.4	48	0.0	582.3	2.2
423930	Recyclable Material Merchant	133	0.0	144	0.8	243	0.1	52.2	0.2
532412	Constr, Mng, & Forstry Mach & Eqp	234	0.1	428	2.3	8	0.0	81.1	0.3
541310	Architectural services	1,034	0.3	295	1.6	645	0.3	231.6	0.9
541330	Engineering Design Services	10,901	2.7	891	4.8	4,000	1.8	355	1.3
541380	Testing Laboratories	618	0.2	243	1.3	34	0.0	234.8	0.9
541620	Envir. Consulting Svcs	372	0.1	1	0.0	2	0.0	120.7	0.5
541690	Energy Consulting Services	26,300	6.4	3,585	19.3	1,258	0.6	495.6	1.9
541712	R&D in Physical, Engineering & Life	90	0.0	777	4.2	397	0.2	53.2	0.2
562111	Solid Waste Collection	100	0.0	2	0.0	2	0.0	11.2	0.0
562212	Solid Waste Landfill	11	0.0	192	1.0	0	0.0	14.4	0.1
562213	Solid Waste Incinerators	0	0.0	190	1.0	0	0.0	0	0.0
562219	Other Nonhazardous Waste Treat	32	0.0	200	1.1	1	0.0	21.6	0.1
562910	Remediation Services	332	0.1	409	2.2	27	0.0	142.1	0.5
562920	Materials Recovery Facilities	80	0.0	288	1.6	6	0.0	38	0.1
TOTAL REVENUES		$407,966	100%	$18,568	100%	$225,942	100%	$26,748	100%
% OF REVENUES: COUNTIES TO BN		1525%		69%		845%			

Biomass NAICS Comparative Analysis—Number of Firms

	COUNTY:	Fulton		Marion		St. Louis		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
111110	Soybean Farming	1	0.0	49	0.0	3	0.0	47	0.0
111120	Oilseed (except Soybean) Farming	0	0.0	0	0.0	0	0.0	0	0.0
111150	Corn Farming	3	0.0	67	0.0	1	0.0	201	0.0
111199	All Other Grain Farming	0	0.0	9	0.0	1	0.0	47	0.0
111998	All Other Miscellaneous Crop Farming	91	0.0	101	0.0	15	0.0	497	0.0
113210	Forest Nurseries/Gathering Forest Pr	1	0.0	0	0.0	0	0.0	3	0.0
115114	Postharvest Crop Activities	3	0.0	2	0.0	2	0.0	12	0.0
115115	Farm Labor Contractors	1	0.0	1	0.0	0	0.0	1	0.0
115310	Support Activities for Forestry	8	0.0	2	0.0	3	0.0	9	0.0
221122	Electric Power Distribution	12	6.8	4	6.8	3	6.8	8	6.8
236210	Industrial Building Construction	77	0.1	52	0.1	24	0.1	85	0.1
237130	Power/Comm. Line/Related Cons	20	0.0	11	0.0	4	0.0	15	0.0
321113	Sawmills	8	4.7	4	4.7	2	4.7	26	4.7
321999	All Other Misc Wood Product	27	0.0	17	0.0	15	0.0	58	0.0
322110	Pulp Mills	10	5.0	4	5.0	1	5.0	2	5.0
322121	Paper (except Newsprint) Mills	42	1.5	7	1.5	4	1.5	7	1.5
322299	Fuel cell forms, crdbd, Convd Ppr Pr	20	5.1	13	5.1	11	5.1	11	5.1
324110	Petroleum Refineries	6	0.0	4	0.0	4	0.0	15	0.0
324199	All Other Petroleum & Coal Products	1	0.0	4	0.0	2	0.0	1	0.0
325193	Ethyl Alcohol Mfg	2	0.0	0	0.0	0	0.0	1	0.0
325199	All Other Basic Organic Chemical Mfg	15	0.0	7	0.0	11	0.0	15	0.0
325211	Encapsulant	11	0.1	13	0.1	7	0.1	24	0.1
327993	Mineral Wool Mfg	2	0.0	2	0.0	0	0.0	5	0.0
331210	Iron/Steel Pipe/Tube Mfg from Purch	2	0.0	2	0.0	3	0.0	7	0.0
331421	Copper Rolling, Drawing, & Extrudi	2	0.0	1	0.0	0	0.0	5	0.0
332312	Fabricated Structural Metal Manufact	23	0.3	43	0.3	35	0.3	3	0.3
332322	Sheet Metal Work Mfg	41	0.5	64	0.5	30	0.5	59	0.5
332410	Power Boiler/Heat Exchanger Mfg	4	5.4	2	5.4	3	5.4	12	5.4
332420	Metal Tank (Heavy Gauge) Mfg	2	0.0	2	0.0	1	0.0	4	0.0
332911	Industrial Valve Mfg	6	5.9	4	5.9	7	5.9	13	5.9
332999	All Other Misc. Fab. Metal Product	21	0.4	22	0.4	9	0.4	29	0.4
333120	Construction Machinery Mfg	13	0.0	5	0.0	6	0.0	21	0.0
333210	Sawmill & Woodworking Mach Mfg	4	0.0	7	0.0	0	0.0	7	0.0
333291	Paper Industry Mach Mfg	8	0.1	5	0.1	5	0.1	5	0.1
333298	All Other Industrial Machinery Mfg	20	5.4	23	5.4	15	5.4	23	5.4
333411	Air Purification Equipment Mfg	7	0.0	3	0.0	1	0.0	10	0.0
333412	Industrial/Commercial fans/blowers	5	0.0	7	0.0	4	0.0	11	0.0
333414	Heating Equip (ex. Warm Air)	6	0.5	5	0.5	2	0.5	8	0.5
333415	AC & WAH Equip & Cml & Ind Ref Eq	11	0.5	17	0.5	7	0.5	31	0.5
333611	Turbines, & Turb Gentrs, & Turb Gen	7	5.4	5	5.4	1	5.4	10	5.4
333612	Speed Changer, Industrial	4	5.4	4	5.4	5	5.4	10	5.4
333613	Power Transmission Equip	7	0.0	7	0.0	1	0.0	11	0.0
333911	Pump/Pumping Equip Mfg	6	0.0	3	0.0	7	0.0	12	0.0
333912	Air/Gas Compressor Mfg	4	5.4	5	5.4	1	5.4	14	5.4
333922	Conveyor/Conveying Equipment Mfg	8	0.0	19	0.0	11	0.0	12	0.0
333923	Ovrhd Tvlg Crane, Hoist & Monorail	3	0.0	6	0.0	0	0.0	7	0.0
333995	Fluid Power Cylinder/Actuator Mfg	3	0.0	2	0.0	2	0.0	9	0.0
333997	Scale/Balance (ex Laboratory) Mfg	2	0.2	2	0.2	0	0.2	3	0.2
333999	All Other Misc Gen. Purpose Mach	26	0.0	33	0.0	10	0.0	42	0.0
334112	Computer Storage Device Mfg	9	0.0	3	0.0	1	0.0	5	0.0
334418	Printed circuits	9	0.1	3	0.1	3	0.1	8	0.1
334513	Instr/Reld Prod Mfg for Meas, Dispy	19	5.6	8	5.6	7	5.6	21	5.6
334515	Meter	21	0.0	8	0.0	1	0.0	16	0.0

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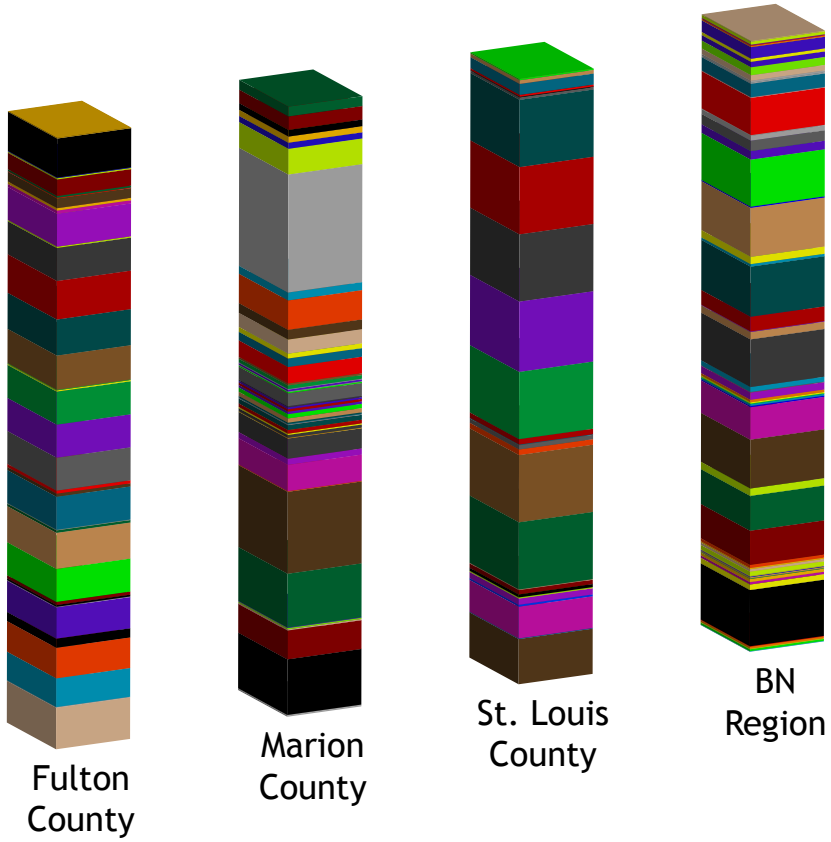
Biomass NAICS Comparative Analysis—Number of Firms

(Continued)

	COUNTY:	**Fulton**		**Marion**		**St. Louis**		**BN Region**	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
334519	Other Measuring/Controlling Device	20	5.9	12	5.9	6	5.9	110	5.9
335311	Power, Distrib & Specialty Transform	9	6.3	6	6.3	5	6.3	8	6.3
335312	Motor & Generator	12	5.4	16	5.4	3	5.4	14	5.4
335313	Switchgear/Switchboard Mfg	14	0.2	4	0.2	3	0.2	10	0.2
335314	Relay and Industrial Control	8	5.4	22	5.4	6	5.4	24	5.4
335931	Electrical Connections	5	0.5	9	0.5	4	0.5	12	0.5
336399	All Other Motor Vehicle Parts Mfg	28	0.4	41	0.4	6	0.4	46	0.4
336510	Railroad Rolling Stock Mfg	2	0.0	1	0.0	2	0.0	4	0.0
423720	Plumbing/Heating Equip Merch	57	1.6	65	1.6	29	1.6	10	1.6
423930	Recyclable Material Merchant	50	0.0	23	0.0	27	0.0	76	0.0
532412	Constr, Mng, & Forstry Mach & Eqp	22	0.1	28	0.1	7	0.1	35	0.1
541310	Architectural services	473	0.3	170	0.3	185	0.3	143	0.3
541330	Engineering Design Services	807	2.7	362	2.7	162	2.7	332	2.7
541380	Testing Laboratories	74	0.2	65	0.2	24	0.2	59	0.2
541620	Envir. Consulting Svcs	34	0.1	14	0.1	9	0.1	29	0.1
541690	Energy Consulting Services	659	6.4	227	6.4	103	6.4	251	6.4
541712	R&D in Physical, Engineering & Life	218	0.0	105	0.0	54	0.0	76	0.0
562111	Solid Waste Collection	9	0.0	5	0.0	4	0.0	4	0.0
562212	Solid Waste Landfill	16	0.0	10	0.0	0	0.0	22	0.0
562213	Solid Waste Incinerators	0	0.0	1	0.0	0	0.0	0	0.0
562219	Other Nonhazardous Waste Treat	23	0.0	14	0.0	12	0.0	23	0.0
562910	Remediation Services	22	0.1	22	0.1	11	0.1	18	0.1
562920	Materials Recovery Facilities	64	0.0	33	0.0	17	0.0	50	0.0
TOTAL FIRMS		3,290	100%	1,948	100%	970	100%	2,874	100%



Biomass Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

NUCLEAR SECTOR

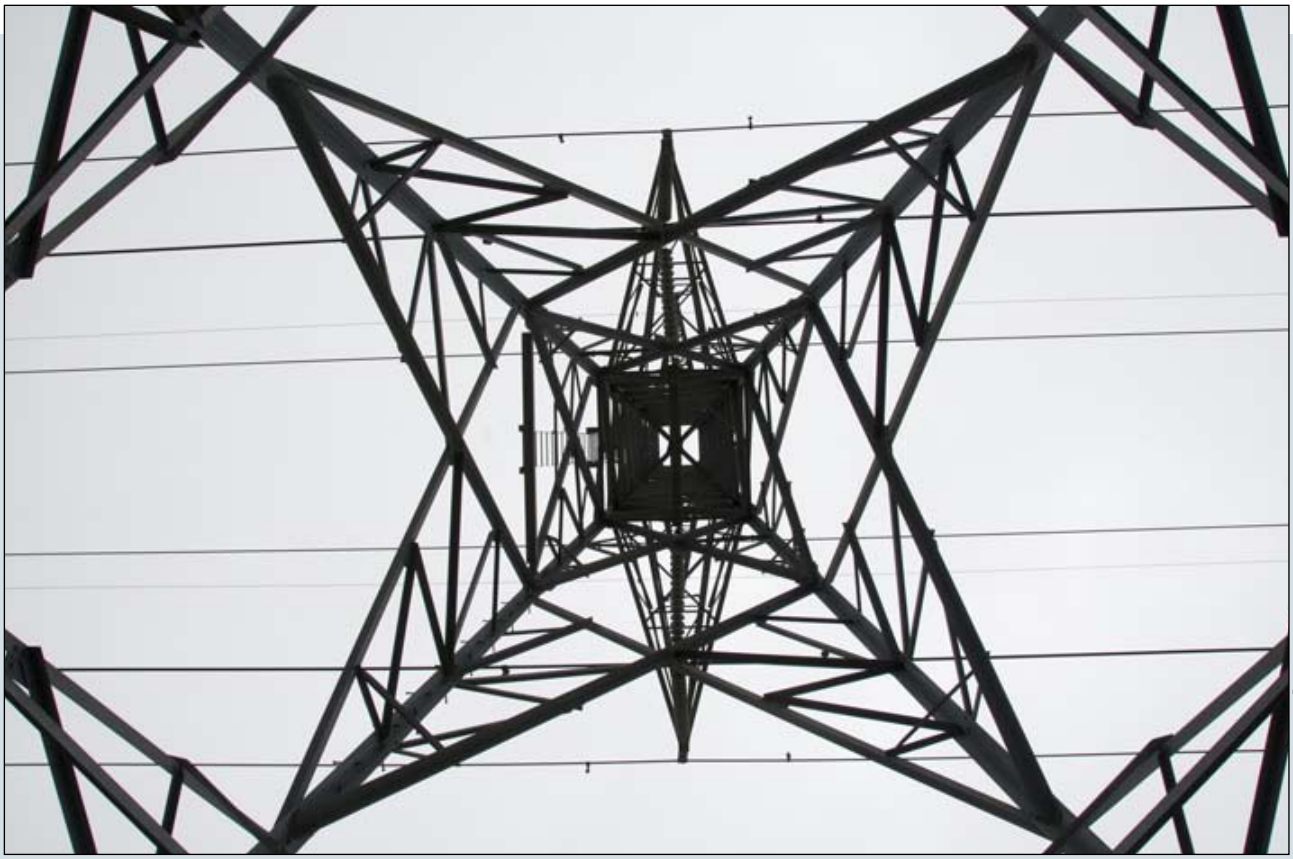
The three entities identified were: Northampton County, Pa., where Areva and Northrop Grumman are transforming Lehigh Heavy Forge into a worldwide manufacturing facility; Calcasieu Parish, La., site of a Westinghouse and Shaw Group joint venture to build the first U.S. module fabrication and assembly facility for nuclear components; and Rockingham, County, N.H., where Westinghouse's Newington Operations facility has manufactured nuclear components for more than 40 years.

Buffalo Niagara is far larger in size than the three selected, having more than twice their combined population. Whereas Buffalo Niagara tended to be one of the highest ranked in terms of percentage of people employed in manufacturing in most other sectors, in this sector, the range was less diverse and Buffalo Niagara ranked third. In terms of college-educated population, Buffalo Niagara ranks higher than Calcasieu, about on the same level as Northampton and lower than Rockingham. That is not surprising as Rockingham is near Boston, which also helps to contribute to higher housing values. In comparison, Buffalo Niagara housing is at the low end of the range, with a median just above Calcasieu.

The comparative NAICS distribution within the Nuclear sector reflected the diversity seen in most other sectors with Northampton having 41.95% of revenues concentrated in All Other Industrial Machine Manufacturing and Calcasieu having 38.68% in Engineering Services. Rockingham County was more balanced though it has five codes over 10% while Buffalo Niagara has only one. At the same time, while Buffalo Niagara is not generally seen as strong a contender in nuclear components, it has about 10% more firms and almost 2.7 times as many revenues as the other three counties combined.

Nuclear Comparative Analysis—Demographic Information

COUNTY OR PARISH	**NORTHAMPTON**	**CALCASIEU**	**ROCKINGHAM**	**BN REGION**
STATE	**PA.**	**LA.**	**N.H.**	**N.Y.**
Population	267,066	183,577	277,359	1,591,708
Population as % of BN	17%	12%	17%	100%
Revenues as % of BN	9%	1%	27%	100%
Firms (Total)	16,935	10,740	23,824	72,377
# People per Firm	15.8	17.1	11.6	22.0
# People per Nuclear Firm	571	850	360	977
# People employed in Mfg	26,489	11,822	27,498	120,877
% People employed in Mfg	9.9%	6.4%	9.9%	7.6%
% College degree or above	19.4%	13.8%	28.5%	19.9%
Median House Value	$120,000	$80,500	$164,900	$88,213
Average House Value	$135,283	$135,283	$195,683	$78,094



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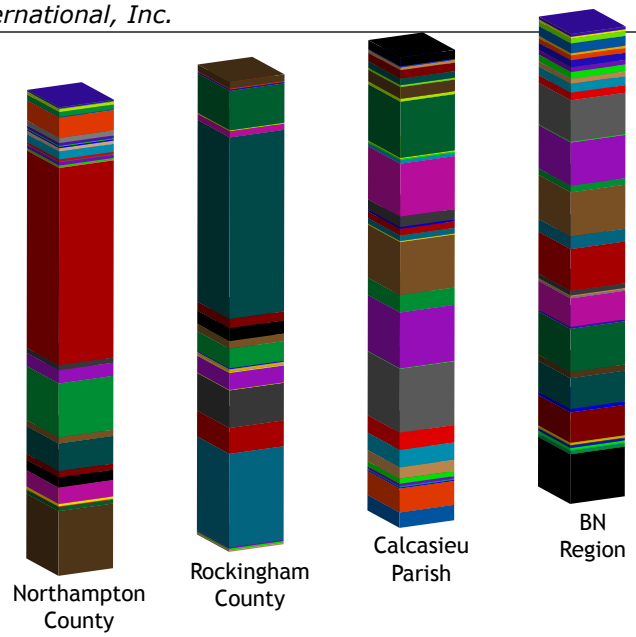
Nuclear NAICS Comparative Analysis—Revenues (In Millions $)

COUNTY OR PARISH:		Northampton		Calcasieu		Rockingham		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
221113	Nuclear Electric Power Generation	0	0.0	0	0.0	210	3.3	0	0.0
221122	Electric Power Distribution	0	0.0	0	0.0	317	5.1	2464.4	10.6
237130	Power/Comm. Line/Const.	0	0.0	1	0.3	14	0.2	11.3	0.0
325188	Other Basic Inorganic Chemical Mfg	300	13.8	0	0.1	0	0.0	141.9	0.6
331210	Iron/Steel Pipe/Tube Mfg	18	0.8	0	0.0	0	0.0	46.5	0.2
331421	Copper Rolling, Drawing, & Extruding	2	0.1	0	0.0	0	0.0	127	0.5
331511	Iron Foundries	2	0.1	0	0.0	0	0.0	1.6	0.5
332111	Iron & Steel Mills	11	0.5	1	0.3	0	0.0	21.9	0.1
332112	Pipg & Pres Vess Cpts, Pipets, Nucl Fitg,	0	0.0	0	0.0	0	0.0	82.6	0.4
332311	Prefab Metal Building/Component Mfg	76	3.5	1	0.3	17	0.3	27.5	0.1
332312	Fabricated Structural Metal Mfg	48	2.2	37	19.9	29	0.5	1505.3	6.5
332313	Plate Work Mfg	28	1.3	10	5.5	69	1.1	159.4	0.7
332322	Sheet Metal Work Mfg	128	5.9	15	8.0	148	2.4	1532.3	6.6
332410	Power Boiler/Heat Exchanger Mfg	0	0.0	0	0.0	0	0.0	311.5	1.3
332420	Metal Tank (Heavy Gauge) Mfg	0	0.0	0	0.0	1	0.0	11	0.0
332911	Industrial Valve Mfg	29	1.3	0	0.1	234	3.7	2147.7	9.2
332996	Fabricated Pipe & Pipe Fitting Mfg	250	11.5	7	3.6	230	3.7	97.1	0.4
332999	All Other Misc. Fab. Metal Product Mfg	62	2.8	0	0.2	850	13.6	1425.9	6.1
333120	Construction Machinery Mfg	24	1.1	0	0.1	4	0.1	60	0.3
333298	All Other Industrial Machinery Mfg	911	42.0	0	0.0	743	11.9	75.9	0.3
333613	Power Transmission Equip	5	0.2	0	0.0	0	0.0	225.4	1.0
333911	Pump/Pumping Equip. Mfg	6	0.3	0	0.0	231	3.7	2078.6	8.9
333923	Ovrhd Tvlg Crane, Hoist, & Monorail Sys Mfg	0	0.0	1	0.4	0	0.0	632.3	2.7
333995	Fluid Power Cylinder/Actuator Mfg	16	0.7	0	0.0	707	11.3	2197.9	9.4
334112	Computer Storage Device Mfg	0	0.0	0	0.0	14	0.2	1.3	0.0
334418	Printed circuits & electronics assembly	0	0.0	0	0.0	75	1.2	319.5	1.4
334513	Instr/Reld Prod Mfg for Meas, Dispy & Cont	5	0.2	0	0.1	86	1.4	2136.8	9.2
334515	Meter	9	0.4	0	0.0	26	0.4	54	0.2
334519	Other Measuring/Controlling Device Mfg	37	1.7	0	0.2	137	2.2	2053.8	8.8
335311	Power, Distrib & Specialty Transformer Mfg	14	0.7	0	0.0	708	11.3	373.5	1.6
335312	Motor & Generator	7	0.3	0	0.0	43	0.7	446.9	1.9
335313	Switchgear/Switchboard Apparatus Mfg	0	0.0	8	4.2	0	0.0	9.8	0.0
335314	Relay & Industrial Control	5	0.2	3	1.6	16	0.3	226.6	1.0
335931	Electrical Connections	0	0.0	0	0.0	10	0.2	15.7	0.1
335999	Charge Controller	14	0.6	5	2.8	753	12.0	331.9	1.4
541310	Architectural services	25	1.1	4	1.9	35	0.6	231.6	1.0
541330	Engineering Services	93	4.3	72	38.7	157	2.5	355	1.5
541380	Testing Laboratories	5	0.2	2	1.3	26	0.4	234.8	1.0
541620	Envir. Consulting Svcs	0	0.0	0	0.2	90	1.4	120.7	0.5
541690	Energy Consulting Services	22	1.0	16	8.4	116	1.8	495.6	2.1
541712	R&D	12	0.6	1	0.3	40	0.6	229.7	1.0
562112	Hazardous Waste Collection	0	0.0	0	0.0	0	0.0	10.5	0.0
562211	Hazardous Waste Treatment and Disposal	2	0.1	0	0.2	11	0.2	90.5	0.4
562910	Remediation Services	6	0.3	3	1.4	121	1.9	142.1	0.6
TOTAL REVENUES (IN MILLIONS)		$2,172	100%	$185	100%	$6,265	100%	$23,265	100%
% OF REVENUES: COUNTIES TO BN		9%		1%		27%			

Nuclear NAICS Comparative Analysis—Number of Firms

	COUNTY OR PARISH:	Northampton		Calcasieu		Rockingham		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
221113	Nuclear Electric Power Generation	0	0.0	0	0.0	1	0.1	0	0.0
221122	Electric Power Distribution	1	0.2	1	0.5	4	0.5	8	0.5
237130	Power/Comm. Line/Const.	3	0.6	2	0.9	7	0.9	15	0.9
325188	Other Basic Inorganic Chemical Mfg	16	3.4	9	4.2	5	0.6	25	1.5
331210	Iron/Steel Pipe/Tube Mfg	2	0.4	1	0.5	1	0.1	7	0.4
331421	Copper Rolling, Drawing, & Extruding	1	0.2	0	0.0	0	0.0	5	0.3
331511	Iron Foundries	1	0.2	0	0.0	0	0.0	91	0.3
332111	Iron & Steel Mills	2	0.4	1	0.5	0	0.0	18	1.1
332112	Pipg & Pres Vess Cpts, Pipets, Nucl Fitg,	0	0.0	0	0.0	0	0.0	5	0.3
332311	Prefab Metal Building/Component Mfg	4	0.9	2	0.9	7	0.9	10	0.6
332312	Fabricated Structural Metal Mfg	17	3.6	13	6.0	14	1.8	74	4.5
332313	Plate Work Mfg	9	1.9	3	1.4	8	1.0	33	2.0
332322	Sheet Metal Work Mfg	18	3.8	9	4.2	25	3.2	59	3.6
332410	Power Boiler/Heat Exchanger Mfg	0	0.0	1	0.5	0	0.0	12	0.7
332420	Metal Tank (Heavy Gauge) Mfg	0	0.0	0	0.0	1	0.1	4	0.2
332911	Industrial Valve Mfg	3	0.6	2	0.9	3	0.4	13	0.8
332996	Fabricated Pipe & Pipe Fitting Mfg	2	0.4	3	1.4	3	0.4	12	0.7
332999	All Other Misc. Fab. Metal Product Mfg	6	1.3	1	0.5	7	0.9	29	1.8
333120	Construction Machinery Mfg	4	0.9	1	0.5	5	0.6	21	1.3
333298	All Other Industrial Machinery Mfg	13	2.8	0	0.0	12	1.6	23	1.4
333613	Power Transmission Equip	5	1.1	0	0.0	1	0.1	11	0.7
333911	Pump/Pumping Equip. Mfg	3	0.6	2	0.9	4	0.5	12	0.7
333923	Ovrhd Tvlg Crane, Hoist, & Monorail Sys Mfg	0	0.0	2	0.9	1	0.1	7	0.4
333995	Fluid Power Cylinder/Actuator Mfg	1	0.2	0	0.0	2	0.3	9	0.6
334112	Computer Storage Device Mfg	0	0.0	0	0.0	2	0.3	5	0.3
334418	Printed circuits & electronics assembly	0	0.0	0	0.0	22	2.9	8	0.5
334513	Instr/Reld Prod Mfg for Meas, Dispy & Cont	5	1.1	2	0.9	14	1.8	21	1.3
334515	Meter	5	1.1	0	0.0	12	1.6	16	1.0
334519	Other Measuring/Controlling Device Mfg	12	2.6	2	0.9	13	1.7	110	6.8
335311	Power, Distrib & Specialty Transformer Mfg	2	0.4	0	0.0	4	0.5	8	0.5
335312	Motor & Generator	5	1.1	0	0.0	6	0.8	25	1.5
335313	Switchgear/Switchboard Apparatus Mfg	1	0.2	2	0.9	1	0.1	10	0.6
335314	Relay & Industrial Control	6	1.3	4	1.9	8	1.0	24	1.5
335931	Electrical Connections	0	0.0	1	0.5	6	0.8	12	0.7
335999	Charge Controller	10	2.1	4	1.9	29	3.8	14	0.9
541310	Architectural services	39	8.3	20	9.3	68	8.8	143	8.8
541330	Engineering Services	143	30.6	52	24.1	227	29.4	331	20.3
541380	Testing Laboratories	20	4.3	20	9.3	22	2.9	59	3.6
541620	Envir. Consulting Svcs	3	0.6	4	1.9	14	1.8	29	1.8
541690	Energy Consulting Services	56	12.0	32	14.8	127	16.5	251	15.4
541712	R&D	35	7.5	6	2.8	52	6.7	18	1.1
562112	Hazardous Waste Collection	0	0.0	0	0.0	1	0.1	4	0.2
562211	Hazardous Waste Treatment and Disposal	9	1.9	5	2.3	13	1.7	20	1.2
562910	Remediation Services	6	1.3	9	4.2	19	2.5	18	1.1
TOTAL FIRMS		468	100%	216	100%	771	100%	1,629	100%



Nuclear Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

ENERGY TRANSMISSION & STORAGE

The three counties identified were: Strafford County, N.H., where GE Smart Meters is located, Boulder County, Colo., where Tendril Co. is based; and Los Angeles County, Calif., site of Pentadyne.

Buffalo Niagara is far larger in size than Strafford or Boulder counties and far smaller than Los Angeles. While Strafford leads slightly in terms of the number of people employed in manufacturing, the range is small compared to other comparisons. Boulder has more than twice as many people with a college education, and Buffalo Niagara is just below Strafford and Los Angeles counties and has the lowest housing values of all locations.

Buffalo Niagara's NAICS distribution is more concentrated in this sector than most others, with four codes—Electric Power Distribution (14.09%), Industrial Valve Manufacturing (12.28%), Instruments/Related Products Mfg for Measure, Display & Control (12.21%) and Other Measuring/Controlling Device Mfg (11.74%)—accounting for about half of all revenues generated. On the other hand, Strafford County has two codes, Utilities Management Consulting Services (29.46%) and Architectural Services (14.02%), that account for nearly 44%, making it even more concentrated. In Boulder, four codes account for nearly 60%, and in Los Angeles, which would seem to have a more diverse economy, the top four codes accounted for about 66% of total revenues.

ETS Comparative Analysis—Demographic Information

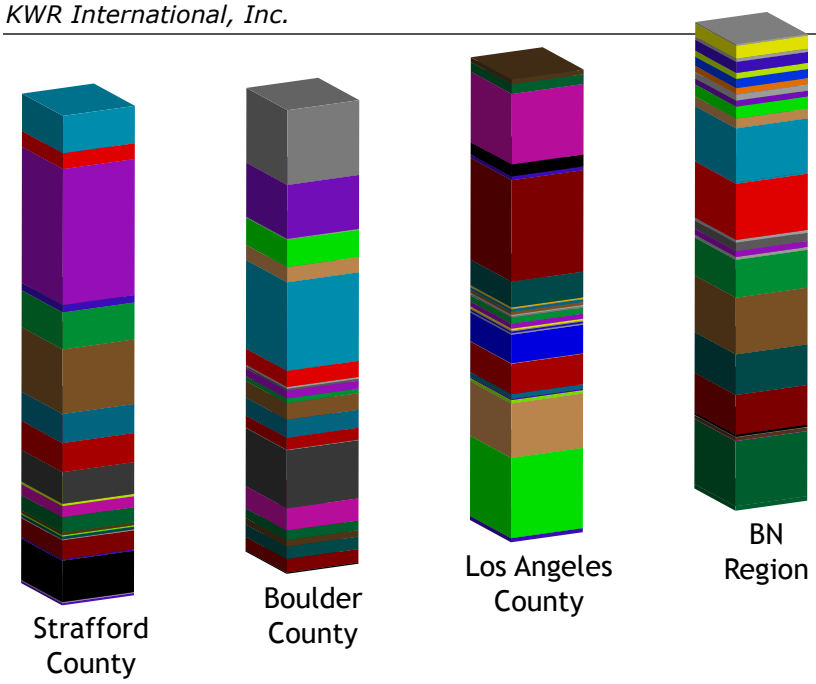
COUNTY STATE	STRAFFORD N.H.	BOULDER COLO.	LOS ANGELES CALIF.	BN REGION N.Y.
Population	112,233	291,288	9,519,338	1,591,708
Population as % of BN	7%	18%	598%	100%
Revenues as % of BN	2%	17%	855%	100%
Firms (Total)	6,274	31,305	594,891	72,377
# People per Firm	17.9	9.3	16.0	22.0
# People per ETS Firm	520	139	514	977
# People employed in Mfg	11,322	22,846	586,627	120,877
% People employed in Mfg	10.1%	7.8%	6.2%	7.6%
% College degree or above	22.5%	47.0%	20.8%	19.9%
Median House Value	$121,000	$241,900	$209,300	$88,213

ETS NAICS Comparative Analysis—Revenues (In Millions $)

	COUNTY:	Strafford		Boulder		Los Angeles		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
221119	Other Electric Power Generation	2	0.5	8	0.3	1,333	0.9	182	1.0
221122	Electric Power Distribution	0	0.0	88	2.9	25,966	17.4	2464.4	14.1
237130	Power/Comm. Line/Related Structures	1	0.2	82	2.7	17,726	11.8	11.3	0.1
331421	Copper Rolling, Drawing, & Extruding	0	0.0	0	0.0	701	0.5	127	0.7
332111	Iron & Steel Mills	29	9.0	1	0.0	278	0.2	21.9	0.1
332112	Nonferrous Forging	0	0.0	0	0.0	522	0.3	82.6	0.5
332312	Fabricated Structural Metal Mfg	1	0.3	41	1.4	1,491	1.0	1505.3	8.6
332322	Sheet Metal Work Mfg	13	4.1	64	2.1	9,863	6.6	1532.3	8.8
332911	Industrial Valve Mfg	0	0.0	145	4.8	192	0.1	2147.7	12.3
332999	All Other Misc. Fab. Metal Product Mfg	0	0.0	382	12.6	9,270	6.2	1425.9	8.2
333415	AC & WAH Equip & Cml & Indust Ref	1	0.2	3	0.1	312	0.2	108.8	0.6
333613	Power Transmission Equip	0	0.0	0	0.0	152	0.1	225.4	1.3
334112	Computer Storage Device Mfg	2	0.6	77	2.6	650	0.4	1.3	0.0
334418	Printed circuits & electronics	0	0.0	119	3.9	319	0.2	319.5	1.8
334512	Auto Envirl Conl Mfg for Res, Comm,	1	0.3	1	0.0	72	0.0	110	0.6
334513	Instr/Reld Prod Mfg for Meas, Dispy	2	0.6	107	3.6	576	0.4	2136.8	12.2
334515	Meter	11	3.3	29	1.0	1,702	1.1	54	0.3
334519	Other Measuring/Controlling Device	8	2.4	52	1.7	1,904	1.3	2053.8	11.7
335311	Power, Distrib & Specialty Transform	2	0.5	0	0.0	383	0.3	373.5	2.1
335312	Motor & Generator Mfg	23	6.9	0	0.0	474	0.3	446.9	2.6
335313	Switchgear/Switchboard Apparatus Mf	0	6.3	0	0.4	404	0.6	9.8	1.3
335314	Relay/Industrial Control Mfg	20	6.3	11	0.4	870	0.6	226.6	1.3
335911	Storage Batteries	0	0.0	0	0.0	108	0.1	0.6	0.0
335931	Electrical Connections	0	0.0	0	0.0	469	0.3	15.7	0.1
541310	Architectural Services	45	14.0	106	3.5	8,357	5.6	231.6	1.3
541330	Engineering Design Services	26	8.0	578	19.2	32,990	22.0	355	2.0
541380	Testing Laboratories	5	1.6	98	3.3	1,175	0.8	234.8	1.3
541618	Utilities Mgt Consulting Svcs	95	29.5	179	5.9	3,840	2.6	420.9	2.4
541620	Envir. Consulting Svcs	0	0.0	5	0.2	22,891	15.3	120.7	0.7
541690	Energy Consulting Services	11	3.4	352	11.7	3,112	2.1	495.6	2.8
541712	R&D	26	8.1	488	16.2	1,522	1.0	53.2	0.3
TOTAL REVENUES (IN MILLIONS)		$324	100%	$3,017	100%	$149,618	100%	$17,495	100%
% OF REVENUES: COUNTIES TO BN		2%		17%		855%			

ETS NAICS Comparative Analysis—Number of Firms

	COUNTY:	Strafford		Boulder		Los Angeles		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
221119	Other Electric Power Generation	4	1.9	12	0.6	139	0.8	50	2.5
221122	Electric Power Distribution	0	0.0	4	0.2	18	0.1	8	0.4
237130	Power/Comm. Line/Related Structures	2	0.9	4	0.2	51	0.3	15	0.8
331421	Copper Rolling, Drawing, & Extruding	0	0.0	0	0.0	5	0.0	5	0.3
332111	Iron & Steel Mills	2	0.9	4	0.2	51	0.3	18	0.9
332112	Nonferrous Forging	0	0.0	0	0.0	19	0.1	5	0.3
332312	Fabricated Structural Metal Mfg	5	2.3	22	1.0	205	1.1	74	3.8
332322	Sheet Metal Work Mfg	6	2.8	19	0.9	433	2.3	59	3.0
332911	Industrial Valve Mfg	0	0.0	2	0.1	32	0.2	13	0.7
332999	All Other Misc. Fab. Metal Product Mfg	1	0.5	14	0.7	211	1.1	29	1.5
333415	AC & WAH Equip & Cml & Indust Ref Eq	1	0.5	7	0.3	119	0.6	31	1.6
333613	Power Transmission Equip	0	0.0	1	0.0	28	0.2	11	0.6
334112	Computer Storage Device Mfg	1	0.5	22	1.0	54	0.3	5	0.3
334418	Printed circuits & electronics	1	0.5	14	0.7	60	0.3	8	0.4
334512	Auto Envirl Conl Mfg for Res, Comm,	2	0.9	4	0.2	35	0.2	14	0.7
334513	Instr/Reld Prod Mfg for Meas, Dispy	2	0.9	22	1.0	100	0.5	21	1.1
334515	Meter	3	1.4	24	1.1	123	0.7	16	0.8
334519	Other Measuring/Controlling Device	2	0.9	22	1.0	156	0.8	110	5.6
335311	Power, Distrib & Specialty Transform	2	0.9	1	0.0	60	0.3	8	0.4
335312	Motor & Generator Mfg	6	2.8	1	0.0	75	0.4	14	0.7
335313	Switchgear/Switchboard Apparatus Mfg	0	2.3	3	0.6	53	0.6	10	1.2
335314	Relay/Industrial Control Mfg	5	2.3	12	0.6	115	0.6	24	1.2
335911	Storage Batteries	0	0.0	2	0.1	28	0.2	4	0.2
335931	Electrical Connections	0	0.0	1	0.0	60	0.3	12	0.6
541310	Architectural Services	14	6.5	224	10.7	2,144	11.6	143	7.2
541330	Engineering Design Services	40	18.5	445	21.2	3,752	20.2	332	16.8
541380	Testing Laboratories	8	3.7	39	1.9	484	2.6	59	3.0
541618	Utilities Mgt Consulting Svcs	70	32.4	702	33.5	6,844	36.9	519	26.3
541620	Envir. Consulting Svcs	0	0.0	17	0.8	101	0.5	29	1.5
541690	Energy Consulting Services	26	12.0	281	13.4	2,126	11.5	251	12.7
541712	R&D	13	6.0	173	8.2	852	4.6	76	3.9
TOTAL FIRMS		216	100%	2,098	100%	18,533	100%	1,973	100%



ETS Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

GREEN BUILDING SECTOR

The three counties identified were: Baltimore County, Md., home to Solaroad Technologies Group; Boulder County, Colo., with the Boulder Green Building Guild, which includes numerous small- and mid-sized firms; and Berrian County, Mich., home to Whirlpool Corp.

Buffalo Niagara has a higher percentage of college-educated people than Baltimore and Berrian, though far lower than Boulder. It has nearly the same percentage of people employed in manufacturing as Boulder, but less than Berrian and more than Baltimore. Boulder County housing prices are far higher than Buffalo Niagara's and the other selected locations, which does help to support more green-building activity in that area.

Four of Baltimore's codes account for about 80% of revenues. Berrian, dominated by Whirlpool, has two: Household Cooking Appliances and Other Major Household Appliances, each of which Hoover's lists at 48.79% of the total. While it is clear this code is the county's largest, this is an example of the double-counting that limits an analysis of this kind given that total revenues are listed for entire companies rather than for the particular code alone. Boulder and Buffalo Niagara have more diverse distributions, though Boulder's appears more oriented toward services and local activity; Buffalo Niagara's orientation seems to be more industrial.

Green Building Comparative Analysis—Demographic Information

COUNTY STATE	BALTIMORE MD.	BOULDER COLO.	BERRIAN MICH.	BN REGION N.Y.
Population	651,154	291,288	291,288	1,591,708
Population as % of BN	41%	18%	18%	100%
Revenues as % of BN	132%	17%	24%	100%
Firms (Total)	55,572	31,305	31,444	72,377
# People per Firm	11.7	9.3	9.3	22.0
# People per Gr Bldg Firm	129	139	73	269
# People employed in Mfg	20,082	22,846	22,846	120,877
% People employed in Mfg	3.1%	7.8%	7.8%	7.6%
% College degree or above	18.0%	47.0%	47.0%	19.9%
Median House Value	$69,100	$241,900	$241,900	$88,213

Green Building NAICS Comparative Analysis—Revenues (In Millions $)

	COUNTY:	Baltimore		Boulder		Berrian		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
221122	Electric Power Distribution	0	0.0	88	1.8	0	0.0	2,464.4	12.3
236115	New Single-Family Housing Const	433	1.6	329	6.8	76	0.2	491.3	2.4
236116	New Multifamily Housing Const	333	1.3	85	1.8	35	0.1	78.1	0.4
236117	New Housing - (spec) operative build	98	0.4	38	0.8	1	0.0	22.8	0.1
236118	Residential Remodelers	259	1.0	60	1.3	25	0.1	169.4	0.8
236210	Industrial Building Construction	173	0.7	271	5.6	19	0.0	243.5	1.2
236220	Comm./Instit. Building Construction	4,818	18.2	346	7.2	49	0.1	877.7	4.4
237130	Power/Comm. Line/Related Struct Cons	27	0.1	82	1.7	3	0.0	11.3	0.1
238220	Plumbing, Heating, and AC Contractor	4,589	17.3	189	3.9	102	0.3	804.7	4.0
321999	All Other Miscellaneous Wood Product	2	0.0	2	0.0	3	0.0	132.1	0.7
326199	All Other Plastics Product Mfg	109	0.4	260	5.4	79	0.2	400.7	2.0
327211	Top Surface	7	0.0	2	0.0	9	0.0	5.3	0.0
327993	Mineral Wool Manufacturing	0	0.0	0	0.0	0	0.0	3.9	0.0
331210	Iron/Steel Pipe/Tube Mfg from Purchd	0	0.0	0	0.0	0	0.0	46.5	0.2
331421	Copper Rolling, Drawing, and Extruding	0	0.0	0	0.0	0	0.0	127	0.6
332111	Iron and Steel Mills	13	0.0	1	0.0	6	0.0	21.9	0.1
332311	Prefabricated Metal Bldg/Component	4	0.0	1	0.0	1	0.0	27.5	0.1
332312	Fabricated Structural Metal Mfg	503	1.9	41	0.9	2	0.0	1505.3	7.5
332322	Sheet Metal Work Manufacturing	52	0.2	64	1.3	20	0.1	1532.3	7.6
332999	All Other Misc. Fab. Metal Product	6,096	23.0	382	7.9	0	0.0	1425.9	7.1
333120	Construction Machinery Mfg	2	0.0	63	1.3	0	0.0	60	0.3
333411	Air Purification Equipment Mfg	6	0.0	8	0.2	0	0.0	11.8	0.1
333412	Industrial/Commercial fans/blowers	3	0.0	14	0.3	38	0.1	21.1	0.1
333415	AC & WAH Equip & Cml & Indust Ref Eq	56	0.2	3	0.1	160	0.4	108.8	0.5
334112	Computer Storage Device Mfg	0	0.0	77	1.6	0	0.0	1.3	0.0
334418	Printed circuits and electronics	2	0.0	119	2.5	0	0.0	319.5	1.6
334512	Auto Envirl Conl Mfg for Res, Comm	44	0.2	1	0.0	0	0.0	110	0.5
334513	Instr/Reld Prod Mfg for Meas, Dispy	25	0.1	107	2.2	70	0.2	2136.8	10.6
334515	Meter	12	0.0	29	0.6	64	0.2	54	0.3
334519	Other Measuring/Controlling Device	11	0.0	52	1.1	4	0.0	2053.8	10.2
335110	Electric Lamp Bulb/Parts	0	0.0	2	0.0	0	0.0	6.7	0.0

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Green Building NAICS Comparative Analysis—Revenues (In Millions $)

(Continued)

		COUNTY: Baltimore		Boulder		Berrian		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
335121	Resid. Electric Light Fixtures	2	0.0	0	0.0	0	0.0	15.5	0.1
335122	Commercial, Industrial, Instit. Light	0	0.0	0	0.0	0	0.0	25.9	0.1
335129	Other Lighting Equipment	6,087	23.0	4	0.1	0	0.0	176.8	0.9
335221	Household Cooking Appliance	5	0.0	0	0.0	18,907	48.8	8.5	0.0
335228	Other Major Household Appliances	1	0.0	0	0.0	18,907	48.8	0.1	0.0
335311	Power, Dist., Spec. Transformers	4	0.0	0	0.0	0	0.0	373.5	1.9
335312	Motor and Generator	28	0.1	0	0.0	48	0.1	446.9	2.2
335313	Switchgear/Switchboard Apparatus	2	0.0	0	0.0	0	0.0	9.8	0.0
335314	Relay and Industrial Control	53	0.2	11	0.2	0	0.0	226.6	1.1
335911	Storage Battery	2	0.0	0	0.0	0	0.0	0.6	0.0
335912	Primary Battery	0	0.0	1	0.0	0	0.0	318.8	1.6
335931	Electrical Connections	0	0.0	0	0.0	12	0.0	15.7	0.1
335999	Charge Controller	9	0.0	108	2.2	1	0.0	331.9	1.7
423720	Plumbing/Heating Equip. Merch./Who	172	0.6	28	0.6	8	0.0	582.3	2.9
532412	Constr, Mng, & Forstry Mach & Eqp Rt	432	1.6	114	2.4	2	0.0	81.1	0.4
541310	Architectural services	67	0.3	106	2.2	10	0.0	231.6	1.2
541330	Engineering Services	934	3.5	578	12.0	34	0.1	355	1.8
541350	Building Inspection Services	7	0.0	3	0.1	1	0.0	3.6	0.0
541380	Testing Laboratories	14	0.1	98	2.0	1	0.0	234.8	1.2
541420	Indust. Design Svcs (Energy Effic.)	6	0.0	2	0.0	1	0.0	49.7	0.2
541618	Utilities Mgt Consulting Svcs	414	1.6	179	3.7	10	0.0	420.9	2.1
541620	Envir. Consulting Svcs	143	0.5	5	0.1	0	0.0	120.7	0.6
541690	Energy Consulting Services	82	0.3	352	7.3	18	0.0	495.6	2.5
541712	R&D in Physical, Engineering, & Life	70	0.3	488	10.1	1	0.0	53.2	0.3
562111	Solid Waste Collection	17	0.1	5	0.1	18	0.0	11.2	0.1
562119	Other Waste Collection	0	0.0	0	0.0	0	0.0	1.1	0.0
562212	Solid Waste Landfill	4	0.0	0	0.0	2	0.0	14.4	0.1
562213	Solid Waste Combustors & Incinerator	0	0.0	0	0.0	0	0.0	0	0.0
562219	Other Nonhazardous Waste Treatmen	6	0.0	7	0.1	0	0.0	21.6	0.1
562910	Remediation Services	154	0.6	1	0.0	0	0.0	142.1	0.7
562920	Materials Recovery Facil.	27	0.1	4	0.1	7	0.0	38	0.2
562991	Septic Tank & Related Svcs	64	0.2	3	0.1	2	0.0	10.2	0.1
562998	All Other Misc Waste Mgt Svcs	2	0.0	0	0.0	0	0.0	0.4	0.0
TOTAL REVENUES (IN MILLIONS)		$26,482	100%	$4,814	100%	$38,755	100%	$20,093	100%
% OF REVENUES: COUNTIES TO BN		132%		24%		193%			

Green Building NAICS Comparative Analysis—Number of Firms

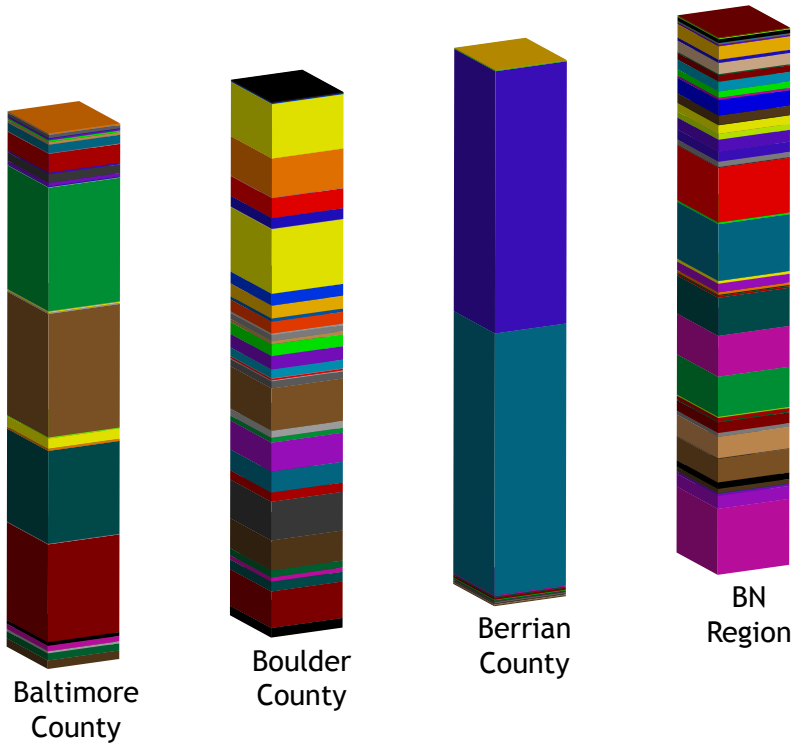
	COUNTY:	Baltimore		Boulder		Berrian		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
221122	Electric Power Distribution	1	0.0	4	0.1	2	0.2	8	0.1
236115	New Single-Family Housing Const	969	19.1	729	18.3	334	30.0	1,248	21.1
236116	New Multifamily Housing Const	180	3.6	153	3.8	60	5.4	221	3.7
236117	New Housing - (spec) operative build	45	0.9	28	0.7	2	0.2	21	0.4
236118	Residential Remodelers	573	11.3	201	5.1	81	7.3	643	10.9
236210	Industrial Building Construction	72	1.4	28	0.7	28	2.5	85	1.4
236220	Comm./Instit. Building Construction	375	7.4	168	4.2	55	4.9	438	7.4
237130	Power/Comm. Line/Related Struct Cons	9	0.2	4	0.1	4	0.4	15	0.3
238220	Plumbing, Heating, and AC Contractor	719	14.2	313	7.9	156	14.0	892	15.1
321999	All Other Miscellaneous Wood Product	16	0.3	14	0.4	21	1.9	58	1.0
326199	All Other Plastics Product Mfg	34	0.7	51	1.3	21	1.9	91	1.5
327211	Top Surface	3	0.1	5	0.1	3	0.3	6	0.1
327993	Mineral Wool Manufacturing	0	0.0	1	0.0	1	0.1	5	0.1
331210	Iron/Steel Pipe/Tube Mfg from Purchd	0	0.0	0	0.0	0	0.0	7	0.1
331421	Copper Rolling, Drawing, and Extruding	0	0.0	0	0.0	0	0.0	5	0.1
332111	Iron and Steel Mills	3	0.1	4	0.1	2	0.2	18	0.3
332311	Prefabricated Metal Bldg/Component	7	0.1	2	0.1	1	0.1	10	0.2
332312	Fabricated Structural Metal Mfg	27	0.5	22	0.6	6	0.5	3	0.1
332322	Sheet Metal Work Manufacturing	28	0.6	19	0.5	17	1.5	59	1.0
332999	All Other Misc. Fab. Metal Product	17	0.3	14	0.4	0	0.0	29	0.5
333120	Construction Machinery Mfg	4	0.1	10	0.3	2	0.2	21	0.4
333411	Air Purification Equipment Mfg	6	0.1	4	0.1	0	0.0	10	0.2
333412	Industrial/Commercial fans/blowers	4	0.1	3	0.1	3	0.3	11	0.2
333415	AC & WAH Equip & Cml & Indust Ref Eq	5	0.1	7	0.2	7	0.6	31	0.5
334112	Computer Storage Device Mfg	2	0.0	22	0.6	0	0.0	5	0.1
334418	Printed circuits and electronics	6	0.1	14	0.4	0	0.0	8	0.1
334512	Auto Envirl Conl Mfg for Res, Comm	4	0.1	4	0.1	0	0.0	14	0.2
334513	Instr/Reld Prod Mfg for Meas, Dispy	8	0.2	22	0.6	6	0.5	21	0.4
334515	Meter	8	0.2	24	0.6	4	0.4	16	0.3
334519	Other Measuring/Controlling Device	12	0.2	22	0.6	4	0.4	110	1.9
335110	Electric Lamp Bulb/Parts	0	0.0	3	0.1	0	0.0	3	0.1

Continued on next page

Green Building NAICS Comparative Analysis—Number of Firms

(Continued)

	COUNTY:	Baltimore		Boulder		Berrian		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
335121	Resid. Electric Light Fixtures	5	0.1	0	0.0	1	0.1	3	0.1
335122	Commercial, Industrial, Instit. Light	3	0.1	1	0.0	0	0.0	5	0.1
335129	Other Lighting Equipment	6	0.1	4	0.1	0	0.0	14	0.2
335221	Household Cooking Appliance	4	0.1	0	0.0	2	0.2	1	0.0
335228	Other Major Household Appliances	3	0.1	0	0.0	2	0.2	1	0.0
335311	Power, Dist., Spec. Transformers	1	0.0	1	0.0	0	0.0	8	0.1
335312	Motor and Generator	4	0.1	1	0.0	1	0.1	14	0.2
335313	Switchgear/Switchboard Apparatus	3	0.1	3	0.1	1	0.1	10	0.2
335314	Relay and Industrial Control	9	0.2	12	0.3	0	0.0	24	0.4
335911	Storage Battery	2	0.0	2	0.1	1	0.1	4	0.1
335912	Primary Battery	1	0.0	1	0.0	0	0.0	2	0.0
335931	Electrical Connections	1	0.0	1	0.0	2	0.2	12	0.2
335999	Charge Controller	16	0.3	30	0.8	4	0.4	14	0.2
423720	Plumbing/Heating Equip. Merch./Whole	50	1.0	25	0.6	11	1.0	10	0.2
532412	Constr, Mng, & Forstry Mach & Eqp Rt	21	0.4	13	0.3	2	0.2	35	0.6
541310	Architectural services	45	0.9	224	5.6	31	2.8	143	2.4
541330	Engineering Services	421	8.3	445	11.2	53	4.8	332	5.6
541350	Building Inspection Services	28	0.6	23	0.6	10	0.9	39	0.7
541380	Testing Laboratories	35	0.7	39	1.0	4	0.4	59	1.0
541420	Indust. Design Svcs (Energy Effic.)	13	0.3	15	0.4	4	0.4	16	0.3
541618	Utilities Mgt Consulting Svcs	770	15.2	702	17.6	75	6.7	519	8.8
541620	Envir. Consulting Svcs	22	0.4	17	0.4	2	0.2	29	0.5
541690	Energy Consulting Services	219	4.3	281	7.1	37	3.3	251	4.2
541712	R&D in Physical, Engineering, & Life	111	2.2	173	4.3	8	0.7	76	1.3
562111	Solid Waste Collection	20	0.4	4	0.1	3	0.3	4	0.1
562119	Other Waste Collection	2	0.0	1	0.0	0	0.0	2	0.0
562212	Solid Waste Landfill	17	0.3	5	0.1	6	0.5	22	0.4
562213	Solid Waste Combustors & Incinerator	0	0.0	0	0.0	0	0.0	0	0.0
562219	Other Nonhazardous Waste Treatment	15	0.3	7	0.2	3	0.3	23	0.4
562910	Remediation Services	19	0.4	5	0.1	1	0.1	18	0.3
562920	Materials Recovery Facil.	25	0.5	21	0.5	10	0.9	50	0.8
562991	Septic Tank & Related Svcs	37	0.7	25	0.6	19	1.7	60	1.0
562998	All Other Misc Waste Mgt Svcs	2	0.0	2	0.1	0	0.0	8	0.1
TOTAL FIRMS		5,067	100%	3,978	100%	1,113	100%	5,920	100%



Green Building Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

TRANSPORTATION SECTOR

The three counties identified were: San Mateo County, Calif., home to Tesla Motors; Oakland County, Mich., which contains Cobasys; and Platte County, Mo., site of Smith Electric Vehicles.

All three counties had lower populations and higher levels of college education than Buffalo Niagara. San Mateo and Platte counties have less people working in manufacturing and even lower transportation-related revenues; San Mateo has significantly higher housing prices. Oakland County, near Detroit, has a higher percentage employed in manufacturing and generated more than eight times higher revenues in the selected NAICS codes.

The distributions reflected in Transportation were similar to those in other sectors, in that Buffalo Niagara has a more balanced range of firms conducting different industrial applications than the selected counties where activity was concentrated in fewer codes. For example, in San Mateo County, almost 80% of revenues were concentrated in five codes with nearly 40% of that in Instruments/Related Products Manufacturing for Measure, Display & Control and Other Measuring/Controlling Device Manufacturing. Oakland generated 58.88% of revenues with All Other Motor Vehicle Parts Mfg and another 15.29% in Automobile Manufacturing. Platte County generated more than 90% of revenues in four codes, with Engineering Services (30.05%) and Iron Foundries (27.08%) accounting for about two-thirds of this amount. Meanwhile, Buffalo Niagara, which generated respectable revenues for the selected Transportation-related codes, had only two (Fluid Power Cylinder/Actuator Mfg and Instruments/Related Products Mfg for Measure, Display & Control) that produced 10%.

Transportation Comparative Analysis—Demographic Information

COUNTY STATE	SAN MATEO CALIF.	OAKLAND MICH.	PLATTE MO.	BN REGION N.Y.
Population	707,161	1,194,156	73,781	1,591,708
Population as % of BN	44%	75%	5%	100%
Revenues as % of BN	30%	879%	2%	100%
Firms (Total)	47,993	96,036	6,589	72,377
# People per Firm	14.7	12.4	11.2	22.0
# People per Transp Firm	709	403	683	1,128
# People employed in Mfg	37,189	134,003	4,013	120,877
% People employed in Mfg	5.3%	11.2%	5.4%	7.6%
% College degree or above	37.1%	36.0%	29.2%	19.9%
Median House Value	$469,200	$181,200	$126,700	$88,213

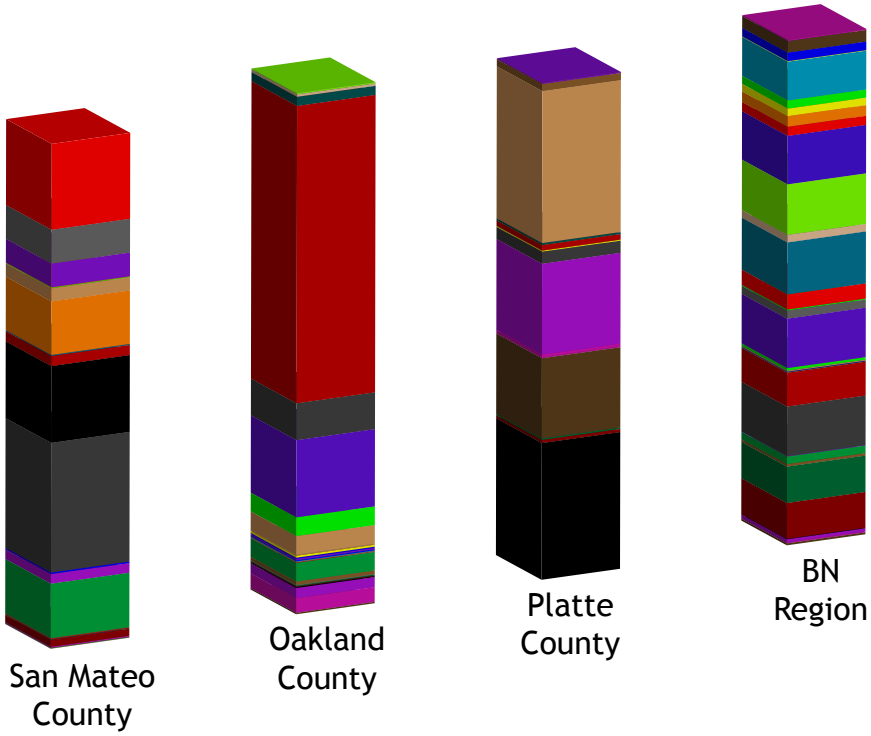
Freerange photo

Transportation NAICS Comparative Analysis—Revenues (In Millions $)

		San Mateo		Oakland		Platte		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
326299	Fuel cells, solid-state	3	0.1	502	0.3	0	0.0	94.3	0.4
327993	Mineral Wool Mfg	1	0.0	5,497	2.9	0	0.0	3.9	0.0
331210	Iron/Steel Pipe/Tube Mfg from Purch	5	0.1	32	0.0	0	0.0	46.5	0.2
331421	Copper Rolling, Drawing & Extruding	1	0.0	6	0.0	0	0.0	127	0.6
331511	Iron Foundries	0	0.0	3,802	2.0	144	27.1	1.6	0.0
332111	Iron & Steel Mills	1	0.0	397	0.2	0	0.0	27.5	0.1
332312	Fabricated Structural Metal Mfg	12	0.2	121	0.1	3	0.6	1505.3	7.1
332322	Sheet Metal Work Mfg	88	1.4	80	0.0	2	0.3	1532.3	7.2
332996	Fabricated Pipe & Pipe Fitting Mfg	5	0.1	437	0.2	0	0.0	97.1	0.5
332410	Power Boiler/Heat Exchanger Mfg	1	0.0	14	0.0	0	0.0	311.5	1.5
332420	Metal Tank (Heavy Gauge) Mfg	0	0.0	20	0.0	0	0.0	11	0.1
332911	Industrial Valve Mfg	1	0.0	136	0.1	0	0.0	2078.6	9.8
332999	All Other Misc. Fab Metal Product	4	0.1	1,378	0.7	0	0.0	1425.9	6.7
333411	Air Purification Equipment Mfg	0	0.0	42	0.0	85	15.9	11.8	0.1
333412	Industrial/Commercial fans/blowers	1	0.0	67	0.0	0	0.0	21.1	0.1
333414	Heating Equip ex. Warm Air Furnace	7	0.1	12	0.0	0	0.0	48.5	0.2
333415	AC & WAH Equip & Cml & Ind Ref Eq	688	10.8	68	0.0	1	0.2	108.8	0.5
333911	Pump/Pumping Equip. Mfg	2	0.0	6,929	3.7	3	0.5	2078.6	9.8
333912	Air/Gas Compressor Mfg	0	0.0	12	0.0	0	0.0	333.3	1.6
333922	Conveyor/Conveying Equipment Mfg	1	0.0	262	0.1	96	18.0	32.8	0.2
333923	Ovrhd Tvlg Crane, Hoist, & Monorail	2	0.0	5	0.0	13	2.4	632.3	3.0
333995	Fluid Power Cylinder/Actuator Mfg	0	0.0	68	0.0	0	0.0	2197.9	10.3
334112	Computer Storage Device Mfg	118	1.9	263	0.1	0	0.0	1.3	0.0
334418	Printed circuits & electronics	21	0.3	223	0.1	0	0.0	319.5	1.5
334513	Instr/Reld Prod Mfg for Meas, Dispy	1,632	25.7	390	0.2	1	0.2	2136.8	10.0
334519	Other Measuring/Controlling Device	968	15.2	533	0.3	0	0.0	2053.8	9.6
335311	Power, Distrib & Specialty Trans	128	2.0	327	0.2	0	0.0	373.5	1.8
335312	Motor & Generator	12	0.2	786	0.4	0	0.0	446.9	2.1
335313	Switchgear/Switchboard Mfg	671	10.6	154	0.1	6	1.1	9.8	0.0
335911	Storage Battery	1	0.0	36	0.0	0	0.0	0.6	0.0
335912	Primary Battery	0	0.0	278	0.1	0	0.0	318.8	1.5
335931	Electrical Connections	5	2.6	172	3.7	9	0.0	15.7	1.6
335999	Charge Controller	163	2.6	6,866	3.7	0	0.0	331.9	1.6
336111	Automobile Manufacturing	2	0.0	28,642	15.3	2	0.4	3.1	0.0
336112	Light Truck & Utility Vehicle Mfg	0	0.0	13,581	7.3	0	0.0	0	0.0
336399	All Other Motor Vehicle Parts Mfg	4	0.1	110,278	58.9	0	0.0	1636.3	7.7
336510	Railroad Rolling Stock Mfg	5	0.1	32	0.0	0	0.0	16.7	0.1
541330	Engineering Design Services	301	4.7	3,450	1.8	160	30.1	355	1.7
541690	Energy Consulting Services	424	6.7	913	0.5	8	1.4	495.6	2.3
541712	R&D	1,078	17.0	466	0.2	1	0.2	53.2	0.2
TOTAL REVENUES (IN MILLIONS)		$6,353	100%	$187,277	100%	$531	100%	$21,296	100%
OF REVENUES: COUNTIES TO BN		30%		879%		2%			

Transportation NAICS Comparative Analysis—Number of Firms

	COUNTY:	San Mateo		Oakland		Platte		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
326299	Fuel cells, solid-state	6	0.6	30	1.0	0	0.0	30	2.1
327993	Mineral Wool Mfg	1	0.1	2	0.1	0	0.0	5	0.4
331210	Iron/Steel Pipe/Tube Mfg from Purch	1	0.1	4	0.1	0	0.0	7	0.5
331421	Copper Rolling, Drawing, & Extruding	1	0.1	2	0.1	0	0.0	5	0.4
331511	Iron Foundries	1	0.1	10	0.3	2	1.9	91	6.4
332111	Iron & Steel Mills	3	0.3	23	0.8	0	0.0	18	1.3
332312	Fabricated Structural Metal Mfg	14	1.4	47	1.6	4	3.7	74	5.2
332322	Sheet Metal Work Mfg	29	2.9	65	2.2	4	3.7	59	4.2
332996	Fabricated Pipe & Pipe Fitting Mfg	1	0.1	28	0.9	0	0.0	12	0.9
332410	Power Boiler/Heat Exchanger Mfg Metal	1	0.1	4	0.1	1	0.9	12	0.9
332420	Tank (Heavy Gauge) Mfg	0	0.0	4	0.1	0	0.0	4	0.3
332911	Industrial Valve Manufacturing	2	0.2	15	0.5	0	0.0	25	1.8
332999	All Other Misc. Fab Metal Product	13	1.3	33	1.1	1	0.9	29	2.1
333411	Air Purification Equipment Mfg	0	0.0	11	0.4	2	1.9	10	0.7
333412	Industrial/Commercial fans/blowers	2	0.2	10	0.3	0	0.0	11	0.8
333414	Heating Equip ex. Warm Air Furnace	3	0.3	6	0.2	0	0.0	8	0.6
333415	AC & WAH Equip & Cml & Ind Ref Eq	11	1.1	24	0.8	1	0.9	31	2.2
333911	Pump/Pumping Equip. Mfg	5	0.5	12	0.4	1	0.9	12	0.9
333912	Air/Gas Compressor Mfg	2	0.2	5	0.2	0	0.0	14	1.0
333922	Conveyor/Conveying Equipment Mfg	3	0.3	39	1.3	5	4.6	12	0.9
333923	Ovrhd Tvlg Crane, Hoist, & Monorail	3	0.3	6	0.2	3	2.8	7	0.5
333995	Fluid Power Cylinder/Actuator Mfg	1	0.1	11	0.4	0	0.0	9	0.6
334112	Computer Storage Device Mfg	14	1.4	19	0.6	0	0.0	5	0.4
334418	Printed circuits & electronics	9	0.9	21	0.7	0	0.0	8	0.6
334513	Instr/Reld Prod Mfg for Meas, Dispy	19	1.9	71	2.4	1	0.9	21	1.5
334519	Other Measuring/Controlling Device	25	2.5	68	2.3	1	0.9	110	7.8
335311	Power, Distrib & Specialty Trans	4	0.4	16	0.5	0	0.0	8	0.6
335312	Motor & Generator	2	0.2	24	0.8	0	0.0	14	1.0
335313	Switchgear/Switchboard Mfg	3	0.3	34	1.1	1	0.9	10	0.7
335911	Storage Battery	1	0.1	6	0.2	0	0.0	4	0.3
335912	Primary Battery	1	0.1	3	0.1	0	0.0	2	0.1
335931	Electrical Connections	5	2.3	6	1.6	1	0.9	12	1.0
335999	Charge Controller	23	2.3	47	1.6	1	0.9	14	1.0
336111	Automobile Manufacturing	2	0.2	64	2.2	1	0.9	9	0.6
336112	Light Truck & Utility Vehicle Mfg	0	0.0	5	0.2	0	0.0	0	0.0
336399	All Other Motor Vehicle Parts Mfg	16	1.6	342	11.5	3	2.8	46	3.3
336510	Railroad Rolling Stock Mfg	3	0.3	5	0.2	0	0.0	4	0.3
541330	Engineering Design Services	349	35.0	1,207	40.7	34	31.5	332	23.5
541690	Energy Consulting Services	244	24.5	446	15.0	32	29.6	251	17.8
541712	R&D	174	17.5	191	6.4	9	8.3	76	5.4
TOTAL FIRMS		997	100%	2,966	100%	108	100%	1,411	100%



Transportation Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

SOLID WASTE MANAGEMENT SECTOR

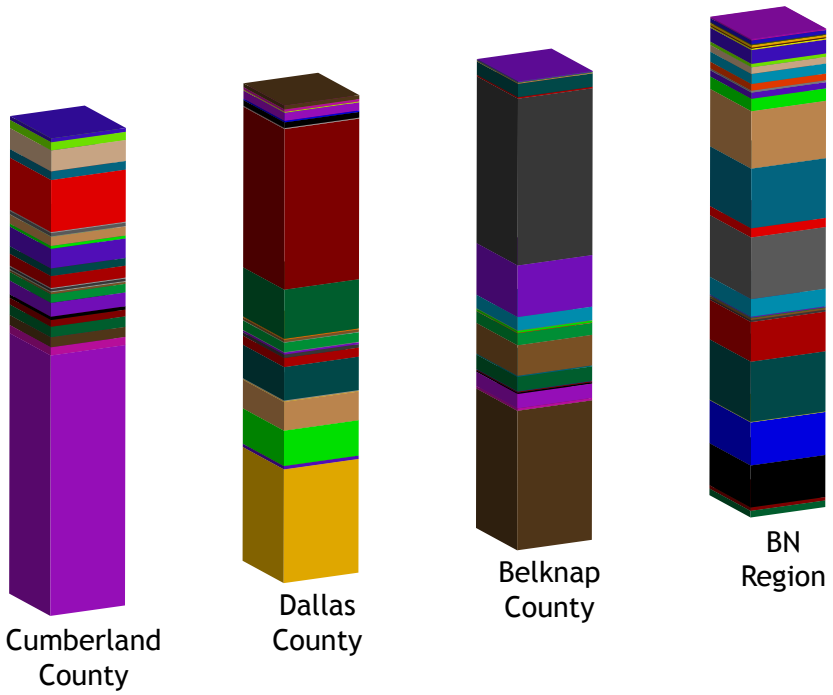
The three counties identified were: Cumberland County, N.J., in which Covanta Energy is located; Dallas County, Texas, with Pollution Control Products; and Belknap County, N.H., home to Forrester Environmental Services.

Buffalo Niagara is smaller than Dallas County though far larger than Cumberland and Belknap. Similarly, perhaps, due to the bias in the model, in which double-counting tends to exaggerate revenues in larger counties, Dallas has far higher revenues, while Cumberland and Belknap have significantly less. All of the markets are fairly similar in terms of percent of college-educated population (though Cumberland has less), housing values and percent of people employed in manufacturing.

Again, Buffalo Niagara has a far more balanced industrial base than the other markets. This is true even in Dallas, which, as with Los Angeles, one might imagine would have a more balanced distribution given its size and position within the Top 10 U.S. metro areas. Within Dallas, for example, almost 68% of revenues within these codes were accounted for by Industrial Business Construction and Engineering and Architectural Services. Similarly, in Cumberland, Industrial Business Construction accounted for 54.52%, and in Belknap, Industrial Business Construction and Engineering Services tallied more than 57%. In Buffalo, the four largest codes each totaled about 12.5%, making up about 50% of revenues. This includes Industrial Valve Manufacturing, Fluid Power Cylinder/Actuator Manufacturing, Printed Circuits and Electronics Assemblies and Instruments/Related Products Mfg for Measure, Display & Control. These are arguably more important, in any case, to manufacturing and Waste Management and Remediation equipment than the leading codes in other markets.

Solid Waste Mgt Comparative Analysis—Demographic Information

COUNTY	**CUMBERLAND**	**DALLAS**	**BELKNAP**	**BN REGION**
STATE	**N.J.**	**TEXAS**	**N.H.**	**N.Y.**
Population	146,438	2,218,899	56,325	1,591,708
Population as % of BN	9%	139%	4%	100%
Revenues as % of BN	2%	626%	1%	100%
Firms (Total)	7,756	189,024	5,182	72,377
# People per Firm	18.9	11.7	10.9	22.0
# People per SW Mgt Firm	933	528	414	924
# People employed in Mfg	10,819	125,991	4,807	120,877
% People employed in Mfg	7.4%	5.7%	8.5%	7.6%
% College degree or above	10.2%	22.1%	21.5%	19.9%
Median House Value	$91,200	$92,700	$109,600	$88,213



Solid Waste Industry Segments Revenue Percent to Total

This graph represents a visual comparison of NAICS codes by total revenues on a percentage basis. A greater number of colored bands amounts to more diversity within a particular location.

Solid Waste Mgt NAICS Comparative Analysis—Revenues (In Millions $)

	COUNTY:	Cumberland		Dallas		Belknap		BN Region	
NAICS	**INDUSTRY SEGMENT**	**$$**	**%**	**$$**	**%**	**$$**	**%**	**$$**	**%**
236210	Industrial Building Construction	196	54.5	$25,486	23.8	$31	29.2	243.5	1.4
331421	Copper Rolling, Drawing & Extruding	0	0.0	1	0.0	0	0.0	127	0.7
332312	Fabricated Structural Metal Mfg	0	0.0	12	0.0	0	0.0	1505.3	8.8
332322	Sheet Metal Work Mfg	6	1.7	795	0.7	1	0.5	1532.3	9.0
332420	Metal Tank (Heavy Gauge) Mfg	0	0.0	3	0.0	0	0.0	11	0.1
332911	Industrial Valve Mfg	0	0.0	7,874	7.4	3	3.0	2147.7	12.6
332999	All Other Misc Fab Metal Product Mfg	8	2.1	6,393	6.0	0	0.0	1425.9	8.3
333120	Construction Machinery Mfg	0	0.0	126	0.1	0	0.3	60	0.4
333298	All Other Industrial Machinery Mfg	8	2.2	47	0.0	0	0.2	75.9	0.4
333411	Air Purification Equipment Mfg	5	1.4	110	0.1	0	0.1	11.8	0.1
333922	Conveyor/Conveying Equipment Mfg	3	0.7	54	0.1	0	0.0	32.8	0.2
333923	Ovrhd Tvlg Crane, Hoist, & Monorail	11	2.9	1	0.0	0	0.0	632.3	3.7
333995	Fluid Power Cylinder/Actuator Mfg	0	0.0	7,439	7.0	3	3.0	2197.9	12.9
334112	Computer Storage Device Mfg	0	0.0	2,043	1.9	0	0.2	1.3	0.0
334418	Printed circuits & electronics assembly	0	0.0	711	0.7	7	6.4	319.5	1.9
334513	Instr/Reld Prod Mfg for Meas, Dispy	7	1.8	414	0.4	3	2.5	2136.8	12.5
334519	Other Measuring/Controlling Device Mfg	2	0.4	87	0.1	0	0.1	2053.8	12.0
335312	Motor &Generator Mfg	1	0.2	2,174	2.0	0	0.0	446.9	2.6
335314	Relay/Industrial Control Mfg	2	0.5	140	0.1	0	0.4	226.6	1.3
335931	Electrical Connections	1	0.2	508	0.5	0	0.0	15.7	0.1
423930	Recyclable Material Merchant Wholesale	9	2.5	198	0.2	0	0.1	52.2	0.3
541310	Architectural services	6	1.6	11,023	10.3	3	2.8	231.6	1.4
541330	Engineering Services	15	4.1	35,926	33.6	11	10.8	355	2.1
541380	Testing Laboratories	2	0.6	168	0.2	37	34.9	234.8	1.4
541620	Env. Consulting Services	0	0.0	4	0.0	0	0.3	120.7	0.7
541690	Energy Consulting Services	7	1.9	1,290	1.2	3	2.8	495.6	2.9
541712	R&D	0	0.1	360	0.3	0	0.2	53.2	0.3
562111	Solid Waste Collection	3	0.7	12	0.0	0	0.0	11.2	0.1
562112	Hazardous Waste Collection	0	0.0	26	0.0	0	0.0	10.5	0.1
562119	Other Waste Collection	1	0.2	13	0.0	0	0.0	1.1	0.0
562211	Hazardous Waste Treatment &Dispos	39	10.9	1,789	1.7	0	0.1	90.5	0.5
562212	Solid Waste Landfill	0	0.0	18	0.0	0	0.2	14.4	0.1
562219	Other Nonhazardous Waste Treatment &	6	1.8	165	0.2	0	0.0	21.6	0.1
562910	Remediation Services	16	4.4	53	0.0	1	1.0	142.1	0.8
562920	Materials Recovery Facil.	6	1.7	550	0.5	0	0.0	38	0.2
562991	Septic Tank & Related Svcs	3	0.8	15	0.0	1	0.7	10.2	0.1
562998	All Other Misc Waste Mgt Svcs	0	0.0	903	0.8	0	0.3	0.4	0.0
TOTAL REVENUES (IN MILLIONS)		$360	100%	$106,929	100%	$106	100%	$17,087	100%
% OF REVENUES: COUNTIES TO BN		2%		626%		1%			

Solid Waste Mgt NAICS Comparative Analysis—Number of Firms

	COUNTY:	Cumberland		Dallas		Belknap		BN Region	
NAICS	**INDUSTRY SEGMENT**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
236210	Industrial Building Construction	11	7.0	116	2.8	20	14.7	85	4.9
331421	Copper Rolling, Drawing & Extruding	0	0.0	4	0.1	0	0.0	5	0.3
332312	Fabricated Structural Metal Mfg	0	0.0	11	0.3	0	0.0	74	4.3
332322	Sheet Metal Work Mfg	8	5.1	158	3.8	2	1.5	59	3.4
332420	Metal Tank (Heavy Gauge) Mfg	2	1.3	2	0.0	0	0.0	4	0.2
332911	Industrial Valve Mfg	0	0.0	15	0.4	1	0.7	13	0.8
332999	All Other Misc Fab Metal Product Mfg	5	3.2	51	1.2	0	0.0	29	1.7
333120	Construction Machinery Mfg	0	0.0	33	0.8	1	0.7	21	1.2
333298	All Other Industrial Machinery Mfg	3	1.9	37	0.9	1	0.7	23	1.3
333411	Air Purification Equipment Mfg	1	0.6	32	0.8	1	0.7	10	0.6
333922	Conveyor/Conveying Equipment Mfg	1	0.6	20	0.5	0	0.0	12	0.7
333923	Ovrhd Tvlg Crane, Hoist, & Monorail	1	0.6	4	0.1	0	0.0	7	0.4
333995	Fluid Power Cylinder/Actuator Mfg	0	0.0	4	0.1	1	0.7	9	0.5
334112	Computer Storage Device Mfg	0	0.0	21	0.5	1	0.7	5	0.3
334418	Printed circuits & electronics assembly	0	0.0	47	1.1	3	2.2	8	0.5
334513	Instr/Reld Prod Mfg for Meas, Dispy	2	1.3	33	0.8	1	0.7	21	1.2
334519	Other Measuring/Controlling Device Mfg	2	1.3	47	1.1	1	0.7	110	6.4
335312	Motor &Generator Mfg	1	0.6	27	0.6	0	0.0	14	0.8
335314	Relay/Industrial Control Mfg	1	0.6	43	1.0	1	0.7	24	1.4
335931	Electrical Connections	1	0.6	21	0.5	1	0.7	12	0.7
423930	Recyclable Material Merchant Wholesale	4	2.5	86	2.0	1	0.7	76	4.4
541310	Architectural services	15	9.6	661	15.7	14	10.3	143	8.3
541330	Engineering Services	33	21.0	1,145	27.3	41	30.1	332	19.3
541380	Testing Laboratories	8	5.1	135	3.2	2	1.5	59	3.4
541620	Env. Consulting Services	1	0.6	43	1.0	4	2.9	29	1.7
541690	Energy Consulting Services	13	8.3	847	20.2	15	11.0	251	14.6
541712	R&D	1	0.6	245	5.8	2	1.5	76	4.4
562111	Solid Waste Collection	2	1.3	13	0.3	0	0.0	4	0.2
562112	Hazardous Waste Collection	0	0.0	8	0.2	0	0.0	4	0.2
562119	Other Waste Collection	1	0.6	3	0.1	0	0.0	2	0.1
562211	Hazardous Waste Treatment &Dispos	7	4.5	28	0.7	2	1.5	20	1.2
562212	Solid Waste Landfill	2	1.3	18	0.4	2	1.5	22	1.3
562219	Other Nonhazardous Waste Treatment &	2	1.3	42	1.0	2	1.5	23	1.3
562910	Remediation Services	3	1.9	31	0.7	1	0.7	18	1.0
562920	Materials Recovery Facil.	8	5.1	86	2.0	0	0.0	50	2.9
562991	Septic Tank & Related Svcs	17	10.8	76	1.8	13	9.6	60	3.5
562998	All Other Misc Waste Mgt Svcs	1	0.6	6	0.1	2	1.5	8	0.5
TOTAL FIRMS		157	100%	4,199	100%	136	100%	1,722	100%

VI INTERVIEWS & ANALYSIS

Heightened interest in the new green economy and green jobs has drawn the attention of top-level people in government, business and academia worldwide. New questions and ideas are emerging on the impact of "green" within Buffalo Niagara as well as the U.S. and global economy. These and other issues uncovered in KWR International's research were investigated through additional analysis and discussions with business executives, regulatory officials, academics, trade-association managers, attorneys and service professionals, analysts, journalists, and other targeted individuals. They were selected for their ability to provide insight from a local and external perspective. To ensure frank discussion, interview subjects were identified by by title and, where relevant, affiliation.

Are Renewable Energy-Related Products Ready to be Commercialized?

One of the key questions related to renewable energy-related products and equipment is whether there is sufficient scale and economic viability upon which to base competitive industries and manufacturing operations. This is compounded by the high capital requirements of renewable-energy projects, particularly given current economic uncertainty, and the difficulty of forecasting payback periods given the volatility of energy prices and reliance on new, often unproven technologies.

Commenting on this concern, an investment banker/analyst who follows both the energy and renewable energy sector noted "I don't think in the short run there are meaningful manufacturing sides to alternative energy as the economics are not there. So much transitional research has to go on, it will take two to four years minimum. You're going to need concerted research in solar cells, turbines and many other applications. There is little momentum. The people in Washington are talking about creating 4 million-plus green jobs; that is just not going to happen."

"You need to position yourself where the technology is going and make plans now. Another key issue is how these companies will finance themselves," he stated. "That is a real problem. It was not long ago oil spiked up over $150 a barrel. Without exploration and new approaches—both extremely risky activities—we are almost certain to see even greater volatility going forward. Yet in the current economic environment, obtaining risk capital is not easy."

A similar view was expressed by a research analyst, who stated, "Yes, there is technology now for photovoltaic. But these are mom-and-pop technologies and processes. They only have the potential to deliver a very small part of our energy needs. The big hits will take large amounts of research and time to develop."

The fact that renewable energy is still largely in its infancy has important implications. First, there are not likely to be quick fixes, and the development of economically viable components and processes across a full range of integrated green sectors is almost sure to take far more time than anticipated.

Second, given the importance of research and development and risk capital, close links with universities, research institutions and venture capitalists is important—not only to allow access to the latest knowledge, innovation and resources—but to actual production.

As an alternative-energy journalist commented: "Plug-in hybrid technology for electric cars is not only being financed in northern California, but the production is also taking place there. Why is it not happening in Detroit? Tesla is making $50,000 cars in Northern California and now they are setting up production in San Diego. That has to be more expensive than in Michigan."

The key, the investment banker/analyst noted, is "we have a world-class curriculum in the U.S. and there are important synergies that can be obtained between industry and academia, particularly in an emerging field like alternative energy. One must determine what are the leading thinkers doing and then apply their thoughts into the industrial sector with input and capital from venture capitalists and other investors. One area that gets little attention is energy conservation. With all the snow and older building stock, that could be a natural area for Buffalo."

This type of thinking should not be new to Buffalo Niagara. In a sense it is the story behind its Medical Campus. One might also look at this period of experimentation in renewable energy as similar to the work done by NASA in the space program. That initiative also required substantial outlays of research and government funding and could not be justified in strictly economic terms. Yet the spin-offs and long-term benefits were enormous. One local vice president for alternative-energy manufacturing noted: "The Medical Campus is an example that can serve us well. We now have numerous companies

operating there. We just have to package our strengths and use it to attract companies."

The bottom line, however, is no one knows how long it will take alternative energy to reach cost parity with traditional energy sources. If one believes the underlying story, the main goal needs to be to develop a structure that may for the moment require incentives. Over time, these can be phased out as parity is achieved. This will help to drive activity in the field.

How Essential are Government Stimulus & Incentive Programs?

Research is essential to advance the development of alternative energy, but much of the underlying knowledge is already known. The main challenge is to develop the economies of scale and industrial and delivery mechanisms needed to allow production, storage and distribution in a way in which they offer cost-effective alternatives to hydrocarbon products.

This is a problem as the search for alternatives has traditionally been correlated to always-changing price, supply and security concerns. As a result, it has been difficult to develop noncarbon-based technologies on a strictly commercial basis. Recognizing this problem, governments have stepped in to provide incentives and subsidies, a trend that is only likely to accelerate as governments worldwide introduce stimulus and public-works projects with an emphasis on developing green businesses, business practices and technologies.

'People need to realize all energy is subsidized—that includes oil and gas—so one shouldn't think only alternative energy is subsidized.'

"The problem with alternative energy has been the difficulty of balancing short- with long-term concerns," one Washington-based policy analyst stated. "We can see that in the SUV phenomenon. It proved a major moneymaker for the auto industry but only took them further away from the goal of developing energy-efficient vehicles. As a result, incentives become key. Germany has become a global leader in solar and they also offer some of the best incentives. Japan has also done well, but purchases declined when subsidies were eliminated in 2005."

Speaking on an operating level, a Buffalo Niagara business owner, who focuses on solar primarily for government clients stated: "If we didn't have this recession then there would not be as much emphasis on stimulus and incentives. Most of our work has traditionally been to the government. Selling to the general public is difficult as the return on investment is not there unless you sell junk, and what we turn out is a high-quality product. Before this goes mainstream, you need incentives or we wouldn't see any solar; we are looking at tens of millions of dollars in potential sales, but it is all in stimulus. But I am not sure what you are going to see in the grass roots. I wouldn't be in the business if I didn't believe (in it), but I just don't see it in the near future without incentives. You need a lot of new technology. In the case of electric cars, you need battery power and storage, but you can't do it now at a price that makes sense in terms of selling to a broad consumer market."

Government inefficiencies and belief, as one investment analyst said, that "a lot of money will be wasted," has generated controversy and many emphasize the need for "market-based mechanisms." Others say we are unlikely to see the results of stimulus until later this year or 2010. Speaking in defense of these measures, the journalist stated: "People need to realize all energy is subsidized—that includes oil and gas—so one shouldn't think only alternative energy is subsidized. If you don't want to subsidize solar, geothermal, wind, biomass and other new technologies, you need to stop subsidizing traditional energy as well."

Questioning whether incentives were sufficient by themselves, the Buffalo-based vice president stated "This is all so new. Small-scale projects are still pretty expensive, even with incentives. It can cost $75,000 to put up a small wind tower; how can you pay that back? It will take a long time. For now, large-scale projects are more feasible. But the people who learn how to make modifications and reduce costs will do well."

Is Excess Capacity Positive or Negative in Terms of Seeking Investment?

When speaking of Buffalo Niagara much of the marketing "sales pitch" is oriented toward the availability of excess capacity. Since the region was designed for a much larger industrial base, there are a multitude of physical and human resources available that offer advantages to new companies entering the region.

But overcapacity represents a challenge as well. As stated in the City of Buffalo's own Comprehensive Plan,[26] "Buffalo's physical infrastructure presents an important challenge as well as a great resource. . . . it is a resource in that it represents an extraordinary investment in economically useful capital. It is a challenge because it is aging and oversized for Buffalo's shrunken population, and while the financial resources needed to manage and maintain it are greater than before, revenue from its users has declined. The needs are great because the city has underinvested for decades in systems they own and manage, deferring maintenance, replacement and necessary upgrades."

The overcapacity issue also applies to human infrastructure, which offers real potential to firms seeking industrial talent. "There is a range of skills and that is a real plus here," the local business owner stated. "If you go to Arizona you get lots of lower-skilled labor but you can't get skilled trades people. So if I need fabricated steel or sophisticated electrical work, I don't have to go very far while other locations such as Arizona are hiring people from here."

'There is a range of skills and that is a real plus here. If you go to Arizona you get lots of lower-skilled labor but you can't get skilled trades people.'

Buffalo Niagara is not the only area with excess capacity. "I have a graph I use showing we are now at the lowest level of industrial capacity since the Great Depression. One issue is whether this excess capacity can be used for alternative-energy applications. In my view, it will be some time before we can answer this question," the banker/analyst said.

The implications of this capacity question have a dramatic effect on taxation issues and the cost of doing business. "Taxes are high in the region—I would move if I could," the local business owner declared. "The cost of doing business here is much more than North or South Carolina. They might not have employees with the right skills but you can import them. Look at Bethlehem Steel. That plant in Lackawanna paid more (property) taxes than all their other plants. Why? Because it was there and constituted a fixed asset. Everyone said there was no way they would shut it down but ultimately they did. Until then it was seen as a cash cow for government.

How Important is Location & Buffalo Niagara's Proximity to Canada?

Much has been written about Buffalo Niagara's strategic location and the fact it is within 500 miles of 41% of the U.S. population and 59% of Canada's. This provides many benefits, particularly when one factors in its water, rail and highway links and the fact it is home to eight international ports of entry.

Buffalo Niagara's proximity to Toronto, a global business and financial center, is not only a portal to Canada but to the world. "Buffalo is the first land crossing between the U.S. and Toronto and this connection should not be underestimated," a local attorney who is active in renewable energy and the environment commented. The investment banker/analyst went further: "I grew up across from Buffalo in Canada and cooperation could generate good opportunities across both sides of the water. It may be possible to generate collaborative efforts in terms of research and business with universities, firms and government agencies on the provincial and national level."

On the other hand, one local business manager noted "Canadian companies might be more prone to locate here to access the U.S., but it probably does not make sense to base here if your main goal is to service Canada. In that case you are likely to be better off basing in Ontario itself."

The problem with location-based strategies, however, was highlighted by one international real estate developer who commented: "You can easily declare any place a strategic location. I am from Rhode Island. It is on the Eastern seaboard, convenient to major highway interchanges, situated close to major population centers and between New York and Boston. Even so, it is still Rhode Island and most companies in New York or Boston are in those cities despite the higher costs."

Is the Sum of Renewable Energy Worth More Than Individual Sectors?

Most energy use during the 20th century was based on the use of hydrocarbons. The 21st century is likely to draw from a range of new energy sources, both complementing and competing for maximum utility and minimum environmental impact. These will then be utilized within a seamless super grid as well as localized micro-

[26] *Queen City in the 21st Century: Buffalo's Comprehensive Plan." City of Buffalo, Office of Strategic Planning, Timothy E. Wannamaker, Director. February, 2006.*

grids. Like the Internet, this will contribute as well as draw resources in a manner that extends beyond borders and government control.

This realization has particular importance for Buffalo Niagara, where the region has a far broader and diverse industrial base than many potential competitors. As one local director of an industrial training and consulting center, stated: "We have built cars and airplanes. I don't care what you want to make, Buffalo has all you that you need. We have injection molding, forms, all kinds of metallurgical processing, R&D, and skilled tradespeople in almost any industrial discipline as well as engineering talent. So we don't have to go to different parts of the country and world to make things. This does not only extend to manufacturing as we have agricultural businesses, food processors, juice makers and an ability to make just about anything."

This diversity and ability to provide a credible presence across green and alternative-energy sectors is a major positive, especially given the Smart Grid's vital importance and integrating various energy sources within it.

Can Buffalo Niagara Serve as a Laboratory for a New U.S. Industrial Future?

One would think Buffalo Niagara's diverse industrial base would provide it with a major advantage. This capacity, however, has hurt the region in recent decades as U.S. firms increasingly outsourced their manufacturing needs to Asian countries and other low-cost producers.

Corporate strategists have defended this strategy, utilizing metrics such as the "smiling curve" theory.[27] It was developed by Acer Computer founder Stanley Shih in the early 1990s, based on his realization that U.S., European and Japanese manufacturers retained the most profitable functions while outsourcing only production and assembly, which had the thinnest margins.

Nevertheless, as discussed in a KWR Report[28] that examined the international expansion plans of technology firms, this cycle ultimately leads to these same firms moving R&D functions and a wealth of more profitable ancillary facilities and services overseas, closer to the actual production site. While strengthening the profitability of corporations who could manage this process by reducing their cost structures, this further eroded the ability of the U.S. to focus on production and local communities to retain their industrial base. The result was further reductions in manufacturing-related employment and interest in engineering as a career choice. This prompted an accelerating reliance on services as a primary driver of U.S. economic growth.

As the local business owner stated "We go through a lot of solar panels and (we) looked at manufacturing on our own. We evaluated the costs and found I can go to China and buy panels for the same cost or less and don't have to go through the expense (of) managing a manufacturing facility. That is why this kind of production, which had been done here, winds up in Third World countries as the technologies are taken there by large, multinationals such as GE. We can't compete, so we source from over there as costs here are too high."

When asked about the new Globe Metal plant, which will produce high-grade silicon for solar panels and offer a portion of production to local customers at a discount, he replied: "I would be a potential customer, but why would I do that when I can source the complete product from China at better prices? We just don't have the scale here. The U.S. will be made of small manufacturers, not tiny, but $25-50 million companies. The big ones will be located elsewhere."

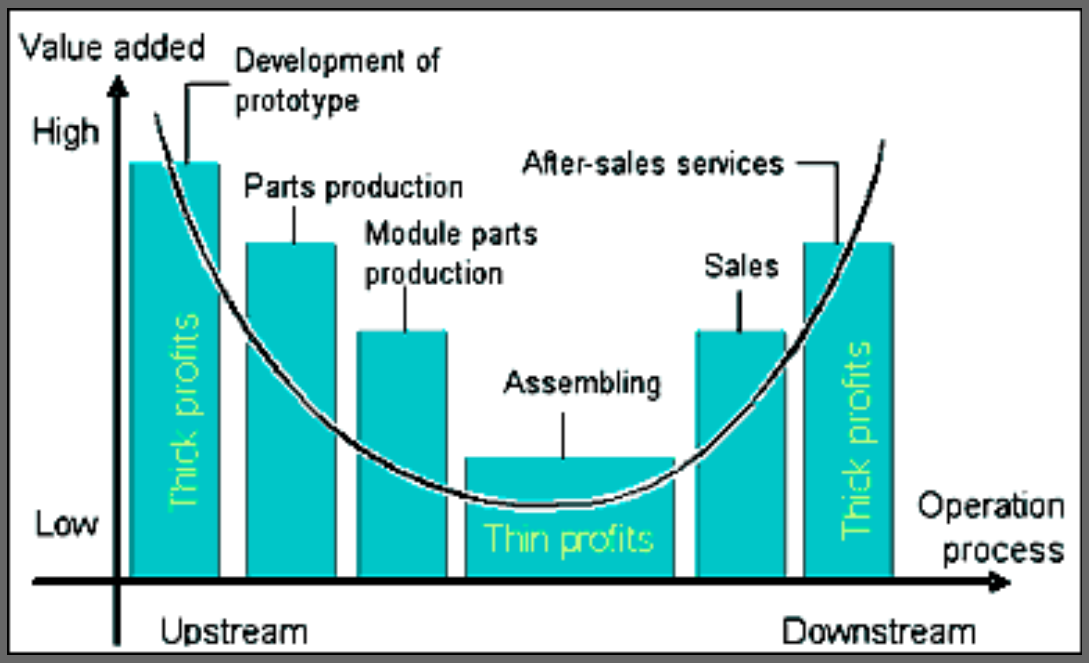
A local business development manager for a firm that markets industrial gases, stated his belief that government interest in the renewable sector would lead to more domestic manufacturing. When asked how Buffalo Niagara could compete when product could be sourced overseas at a cheaper price, he said: "That is the interesting one. My focus is photovoltaic. It seems it will be the first industry in a long time that will be globally distributed. PCs and flat-panel televisions all went to China and we did not really benefit. But with solar, everyone is trying to attract manufacturing and I think we will see it here. If you bring a plant to the U.S.—I may be biased—but I would put Buffalo into the top five of potential locations

Buffalo Niagara has been a victim of this movement toward deindustrialization and a greater reliance of services for many decades. Those employed in manufacturing within Buffalo declined from about 45% in 1950 to about 18% in 1990.[29] The city's population also declined

[27] *"China Grows but Wealth Remains Elusive." KWR International Advisor Newsletter, DATE, by C.H. Kwan, Senior Fellow, Research Institute of Economy, Trade and Industry (RIETI), Tokyo. September 2002.*

[28] *"From Supply to Demand: Moving Toward a New International Business Development Paradigm" for CMP Media LLC by KWR International Inc. October 2005.*

'The smiling curve" theory was developed by Acer Computer founder Stanley Shih is based on his realization that U.S., European and Japanese manufacturers retained the most profitable functions while outsourcing only production and assembly, which had the thinnest margins.'



from a peak of 580,132 in 1950 to 282,864 in 2004, its lowest level since the late 1800s.

The present financial crisis, however, is leading to a more serious reevaluation of this trend. This is creating a growing determination among policymakers as to how best to reverse this loss of industrial capacity and reinvigorate U.S. manufacturing. President Obama clearly expressed this sentiment at Georgetown University in April 2009. Noting that a changing economy means fewer people will be going into finance and Wall Street jobs, he said: "One of the changes that I would like to see—and I'm going to be talking about in this in weeks to come—is seeing our best and our brightest commit themselves to making things—engineers, scientists, innovators. For so long, we have placed at the top of our pinnacle folks who can manipulate numbers and engage in complex financial calculations. And that's good. We need some of that. But you know what we can really use is some more scientists and some more engineers who are building and making things that we can export to other countries."

At the same time, concern over climate change and a desire to promote the "industries of the future" and to channel stimulus funds into productive investments is leading to an emphasis on green jobs and renewable energy. Advocates of green jobs often claim what makes them so important is they are difficult to ship overseas. One reason is equipment such as windmills and other large industrial components are bulky, heavy and expensive to ship. Other jobs, such as green construction, retrofitting and remediation tend to be localized and done by American workers in local communities.

Given Buffalo Niagara's aging industrial and residential building stock, as well as its long experience managing the challenge of deindustrialization, it may have an advantage. As the local business development manager said: "We have a strong industrial and component base. There are many opportunities. I help clients achieve

[29] *"Race, Neighborhoods and Community Power, Buffalo Politics 1934-1997" Neil Kraus State University of New York Press. November 2000.*

POPULATION CHANGE SINCE 1950

JURISDICTION/POPULATION	1950	1970	1990	2000
Buffalo (city)	580,132	462,768	328,123	292,648
Remainder of Erie County	319,106	650,723	640,409	657,617
Buffalo-Niagara MSA	1,089,230	1,349,211	1,189,288	1,170,111
New York state	14,830,192	18,241,391	17,990,455	18,976,457
United States	151,325,798	203,302,031	248,709,873	281,421,906

Source: U.S. Census Bureau/OSP Information & Data Analysis

Buffalo Niagara has been a victim of this movement toward deindustrialization and a greater reliance of services for many decades. Those employed in manufacturing within Buffalo declined from about 45% in 1950 to about 18% in 1990. The city's population also declined from a peak of 580,132 in 1950 to 282,864 in 2004, its lowest level since the late 1800s.

amazing efficiencies by upgrading antiquated lighting, equipment and facilities. This is the type of thing that can be replicated and developed, providing the skills and knowledge needed to compete elsewhere."

There is, however, an emerging concern: If the U.S. is able to engineer the surge in green-oriented manufacturing it is seeking, will the wages provided be sufficient to replace those that have disappeared? For example, a recent report from Good Jobs First (GJF)[30] states it's not uncommon for workers in the green field to earn as little as $8.25 an hour. This is well below the income needed to support a single adult with one child.

While perhaps not as large as the figures noted above, this shortfall was also referenced by the local business owner: "We have a 32,000-square-foot facility here and the pay scale here isn't anywhere near what GM was."

More specifically, the U.S. Bureau of Labor Statistics says the average wage for production workers on manufacturing payrolls in durable-goods industries is $18.88 an hour, yet the majority of wind and solar companies surveyed by GJF pay far less.

It cites United Solar Ovonic, which received subsidies of up to $277,000 for every new job created. United Solar then got into a dispute with Battle Creek, Mich., before agreeing to pay workers $14 an hour, well below the average wage for production workers in the durable goods industry. In New York there have been proposals to require certain minimum-wage levels as a condition of receiving financial incentives. This will require a careful balance between a desire to attract industry and address local labor force's interests.

Another problem in contemplating a shift from traditional to green manufacturing is labor unions. Given the green industry is very new, few workers and companies are backed by collective-bargaining agreements.

While the answers to these questions are still emerging, it is clear the current economic crisis is greatly increasing their importance. It is causing business, government, academia and U.S. society itself to challenge assumptions, which have become common wisdom over the past few decades. Within this paradigm, companies accepted the promise of globalization with little regard to local impact, and their managements were often rewarded for their expertise in financial, rather than industrial, engineering and M&A over operating expertise. The search for alternative energies can greatly benefit, and draw upon, Buffalo Niagara's experience, which can be used not only to examine the problem but to devise a solution.

This is true not only because Buffalo Niagara, with a broad diversity of industrial, physical, logistical and human resources, has the underlying capacity and capability; but also because it has decades of experience dealing with deindustrialization, reindustrialization, and

[30] *High Road or Low Road? Job Quality in the New Green Economy. Philip Mattera. Good Jobs First. February 2009.*

training and other programs oriented toward displaced workers, unions and the allocation of scarce resources. Unlike the Detroit metro area, whose fortunes are tied to automobiles, Buffalo Niagara has experience across a wide range of sectors. In a sense, the region serves as an ideal laboratory in which to research, debate and discover the business, social and financial solutions and initiatives needed to initiate not only a new "green paradigm" but also the commitment to "making things" that President Obama spoke of in his Georgetown visit.

This entails not only the actual production but also the higher value-added engineering, research and development, and other ancillary services and branding that have been increasingly moving off U.S. shores.

Is Success Simply a Case of Better Promotion & Outreach?

Many people interviewed in Buffalo Niagara expressed the belief that most of the essential elements were already in place and that economic development could be significantly enhanced through better marketing and promotion. As the business development manager commented, "Buffalo is trying hard to attract people. We can offer hydropower and the cost of housing and living is low. You can be an instant hero if you open a business. Toronto is close by, we have sports teams, a major university, hunting and the space and infrastructure needed to support new facilities as they emerge."

In a similar vein, the attorney noted: "Buffalo has very unique attributes. We have significant transportation capacity; on the Bethlehem steel site we even have a railroad. There are many shovel-ready sites, and we have all the capacity one needs to conduct a range of industrial activity. We are well-situated and there is a lot of opportunity here. We are hosting this year's national solar conference at least partially due to the wind turbines on the lake, and we are encouraging business-to-business linkages. We are at a crossroads here between Canada, the Northeast and the Midwest. Small-town values, sports teams and great parks. But we need to let people know. How many locations have brownfield sites that will give you a 20% tax credit immediately? We have acres of that as well as numerous greenfield sites."

Buffalo's advantages, however, will mean little if the region is unable to attract the entrepreneurs, companies and investors who can make use of it. "We need to promote and bring the investors in one at a time," said the attorney. "There is no one big silver bullet."

The problem is that all locations have perceived strengths and an ability to present available information in the best positive light. Evaluating and comparing the real differences between them takes substantial work and most potential investors are not willing to conduct the necessary due diligence until an initial determination has been made and a short list prepared.

There is also a tendency in economic development programs to rely on incentives and to confuse tactics with strategy. This results in excessive focus on occasional trade shows or other special events, rather than the positioning and underlying strategy needed to define and communicate a region's unique strengths and competitive advantage in a credible and coherent manner.

In addition, an ongoing capacity to service, identify and nurture contacts, to build a network of potential investors and other core constituencies through continual follow up and support, is absolutely essential.

The local business development manager's comments reflected the complexity of this mission: "If you can demonstrate this is a lower-cost and more efficient place to operate through a value chain that possesses both the industrial base and the educational resources, employees, housing and other necessary attributes, that is a major advantage. But you can have all the critical inputs in place and the whole value chain identified and still need to attract the critical mass of companies needed to effectively utilize them. That is where we fall short at present."

Do Investors & Site Selectors Help Those Who Help Themselves?

Buffalo Niagara clearly has an ability to bridge gaps, explore synergies and provide industrial capacity across a wide range of emerging green- and alternative-energy sectors. It also has superior logistical and geographic infrastructure: cost and lifestyle advantages and one of the largest public universities in the Northeast. These are just a few of the many characteristics that serve as a foundation and will help the region as it seeks to position itself as an emerging center for manufacturing green and renewable-energy equipment and components.

Economic-development initiatives, however, sometimes tend to place all their energy on attracting new companies—the bigger the better—with the assumption this will lead to large increases in incremental employment.

This is problematic for several reasons. First, as one local university professor who focuses on community involvement in the green-energy sector noted: "There is really a need to build up your own capacity rather than just saying we want someone to come from the outside to locate here. That could happen, but it is more likely if you are committed and involved in all aspects of being a green community."

Second, the ability of Buffalo Niagara to define itself as a green community, a region that has both the capacity and desire to support and nurture green business and infrastructure is extremely important. It will lessen the need to rely on tax cuts and other incentives and place Buffalo Niagara's destiny more firmly in its own hands rather than relying on measures that must be enacted in Albany or on the federal level.

Business executives have repeatedly stated that in most cases, incentives are usually secondary considerations. It is not that they don't matter and that locations should not use incentives to tip the scales in their favor, but, rather, the provision of value and ability of a location to define itself as a desirable location for a particular industry lessens the need for these cost-inducements. This results in more profitable arrangements for the region and, in most cases, the firm itself.

In that sense, one can view the need for incentives as being negatively correlated to a destination's underlying attractiveness. While the Internet and modern telecommunications have made site location more flexible, many firms continue to pay premiums to locate in places they believe enhances their competitiveness. For example, many entertainment firms locate in Los Angeles even though it would be less expensive to base them elsewhere. The same can be said for technology and Silicon Valley, government services and Washington, financial and service firms and New York City, Latin American private banking and Miami, and oil services in Houston.

The professor said that taking steps to nurture local green initiatives "creates a knowledge base as well as brand and connections. It also introduces synergies and creates local demand for green products and services. This creates a laboratory and an interest and exchange of ideas on the local level. So all those things point to not how we can attract businesses, but how we can green ourselves. Ultimately, this will achieve the same goal, potentially with higher value and success.

"What has happened in a lot of cities has been the formation of a 'green team," he added. "Seattle, Milwaukee, Cincinnati, Portland, San Francisco, New York and Toronto have all drawn up green plans, bringing together business, city and community groups to form and implement a sustainability plan. This can include offering subsidies to help businesses that expand in a green way."

A similar sentiment was expressed by the Director of an Industrial Training and Consulting Center who suggested "Build programs – and form a regional steering committee with cross functional input. This should include state, federal and local economic development agencies and business associations as well as the private sector, academia and community groups. They need to identify the top five priorities to focus on, identify industry sector champions, target sectors, vision, leadership, resources, documents, marketing, and an integrated programmatic approach. This can then serve as a conduit for communication and the sharing of ideas within the region and nationally."

While that is sound advice at any time, it is particularly salient when talking about green and alternative energy. That is because this sector is still in formation and no location at present can lay claim to being a preeminent "focal point", in the same way that Detroit became the "Motor City", or the other cities listed above for their own respective industries.

This is especially relevant given the current financial and economic uncertainty, which negatively impacting corporate expansion strategies and the ability to access capital. This is requiring local regions to both depend more on their own actions and to make up for deteriorating fundamentals. Enhanced efforts are therefore necessary to define and communicate a region's strengths so they will be able to stand on their own and when appropriate, to make their site the one most worthy of consideration.

VII CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS OF THE REPORT

The uniqueness and potential of Buffalo Niagara in renewable energy rests far more with its ability to provide credible capacity across all the sectors examined in this report rather than any individual area or sub-sector. This is not to suggest the region does not have areas of relative strength, such as hydropower, given the existence of Niagara Falls; solar, with the subsidized supply of high-

Brian Pickard, shutterbug.com

'This underlying diversity makes Buffalo Niagara an ideal laboratory to explore America's reindustrialization.'

grade silicon from Globe Metals and industrial gases and other essential resources from local suppliers; or wind, due to the existence of Steel Winds and related industrial and metals-related firms. Rather, it is to recognize the future of renewable energy will stem from an ability to mix and match utilization between different sectors within an upgraded grid. Furthermore, a multitude of locations can demonstrate strength within individual sectors but few can demonstrate the same across-the-board competitiveness as Buffalo Niagara. This would appear to be, not only its primary area of strength, but a basis for enhanced growth and profitability, as well as wider participation across this emerging field.

Perhaps the most important finding of this report resulted from the portion of analysis in which Buffalo Niagara was compared to three other locations in each of the 10 sectors examined. In almost every other occasion, the NAICS codes were highly concentrated, with a small number accounting for the vast majority of revenues generated. This was true even in Dallas (where two codes in Waste Management accounted for 57.4% of revenues) and Los Angeles (where four codes in Energy Transmission and Storage accounted for 66.55% of revenues) even though one would think these larger markets would have greater diversity than Buffalo Niagara. In comparison, few codes in Buffalo Niagara's case exceeded 12% of revenues and only one in all 10 sectors examined (Electric Power Generation in Energy Transmission and Storage) reached 14.09%. Buffalo Niagara (despite the noted statistical distortions) appears to have a far more diverse and balanced industrial base, at least within the NAICS codes and locations analyzed in this report. This provides it with a major advantage as it seeks to provide industrial capacity and ancillary services to firms seeking to manufacture equipment, components and other green and renewable energy-related products.

This underlying diversity makes Buffalo Niagara an ideal laboratory to explore America's reindustrialization. Current economic turmoil is causing U.S. business, government and academia to more seriously face up to the problem of deindustrialization and to determine how best to reinvigorate manufacturing in the U.S. This is an area that has long been neglected due to the theory the U.S. could compete in financial and other services, branding and distribution, while leaving "dirtier" production to lower-cost suppliers overseas or in the southern U.S. where companies could bypass higher union wages and costlier infrastructure in more established manufacturing centers. This trend hit regions such as Buffalo Niagara especially hard, leading to displaced workers, urban blight, population flight, poverty and a range of other serious economic and social problems.

The prospect of bankruptcy for major U.S. automotive makers is one of many factors leading to a realization the nation can no longer neglect its industrial capacity. The challenge, however, is to rectify this in a manner that can enhance its competitiveness and innovative

abilities, attract talent, resist the allure of protectionism, deal with climate change, energy security and supply, while maintaining and expanding U.S. living standards. This must also be done in a way that can access the long-neglected productive capacity and skills based in the rust belt that have been burdened by the legacy and transformational costs Buffalo Niagara and other locations have had to deal with for several decades. As the nation prepares to debate and form the policy responses to deal with these essential challenges, Buffalo Niagara can play a vital role in devising solutions, given its broad industrial base and experience with these issues.

In a U.S. that embraced outsourcing production to overseas suppliers, there was little emphasis on locating businesses in the rust belt and other areas known for their manufacturing prowess. This was particularly true with new industries such as personal computers. Embracing the "smiling curve" theory highlighted in the previous section, corporate headquarters, research, design and marketing functions were based in locations such as Silicon Valley, which also possessed venture capitalists, attorneys and other service providers while production and procurement were increasingly sourced overseas. Gradually, some of these higher-value functions also moved overseas as skill levels rose and there was a need to be closer to the producers.

While this will remain a problem moving forward, there is some evidence that in the case of green and renewable energy, access to industrial capacity in the U.S. will prove an advantage. One reason is that large-scale products such as windmills are difficult to ship and localized production provides an advantage. These sectors also rely on government stimulus and incentives, which are subject to conditions. Many also believe green manufacturing is better able to draw on the NAICS codes and facilities offered in traditional manufacturing centers, which will facilitate activity given their skilled work force and the contract workshops and parts suppliers that abound. It is also possible to transform older facilities for modern use with substantial cost savings. One example is Globe Metallurgical, which is refurbishing and reopening a furnace and plant closed in 2003, but has a history back to the 1890s. RiverWright, in a similar project, plans to transform 75-year-old grain elevators into a $185 million ethanol production facility and the basis for a larger-scale "renewable-energy corridor."

The many additional benefits, such as the Northeast's largest public university, which houses New York's second-largest engineering department, lower housing and living costs, and the capacity to compete across almost all renewable-energy sectors being examined, makes Buffalo Niagara an ideal platform from which to commercialize green and renewable energy-related products.

Furthermore, the confluence of factors that contributed to Buffalo's rise as a major manufacturing and transportation center in the 19th and early 20th century—including its strategic location between the Northeast, Midwest and Canada, access to waterways and hydroelectric power, and a skilled, well-organized unionized work force—ultimately contributed to its downfall. The rise of the railroad, automobile and airplane made water transportation less essential, improved electricity transmission reduced the need to be close to Niagara Falls, and advances such as the computer, air-conditioning, automation and telecommunications introduced far more flexibility as to where companies were able to base industrial facilities. History moved on and a once-thriving municipality saw itself fall from America's 13th-largest city at the onset of the Great Depression to a region now considered one of the nation's 20 most quickly deteriorating areas. The enormous challenge to restore the region's competitiveness caused Harvard professor Edward Glaeser to write an article "Can Buffalo Ever Come Back?" in the City Journal 's Autumn 2007 edition.

If one subscribes to a cyclical approach to history, however, and a belief the "cover story" often marks the bottom or top of a trend, there is ample reason to believe the forces that led to Buffalo Niagara's decline have now begun to reverse themselves. While it is true "history does not repeat itself" as Mark Twain stated "it does rhyme." Movement toward increased attention on green and alternative-energy technologies as well as President Obama's speech regarding the need for America to again focus its attention on "making things" serve as two of many indicators pointing to the dramatic shift in values, business strategies, and economic and political priorities that has begun to take hold in the U.S. Over time, this can help lead to the region's resurgence.

This will not, however, happen simply by inviting companies to set up new facilities. It will require substantial, proactive, and concerted effort and leadership by business, government and academia on local, state and national levels. It will also require careful positioning and the development of wide networks and input from numerous additional entities around the world.

Many of the same attributes that led to the region's original rise, including access to water and hydroelectric power, a strategic position among the Northeast and Midwest and Canada, a skilled work force, established

industrial capacity and building stock (much of which can be utilized at a fraction of the cost of new facilities), can once again provide it with an advantage. Furthermore, its ability to provide credible capacity in almost all alternative-energy solutions now being proposed, the presence of the Northeast's largest public university and a relatively low cost structure are just a few of many factors that provide the region with an ability to become a center of innovation where "Industry Creates Energy."

MAJOR CONCLUSIONS

•The new green economy offers Buffalo Niagara unique job-growth opportunities as alternative-energy demand grows. The potential stems from its ability to provide manufacturing capacity in almost all alternative-energy sectors, rather than any one area or sub-sector.

•Buffalo Niagara can be competitive in securing green jobs because it has a more diverse, balanced industrial base than competitors. This provides an opportunity to take a leading role as a component supplier in numerous aspects of renewable-energy use and production.

•Buffalo Niagara can establish itself as America's reindustrialization model in the new green economy and serve as a laboratory for restoring manufacturing jobs.

•Buffalo Niagara has the opportunity to establish itself as a North American center for the commercialization of green and renewable-energy-related products.

•Positioning Buffalo Niagara as a region where "Industry Creates Energy" can allow the region to participate in a revitalized American economy by capitalizing on its historic advantages to reclaim its manufacturing heritage and create new jobs.

Additional Findings:

•Green-economy jobs are the basic manufacturing and construction jobs that have been Buffalo Niagara's historic strength and can be repurposed to energy and environmental conservation with moderately upgraded skills. They are accompanied by jobs centered on innovation and entrepreneurship that lower costs and facilitate use of alternative-energy sources. Buffalo Niagara has the right mix of research capabilities, facilities, companies and skilled labor to be an active participant in capturing green jobs and attracting new businesses.

•Manufacturing will play a vital role in the green economy. Manufactured goods are required throughout the value chain of renewable-energy generation and the derivative functions of transmission and storage, transportation, building materials, and solid-waste disposal. The U.S. government's large investments in the green economy—and those of other nations—as an economic stimulus makes manufacturing-job growth inevitable and a significant opportunity for Buffalo Niagara.

•The greatest opportunities for manufacturing and job creation are likely in the solar and wind sectors as they should experience the most rapid growth. Biomass, hydropower and geothermal also offer significant manufacturing opportunities within their value chain. Nuclear power plant construction would offer highly significant opportunities for manufacturing growth, including a demand for heavy-industry products.

•Government incentives to shift to alternative energies and energy conservation will create growth in new industries that will require manufactured components. These include the construction of a new energy grid transmission system; fuel-efficient transportation; energy-efficient appliances and building materials; and equipment related to recycling, reuse and disposal. In addition to manufacturing, this will create jobs in research, technology, engineering and support services.

•Buffalo Niagara's access to population centers, proximity to Canada, Great Lakes location and transportation infrastructure are significant advantages in attracting green jobs. In particular, its proximity to Toronto and southern Ontario holds potential for the region to benefit from green initiatives for private-sector expansion implemented by national and provincial governments of Canada and the U.S.

•Buffalo Niagara's existing manufacturing base, facilities and skilled work force can be the foundation for green-job growth. The region has a significant number of companies that manufacture components similar to those required in alternative-energy supply chains.

•In the academic and private sectors, the region has ongoing research and development programs related, directly or indirectly, to the research and development required in a green economy. A primary strength is the UB School of Engineering, since the growth of a green economy demands highly qualified engineers in all sectors.

•Component manufacturing for alternative-energy facilities does not necessarily have to take place nearby. It

is, however, an advantage for component manufacturers to be close to alternative sources of energy generation. Buffalo Niagara has opportunities for both large- and small-scale generation of alternative energy.

•Wind is likely to offer the greatest opportunity for the region to generate large-scale alternative energy that can be supplied to the grid. The region's rural areas, Great Lakes shoreline, and Lake Erie's off-shore facilities have been classified as significant wind-resource areas. Wind is a sector where proximity plays a large role, since parts of the wind turbines are large and difficult to transport.

•While the region has more solar availability then is generally thought, large-scale solar generation is not likely to be feasible given current technology. Solar is, however, feasible as a supplemental energy source in micro-grids and as an energy source in commercial buildings and homes. The region's ability to provide high-grade silicon to the photovoltaic industry offers opportunities for growth in PV manufacturing and related facilities.

•Hydropower generation can play a significant role in the region's alternative-energy generation if emerging technologies in hydrokinetic turbines prove feasible. The Niagara River, both above and below the Falls, can prove a significant source of low-cost electricity.

•Large-scale geothermal-energy production is not likely to be feasible for the region, although commercial and residential heat pumps are feasible in most areas. There are, however, pockets of significant geothermal energy in the southern and eastern portion of the region.

•Biomass and biofuels offer potential growth. The region has facilities for large-scale biomass storage (grain elevators) and bulk transport. Massive landfills can be a methane-gas source. Rural areas could be utilized for biomass production when economically and environmentally feasible crops are identified.

•Though placing a nuclear plant in the region might meet opposition, significant manufacturing opportunities associated with producing parts for nuclear plants exist elsewhere. In particular, such plants require steel and cast-concrete production of the type once done in the region but which has since moved overseas.

•Energy-efficient construction/retrofit, building a new national energy grid system, of energy-efficient transportation production, and recycling and reuse equipment can create new manufacturing opportunities that can utilize the region's traditional manufacturing strengths.

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•The region does not have a "green image," which is important to green-economy investors and entrepreneurs. Buffalo fails to rank in any national green-communities listing largely because the region's leadership has not embraced an environmental-economy concept.

•At the local level, the region has not formulated special incentives or programs that would foster green jobs that need not be cost-intensive. There has been little follow-up on green-program plans. Building codes in most communities do not address energy-efficiency issues. Government building programs or companies receiving government assistance have not been required to address energy issues.

•New York's reputation as one of the worst states in which to do business is a particular disadvantage upstate where the counterbalance of proximity to New York City does not exist. Though the state has taken a strong role in encouraging alternative-energy production, it has not addressed the overarching problem of high taxes and fees with complicated laws and regulations that are a disincentive to investment.

•New York is a leader in energy incentives. However, little effort has been made to link these programs to traditional-manufacturing incentive programs as they might apply to the alternative-energy value chain. These multiple-state programs, plus multiple local incentive programs, create a bureaucratic obstacle course that keep companies from accessing applicable incentives and making New York competitive with other states.

RECOMMENDATIONS OF THE REPORT

Establishing Buffalo Niagara as one of the most attractive centers for green and renewable energy-related manufacturing will not happen by itself or come about through the entry of one or more new companies into the region. It will require intensive effort and cooperation among the diverse group of constituencies that must contribute to the success of an initiative of this kind.

This is particularly true in the current environment where companies are extremely reluctant to expand and make new investments, and there is substantial competition from numerous other states and local governments that are also focusing on green initiatives. Forming an ongoing "Green Team" with representation from important internal constituencies, possibly supplemented by an outside advisory group and governed by a steering committee, will help in this regard. It would allow greater cooperation and commitment, the development of a consensus, guidelines, and a green and sustainability plan.

Subcommittees could also be formed to focus on important areas of concern. For example, an education committee might promote cooperation between UB—and other schools—and businesses to facilitate relevant research, employment, briefing sessions, seminars and training. A manufacturing committee could explore measures to assist local businesses expanding into green and alternative-energy products. A finance and entrepreneurship committee might propose noncash incentives to facilitate new business creation and encourage investment in local projects. A grass roots committee could focus on green housing, energy efficiency, urban farming, and other community programs including support for local green businesses and awareness.

If Buffalo Niagara is to develop the "soft infrastructure" that will enable it to become a top choice for green and renewable energy-related manufacturers, it must demonstrate a clear commitment to developing a supportive business environment as well as to become a region dedicated to utilizing green technologies and practices.

This is essential since innovators, thought leaders and others committed to this field are not simply seeking locations that offer cash and business incentives. While incentives are necessary, it is far better to emphasize value over cost and to provide a venue where these entities want to work and live and where local companies can see these technologies in action. This will not only attract new investment but provide a local test laboratory that encourages innovation, awareness, direction, cooperation and synergies that might not otherwise be realized. It will also reduce Buffalo Niagara's environmental footprint and equate the region with green, clean and renewable energy in the minds of its citizens, green-oriented companies, policymakers and the public.

The Green Team can act as a clearinghouse, facilitating cooperation and communication among internal constituencies. Since Buffalo can truly be a demonstration project for the rest of the state and nation, the region should seek state and federal funding for these activities in addition to local contributions from foundations, government, academia and business groups.

But this will not be enough. No one entity or group is likely to possess the time, resources or manpower required to translate rhetoric into action and to address the competitive challenges of the many other regions and municipalities with similar aspirations. Further action will be necessary to realize the goal of establishing Buffalo Niagara as a leader, rather than a follower, in developing a new green economy.

It is not enough to talk about Buffalo Niagara's attractions and quality of life, its ability to deliver incentives, or even to use tangible examples of both industrial success stories and a commitment to creating a green economy on a local level. Buffalo Niagara should seek to embed itself in the center of thought and discussion concerning green reindustrialization and other issues that reflect its capabilities and strategic objectives.

Acting as host of the 2009 National Solar Conference is the kind of model activity that allows local businesses to meet, present themselves to and begin developing relationships with industry participants from the U.S. and other locations. Workshops on issues such as "Commercializing Green Manufacturing," "Developing a Green Work Force," "Making Brownfields Green," "Urban Renewal in a Green Economy" and "Financing Green Entrepreneurship" could be undertaken through the cooperative efforts of entities such as Buffalo Niagara Enterprise, Buffalo Niagara Partnership, UB, Alfred University, the Center for Industrial Excellence, the Southern Tier West Regional Planning and Development Board, ESDC, NYSERDA, and other relevant local, national and international entities. Participants could include companies, academics, journalists, service professionals and others with an interest and the results could be broadcast over the Internet and published in reports to attract and interest a national and global audience with similar concerns.

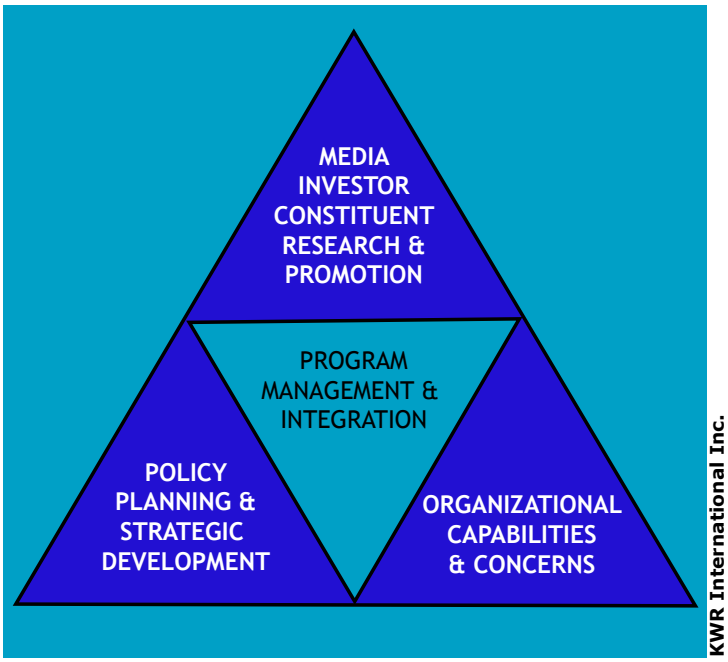
This will help to develop the knowledge base, place Buf-

falo Niagara in the center of this discussion and activity, and, through direct participation and promotion, familiarize industry thought leaders and other targeted individuals with Buffalo Niagara's commitment and what it has to offer. That will also help BNE and other entities to identify and to attract prospective investors into the region on a more cost-effective basis.

Too often, economic-development programs consist of occasional reports and publications, special events and trade-show appearances with little regard to continuity, the development of an overall strategy, and the ongoing follow-up and support needed to nurture, maintain and maximize sustainable interest and results.

To achieve the desired results, BNE could, with input and participation from other important internal constituencies, conduct a planning session to refine the "Industry Becomes Energy" theme and other ideas identified within this report with the goal of organizing an integrated support and outreach program. This should be done in a manner that successfully balances the core functions outlined in the diagram. It illustrates the need for, and relationship between, media/investor/constituent outreach and promotion; policy, planning and development; organizational capabilities and concerns; and the program management and integration needed to gain support across institutions and to access the resources necessary to mount a credible effort.

All of these factors need to be placed into a cohesive structure, designed to address agreed-upon goals, needs and objectives. This is the only way to achieve real and sustainable results. Without an appropriate emphasis on policy, planning and strategic development, it is pointless to undertake outreach and promotion. Similarly, necessary infrastructure must be in place to handle the added demands generated through effective outreach and to manage the needs and demands of potential investors and other internal and external constituencies.



KWR International Strategic Matrix

MAJOR RECOMMENDATIONS

•Buffalo Niagara should consider forming a regionally based "Green Team" to facilitate and guarantee the region's participation in the new green economy. It should provide leadership and foster cooperation and commitment among all constituencies for the development of a consensus, guidelines and a green sustainability plan.

•Buffalo Niagara should position itself for a leadership role in the new green economy by developing the soft infrastructure that will complement the manufacturing infrastructure already in place. This will require initiatives by government, business, academia and the comunity as whole in supporting green technologies and practices. The establishment of Buffalo's green identity is vital to the attraction of new investment and jobs.

•Buffalo Niagara should encourage its institutions, organizations and businesses to actively participate in the global dialogue on, and development of, alternative-energy production to establish a leadership role in green-manufacturing processes and green jobs.

•Buffalo Niagara should develop an integrated green initiative for the regional promotion and coordination of planning and policy development, organization capabilities and program management to build the foundation of a credible action plan and agenda for outreach and promotion that will generate new jobs and investment.

ADDITIONAL SUGGESTED ACTIONS

•The region should help existing companies retool, remarket and reinvent themselves as green companies; develop programs for existing manufacturers to help them identify new product lines that are in demand as the alternative energy industry grows; and work with training providers to upgrade labor skills that match demands for trades based on energy conservation.

•The region has the ability to put together manufac-

turing sites and facilities that would reduce a manufacturer's carbon footprint in "low-carbon energy zones." Niagara Falls hydropower could be used to supplement micro-grids of wind, solar and hydrokinetic-generated power systems as well as the development of brownfield sites to drastically reduce the pollutants used in manufacturing. This would give a unique competitive advantage to a small manufacturer and be of high interest to large companies concerned about total company emissions under any future carbon cap-and-trade system.

•Buffalo Niagara should work with its educational institutions to enhance research on green manufacturing and develop new programs and adapt existing ones to the new green-economy requirements. The region can seek out the development of overlapping technologies in fields such as biomedical research that might have application to alternative-energy development.

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•The region should package and market energy incentives with traditional manufacturing incentives and new federal programs, promoting them in the context of the region's strengths in the green economy. With many opportunities emerging at once, the region can distinguish itself by providing advisory and other support services to entrepreneurs and companies that can expand the region's growth in the new economy.

•Buffalo Niagara should accelerate its efforts to rebrand itself as a green community. Government should provide leadership by working closely with citizen groups that have been working toward such a goal and lead by example. Sustainability offices in local government should be established to provide leadership and ideas, tap into new federal resources, and save tax dollars over the long term.

•Tax breaks and other incentives for energy-efficient buildings can encourage retrofits and enhance the feasibility of new construction, thereby encouraging the creation of new companies and new jobs.

•Buffalo Niagara should aggressively examine and pursue green-energy opportunities specific to its location on the Great Lakes and transform Ontario from a competitor into a partner. It should work with local citizen groups, academic instituitions and binational and Canadian organizations to develop the Great Lakes potential in wind and hydrokinetic energy in a sustainable, environmentally friendly manner.

•Buffalo Niagara can take advantage of its proximity to southern Ontario and Toronto companies that are developing new green technologies. The region can facilitate partnerships with U.S. firms and institutions and offer assistance in developing manufacturing facilities for new products to serve the U.S. market.

•Buffalo Niagara should develop a global plan to facilitate access to international markets and to seek foreign investments and partnerships with companies in Canada, the EU, Asia and locations that have established leadership roles and wish to participate in alternative-energy development. It should develop a global marketing effort to facilitate outreach to alternative-energy companies, building on Niagara Falls' fame as one of the world's largest and oldest sustainable energy sources.

•Buffalo Niagara should form a task force of industry experts to determine ways it can assist its auto-part manufacturers in being ready to participate in new alternative-fuel vehicles that will be produced in coming years. It should also seek and implement any actions it can take to ensure a place in battery and fuel-cell production for vehicles. Similar efforts can be undertaken in other sectors.

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APPENDIX

COMPONENT INDUSTRIES IN RENEWABLE ENERGY BY NAICS CODE

NIACS	Description	Biomass	Hydro	Storage	Geo	Green Building	Grid	Nuclear	Solar	Transp	Waste	Wind
111110	Soybean Farming	●										
111120	Oilseed (except Soybean) Farming	●										
111150	Corn Farming	●										
111199	All Other Grain Farming	●										
111998	All Other Misc. Crop Farming	●										
113210	Nurseries/Gathering Forest Prod.	●										
115114	Postharvest Crop Activities (ex. Cotton Ginning)	●										
115115	Farm Labor Contractors	●										
115310	Support Activities for Forestry	●										
211111	Hydroelectric Power Generation		●		●							
221113	Nuclear Electric Power Generation							●				
221119	Other Electric Power Generation		●	●	●		●		●			●
221122	Electric Power Distribution	●	●	●	●	●	●	●	●			●
221330	Steam & Air-Conditioning Supply											
236115	New Single F. Housing Const/					●						
236116	New Multifamily Housing Const.					●						
236117	New Housing - (spec) builders					●						
236118	Residential Remodelers					●						
236210	Industrial Building Construction	●				●					●	
236220	Comm./Instit. Bldg Construction					●						
237130	Power/Comm. Line/Reated. Structures Const.	●	●	●	●	●	●	●	●			●
238220	Plumbing, Heating, and Air-Conditioning Contractors					●			●			
321113	Sawmills	●										
321999	All Other Miscellaneous Wood Product Mfg	●				●						
322110	Pulp Mills	●										
322121	Paper (except Newsprint) Mills	●										
322299	Cardboard, All Other Converted Paper Product Mfg	●		●								
324110	Petroleum Refineries	●										
324199	All Other Petrol/Coal Prod. Mfg	●										
325188	All Other Basic Inorganic Chemical Mfg.							●				
325193	Ethyl Alcohol Mfg	●										
325199	All Other Basic Organic Chemical Mfg	●										
325211	Encapsulant	●							●			
326113	Rear Layer								●			

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COMPONENT INDUSTRIES IN RENEWABLE ENERGY BY NAICS CODE

NIACS	Description	Biomass	Hydro	Storage	Geo	Green Building	Grid	Nuclear	Solar	Transp	Waste	Wind
326199	All Other Plastics Product Mfg			●		●						●
326299	Fuel cells, solid-state			●					●	●		●
327211	Top Surface					●			●			
327993	Mineral Wool Mfg	●				●				●		
331210	Iron/Steel Pipe/Tube Mfg from Purchased Steel	●	●		●	●		●		●		
331316	Aluminum Extruded Product Mfg			●					●			●
331421	Copper Rolling, Drawing, and Extruding	●	●	●	●	●	●	●	●	●	●	●
331511	Iron Foundries		●		●			●		●		●
332111	Iron and Steel Mills		●	●	●	●	●	●		●		●
332112	Nonferrous Forging			●			●					
332996	Fabricated Pipe and Pipe Fitting Mfg		●		●			●		●		
332311	Prefabricated Metal Building/ Component Mfg					●		●	●			
332312	Fabricated Structural Metal Mfg	●	●	●	●	●	●	●	●	●	●	●
332313	Plate Work Mfg											
332322	Sheet Metal Work Mfg	●	●	●	●	●	●	●	●	●	●	●
332410	Power Boiler/Heat Exchanger Mfg	●			●			●	●	●		
332420	Metal Tank (Heavy Gauge) Mfg	●			●			●		●	●	
332911	Industrial Valve Mfg	●	●		●		●	●		●	●	●
332999	All Other Misc. Fab. Metal Product Mfg	●	●	●	●	●	●	●	●	●	●	●
333120	Construction Machinery Mfg	●				●		●			●	
333132	Oil/Gas Field Machinery and Equipment Mfg				●							
333210	Sawmill and Woodworking Machinery Mfg	●										
333291	Paper Industry Machinery Mfg	●										
333298	All Other Industrial Machinery Mfg	●						●			●	
333411	Air Purification Equipment Mfg	●				●				●	●	
333412	Industrial/Commercial fans/blowers	●			●	●			●	●		●
333414	Heating Equip.(ex. Warm Air Furnace) Mfg	●							●	●		
333415	Air-Con/Warm Air Heating Equip. & Comm./Indust. Refrig. Equip. Mfg.	●	●		●	●	●		●	●		
333611	Turbines, Turb. Generators, & Turb. Gen. Sets	●	●	●	●							●
333612	Speed Changer, Industrial	●	●	●	●							●
333613	Power Transmission Equip	●	●	●	●		●	●	●			●
333911	Pump/Pumping Equip. Mfg	●	●		●			●	●	●		
333912	Air/Gas Compressor Mfg	●		●	●				●	●		●
333922	Conveyor/Conveying Equipment Mfg	●								●	●	

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COMPONENT INDUSTRIES IN RENEWABLE ENERGY BY NAICS CODE

NIACS	Description	Biomass	Hydro	Storage	Geo	Green Building	Grid	Nuclear	Solar	Transp	Waste	Wind
333923	Overhead Traveling Crane, Hoist, Monorail Mfg	●	●		●			●		●	●	
333995	Fluid Power Cylinder/Actuator Mfg	●	●		●			●		●	●	●
333997	Scale/Balance (ex Laboratory) Mfg	●										
333999	All Other Misc. Gen. Purpose Mach. Mfg	●										
334112	Computer Storage Device Mfg	●	●	●	●	●	●	●	●	●	●	●
334413	Solar Cells								●			
334418	Printed circuit electronic assemblies	●	●	●	●	●	●	●	●	●	●	●
334512	Automatic Environmental Control Mfg for Residential, Commercial, and Appliance Use					●	●					
334513	Instruments/Products Mfg for Meas., Display Control	●	●	●	●	●	●	●	●	●	●	●
334515	Meter (Instrument Mfg for Measuring and Testing Electricity and Electrical Signals)	●	●	●	●	●	●	●	●			●
334519	Other Measuring/Controlling Device Mfg	●	●	●	●	●	●	●	●	●	●	●
335110	Electric Lamp Bulb/Parts					●						
335121	Resid. Electric Light Fixtures					●						
335122	Commercial, Industrial, Instit. Lighting Fixtures					●						
335129	Other Lighting Equipment (floodlights, street lights)					●						
335221	Household Cooking Appliance					●						
335228	Other Major Household Appliances					●						
335311	Power, Distribution & Specialty Transformer Mfg	●	●	●	●	●	●	●	●	●		●
335312	Motor and Generator	●	●	●	●	●	●	●	●	●	●	●
335313	Switchgear/SwitchboardApparatus Mfg	●	●	●	●	●	●	●	●	●		●
335314	Relay and Industrial Control	●	●	●	●	●	●	●	●	●	●	●
335911	Storage Battery			●		●	●		●	●		●
335912	Primary Battery Mnf			●		●				●		
335931	Electrical Connections	●	●	●	●	●	●	●	●	●	●	●
335999	Charge Controller		●	●	●	●		●	●	●		●
336111	Automobile Mfg									●		
336112	Light Truck and Utility Vehicle Mfg									●		
336399	All Other Motor Vehicle Parts Mfg	●								●		
336510	Railroad Rolling Stock Mfg	●								●		
423720	Plumbing/Heating Equip. Merch./ Wholesalers	●	●			●			●			
423930	Recyclable Material Wholesalers	●									●	
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	●			●	●						
541310	Architectural services	●	●	●	●	●	●	●	●		●	●

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COMPONENT INDUSTRIES IN RENEWABLE ENERGY BY NAICS CODE

NIACS	Description	Biomass	Hydro	Storage	Geo	Green Building	Grid	Nuclear	Solar	Transp	Waste	Wind
541330	Engineering Design Services	●	●	●	●	●	●	●	●	●	●	●
541350	Building Inspection Services					●						
541380	Testing Laboratories	●	●		●	●	●	●			●	
541420	Indust. Design Svcs (Energy Effic.)					●						
541618	Utilities Mgt Consulting Svcs					●	●					
541620	Envir. Consulting Svcs	●	●	●	●	●	●	●			●	●
541690	Energy Consulting Services	●	●	●	●	●	●	●	●	●	●	●
541710	R&D in Physical, Engineering, and Life Sciences	●	●	●	●	●	●	●	●	●	●	●
562111	Solid Waste Collection	●				●					●	
562112	Hazardous Waste Collection							●			●	
562119	Other Waste Collection					●					●	
562211	Hazardous Waste Treatment/ Disposal							●			●	
562212	Solid Waste Landfill	●				●					●	
562213	Solid Waste Combustors and Incinerators	●				●						
562219	Other Nonhazardous Waste Treatment/Disposal	●				●					●	
562910	Remediation Services	●				●		●			●	
562920	Materials Recovery Facil.	●				●					●	
562991	Septic Tank & Related Svcs					●					●	
562998	All Other Misc Waste Mgt Svcs					●					●	

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