Growing Green: The Potential for Green Job Growth in Tennessee

Department of Labor and Workforce Development
Employment Security Division
Labor Market Information Section

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Executive Summary

- Tennessee is at the forefront of investment in key areas of renewable energy (RE) and energy efficiency (EE) technology, including alternative fuels, energy conservation, solar photovoltaic, and electric and hybrid vehicles. Investment in energy technology is viewed as a key to the state's economic development and job creation.
- In March, 2008, Governor Phil Bredesen signed an Executive Order establishing the Governor's Task Force on Energy Policy. The Task Force is to develop a state energy plan by December, 2008 addressing broad ranging energy efficiency and renewable energy policies. State government will lead by example in conserving energy.
- Important milestones in moving towards an energy policy include: (May , 2008) adopting minimum energy conservation standards in the new state Energy Code for Residential Building, which can be used by builders on a voluntary basis; (April, 2008) mandatory policies for energy efficiency in state buildings; (January, 2008) the Comptroller's report "State Government Energy Conservation Efforts;" and in the spring of 2007, the Biofuels Initiative.
- Green jobs have been defined as family-supporting jobs that contribute significantly to preserving or enhancing environmental quality. They reside primarily in sectors that compose the clean energy economy – efficiency, renewables, alternative transportation, and fuels. [1]
- Areas of most promise for alternative energy resources in Tennessee include biomass, geothermal heat pumps, hydropower, solar photovoltaic, wind, and energy efficiency. [2]
- A 2004 study found that every 1000 MW of developed wind power created the potential for 3,000 jobs in manufacturing, 700 jobs in installation, and 600 in operations and maintenance. [3]
- Part of Tennessee's loss of manufacturing jobs in the 1990's and early 2000's could be replaced by jobs in renewable energy, particularly in the manufacture of wind and solar components.
- In the U.S., the total number of direct and indirect jobs in energy efficiency (EE) is nearly 18 times greater than the number in renewable energy (RE). Employment growth in RE jobs is expected to be much faster than in EE jobs, however; 24% compared to 3.5%.
- TVA's renewables supply (other than hydro) is nearly 50 MW, with half of that in wind energy.
- Early estimates were that with an accelerated investment effort Tennessee could gain 4,233 full time jobs in wind and nearly 400 in solar by 2015.
- With commercial implementation of biofuels, in several years, an estimated 4,000 jobs could be created in rural Tennessee counties, with a potential for 3,000 additional jobs in satellite plants.
- Creating energy efficient buildings is considered the most cost-effective way to reduce our energy consumption in the U.S. Buildings account for 40% of U.S. energy use and produce 43% of carbon emissions. Energy consumption in buildings could be reduced 23% by 2025 through EE measures. Due to the potential for significant savings with relatively short payback periods, job creation related to improving energy efficiency is needed and can take place in every community.
- Tennessee's universities are essential partners in identifying new pathways to transform the state's energy use. For example, Tennessee Technological University's Industrial Assessment Center has identified industrial energy reductions of from 3% to 40%. [5]
- Home construction is being transformed by energy-saving technology. It is possible to build homes today in Tennessee that can save 60 to 70% on energy, using advanced technology such as heat pump water heaters; alternative technologies for roofing, utility walls, ventilation, exterior walls, and the basement; and through use of the renewable technologies of solar panels and geothermal. [6]

- Tennessee is at the forefront of research in reducing residential and commercial energy consumption. Oak Ridge National Laboratory (ORNL) is participating in a U.S. Department of Energy initiative to develop affordable, net-zero-energy housing by 2020 and zero-energy commercial buildings by 2025. This could spur future job growth if incentives and credit policies revive housing and commercial construction in 2009.

- Based on findings from a state retrofit pilot program, an estimated 2,000 jobs could be created by the State of Tennessee and Tennessee higher education if retrofitting were accomplished to create a conservative 25% savings in energy use in buildings.
- Industrial and environmental engineers, construction managers, customer service representatives, wholesale sales representatives, electricians, plumbers, millwrights, and mobile heavy equipment mechanics could be some of the occupations experiencing shortages with higher investments in energy efficiency and renewable energy.
- Policies to grow the green workforce in Tennessee need to include reemployment efforts for manufacturing workers and creation of more effective education and career opportunities for lower income workers including women and minorities.

- Due to the far-ranging changes in technology and the many innovations in EE and RE that are taking place, additional studies will be needed to identify the industries most affected and to further define skill shortages and emerging occupations.
- New estimates for jobs to be created in Tennessee through the use of key green technologies are significant. Recent estimates are that more than 40,000 direct, indirect, and induced jobs could be created from $1.9 billion invested in energy efficient building retrofits; mass transit and freight rail; smart grid; and renewables including wind and solar power and advanced biofuels.
- Meeting the needs of the clean energy economy will require Tennessee to upgrade the skills of its workforce. Investment in state and local green collar worker training will be needed at all levels –
  - -high school career and technical science and pre-engineering courses;
  - -on-the-job training programs;
  - -certificate programs at Tennessee technology centers;
  - -union apprenticeship programs for skilled trades;
  - -associate degree programs in areas such as renewable energy installation and audits; and
  - -bachelor's and master's programs in science, engineering and management related to agriculture and green technologies.
- New energy technologies will require a workforce prepared to design, build, and implement the technologies. A demand-driven model will need to closely link regional economic development and workforce development.

Introduction

On July 22, 2008, the president and chief executive of Nissan, Carlos Ghosn, announced that the company had signed a memorandum of understanding with Gov. Phil Bredesen to work jointly with the state and TVA to develop a charging network for plug-in electric vehicles in Middle Tennessee. Nissan plans to start producing the zero emission electric vehicles in 2010. [8] The partnership with Nissan, now headquartered in Tennessee, marks a new era in the state's path to respond to climate change and promote the development of green jobs.

Global warming and the perils of dependence on crude oil with ever rising prices can no longer be ignored. Recognizing that changes must be made in the way energy is created and used, in March 2008, Tennessee Governor Phil Bredesen signed an executive order establishing the Governor's Task Force on Energy Policy. The charge to the task force is to develop, by December 2008, a state energy plan addressing broad ranging energy efficiency and renewable energy policies and strategies.

Additionally, the governor intends state government itself to be a leading player in conserving energy. [9] The Tennessee Comptroller's audit report "State Government Energy Conservation Efforts" [10] points out that the Governor's Energy Policy Work Group confirms that energy conservation must be the cornerstone of any long term energy policy in Tennessee.

The Audit states that energy efficiency can provide tremendous economic and environmental benefits. By reducing energy use it can improve industrial competitiveness, help community development, reduce business and household costs, and meet short term increases in demand. It will boost innovation with new ways to produce goods and services, heat and cool buildings, and power vehicles.

Conserving energy in transportation can include telecommuting, mass transit, and other alternative transportation strategies; reducing the number of miles traveled will reduce emissions and energy use. New transportation technologies such as alternative fuel vehicles and advanced engines and components (including plug in hybrids) can increase efficiency and reduce emissions. With 23 counties not meeting federal Environmental Protection Agency (EPA) air quality standards, reducing emissions is an important public health goal for Tennessee.

Renewable fuels (such as E85- ethanol and B20- biodiesel) can increase energy security while reducing emissions. At the same time, they can positively impact the economy of Tennessee's rural counties.

Recent initiatives indicate that energy-related policy, grants, loans, and research, as well as public and private investments, are moving Tennessee's economy into the future. The Tennessee Valley Authority has developed some renewable energy resources. The state is now poised to make greater progress in developing these resources, as well as promoting greater energy efficiency.

Since Tennessee uses more residential electricity per person than any other state (in 2005, Tennessee averaged 6,868 kwh per person annually; California averaged 2,379), these steps are essential. TVA currently has a goal of reducing peak electricity use by 1,400 MW within five years; in May 2008 they set a goal of generating half their power from low or non-carbon-producing sources by 2020. [11]

Maximizing this progress will have several advantages. It will lessen our dependence on fossil fuels, and reduce the negative health and environmental effects of their emissions. It can also help preserve and increase a precious resource, Tennessee jobs. Current employment related to energy efficiency and renewable energy, the potential for developing new jobs, and the skills that are and will be required to meet these new employment challenges are the focus of this report.

Tennessee has lost more than a hundred thousand manufacturing jobs since 1997, nearly 54,000 of them in the durable goods manufacturing industries. These are precisely the industries that could gain employment if renewable energy component manufacturing could be expanded in the state. Tennessee already has some key manufacturing facilities here for renewables. A much broader possibility for job growth is from energy efficiency, which can create energy savings of 25 to 40% in many residential and commercial buildings, and additional savings for industrial users. Every city has the potential for considerable savings and job creation.

Promising biofuels initiatives are already employing farmers to grow biomass crops such as switchgrass which can create jobs in rural areas. Geothermal applications, especially in the government and residential sectors, can create jobs in construction and installation. Public support for the development of new energy saving and creating technologies will be strengthened when accompanied by workforce policies and investment that create high skill and high wage jobs in viable long term industries in Tennessee.

Green-focused Workforce Development

Expansion of the number of jobs in the green economy sector could serve several purposes important to Tennessee's workforce: reducing the unemployment rate; reducing manufacturing job losses and employing dislocated workers; increasing income growth; encouraging students and workers to complete high school and college training at higher rates; and providing more direct employment paths for women and minority workers into better jobs.

For these reasons, the Labor Market Information Unit of the Tennessee Department of Labor and Workforce Development's Employment Security Division has identified and analyzed the occupations most likely to be affected by an economy increasingly focused on energy efficiency (EE) and renewable energy (RE). The focus was on five RE and EE sectors:

- Green Building
- Biofuels
- Wind Energy
- Solar Energy
- Geothermal Energy

A total of 162 occupations with significant employment in the above sectors, most requiring some training, were identified. Of these, nearly 60% were high skill; at least half were high wage; and more than two out of three were occupations in demand (already experiencing some shortages).

Some of the occupations which may be in short supply in the energy efficiency and renewable energy sectors include industrial, environmental, and electrical engineers; customer service personnel; construction and farm managers; civil engineering technicians; computer controlled machine tool operators; skilled trades people; heating and air conditioning mechanics; millwrights; and machinists.

Key knowledge categories for success in green jobs include production skills; English, mathematics, and customer and personal service; transportation, administration and management; and biology and chemistry.

The Energy Independence and Security Act (EISA) was signed into law on December 19, 2007. Key features of the legislation include: increased fuel economy and incentives, an Energy Efficiency and Conservation Block Grant program with awards to state and local governments, and requirements for federal and commercial buildings to be more energy efficient.

Title X of the EISA is the Green Jobs Act, for which $125 million was authorized but not appropriated. State components of the program were to include state labor market research, energy training partnerships, and demonstrations of programs to provide pathways out of poverty, including a comprehensive supportive services component.

Leverage of funds is important- state and local governments and private sector partnerships that have already invested in their own green jobs initiatives are more likely to be awarded grants.

Despite the lack of funding, the U.S. DOL, in consultation with DOE, was required to establish the Energy Efficiency and Renewable Energy Worker program by May 2008. Some of the EISA funds may be used for preliminary grant making for the Green Jobs Act. This may provide an opportunity for states to move ahead with labor market research and with demonstration training programs for green jobs.

A demand-driven workforce policy focused on green jobs in Tennessee will require: creating the demand, building partnerships for training, providing pathways out of poverty, and continuing to leverage political support for this economic transformation.

The following sections will examine the need for green jobs, current estimates for the U.S., Tennessee's resources and initiatives, the characteristics of potential occupations, current training underway, and positive policies for promoting green job growth in Tennessee.

The Need for Renewable Energy and Energy Efficiency in the U.S. and Tennessee

This paper will explore projections for growth in "green" industries nationally and in Tennessee. Various scenarios for growth will be explored. Growth in these emerging industries has been highly dependent on federal and state incentives to spur growth. After the price of oil rose to more than $130 a barrel in the summer of 2008, however, alternatives to fossil fuels began to appear increasingly attractive, which may spur a higher rate of private sector investment.

Failure to act on climate change can have negative economic consequences. A report prepared by Sir Nicholas Stern, former chief economist of the World Bank, for the U.K. government in October 2006 concluded that the cost of extreme weather events could reach .5 to 1% of GDP by the middle of the century; a 2 to 3 degree Celsius rise in temperature could reduce global output by 3%; and a rise of 5% could result in 10% of global output being lost.[16] The mid-2008 floods of Midwest prime agricultural areas could indicate that the economic losses due to inaction on climate change may already be reality.

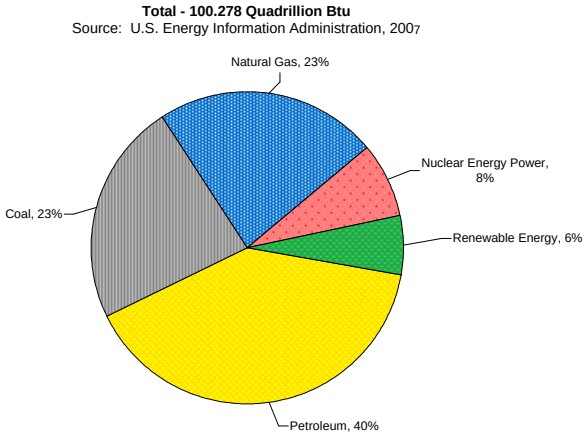
Sustainable or alternative energy production can be divided into three main categories. The first is energy generation from renewable sources (RE), consisting of wind, solar, hydro/marine, biofuels/biomass, and geothermal. RE sources increase the supply of energy or replace current supply. A second category is energy efficiency (EE), which reduces the demand for energy. EE can be achieved through changes in lighting; use of glass; and the construction, retrofitting, and operation of buildings. The third category, transportation, can incorporate both — RE can be used as alternative sources of power, and EE achieved through increasing fuel mileage.

Tennessee is uniquely situated to propel RE and EE forward. Tennessee is one of the top 10 states to lose manufacturing jobs in the 1990's and early 2000's. However, with a large manufacturing base and an experienced manufacturing workforce, Tennessee is positioned to move forward with activities such as wind and solar component manufacturing. As one of the states under the Tennessee Valley Authority (TVA), groundbreaking efforts in RE and EE have taken place which can be revived.

The disadvantage is that TVA's relatively cheap power has pushed electricity consumption in Tennessee to one of the highest levels in the U.S. A lack of focus on EE in the last few years as the population has increased puts Tennessee in a position somewhat behind other states in implementing RE and EE policy. However, several recent initiatives are underway which have promise for fostering the growth of RE and EE.

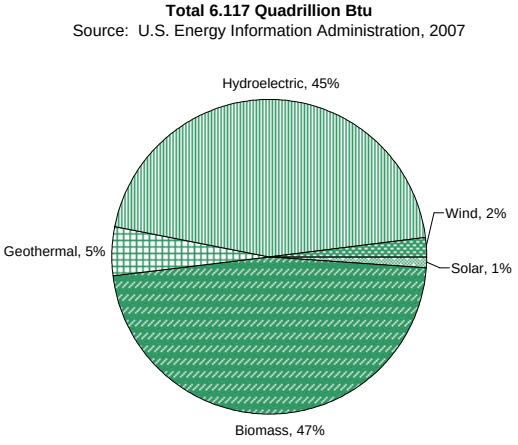
A recent report by the American Solar Energy Society (ASES) cites the U.S. Energy Information Administration's data on power sources in the U.S. in 2006. [17] Measured in quadrillion British thermal Units (BTU's), the sources are:

All Energy Sources



Renewable Energy (6%)

Within the 6% produced by renewables (6.117 quadrillion BTU), the individual sources are as follows:



Although the proportions seem small, growth in the emerging renewables sector has been significant. According to ASES: [18]

"Renewable energy and energy efficiency technologies (RE and EE) are driving significant economic growth in the United States. In 2006, these industries generated 8.5 million new jobs, nearly $970 billion in revenue, more than $100 billion in industry profits, and more than $150 billion in increased federal, state, and local government tax revenues."

Impact of Federal and State Policies and Funding on Energy Research, Production, Distribution, and Use in Tennessee

Federal and state government policies on energy efficiency and renewable energy have been major drivers of energy-related activities in Tennessee. These policies, whether in the form of grants, loans, tax credits and other financial incentives or of unfunded mandates, will continue to provide the foundation for Tennessee's progress in this sphere.

Federal Incentives and Mandates

Federal policy affects Tennessee both directly and indirectly. Directly, it can require and fund changes in energy production and use by Tennessee residents, businesses, communities and agencies. As only one example of many, Tennessee has received startup and administration grants under the U.S. Department of Energy's Clean Cities Program, a program promoting the purchase of alternative fuel vehicles and expansion of infrastructure needed for refueling. There are now active Clean Cities programs in east, west and middle Tennessee.[19] Some of the major federal incentives and initiatives are summarized in Table 17, page 60; Table 18, page 64; and Table 19, page 66. Additionally, some federal programs administered by departments of Tennessee's government are listed in Table 20, page 67 and Table 21, page 69.

Indirectly, federal policies affecting use of biofuels across the country can accelerate Tennessee-based research and stimulate agricultural and manufacturing opportunities in the state. This was recognized in a January 2006 report "Alternative Fuels and Tennessee", which alludes to the federal Energy Policy Act of 2005 as an incentive for the state to "capture a share of this growing market as federal renewable fuel requirements take effect." [20]

The Energy Independence and Security Act signed into law in December 2007 promises added stimulus. Among its incentives, the act authorizes solar energy and geothermal grants to states. [21] It also initiates grants to implement a broad array of energy efficiency measures, including an Energy Efficiency and Conservation Block Grant Program. [22] And the act's mandate for renewable fuel standards for vehicles, with cellulosic and biomass diesel fuels specified, can be expected to spur additional biofuel research and implementation efforts in Tennessee. [23]

State Incentives and Mandates

Among the most active departments of Tennessee government in administering federal and state energy programs and funds are the Departments of Agriculture, Transportation, Environment and Conservation, as well as the Department of Economic and Community Development through its Energy Division. Additionally, the Department of General Services and the Department of Finance and Administration hold responsibility for the energy efficiency of state government buildings and vehicles.

Tennessee government has become increasingly active in developing policies and dedicating funds to energy efficiency and renewable energy. Beginning in 1987, a small business energy loan program has encouraged businesses to upgrade buildings and equipment for greater energy efficiency. A similar loan program has encouraged local governments to retrofit public buildings for greater energy efficiency since 1991. [24]

The state's investment in time and money intensified following adoption of the state's first official energy policy in 2002. [25] From 2003 on, both the governor and the General Assembly began encouraging study and action in identifying problems and solutions relating to energy use in Tennessee. [26] The pace of state funding accelerated beginning with the Tennessee Clean Energy Technology (TN-CET) grant program in 2006. [27] In an effort to help reduce electrical energy and fossil fuel use, the state has instituted grants, loans, and production and tax incentives to businesses, local governments and school systems, and state-funded universities. Table 20, page 67).

Although, some funds have been offered to encourage use of solar and wind as renewable energy sources, biofuels have received most of the attention. A feedstock processing loan program and the Tennessee Biodiesel Manufacturer Grant program initiated in 2007 have provided incentives for businesses. Alternative Fuel Innovation Grants in 2007 encouraged local governments and state-funded universities to invest in alternative fuels. [28] The 2007 Biofuel Green Island Corridor Grant Project's $1.5 million in grants to encourage retail fuel stations to install equipment to pump E85 ethanol and B20 biodiesel has been one major investment. [29] As of July 2008, the state's Bio-Tenn website listed 37 B20 biodiesel refueling stations in 20 counties and 16 E85 ethanol stations in 10 counties. [30]

Synergy between State and Federal Investments

Tennessee has unique potential for contributing to the growth of the green economy and green jobs through the relationship between the University of Tennessee (UT) with the U.S. DOE's largest science and energy laboratory, the Oak Ridge National Laboratory (ORNL). [31] ORNL houses the Bioenergy Science

Center, Buildings Technology Center, High Temperature Materials Laboratory, and the National Transportation Research Center, all committed to researching and developing energy-efficient products ranging form zero-energy homes to electric cars. [32, 33]

In a complex and productive relationship, the University of Tennessee is ORNL's largest research partner, conducting more than $20 million annually in joint research. [34] Among these research ventures is the Joint Institute for Biological Sciences. [35]

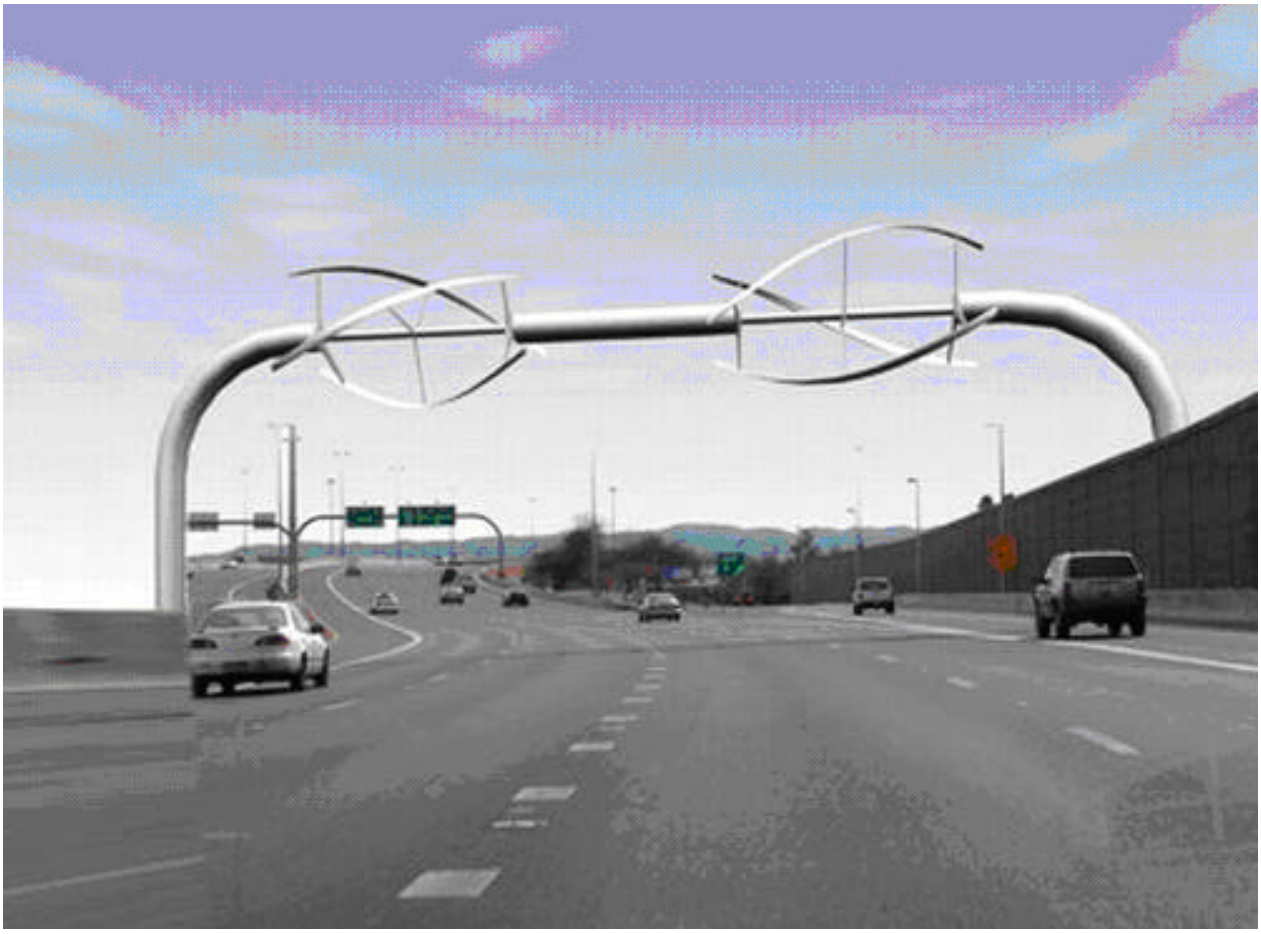
Tennessee Research Dollars More Than Matched by Federal Dollars

The importance of Tennessee's investment in energy innovation is illustrated in the impact of its **5-year commitment of $70 million state dollars** for the UT Biofuels Initiative. Kelly J. Tiller, Ph.D., Director of External Operations at UT's Office of Bioenergy Programs, reported to a state government committee in February 2008: "Your commitment has been leveraged to help Oak Ridge National Laboratory secure **$135 million from the US Department of Energy** last year for one of three new [national] Bioenergy Science Centers. ORNL's Bioenergy Science Center is up and running, housed in the new **state-funded** Joint Institute for Biological Sciences (JIBS) building." [36]

State and federal governments acting together are putting in place two of the necessary elements for ethanol innovation. Through the UT Biofuels Initiative, they are funding a demonstration biorefinery and, in conjunction, are providing incentives for local farmers to grow the feedstock for the refinery, switchgrass. Switchgrass is not now grown commercially in Tennessee, but it holds promise as a viable non-food feedstock for ethanol. This governmental partnership is expected to yield promising research on cost-effective processes for producing cellulosic ethanol. [37]

In addition, a public-private partnership is increasing the probable success for this experimental venture: DuPont Danisco Cellulosic Ethanol, LLC has contracted to develop and operate the biorefinery. An April 2008 grant of $26 million for the refinery from the U.S. DOE recognized the importance of this research.

These recent state and federal government policies and funding are intended to increase both the demand for and the supply of ethanol. Demand for ethanol and biodiesel is being increased as both levels of government mandate purchase of flex fuel government vehicles and increased use of renewable fuels. And Tennessee's incentives for fueling stations to provide biodiesel and high-ethanol gas for their customers can also increase demand. The government-funded experiment to produce cellulosic ethanol is expected to result in increased supplies of non-food-based fuel to help meet some of this demand.



These turbines sit over the road. It is the turbulence of the vehicles passing below that drive the turbines around. It is this movement that generates the power. The idea came from a student from Arizona State University, and each turbine would be capable of generating enough power to light up a medium sized apartment, even if the wind is only at a low 10 mph.

Table 1 Major Tennessee State Government Milestones

Energy Efficiency and Renewable Energies Policies and Funding
2002 Forward

May 2002	Tennessee's first official energy policy adopted based on policy recommendations of the Governor's Interagency Energy Policy Work Group established by Executive Order 27, in July 2001. http://state.tn.us/enviroment/altfuels/pdf/draftreport.pdf
July 2003	Executive Order 11 charges commissioners of several departments of state government to partner with local governments and the business community to achieve new federal air quality standards. http://state.tn.us/enviroment/altfuels/pdf/draftreport.pdf
2004 and 2005	Public Chapter (PC) 891 enacted in 2004 directs the Comptroller of the Treasury to provide recommendations to encourage the production and distribution of biodiesel and ethanol. The Comptroller's report, "Ethanol and Biodiesel: Questions and Answers", is issued in March 2005. http://state.tn.us/enviroment/altfuels/pdf/draftreport.pdf
2005	General Assembly passes Senate Joint Resolution 251 and House Joint Resolution 92 supporting renewable energy and energy conservation in state agencies. http://state.tn.us/enviroment/altfuels/pdf/draftreport.pdf
January 2006	Work group created by commissioners of five state departments submits report "Alternative Fuels and Tennessee" recommending increased production, distribution and use of biofuels in the state. http://state.tn.us/enviroment/altfuels/pdf/draftreport.pdf
2006	A "State Building Energy Management Program Status Report" cites an energy cost spike of 12.5% in most recent year for which data were available. However, attention to energy efficiency is expected to produce annual savings in Tennessee Board of Regents buildings, and energy cost savings are reported for several executive branch agencies and departments. http://state.tn.us/finance/rpa/documents/SBEM2006RptLeg.pdf
February 2006	Governor signs Executive Order 33 creating the Alternative Fuels Working Group consisting of commissioners of six state government departments and charged with developing a comprehensive state alternative fuels strategy. http://www.tennesseeanytime.org/governor/viewArticleContent.do?id=740&page=1
February 2007	Governor makes $3.5 million available in grants and loans recommended by the Alternative Fuels Working Group: up to $1 million in Agricultural Feedstock Processing Loans to encourage development of soybean crushing facilities; $1 million in Alternative Fuel Innovation Grants to encourage cities and universities to use alternative fuels in their fleets; and $1.5 million in the Green Island Corridor Grant Project to encourage establishment of a statewide network of 70 new E85 (ethanol) and B20 (diesel) refueling stations. http://state.tn.us/environment/news/release/2007/Feb/altfuels.shtml
Spring 2007	General Assembly commits to funding the University of Tennessee Biofuels Initiative: $40.7 million for capital expenditures for a cellulosic biorefinery and $8.25 million for research, farmer incentives, and operating expenses as part of the General Assembly's 5-year commitment of $70 million. http://www.utbioenergy.org/TNBiofuelsInitiative/About.htm
May 2007	First Governor's Conference on Biofuels convenes, sponsored by the state Alternative Fuels Working Group.http://www.biotenn.org/docs/word/05-31-07%20Governor%20Bredesen_Biofuels%20Conference.doc

Table 1 Major Tennessee State Government Milestones

Energy Efficiency and Renewable Energies Policies and Funding
2002 Forward (continued0

May 2007	Governor endorses the goals of the 25 X '25 initiative goal for the nation to provide 25% of its energy from its farms, ranches and forests by 2025. http://biotenn.org/docs/pdf/05-22-07%2025x25%20letter_PBN.pdf
July 2007	Governor announces recipients of a total of $881,000 in Alternative Fuel Innovation Grants to 3 cities and 4 state colleges and universities. http://tennessee.gov/environment/news/release/2007/Jul/altfuelgrants.shtml
December 2007	U.S. Environmental Protection Agency selects Tennessee State Employee Recycling Program as State Government Partner of the Year for fifth year in a row. http://www.state.tn.us/environment/news/release/2007/Dec/wastewiseaward.shtml
January 2008	Audit report by the Comptroller of the Treasury, "State Government Energy Conservation Efforts", suggests governmental costs and risks could be reduced by reducing energy consumption by state governmental entities and by developing alternative fuels. http://www.comptroller1.state.tn.us/repository/SA/pa07110.pdf
January 2008	Governor's 2008-2009 budget includes $5.6 million for the University of Tennessee Biofuels Center and $4 million for the state's alternative fuels initiative. http://www.25x25.org/index.php?option=com_content&task=view&id=405&Itemid=57
March 2008	Governor signs Executive Order 54 establishing the Governor's Task Force on Energy. The task force is required to present findings and recommendations by July 1, 2008 and to deliver a state energy plan to the governor by December 1, 2008. http://www.state.tn.us/ecd/energypolicy.htm http://www.state.tn.us/ecd/pdf/energy/Executive order_54.pdf
April 2008	Governor signs bill making mandatory a set of policies for energy efficiency and management of buildings operated by state agencies and by colleges and universities operated by the Tennessee Higher Education Commission and the State Board of Education. These policies had been initiated in 2001 as voluntary guidelines known as the "Energy Action Plan for Tennessee Buildings". http://www.General Assembly.state.tn.us/bills/currentga/Chapter/PC0718.pdf
April 2008	General Assembly becomes the 14th state legislature to endorse the "25 X '25" goal for the nation to provide 25% of its energy from its farms, ranches and forests by 2025 while continuing to produce safe, abundant and affordable feed and fiber. http://www.25x25.org/index.php?option=com_content&task=view&id=405&Itemid=57
May 2008	Governor chairs first meeting of Governor's Task Force on Energy. http://www.tennesseeanytime.org/energy/
May 2008	General Assembly passes Green Energy Tax Credit legislation for "certified green energy supply chain manufacturers" initiating or expanding facilities in Tennessee with an investment of at least $250 million. http://www.General Assembly.state.tn.us/bills/currentga/asp/WebBillInfo/Summary.aspx?BillNumber=SB4173

Table 1 Major Tennessee State Government Milestones

Energy Efficiency and Renewable Energies Policies and Funding
2002 Forward (continued0

May 2008	General Assembly passes State Energy Code for Buildings establishing the minimum energy conservation standards for any new residential building construction on or after January 1, 2009, as the 2003 International Energy Conservation Code and encourages builders to voluntarily comply. http://legislature.state.tn.us/bills/currentga/asp/WebBillInfo/Summary.aspx?BillNumber=SB0116
June 2008	Governor's Task Force on Energy holds second meeting on June 6, 2008 http://bree.tnanytime.org/energy/sites/default/files/Task%20Force%20mtg%20summary%206%206%20finalr_0.pdf
June 2008	Governor appoints four-member ad hoc group of Task Force members to develop immediate recommendations for energy efficiency measures for state government buildings and vehicles and present them at the third Task Force meeting on July 16, 2008. http://www.tennessean.com/apps/pbcs.dll/article?AID=2008806080412
June 2008	General Assembly enacts the "Energy Efficient Schools Initiative (EESI) of 2008." A twelve-member Energy Efficiency Schools Council is empowered to raise funds and award grants and loans to school systems for capital outlay projects to establish and support energy management programs. http://legislature.state.tn.us/bills/currentga/Chapter/PC1188.pdf

The Growth of the Renewable Energy and Energy Efficiency Industries in the U.S. and Tennessee

Green jobs have been defined as family-supporting jobs that contribute significantly to preserving or enhancing environmental quality. They reside primarily in sectors that compose the clean energy economy – efficiency, renewables, alternative transportation, and fuels. [39]

A more complete definition has been developed by the United Nations Environment Program. Green jobs are defined as follows:

…positions in agriculture, manufacturing, R and D, administrative, and service activities aimed at alleviating the myriad environmental threats faced by humanity. Specifically, but not exclusively, this includes jobs that help to protect and restore ecosystems and biodiversity, reduce energy consumption, decarbonizes the economy, and minimize or altogether avoid the generation of all forms of waste and pollution. [40]

Current and Projected National Employment in Jobs Related to Energy Efficiency and Renewable Energy

The majority of jobs created by renewable energy and energy efficiency are not emerging jobs — they are standard jobs in such occupations as accountants, engineers, computer analysts, factory workers, and truck drivers. The following table displays estimates of the number of jobs in the renewable energy sectors in the United States in 2006 — both direct and indirect jobs — from a recent study by the American Solar Energy Society (ASES). [41]

Wind farms like that at Kahuku have been built for 20 years. Hawaii is well placed to take advantage of wind power.
Credit: Hawaiian Electric Light Company (HELCO)

Table 2 Number of U.S. Jobs in Renewable Energy in 2006

Industry Segment	Direct Jobs	Total (Direct plus Indirect) Jobs Created
Wind	16,000	36,800
Photovoltaics	6,800	15,700
Solar Thermal	800	1,900
Hydroelectric Power	8,000	19,000
Geothermal	9,000	21,000
Biomass		
Ethanol	67,000	154,000
Biodiesel	2,750	6,300
Biomass Power	66,000	152,000
Fuel Cells	4,800	11,100
Hydrogen	4,000	9,200
Total, Private Industry	**185,150**	**427,000**
Federal Government	800*	1,850
DOE Laboratories	3,600**	8,300
State and Local Government	2,500	5,750
Total Government	**6,900**	15,870
Trade and Professional Associations and NGOS	1,500	3,450
Total, All Sectors	**193,550**	**446,320**

Source: Management Information Services, Inc. and American Solar Energy Society, 2007

**Includes Federal employees and direct support contractors.*
***Includes Federal employees, laboratory employees, and direct support contractors.*

Projected Growth of Renewable Energy

The ASES made two sets of projections for job growth in the renewable energy sectors through 2030 – a base case and a moderate scenario. [42]

In the **Base Case**, involving little policy change, total direct and indirect jobs would increase by 190% from 446,320 to 1.3 million. Over the 24 years from 2006 to 2030, then, growth would be approximately 7.9% per year on average for all sectors combined.

In the **Moderate Scenario**, with 15% of electricity generation attributable to renewable energy, total direct and indirect jobs in RE increase to 3.1 million. This is an increase of 595% or approximately 24% per year between 2006 and 2030.

Table 3 Number of U.S. Jobs in Energy Efficiency in 2006

Industry Segment	**Direct Jobs** (thousands)	**Total** (Direct plus Indirect) **Jobs Created** (thousands)
Insulation	26	60
ESCO (Energy Service Co.)	19	44
Recycling	1,310	3,013
Vehicle Manufacturing	165	380
Household Appliances and Lighting	86	198
Windows and Doors	51	117
Computers, copiers and FAX machines	312	718
TV, video, and audio equipment	183	421
HVAV systems	45	104
Industrial and related machinery	76	175
Miscellaneous durable manufacturing	389	894
Nondurable manufacturing	528	1,214
Utilities	14	32
Construction	227	522
Total, Private Industry	**3,431**	**7,892**
Federal Government EE Spending	15	35
State Government EE Spending	28	64
Local Government EE Spending	21	48
Total Government	**64**	**147**
Trade and Professional Associations and NGOS	3	7
Total, All Sectors	**3,498**	**8,046**

Source: Management Information Services, Inc. and American Solar Energy Society, 2007

Jobs Created by Energy Efficiency

Trying to identify industries related to EE is difficult because most EE spending relates to segments of large industries, such as vehicles, buildings, lighting, and appliances. The ASES study, for the private sector, included insulation sales, energy service company (ESCO) industry sales, and the U.S. recycling and reuse industry sales. In addition:

For other industries, we only included the portion of their sales that related to EE. For example, we included vehicles that get at least 10 percent better mpg than the CAFÉ mileage as energy efficient vehicles. We used the Energy Star ratings for lighting products and household appliances, windows and doors, and components of the industrial sector. [43]

Table 3 shows the ASES estimates of the number of jobs in 2006 in the U.S. in the energy efficiency industries, including both direct and indirect jobs. In the direct jobs category, energy service companies (ESCO), insulation, and utilities jobs together are estimated at 59,000; construction jobs related to energy efficiency at 227,000; and recycling at 1,300,000. (Recycling can include both manufacturing and non manufacturing activities). The remainder of the jobs, about 54%, are in the manufacture of energy efficient vehicles, appliances, and other products (see Table on this page). [44]

Projected Growth for Energy Efficiency

ASES produced two sets of projections for energy efficiency job growth to 2030, the base case and the moderate scenario.

In the **Base Case**, involving little policy change, total direct and indirect jobs would increase by 85% from 8 to 15 million. Over the 24 years from 2006 to 2030, growth would be approximately 3.5% per year.

In the **Moderate Scenario**, with 15% of electricity generation attributable to renewable energy and similar growth forecast for the deployment of energy efficiency technologies, total direct and indirect jobs in EE increase to 17.8 million. Over the 24 years from 2006 to 2030, this is an increase of 123% or 5.1 % per year.

ASES concludes, "Thus, under all scenarios RE growth is much larger than EE growth, but the economic and job impact of EE remains orders of magnitude larger than RE." [45] With the moderate growth scenario, a total of 20,963,000 jobs would be created in RE and EE industries in the U.S.— 3,138,000 direct and indirect jobs in RE, and 17,825,000 direct and indirect jobs in EE.

Switchgrass is one of the materials that can be used to produce ethanol from cellulose.
Credit: Marie Walsh, University of Tennessee

Tennessee's Electricity Generation

Before looking at the potential for RE and EE jobs in Tennessee, it is useful to look at the current sources of electricity generation. Tennessee's electric power is provided by the Tennessee Valley Authority (TVA). In December 2007, Tennessee 's total net electricity generation was as follows: [46]

Net Electricity Generation	MWh	% of Total	Share of U.S.
Total Net Electricity Generation	7,870 thousand MWh	100.0	2.3%
Petroleum-Fired	19 thousand MWh	0.2%	0.7%
Natural Gas-Fired	36 thousand MWh	0.5%	0.1%
Coal-Fired	4,990 thousand MWh	63.4%	2.9%
Nuclear	2,611 thousand MWh	33.2%	3.6%
Hydroelectric	207 thousand MWh	2.6%	1.1%
Other Renewables	45 thousand MWh	0.6%	0.5%

Source: U.S. Energy Information Administration, State Energy Profiles, May 2008

Three fifths of the electricity in Tennessee is generated by coal, most of which is imported from other states. Tennessee is among the leading nuclear power states in the country, with two plants located near Chattanooga, and is one of the top hydroelectric power producers east of the Rocky Mountains. Tennessee is first in the U.S. in per capita residential electricity consumption. The importance of increasing energy efficiency and increasing renewable production is clear.

TVA reported on the current renewables supply as of January 1, 2008: [47]

TVA Current Renewables Supply (Excluding Hydro Modernization):

	Capacity (MW)	Energy (MWh)
Generation Partners	0.24	281
TVA Solar	0.35	460
TVA Wind	2.00	3,854
Middlepoint Landfill Gas PPA	2.20	13,490
Allen Fossil digester gas cofiring	8.00	35,040
Colbert Fossil wood waste cofiring (in Alabama)	7.00	45,990
Wind PPA with Invenergy	27.00	54,400
Total	**46.79**	**153,515**

Source: TVA, Governor's Task Force on Energy, June 2008

Table 4 TVA Generation Types for Tennessee
(Summer 2008: assumes no limitations on water)

Type	Capacity (MW)	%
Coal	8,379	41.3%
Nuclear	3,409	16.8%
Hydro	2,461	12.1%
Pumped Storage	1,650	8.1%
Combustion Turbines	4,334	21.4%
Renewables (as of 1/1/08)	39.79	0. 2%
Generation Partners	0.24	.001%
TVA Solar	0.35	.002%
TVA Wind	2.00	.010%
Middlepoint Landfill Gas PPA (methane)	2.20	.011%
Allen Fossil digester Gas cofiring (methane)	8.00	.039%
Wind PPA with Invenergy	27.00	.133%
Total	20,272.79	100%

Sources: Source: TVA, Governor's Task Force on Energy, June 2008; and Susan Humber Ross, TVA, July 22, 2008, email; August 6, 2008, telephone.

TVA's Green Power Switch Program

TVA and public power companies, in cooperation with the environmental community, have developed the Green Power Switch Program to bring green power to TVA customers throughout the Southeast. There are two aspects of the program to benefit individuals and businesses.

One way to participate is to purchase blocks of green power from a local power distributor. (TVA refers to these distributors as Green Power Distributors.) The cost is $4 added to your monthly power bill for every 150 kilowatt-hours of power purchased, or approximately 12% of a typical household's monthly energy use. Businesses are asked to purchase blocks according to their average monthly usage. These proceeds are then used to produce electricity from renewable sources and add it to the Tennessee Valley's power mix.

In addition to the green power distributors selling green power blocks, TVA involves Green Power Switch (GPS) Generation Partners to help create TVA's power mix. Residential and small commercial power customers install solar or wind generation sources. TVA then purchases 100% of the green power output at a rate of 15 cents per kilowatt-hour. (Residential customers may also qualify for an additional $500 incentive to help offset start-up costs.) "Payment is made in the form of a credit issued by the local power distributor on the monthly power bill for the home or business where the generation system is located." [48] Payments are guaranteed for 10 years from the date of the contract. Energy consumed at the home or business, whether it is generated at the site or delivered over the local power distribution system, is billed at the standard rate. Use of renewable energy sources allows GPS Generation Partners to support the environment while helping themselves with investment costs and lowering their monthly energy bills through the revenue received from the sale of the green power.

While this very good program is in place, the amount of renewable generation capacity currently is small.

A Closer Look at U.S. Renewables and the Potential for Tennessee Expansion

Wind Energy

Currently there is 16,800 MW of installed wind capacity in the U.S., which has led the world in annual wind power installation — or incremental capacity — for three years in a row. [49] California has more than 2000 MW of installed capacity. As of 2008, Texas has over 4,000 megawatts of wind power generating capacity, producing about 3% of its electricity. [50] Texas wind power received a boost in 1999 when Governor George W. Bush adopted a renewable electrical standard requiring investor-owned utilities to install 2,000 MW of new renewable electricity by 2009. In 2005, the target was increased to 5,880 MW by 2015, which would be 5% of their demand. [51]

The Renewable Energy Policy Project (REPP) produced a study of a proposed Renewable Portfolio Standard (RPS) in Pennsylvania. An RPS mandates the proportion of total energy or electricity generation that is to consist of renewables in the target year. The 2004 study found that every 1000 MW of developed wind power created the potential for 3,000 jobs in manufacturing, 700 jobs in installation, and 600 in operations and maintenance. [52] The job potential looks like a pyramid: 70% of potential job creation is in manufacturing the components; 17% in installation; and 13% in operations and maintenance.

A federal RPS of 10% would support roughly 50,000 MW of wind development; a federal RPS of 20% would support 77,000 MW, according to Energy Information Analyses. This could generate $50 to $77 billion in investments.

Tennessee is identified by REPP as one of the top states that could benefit from wind investment. From January 2001 to May 2004, Tennessee lost 59,000 manufacturing jobs (15th in the nation in such losses). With an average investment of $1.41 billion in wind energy, Tennessee could create **4,233 full time jobs**. Appendix A (Table 13, page 55) lists the NAICS industry codes associated with wind energy components manufacturing.

TVA has 18 wind-powered turbines in Anderson County which have the capacity of 29 MW, 27 of those owned by Invenergy, LLC of Chicago which has a 20 year power purchasing contract with TVA.[53]

Other countries have created significant numbers of jobs by investing in wind energy. In 10 years (1997 to 2007) Spain has increased installed wind power from 500 MW to 15,000 MW and is now the world's third largest wind producer after the U.S. and Germany. [54] In 2005, Spain's wind industry had created 30,000 jobs; 60,000 jobs are expected if they reach 20,000 MW of installed wind power by 2010.

Solar Energy

What projections have been done relating to photovoltaic solar energy (PV), and what lies in the future for Tennessee? A 2005 report by the Renewable Energy Policy Project describes the potential growth of solar PV in the U.S. from the 2005 installed level of 340 MW to 9600 MW of installed capacity with the incentivized PV Industry Roadmap. [55] The PV Industry Roadmap would require these incentives: residential and commercial solar tax credits, uniform net metering and interconnection standards, and federal government procurement of $100 million per year for PV solar power. (Over ten years, incentives would total one billion dollars).

The total cost of the increased solar PV capacity would be $34 billion, including $27 billion for manufacturing and $7 billion for construction and installation. With the Roadmap, 80% of jobs would be created in manufacturing and 20% in construction and installation. U.S. jobs could increase from 20,000 in direct employment to 62,000 by 2015. Without the Roadmap, solar PV is expected to increase to 3,800 MW installed by 2015 and only 28,000 jobs.

With the Roadmap, Tennessee has the potential to gain 375 jobs; 240 in manufacturing and construction and 134 in construction and installation, by 2015. This would be the equivalent of one to two solar panel manufacturing plants in number of jobs. The investment cost would be $307 million.

Since October, 2003, Tennessee has had a solar panel manufacturing facility in Memphis to assemble 165-, 167- and 185- watt solar panels for residential and commercial applications. As of a recent year, the plant employed 130 people. The company estimated that 1,000 to 2,000 jobs for solar installers, product distributors, and the like are supported by this factory. [56]

Appendix A (Table 14, page 55) lists the NAICS industry codes of manufacturing firms with the technical potential to enter the solar PV market. [57] In the U.S., this includes more than 10,000 firms with more than 710,000 employees and an annual payroll of more than $36 billion. At the time of the study, Tennessee had 136 firms with the potential to produce one of the 14 identified solar PV components.

Tennessee currently has less than 1 MW of electricity produced by solar energy. In contrast, one of the world leaders in solar photovoltaics, Spain, installed 11 large-scale plants in 2007 alone, which added more than 100 MW of electricity to their grid.[58] They also are rapidly developing concentrating solar power (CSP) facilities.

Knoxville Selected as a "Solar America City"

"KUDOS to Knoxville," to quote an editorial in the April 12, 2008, Knoxville News Sentinel on-line edition. The paper reports Knoxville will receive up to $200,000 as one of 12 Solar America Cities designated recently by the U.S. Department of Energy to help integrate solar energy technology into their operations. According to the paper, grant funds will be used to install solar panels at a planned downtown public transit center and on a model, net-zero energy home in the city's South Waterfront development area. [59]

Solar Thermal

Concentrating solar power uses mirrors to focus sunlight on a receiving fluid, which is used to produce steam to turn a turbine and produce electricity. New policies enacted by Southwestern states are creating an unprecedented growth in solar power that is expected to produce more than 4,000 megawatts of solar thermal coming on line in the next few years. [60] The Southwestern U.S. has the potential, through concentrating solar power, to generate seven times the nation's electric generating capacity. [61]

Geothermal

Geothermal energy involves using the earth's heat and/or the differences in temperature between the earth and other media to produce heat or electricity. According to the National Renewable Energy Laboratory, electricity produced through geothermal means could meet 4 to 20 percent of current U.S. electricity needs. [62] As of October 2007, 24 countries were known to have geothermal power plants, with combined generating capacity of 8,900 MW. The U.S. had the largest share, with 2,850 MW (2,490 MW in California). [63]

TVA has been actively working with local school districts to implement geothermal energy projects in elementary and secondary schools that are being constructed or renovated. The Sumner County School system has 10 buildings with geothermal installed; [64] Cheatham, Clay, and Overton County also have systems installed. Geothermal is also being used in the Tennessee Executive Residence.

Geothermal or ground source heat pumps use loops made of polyethylene piping installed vertically or horizontally in the earth; they may also be installed in a pond or lake. At 10 feet deep, the ground remains a constant 50 to 60 degrees Fahrenheit year-round. In the winter, the fluid in the pipes takes heat from the earth and puts in into a building. In the summer, heat is pulled from the building and deposited in the ground.

The systems emit no pollutants on site and with few moving parts, can be maintenance free for 20 years or more. [65] Use of geothermal can represent savings to homeowners of 30 to 70 percent in the heating mode and 20 to 50 percent in the cooling mode, compared to conventional systems, reports the Geothermal Heat Pump Consortium in Columbia, Maryland. [66] According to Herb Stonebrook, energy management administrator for the State of Tennessee's Department of Finance and Administration, *"It's technology touted by the Environmental Protection Agency and the Department of Energy to be one of the best heating and cooling systems possible these days."* [67]

Effect of a Renewable Electricity Standard (RES) (or Renewable Portfolio Standard —RPS)

Renewable Electricity Standards (RES) require that a certain percentage of a state's electricity production come from renewable energy resources. As of June 2008, 26 states had passed a RES.[68] An updated study [69] (July, 2007) by the Union of Concerned Scientists found that Tennessee could create 4,300 new jobs from renewable energy development with an RPS of 20 percent by 2020. Of these, 960 new long term jobs would be created manufacturing components for wind turbines, solar photovoltaic panels and films, biomass facilities, and geothermal power plants-ranking Tennessee 17th among all states.

There is also the possibility of export opportunities. Besides jobs in manufacturing and construction, jobs in operations, maintenance, finance, sales, shipping, and other industries would be created; other jobs would result from workers in these industries spending their earnings and from consumers spending their energy savings.

The analysis found that with the 20% standard, Tennessee's renewable power generating capacity would increase to 1,970 megawatts (MW) by 2020. These wind, bioenergy, and solar power resources would produce enough electricity to serve the needs of more

than 2 million typical homes, supplying 11 percent of total state electricity sales. [70] The need to import fossil fuels, primarily coal, to produce electricity would also be reduced; in 2005, all of Tennessee's coal was imported.

Besides the jobs created, the 20 percent standard would improve Tennessee's economy in the following ways:

- $538 million in new capital investment in renewable energy,
- $1.79 billion in new income for farmers and rural landowners producing biomass and/or leasing land to wind developers, and
- $21 million in new property tax revenues.

Biofuels

In December 2007, Congress passed the Energy Independence and Security Act (EISA) of 2007. It called for increasing fuel economy standards for the first time in 32 years to at least 35 miles per gallon by 2020. In addition, the bill included an expansion of the renewable fuel standard (RFS), which requires an increasing amount of biofuels (fuels produced from biological materials like plants) in the U.S. vehicle fuel mix. This RFS could boost biofuel production fivefold. Today's 7 billion gallons could increase to 36 billion gallons by 2022. [71] Advanced biofuels, if done right, can generate significantly less global warming pollution than gasoline. [72]

Renewable bioenergy sources for biofuels and electricity production In the conclusion to a 2007 article, "Biomass-Bioenergy Crops in the United States: A Changing Paradigm", the authors state, "Conservation and efficient energy use are not merely idealistic concepts, but are inevitable for survival. Nevertheless, bioenergy can and will help to make a significant reduction in our dependence on petroleum." The authors, researchers with the U.S. Department of Agriculture, evaluate the most recent research on bioenergy crops in The American Journal of Plant Science and Biotechnology. Their conclusions: "The first source of biomass energy should be those materials that would otherwise be put in landfills. This includes such materials as . . . used vegetable oils. Agricultural biomass . . . only should be harvested for bioenergy once the needs for protecting soil have been satisfied. Perennial biomass crops (grasses and woody) have several advantages over annual crops." They present a favorable analysis regarding the cultivation of the perennial crop switchgrass as a bioenergy feedstock. [73]

Biodiesel (Table 22, page 79; Table 23, page 80). Biodiesel is being produced from soybean oil in a few commercial plants across Tennessee (Table 22, page 79).[74, 75, 76] But the growing concern about using human and animal foods as feedstock for fuel suggests two other sources may become increasingly important.

Used restaurant cooking oil is expected to be a fairly economical energy source and is readily available across the state. One venture attempting to exploit this source is under development in the Fairview Technology Center business incubator and hopes to become commercially viable (Table 23, page 80).[77] Additionally, the non-profit Southern Alliance for Clean Energy, partnering with the University of Tennessee Institute of Agriculture, plans to replicate their successful biodiesel production and distribution system located in Atlanta. Their used-oil-based product is intended to fuel at least part of the diesel fleet at the Knoxville campus of the university (Table 23, page 80).[78]

Oil from algae, still experimental as a non-food energy source, will be produced by Northington Energy, LLC. Located in Wartburg, the company currently depends on soybean oil for diesel production. But it announced in December 2007 that it is developing processes for growing and processing algae for biodiesel oil, also in Wartburg (Table 23, page 80)[79,80,81]

Tennessee Expects to Have the First U. S. Biodiesel Plant Powered Entirely by Renewable Energy

On June 2, 2008, Northington Energy announced on their website, *northingtonenergy.com*, that its new 15,000-square foot biodiesel manufacturing plant in Wartburg will run on photovoltaic solar power backed up by a biodiesel generator. A spokesperson stated, "From a company standpoint, when it's possible to produce our products with alternative energy, then we're going in that direction." The eco-friendly power plant will be installed during the final phase of plant construction in 2008, the company reports.

Ethanol Tennessee has had a corn processing ethanol facility since 1981, producing about 60 million gallons of ethanol annually.[82] A 100-million-gallon-per year ethanol plant is under construction near Obion, Tennessee and was expected to be operating by the end of 2008.[83] In 2007 Tennessee has 12 fueling stations for ethanol.[84]

However, it is questionable whether corn-based ethanol production will increase appreciably in Tennessee, as corn has gone steadily out of favor as an energy source and become increasingly expensive.

Cellulosic ethanol, without the same environmental and food crop concerns as corn, may have a more promising future as a Tennessee energy feedstock. In examining life cycle global warming pollution relative to gasoline, cellulosic ethanol is expected to emit 70 percent less, and high carbon liquid coal 80 percent more.[85]

The University of Tennessee Biofuels Initiative (UTBI) is a five year, $70 million commitment from the state of Tennessee. In 2007, the legislature appropriated $40.7 million for capital construction and $8.25 million for research, farmer incentives, and operating incentives for the Biofuels Initiative. The goal is to produce switchgrass, a non-food crop not previously grown commercially in Tennessee, through a farmer incentive program, and to construct and operate a pilot biorefinery with the capacity to produce 5 million gallons of cellulosic ethanol per year (about the amount the state currently uses each year for the state fleet).[86]

UTBI, a public-private partnership, will fund a research and demonstration biorefinery (to be developed and run by DuPont Danisco Cellulosic Ethanol, LLC) for production of cellulosic ethanol from switchgrass as well as wood residues. It has begun providing subsidies encouraging farmers to plant switchgrass. The biorefinery near Vonore is expected to begin construction during 2008, with ethanol production expected in 2010 or after (Table 24, Page 81).[87, 88, 89]

Additionally, a biomass and bioenergy overview from the Southeastern Regional SunGrant Initiative suggests willow and hybrid poplar trees could be grown in Tennessee specifically for bioenergy use. Research on wood utilization as a feedstock for ethanol is underway at the University of Tennessee Agricultural Experiment Station.[90]

In February 2008 testimony before a committee of the state legislature on the Tennessee Biofuels Initiative, Kelly J. Tiller, Ph.D., of the U.T. Office of Bioenergy Programs, cautioned: "While cellulosic ethanol in general and our project in particular, is an appealing value proposition, technologies and commercial scale up are not proven today."[91]

However, as the technology improves, it is expected that public and private partners will produce multiple commercial scale biorefineries. With commercial implementation, an estimated 4,000 jobs would be created in rural Tennessee counties, with a potential for 3,000 additional jobs in satellite plants producing chemical co-products useful in other industries.[92]

Methane gas for electricity generation

As of December 2007, the U.S. Environmental Protection Agency reported Tennessee had six landfills producing methane and generating electricity, with three additional sites under construction and expected to open in 2008. As many as 11 more landfills across the state were identified as having the potential for generating electricity.[93]

Estimates of the Energy Efficiency Potential and the Number of Jobs Related to Improving Energy Efficiency in Tennessee

Jobs in the energy efficiency (EE) sector outnumber those in the renewable energy (RE) sector by about 18 to 1. As reported in an earlier section, the American Solar Energy Society has estimated the total number of direct and indirect jobs related to the energy efficiency industry in 2006 in the U.S. as 8 million, 46 thousand (8,046,000), whereas the number of jobs estimated for renewables is 446 thousand (446,000) (see Table s 2 and 3 on pages 19 and 20, respectively).

There is potential for saving energy through efficiency measures in every community. Buildings account for 40% of U.S. energy use — more than industry, at 32%, and transportation, at 28.%. Buildings use 71% of domestic electric power and 55% of the natural gas in the U.S. — and produce 43% of carbon emissions.[94]

> *"Green buildings" as described by the U.S. Green Building Council are those which use elements of energy efficiency, water efficiency, location on a sustainable site, recycled and sustainable materials in construction, and measures to maintain indoor air quality.* [95]

Creating energy efficient buildings is considered the most cost-effective way to reduce our energy consumption in the U.S. Unless vigorous action to reduce demand is taken, residential energy consumption is expected to rise 1%, and commercial energy consumption by 2%, annually through 2025. Commercial use of energy is increasing primarily due to computers and other office equipment.[96]

Several states are moving aggressively to reduce residential energy demand. New York's Energy Smart program targets single- and multi-family residences, renters, and low income households. Through extensive consumer education, low interest loans for homeowners focusing on more efficient appliances, heating and air conditioning systems, lighting, windows and hot water systems and insulation and weatherization improvements, the programs save about 3.1 billion kwh of electricity per year.[97]

Vermont has established an "energy efficiency" utility named Efficiency Vermont which in 2007 saved enough electricity to fully offset the annual growth in demand in the state at a cost of 2.6 cents per kwh (Tennessee produces electricity at about 8 cents per kwh). Energy savings created 6.5 % of the state's electricity needs.[98]

Energy consumption in buildings (residential and commercial) could be reduced 23% by 2025 through energy efficiency measures. [99] A private sector initiative Architecture 2030 issued the "2030 Challenge" in January 2006 for all new buildings and major renovations to achieve fossil fuel reductions below 50% of the current regional average.[100]

Studies done in 2000 and 2005 by the Energy Center of Wisconsin, applied to Milwaukee and adjusted for inflation indicate that energy costs for the city's housing would be cut by $83 million per year with a $243 million retrofit. [101] To minimize the use of carbon-based fuels, experts recommend conserving first and utilizing renewable energy systems second.

Since 2000, the headquarters of the Adobe Corporation in San Jose has reduced per employee electricity use by 35%. [102] A $1.1 million investment yielded annual energy savings of more than $1 million per year. The average commercial building can reduce energy use by about 30%.[103]

Besides residential and commercial buildings, industrial plants have significant potential for energy savings. Wisconsin began a statewide program in 2001 to provide expert technical and financial assistance to industries with a need to improve energy efficiency. Five high energy use industries have special programs. Methods to reduce energy consumption include using advanced motors, more efficient equipment, better management of heat energy, and combined heat-and-power (which uses waste heat from industrial operations to generate electricity). Since the beginning of the program, more than 1,500 industrial customers were served, with a net savings of 141 million kWh of electricity and 15 million therms of natural gas.[104]

The potential for energy efficiency is vast- including everything from increasing insulation to installing energy efficient household appliances, lighting, windows, and doors to using more energy efficient computers, cars, heating and cooling systems, and industrial machinery, to revamping entire industrial processes. It has been estimated that a 20% savings of energy consumption in Europe by 2020 could have the potential to directly or indirectly create up to one million new jobs in Europe, especially semi-skilled workers in the building sector.[105]

Trying to identify industries related to EE is difficult because most EE spending relates to segments of large industries, such as vehicles, buildings, lighting, and appliances.

The American Solar Energy Society study, for the private sector, included insulation sales, energy service company (ESCO) industry sales, and the U.S. recycling and reuse industry sales. In addition:

For other industries, we only included the portion of their sales that related to EE. For example, we included vehicles that get at least 10 percent better mpg than the CAFÉ mileage as energy efficient vehicles. We used the Energy Star ratings for lighting products and household appliances, windows and doors, and components of the industrial sector.[106]

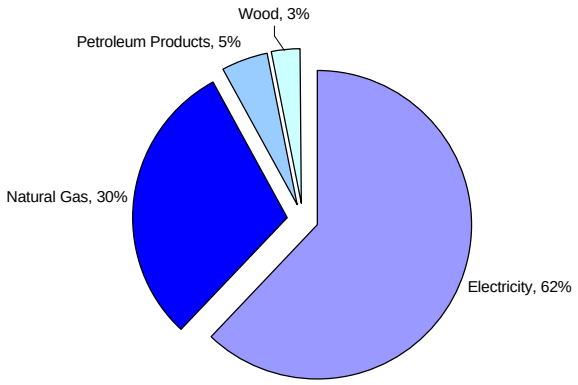
In the direct jobs category, in the U.S., energy service companies (ESCO), insulation, and utilities jobs together are estimated at 59,000; construction jobs related to energy efficiency at 227,000; and recycling at 1,300,000. (Recycling can include both manufacturing and non manufacturing activities). The remainder of the jobs, about 54%, are in the manufacture of energy efficient vehicles, appliances, and other products.

Significant economic activity already exists in retrofitting buildings. Between 1990 and 2003, energy service companies did $12 billion to $16 billion of retrofit work for municipalities, universities, schools, and hospitals. [107] The ESCO industry did about $2 billion in projects in 2000 and is expecting to do $5 billion in 2008. [108] It is estimated that every $1 million invested in efficiency creates 8 to 11 direct jobs. [109]

To increase energy efficiency, these steps can be taken: updating building codes; doing retrofits of existing buildings (some states, and cities such as Cambridge, Massachusetts through the Cambridge Alliance) are doing this in a very comprehensive way; encouraging Leadership in Energy and Environmental Design (LEED) operating standards; and using public benefit funds. Energy efficiency resource standards (EERS) are mechanisms to encourage efficiencies in consumption and transmission of gas and electric power. They set savings targets in order to mandate efficiency levels. Tennessee does not yet have an EERS. [110] Through use of energy efficiency measures, California has held energy electricity consumption per capita constant since 1975, while it has grown 60% in the rest of the country.[111]

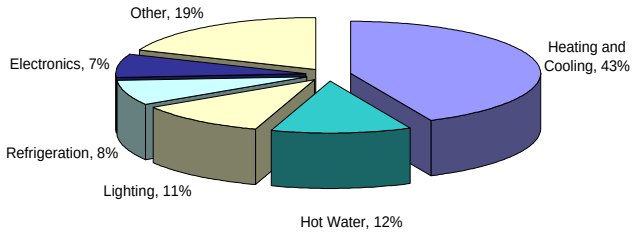
Speaking at the Governor's Energy Task Force meetingon May 5, 2008, Jeffrey Wadsworth of the Battelle Institute identified significant opportunities for energy efficiency in Tennessee. Reductions in energy demand could be dramatic. Tennesseans are first in the nation in **residential electricity** use per capita. The sources of energy in Tennessee homes are as follows:

Tennessee Residential Electricity Sources
Source: Governor's Energy Task Force, Nashville, TN, May 5, 2008
Jeffrey Wadsworth



The uses of residential energy fall into familiar categories:

Uses of Residential Energy
Source: Governor's Energy Task Force, Nashville, TN, May 5, 2008
Jeffrey Wadsworth



According to Mr. Wadsworth, it is possible to build homes today in Tennessee that can save 60 to 70% on energy, using advanced technology such as heat pump water heaters; using alternative technologies for roofing, utility walls, ventilation, exterior walls, and the basement; and through use of the renewable technologies of solar panels and geothermal. [112] Geothermal heat pumps use 25 to 50 percent less electricity than traditional heating and cooling systems). [113] Slowing the potential for efficiency, Tennessee's building codes do not meet Energy Policy and Conservation Act (EPCA) standards (it is one of only 15 states whose codes do not).

On a positive note, Tennessee is at the forefront of research in reducing residential energy consumption. Oak Ridge National Laboratory (ORNL) is participating in a U.S. Department of Energy initiative to develop affordable, net-zero-energy housing by 2020 and zero-energy commercial buildings by 2025. Oak Ridge National Laboratory (ORNL) has constructed near zero energy Habitat for Humanity houses in Lenoir City in which residents pay as little as $0.40 a day for electricity. (For 30 days, this would be $12, compared to homeowners' previous bills which could be $200 per month).[114]

Key features in these houses include solar panels, basement walls serving as thermal mass, geothermal energy, especially reflective metal roofs, utility walls consolidating hot water plumbing, energy efficient exterior walls, and structural insulated panels. [115]

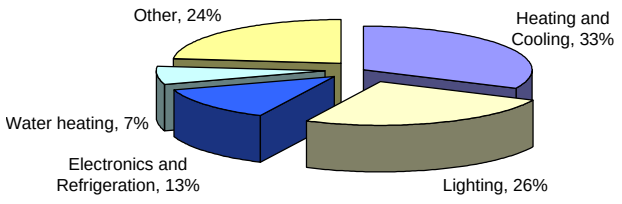
Besides extensive research on energy efficient building materials of all types,

> *"The Laboratory has developed software tools to assess the potential for moisture-related damage in construction materials; provide energy efficiency ratings for entire buildings; audit homes for weatherization as part of DOE's low-income weatherization Assistance Program and performs analysis to support the design of more efficient heat pumps and other equipment."* [116]

To further develop and implement energy efficient materials and methods, 7,000 homes with energy saving and generating technologies, similar to those used in the near-zero-energy Habitat houses, were planned to be built near Crossville, Tennessee in Walden Reserve. However, in the 2008 credit crisis Walden Reserve has not survived as a project.

According to Wadsworth, significant energy efficiencies could be achieved in **commercial energy** consumption in Tennessee as well. The major uses of energy by commercial customers include:

Uses of Commercial Energy
Source: Governor's Energy Task Force, Nashville, TN, May 5, 2008
Jeffrey Wadsworth



Commercial buildings can regularly save 20% of their energy use, with 10 to 15 year paybacks, by such measures as new fluorescent bulbs, occupancy sensors, daylighting, and LEDs to reduce lighting expenditures; energy service contracting, energy management systems and cool roofs to reduce heating and air conditioning; and using indoor air quality sensing, controls, and Energy Star equipment and appliances. The total savings in Tennessee could be $500 million per year.

An incentive to achieve these savings would be for the state to implement commercial state energy codes meeting Energy Policy and Conservation Act (EPCA) standards. Tennessee is one of only 10 states that do not have commercial state energy codes, and one of only 14 states that do not have codes that meet EPCA standards.

The state sponsored a retrofit pilot program in 2000-2004 in two downtown state office buildings, the Rachel Jackson and Andrew Jackson office buildings, to gauge potential savings due to energy efficiency. To accomplish this, the state partnered with the Tennessee Valley Authority (TVA) and the Nashville Electric Service (NES). Annual savings of $800,000 were achieved, using 42% less electricity and 55% less energy, at a cost of nearly $4 million and average payback time of 5 years. [117] If the utility savings were $800,000, and represented 42% of the total, the total utility bill must have been about $ 1.9 million.

In 2007, state energy costs for total general government and the total Tennessee Board of Regents (TBR) and University of Tennessee systems were $129,008,162. [118] If a conservative 25% savings in energy use were achieved, $32,252,040 would be saved annually. If costs were as high as $161,260,200 (assuming a five year payback period), then there would be the potential for creating 1,774 direct jobs (at 11 jobs per million in expenditures). For ESCO and construction, the number of direct and indirect jobs in EE is about double the number of direct jobs, so direct and indirect jobs would be nearly 3,548 in just the state's EE effort. Were codes to change and incentives put in place, job creation through private sector retrofits could be notable.

Tennessee is 12th in the nation in industrial energy consumption, primarily powered by fossil energy. Over half of industrial energy comes from petroleum products (31%) and electricity (22%).[119] Significant savings may be possible for industrial users. The Tennessee Industrial Technology program can assist in identifying savings; Tennessee Technological University has an Industrial Assessment Center. Average energy reductions identified were 3.3%, but savings of up to 40% have been found.[120]

Transportation efficiencies can reduce carbon dioxide emissions and save money on fuels as well. In Tennessee, this sector is responsible for 29% of the state's energy consumption.[121] Petroleum is 96% of the fuel used. A total of 1.1 billion gallons of diesel and 3.1 billion gallons of gasoline were purchased by Tennesseans in 2005.

Reduced fossil fuel use and reduced carbon emissions can result from the following;

- Working with manufacturers to improve vehicle efficiency
- Increasing the availability of B20 and E85, and
- Producing and using advanced technology hybrid cars (like plug-in hybrids) and electric vehicles. [122]

A recently announced partnership between Tennessee state government and Nissan automobile manufacturing company may make the electric vehicle a feasible transportation alternative beginning as early as the year 2011, according to a Nissan vice president. He states they will initiate a feasibility study intended to "pilot a full-scale electric vehicle project," with support from TVA and other partners, by that date. [123] Nissan hopes to have some electric cars for sale in the U.S. by 2010, according to a *Tennessean* editorial. [124]

Easy access to charging stations is key to the success of transitioning to electric vehicles. Tennessee state government recently committed to supporting development of charging stations for plug-in electric vehicles in public spaces, for example downtown parking lots, retail hubs, and other high density parking areas. And in coordination with others, including Nissan and TVA, the state will investigate ways to develop charging stations along major interstate routes. [125]

As of May 2008, Tennessee state government had 1,549 Flex Fuel Vehicles (FFV); of those 648 were purchased in 2007-08. Additionally, 15 hybrids were purchased that year. For 2008-09, 650 additional

units are expected to be purchased, including 480 either FFVs or hybrids.

During 2007, the amount of fuel purchased for the Tennessee state government by type included:

Fuel type	Total Gallons	%
Unleaded	4,466,734.38	91.8%
Diesel	365, 967.74	7.5%
Ethanol(E-85)	9,023.89	.2%
Biodiesel (B20)	25,194.05	.5%
Total	4,866,920.06	100.0

at a total cost of $10, 970,465.48. One goal of the State of Tennessee Motor Vehicle Management Division for 2008 is to establish statewide contracts for biofuels for state owned facilities with onsite fuel pumps. A state government work group is developing strategies to reduce the use of fossil fuels and overall fuel consumption by state government.

Sustainable Agriculture

Besides energy efficiencies achieved in the residential, commercial, industrial and transportation sectors, there is potential for reducing energy use and achieving green employment benefits through sustainable small-scale farming, both in rural and urban areas. With concern over food safety and the costs of transportation increasing, institutional and individual consumers are more interested in buying locally-produced food.

Tennessee supports consumer choice in this area through the Department of Agriculture's web site ***picktnproducts.org***. With about 32,000 employees in agricultural industries in 2006, it is not known how many are involved in small scale sustainable agriculture or what the growth potential may be.

This image of switchgrass is an image taken during the course of an employee's official duties. The image is in the public domain. .

New Estimates of the Potential for Green Jobs in Tennessee

The Political Economy Research Institute (PERI) at the University of Massachusetts recently issued the report "Green Recovery," creating new estimates of the potential for green job creation in Tennessee across the span of energy efficiency and renewable energy sectors.[126] With an expenditure of $100 billion in the U.S. and $1.9 billion in Tennessee over a period of two years, they estimate that 44,942 new jobs could be created here. The expenditures would be in the following areas:

- Retrofitting buildings
- Expanding mass transit and freight rail
- Constructing smart energy grids
- Expanding production of wind and solar power and advanced biofuels

Estimated expenditures to create these jobs would be as follows: (1) energy efficiency building retrofits, $761 million (40%); (2) mass transit/ freight rail $380 million (20%); (3) smart grid, $180 million (10%); (4) wind, solar, and advanced biofuels, $571 million (30%).

The expenditures would be approximately 50% from tax credits; 46% in direct government spending, and 4% as federal loan guarantees.

The higher number of jobs compared to previous studies results from inclusion of all three types of job creation associated with expanded spending — direct effects, such as the initial construction or manufacturing activity; indirect effects, such as manufacturing or service jobs that supply inputs to the above processes; and induced effects, including retail and wholesale jobs created by workers in the above industries when they spend they money they earn.

What would be the effect of this job creation in TN? Based on the actual Tennessee unemployment rate in June 2008 (6.8 %), the Green Recovery program could reduce Tennessee's unemployment rate to 5.3% within two years. Jobs would be created in construction and manufacturing, two areas that have been hardest hit by job losses in recent years. Investments in energy efficiency would potentially save businesses and consumers 30% on their annual energy expenditures.

How fast could these targeted expenditures take place? The most rapid implementation would be through retrofitting buildings by expanding existing federal programs such as weatherization assistance, energy efficiency retrofit programs like LIHEAP, providing federal dollars to match state and local energy efficiency programs for public and private buildings, requiring retrofitting of all U.S. and state government buildings, and through Energy Efficiency Conservation Block Grants (authorized but not funded).

Renewable energy expansion requires long term incentives and a stable policy environment, including tax incentives (both investment and production tax credits) and credit subsidies. Federal tax credits for wind and solar energy were recently (October , 2008) renewed in the financial sector bailout legislation.

The State of Tennessee has made substantial fuel infrastructure investments and will be involved in the first national renewable fuel distribution corridor.[127] Other suggestions by PERI for green jobs investment – such as providing funding to lower bus fares and expand existing public transportation – would strengthen Tennessee's workforce program. Smart grid investments can be aided by a matching grant program through EISA 2007.

Green Occupations Related to Industry Growth

Expansion of the number of jobs in the green economy sector could serve several purposes important to Tennessee's workforce: reducing the unemployment rate; reducing manufacturing job losses and employing dislocated workers; increasing income growth; encouraging students and workers to complete high school and college training at higher rates; and providing more direct employment paths for women and minority workers into better jobs.

For this reason, the Labor Market Information Unit of the Tennessee Department of Labor and Workforce Development's Employment Security Division has identified and analyzed the occupations most likely to be affected by an economy increasingly focused on energy efficiency (EE) and renewable energy (RE).

Methodology:

Although other states and organizations have provided some preliminary studies in the area of estimating and projecting employment in jobs related to green industries, this exploration is basically in its infancy. Identifying green industries, and from that, green occupations, has been done differently by different researchers. After conferring with other researchers, the Research and Statistics unit of the Tennessee Department of Labor and Workforce Development's Employment Security Division developed a methodology to determine the potential for job expansion in the green economy in Tennessee. This methodology takes advantage of the most recent and reliable data available on both industries and occupations.

Identifying occupations to evaluate. To determine green jobs which could be expected to be available in Tennessee entailed the following steps.

First, industries related to the green economy were identified. This was done by conducting a keyword search of North American Industry Classification System (NAICS) six-digit industry code titles and descriptions for the following terms: solar, wind power, photovoltaic, thermal, geothermal, ethanol, hydro power, construction, architect, and engineer. Additional industry lists were obtained from technical studies related to wind component and solar photovoltaics manufacturing.[128]

Next, occupations designated by Standard Occupational Classification (SOC) codes provided by the U. S. Bureau of Labor Statistics were identified. To do this, industries on the compiled list were matched to four-digit occupational staffing patterns derived from the Tennessee Occupational Employment and Wages Survey (OES). Occupations were combined into files for five RE and EE sectors:

- Green Building
- Biofuels
- Wind Energy
- Solar Energy
- Geothermal Energy

Occupations with significant employment in each sector, most requiring some training, were identified. These 162 occupations are displayed in tables 5 through 9.

Selected occupational characteristics.
Three key occupational characteristics were utilized in analyzing the contributions these occupations could potentially make to Tennessee's economy: training and education required, average wages, and whether the occupation is deemed to be in demand.

Each occupation is assigned a usual training time by the U.S. Bureau of Labor Statistics. There are 11 training and education levels designating preparation usually necessary for successful job performance. These range from "short demonstration only" at the lowest level to "professional degree" at the highest level. For this analysis, "high skill" was defined by a training requirement of "long-term training" or above.

Occupational wages were derived from the OES wage survey. Median wages for May 2007, the most recent available, were used. The designation "high wage" was reserved for occupations paying at least $33,552 or above, which is 20% more than the state median wage for all occupations across the state.

Occupations' demand status is based on measures of demand and supply provided by the Labor Market Information unit. For the purpose of this analysis, demand is evaluated on the basis of occupational growth rates and expected job openings derived from Tennessee's long-term projections to 2016. Supply is defined as the most recent data on Tennessee training and education completers. Occupations designated "in demand," in general, are those which have a positive growth rate and for which the number of training completers is no more than one and one-half times the number of expected job openings on an annual basis.

Findings

A total of 162 occupations in these five sectors were analyzed Occupations were selected on the basis of numbers employed in 2006, with at least 28 occupations with high employment analyzed in each sector. The occupations analyzed in each sector are displayed

in tables 5 through 9. The findings for educational and other occupational characteristics within sectors are summarized below.

Education requirements: Among the total 162 occupations, at least three out of four jobs do not require a college education. Tables 5 – 9) And in the solar sector, more than 90 % of the largest jobs do not require a college degree. (Table 8) In the green building, biofuels, and geothermal areas, from 20 to 24% of the largest jobs require a bachelor's degree or more. (Tables 5, 6, and 9)

Workers install a new solar panel, left, to power a refrigerator and clean algae from an older solar panel, right, in the village of Alto Conte, at the Brunca Indigenous Reservation in southern Costa Rica, Thursday, Nov. 8, 2007. AP photo by Kent Gilbert.

Table 5 Occupations in the Green Building Sector

SOC Codes*	Occupational Title	Training and Educational Level	Annual Median Wage 2007	High Skill	High Wage	In De-mand
111011	Chief Executives	Bachelor's or higher degree, plus work experience	$126,905	Y	Y	
111021	General and Operations Managers	Bachelor's or higher degree, plus work experience	$71,278	Y	Y	
113031	Financial Managers	Bachelor's or higher degree, plus work experience	$66,371	Y	Y	Y
119021	Construction Managers	Bachelor's degree	$55,376	Y	Y	Y
131051	Cost Estimators	Bachelor's degree	$48,469	Y	Y	
132011	Accountants and Auditors	Bachelor's degree	$49,672	Y	Y	Y
151021	Computer Programmers	Bachelor's degree	$61,364	Y	Y	
151041	Computer Support Specialists	Associate degree	$41,042	Y	Y	Y
171011	Architects, Except Landscape and Naval	Bachelor's degree	$65,291	Y	Y	
172051	Civil Engineers	Bachelor's degree	$68,417	Y	Y	
173011	Architectural and Civil Drafters	Postsecondary vocational training	$43,084	Y	Y	
373011	Landscaping and Groundskeeping Workers	Short-term on-the-job training	$21,057			Y
414011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Work experience in a related occupation	$64,277	Y	Y	Y
414012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	Work experience in a related occupation	$48,412	Y	Y	Y
431011	First-Line Supervisors/Managers of Office and Administrative Support Workers	Work experience in a related occupation	$39,032	Y	Y	Y
433031	Bookkeeping, Accounting, and Auditing Clerks	Moderate-term on-the-job training	$29,045			Y
471011	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	Work experience in a related occupation	$44,101	Y	Y	
472021	Brickmasons and Blockmasons	Long-term on-the-job training	$42,645	Y	Y	Y
472031	Carpenters	Long-term on-the-job training	$30,239	Y		Y
472051	Cement Masons and Concrete Finishers	Moderate-term on-the-job training	$28,322			Y
472061	Construction Laborers	Moderate-term on-the-job training	$24,362			Y
472073	Operating Engineers and Other Construction Equipment Operators	Moderate-term on-the-job training	$30,642			Y
472111	Electricians	Long-term on-the-job training	$39,635	Y	Y	Y
472131	Insulation Workers, Floor, Ceiling, and Wall	Moderate-term on-the-job training	$29,126			Y
472132	Insulation Workers, Mechanical	Moderate-term on-the-job training	$36,053		Y	Y
472141	Painters, Construction and Maintenance	Moderate-term on-the-job training	$29,011			Y
472181	Roofers	Moderate-term on-the-job training	$29,315			Y
472211	Sheet Metal Workers	Long-term on-the-job training	$32,214	Y		Y
473012	Helpers--Carpenters	Short-term on-the-job training	$22,229			Y
493042	Mobile Heavy Equipment Mechanics, Except Engines	Long-term on-the-job training	$35,219	Y	Y	Y
499021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Long-term on-the-job training	$28,641	Y		Y
499041	Industrial Machinery Mechanics	Long-term on-the-job training	$37,296	Y	Y	Y
499042	Maintenance and Repair Workers, General	Moderate-term on-the-job training	$31,137			Y
511011	First-Line Supervisors/Managers of Production and Operating Workers	Work experience in a related occupation	$42,770	Y	Y	
512041	Structural Metal Fabricators and Fitters	Moderate-term on-the-job training	$31,291			Y
512092	Team Assemblers	Moderate-term on-the-job training	$26,609			
514041	Machinists	Long-term on-the-job training	$35,603	Y	Y	Y
514121	Welders, Cutters, Solderers, and Brazers	Postsecondary vocational training	$30,693	Y		Y
533033	Truck Drivers, Light or Delivery Services	Short-term on-the-job training	$25,206			

Source: TN Department of Labor and Workforce Development, Employment Security Division, Research and Statistics

*SOC Codes are Standard Occupational Classification Codes

Table 6 Occupations in the Biofuels Sector

SOC Codes*	Occupational Title	Training and Educational Level	Annual Median Wage 2007	High Skill	High Wage	In Demand
111011	Chief Executives	Bachelor's or higher degree, plus work experience	$126,905	Y	Y	
111021	General and Operations Managers	Bachelor's or higher degree, plus work experience	$71,278	Y	Y	
119011	Farm, Ranch, and Other Agricultural Managers	Bachelor's or higher degree, plus work experience	$56,151	Y	Y	Y
131022	Wholesale and Retail Buyers, Except Farm Products	Long-term on-the-job training	$38,860	Y	Y	Y
132011	Accountants and Auditors	Bachelor's degree	$49,672	Y	Y	Y
151021	Computer Programmers	Bachelor's degree	$61,364	Y	Y	
172041	Chemical Engineers	Bachelor's degree	$72,582	Y	Y	
172112	Industrial Engineers	Bachelor's degree	$63,946	Y	Y	Y
172141	Mechanical Engineers	Bachelor's degree	$65,065	Y	Y	
192031	Chemists	Bachelor's degree	$51,836	Y	Y	
411012	First-Line Supervisors/Managers of Non-Retail Sales Workers	Work experience in a related occupation	$61,026	Y	Y	Y
414011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Work experience in a related occupation	$64,277	Y	Y	Y
414012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	Work experience in a related occupation	$48,412	Y	Y	Y
431011	First-Line Supervisors/Managers of Office and Administrative Support Workers	Work experience in a related occupation	$39,032	Y	Y	Y
433031	Bookkeeping, Accounting, and Auditing Clerks	Moderate-term on-the-job training	$29,045			Y
434051	Customer Service Representatives	Moderate-term on-the-job training	$27,297			Y
451011	First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	Work experience in a related occupation	$34,125	Y	Y	Y
452011	Agricultural Inspectors	Bachelor's degree	$34,575		Y	
452091	Agricultural Equipment Operators	Moderate-term on-the-job training	$22,641			Y
452092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	Short-term on-the-job training	$17,853			Y
472111	Electricians	Long-term on-the-job training	$39,034	Y	Y	Y
491011	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	Work experience in a related occupation	$46,327	Y	Y	
493041	Farm Equipment Mechanics	Long-term on-the-job training	$26,505	Y		Y
493042	Mobile Heavy Equipment Mechanics, Except Engines	Long-term on-the-job training	$35,219	Y	Y	Y
499041	Industrial Machinery Mechanics	Long-term on-the-job training	$37,296	Y	Y	Y
499042	Maintenance and Repair Workers, General	Moderate-term on-the-job training	$31,137			Y
511011	First-Line Supervisors/Managers of Production and Operating Workers	Work experience in a related occupation	$42,770	Y	Y	
512092	Team Assemblers	Moderate-term on-the-job training	$26,609			
514041	Machinists	Long-term on-the-job training	$35,603	Y	Y	Y
514121	Welders, Cutters, Solderers, and Brazers	Postsecondary vocational training	$30,693	Y		Y
519011	Chemical Equipment Operators and Tenders	Moderate-term on-the-job training	$42,847		Y	
533032	Truck Drivers, Heavy and Tractor-Trailer	Moderate-term on-the-job training	$36,798		Y	Y
537062	Laborers and Freight, Stock, and Material Movers, Hand	Short-term on-the-job training	$20,324			

Source: TN Department of Labor and Workforce Development, Employment Security Division, Research and Statistics

*SOC Codes are Standard Occupational Classification Codes

Table 7 Occupations in the Wind Energy Sector

SOC Codes*	Occupational Title	Training and Educational Level	Annual Median Wage	High Skill	High Wage	In De-mand
113051	Industrial Production Managers	Work experience in a related occupation	$64,647	Y		
172081	Environmental Engineers	Bachelor's degree	$77,378	Y	Y	Y
172112	Industrial Engineers	Bachelor's degree	$63,946	Y	Y	Y
172141	Mechanical Engineers	Bachelor's degree	$65,065	Y	Y	
414012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	Work experience in a related occupation	$48,412	Y	Y	Y
433031	Bookkeeping, Accounting, and Auditing Clerks	Moderate-term on-the-job training	$29,045			Y
434051	Customer Service Representatives	Moderate-term on-the-job training	$27,297			Y
435061	Production, Planning, and Expediting Clerks	Moderate-term on-the-job training	$36,266		Y	
472061	Construction Laborers	Moderate-term on-the-job training	$24,361			Y
472073	Operating Engineers and Other Construction Equipment Operato	Moderate-term on-the-job training	$30,642			Y
472111	Electricians	Long-term on-the-job training	$39,034	Y	Y	Y
472211	Sheet Metal Workers	Long-term on-the-job training	$32,214	Y		Y
499021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Long-term on-the-job training	$30,225	Y		Y
499041	Industrial Machinery Mechanics	Long-term on-the-job training	$37,296	Y		
499042	Maintenance and Repair Workers, General	Moderate-term on-the-job training	$31,137			Y
499044	Millwrights	Long-term on-the-job training	$42,641	Y	Y	Y
512041	Structural Metal Fabricators and Fitters	Moderate-term on-the-job training	$31,291			Y
512092	Team Assemblers	Moderate-term on-the-job training	$26,609			
514011	Computer-Controlled Machine Tool Operators, Metal and Plastic	Moderate-term on-the-job training	$32,598			Y
514031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$26,596			
514033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$30,426			Y
514041	Machinists	Long-term on-the-job training	$35,603	Y	Y	Y
514081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$28,388			Y
514111	Tool and Die Makers	Long-term on-the-job training	$41,599	Y		Y
514121	Welders, Cutters, Solderers, and Brazers	Postsecondary vocational training	$30,693	Y		Y
514191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$31,195			Y
519061	Inspectors, Testers, Sorters, Samplers, and Weighers	Moderate-term on-the-job training	$27,360			
519121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	Moderate-term on-the-job training	$25,836			
Source: TN Department of Labor and Workforce Development, Employment Security Division, Research and Statistics						

*SOC Codes are Standard Occupational Classification Codes

Table 8 Occupations in the Solar Energy Sector

SOC Codes*	Occupational Title	Training and Educational Level	Annual Median Wage 2007	High Skill	High Wage	In Demand
119021	Construction Managers	Bachelor's degree	$55,376	Y	Y	Y
172112	Industrial Engineers	Bachelor's degree	$63,946	Y	Y	Y
172141	Mechanical Engineers	Bachelor's degree	$65,065	Y	Y	
414012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Sceintific Products	Work experience in a related occupation	$48,412	Y	Y	Y
433031	Bookkeeping, Accounting, and Auditing Clerks	Moderate-term on-the-job training	$29,045			Y
434051	Customer Service Representatives	Moderate-term on-the-job training	$27,297			Y
435061	Production, Planning, and Expediting Clerks	Moderate-term on-the-job training	$36,266		Y	
472073	Operating Engineers and Other Construction Equipment Operators	Moderate-term on-the-job training	$30,642			Y
472111	Electricians	Long-term on-the-job training	$39,034	Y	Y	Y
472152	Plumbers, Pipefitters, and Steamfitters	Long-term on-the-job training	$36,360	Y	Y	Y
472211	Sheet Metal Workers	Long-term on-the-job training	$32,214	Y		Y
492094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	Postsecondary vocational training	$42,173	Y	Y	
499041	Industrial Machinery Mechanics	Long-term on-the-job training	$37,296	Y	Y	
499042	Maintenance and Repair Workers, General	Moderate-term on-the-job training	$31,137			Y
499043	Maintenance Workers, Machinery	Moderate-term on-the-job training	$31,920			Y
512041	Structural Metal Fabricators and Fitters	Moderate-term on-the-job training	$31,291			Y
512092	Team Assemblers	Moderate-term on-the-job training	$26,609			
514011	Computer-Controlled Machine Tool Operators, Metal and Plastic	Moderate-term on-the-job training	$32,598			Y
514021	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$28,566			Y
514031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$26,596			
514072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$25,586			
514081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$28,388			Y
514121	Welders, Cutters, Solderers, and Brazers	Postsecondary vocational training	$30,693	Y		Y
514191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	Moderate-term on-the-job training	$31,195			Y
516091	Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers	Moderate-term on-the-job training	$38,316			
518091	Chemical Plant and System Operators	Long-term on-the-job training	$43,716	Y	Y	
519041	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	Moderate-term on-the-job training	$26,697			
519061	Inspectors, Testers, Sorters, Samplers, and Weighers	Moderate-term on-the-job training	$27,360			
519121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	Moderate-term on-the-job training	$25,836			
533032	Truck Drivers, Heavy and Tractor-Trailer	Moderate-term on-the-job training	$36,798		Y	Y
537062	Laborers and Freight, Stock, and Material Movers, Hand	Short-term on-the-job training	$20,324			

Source: TN Department of Labor and Workforce Development, Employment Security Division, Research and Statistics

*SOC Codes are Standard Occupational Classification Codes

Table 9 Occupations in the Geothermal Energy Sector

SOC Codes*	Occupational Title	Training and Educational Level	Annual Median Wage 2007	High Skill	High Wage	In Demand
111021	General and Operations Managers	Bachelor's or higher degree, plus work experience	$71,278	Y	Y	
119021	Construction Managers	Bachelor's degree	$55,376	Y	Y	Y
131051	Cost Estimators	Bachelor's degree	$48,469	Y	Y	
132011	Accountants and Auditors	Bachelor's degree	$49,672	Y	Y	Y
171011	Architects, Except Landscape and Naval	Bachelor's degree	$65,291	Y	Y	
172051	Civil Engineers	Bachelor's degree	$68,417	Y	Y	
172071	Electrical Engineers	Bachelor's degree	$75,659	Y	Y	Y
173011	Architectural and Civil Drafters	Postsecondary vocational training	$43,084	Y	Y	
173022	Civil Engineering Technicians	Associate degree	$41,999	Y	Y	Y
173023	Electrical and Electronic Engineering Technicians	Associate degree	$48,587	Y	Y	
414012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	Work experience in a related occupation	$48,412	Y	Y	Y
431011	First-Line Supervisors/Managers of Office and Administrative Support Workers	Work experience in a related occupation	$39,032	Y	Y	Y
433031	Bookkeeping, Accounting, and Auditing Clerks	Moderate-term on-the-job training	$29,045			Y
434051	Customer Service Representatives	Moderate-term on-the-job training	$27,297			Y
435071	Shipping, Receiving, and Traffic Clerks	Short-term on-the-job training	$25,854			
436014	Secretaries, Except Legal, Medical, and Executive	Moderate-term on-the-job training	$24,632			Y
471011	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	Work experience in a related occupation	$44,101	Y	Y	
472031	Carpenters	Long-term on-the-job training	$30,239	Y		Y
472051	Cement Masons and Concrete Finishers	Moderate-term on-the-job training	$28,322			Y
472061	Construction Laborers	Moderate-term on-the-job training	$24,362			Y
472073	Operating Engineers and Other Construction Equipment Operators	Moderate-term on-the-job training	$30,642			Y
472111	Electricians	Long-term on-the-job training	$39,034	Y	Y	Y
472151	Pipelayers	Moderate-term on-the-job training	$28,516			Y
472152	Plumbers, Pipefitters, and Steamfitters	Long-term on-the-job training	$36,360	Y	Y	Y
472211	Sheet Metal Workers	Long-term on-the-job training	$32,214	Y		Y
473013	Helpers--Electricians	Short-term on-the-job training	$23,621			Y
473015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	Short-term on-the-job training	$23,725			Y
491011	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	Work experience in a related occupation	$46,327	Y	Y	
499021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Long-term on-the-job training	$30,225	Y		Y
499042	Maintenance and Repair Workers, General	Moderate-term on-the-job training	$31,137			Y
514121	Welders, Cutters, Solderers, and Brazers	Postsecondary vocational training	$30,693	Y		Y

Source: TN Department of Labor and Workforce Development, Employment Security Division, Research and Statistics

*SOC Codes are Standard Occupational Classification Codes

Green Building
Of 39 occupations commonly found in the industry (see Table 5, page 36), 25 can be considered high skill, requiring long term training, work experience in a related occupation, or college. Nine of these usually require a college degree or more. Of the 25 considered high skill, all but four are also high wage (with a median wage 20% above the statewide median wage). 28 of the 39 occupations are considered in demand at the state level. Occupations in demand are not expected to have sufficient trained personnel to fill projected openings.

Biofuels Energy
Of 33 key occupations (see Table 6, page 37), 23 will require long term training or more. 24 of these are also high wage occupations. Two occupations, chemical equipment operators and heavy and tractor-trailer truck drivers, require only moderate term training but are high wage occupations. 21 of the 33 are demand occupations.

Wind Energy
Of the 28 most prominent jobs in this sector, (see Table 7, page 38), only about half, or 13, can be considered high skill jobs, and eight are high wage. Most of the jobs are in component manufacturing. 20 are occupations in demand.

Solar Photovoltaics:
11 of the 31 most prominent occupations are (see Table 8, page 39), high skill (many of the jobs in component manufacturing require only moderate term training). Most of the high skill occupations are also high wage. 18 are in demand.

Geothermal Energy
Of the 31 prominent occupations (see Table 9, page 40), 20 are considered high skill. 16 are high wage occupations. 22 of the occupations are considered to be in demand.

Dr. Blake Brown, director of the UT Research and Education Center at Milan, demonstrates the vigor of switchgrass during the 2007 drought. This field rebounded from the famous Easter Freeze. At harvest it was more than 10 feet tall.

Shortage or Potential Shortage Occupations

Because they are in demand and/or appear in several of the industries, some of the occupations which may be in short supply in the energy efficiency and renewable energy sectors include:

Industrial engineers
Environmental engineers
Electrical engineers
Accountants and auditors
Sales representatives, wholesale and manufacturing
Customer service representatives
Construction managers
Farm managers
Civil engineering technicians
Computer controlled machine tool operators
Brick masons
Welders
Electricians
Plumbers, pipe fitters, and steamfitters
Heating, air conditioning, and refrigeration mechanics and installers
Mobile heavy equipment mechanics
Truck drivers, heavy and tractor-trailer
Millwrights
Machinists

Skills, Knowledge, and Work Style Attributes Important to Jobs in the EE and RE Industries

It can be useful to examine attributes employees have identified as important for success in their jobs. Three types of attributes—knowledge, skills, and work styles--were investigated. The O*Net online occupational database provides average ratings for individual occupations on these attributes.

Based on these employee ratings, worker attributes were estimated for two sets of employment numbers:

- Estimated total employment in these EE and RE industries in 2006
- Numbers of new job openings projected for the 10 years 2006 to 2016.

Employment data for 2006 was estimated for these industries by the Employment Security Division's Labor Market Information Unit. Employment expected in new jobs was projected using employment history and statistical methodology

Tables 10, 11 and 12 present these worker attribute ratings. We are particularly interested in attributes workers in new jobs in these industries are likely to need. The tables are therefore sorted by scores estimated for these added jobs, displayed in the last column of each table.

Knowledge (Table 10)
Average ratings for thirty- three types of knowledge were derived by averaging their importance ratings weighted by the number of new jobs expected in each occupation between 2006 and 2016. Importance ratings range from 1, Not Important to 5, Highly Important. The top three knowledge categories were production and processing reflecting the number of jobs in production and installation occupations; English language; and mathematics.

Other important knowledge types include customer and personal service, administration and management, and transportation. Also in the top third in terms of knowledge are personnel and human resources, biology, and chemistry. Education and training, mechanical, sales and marketing, and economics and accounting are mentioned.

Job Skills (Table 11)
O*Net online also allows us to look at the most critical skills out of 35 which are available. Ratings for the thirty-five types of skills were obtained by the same method as the knowledge ratings.

In these growing occupations and industries, the three most important skills were active listening, coordination, and speaking. With emerging technologies, much on-the-job learning and self-instruction are probably needed, making these learning and communication skills increasing important. Time management, instructing, and reading comprehension are also rated highly. Mathematics and writing represent the need for numerical and linguistic skills. Equipment selection, monitoring, and equipment maintenance reflect the production and construction aspects of the emerging industries.

Work Styles (Table 12)
The top six work style attributes would be on any employer's list: dependability, integrity, cooperation, attention to detail, self control, and stress tolerance. Persistence, adaptability and flexibility, and concern for others are also in the top tier for importance.

Summary
These analyses suggest that training programs designed to ready the workforce for the new jobs in the energy efficiency and renewable energy industries need to address these critical knowledge, skill, and work style components in addition to increasing workers' knowledge of the specific emerging technologies in use in each industry.

Table 10 Average Knowledge Scores for Energy Efficiency/Renewable Energy Industries, Tennessee, 2006—2016

Category	2006 Employment	All Total Openings to 2016	All Growth Openings to 2016	Difference in Growth/ Total Importance Score
Production and Processing	3.0	3.0	3.2	8.0%
English Language	3.1	3.1	3.1	1.0%
Mathematics	2.9	2.9	3.0	5.8%
Customer and Personal Service	2.9	2.8	3.0	3.6%
Administration and Management	2.8	2.7	3.0	6.4%
Transportation	2.7	2.8	2.9	6.7%
Personnel and Human Resources	2.6	2.6	2.9	9.0%
Biology	2.4	2.5	2.8	13.5%
Chemistry	2.6	2.6	2.8	7.7%
Education and Training	2.6	2.6	2.7	4.8%
Mechanical	2.6	2.6	2.7	3.5%
Sales and Marketing	2.3	2.3	2.6	13.4%
Economics and Accounting	2.4	2.4	2.5	7.3%
Public Safety and Security	2.3	2.3	2.3	0.8%
Clerical	2.2	2.2	2.3	2.8%
Design	2.1	2.1	2.2	8.0%
Building and Construction	2.1	2.1	2.2	3.2%
Law and Government	2.0	2.0	2.2	7.3%
Geography	2.0	2.0	2.1	7.3%
Psychology	1.9	1.9	2.1	9.5%
Physics	2.0	2.0	2.0	3.3%
Food Production	2.1	2.1	2.0	-3.1%
Engineering and Technology	1.8	1.8	2.0	8.4%
Communications and Media	1.8	1.8	1.9	5.0%
Computers and Electronics	1.8	1.8	1.8	-0.5%
Foreign Language	1.6	1.6	1.7	7.9%
Philosophy and Theology	1.4	1.4	1.6	13.4%
Sociology and Anthropology	1.4	1.5	1.5	6.7%
Medicine and Dentistry	1.5	1.6	1.5	-0.8%
Telecommunications	1.6	1.5	1.5	-5.6%
History and Archeology	1.4	1.4	1.5	6.7%
Therapy and Counseling	1.4	1.4	1.4	0.9%
Fine Arts	1.1	1.1	1.1	0.3%

Table 11 Average Skill Scores for Energy Efficiency/Renewable Energy Industries Tennessee 2006—2016

Category	2006 Employment	All Total Openings to 2016	All Growth Openings to 2016	Difference in Growth/Total Importance Score
Active Listening	3.7	3.7	3.8	1.8%
Coordination	3.5	3.5	3.6	3.5%
Speaking	3.5	3.5	3.6	3.0%
Time Management	3.5	3.5	3.6	3.2%
Instructing	3.5	3.5	3.6	3.3%
Reading Comprehension	3.3	3.3	3.5	4.4%
Mathematics	3.2	3.2	3.4	4.9%
Writing	3.1	3.2	3.3	7.5%
Equipment Selection	3.2	3.2	3.3	4.7%
Active Learning	3.2	3.2	3.3	4.3%
Monitoring	3.1	3.1	3.3	4.6%
Critical Thinking	3.1	3.1	3.2	3.8%
Equipment Maintenance	3.2	3.3	3.2	-1.7%
Judgment and Decision Making	3.1	3.1	3.1	0.6%
Learning Strategies	3.0	2.9	3.1	5.1%
Service Orientation	3.0	3.0	3.1	3.2%
Operation and Control	3.0	3.0	3.1	3.0%
Quality Control Analysis	2.8	2.9	3.1	7.3%
Management of Material Resources	2.8	2.9	3.0	6.6%
Social Perceptiveness	2.9	2.9	3.0	3.6%
Repairing	2.9	3.0	3.0	1.4%
Management of Personnel Resources	2.7	2.8	3.0	8.3%
Persuasion	2.8	2.8	3.0	7.0%
Operation Monitoring	2.8	2.9	2.9	4.0%
Negotiation	2.7	2.7	2.9	8.4%
Troubleshooting	2.8	2.8	2.9	3.0%
Complex Problem Solving	2.7	2.6	2.8	6.7%
Management of Financial Resources	2.6	2.6	2.8	9.5%
Science	2.5	2.5	2.7	11.0%
Operations Analysis	2.5	2.5	2.7	8.8%
Systems Evaluation	2.3	2.3	2.5	7.5%
Systems Analysis	2.3	2.3	2.4	6.0%
Installation	2.3	2.3	2.3	1.8%
Technology Design	2.1	2.1	2.2	8.2%
Programming	1.7	1.8	1.8	3.7%

Table 12 Average Work Style Scores for Energy Efficiency/Renewable Energy Industries Tennessee, 2006—2016

Category	2006 Employment	All Total Openings to 2016	All Growth Openings to 2016	Difference in Growth/ Total Importance Score
Dependability	4.2	4.2	4.3	2.9%
Integrity	4.0	4.0	4.1	2.9%
Cooperation	3.9	4.0	4.1	2.8%
Attention to Detail	4.0	4.0	4.0	0.2%
Self Control	3.8	3.8	3.9	2.4%
Stress Tolerance	3.6	3.6	3.7	2.1%
Persistence	3.5	3.5	3.7	3.8%
Adaptability/Flexibility	3.6	3.6	3.7	2.9%
Concern for Others	3.5	3.5	3.6	1.0%
Achievement/Effort	3.4	3.4	3.6	3.7%
Leadership	3.3	3.2	3.5	6.5%
Independence	3.5	3.4	3.5	0.2%
Initiative	3.4	3.3	3.5	3.1%
Social Orientation	3.2	3.2	3.3	5.1%
Analytical Thinking	3.2	3.1	3.3	5.4%
Innovation	3.0	2.9	3.1	4.3%

www.makower.com/

The Green Jobs Act

The Energy Independence and Security Act (EISA) was signed into law on December 19, 2007. Key features of the legislation include:

- Increased fuel economy and incentives to develop better vehicle batteries and plug-in hybrids
- An increased renewable fuels standard
- A new Energy Efficiency and Conservation Block Grant program ($2 billion per year awarded to state and local governments)
- Sub-grants possible for nonprofits and governmental agencies for performing energy efficiency retrofits
- Requirements for federal and commercial buildings to be more energy efficient

Title X of the EISA is the Green Jobs Act, for which $125 million was authorized but not appropriated. State components of the program were to include:

- State Labor Market Research
- A state Energy Training Partnership Program
- The Pathways out of Poverty Demonstration Program

Pathways out of Poverty will include 10 competitive grants to training partnerships serving individuals living at less than 200% of poverty. The partnerships should have experience with successful training strategies with the low income population and should be prepared to provide comprehensive supportive services.

Leverage of funds is important. "For this reason, state and local governments and private sector partnerships that have already invested in their own green jobs initiatives will be in a more competitive position to be awarded GJA grants." [129]

Despite the lack of funding, the U.S. DOL, in consultation with DOE, was required to establish the Energy Efficiency and Renewable Energy Worker program by May 2008.

Some of the EISA funds can probably be used for preliminary grant making for the Green Jobs Act. This may provide an opportunity for states to move ahead with labor market research and demonstration training programs.

Recruitment and Training Opportunities Related to Energy Efficiency and Renewable Energy

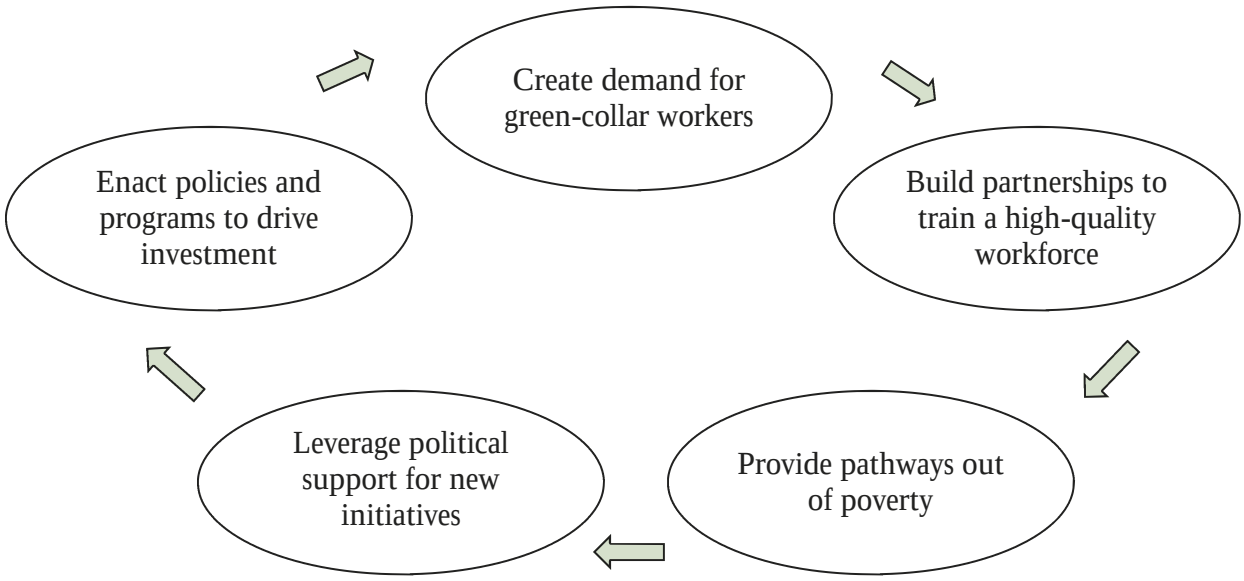
Many green jobs may require traditional training, while others require specialized new community college, technology center, or university level courses. Other states have taken some dramatic initiatives to identify and prepare their workforces for jobs in the renewable energy and energy efficiency sectors.

The State of Pennsylvania faced a workforce development challenge when they recruited the Spanish wind turbine manufacturer and wind farm developer Gemesa to the town of Ebensburg as they pursued a path of Green Reindustrialization. Training opportunities were developed through strategic partnerships. The region developed detailed profiles of the job skills of dislocated workers that were included in a detailed database administered by Pennsylvania CareerLink. This showed Gemesa the skills that were available in the potential workforce, and recruitment went well.[130]

In Iowa, the New Jobs Training Program (NJTP) authorizes their 15 community colleges to issue bonds such as their Biofuels Job Training Bonds for a business that is creating jobs. The bond sale supports the training for the new jobs. The bonds are paid off by diverting to the college 1.5 or 3 percent of increased payroll taxes from the new jobs.[131]
North Central Indiana is using WIRED funds to identify teams of manufacturing employees in 28 companies and train them as "energy efficiency practitioners."[132]

Skills certifications are credentials that increase worker bargaining power with employers. One example is provided by the North American Board of Certified Energy Practitioners (NABCEP), which in 2002 did a task analysis for photovoltaic system installers. The National Science Foundation has developed extensive descriptions on current and emerging occupations in what they term the Energy Technologies and Services career field, including job descriptions and task lists. This may prove to be a valuable tool in moving toward skills certifications in some high demand areas.[132] Four job descriptions summarized from this publication are shown following this paragraph.

Demand-Driven Green Jobs Policy Model



Adapted from Apollo Alliance

Examples of Emerging Occupations

ENERGY AUDITOR

Energy auditors interview customers to determine their wants and needs. Analyze historic energy bills and usage data to determine needs for heating, cooling, and lighting for a building or facility. Apply engineering principles to identify and explore opportunities for improving energy production and use, operation, maintenance, and energy efficiency of systems. Inspect and evaluate building envelopes, mechanical systems, electrical systems, and process systems to determine the energy consumption of each system. They use tools such as data logger, universal data recorder, light meter, sling psychrometer, psychrometric chart, flue gas analyzer, amp-probe, watt meter, volt meter, thermometer, utility meter, infrared camera, lighting spreadsheet, and motor master software. Collect, analyze, and validate the energy usage data in the field. Write reports on results and recommendations for energy cost savings and describe environmental impact from recommended system changes.

RENEWABLE ENERGY SYSTEMS INSTALLER

Renewable energy systems installers plan the general job layout. Receive and/or verify equipment is ready for assembly or construction. Assemble components and construct and place system components and support structures in designated locations and configurations in accordance with fire prevention and occupational health/safety codes. Complete the start up commissioning and perform system operations tests. Connect system to the utility systems and controls systems. May require operation of a tractor or skid loader and skills in carpentry, concrete, electrical, roofing, climbing, and use of hand and power tools.

BUILDING CONTROL OPERATOR

Building control operators optimize energy efficiency and lighten environmental impacts. Program automated control system of building and/or facilities. Troubleshoot systems and controls. Install, replace, and repair basic building systems and controls. Respond to and coordinate with maintenance, operation, and service personnel. Respond to occupants' requests and participate in commissioning of buildings.

BIOFUELS (LIQUID) PROCESSING TECHNICIAN

Biofuels processing technicians measure and monitor the raw biofuels feedstock and processing additives for quality and quantity before processing. Preprocess feedstock in preparation for physical/chemical/biological fuel production process. Calculate, measure, load, mix, and process refined feedstock with additives in fermentation/reaction process container and monitor production process. Extract the fuel product, measure quality, and monitor storage until transferred to user. Extract secondary by-product or reusable fraction and monitor in storage until reused or transferred to user. Clean, maintain, and prepare the processing equipment. Rebuild and/or repair components of equipment.

Additional alternative titles for occupations can be found in Appendix G.

Training Opportunities in Tennessee

The Department of Labor and Workforce Development, Employment Security Labor Market Information Section, has worked with the Tennessee Department of Education, Career and Technical Education Division to complete in spring 2008 the *Tennessee Careers* series. These publications contain information on all the training and educational opportunities available in Tennessee public postsecondary institutions, current to December 2007, complete with degrees offered. This information, in addition to data on private and proprietary educational institutions, is also available on the web site, www.sourcetn.org

The *Tennessee Careers* publications are available for all 16 national clusters. The clusters with educational programs most closely related to energy efficiency and renewable energy include Agriculture and Natural Resources; Architecture and Construction; Manufacturing; and Science, Technology, Engineering, and Mathematics (STEM). The business and marketing clusters are relevant as well.

The relevant CTE clusters include:

Agriculture and Natural Resources: *biofuels*
Architecture and Construction: *green building, geothermal*
Business Management and Administration: *all sectors*
Finance: *all sectors*
Manufacturing: *green building, wind, solar, biofuels*
Marketing: *all sectors*
STEM: *wind, solar, biofuels, green building, geothermal*
Transportation: *biofuels*

Meeting the needs of the clean energy economy will require Tennessee to upgrade the skills of its workforce. Investment in state and local green collar worker training will be needed at all levels –

- high school career and technical science and pre-engineering courses
- on-the-job training programs
- certificate programs at Tennessee technology centers
- union apprenticeship programs for skilled trades
- associate degree programs in renewable energy installation
- bachelor's and master's programs in science, engineering and management related to agriculture and green technologies

Most training related to green building will take place in traditional training programs for construction, architecture, and engineering. Although training programs for a number of trades exist through the state (for instance, there are 10 certificate programs for electricians) insufficient numbers of graduates exist to even meet current demand. Only one program exists in construction management (a bachelor's degree); there is only one certificate program for construction equipment operator; and only two certificate programs for plumbers and pipefitters at Tennessee technology centers. Additional opportunities exist in apprenticeship programs, in career and technical education programs in high schools, and through the Job Corps.

Some newer training related to biofuels, renewable energy, and energy efficiency has been developed in Tennessee. Examples of this follow.

Emerging Training opportunities:

- The Sharp Corporation in Memphis, the world's leading solar manufacturer, offers a two day installation program for dealers and contractors of Sharp grid-connected inverters and residential solar systems – held in Huntington, California and Mahwah, New Jersey.
- Biosucceed- The University of Tennessee Agricultural Experiment Station is developing an MS degree program with six graduate level classes, two undergraduate classes, and additional modules. They can be delivered with distance learning.[134] Partners in the curriculum development project include North Carolina State University and North Carolina A & T. Funding was provided by U.S. Department of Agriculture Higher Education Grant.
- David Lipscomb University is now offering the first Sustainability MBA in Tennessee.[135]
- Cleveland State Community College includes techniques for energy efficiency and solar power installation for residential construction in their associate degree Construction Technology Concentration in the Technology Department. This plus experience can lead to solar PV installer certification.[136]
- Project Lead the Way is a pre-engineering program in 33 school sites in the state which may introduce students to concepts related to energy efficiency.
- Incumbent worker training, funded by the state, could be used to upgrade worker skills in new technologies such as renewable energy.

Other training opportunities could emerge from consortiums such as the Tennessee Energy, Industry, and Construction Consortium (TEICC), which includes a variety of private and public sector employers and unions.

Other Workforce Considerations for Green Job Growth: Skill Gaps, Creating Good Green Jobs

Green jobs or green-collar jobs provide hope at time when workers see blue-collar and even professional and service jobs being reduced in the U.S. and outsourced overseas. To many, green jobs mean local jobs, created by money staying in the community and creating a multiplier effect locally. Green jobs also do not worsen public health.

Workers who have not had adequate opportunities in the current economy look to green jobs as those requiring the acquisition of updated skills which could benefit communities of color or low-income workers. Ideas to promote these workforce outcomes include a Green Jobs Corps (a training partnership among labor unions, community colleges, and local governments), Green Enterprise Zones, and comprehensive Green Economic Development Plans.[137]

What States Can Do to Promote Green Jobs Initiatives, and Examples of Tennessee's Progress

Tennessee is moving ahead on key policy principles[138] important for the success of green jobs initiatives. The principles are stated below, with a brief description of what the state is doing in each policy area. As many new initiatives are developed, Tennessee can take some important steps to more tightly link economic development and innovation with its significant workforce development needs.

1) Target specific green jobs and develop regional data

A green jobs initiative needs to specify the green industries and/or high demand jobs on which to focus, so success can be determined. Tennessee has targeted biofuels production and distribution, energy efficient vehicles, smart grids, energy efficiency of public buildings and industries, and photovoltaic, geothermal , and wind renewables expansion. This report begins to identify related jobs, training requirements, and potential job shortages in these areas.

2) Measure program success

With new green jobs initiatives, program evaluations with realistic measures are needed to capture what works and what doesn't. For the biofuels initiative in Tennessee, estimates of number of jobs which may be created (both in farm production of switchgrass, and in processing) have been created. Goals and timetables for industry growth are being developed by other energy project partners, which can be reviewed for project success.

3) Use energy standards to help create green jobs- LEED certification, RPS, etc.

Use of energy efficiency and renewable standards such as LEED, RPS, and the like can be used as an economic and job development tool, to spur market development. TVA's goal to reduce peak electricity use by 1400 MW within five years can be aided by LEED certification.

4) Upgrade and retool for the new economy

Saving current jobs and creating new ones through the retooling of existing plants to advance new energy technology and practices could be a significant boost to Tennessee's economy. The new Green Recovery report for Tennessee [see page 33] estimates that by more fully using Tennessee's current infrastructure in construction and manufacturing, the unemployment rate could be reduced by one and a half percent with $1.9 billion in new green jobs investment.

5) Connecting green economic and workforce development

For workers and communities to fully benefit, state and local leaders need to plan together to link together job training and economic development opportunities. Skilled workers need to be trained when the jobs are available, and career paths need to be created. Better data on current training opportunities like apprenticeships needs to be available.

Tennessee's incumbent worker training program is an important model. The Biosucceed program is being developed as Tennessee moves forward with biofuels investments. The Tennessee Energy, Industry, and Construction Consortium is planning recruiting and training strategies for skilled trades workers that could be linked with energy efficiency projects.

Green jobs initiatives can be linked to current state education initiatives such as career academies and high school to post-high-school transition programs, as well as to career and technical education curriculum development.

6) Build green partnerships

Regional public-private partnerships within industry sectors can create jobs and direct training resources to the most critical areas. Employers, labor leaders, educators, workforce boards, economic developers, career center personnel, and key community leaders need to coordinate initiatives and integrate them into the current workforce system.

The State is building essential partnerships with Nissan and TVA on the development of electric cars and electric charging capability; with Oak Ridge National Lab, the University of Tennessee and thirteen other partners on biofuels; with TVA and NES on retrofit projects; and with a myriad of other partners on the state's Energy Task Force.

7) Build pathways out of poverty

With Tennessee's poverty rate at 15%, an important goal of green job creation can be to provide new opportunities for those with basic skills, incumbent low wage workers and the underemployed to move into more highly skilled jobs with higher pay.

Adults applying for Hope scholarships, TAA training, welfare- to- work, and food stamp programs could be provided opportunities to advance in green jobs programs aided by mentoring and needed support services.

Conclusion

Green technology is playing an important role in the Tennessee economy. This is welcome news for an economy that has seen significant job losses in manufacturing and is ready to forge new paths.

"Green technology has taken on an important new role-that of market stimulus, and entrepreneurs are leveraging it to forge a clear path to economic recovery," said Chairwoman Nydia M. Velázquez of the U.S. House of Representatives' Committee on Small Business. "That's definitely good for the environment, but it also means new jobs and increased economic activity… Green firms add $933 billion to the economy each year and employ more than 11 million workers…Most of the jobs are in small business industries, including farming, construction, plumbing, and electrical engineering."[139]

A coalition of 16 of the nation's leading business organizations is calling for doubling the number of degrees awarded in science, technology, engineering and math by 2015. They are concerned that we are losing our advantage in innovation, competitiveness and leadership, pointing to the successes of European countries is such areas as clean technology.[140]

The world is at a critical point with regard to climate change. On July 17, 2008, Al Gore said that consultations with leading experts predict we have "less than 10 years to make dramatic changes in our global warming pollution" or we will never be able to recover from the current environmental crisis. He has challenged the U.S. to commit to producing 100% of our electricity from renewable energy and truly clean carbon free sources within 10 years.[141]

Sufficient renewable resources are available. Scientists say that in 40 minutes, enough solar energy falls on the earth to meet 100% of the world's energy needs for a year. Enough wind power blows through the Midwest corridor daily to meet 100% of U.S. electricity demand. Geothermal has great potential, as does conservation.

Rapidly rising carbon-based fuel costs are affecting every sector of the economy, and are accelerating the growth of renewable technologies. Even in 2006, renewables world wide had double digit growth rates:

Growth Rates 2006

Wind	25-30%
Solar PV (grid)	50-60%
Solar hot water	15-20%
Biofuels	15-20%

Targets for future shares and amounts of renewable energy exist in 58 countries worldwide.[142]

How can Tennessee continue to foster green job growth, meet its workforce challenges and provide the skills necessary to move to a greener and more energy efficient economy? Tennessee

- Is leading by example
- Is fostering public- private partnerships
- Has the potential for significant savings due to energy efficiency especially in the state government sector and the universities, and is leading the way in zero energy use home construction
- Has significant potential for wind, geothermal. and solar PV
- Needs to continue to provide sufficient incentives for green job creation in Tennessee
- Needs to continue to develop workforce policies so that rural communities, dislocated workers, and lower income and/or less skilled workers including women and minorities have the opportunity to gain from new growth areas in the economy.

Green jobs initiatives can become a vital component of workforce development, as the policies described on the previous page demonstrate.

An example of such a focus is Washington State, which passed a voter initiative that 15 percent of the state's electricity needs must be met with renewable energy and energy efficiency. Washington's legislation, SB 6001, which passed in March 2008, has specific goals to reduce the emissions of greenhouse gases. It also has a strong green jobs provision requiring the Employment Security Department to analyze the labor market for green jobs and propose which industries should be considered high demand green industries.

As part of Washington's emphasis, green industry skill panels (GISP) will be convened, consisting of business, labor, employer associations, educational institutions, and local workforce agencies. These skill panels will be responsible for planning strategies to meet the recruitment and training needs of the industries. The legislation also sets up a Green-Collar Job Training Fund to train workers for high wage occupations, or those with career pathways towards higher wage occupations, in high demand industries related to clean energy. Target populations are adults and youth in poverty; entry or incumbent workers in green industries; or dislocated workers who can be retrained for high wage occupations in high-demand green industries.[143]

The Tennessee Valley Authority (TVA) currently has a goal of reducing peak electricity use by 1,400 MW within five years; in May 2008, they set a goal of generating half their power from low or non-carbon-producing sources by 2020.[144] Many businesses and consumers will need to change current practices and processes for this goal to be achieved.

In the last few years under the leadership of Governor Bredesen, Tennessee has taken major steps to lay the groundwork for innovation and production in the areas of energy efficiency and renewable energy. In important areas, Tennessee has significant challenges and tremendous opportunities: in reducing carbon emissions; in cutting-edge biofuels production; in increasing the use of alternative fuel vehicles; in boosting commercial and residential energy efficiency; and especially in preparing the workforce to meet the possibilities and demands of employment in the industries that will grow as a result of these advances.

New estimates for the number of jobs to be created in Tennessee are significant. Investment in green jobs technology could assist the recovery of Tennessee in the construction and manufacturing areas if investments are targeted towards industries which can expand in Tennessee, such as building retrofits and manufacturing of wind and solar components and expansion of energy efficient transit options and biofuels. Building retrofits are the option which can most rapidly create the most new jobs and can have payback periods of five years or less, with ongoing energy savings.

Appendix A: Green Industries

Table 13 Manufacturing Firms with the Technical Potential to Enter the Wind Turbine Components Market

NAICS Code	Code Description	Components
326199	All Other Plastics Products	Rotor Blade, Nacelle Case
331511	Iron Foundries	Blade Extender, Hub, Nacelle Frame, Tower Flange
332312	Fabricated Structural Metal	Tower
332991	Ball and Roller Bearings	Bearings
333412	Industrial and Commercial Fans and Blowers	Cooling System
333611	Turbines, and Turbine Generators, and Turbine Generator Sets	Generator
333612	Speed Changer, Industrial	Gear Box
333613	Power Transmission Equipment	Brakes, Coupling, Shafts
334418	Printed Circuits and Electronics Assemblies	Electronic Controller
334519	Measuring and Controlling Devices	Anemometer, Sensors
335312	Motors and Generators	Pitch Drive, Yaw Drive
335999	Electronic Equipment and Components, NEC	Power Electronics

Source: Sterzinger 2004, p. 57

Table 14 Manufacturing Firms with the Technical Potential to Enter the Solar PV Market

NAICS Code	Code Description
325211	Plastics Material and Resin Manufacturing
326113	Unlaminated Plastics Film and Sheet (Except Packaging) Manufacturing
327211	Flat Glass
331422	Copper Wire (except Mechanical) Drawing
332322	Sheet Metal Work Manufacturing
334413	Semiconductors and Related Devices
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
335313	Switchgear and Switchboard Apparatus Manufacturing
335911	Storage Batteries
335931	Current-Carrying Wiring Device Manufacturing
335999	Electronic Equipment and Components, NEC

Source : Sterzinger 2005, p. 9

Table 15 Industries Included as Green in TN

NAICS Industry	NAICS Industry Title	Total Establishments	Total Employment 3rd Qtr 2006
	Agriculture		
111998	All Other Miscellaneous Crop Farming	10	85
	Mining and Quarrying		
212321	Construction Sand and Gravel Mining	17	341
	Utilities		
221111	Hydroelectric Power Generation	41	5323
	Construction		
236115	New Single-Family Housing Construction	2154	11128
236116	New Multifamily Housing Construction	33	249
236117	New Housing Operative Builders	60	362
236118	Residential Remodelers	811	3679
236210	Industrial Building Construction	153	4025
236220	Commercial Building Construction	751	12547
237110	Water and Sewer System Construction	283	3421
237130	Power/Communication System Construction	108	1994
237310	Highway, Street, and Bridge Construction	385	11900
237990	Other Heavy Construction	149	1558
238110	Poured Concrete Foundation Contractors	308	3358
238120	Structural Steel and Precast Concrete Contractors	109	1491
238140	Masonry Contractors	449	4867
238160	Roofing Contractors	299	3534
238190	Other Founcation, Structure, Building Exterior Contractors	89	1154
238220	Plumbing, Heating, and Air Conditioning Contractors	1698	20624
238320	Painting and Wall Covering Contractors	432	3236
238350	Finish Carpentry Contractors	358	1789
238910	Site Preparation Contractors	935	8453
238990	All Other Specialty Trade Contractors	632	5449
	Manufacturing		
321114	Wood Preservation	10	108
321214	Truss Manufacturing	30	957
325510	Paint and Coating Manufacturing	27	911
325520	Adhesive Manufacturing	12	329
326113	Nonpackaging Plastics Film and Sheet	18	1288
326199	All Other Plastics Product Manufacturing	155	6606
327112	Vitreous China and Earthenware Articles	18	181
327331	Concrete Block and Brick Manufacturing	31	1276
327390	Other Concrete Product Manufacturing	64	2200
327991	Cut Stone & Stone Product Manufacturing	69	812
331511	Iron Foundries	12	1301
332312	Fabricated Structural Metal Mfg	139	2704
332322	Sheet Metal Work Manufacturing	75	1905
332323	Ornamental and Architectural Metal Work	60	780
332991	Ball and Roller Bearing Manufacturing	6	792
333111	Farm Machinery & Equipment Manufacturing	21	628

Table 15 Industries Included as Green in TN *(continued)*

NAICS Industry	NAICS Industry Title	Total Establishments	Total Employment 3rd Qtr 2006
	Manufacturing *(continued)*		
333120	Construction Machinery Manufacturing	17	2111
333412	Industrial & Commercial Fans & Blowers	3	61
333414	Heating Equipment, ex. Warm Air Furnaces	16	2173
333613	Mechanical Power Transmission Equipment	7	296
333991	Power-Driven Handtool Manufacturing	4	793
334418	Printed Circuit Assemblies	10	592
334515	Electricity & Signal Testing Instruments	5	37
334519	Other Measuring and Controlling Devices	17	789
335121	Residential Electric Lighting Fixtures	6	91
335122	Nonresidential Electric Lighting Fixture	11	1665
335312	Motor and Generator Manufacturing	22	1904
335313	Switchgear and Switchboard Apparatus	10	1987
335931	Current-Carrying Wiring Device Mfg	8	551
335999	Miscellaneous Electrical Equipment	8	531
336322	Other Motor Vehicle Electrical Equipment	23	3313
337212	Custom Architectural Woodwork & Millwork	26	570
	Wholesale Trade		
423320	Masonry Material Merchant Wholesalers	75	1134
423330	Roofing and Siding Merchant Wholesalers	90	840
423390	Other Construction Supply Merchant Whsle	67	850
423490	Other Professional Goods Merchant Whsle	39	399
423520	Coal/Other Mineral Merchant Wholesalers	9	41
423610	Wiring & Equipment Merchant Wholesalers	247	4067
423690	Other Electronic Parts Merchant Whsle	173	1660
423720	Plumbing Goods Merchant Wholesalers	141	1414
423810	Construction Equip Merchant Wholesalers	127	2704
423820	Farm & Garden Equip Merchant Wholesalers	204	2174
424690	Other Chemical Merchant Wholesalers	225	2362
	Finance		
522292	Real Estate Credit	561	4829
532412	Other Heavy Machinery Rental and Leasing	41	369
	Professional, Scientific, and Technical Services		
541310	Architectural Services	336	3654
541320	Landscape Architectural Services	176	1001
541330	Engineering Services	1027	14730
541380	Testing Laboratories	140	1719
541512	Computer Systems Design Services	1153	5498
541711	Scientific Research and Development Services	37	309
541712	Scientific Research and Development Services	160	6596
	Administrative, Support, Waste Management Services		
561730	Landscaping Services	1319	11148
	Health Care and Social Assistance		
624229	Other Community Housing Services	43	364

Table 15 Industries Included as Green in TN *(continued)*

NAICS Industry	NAICS Industry Title	Total Establishments	Total Employment 3rd Qtr 2006
	Other Services		
811310	Commercial Machinery Repair/Maintenance	492	3593
813910	Business Associations	381	1853
813920	Professional Organizations	99	787
	Public Administration		
924110	Air, Water and Waste Program Admin	4	7
926130	Utility Regulation and Administration	14	93
926140	Agricultural Commodity/Market Regulation	58	669
Grand Total		**18642**	**225673**

Table 16 California Green Establishments, Employment

NAICS		Establish-ments	Employment
31-33	**Manufacturing**	**100%**	**100%**
334413	Semiconductor and Related Device Manufacturing	12%	18%
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	7%	11%
335121	Residential Electric Lighting Fixture Manufacturing	0%	10%
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	4%	7%
335911	Storage Battery Manufacturing	3%	6%
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	12%	5%
333319	Other Commercial and Service Industry Machinery Manufacturing	4%	5%
334512	Automatic Environmental and Control Manufacturing for Residential, Commercial, and Appliance Use	5%	4%
333611	Turbine and Turbine Generator Set Unit Manufacturing	2%	3%
326199	All Other Plastics Products Manufacturing	1%	2%
334519	Other Measuring and Controlling Device Manufacturing	3%	2%
54	**Professional, Scientific Services**	**100%**	**100%**
541690	Other Scientific and Technical Consulting Services	56%	38%
541330	Engineering Services	14%	19%
541710	Research and Development in the Physical, Engineering, and Life Sciences	13%	15%
541910	Marketing Research and Public Opinion Polling	0%	4%
541310	Architectural Services	1%	3%
541380	Testing Laboratories	0%	3%
541618	Other Management Consulting Services	4%	2%
541613	Marketing Consulting Services	1%	2%
541720	Research and Development in the Social Sciences and Humanities	1%	2%
23	**Construction**	**100%**	**100%**
238220	Plumbing, Heating, and Air Conditioning Contractors	55%	53%
238210	Electrical Contractors	28%	29%
238290	Other Building Equipment Contractors	3%	8%
236116	New Multifamily Housing Construction(Except Operative Builders)	0%	3%
42	**Wholesale Trade**	**100%**	**100%**
423690	Other Electrical Parts and Equipment Merchant Wholesalers	13%	30%
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	34%	16%
423120	Motor Vehicle Supplies and New Parts Wholesalers	3%	15%
423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	19%	14%
423830	Industrial Machinery and Equipment Merchant Wholesalers	7%	6%
424710	Petroleum Bulk Stations and Terminals	5%	4%
423510	Metal Service Centers and Other Metal Merchant Wholesalers	2%	3%
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	1%	3%
423840	Industrial Supplies Merchant Wholesalers	2%	2%

Source: Doug Henton, et. al."Clean Technology and the Green Economy." March 2008.

Appendix B: Incentives and Initiatives

Table 17 Federal Incentives

SELECTED FEDERAL INCENTIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
2008	Cellulosic Biofuel Production Credit (2009 -2012)	$1.01 per gallon tax credit	Cellulosic biofuel	Cellulosic biofuel produced and sold in the U.S.	http://www.brdisolutions.com/default.aspx
2008	Biorefinery Construction	Grants and loan guarantees	Emphasis on advanced bioenergy sources, others also included	Commercially viable advanced biofuel refineries	http://www.brdisolutions.com/default.aspx
2008	Repowering Assistance	Funding to replace fossil fuels used to operate biorefineries with bioenergy	Unspecified biofuels	Existing biorefineries	http://www.brdisolutions.com/default.aspx
2008	Bioenergy Program for Advanced Biofuels	Payment contracts	"Advanced" biofuels	Refineries with a capacity greater than 150 million gallons annually	http://www.brdisolutions.com/default.aspx
2008	Biomass Crop Assistance Program	Payments up to $45 per ton for 2 years for collection, harvest, transportation and storage	Renewable biomass	Agricultural and forest land owners and operators	http://www.brdisolutions.com/default.aspx
2008	Feedstock Flexibility Program	Federal government purchase and resell crops via Commodity Credit Corporation	Unspecified bioenergy crops	Crop producers, biofuel producers	http://www.brdisolutions.com/default.aspx
2008	Biomass Research and Development	Grants, contracts, and financial assistance	Biofuels and biobased products	Research and development	http://www.brdisolutions.com/default.aspx
2008	REAP: Rural Energy for America Program (formerly USDA Renewable Energy Systems and Energy Efficiency Improvements Program)	Grants, production credits and loan guarantees	Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Photovoltaics, Wind, Biomass, Hydroelectric, Renewable Transportation Fuels, Geothermal Electric, Geothermal Heat Pumps, CHP/Cogeneration, Hydrogen, Direct-Use Geothermal, Anaerobic Digestion, Small Hydroelectric, Renewable Fuels, Fuel Cells using Renewable Fuels, Microturbines	Grants to Commercial, Schools, Local Government, State Government, Rural Electric Cooperative, Agricultural, Public Power Entities; Loans to Commercial, Agricultural	http://www.dsireusa.org/library/includes/Printfederalall.cfm
Extended in 2008 (originated in 2005)	Business Energy Tax Credit	Corporate tax credit up to 30% cost of equipment	Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Geothermal, Fuel Cells, Solar Hybrid Lighting, Microturbines	Commercial, Industrial	http://www.dsireusa.org/library/includes/Printfederalall.cfm

Table 17 Federal Incentives *(continued)*

SELECTED FEDERAL INCENTIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
Extended in 2008 (originated in 2005)	Modified Accelerated Cost-Recovery System (MACRS) & Bonus Depreciation	Corporate Depreciation	Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Landfill Gas, Wind, Biomass, Renewable Transportation Fuels, Geothermal, Fuel Cells, Solar Hybrid Lighting, Anaerobic Digestion, Microturbines	Commercial, Industrial	http://www.dsireusa.org/library/includes/Printfederalall.cfm
2007	Solar America Initiative expanding the Million Solar Roof Initiative of 1997	Funding to accelerate development of cost-effective photovoltaic solar energy	Photovoltaic solar energy	Industry, universities, state governments, federal agencies, other non-governmental entities	http://www1.eere.energy.gov/solar/solar%5Famerica/
2007	Loan guarantee program (pending appropriations)	Loans from private institutions to construct manufacturing plants in U.S. for advanced vehicle batteries and related technology	Advanced lithium ion batteries, hybrid electrical systems	Industry	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Loan program for up to 30% of costs for manufacturers of advanced technology vehicles and components	Up to $25 billion in loans to auto manufacturers for (a) establishment or modification of facilities or (b) engineering intengration	Advanced technology vehicles and components	Auto and components manufacturers, with 10% or more of the loan dollars to go to small manufacturers	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Programs to promote and fund improved vehicle technology and increased domestic production of advanced vehicles and parts (pending appropriations)	Grants, Loans, Loan Guarantees, and Credits	Plug-in electric, hybrid electric, and "advanced diesel" vehicles and fuel-efficient parts including lithium ion batteries.	Research, development, production and sales, and training by governmental, quasi-governmental, and private or nonprofit entities as well as automobile and automotive parts manufacturers	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Energy Efficiency and Conservation Block Grants (pending appropriations)	Grants	Energy Efficiency in Transportation, Building, etc., Sectors	State and Local Governments, including subgrants to non-profits	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Solar industry grants (pending appropriations)	Grants	Solar energy	States; research, development and demonstration entities; workforce training for installing and maintaining solar energy products	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Amendments to Small Business Act (pending appropriations)	Loans up to $4 million each	Energy efficiency and use and production of renewable energies	State and local development companies, commercial, industrial	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&

Table 17 Federal Incentives *(continued)*

SELECTED FEDERAL INCENTIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
2007	National and state Energy Training Partnerships Grants (pending appropriations)	Grants	Renewable energy and energy efficiency workforce training programs	State government and non-profit partnership worker training programs	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	State Labor Market Research (pending appropriations)	Grants	Renewable energy and energy efficiency workforce research	State governments	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2006	Various tax credits for alternative fuel vehicles	Income tax credits	Qualified hybrid vehicles; vehicles fueled wholly or partly by natural gas, liquefied petroleum gas, hydrogen, methanol; or powered by advanced lean burn technology or by light duty fuel cells	Individuals	http://www.irs.gov/newsroom/article/0,,id=157632,00.html
2006 (expires 12 31 2008)	Residential Solar and Fuel Cell Tax Credit	Personal Tax Credit	Solar Water Heat, Photovoltaics, Fuel Cells, Other Solar Electric Technologies	Residential	http://www.energyright.com/tax_credit_pdf/solar.pdf
2005 (expires 12 31 2008)	Clean Renewable Energy Bonds	Federal Loan Program	Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Small Irrigation Power	Local Government, State Government, Tribal Government, Municipal Utility, Rural Electric Cooperative	http://www.irs.gov/irb/2007-14_IRB/ar17.html
2005 reauthorized through 2026	Renewable Energy Production Incentive (REPI)	Production incentive for electricity produced by "newly qualifying renewable energy facilities"	Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Livestock Methane, Tidal Energy, Wave Energy, Ocean Thermal, Fuel Cells using Renewable Fuels	Municipal Utility, Rural Electric Cooperative, State/Local gov'ts that sell project's electricity	http:www.eere.energy.gov/rei
2005 (Expires 12 31 2008)	Biodiesel Income Tax Credit	$1.00 per gallon of agri-biodiesel, $.50 per gallon biodiesel from other sources (e.g waste grease)	Pure, unblended biodiesel (B100)	Fueling station owners and business owners using biodiesel in their business	http://www.afdc.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0
2005 (Expires 12 31 2008)	Biodiesel Mixture Excise Tax Credit	$1.00 per gallon of agri-biodiesel, $.50 per gallon biodiesel from other sources (e.g waste grease)	Diesel based on soybean oil or waste grease	Biodiesel blenders	http://www.afdc.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0
2005 (Expires 12 31 2008)	Small Agri-Biodiesel Producer Tax Credit	Income tax credit $.10 per gallon up to 15 million gallons annually	Specified crops plus animal fats	Producers of less than 60 million gallons of agri-biodiesel annually	http://www.eere.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0

Table 17 Federal Incentives *(continued)*

SELECTED FEDERAL INCENTIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
N/A (Expires 12 31 2010)	Volumetric Ethanol Excise Tax Credit	Federal Excise Tax Credit up to $.45 per gallon	Ethanol blended with gasoline for sale or use	Ethanol blenders	http://www.afdc.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0
N/A (Expires 12 31 2008)	Small Ethanol Producer Tax Credit	Income tax credit $.10 per gallon up to 15 million gallons annually	Ethanol	Producers of less than 60 million gallons of ethanol annually	http://www.eere.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0
2003	USDA Renewable Energy Systems and Energy Efficiency Improvements Program	Loans, loan guarantees, and grants	Purchase renewable energy systems and make energy efficiency improvements.	Farmers, ranchers and rural small businesses	http:www.rurdev.usda.gov/rbs/farmbill/
Variable (expires 12 31 2008)	Renewable Electricity Production Tax Credit	Corporate Tax Credit	Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Refined Coal, Small Hydroelectric	Commercial, Industrial	http://www.irs.gov/pub/irs-pdf/f8835.pdf
Variable	Energy Efficient Mortgage	Federal Loan Program	Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Photovoltaics, Daylighting	Residential	http://www.dsireusa.org/library/includes/Printfederalall.cfm
N/A (Expires 12 31 2009, except hydrogen expires 12 31 2014)	Alternative Fuel Infrastructure Tax Credit	Tax credit up to 30% cost of installing alternative fueling equipment up to $30,000 ($1,000 residential)	Natural gas, liquefied petroleum gas, hydrogen,E85 ethanol, B20 biodiesel	Fueling station owners, residential	http://www.eere.energy.gov/afdc/progs/fed_summary.cgi?afdc/US/0

Table 18 Federal Initiatives

SELECTED FEDERAL INITIATIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008						
Date	**Initiative Name**	**Initiative Type**	**Administrative Entities**	**Relevant Energy Sources**	**Sectors Involved**	**Contact Web Site**
2008	Southeast Industrial Energy Efficiency Summit	Summit meeting held at Oak Ridge National Laboratory	US Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL)	Industrial sector energy efficiency	DOE and ORNL officials in partnership with companies in the Southeast region to reduce energy intensity	http://www1.eere.energy.gov/industry/newsandevents/news_detail.html?news_id=11826
2008	Renewable Energy Committee	Committee to conduct a study of the research and economics affecting renewable energy industry	US Departments of Energy and Agriculture	Renewable energy	Economics of renewable energy	http://www.brdisolutions.com/default.aspx
2008	Biofuels Infrastructure Committee	Study infrastructure needs for delivery of biofuels, explore alternatives for delivery of biofuels and recommend development actions to be taken. Report to Congress	US Environmental Protection Agency and Departments of Energy, Transportation and Agriculture	Biofuels	Biofuels delivery infrastructure	http://www.brdisolutions.com/default.aspx
2008	Comprehensive Study of Biofuels	Study current and future projections of U.S. capability of producing biofuels, including cellulosic. Report to Congress	US Environmental Protection Agency and Departments of Energy, Treasury, and Agriculture	Biofuels	Biofuels production	http://www.brdisolutions.com/default.aspx
2007	Fuel Economy (CAFÉ) Standards	Energy Independence and Security Act of 2007 requires average of 35 mpg for new cars by 2020	US Secretary of Transportation	Manufacturers to design cars appropriately to reduce fossil fuel use	Auto manufacturing	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Renewable Fuel Standards	Gallons of renewable U.S. fuel use mandated: 9 billion in 2008, increasing to 36 billion by 2022. Beginning in 2013, percent requirements for advanced or cellulosic ethanol and biomass diesel mixes in energy fuels will be specified.	US Department of Energy, Environmental Protection Agency	Biofuels	Bioenergy and biofuel producers	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Federal Green Power Purchasing Goal	Requires federal renewable electric energy increases through 2013	U.S. Department of Energy, Federal Energy Management Program	Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste	Federal agencies	http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=US01R&search=implementing&implementingsector=F&currentpageid=2&EE=0&RE=1

Table 18 Federal Initiatives *(continued)*

SELECTED FEDERAL INITIATIVES PROMOTING RENEWABLE ENERGY AND ENERGY EFFICIENCY August 2008						
Date	**Initiative Name**	**Initiative Type**	**Administrative Entities**	**Relevant Energy Sources**	**Sectors Involved**	**Contact Web Site**
2007	Energy Reduction Goals for Federal Agencies	Promote use of renewable fuel vehicles, other alternative fuel vehicles in federal fleets	U.S. Department of Energy, Federal Energy Management Program	Vehicle fuels	Federal agencies	http://www1.eere.energy.gov/femp/about/eo_fedmgmt.html
2007	Energy Goals and Standards for Federal Buildings	Promote energy efficiency for government buildings by requiring 30% reduction from 2003 baseline usage	U.S. Department of Energy, Federal Energy Management Program and General Services Administration	Multiple methods of increasing energy efficiency	Federal agencies	http://www1.eere.energy.gov/femp/about/eo_fedmgmt.html
2007	Public electricity utility and natural gas companies required to make energy efficiency a priority	Promote energy efficiency	N/A	Electricity and Natural Gas suppliers	Electricity and Natural Gas suppliers	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2007	Renewable Fuel Capital Investment Program	Establishment of a venture capital program to invest in small businesses	Small Business Administration	Goods, products or services that generate or support the production of renewable energy	Commercial, Industrial	http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@@L&summ2=m&
2005	Interconnection Standards for Small Generators	Interconnection	Federal Energy Regulatory Commission	Spectrum of renewable and alternative energy generators	Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Federal Government, Agricultural, Institutional	http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=9061
2003	Hydrogen Fuel Initiative	Develop the technology needed for commercially viable hydrogen-powered fuel cells	US Department of Energy	Hydrogen storage technologies	Transportation, and stationary and portable power	http://www.energy.gov/print/6480.htm
2000 (reauthorized in 2008)	Biomass Research and Development Initiative	Coordinate and accelerate all federal biobased products and bioenergy research and development	US Department of Energy and US Department of Agriculture	Biomass-based products, bioenergy, biofuels (including converting cellulosic fibers to fuel), and related processes	Institutions of higher education, National Laboratories, Federal and State research agencies, Private sector entities, Nonprofit organizations	http://www.brdisolutions.com/default.aspx

Table 19 Clean Cities

U. S. Department of Energy Clean Cities Program August 2008					
Clean Cities Program Name	**Special Projects Grants from the U.S. Department of Energy**	**Purpose of Grants**	**Coordinate with:**	**Applicable Sectors**	**Contact Web Site**
East Tennessee Clean Fuels Coalition	$20,000 for administration currently	Sponsored by the US Department of Energy to promote purchase of alternative fuel vehicles and expand the alternative fuel refueling infrastructure. Administered by the TN Department of Economic and Community Development	Tennessee Farmers' Co-ops, Tennessee Farm Bureau, Tennessee Soybean Council	Coordinators of each coalition outreach to local government officials, public and private fleet directors and fuel suppliers	http://tennessee.gov/ecd/pdf/energy/energyAnnualReport06_07.pdf
Clean Cities of Middle Tennessee	$20,000 for administration currently				
West Tennessee Clean Cities Coalition	Received $83,500 startup funds October 2005				

Table 20 Tennessee Incentives

INCLUDES FEDERAL AND NON-GOVERNMENTAL SPONSORSHIPS August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
2008	Green Energy Tax Credit	State Tax Credit	Unspecified	New or expanding "certified green energy supply chain manufacturers" investing $250 million or more	http://www.legislature.state.tn.us/info/Leg_Archives/105GA/Bills/BillSummary/HB4129.htm
2008	Pilot Diesel Retrofit Program for School Buses	State Grant Program	Reduction in pollution from diesel engines	16 county school systems	http://info.tnanytime.org/tngov/?p=1544
2007	Tennessee Biodiesel Manufacturer Grant	Per gallon reimbursement grant	Biodiesel	Manufacturers of biodiesel in Tennessee	http://www.state.tn.us/ecd/energy_biodiesel_manufact_grant.htm
2007	Feedstock Processing Loan Program	Production Incentive	Alternative fuel feedstock	Businesses processing more than 200,000 bushels annually	http://www.state.tn.us/environment/news/release/2007/Feb/altfuels.shtml
2007	Biofuel Green Island Corridor Grant Project	State Grant Program	Capital costs of establishing infrastructure for pumping of E85 ethanol and or B20 diesel oil	Retail fuel stations	http://www.tdot.state.tn.us/biofuel/default.htm
2007	Alternative Fuel Innovations Grants	State Grant Program	Purchasing alternative fuel or maintenance and capital projects	Local governments and state-funded universities	http://state.tn.us/environment/altfuels/funding/
2007	Weatherization Assistance Program reauthorized (originated in 1977)	Federal grant program administered by the Tennessee Department of Human Services	Increasing energy efficiency through diminished heat loss in homes	Low income home owners	http://www.waptac.org/sp.asp?id=1960
2006	Tennessee Clean Energy Technology	State Grant Program	Solar Water Heat, Photovoltaics, Wind, Solar Hybrid Lighting, Fuel Cells using Renewable Fuel	Commercial/Industrial	http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=TN50F&state=TN&CurrentPageID=1&RE=1&EE=1
2003	Wind Energy Systems Exemption	Property Tax Exemption	Wind	Commercial, Industrial, Utility	http://www.state.tn.us/sos/acts/103/pub/pc0377.pdf
1991	Local Government Energy Loan Program	Loan Program plus energy efficiency audits	Loans for energy-efficient retrofits of public buildings	Municipal and county governments	http://tennessee.gov/ecd/energy_lgelp.htm
1987	Small Business Energy Loan Program	State Loan Program	Energy efficient retrofits: Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Renewable Transportation Fuels, Geothermal Electric, Municipal Solid Waste	Businesses with less than 300 employment or less than $3.5 million annual gross receipts	http://www.state.tn.us/ecd/energy_sbel.htm
N/A	Biodiesel Infrastructure Grant Program	State Grant Program	Biodiesel tanks, pumps, card readers for fueling biodiesel vehicles.	County governments	http://tennessee.gov/ecd/energy_biodiesel.htm

Table 20 Tennessee Incentives *(continued)*

INCLUDES FEDERAL AND NON-GOVERNMENTAL SPONSORSHIPS August 2008					
Date	**Incentive Name**	**Incentive Type**	**Eligible Energy Sources**	**Applicable Sectors**	**Contact Web Site**
N/A	Main Street Lighting Program	State Grant Program	purchase and installation of energy efficient street, park and traffic lighting	Communities	http://tennessee.gov/ecd/pdf/energy/energyAnnualReport06_07.pdf
N/A	Green Power Switch Generation Partners Program	Production Incentive	Photovoltaics, Wind	Commercial, Residential	http://www.tva.com/greenpowerswitch/partners/

Table 21 Tennessee Initiatives

SELECTED TENNESSEE INITIATIVES PROMOTING RENEWABLE ENERGY AND ENERGY INCLUDES FEDERAL AND NON-GOVERNMENTAL SPONSORSHIPS August 2008						
Date	**Initiative Name**	**Initiative Type**	**Administrative Entities**	**Eligible Energy Activities**	**Applicable Sectors**	**Contact Web Site**
2003	Million Solar Roofs Initiative sponsored by the U.S. Department of Energy	Establish state and community partnerships to increase acceptance and utilization of solar energy	TN Dept. Environment and Conservation contracted to Southern Alliance for Clean Energy	Brings together stakeholders at local level to reduce barriers to use of solar energy	Photovoltaic and solar thermal panels	http://state.tn.us/ecd/energy_renewables.htm
N/A	Wind Prospecting in the Tennessee Valley Region funded by the U.S. Department of Energy	Two-year project to assess the wind generating potential of various high altitude sites in eastern Tennessee	TN Dept. Economic and Community Development Energy Division jointly with Tennessee Valley Authority and Appalachian State University	Will directly support TVA's Green Power Switch program	Wind	http://state.tn.us/ecd/energy_renewables.htm
N/A	Tennessee Industrial Technology Program	Department of Economic and Community Development partners with core energy-intensive industry manufacturing sectors to implement energy efficiency in manufacturing	Tennessee Dept. of Economic and Community Development with the U.S. DOE Office of Energy Efficiency and Renewable Energy (EERE) http://www1.eere.energy.gov/industry/program_areas/index.html	Efficiency	Industries accounting for 75% of industrial energy consumption nationally: aluminum, chemical, forest products,glass, metal casting, mining, petroleum refining, steel	http://tennessee.gov/ecd/pdf/energy/energyAnnualReport06_07.pdf
N/A	Industries of the Future Tennessee 3-Star Industrial Assessment Center through TN Tech University	Free energy assessments, 1 year follow-up support		Efficiency	Chemical and metal-casting manufacturing	http://tennessee.gov/ecd/pdf/energy/energyAnnualReport06_07.pdf
N/A	Best Practices energy assessments and workshops	Technical support for energy management practices		Efficiency	Manufacturing systems involving steam, compressed air, industrial lighting and boiler/chiller systems	http://tennessee.gov/ecd/pdf/energy/energyAnnualReport06_07.pdf

Appendix C: Executive Orders

STATE OF TENNESSEE

EXECUTIVE ORDER

BY THE GOVERNOR

Number 33

AN ORDER TO ESTABLISH THE GOVERNOR'S INTERAGENCY ALTERNATIVE FUELS WORKING GROUP

WHEREAS, this Administration is dedicated to the protection of our natural resources, our environment, our economy and the health of Tennessee's citizens; and

WHEREAS, the increased use of renewable alternative fuels, such as biodiesel and ethanol ("biofuels"), made from agricultural products will provide greater diversity in the state's energy supplies, help reduce dependence on imported oil, and strengthen the state's ability to withstand future fuel supply disruptions and spikes in fuel prices; and

WHEREAS, the increased use of biofuels and the local production of biodiesel and ethanol using domestic crops and other raw materials as feedstock will benefit Tennessee's rural communities and agricultural economy; and

WHEREAS, air pollutants from vehicles and other mobile sources have a significant impact on air quality in the state, and the use of alternative fuels can help reduce vehicle emissions; and

WHEREAS, state government should take the lead in promoting the efficient use of natural resources to protect and enhance the state's environment, the health of its citizens and its economy.

NOW THEREFORE, I, Phil Bredesen, Governor of the State of Tennessee, by virtue of the power and authority vested in me by the Tennessee Constitution and law, do hereby order and direct the following:

1. The Governor's Interagency Alternative Fuels Working Group ("Working Group") is hereby established. The Working Group shall consist of the following six (6) members or their designees:

    a. The Commissioner of Agriculture;
    b. The Commissioner of Economic and Community Development;
    c. The Commissioner of Environment and Conservation;
    d. The Commissioner of General Services;
    e. The Commissioner of Health; and
    f. The Commissioner of Transportation

2. The Commissioners of the Departments of Environment and Conservation and Agriculture or their designees shall serve as co-chairpersons of the Working Group.

3. The Working Group shall meet at such times and places as determined by its co-chairpersons and shall make regular reports to the Governor regarding its work.

4. The Working Group shall be attached to the Department of Environment and Conservation for administrative purposes.

5. All Executive Branch departments, agencies, boards and commissions and any other divisions of the Executive Branch of state government shall fully cooperate with the Working Group.

6. The Working Group shall develop a comprehensive state alternative fuels strategy that will provide a roadmap to make Tennessee a leader in the production, distribution and use of biofuels in the Southeast.

7. In developing its recommendations for a state alternative fuels strategy, the Working Group should seek the input of appropriate stakeholders, including but not limited to the following:

    a. Tennessee Farm Bureau Federation;
    b. Tennessee Farmers Cooperative;
    c. Tennessee Oil Marketers Association;
    d. Tennessee Soybean Association;
    e. Tennessee Corn Growers Association;
    f. Southern Alliance for Clean Energy;
    g. Oak Ridge National Laboratory;
    h. University of Tennessee, Center for Profitable Agriculture;
    i. Tennessee Petroleum Council;
    j. East Tennessee Clean Fuels Coalition;
    k. Clean Cities of Middle Tennessee;
    l. West Tennessee Clean Cities Coalition; and
    m. Public and private colleges and universities located within Tennessee

8. The Working Group shall develop a comprehensive, statewide public education and outreach campaign to increase public awareness and understanding of alternative fuels, particularly biofuels. This campaign shall also assist travelers in locating publicly accessible refueling locations.

9. State agencies shall strive to use ethanol and biodiesel in appropriate state-owned vehicles whenever possible. The Departments of General Services and Transportation shall develop a program to educate all state employees about the use of biofuels and to publicize fuel availability as new refueling sites become available.

10. The Department of Agriculture shall take immediate steps to establish interim state standards for blends of biodiesel that will provide an adequate level of quality assurance for biofuels blending and distribution until a national standard is finalized. The Department of Agriculture should continue to participate actively in the development of a national fuel standard for biodiesel blends.

11. The Departments of Economic and Community Development and Agriculture shall work together in a partnership to make alternative fuels production capacity and infrastructure, including biofuels production facilities and biofuels feedstock processing facilities, an economic development priority.

12. State agencies shall encourage and support the development of biofuels refueling infrastructure with available federal or other funds in order to stimulate the growth of biofuel refueling stations across the state.

a. The Department of Transportation shall continue efforts to encourage development of publicly accessible biofuels refueling stations at strategically located retail fuel stations and farm co-ops across the state. The department may continue to seek available funds for this purpose as necessary.

b. State agencies operating diesel vehicles and equipment shall assist in identifying appropriate state-owned sites for dispensing biodiesel.

IN WITNESS WHEREOF, I have subscribed my signature and caused the Great Seal of the State of Tennessee to be affixed this 14th day of February, 2006.

GOVERNOR

ATTEST:

SECRETARY OF STATE

STATE OF TENNESSEE

EXECUTIVE ORDER

BY THE GOVERNOR

Number 54

AN ORDER ESTABLISHING THE GOVERNOR'S TASK FORCE ON ENERGY POLICY

WHEREAS, ensuring a clean, safe, reliable, and affordable energy supply is critical to the prosperity of the state economy, the sustainability of Tennessee's environment, and the general welfare of Tennessee's citizens; and

WHEREAS, Tennessee's citizens, businesses, and governments are faced with escalating energy costs, challenges to expanding energy production, and varying environmental effects of energy production and consumption; and

WHEREAS, state government, as one of the largest consumers of energy within Tennessee, has the capacity and responsibility to lead by example in reducing energy consumption and improving energy efficiency; and

WHEREAS, Tennessee is home to a wealth of public and private research and technology expertise that can drive the development of clean-energy technology and increase economic development potential in the energy sector; and

WHEREAS, energy efficiency and use of alternative fuels and renewable energy sources is a key component to energy conservation and the prudent use of available and potential energy supplies.

NOW THEREFORE, I, Phil Bredesen, Governor of the State of Tennessee, by virtue of the power and authority vested in me by the Tennessee Constitution and law, do hereby order and direct the following:

1. The Governor's Task Force on Energy Policy ("Task Force") is hereby established. The Task Force is charged with developing a state energy plan ("the Plan") to make Tennessee a national leader in energy efficiency and conservation, use of alternative fuels and renewable energy sources, and development of clean-energy technology that can provide economic and environmental benefits to its citizens.

2. In developing the Plan, the Task Force shall consider the advice of recognized experts in the fields of energy efficiency and conservation, energy production, clean-energy technology research and development, and strategies for expanding use of alternative fuels and renewable energy sources. The Task Force also shall consider the cost/benefit relationship of

proposed actions and any other factors it deems to be relevant.

3. In developing the Plan, the Task Force shall identify:

   a. Opportunities for state government to lead by example in energy efficiency and conservation, with an emphasis on building construction and management, and vehicle fleet purchasing and management;

   b. Prospective policies, legislation, regulations, and/or incentives to encourage statewide energy efficiency and conservation in both the public and private sectors;

   c. Possible public-private partnerships and collaborations to encourage research and development of clean-energy technology and increase economic development potential in the state's energy sector; and

   d. Strategies for expanding use of alternative fuels and renewable energy sources to support the sustainability of Tennessee's environment.

4. The Governor or his designee shall serve as Chairperson of the Task Force. The Task Force shall have (16) additional members, to be appointed by the Governor and consisting of the following individuals:

   a. The Commissioner of Economic and Community Development or his designee;
   b. The Commissioner of Environment and Conservation or his designee;
   c. The Commissioner of Finance and Administration or his designee;
   d. The Commissioner of General Services or her designee;
   e. Two (2) representatives of the utility sector, including power generation and/or distribution;
   f. Two (2) representatives of environmental advocacy organizations;
   g. Two (2) representatives of academic and/or research institutions;
   h. Two (2) representatives of the building and/or construction sector;
   i. Two (2) representatives of the manufacturing sector and/or general business community;
   j. One (1) member of the Tennessee Senate; and
   k. One (1) member of the Tennessee House of Representatives.

5. The Task Force shall be attached to the Department of Economic and Community Development for administrative purposes.

6. All Executive Branch departments, agencies, boards and commissions, and any other divisions of state government shall fully cooperate with the Task Force in carrying out the mandates of this Executive Order, and shall provide staff support and any other assistance as requested.

7. Non-legislative Task Force members shall receive no compensation for service but may be reimbursed for expenses allowed by the provisions of the comprehensive travel regulations as promulgated by the Department of Finance and Administration and approved by the Attorney General and Reporter. Members of the General Assembly shall be reimbursed in the same manner as they are paid for attending legislative meetings pursuant to Tennessee Code Annotated, Section 3-1-106.

8. The Task Force shall convene for its initial meeting on or before April 7, 2008, at a place and time determined by the Chairperson. Thereafter, the Task Force shall meet at such times and places as determined by the Chairperson.

9. The Task Force shall deliver to the Governor short-term recommendations identifying opportunities for state government to lead by example by July 1, 2008, and shall deliver the state energy plan by December 1, 2008.

IN WITNESS WHEREOF, I have subscribed my signature and caused the Great Seal of the State of Tennessee to be affixed this 19th day of March, 2008.

GOVERNOR

ATTEST:

SECRETARY OF STATE

Appendix D: Biodiesel and Ethanol Production

Table 22 Biodiesel Production Facilities in Tennessee as of June 2008

Biodiesel Production Facilities in Tennessee as of June 2008				
Plant Name	**Location**	**1st year in production**	**Feedstock**	**Annual millions of gallons**
Memphis Biofuels	Memphis	Expected September 2007	Multi-feedstock	Expect 36 MMGY
NuOil, Inc.	Counce	Unknown	Soybean oil	1 MMGY
Agri Energy, Inc	Lewisburg	Unknown	Soybean oil	
Freedom Biofuels, Inc.	Madison	Expected May 2007	Unknown	Expect 12 MMGY
Milagro Biofuels	Memphis	2006	Soybean oil	5 MMGY
Biofuel of Tennessee	Decaturville	Unknown	Unknown	Expect 10 MMGY
Nu Energie, LLC	Blountville	2008	Multi-feedstock	Expect 5 MMGY
SunsOil, LLC	Athens	2008	Soybean oil and other	Expect 1.5 MMGY
Tennessee Bio Energy, Inc.	Manchester	Announced March, 2004	Soybean oil	Expect 900,000 gallons/yr

Table 23 Biodiesel Research and Production Planned, Under Development in Tennessee as of June 2008

Biodiesel Research and Production Planned or Under Development in Tennessee as of June 2008							
Plant Name	**Location**	**Owners/ Developers**	**Source of Funding**	**In production**	**1st year in production**	**Feedstock**	**Annual millions of gallons**
Northington Energy	Wartburg	Northington Energy, LLC	Private	Not as of June 15, 2008	Unknown	Soybean oil	Expect 6 MMGY
Northington Energy Zenalgae bioreactor	Wartburg	Northington Energy, LLC	Unknown	Not as of June 15, 2008	Unknown: announced December 2007	Algae	Unknown
BioPowerUSA	Knox County	Two individuals through the Fairview Technology Center business incubator	Will seek private investors after prove process works	Not as of June 15, 2008	Unknown: announced April 2008,expect 2009	Restaurant waste	Expect 5 MMGY
Planned replication of an Atlanta, GA, Refuel Biodiesel facility	Knoxville Area	Southern Alliance for Clean Energy, UT Institute of Agriculture	Unknown	Not as of June 15, 2008	Unknown	Used vegetable oil	Unknown
Alliance Biofuels	McMinnville	Alliance Biofuels	Unknown	Not as of summer 2007	Unknown	Soybean oil	Unknown

Table 24 Ethanol Producers

Ethanol Production Facilities in Tennessee Facilities Producing, Under Construction, or Planned as of June 2008								
Plant Name	**Location**	**Owners/ Developers**	**Source of Funding**	**In production**	**1st year in production**	**Feedstock**	**Gallons per Year**	**Sources**
Tate and Lyle	Louden	Tate and Lyle, LLC	private	Yes	1981	Corn	75 million	b.
Ethanol Grain Processors, LLC	Obion County	VBV,LLC	private	No	Under construction, expect 2008	Corn	Expect 100 million	b.
DuPont Danisco Cellulosic Ethanol LLC	Vonore	UT Research Foundation through Genera Energy LLC, with DuPont Danisco Cellulosic Ethanol, LLC	Federal and state governments, private corporation	No	Expect to begin construction late 2008, may produce ethanol in 2009	Primarily switchgrass, plus corn stover	Expect 250,000	

Sources:

University of Tennessee. News Release. July 23, 2008. http://www.utk.edu/news/article.php?id=4676

Kyle Holmberg. Tennessee Department of Agriculture. "Tennessee Biofuels Production." Unpublished list March 2008.

Appendix E: Green Companies in Tennessee

A consistent definition of green jobs and green employers has not been agreed upon in the labor market information community. This is a fertile area for research. To aid that future effort, several lists of green companies/agencies are presented here, including: (1) attendees at Tennessee's First Annual Green Expo, April 3, 2008, sponsored by David Lipscomb University; (2) the Southern Alliance for Clean Energy's list of renewable energy companies; and (3) web search information on renewables. In addition, the number of firms and employees in Tennessee in the RE/EE industries used in this report are included.

Tennessee Green Business Summit and Expo
Lipscomb University
April 3-5, 2008

Exhibitors

Exhibitor	Exhibitors Reference Info
Advent	www.adventresults.com
All Green Environmental Solutions	www.allgreenes.com
American Institute of Graphic Arts	www.nashville.aiga.org
Aquashield	www.aquashieldinc.com
Armstrong Commercial Floor Products	www.armstrong.com/commercialflooring
Beaman Toyota	www.beamantoyota.com
Bridgestone Firestone Building Products	www.bridgestone-firestone.com
Cast Designs	www.castdesignsupply.com
Center for Holistic Ecology	www.holisticecology.org
Chevrolet	www.chevy.com
Climate Project	www.theclimateproject.org
Corporate Express	www.coporateexpress.com
Courier Printing	www.courierprinting.com
Darrell Waltrip Honda Volvo	www.darrellwaltripvolvo.com
Databank IMX	www.databankimx.com
David Lipscomb Elementary – Green Performance Partner Initiative	www.dles.lipscomb.edu
Design Resource	(615) 793-7694
Dugger Printed Business Products	www.duggerpromo.com
Earth Savers	www.earthsavers.org
Eastside Scooters	www.eastsidescooters.com
Ecology Fashion	www.ecologyfashion.com
Ecoville Architects	www.earthandstraw.com
E3 Innovate, LLC	www.e3innovate.com
Ewing Irrigation	www.ewing.com
Firestone Complete Auto Care Center	www.bridgestone-firestone.com
Gardens of Babylon	www.gardensofbabylon.com
Gresham, Smith and Partners	www.gspnet.com
GroWild Nursery	www.growildnursery.com
Hastings Architecture Associates	www.haa.us
HRP Associates	www.hrpassociates.com
Kelsan	www.kelsan.biz
Kilowatt Ours	www.kilowattours.org
Kone, Inc.	www.kone.com

Exhibitor	Exhibitors Reference Info
Lawrence Brothers, LLC	www.lawrencebrosllc.com
Lee Company	www.leecompany.com
LightWave Solar Electric	www.lightwavesolarelectric.com
Lipscomb University	www.lipscomb.edu
Lipscomb University College of Business	www.business.lipscomb.edu
Lipscomb University Institute for Sustainable Practice	www.sustainability.lipscomb.edu
Lord, Aeck and Sargent Architecture	www.lordaecksargent.com
McQuiddy Printing	www.mcquiddy.com
Metrolight, Inc.	www.metrolight.com
Nashville Natives – Live Roof TN	www.nashvillenatives.com
Nashville Office Interiors	www.noifurniture.com
National Wildlife Federation	www.nwf.org
Nissan	www.nissanusa.com
Nova Copy	www.novacopy.com
Positively Green Magazine	www.positivelygreen.com
Puffy Stuff	www.puffystufftn.com
SCA Tissue	www.scatissue.com
Smurfit-Stone Recycling	www.smurfit.com
Southeast Recycling	www.recyclebulbs.com
Telbari, Inc.	www.telbari.com
Tennessee Department of Environment and Conservation	www.state.tn.us/environment
Tennessee Environmental Council	www.tectn.org
TN Dept. of Tourist Development	www.sustainabletourismsummit.com
Trane	www.trane.com
Two Rivers Ford	www.tworiversford.com
Walk/Bike Nashville	www.walkbikenashville.org

Renewable Energy Businesses in Tennessee – Created 07/25/2007 (additions July 2008)
- compiled by the Southern Alliance for Clean Energy

Aerisyn, Inc.
"Taking tower manufacturing to the Exceptional"
1025 West 19th Street
Chattanooga, TN 37408
Phone: (423) 648-3884
Fax: (715) 384-3424

AFG Industries
AFG Industries, Inc.
1400 Lincoln Street
Kingsport, TN 37660
Phone: (423) 229-7200
Www.afgglass.com

Alpine Power Systems, Inc.
5595 Tayfor Drive,
Millington, Tennessee 38053
Phone: 1-800-877-9958
Fax: 901-358-3838

Alternative Power Systems Inc
Phone: (931)-879-9596 ?

Alternative Independent Energy ?
Phone: (931)-232-8759

Barnhart Cranes and Rigging
"Minds over Matter"
www.barnhartcrane.com
Knoxville Location:
100 Crane Lane
Oak Ridge, TN 37830
Phone: (865) 966-9786
Fax: (865) 966-9705

Big Frog Mountain, Inc
100 Cherokee Boulevard Suite 321
Chattanooga, TN 37405
Phone: (423) 265-0307
Fax: (423) 265-9030
www.bigfrogmountain.com

Bountiful Energy
35 Martin Road
Bon Aqua TN 37025
Phone: (615)-412-5200

Des-Case Corporation
3045 Union Road
White House, Tennessee 37188
Phone: (615) 672-0668
Fax: (615) 672-0701
www.des-case.com

Earthlog Equity Group
P.O. Box 685
Talbott, TN
Phone: (865) 475-1815
EarthlogEG@aol.com

Enernex Corporation
170C Market Place Boulevard
Knoxville, TN 37922
Phone: (865) 691-5540 x 142
Fax: (865) 691-5046

Flash Technologies
332 Nichol Mill Lane
Franklin, TN 37067
Phone: (615)-503-2131
Fax: (615) 261-2600

(2008)
General Electric Wind Energy
Memphis, TN

Green Earth Services
9409 S. Northshore Drive
Knoxville, TN 37922
Phone: (865) 769-7337

Invenergy, LLC
"Invenergy LLC is a leading energy investment company focused on the development, acquisition and management of large-scale power generation assets".
www.invenergyllc.com

Buffalo Mountain Energy Center Location
1980 Windrock Road
P.O. Box 153
Oliver Springs, TN 37840
Phone: (865) 633-6785 ext. 66

Lightwave Electric
301 Battle Road
Cane Ridge, TN 37013
615-294-9630
stevejohnson@comcast.net

Mid-South Alternate Energy
6530 Finch Road
Memphis, TN 38141
Phone: (931) 363-1021

National Solar Supply
125 Towee Falls Road
Tellico Plains, TN 37385
Phone: 1-866-255-1829

Power Source Plus
Power Source Plus Electric Company, Inc.
469 McQuiston Road
Brighton, TN 38011
Phone: (901) 219-7462

Residential Energy Solutions
Laurel Avenue (Apt. 15)
Knoxville, TN 37916
Phone: (931) 265-0777
ResidentialEnergySolutions@gmail.com

Scott Electric
116 Christiana Drive
Rogersville, TN 37857
Phone: (423) 327-1199

Sharp Solar
Memphis, TN
www.sharpusa.com
1-800-SOLAR06

(2008)
Shoals Technologies (building a solar components plant)
Gallatin, TN
http://www.tvaed.com/news/2008/shoals_tech.htm

Signal Wind Energy
6148 Lee Highway, Suite 200
Chattanooga, TN 37421
Phone: (423) 443-4190
Fax: (615) 250-9736
Email: info@signalwind.com
www.signalwind.com

Solar Pathfinder
3953 Marsh Creek Road
Linden, TN 37096
Phone: (317) 501-2529
Fax: (931) 589-5400
info@solarpathfinder.com

Solar Energy Consultants
1092 Ridgecrest Road
Kingston Springs, TN 37082
Phone: (615) 361-3474
Fax: (615) 360-9202

Solar Sales & Service
2101 Griffintown Road
White Bluff, Tennessee USA 37187
Phone: 1-800-398-5188
www.solarsales.com

Steam & Control Systems, Inc.
2805 Riverside Drive
Chattanooga, TN 37406
Phone: (423) 624-1727

Sunlight Direct
Sunlight Direct, LLC
1020 Commerce Park Drive
Suite G
Oak Ridge, TN 37830
1-865-483-6624 (phone)
1-865-483-5997 (fax)

Sustainable Futures
2315 Sugar Grove Valley Road
Harriman, TN 37748
www.sustainablefutures.biz

Thomas & Betts Corporation
8155 T&B Boulevard
Memphis, Tennessee 38125
Phone: (901) 252-8000
Fax: (901) 252-1304
www.tnb.com/ps/pubint/

Tubular Skylight
2807 Bransford Avenue
Nashville, TN 37204
Phone: (615) 297-1706
www.tubularskylight.com

TVIG—Tennessee Valley Infrastructure Group, Inc.
"Powering Communities through the Energy of Innovation"
1200 Mountain Creek Rd
Suite 410
Chattanooga, TN 37405
Phone: (423) 266-0502
Fax: (423) 267-4616
Email: general@tvigroup.com
www.tvigroup.com

Utility Wind Integration Group
Phone: (865) 691-5540 x141
Fax: (865) 691-5048
www.UWIG.org

Webfoot Leisure
1024 Chenault Lane
Castalian Springs, Tennessee 37031
866-530-9801
http://www.webfootleisure.com

Location of Renewable Energy Businesses

Additional listings of renewable businesses can be found by using:
http://energy.sourceguides.com/

http://energy.sourceguides.com/businesses/index.shtml

- **Renewable Energy Businesses in the World by Location**
- **Locate Renewable Energy Businesses in the United States by State**
- **Renewable Energy Businesses in Tennessee by Product**

http://energy.sourceguides.com/businesses/byGeo/US/byS/TN/TN.shtml

Appendix F: Major RE/EE Organizations

American Solar Energy Society
2400 Central Ave, Suite A
Boulder, Colorado 80301
Tel: 303.443.3130
Fax 303.443.3212
http://www.ases.org/

American Wind Energy Association
1101 14TH Street NW, 12th Floor
Washington, DC 20005
Tel: 202.383.2500
Fax: 202.383.2505
http://www.awea.org

Appalachian Regional Commission
1666 Connecticut Avenue, NW
Suite 700
Washington, DC 20009-1068
Tel: 202.884.7700
http://www.arc.gov/

Energy Efficiency and Renewable Energy
http://www.eere.energy.gov

Middle TN Chapter of the U.S. Green Building Council
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Washington, DC 20036
http://chapters.usgbc.org/middletn/

Natural Resources Defense Council (NRDC)
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http://www.nrdc.org/

National Science Foundation
Advanced Technology Environmental and Energy Center
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Oak Ridge National Laboratory
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Solar Living Institute
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Southern Alliance for Clean Energy
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TVA Green Power Switch
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Appendix G: Energy Technologies and Services Occupations

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