The Economic Impact of the Renewable Energy/Energy Efficiency Industry on the Connecticut Economy

Prepared by

DECD

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Executive Summary

The Connecticut Clean Energy Fund (CCEF) contracted with the Department of Economic and Community Development (DECD) to perform an economic and fiscal impact analysis of the renewable energy and energy efficiency (RE/EE) industry group on the state's economy. The RE/EE industry is subsumed in the "clean energy economy" label that the Pew Charitable Trusts defines as one that "…generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources."[1]

The primary contribution of this work is the characterization and identification of the relevant Connecticut RE/EE industries, that is, DECD develops an industry-based taxonomy for subsequent analysis. Using a consensus definition of the core industries in the RE/EE sector, DECD estimates the economic and fiscal impacts on Connecticut's economy using the REMI model of the state economy. DECD uses the industry-based taxonomy because the National Income and Product Accounts (NIPA) are based on aggregates of industries defined in the North American Industrial Classification codes. This classification provides a consistent definition of industries in Canada, Mexico and the United States for tracking employment, establishments, the value of shipments and payroll trends. One can use industry data to develop industry concentration measures and trends that may have policy implications. Researchers can use the industry data to identify supply chains and characterize industry clusters based on a variety of mathematical techniques.

The definition of the RE/EE industry group allows us to trace its evolution in terms of the number of establishments (worksites), employment, and payroll of the industries in which RE/EE firms are embedded. The definition of the RE/EE core group is in terms of the 2007 North American Industry Classification (NAICS) codes that have supplanted the older Standard Industrial Classification (SIC) codes. DECD gathered data at the six-digit level, which is the most detailed data available from the U.S. and state departments of labor.

Within an industry at the six-digit level, there are firms engaged in work wholly unrelated to RE/EE as well as firms that engage exclusively in such work. DECD therefore

[1] "The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America," The Pew Charitable Trusts, June 2009, www.pewtrusts.org.

estimates a range of plausible employment levels associated with each industry for economic and fiscal impact analysis.

To place the present analysis in context, we review several studies in Appendix C that examine the RE/EE industry and extract best practices and policies as they apply to promoting the growth of the RE/EE industry in the U.S and Connecticut.

DECD's analysis identifies 53 industries in which firms operate in the RE/EE field (see Appendix B). These industries range from manufacturing (e.g., generators for wind and hydroelectric facilities), to wholesale and retail establishments that distribute RE/EE goods to system integrators and to households and businesses. The taxonomy is subject to review and amendment as for example firms (we have not included) morph into ones whose significant business is RE/EE. The filtering criteria we use to define the RE/EE industries in Connecticut primarily rely on their presence in and relevance to the state's economy.

Using professional judgment and a survey of Connecticut RE/EE firms,[2] DECD estimates a range of plausible direct employment levels for 2007 in the 53 industries. The survey determined the fraction of the market covered by the surveyed firms and scaled industry employment and sales accordingly. DECD estimated the fraction of firms in a relevant industry engaged in RE/EE work and the fraction of workers (FTEs) in such firms engaged in RE/EE work. This process produced a high and low jobs estimate that brackets the survey result.

The economic analysis hypothetically removes the RE/EE industry from the Connecticut economy and assumes no employment growth in the future. One basis for the no growth assumption is that existing specialty trade contractors (e.g., installers) will perform this new work in addition to or as a substitute for their traditional work. Further, in manufacturing, RE/EE components and assemblies can be produced with little change to traditional processes; therefore, it is not necessary to build new manufacturing facilities. In addition, much of the RE/EE industry is subsidized, the future of which is uncertain.

Table E1 shows the direct, indirect, induced and total employment changes from a baseline forecast of the Connecticut economy as a result of the presence and ongoing

[2] Navigant Consulting conducted the survey of 74 Connecticut firms and researched 95 more as part of this project. See http://www.ctcleanenergy.com/YourBusinessorInstitution/CTRenewableEnergyandEnergyEfficiencyEconomy/tabid/382/Default.aspx.

operations of the RE/EE industry in Connecticut. Direct employment is the number of jobs we estimate that produce RE/EE goods and services, while the indirect employment represents the jobs that arise from business to business transactions. Induced employment is the jobs that result from workers in RE/EE firms spending their incomes on household goods and services.

Table E1: Economic and Fiscal Impacts as Annual Average Changes from Baseline Forecast

	Low Job Estimate	High Job Estimate	Low Estimate: Fraction of State	High Estimate: Fraction of State
Direct Employment	3,661	5,830	0.23%	0.36%
Plus Indirect & Induced Employment	6,002	8,937	0.38%	0.56%
Total Employment	9,663	14,767	0.60%	0.92%
State GDP (Fixed 2007$)	$2,524,157,510	$3,722,300,834	1.17%	1.72%
Personal Income (Fixed 2007$)	$901,627,579	$1,363,575,142	0.47%	0.71%
Net State Revenue (Fixed 2007$)	$81,075,453	$123,806,154	NA	NA

Source: REMI and author's calculation.

To put these results in perspective, Connecticut's 2007 economy generated $216.3 billion in state GDP (value added), its private, nonfarm employment was about 1.6 million jobs, and its labor force was about 1.7 million workers. Connecticut's personal income was $192.6 billion in 2007.[3] Net state revenue is not measured; DECD's economic model (REMI) estimates state revenues from all sources and expenditures in major categories as a result of net new economic activity.

For the two RE/EE employment estimates, these results indicate that Connecticut's RE/EE industry contributes between 1.17% and 1.72% of Connecticut's GDP, between 0.6% and 0.92% of the state's nonfarm employment, and between 0.47% and 0.71% of the state's personal income on average each year. Using the Connecticut economic model (REMI), we calculate an employment multiplier of 2.6 for each employment scenario, that is, for each RE/EE job, on average each year an additional 1.6 jobs are created. This relatively high multiplier arises most likely because of the relatively large local supply of labor and intermediate goods.

The results indicate as well that, all else equal, Connecticut's RE/EE industry would grow even if its employment did not because productivity is growing. Thus, given the state

[3] Sources are CT DoL and the Bureau of Economic Analysis.

and national commitments to renewable energy and related technologies, Connecticut is poised for significant growth in this sector if it makes significant public and private investment in the human and physical capital required.

In this study, we do not quantify the ultimate potential for various classes of renewable energy generation and therefore ignore for the present the benefits of savings from investment in RE/EE technologies in Connecticut. This is future research. Notwithstanding, this analysis is conservative as such investments and the savings they produce that reduce production costs and increase household consumption in other sectors are not counted. In addition, DECD does not estimate the non-financial benefits of reducing Connecticut's carbon footprint adding to the conservative nature of this analysis.

Introduction

The Connecticut Clean Energy Fund (CCEF) contracted with the Department of Economic and Community Development (DECD) to perform an economic and fiscal impact analysis of the renewable energy and energy efficiency (RE/EE) industry group on the state's economy. Of central importance in this work is the characterization and identification of the relevant industries at a high level of industry detail, that is, developing an amendable industry-based taxonomy for consistent analysis. Using a consensus definition of the core industries in the RE/EE sector, DECD estimates the economic and fiscal impacts on Connecticut's economy using the REMI model of the state economy. DECD uses the industry-based taxonomy because the National Income and Product Accounts (NIPA) are based on aggregates of industries defined in the North American Industrial Classification codes. This classification provides a consistent definition of industries in Canada, Mexico and the United States for tracking employment, establishments, the value of shipments and payroll trends.

The definition of the RE/EE industry group allows us to trace its evolution in terms of the number of establishments (worksites), employment, and payroll of the industries in which RE/EE firms are embedded. The definition of the RE/EE core group is in terms of the 2007 North American Industry Classification (NAICS) codes that have supplanted the older Standard Industrial Classification (SIC) codes. The level of industry detail we seek occurs at the six-digit level. It is of course true that within an industry at the six-digit level, there are firms engaged in work wholly unrelated to RE/EE. This compels us to estimate a range of plausible employment levels associated with each industry.

In addition and to place the present analysis in context, we review several studies in Appendix C that examine the RE/EE industry and extract best practices and policies as they apply to promoting the growth of the RE/EE industry in the U.S.

Background

According to the definition of the clean energy economy, clean and/or renewable energy causes little or no harm to the environment Examples of such sources are wind, solar, hydroelectric, wave, tidal and biomass. Clean energy replenishes itself naturally over a short time or is in some sense inexhaustible (such as solar energy). There are several benefits of clean energy, in terms of its impact on energy efficiency (and therefore, life cycle costs), climate change, security of energy supply and long-term economic benefits. Clean energy is important because it reduces our dependence on fossil fuel (primarily from foreign sources), enhances energy efficiency, and reduces greenhouse gas emissions.

Clean energy diversifies energy sources and relieves pressure on conventional energy pricing. It mitigates global warming, provides energy security and enhances power quality. Frequent blackouts, rising energy prices, global warming and climate change have renewed national interest in clean energy technology. Clean energy technology has both macroeconomic and microeconomic benefits. The macroeconomic benefits include investment in new technology and new jobs, greater productivity and higher real disposable income. While on the microeconomic side, clean energy technology will reduce the costs of doing business and helps reduce energy expenditure.[4] Clean energy projects have a significant potential for regional employment growth, offering broad employment opportunities ranging from high-tech manufacturing of photovoltaic cells to biomass production in the agricultural sector.

Clean energy can revitalize rural communities as farmers can partially fulfill their energy requirements locally. Clean energy is economically sustainable because the cost of clean energy tends to fall over time resulting in declining costs of electricity generation from renewable sources. Clean energy is environmentally friendly producing no emissions except from those naturally associated with biomass decomposition. Clean energy technologies mitigate the effects of climate change because of the low level of greenhouse gas (GHG) [CO_2 and H_2O] and noxious emissions (SOX, NOX, unburned HCs, VOCs and particulates). Clean energy technology has several health benefits; for example, such technologies reduce pollution that in turn reduces asthma and respiratory diseases and their concomitant costs.

[4] "U.S. Metro Economies: Current and Potential Green Jobs in the US Economy," Research report prepared by Global Insight (2008). Downloaded from www.usmayors.org.

Clean energy is subject to less supply disruptions. It diversifies a region's power-generating capacity and reduces dependence on imported resources. It reduces the risk and volatility of energy costs. Clean energy can play an important role in providing power to critical infrastructure in case of a natural catastrophe; for example, New Orleans police used solar-powered lighting for emergency services after hurricane Katrina.[5]

Clean energy technology is crucially important for Connecticut for the following reasons:

1. To meet the statutory mandates of Connecticut's energy policy: The General Assembly declared, and state statutes unequivocally specify that "…it is the policy of the State of Connecticut to (1) conserve energy resources by avoiding unnecessary and wasteful consumption; (2) consume energy resources in the most efficient manner feasible; (3) develop and utilize renewable energy resources, such as solar and wind energy, *to the maximum practicable extent*; (4) *diversify the state's energy supply mix*;…" The law states that Connecticut "shall seek *all possible ways* to implement this policy through public education and cooperative efforts involving the federal government, regional organizations, municipal governments, other public and private organizations and concerned individuals, *using all practical means and measures*, including financial and technical assistance, in a manner calculated to promote the general welfare by creating and maintaining conditions under which energy can be utilized effectively and efficiently.

The General Assembly also declares that it is the continuing responsibility of the state to use all means consistent with other essential considerations of state policy to improve and coordinate the plans, functions, programs and resources of the state to attain the objectives stated herein without harm to the environment, risk to health or safety or other undesirable or unintended consequences, to preserve wherever possible a society which supports a diversity and variety of individual choice, to achieve a balance between population and resource use which will permit the maintenance of adequate living standards and a sharing of life's amenities among all citizens, and to enhance the utilization of renewable resources so that the availability of nonrenewable resources can be extended to future generations. The General Assembly declares that the energy policy is essential to the preservation and enhancement of

[5] "American Energy: A renewable path to Energy Security", Research report prepared by the World Watch Institute, Center for American Progress (2006). Downloaded from http://americanenergynow.org.

the health, safety and general welfare of the people of the state and that its implementation therefore constitutes a significant and valid public purpose for all state actions."[6]

2. To mitigate the negative effects of climate change: Clean energy technology is important for Connecticut for mitigating the negative effects of climate change. Climate change can significantly affect important economic resources such as agriculture, forestry, fisheries and water resources. Scientists have universally accepted that global climate change (warming) is real whether human-generated or otherwise. Many countries are trying to reduce GHG emissions by substituting clean energy technologies for fossil fuel. Connecticut is playing its role in this transition to clean energy policies and to reduce the adverse effects of global warming. Research shows that if global warming continues and reaches 500 ppm CO_2, Connecticut can expect dramatic changes in climate with substantial impact on the state's economy. Research shows that Connecticut can significantly mitigate the adverse effects of climate change by replacing fossil fuels with clean energy technologies.[7] Climate change can adversely affect Connecticut's coastal areas, which are home to almost two million people. Connecticut lobster and fish production will be affected because the maximum heat stress threshold for lobster is constantly exceeded due to climate change (see footnote 5).

Similarly, Connecticut's forests, a major source of recreation, tourism and wildlife habitat, will be adversely affected by climate change. Climate change can adversely affect agriculture and fruit production in Connecticut, especially blueberry and pear production that is sensitive to small temperature changes. However, Connecticut can mitigate the effects of climate change by shifting to clean energy technologies that produce lower emissions than fossil fuels. Currently, Connecticut is promoting clean energy technologies to mitigate the adverse effects of climate change (see footnote 36 for the Governor's Energy Vision).

[6] Connecticut General Statutes (CGS) Chapter 298: "Energy Utilization and Conservation," Title: 16a: "Planning and Energy Policy;" Sec. 16a-35k: "Legislative findings and policy." http://search.cga.state.ct.us/surs/Chap298.htm#Sec16a-35k.htm

[7] "Confronting Climate Change in the U.S. Northeast: Sciences, Impacts and Solutions", Research report prepared by the Northeast Climate Impact Assessment Group (2007). Downloaded from http://www.northeastclimateimpacts.org.

3. To increase potential employment opportunities for Connecticut residents: Employment in clean energy industries is growing at a fast pace (see page 17 of the Colorado study in footnote 17). Clean energy generates more jobs compared with fossil fuel power plants both per unit of capacity and per dollar invested. In the U.S., there are about 446,000 direct and indirect jobs in renewable energy industries.[8] Connecticut can increase its employment opportunities by harnessing clean energy technologies. Clean energy jobs are associated with developing new technologies to increase energy efficiency, as well as the use of renewable resources and with jobs that install and maintain existing 'green' technologies. To understand the potential of clean energy technology on the Connecticut economy, it is essential to know the stock of renewable energy resources in Connecticut. Given this information, we can more readily assess the potential for renewable sources to meet the state's energy demand. Connecticut has a comparative advantage in various forms of clean energy technologies.

An examination of the stock of renewable resources in Connecticut proves that the state has the potential to be a leader in clean energy technology. Connecticut is well positioned to take advantage of biomass energy generation with its rich supply of agricultural and animal husbandry waste resources as well as lumber and wood waste.[9] Connecticut can utilize this oldest form of human energy production to create new jobs. Connecticut can utilize biomass for electricity generation and individual firms can develop an extensive biomass infrastructure to generate power for their own use.

Hydropower is the largest and most established renewable energy source in the U.S. Currently the greatest potential is available in "small hydro projects" with capacities ranging from 1 MW to 30 MW.[10] Connecticut's numerous rivers and streams provide a suitable environment to develop (or reinvigorate) small hydro projects.[11] In May 2007, the Connecticut Clean Energy Fund approved a loan of $557,134 to help fund the demonstration of a new 500-kilowatt hydroelectric turbine system at Kirby Mill in Mansfield. Small hydro projects such as this can be helpful for Connecticut in generating local employment (see footnote 10 as well).

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[8] "Green Jobs: Towards sustainable work in a Low-Carbon World", Preliminary report published by UNEP, ILO, ITUC Green Jobs Initiative. Downloaded from www.unep.org.
[9] Connecticut Clean Energy Fund. Downloaded from http://www.ctcleanenergy.com.
[10] Low Impact Hydropower Institute, "Frequently Asked Questions," p. 3. See www.lowimpacthydro.org.
[11] See the Hartford Courant, Jan 18, 2009, "HYDRO: POWERFUL SPLASH FROM PAST."

Wind energy is currently the fastest growing alternative energy source in the U.S.[12] In Connecticut, there are few sites suitable for large wind installations. The Connecticut Clean Energy Fund (CCEF) is focusing on the small wind rebate program and is developing a small demonstration program that will showcase at least two sites near the seashore as well as inland and at least four turbine types in order to identify the best candidate for its small wind rebate program. The highest wind resources in Connecticut occur in the ridge crests in the northwestern part of the state.

There are other forms of clean energy technologies that Connecticut can develop. These are geothermal heat pumps and power generation, landfill gas, waves and the currents in Long Island Sound. Geothermal is a clean energy resource that is expected to be widely utilized in the U.S. and create further job opportunities. This technology taps into heat and/or steam in the earth's crust and uses them directly for heating and cooling or for electricity generation. Connecticut has only the low temperature resources suitable for geothermal heat pumps applications.

Landfill gas production traps gases emanating from decomposing garbage (municipal waste streams) and provides a reliable option for clean energy; however, this technology is nascent in Connecticut. Wave technology seeks to capture the power of breaking waves. Wave technology at Connecticut's shores is limited compared with other coastal states. However, Connecticut can potentially utilize the strong underwater current along Long Island Sound for electricity generation.

Clean energy is critically important for Connecticut to develop to protect its environment, to create sustainable energy sources and to increase employment opportunities.

[12] Wood, Laura (2009). Thompson Reuters Business Wire, Research and Markets: "Wind Energy: The World's Fastest Growing Renewable Energy Source, Find Out Why in New Report." Dublin, Ireland. Jan. 13, 2009. http://www.reuters.com/article/pressRelease/idUS211832+13-Jan-2009+BW20090113.

Economic Impact Methodology

Given the importance of clean energy potential in Connecticut, it is instructive to evaluate the economic impact of utilizing clean energy technology in the state. In this section, we examine the current economic impact of the renewable energy/energy efficiency (RE/EE) industry group on the state economy and provide an assessment of total jobs and state GDP that is directly and indirectly attributable to the operations of firms in this industry group. Unlike most studies reviewed earlier that used either a "static" input-output model or simple spreadsheet-based analytical models, this study uses the REMI model of the Connecticut economy to calculate the economic and fiscal impacts of the RE/EE industry group on the state's economy (see Appendix A for details). The static input-output model ignores dynamic price, productivity and competitiveness impacts of energy policies over time, while the simple analytical model does not include the employment multiplier effects and often under reports employment effects.

Therefore, we use the REMI model, which is a hybrid input-output model with general equilibrium properties as well as Keynesian performance in which aggregate demand determines GDP in the short run as prices are relatively fixed. This means that REMI accounts for the dynamic price, productivity and competitiveness impacts of energy policies over time, as well as the multiplier effects of job creation.

REMI is a dynamic framework in which to assess individual and firm behavioral responses to changes in relative prices over time. Our study provides the potential regional employment impact of the RE/EE industry group in Connecticut. We estimate the number of jobs that arise directly and indirectly from the operations of firms in the RE/EE group as a proxy for the uptake and implementation of clean energy technology in the state. Direct jobs arise from constructing and maintaining clean energy generation facilities as well as from the production of goods and services for the deployment of clean energy technologies. Indirect jobs arise as Connecticut firms that supply labor and materials to clean energy generation facilities buy goods and services from other state firms in their supply chains.

Finally, new jobs can be created in services, retail and other sectors as a result of net new wages earned and spent by workers in the RE/EE industry group and in subsequent rounds of spending (the induced effect). Similarly, direct state GDP impact arises from construction, maintenance and operation of renewable generation facilities and from the

production and sales of goods and services of primary firms in the RE/EE industry group. Indirect and induced effects from renewable energy generation products and increased household wealth are an important source of net new economic activity. We present in this report the policy implications of maximizing clean energy technology in Connecticut.

Characterizing the RE/EE Industry Group

In order to bound the space of RE/EE industries, we review five reports below that ostensibly attempt the same task (see Appendix C for a review of the literature on states' energy policies). From these five reports and a survey of Connecticut firms, we glean a candidate list of NAICS codes organized in the RE, hybrid and EE technology categories.

Component Manufacturing: Ohio's Future in the Renewable Energy Industry[13]

The purpose of this report was to determine the effect of a large investment in renewable energy systems at the national level on Ohio's manufacturing sector. A report by the Renewable Energy Policy Project (REPP) determined that Ohio was in a favorable position to benefit significantly from an investment in wind energy. The methodology in that report was repeated in this study for several other industries including solar, geothermal, and biomass. Once again, Ohio was in a favorable position among all renewable energy sources considered.

The REPP then focused on specific information about the location and nature of the manufacturing potential in Ohio. Census information for manufacturing is broken down to the county level, making it possible to zoom into a state and identify manufacturing potential by specific regions.

In order to perform this task, the REPP followed a three-step process. First, they indentified the component parts that make up each system, then they identified a relevant NAICS code for each component, and finally they used the census data to identify potential manufacturing activity. When identifying the NAICS code, the REPP first looked at the 10-digit code for the component, and then backed up to the 6-digit level (less resolution). The report discusses advantages and disadvantages of this approach in detail.

[13] See http://www.apolloalliance.org/downloads/Ohio_Manufacturing_Report_2.pdf.

Oregon's Energy Efficiency and Renewable Energy Workforce[14]

The Oregon Employment Department wanted to identify jobs that would be created if Oregon were to expand its energy efficiency and renewable energy production efforts. The Department recognized that although none of these jobs is unique to the renewable energy industry, some require additional knowledge and skills that are unique to the industry. Identifying these specialized skills is important; if the renewable energy industry was to expand, persons able to fill newly created and specialized positions would be needed.

The Employment Department used skill certifications unique to the energy efficiency and renewable energy industries to identify some of the necessary skills. One specialized position identified is a tax-credit certified solar technician. To qualify for this position, special training, and satisfactory scores on several approved technology-specific competency exams are necessary. Another specialized position identified is "green building inspector." A March 2008 report, "An Analysis of Clean Energy Workforce Needs and Programs in Oregon," identified existing training for these and other clean energy positions.

While training identifies several industries, those industries focus mainly on installation and not product manufacturing. The state Employment Department recognized that Oregon not only has companies that participate in the manufacturing of energy efficiency and renewable energy products, but also many companies that could easily expand into one or both of the sectors. The Department then identified industries in Oregon by NAICS code that either produce "green" goods, or are readily able to produce them.

Washington State's Green Economy Industries[15]

Washington's House of Representatives passed the Engrossed Second Substitute Bill 2815 in 2008. Its purpose is to make Washington's economy more sustainable and stimulate job creation in both established and emerging sectors of the "green economy."

A research team led by Washington's Community, Trade, and Economic Development Department reviewed literature from government, non-profit, business, and trade association sources on the green economy, green industry, and green jobs/green collar

[14] See http://www.oaklandpartnership.com/GreenAcademy/Reports/Report%20SOW%20Phase%201%20-%20FINAL%20Text%20Only%20Version%203-08.pdf.
[15] See http://www.ecy.wa.gov/climatechange/CTEDdocs/GreenEconomy_StrategicFramework.pdf.

jobs. Their objective was to develop common definitions for "green economy" terms. This list of key definitions includes Green Economy, Green Jobs, Energy Independence, and Environmental Protection.

Once completed, they defined green industries, which included renewable energy, energy efficiency, demand-response, green building and construction, recycling materials, and consulting, and support services. These categories were further defined in a green industry list organized by North American Industries Classification System (NAICS) code.

The Employment Security Department surveyed these NAICS industries to gather data on both "green jobs" that already exist and levels of industry investment directed at preparing for new green jobs in the future.

California Dreaming Green[16]

The report "Renewable Energy Demand: A case study of California" by George Sterzinger and Jerry Stevens (2006) emphasized the importance of developing a national program for renewable energy technology and its benefits to California. This report emphasizes that renewable energy technology will benefit the regions and states that have the best renewable resource base (i.e., solar, wind, biomass, and geothermal), it will also create a demand for billions of dollars of manufactured components that support renewable energy technology. With the appropriate economic incentives, this demand for manufactured components can open up new markets for domestic manufacturers that are already manufacturing similar equipment. This report outlines the potential for California from a national commitment to accelerate renewable energy development and produce new markets for potential manufactured components industries.

This report uses a three-step procedure to assess the dispersion of manufacturing of the components of renewable energy system as following

1. Identify the component parts that make up each renewable energy system.
2. Identify a relevant NAICS code for each manufactured component.
3. Use the Manufacturing Census data to identify potential manufacturing activity.

These steps help to assess the economic potential for manufactured components that support renewable energy systems.

[16] See http://www.apollochallenge.org/CA_JOBS_REPP.pdf.

The report's key findings show that there are nearly 43,000 firms throughout the United States that operate in industries related to manufacturing components that go into renewable energy systems. A national program for renewable energy would represent nearly $160.5 billion dollars of manufacturing investment, and would create in more than 850,600 new jobs. California stands to receive nearly 95,600 new jobs and $20.9 billion dollars of investment in manufacturing components to supply this national development of renewable energy. California ranks first in terms of job gains and first in terms of potential investment.

Colorado RE/EE Industry Characterization and Green Jobs Estimates and Forecasts

The December 2008 American Solar Energy Society (ASES) and the Management Information Services, Inc. (MISI) study of the U.S. and the Colorado RE/EE industries and occupations[17] is among the most ambitious, comprehensive and thorough assessments of the subject. Indeed, the study claims (page 6), "These are difficult, complex, and critical questions, for which there is no single definitive answer. One of the major contributions of this project was the development of a rigorous definition of the RE & EE industry, which will become the standard in terms of any type of economic and job analysis of the industry conducted by researchers in the future. In effect, ASES/MISI is here acting as the definer and "benchmarker" of the industry as it evolves."

The questions to which the study refers involve classifying the industries and occupations in the RE/EE sector (pages 3 through 8). Despite this claim, the study does not list the NAICS codes of industries at any point of the RE/EE value chain. It does list occupations that, while ubiquitous, appear in the RE/EE sector. Their methodology implicitly suggests they cross-tabbed standard occupational codes (SOCs) with NAICS codes to determine the distribution of occupations by RE/EE sector.

The Colorado study's discussion of the issues involved in classifying RE/EE industries and occupations is quite useful because it illustrates the difficult tradeoffs that researchers must make in such evaluations. Notwithstanding, the study proceeds to estimate employment and revenue levels and growth rates of the RE and EE industries in the U.S. and

[17] "Defining, Estimating, And Forecasting The Renewable Energy And Energy Efficiency Industries In The U.S And In Colorado," http://www.ases.org/images/stories/ASES/pdfs/CO_Jobs_Final_Report_December2008.pdf. An abbreviated version of this study appeared in January 2009 under the head, "Green Collar Jobs in the U.S. and Colorado - Economic Drivers for the 21st Century." See http://www.ases.org/images/stories/ASES/pdfs/CO_Jobs_Rpt_Jan2009_summary.pdf.

Colorado as if they knew the underlying NAICS structure of the RE/EE value chain. While there is a compendium of (duplicate) references for their analysis, it is not clear how they arrived at their estimates using which reference works or estimation methodology.

A large portion of the Colorado study involves estimating the growth of green jobs in the U.S. and Colorado under three growth scenarios. An important contribution is the educational and workforce training required to supply the jobs envisioned under each growth scenario.

DECD and CCEF RE/EE Industry Classification

Using the information on the NAICS categorization from the five reports above, we check our own definition against these taxonomies.

The first task is to identify by North American Industrial Classification (NAICS) codes industries that qualify as members of this group. Connecticut's renewable energy industries are involved in solar photovoltaic and hot water systems (not concentrators), wind energy systems, hydroelectric (less than 5 MW) systems, fuel cells, biomass (direct combustion, gasification, co-firing, ADG, LFG, waste-to-energy [WTE]), tidal/wave, and geothermal (heat pumps for Connecticut). Hybrid systems consist of combined heat and power (CHP), smart grid, energy storage, demand/response, and organic Rankine cycle/waste heat recovery.

Energy efficiency industries include energy service companies (ESCOs) consisting of high efficiency HVAC, high efficiency lighting, daylighting, and demand/response firms.[18] We include in the ESCO group firms that make and install energy-efficient doors, windows, weather stripping and related products (notwithstanding footnote 18). These conceptualizations of what industries are included in the RE/EE group will evolve as stakeholders and experts consider and share their deep understandings of the nuances and subtleties of these characterizations.

[18] The Colorado study says (footnote 17), "An energy service company (ESCO) is a professional business providing designs and implementation of energy savings projects that allow building owners to perform projects to upgrade their building assets. The ESCO performs an in-depth analysis of the property, designs an energy efficient solution, installs the required elements, and maintains the system to ensure energy savings during the payback period. The savings in energy costs is used to pay back the capital investment of the project over a five- to twenty-year period, or reinvested into the building to allow for capital upgrades that may otherwise be unfeasible. If the project does not provide returns on the investment, the ESCO is usually responsible for paying the difference.

Excluded Industries

For purposes of the DECD industry-based analysis, we exclude tidal/wave technologies as we believe there is quite limited application in Connecticut's coastal waters. In the geothermal space, we omit deep and/or horizontal wells and direct exchange systems for power generation as Connecticut's most likely application is for residential and commercial establishment heat pumps that would displace oil- and gas-fired heating systems (bolded industries in Tables 1 through 3 below are within our scope, others are not). We omit hydroelectric construction, and other large-scale electric generation, transmission and distribution construction, manufacturing and operation industries (e.g., utilities).

We omit architects who design green buildings, and firms that service appliances and equipment (except specialty trade contractors such as HVAC firms that install solar, wind, and geothermal equipment and provide service). We omit industries that make, install and service stationary gas turbine generators (peaking units) and industries involved with fuel-efficient transportation (hybrid and fuel cell-powered vehicles and trains). We omit primary research activity occurring in universities, government agencies and firms, as well as RE/EE trade, professional and advocacy groups. We omit industries manufacturing, wholesaling and retailing electronic products such as audio and television equipment and computers and related peripherals from the energy-efficient appliance space. Finally, we omit industries engaged in recycling, remanufacturing and reuse. These are conscious choices we make based on our intention to include industries whose principal function is primary manufacturing, distribution (wholesale and retail), installation and servicing in the RE/EE value chain. Our filtering criteria include industries that have a measurable presence in Connecticut.[19]

Connecticut's RE/EE Value Chain

The industries listed in Tables 1 through 3 comprise a significant part of the value chain from primary manufacturers of end user RE/EE equipment and commodities, as well as wholesalers and retailers of such equipment and commodities. Absent are the suppliers to these industries. Examples of supply chain industries are silicon ingot manufacturers and

[19] Privacy and confidentiality considerations prevent the disclosure of industry data if there are five or fewer firms in an industry classification in the state.

manufacturers of electronic components such as transistors and integrated circuits used in inverters. Because the latter industries supply significant portions of their output to other industries such as consumer electronics, we omit them from the RE/EE value chain and identify them to the extent possible in the deep supply chain in future research.

Table 1: Renewable Energy Industry Areas

Solar	Wind	Fuel Cells	Biomass	Water	Geothermal
-Solar PV **-Solar Hot Water** -Concentrating - Solar Power	**-On Shore** **-Off Shore**	**-PEM** **-Solid Oxide (SOFC)** **-PAFC** **-MCFC**	**-Direct Combustion** **-Gasification** **-Co-Firing** **-Anaerobic Digester Gas (ADG)** **-LFG** **-Waste-to-Energy**	**-Hydro (< 5 MW)** -Tidal -Wave	**-Heat Pumps** -Deep Wells -Horizontal -Direct Exchange
Other Electric Power Generation (221119)	Other Electric Power Generation (221119)	Other Electric Power Generation (221119)	Other Electric Power Generation (221119)	Other Electric Power Generation (221119)	Plumbing, Heating, AC Contractors (238220)
Plumbing, Heating, AC Contractors (238220)	Plumbing, Heating, AC Contractors (238220)	Surface-Coated Paperboard Manufacturing (322226)	Other Waste Collection (562119)	Motors and Generators (335312)	Power Boiler and Heat Exchanger Manufacturing (332410)
Semiconductor and Related Device Manufacturing (334413)	Motors and Generators (335312)	Printed circuits and electronics assemblies (334418)	Logging (113310)	Power Transmission Equipment (333613)	Heat pumps manuf. + Heating & air conditioning combo units manuf. (333415)
All Other Miscellaneous Electrical Equipment and Component Manufacturing (335999)	Speed Changer, Industrial (333612)	All Other Miscellaneous Electrical Equipment and Component Manufacturing (335999)	Combustors, nonhazardous solid waste (562213)	All Other Miscellaneous Electrical Equipment and Component Manufacturing (335999)	Heat pumps merchant wholesalers + Heating equipment, warm air (i.e., forced air) merchant wholesalers (423730)

Computer and Computer Peripheral Equipment and Software Merchant Wholesalers (423430)	Power Transmission Equipment (333613)	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers (423430)	Digesters, industrial-type, heavy gauge metal, manufacturing (332420)	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers (423430)	Drilling water wells (except water intake wells in oil and gas fields) (237110)
Batteries (except automotive) merchant wholesalers (423610)	All Other Miscellaneous Electrical Equipment and Component Manufacturing (335999)	Hydrogen manufacturing (325120)		Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) manufacturing (335911)	
Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) manufacturing (335911)	Turbine& Turbine Generator Set Units Manuf. (333611)			Alkaline cell primary batteries manufacturing (335912)	
Alkaline cell primary batteries manufacturing (335912)	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers (423430)			Batteries (except automotive) merchant wholesalers (423610)	
	Batteries (except automotive) merchant wholesalers (423610)				

	Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) manufacturing (335911)				
	Alkaline cell primary batteries manufacturing (335912)				

In general, industries with codes that begin with 11 are in agriculture (logging that produces chips for biomass in this case), those beginning with 23 are specialty trade contractors, those beginning with 32 and 33 are manufacturing industries, those beginning with 42 are wholesalers, and those beginning with 44 and 45 are retailers. Industries with codes beginning with 56 are part of the waste management industry group.

Table 2: Hybrid Systems

CHP	Smart Grid	Energy Storage	Demand Response	Organic Rankine Cycle (WHR)
-Small distributed -Large central	**-AMI -Home Area Networks (HAN) -Data management Communication and controls (sensors and actuators)**	**-Advanced batteries -Compressed Air Energy Storage (CAES) -Vehicle to grid (e.g. PHEVs)**	**-Control and monitoring devices**	**-Waste heat recovery generators**
Other Electric Power Generation (221119)	Cabin environment indicators, transmitters, and sensors manufacturing (334511)	Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) manufacturing (335911)	Temperature controls, automatic, residential and commercial-types, manufacturing + Building services monitoring controls, automatic, manufacturing (334512)	
		Alkaline cell primary batteries manufacturing (335912)	Relay and Industrial Control Mnf. (335314)	
		Batteries (except automotive) merchant wholesalers (423610)		

Table 3: Energy Efficiency Areas

Building Envelope	Heating	Cooling	Lighting	Appliances and Other
-Duct sealing and insulation -Building and window insulation	**-Condensing gas furnaces, boilers, and water heaters -Tankless and heat pump water heaters -Programmable thermostats**	**-Energy star ceiling fans -Energy Star AC units**	**-Lighting motion sensors -Specialty fluorescent bulbs and fixtures -CFLs -LEDs -Daylighting design**	**-Faucet aerators -Low flow showerheads -Energy Star qualified ovens, TVs, refrigerators, washers and dryers, and other appliances. -Efficient commercial dishwashers**
Roofing Contractors (238160)	Power Boiler and Heat Exchanger Manufacturing (332410)	Attic fans manufacturing (333412)	Electric Lamp Bulb/Parts Mnf (335110)	Household Cooking Appliance Manufacturing (335221)
Drywall and Insulation contractors (238310)	Air Purification Equipment Manufacturing (333411)	Bath fans with integral lighting fixture, residential, manufacturing (335211)	Batteries (except automotive) merchant wholesalers (423610)	Appliance stores, household-type (443111)
Urethane and Other Foam Product (except Polystyrene) Manufacturing (326150)	Heating boilers, steam and hot water, merchant wholesalers (423720)	Temperature controls, automatic, residential and commercial-types, manufacturing + Building services monitoring controls, automatic, manufacturing (334512)	Temperature controls, automatic, residential and commercial-types, manufacturing + Building services monitoring controls, automatic, manufacturing (334512)	Appliance stores, household-type, used (453310)
Glass Products Made From Purchased Glass (327215)	Heating equipment, hot water, (except hot water heaters) manuf. (333414)	Fans, household-type, merchant wholesalers (423620)		Faucets, plumbing, manufacturing (332913)
Insulation materials (except wood) merchant wholesalers (423330)	Ovens, commercial-type, manufacturing (333319)	Ceiling fan stores (444190)		Dishwashers, household-type, manufacturing (335228)

Wood window & Door manufacturing (321911)	Ovens, commercial-type, merchant wholesalers (423440)			Household Refrigerator and Home Freezer Manufacturing (335222)
Mineral Wool Manufacturing (327993)	Cabin environment indicators, transmitters, and sensors manufacturing (334511)			Household Laundry Equipment Manufacturing (335224)

Within each RE/EE industry, there are firms that have no relation to RE/EE products or services. For example, some, but not all, firms in the Roofing Contractors industry (NAICS 238160) install daylighting as part of their function. In addition, in a given firm in a particular RE/EE industry, not all employees produce RE/EE goods and/or services. For example, a firm that installs and services high-efficiency heating and cooling systems may deliver oil as well. Therefore, a portion of its workforce is not engaged in RE/EE work. It is necessary therefore to estimate ranges of plausible RE/EE employment and output (sales) in each industry. These scenarios are the basis of a plausible range of economic impacts attributable to the RE/EE industry. Having established this framework for analysis, it will be straightforward to amend the boundary of the RE/EE industry group with subsequent research.

Table B.1 in Appendix B defines the 53 industries appearing in Tables 1 through 3 above (some industries appear in more than one RE/EE category in Tables 1 through 3 because they operate in or supply more than one industry in that category). Because the Connecticut Department of Labor suppresses certain employment data due to confidentiality concerns, we note that Other Electric Power Generation (221119), Surface-Coated Paperboard Manufacturing (322226), Hydrogen manufacturing (325120), Attic fan manufacturing (333412), Bath fans with integral lighting fixture, residential, manufacturing (335211), Household Cooking Appliance Manufacturing (335221), Household Refrigerator and Home Freezer Manufacturing (335222), Household Laundry Equipment Manufacturing (335224), Dishwashers, household-type, manufacturing (335228), Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) manufacturing (335911), and, Alkaline cell primary batteries manufacturing (335912) have a negligible presence in Connecticut and we therefore omit them from the analysis that follows.

Data Sources

The Connecticut Department of Labor (DoL) supplied DECD with Connecticut employment, establishment and payroll data for each RE/EE industry identified in Table B.1 for calendar years 2003 through 2007. As we describe above, in each RE/EE industry, there are firms that perform functions that are clearly in the RE/EE sphere and others that are not because even at the six-digit level of industry detail there is substantial firm heterogeneity. In addition, within a firm in a RE/EE industry, there are workers employed in producing RE/EE goods and services and others who perform wholly unrelated functions. Therefore, we refine the employment and establishment source data based on a survey of firms in the RE/EE industry group in Connecticut.

In 2007, for the industry data DoL disclosed, there were 3,818 Connecticut establishments (worksites) of the 53 RE/EE industries appearing in Table B.1. In 2007, there were 42,943 jobs in these establishments with a payroll of $2.96 billion. A small industry and job subset that we estimate below drives the economic and fiscal impact.

RE/EE Industry Growth in Connecticut 2003-2007

For the group of 53 Connecticut RE/EE industries, the annual average growth rate of establishments from 2003 through 2007 is -11.9% while the simple growth rate from 2003 to 2007 is -31.6%. The group's annual average employment growth rate from 2003 through 2007 is -5.6% while the simple growth rate from 2003 to 2007 is -22.8%. The differences in growth rates arise from fluctuations in establishment and job levels each year that tend to be smoothed and attenuated with the average of year-to-year growth rates. Similarly, annual average (nominal) payroll growth for the group is -0.5% while the simple average (nominal) payroll growth rate is -4.8%. The negative payroll growth in nominal terms indicates that Connecticut workers' wages on average in this industry group did not keep pace with inflation despite a rebound during this period from the 2001 recession.

For economic and fiscal impact analysis purposes (REMI inputs), we aggregate the 53 industries into two- and three-digit level NAICS groups. Table 4 (columns six through eleven) shows the simple and annual average growth rates of the aggregated industries we use for the direct impact in REMI in terms of the number of establishments, employment and payroll from 2003 through 2007. Inspection of this data shows that the number of

establishments in the RE/EE group has remained roughly constant with a few declines notably in retail and waste management and remediation services. Employment growth was negative for several industries notably logging (wood chips, -20%) and wood product manufacturing (windows and doors, -13%) while positive growth did not exceed 4.5% for any industry. Payroll growth in most industries was positive and did not exceed 8%, while for logging (wood chips) and wood product manufacturing (windows and doors), payrolls declined 11.3% and 14.7% respectively in annual average terms. *Recall that these numbers reflect the changes in industry establishments, employment and payroll at the six-digit level of detail and do not necessarily reflect declines in, for example, retail as a whole. Moreover, it is possible that RE/EE firms grew during this period while the industry in which they are embedded declined. Therefore, it is difficult to extract trends for the subset of specific RE/EE industries we seek.*

REMI Modeling Strategy

We model the economic and fiscal impact of the RE/EE industries defined above by subtracting each industry's direct RE/EE employment from the state (model) economy. The REMI model automatically reduces the capital required to support these workers. The result is the difference between the Connecticut economy with the RE/EE industry group and the Connecticut economy in which all traces of the RE/EE industry group as defined are absent.

Almost 37% of the Connecticut RE/EE industry group's jobs are in three specialty trade contractor industries (Roofing Contractors, Plumbing, Heating, AC Contractors [HVAC], and Drywall and Insulation Contractors). This group includes solar PV and solar hot water systems installers and servicers, efficient heating and cooling system installers and servicers (HVAC), and insulation and weatherizer installers and servicers. Twenty-six percent of the state's RE/EE jobs are in the HVAC industry.

Using professional judgment and the Navigant Consulting firm survey (see footnote 2), for purposes of economic and fiscal analysis, we assume RE/EE industry direct employment ranges from 1% to 100% of employment in those firms engaged in RE/EE work weighted by the fraction of each industry's firms engaged in RE/EE work (ranging from 5% to 100%). This procedure yields a low-level total direct employment estimate of 3,661 Connecticut jobs and a high estimate of 5,830 direct jobs for the RE/EE group (the mean job

estimate is 4,746). Table B.1 presents the ranges for each Connecticut RE/EE industry in columns four and five. Table 4 (columns 3 and 4) presents aggregates for the industry job estimates used in REMI. This procedure is admittedly unscientific and the mean estimate corresponds roughly to the estimate of direct jobs extrapolated from the Navigant survey of Connecticut RE/EE firms (see footnote 2). For perspective, Connecticut's fuel cell industry employed 1,156 workers in 2007 representing respectively 31.5% and 19.8% of the low and high job range estimates above.[20]

[20] See http://www.fuelcellseminar.com/pdf/2008/thursday/03_Rinebold_J_COM41-2.ppt.pdf.

Table 4: RE/EE Industry Growth in Aggregate Sectors

REMI 70-Sector Model NAICS Aggregation	REMI NAICS Sectors	RE/EE Jobs 2007 Low Est.	RE/EE Jobs 2007 High Est.	CT Establishment Growth: Avg. Ann. Growth, 2003-07	CT Establishment Growth: 2003-2007 Growth	CT Jobs Growth: Avg. Ann. Growth, 2003-07	CT Jobs Growth: 2003-2007 Growth	CT Payroll Growth: Avg. Ann. Growth, 2003-07	CT Payroll Growth: 2003-2007 Growth	# Establish-ments 2007	# Est. 2006	# Est. 2005	# Est. 2004	# Est. 2003	# Jobs 2007	# Jobs 2006	# Jobs 2005	# Jobs 2004	# Jobs 2003	Payroll 2007	Payroll 2006	Payroll 2005	Payroll 2004	Payroll 2003
Forestry and logging; Fishing, hunting, and trapping	113, 114	1	3	0.28%	0.00%	-20.14%	-62.96%	-11.36%	-67.40%	10	10	9	10	10	10	19	19	27	28	$293,049	$578,332	$656,135	$973,044	$899,039
Construction	23	313	805	1.18%	4.79%	3.48%	5.62%	4.73%	34.65%	2,035	2,034	2,013	1,975	1,942	16,870	15,900	15,832	15,972	14,754	$944,883,336	$797,700,343	$806,776,279	$915,918,655	$701,752,720
Wood product manufacturing	321	19	36	0.38%	0.00%	-13.64%	-59.34%	-14.71%	-60.76%	14	13	15	15	14	74	69	200	182	194	$3,368,059	$3,155,440	$10,073,701	$8,449,881	$8,582,246
Nonmetallic mineral product manufacturing	327	113	192	-1.32%	-5.26%	4.51%	16.13%	4.10%	33.98%	18	18	18	19	19	360	338	368	310	307	$13,123,185	$11,655,065	$11,691,673	$9,549,154	$9,794,607
Fabricated metal product manufacturing	332	161	251	1.54%	5.26%	-3.38%	-2.83%	-0.78%	13.52%	20	20	22	20	19	584	631	736	601	701	$34,293,651	$33,503,302	$45,778,794	$28,954,967	$30,208,578
Machinery manufacturing	333	270	564	-0.81%	-3.64%	-5.27%	-19.17%	7.91%	-5.73%	53	52	54	58	55	3,314	3,169	3,102	4,100	4,248	$270,342,179	$234,792,893	$214,162,745	$278,045,465	$286,788,205
Computer and electronic product manufacturing	334	89	174	0.11%	0.00%	3.26%	7.30%	1.64%	24.60%	52	53	53	56	52	2,601	2,520	2,508	2,424	2,289	$175,557,102	$165,902,188	$166,562,636	$149,606,258	$140,901,870
Electrical equipment and appliance manufacturing	335	1,530	1,867	1.05%	3.75%	0.72%	6.24%	4.87%	40.59%	83	83	89	84	80	4,464	4,197	4,412	4,202	4,359	$422,597,479	$382,054,674	$365,355,278	$296,918,711	$300,595,186
Plastics and rubber products manufacturing	326	191	267	-1.77%	-9.09%	1.24%	17.23%	6.16%	47.16%	10	10	9	9	11	381	372	351	325	367	$22,669,380	$21,132,354	$18,644,697	$15,264,622	$15,404,126
Wholesale trade	42	470	824	0.31%	1.22%	-0.14%	0.04%	4.60%	10.82%	665	665	658	653	657	7,340	7,216	6,948	7,337	7,400	$711,120,950	$780,408,309	$613,332,853	$622,385,909	$641,698,521
Retail trade	44-45	390	577	-2.17%	-8.43%	-1.71%	-3.10%	0.56%	6.20%	652	652	666	688	712	5,814	5,938	5,996	6,000	6,232	$274,880,915	$307,864,304	$272,821,174	$263,580,240	$258,828,655
Professional and technical services	54	36	101	5.97%	25.00%	3.14%	-0.69%	2.62%	30.62%	180	164	160	139	144	720	686	679	725	642	$62,896,956	$60,141,401	$57,093,170	$52,959,868	$48,151,158
Waste management and remediation services	562	80	169	-4.69%	-18.75%	-3.72%	-12.37%	0.18%	-0.40%	26	27	33	33	32	411	389	448	469	483	$28,990,149	$27,787,193	$28,829,902	$29,125,037	$29,106,914
Totals		3,661	5,830																					
Average of High-Low Job Est.		4,746																						

Source: CT Dept. of Labor and author's calculations

Results

Table 5 reports the results for the three RE/EE industry job estimates. As we subtract the jobs in the industries shown in Table 4 from Connecticut's economy, we obtain results that show how the state hypothetically suffers from the loss of these jobs. We turn these results positive and average the yearly job and state GDP changes from the baseline forecast for the Connecticut economy. REMI calculates the changes from a baseline forecast for the state economy due to a shock (such as a change in employment). The results effectively demonstrate what would happen if the RE/EE industry appeared spontaneously at its 2007 level of direct employment and remained at this level through 2050. The requisite fixed capital investment (plant and equipment) is made in the model to support these workers as REMI maintains a constant capital/labor ratio for each industry.

Table 5: Economic and Fiscal Impacts as Annual Average Changes from Baseline Forecast

	Low Job Estimate	High Job Estimate	Low Estimate: Fraction of State	High Estimate: Fraction of State
Direct Employment	3,661	5,830	0.23%	0.36%
Plus Indirect & Induced Employment	6,002	8,937	0.38%	0.56%
Total Employment	9,663	14,767	0.60%	0.92%
State GDP (Fixed 2007$)	$2,524,157,510	$3,722,300,834	1.17%	1.72%
Personal Income (Fixed 2007$)	$901,627,579	$1,363,575,142	0.47%	0.71%
Net State Revenue (Fixed 2007$)	$81,075,453	$123,806,154	NA	NA

Source: REMI and author's calculation.

To put these results in perspective, Connecticut's 2007 economy generated $216.3 billion in state GDP (value added), its total nonfarm employment was about 1.6 million people, its labor force was about 1.7 million people and its population was about 3.2 million people. Connecticut's personal income was $192.6 billion in 2007.[21] Net state revenue is not measured; REMI estimates state revenues from all sources and expenditures in major categories as a result of net new economic activity.

For the two RE/EE employment estimates, these results indicate that Connecticut's RE/EE industry contributes between 1.17% and 1.72% of Connecticut's GDP, between 0.6%

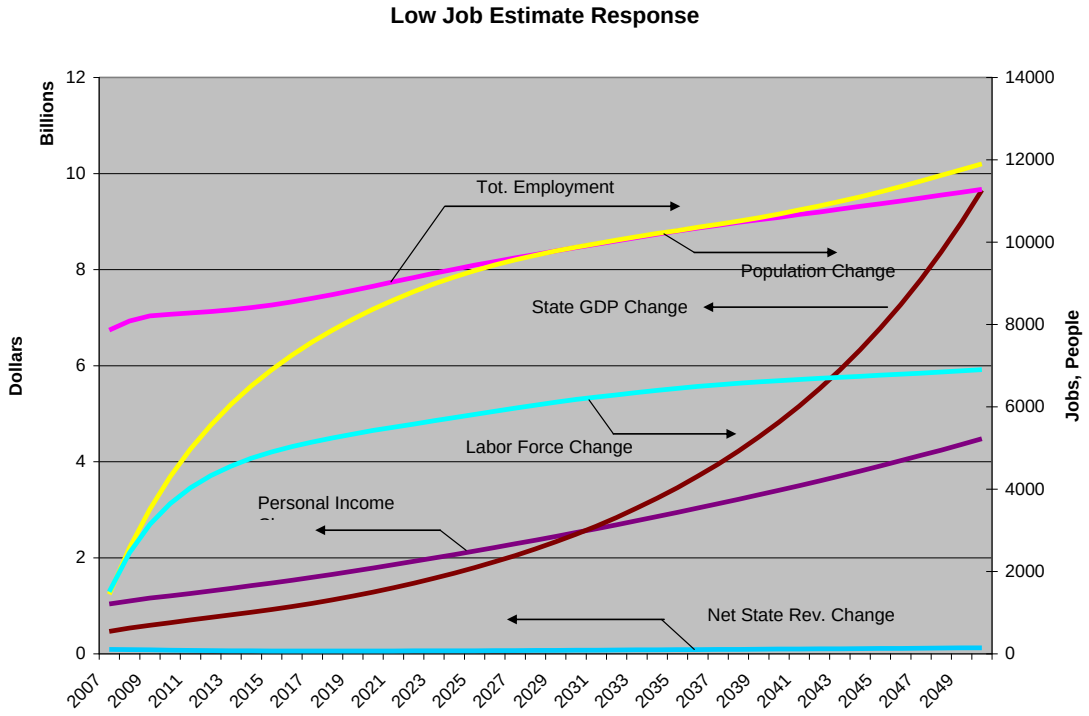
[21] Sources are CT DoL and the Bureau of Economic Analysis. Personal income is income from all sources including wages, pension, alimony, government transfers, interest, dividends and capital gains.

and 0.92% of the state's nonfarm employment, and between 0.47% and 0.71% of the state's personal income on average each year. We infer an implicit employment multiplier of 2.6 for each employment scenario, that is, for each RE/EE job, on average each year an additional 1.6 jobs are created. This relatively high multiplier arises most likely because of the relatively large local supply of labor and intermediate goods.

The results indicate as well that, all else equal, Connecticut's RE/EE industry would grow even if its employment did not because productivity is growing. Thus, given the state and national commitments to renewable energy and related technologies, Connecticut is poised for significant growth in this sector if it makes significant public and private investment in the human and physical capital required.

The dynamic response of the Connecticut economy appears in Chart 1 for the low job estimate (the dynamic response profile for the high scenario is similar but shifted up). The graph depicts changes in economic and fiscal variables above the baseline forecast of the Connecticut economy. While the change in total employment and the labor force level off around 2050, changes in state GDP, personal income (adjusted for inflation) and population continue to grow because Connecticut's RE/EE industry expands even as its direct employment remains constant at 2007 levels. This occurs because of an agglomeration effect and because Connecticut's RE/EE industry is relatively more competitive with similar industries in the rest of the nation (REMI doesn't know that other states are engaging in similar ventures). Labor force growth is significantly smaller than employment growth because unemployment growth is negative, that is, the number of unemployed persons declines more than the number of employed persons increases. The population grows as economic migrants respond to new employment opportunities that the emergence of the RE/EE industry creates.

Chart 1: Dynamic Response of the Connecticut Economy to the Appearance of the RE/EE Industry



Source: REMI and author's calculation.

Conclusion

For the two RE/EE employment estimates, these results indicate that Connecticut's RE/EE industry contributes between 1.7% and 1.72% of Connecticut's GDP, between 0.6% and 0.92% of the state's nonfarm employment, and between 1.64% and 2.47% of the state's personal income on average each year. We infer an implicit, long-run employment multiplier of 2.6 for each employment scenario, that is, for each RE/EE job, on average each year an additional 1.6 jobs are created. This relatively high multiplier arises most likely because of the relatively large local supply of labor and intermediate goods. The results indicate as well that, all things equal, Connecticut's RE/EE industry would grow even if its employment did not because productivity is growing. Thus, given the state and national commitments to renewable energy and related technologies, Connecticut is poised for significant growth in this sector if it makes significant public and private investment in the human and physical capital required.

In this study, we do not quantify the ultimate potential for various classes of renewable energy generation and therefore ignore for the present the benefits of savings from investment in RE/EE technologies in Connecticut. This is future research. Notwithstanding, this analysis is conservative as RE/EE investments and the savings they produce reduce production costs and increase household consumption in other sectors. In addition, DECD does not estimate the non-financial benefits of reducing Connecticut's carbon footprint adding to the conservative nature of this analysis.

APPENDIX A: THE REMI MODEL

The Connecticut REMI model is a dynamic, multi-sector, regional economic model developed and maintained for the Department of Economic and Community Development by Regional Economic Models, Inc. of Amherst, Massachusetts. This model provides detail on all eight counties in the State of Connecticut and any combination of these counties. The REMI model includes the major inter-industry linkages among 466 private industries, aggregated into 67 major industrial sectors. With the addition of farming and three public sectors (state and local government, civilian federal government, and military), there are 70 sectors represented in the model for the eight Connecticut counties.[♣]

The REMI model is based on a national *input-output* (I/O) model that the U.S. Department of Commerce (DoC) developed and continues to maintain. Modern input-output models are largely the result of groundbreaking research by Nobel laureate Wassily Leontief. Such models focus on the inter-relationships between industries and provide information about how changes in specific variables—whether economic variables such as employment or prices in a certain industry or other variables like population affect factor markets, intermediate goods production, and final goods production and consumption.

The REMI Connecticut model takes the U.S. I/O "table" results and scales them according to traditional regional relationships and current conditions, allowing the relationships to adapt at reasonable rates to changing conditions. Listed below are some salient structural characteristics of the REMI model:

- REMI determines consumption on an industry-by-industry basis, and models real disposable income in Keynesian fashion, that is, with prices fixed in the short run and GDP (Gross Domestic Product) determined solely by aggregate demand.
- The demand for labor, capital, fuel, and intermediate inputs per unit of output depends on relative prices of inputs. Changes in relative prices cause producers to substitute cheaper inputs for relatively more expensive inputs.

[♣] The seminal reference is George I. Treyz (1993), Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis, Kluwer Academic Publishers, Boston.

- Supply of and demand for labor in a sector determine the wage level, and these characteristics are factored by regional differences. The supply of labor depends on the size of the population and the size of the workforce.
- Migration—that affects population size—depends on real after-tax wages as well as employment opportunities and amenity value in a region relative to other areas.
- Wages and other measures of prices and productivity determine the cost of doing business. Changes in the cost of doing business will affect profits and/or prices in a given industry. When the change in the cost of doing business is specific to a region, the share of the local and U.S. market supplied by local firms is also affected. Market shares and demand determine local output.
- "Imports" and "exports" between states are related to relative prices and relative production costs.
- Property income depends only on population and its distribution adjusted for traditional regional differences, *not* on market conditions or building rates relative to business activity.
- Estimates of transfer payments depend on unemployment details of the previous period, and total government expenditures are proportional to population size.
- Federal military and civilian employment is exogenous and maintained at a *fixed* share of the corresponding total U.S. values, unless specifically altered in the analysis.
- Because each variable in the REMI model is related, a change in one variable affects many others. For example, if wages in a certain sector rise, the relative prices of inputs change and may cause the producer to substitute capital for labor. This changes demand for inputs, which affects employment, wages, and other variables in those industries. Changes in employment and wages affect migration and the population level that in turn affect other employment variables. Such chain-reactions continue in time across all sectors in the model. Depending on the analysis performed, the nature of the chain of events cascading through the model economy can be as informative for the policymaker as the final aggregate results. Because REMI generates extensive sectoral detail, it is possible for experienced economists in this field to discern the dominant causal linkages involved in the results.

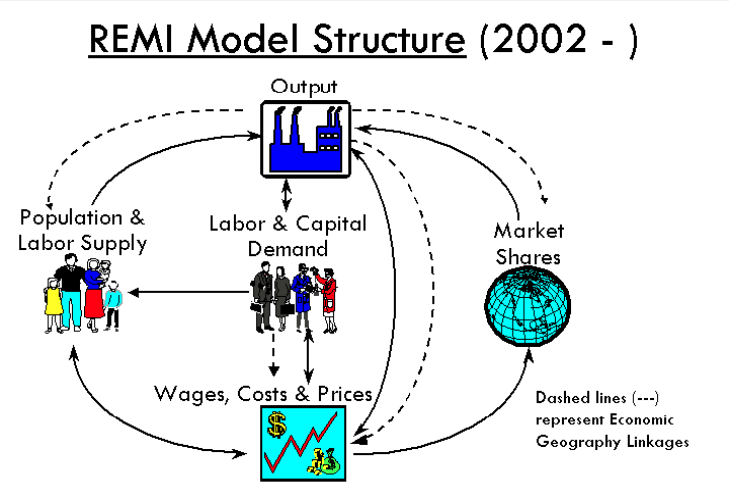
The REMI model is a structural model, meaning that it clearly includes cause-and-effect relationships. The model shares two key underlying assumptions with mainstream economic theory: *households maximize utility* and *producers maximize profits*. In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit output depends on their relative costs, because an increase in the price of one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects population size and its growth rate. People move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply of and demand for labor in the model determine the real wage rate. These wage rates, along with other prices and productivity, determine the cost of doing business for each industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits, depending on the market supplied by local firms. This market share combined with the demand described above determines the amount of local output. The model has many other feedbacks. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment and population growth impacts government spending.

Model Overview

Figure A-1.1 is a pictorial representation of the model. The Output block shows a factory that sells to all the sectors of final demand as well as to other industries. The Labor and Capital Demand block shows how labor and capital requirements depend on both output and their relative costs. Population and Labor Supply are shown as contributing to demand and to wage determination in the product and labor market. The feedback from this market shows that economic migrants respond to labor market conditions. Demand and supply interact in the Wage, Price and Profit block. Once prices and profits are established, they determine market shares, which along with components of demand, determine output.

Figure A-1.1



The REMI model brings together the above elements to determine the value of each of the variables in the model for each year in the baseline forecasts. The model includes each inter-industry relationship that is in an input-output model in the Output block, but goes well beyond the input-output model by including the relationships in all of the other blocks shown in Figure A-1.1.

In order to broaden the model in this way, it is necessary to estimate key relationships econometrically. This is accomplished by using extensive data sets covering all areas of the country. These large data sets and two decades of research effort have enabled REMI to simultaneously maintain a theoretically sound model structure and build a model based on all the relevant data available. The model has strong dynamic properties, which means that it forecasts not only what will happen, but also when it will happen. This results in long-term predictions that have general equilibrium properties. This means that the long-term properties of general equilibrium models are preserved without sacrificing the accuracy of event timing predictions and without simply taking elasticity estimates from secondary sources.

Understanding the Model

In order to understand how the model works, it is critical to know how the key variables in the model interact with one another and how policy changes are introduced into the model. To introduce a policy change, one begins by formulating a policy question. Next, select a baseline forecast that uses the baseline assumptions about the external policy variables and then generate an alternative forecast using an external variable set that includes changes in the external values, which are affected by the policy issue.

Figure A-1.2

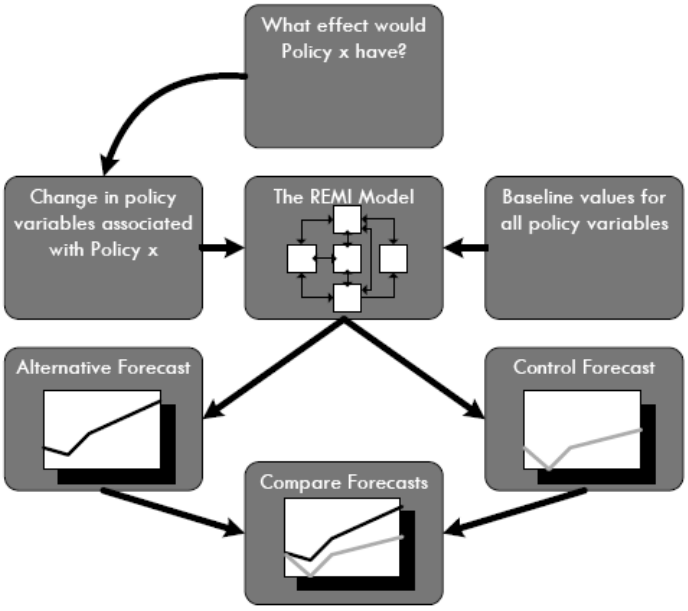


Figure A-1.2 shows how this process would work for a policy change called Policy X. In order to understand the major elements in the model and their interactions, subsequent sections examine the various blocks and their important variable types, along with their relationships to each other and to other variables in the other blocks. The only variables discussed are those that interact with each other in the model. Variables determined outside of the model include:

- Variables determined in the U.S. and world economy (e.g., demand for computers).
- Variables that may change and affect the local area, but over which the local area has no control (e.g., an increase in international migration).

- Variables that are under control of local policy (e.g., local tax rates).

For simplicity, the last two categories are called policy variables. Changes in these variables are automatically entered directly into the appropriate place in the model structure. Therefore, the diagram showing the model structure also serves as a guide to the organization of the policy variables (see Figure A-1.3).

Output Block

The Output Block variables are:

- State and Local Government Spending
- Investment
- Exports
- Consumption
- Real Disposable Income

These variables interact with each other to determine output and depend on variable values determined in other blocks as follows:

Variables in the Output Block	Variables Outside of the Output Block that are Included in its Determinants
State and Local Government Spending	Population
Investment	Optimal Capital Stock (also the actual capital stock)
Output Share of Local Market	(The proportion of local demand supplied locally, called the Regional Purchase Coefficient)

Exports	The Regional Share of Interregional and International Trade
Real Disposable Income	Employment, Wage Rates and the Consumer Expenditure Price Index

Labor and Capital Demand Block

The Labor and Capital Demand block has three types of key variables:

- Employment - determined by the labor/output ratio and the output in each industry, determined in the Output block.
- Optimal Capital Stock - depends on relative labor, capital and fuel costs and the amount of employment.
- Labor/Output Ratio - depends on relative labor, capital and fuel costs.

Simply put, if the cost of labor increases relative to the cost of capital, the labor per unit of output falls and the capital per unit of labor increases.

Population and Labor Supply Block

The model predicts population for 600 cohorts segmented by age, ethnicity and gender. This block also calculates the demographic processes - births, deaths and aging. The model deals with different population sectors as follows:

- Retired Migrants are based on past patterns for each age cohort 65 and over.
- International migrants follow past regional distributions by country of origin.
- Military and college populations are treated as special populations that do not follow normal demographic processes.
- Economic migrants are those who are sensitive to changes in quality of life and relative economic conditions in the regional economies. The economic variables that change economic migration are employment opportunity and real after-tax wage rates.

This block allows the determination of the size of the labor force by predicting the labor force participation rates for age, ethnicity and gender cohorts, which are then applied to their respective cohorts and summed. The key variables that change participation rates within the model are the ratio of employment to the relevant population (labor market tightness) and the real after-tax wage rates.

Wage, Price and Profit Block

Variables contained within the Wage, Price and Profit block are:

- Employment Opportunity
- Wage Rate
- Production Costs
- Housing Price
- Consumer Price Deflator
- Real Wage Rate
- Industry Sales Price
- Profitability

The wage rate is determined by employment opportunity and changes in employment demand by occupation for occupations that require lengthy training. The housing price increases when population density increases. The Consumer Expenditure Price Index is based on relative commodity prices, weighted by their share of U.S. nominal personal consumption expenditures. The model uses the price index to calculate the real after-tax wage rate for potential migrants that includes housing price directly, while the price index used to deflate local income uses the local sales price of construction. Wage rates affect production costs, as well as other costs, and they in turn determine profitability or sales prices, depending on whether the type of industry involved serves mainly local or external markets. For example, a cost increase for all local grocery stores results in an increase in their prices, while an increase in costs for a motor vehicle factory reduces its profitability of production at that facility but may not increase their prices worldwide.

Market Shares Block

The Market Shares Block consists of:

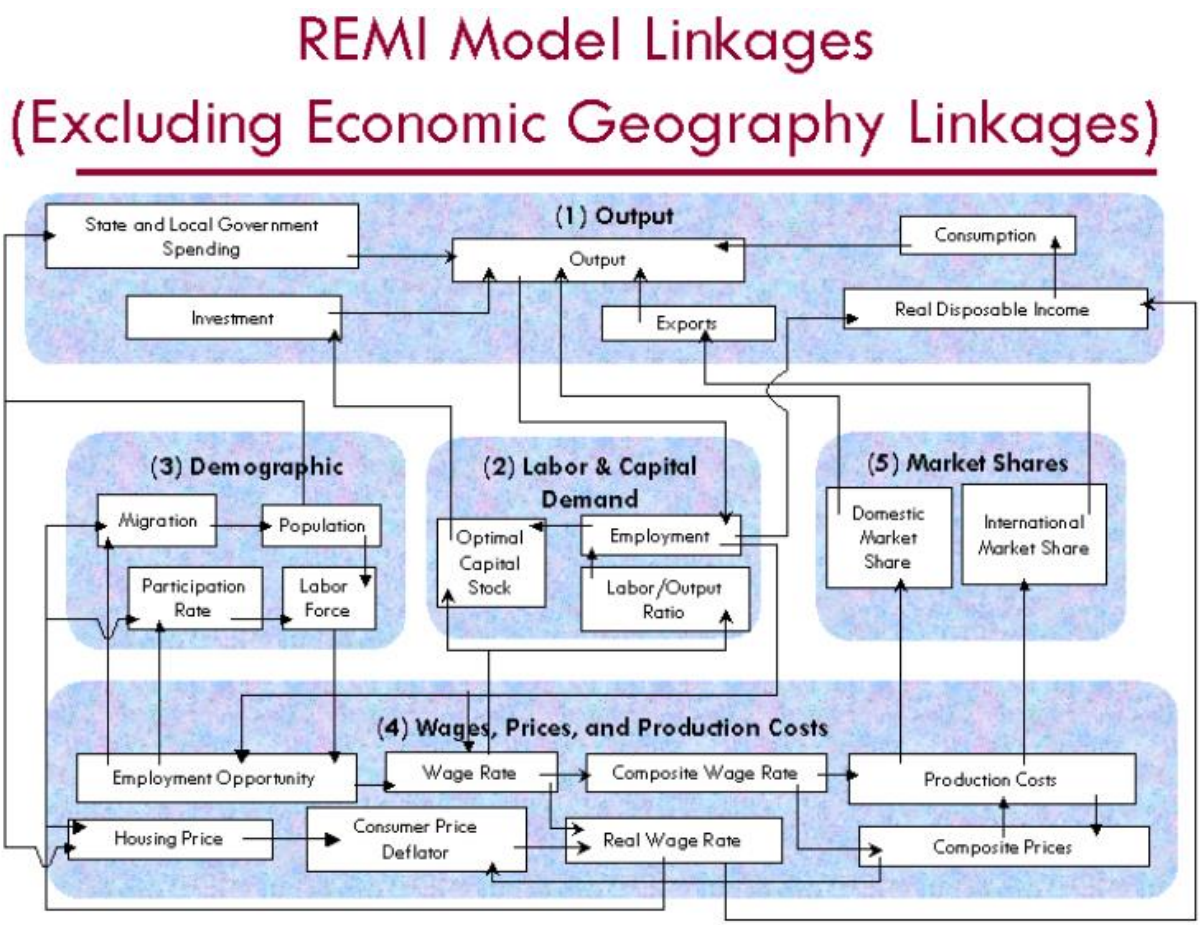
- Share of Local Market
- Share of External Market

An increase in prices leads to some substitution away from local suppliers toward external suppliers. In addition, a reduction in profitability for local factories leads to less expansion of these factories relative to those located in areas where profits have not decreased. These responses occur because the U.S. is a relatively open economy where firms can move to the area that is most advantageous for their business.

The Complete Model

Figure A-1.3 illustrates the entire model and its components and linkages. This diagram is helpful in understanding the complex relationships shared by variables within the various blocks discussed above, as well as their relationships to variables in other blocks.

Figure A-1.3


REMI Model Linkages
(Excluding Economic Geography Linkages)
(1) Output
State and Local Government Spending
Output
Consumption
Investment
Exports
Real Disposable Income
(3) Demographic
Migration
Population
Participation Rate
Labor Force
(2) Labor & Capital Demand
Optimal Capital Stock
Employment
Labor/Output Ratio
(5) Market Shares
Domestic Market Share
International Market Share
(4) Wages, Prices, and Production Costs
Employment Opportunity
Wage Rate
Composite Wage Rate
Production Costs
Housing Price
Consumer Price Deflator
Real Wage Rate
Composite Prices

Appendix B: RE/EE Industry Detail

Table B.1: RE/EE Industry Definitions

NAICS	NAICS Description	Detailed Description	Portion of Firms Engaged in RE/EE Work	Portion of Firms Engaged in RE/EE Work
113310	Logging	This industry comprises establishments primarily engaged in one or more of the following: (1) cutting timber; (2) cutting and transporting timber; and (3) producing wood chips in the field.	10-30%	100%
221119	Other Electric Power Generation	This U.S. industry comprises establishments primarily engaged in operating electric power generation facilities (except hydroelectric, fossil fuel, nuclear). These facilities convert other forms of energy, such as solar, wind, or tidal power, into electrical energy. The electric energy produced in these establishments is provided to electric power transmission systems or to electric power distribution systems.	ND	ND
237110	Drilling water wells (except water intake wells in oil and gas fields)	This industry comprises establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to water, sewer line, and related structures construction. All structures (including buildings) that are integral parts of water and sewer networks (e.g., storage tanks, pumping stations, water treatment plants, and sewage treatment plants) are included in this industry.	1-3%	100%
238160	Roofing Contractors	This industry comprises establishments primarily engaged in roofing. This industry also includes establishments treating roofs (i.e., spraying, painting, or coating) and installing skylights. The work performed may include new work, additions, alterations, maintenance, and repairs.	5-10%	20-40%
238220	Plumbing, Heating, AC Contractors	This industry comprises establishments primarily engaged in installing and servicing plumbing, heating, and air-conditioning equipment. Contractors in this industry may provide both parts and labor when performing work. The work performed may include new work, additions, alterations, maintenance, and repairs.	20-30%	10%

238310	Drywall and Insulation contractors	This industry comprises establishments primarily engaged in drywall, plaster work, and building insulation work. Plaster work includes applying plain or ornamental plaster, and installation of lath to receive plaster. The work performed may include new work, additions, alterations, maintenance, and repairs.	10-30%	20-40%
321911	Wood window & Door Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing window and door units, sash, window and doorframes, and doors from wood or wood clad with metal or plastics.	50-70%	50-70%
322226	Surface-Coated Paperboard Mfg	This U.S. industry comprises establishments primarily engaged in laminating, lining, or surface coating purchased paperboard to make other paperboard products.	ND	ND
325120	Hydrogen Mfg	This industry comprises establishments primarily engaged in manufacturing industrial organic and inorganic gases in compressed, liquid, and solid forms.	ND	ND
326150	Urethane and Other Foam Product (except Polystyrene) Mfg	This industry comprises establishments primarily engaged in manufacturing plastics foam products (except polystyrene).	50-70%	100%
327215	Glass Products Made From Purchased Glass	This U.S. industry comprises establishments primarily engaged in coating, laminating, tempering, or shaping purchased glass.	50-70%	50-70%
327993	Mineral Wool Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing mineral wool and mineral wool (i.e., fiberglass) insulation products made of such siliceous materials as rock, slag, and glass or combinations thereof.	100%	100%
332410	Power Boiler and Heat Exchanger Mfg	This industry comprises establishments primarily engaged in manufacturing power boilers and heat exchangers. Establishments in this industry may perform installation in addition to manufacturing power boilers and heat exchangers.	10-20%	50-70%
332420	Digesters, industrial-type, heavy gauge metal, Mfg	This industry comprises establishments primarily engaged in cutting, forming, and joining heavy gauge metal to manufacture tanks, vessels, and other containers.	5-10%	50%
332913	Faucets, plumbing, Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing metal and plastics plumbing fixture fittings and trim, such as faucets, flush valves, and showerheads.	50-70%	100%

333319	Ovens, commercial-type, Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing commercial and service industry equipment (except automatic vending machines, commercial laundry, dry cleaning and pressing machines, office machinery, optical instruments and lenses, and photographic and photocopying equipment).	10-30%	100%
333411	Air Purification Equipment Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing stationary air purification equipment, such as industrial dust and fume collection equipment, electrostatic precipitation equipment, warm air furnace filters, air washers, and other dust collection equipment.	50-70%	50-70%
333412	Attic fan manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing attic fans and industrial and commercial fans and blowers, such as commercial exhaust fans and commercial ventilating fans.	ND	ND
333414	Heating equipment, hot water, (except hot water heaters) Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing heating equipment (except electric and warm air furnaces), such as heating boilers, heating stoves, floor and wall furnaces, and wall and baseboard heating units.	50-70%	50-70%
333415	Heat pumps manuf. + Heating & air conditioning combo units Mfg	This U.S. industry comprises establishments primarily engaged in (1) manufacturing air-conditioning (except motor vehicle) and warm air furnace equipment and/or (2) manufacturing commercial and industrial refrigeration and freezer equipment.	50-70%	50-70%
333611	Turbine& Turbine Generator Set Units Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing turbines (except aircraft); and complete turbine generator set units, such as steam, hydraulic, gas, and wind.	5-10%	100%
333612	Speed Changer, Industrial	This U.S. industry comprises establishments primarily engaged in manufacturing gears, speed changers, and industrial high-speed drives (except hydrostatic).	ND	ND
333613	Power Transmission Equipment	This U.S. industry comprises establishments primarily engaged in manufacturing mechanical power transmission equipment (except motor vehicle and aircraft), such as plain bearings, clutches (except motor vehicle and electromagnetic industrial control), couplings, joints, and drive chains.	5-10%	20%

334413	Semiconductor and Related Device Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing semiconductors and related solid state devices. Examples of products made by these establishments are integrated circuits, memory chips, microprocessors, diodes, transistors, solar cells and other optoelectronic devices.	5-10%	100%
334418	Printed circuits and electronics assemblies	This U.S. industry comprises establishments primarily engaged in loading components onto printed circuit boards or who manufacture and ship loaded printed circuit boards. Also known as printed circuit assemblies, electronics assemblies, or modules, these products are printed circuit boards that have some or all of the semiconductor and electronic components inserted or mounted and are inputs to a wide variety of electronic systems and devices.	1-5%	10%
334511	Cabin environment indicators, transmitters, and sensors Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing search, detection, navigation, guidance, aeronautical, and nautical systems and instruments. Examples of products made by these establishments are aircraft instruments (except engine), flight recorders, navigational instruments and systems, radar systems and equipment, and sonar systems and equipment.	1-5%	70%
334512	Temperature controls, automatic, residential and commercial-types, manufacturing + Building services monitoring controls, automatic, Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing automatic controls and regulators for applications, such as heating, air-conditioning, refrigeration and appliances.	50-70%	100%
335110	Electric Lamp Bulb/Parts Mfg	This industry comprises establishments primarily engaged in manufacturing electric light bulbs and tubes, and parts and components (except glass blanks for electric light bulbs).	50-70%	100%
335211	Bath fans with integral lighting fixture, residential, Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing small electric appliances and electric house wares for heating, cooking, and other purposes, and electric household-type fans (except attic fans).	ND	ND

335221	Household Cooking Appliance Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing household-type electric and nonelectric cooking equipment (except small electric appliances and electric house wares).	ND	ND
335222	Household Refrigerator and Home Freezer Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing household-type refrigerators and upright and chest freezers.	ND	ND
335224	Household Laundry Equipment Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing household-type laundry equipment.	ND	ND
335228	Dishwashers, household-type, Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing electric and nonelectric major household-type appliances (except cooking equipment, refrigerators, upright and chest freezers, and household-type laundry equipment).	ND	ND
335312	Motors and Generators	This U.S. industry comprises establishments primarily engaged in manufacturing electric motors (except internal combustion engine starting motors), power generators (except battery charging alternators for internal combustion engines), and motor generator sets (except turbine generator set units). This industry includes establishments rewinding armatures on a factory basis.	1-5%	50%
335314	Relay and Industrial Control Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing relays, motor starters and controllers, and other industrial controls and control accessories.	5-10%	50%
335911	Alkaline cell storage batteries (i.e., nickel-cadmium, nickel-iron, silver oxide-zinc) Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing storage batteries.	ND	ND
335912	Alkaline cell primary batteries Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing wet or dry primary batteries.	ND	ND

335999	All Other Miscellaneous Electrical Equipment and Component Mfg	This U.S. industry comprises establishments primarily engaged in manufacturing industrial and commercial electric apparatus and other equipment (except lighting equipment, household appliances, transformers, motors, generators, switchgear, relays, industrial controls, batteries, communication and energy wire and cable, wiring devices, and carbon and graphite products). This industry includes power converters (i.e., AC to DC and DC to AC), power supplies, surge suppressors, and similar equipment for industrial-type and consumer-type equipment.	70-80%	100%
423330	Insulation materials (except wood) merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of nonwood roofing and nonwood siding and insulation materials.	100%	10%
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of computers, computer peripheral equipment, loaded computer boards, and/or computer software.	5-10%	10%
423440	Ovens, commercial-type, merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of commercial and related machines and equipment (except photographic equipment and supplies; office equipment; and computers and computer peripheral equipment and software) generally used in restaurants and stores.	20-30%	100%
423610	Batteries (except automotive) merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of electrical construction materials; wiring supplies; electric light fixtures; light bulbs; and/or electrical power equipment for the generation, transmission, distribution, or control of electric energy.	5-10%	50%
423620	Fans, household-type, merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of household-type electrical appliances, room air-conditioners, gas and electric clothes dryers, and/or household-type audio or video equipment.	50-70%	50-70%

423720	Heating boilers, steam and hot water, merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of plumbing equipment, hydronic heating equipment, household-type gas appliances (except gas clothes dryers), and/or supplies.	10-20%	100%
423730	Heat pumps merchant wholesalers + Heating equipment, warm air (i.e., forced air) merchant wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of warm air heating and air-conditioning equipment and supplies.	10-20%	50%
443111	Appliance stores, household-type	This U.S. industry comprises establishments known as appliance stores primarily engaged in retailing an array of new household appliances, such as refrigerators, dishwashers, ovens, irons, coffeemakers, hair dryers, electric razors, room air-conditioners, microwave ovens, sewing machines, and vacuum cleaners, or retailing new appliances in combination with appliance repair services.	50-70%	100%
444190	Ceiling fan stores	This industry comprises establishments (except those known as home centers, paint and wallpaper stores, and hardware stores) primarily engaged in retailing specialized lines of new building materials, such as lumber, fencing, glass, doors, plumbing fixtures and supplies, electrical supplies, prefabricated buildings and kits, and kitchen and bath cabinets and countertops to be installed.	5-10%	5-10%
453310	Appliance stores, household-type, used	This industry comprises establishments primarily engaged in retailing used merchandise, antiques, and secondhand goods (except motor vehicles, such as automobiles, RVs, motorcycles, and boats; motor vehicle parts; tires; and mobile homes).	1-5%	5-10%
541690	Other Scientific and Technical Consulting Services	This industry comprises establishments primarily engaged in providing advice and assistance to businesses and other organizations on scientific and technical issues (except environmental).	10-20%	50-70%
562119	Other Waste Collection	This U.S. industry comprises establishments primarily engaged in collecting and/or hauling waste (except nonhazardous solid waste and hazardous waste) within a local area. Establishments engaged in brush or rubble removal services are included in this industry.	10-30%	50-70%

562213	Combustors, nonhazardous solid waste	This U.S. industry comprises establishments primarily engaged in operating combustors and incinerators for the disposal of nonhazardous solid waste. These establishments may produce byproducts, such as electricity and steam.	50-70%	50-70%

Appendix C: Review of Literature

Below, we review several reports and studies that analyze the economic and employment impact of clean energy utilization in the United States and Europe. Most of these reports conclude that expanding the use of clean energy is not only good for energy self-sufficiency and the environment, but such use has a significant, positive impact on employment. These studies typically use two methods to derive employment figures from the clean energy growth: (a) input-output models (I-O model) of the economy, and (b) simple spread sheet-based analytical models.[22] Each method has its advantages and disadvantages. The major advantage of I-O models is that they use direct employment as the driver for indirect jobs created by the clean-energy sector. Direct employment includes jobs created in the manufacturing, delivery, installation, project management, operation and maintenance of the different components of clean energy technology industries. The indirect jobs are induced through multiplier effects of the industry under consideration. I-O models capture multiplier effects, as well as the economic impact of spending by workers in new jobs. In addition, I-O models capture the macroeconomic impact of the shift between different sectors of the economy; for example, losses in one sector (fossil fuel sector) of the economy created by the growth of another sector (clean energy sector). However, the major disadvantage of input-output models is that they make several assumptions in order to reach a high level of aggregation.

The simple spreadsheet analytical models primarily calculate the direct jobs, ignore the employment multiplier effects and likely underreport overall employment impacts. However, the simple analytical spreadsheet models are easy to apply and mainly focus on the employment data obtained from detailed surveys of the clean energy sector. We provide a summary of these studies below.

[22] "Putting Renewables to work: how many jobs can the clean energy industry generate," by Daniel M. Kammen, Kamal Kapadia and Matthias Fripp (2006), available at rael.berkeley.edu.

The Apollo Project

The Apollo job report "New Energy for America" (2004) used the input-output methodology to calculate the employment impact of clean-energy firms.[23] It presents a scenario using a $300 billion federal investment spent over 10 years on four categories including increasing energy diversity, investing in industries in the future, promoting high performance buildings and rebuilding public infrastructure. The major finding of this report is that renewable energy creates more jobs than other sources of energy usage, four times as many jobs per megawatt of installed capacity as natural gas and 40% more jobs per dollar invested than coal. Increasing incentives for energy efficiency creates new construction, investment and jobs. Energy-efficiency work is far more labor intensive than power generation, creating 21.5 jobs for every $1 million invested.

The other important findings from this study are:

1. Clean energy will add more than 3.3 million jobs to the U.S. economy.
2. Clean energy will stimulate $1.4 trillion in new GDP.
3. Clean energy will repay the $300 billion federal cost of the project, through $306.8 billion in increased federal tax revenue from increased earnings, during the 10-year period of its implementation.
4. Clean energy will produce $284 billion in net energy cost savings.

The World Wide Fund for Nature report "Clean Energy: Jobs for America's future" (2001) analyzes the employment, macroeconomic, energy and environment effect of clean energy policies using WWF's Climate Protection Scenario.[24] This scenario includes a variety of policy measures in the construction and manufacturing, electricity generation and transport sectors. The building protection scenario includes building codes, appliances and equipment standards, tax credits, public benefit fund, research and development, voluntary measures, and cogeneration for industrial and district energy. The electricity generation sector includes Renewable Portfolio Standard (RPS), carbon cap and trade, whereas the

[23] "New Energy for America," The Apollo Job report: Good Jobs & Energy Independence, Jointly produced by the Institute for America's Future & the Center on Wisconsin Strategy with Perryman Group, Waco TX, (2004). Available at www.apolloalliance.org

[24] "Clean Energy: jobs for America's future," Research report prepared for World Wide Fund by Tellus Institute and MRG Associates. Downloaded from www.worldwildlife.org.

transport sector includes automobile efficiency standards improvement, promotion of efficiency improvement, greenhouse gas standards for motor fuels, travel demand reductions and speed rail. The study used IMPLAN I-O model and found that clean-energy policies create jobs under WWF's Climate Protection Scenario. The study summarized that if Congress were to implement the policies outlined in WWF's climate protection scenario, the U.S. could reap the following benefits:

1. A net annual employment increase of over 700,000 jobs in 2010, rising to approximately 1.3 million jobs in 2020.
2. An 8.5% decline in carbon emissions between 2000 and 2010.
3. Twenty percent of the electricity generation needed in 2020 could come from wind, solar, biomass and geothermal energy.
4. Overall dependence on fossil fuels would decline more than 15 percent between 2000 and 2020.

The research study "Job Jolt: The Economic Impact of Repowering the Midwest: The clean energy development plan for the Heartland" (2001) concluded that clean energy leads to more jobs and repowers the Midwest's clean energy development plan that promotes modern energy-efficient technologies and the development of renewable energy resources especially wind power and biomass energy.[25] The report highlights that energy-efficient technologies and renewable energy development across the Midwest and Great Plains can create a large number of jobs. The study uses the regional econometric input output model developed by Regional Economic Application Laboratory (REAL), a nationally-renowned research center at the University of Illinois, to determine the economic impact of implementing clean energy development. This model tracks employment, income and output data across 53 industrial sectors factoring in 13 demand variables (consumption, investment, and government expenditure among others) and eight demographic variables (e.g., age, sex, and migration). We summarize the major findings below:

1. The Midwest Clean Energy plan will generate as many as 84,000 jobs by 2010. These jobs will generate local direct and indirect income of up to $1.8 billion by 2010.

[25] "Job Jolt, the Economic Impact of Repowering the Midwest: The Clean Energy development plan for Heartland," Research report prepared by Regional Economics Applications Laboratory (2001). Available at www.repowermidwest.org

2. Many of the largest beneficiaries of clean energy are manufacturers already located in the Midwest.

3. The job gain and economic growth greatly outweigh the projected loss of jobs and income in the Midwest electric utility industry caused by reducing the demand for power from coal and nuclear plants.

4. Highly-industrialized states such as Illinois, Indiana, Michigan and Ohio achieve the most substantial job gains from the increased use of clean energy technologies.

5. There are no tradeoffs between the environmental and public health benefits from clean energy technology and economic impact. Clean energy is a win-win for both the environment and the economy.

The research report "A blueprint to achieve 12% of the world's electricity from wind power by 2020" uses data on wind and employment by the Danish Turbine Manufactures Association (DWTMA).[26] The study breaks down manufacturing activities into different sectors: metalwork, electronics, etc. and adds together individual employment contributions. Results cover three areas including direct and indirect employment from wind turbine manufacture, the direct and indirect employment effects of installing wind turbines and the global employment effects of the Danish wind turbine industry's export business. The study calculates the employment effect of the 12% global wind energy scenario. For OECD-North America this means 310,000 MW of wind power installed by 2020; for the U.S. alone the program creates 250,000 MW. The report mentions that prospects of clean energy uptake in the U.S. are very bright. Supportive policies by states would help create a growing market for wind energy. Several states have passed legislation to increase the share of renewable sources in their utilities generation mix. However, the absence of a stable, national policy on wind power is a major constraint on the American wind energy.

The CALPIRG Institute report "Renewables work: Job growth from renewable energy development in California" (2002) highlighted the importance of renewable energy in

[26] Wind force 12 "A blueprint to achieve 12% of the world's electricity from wind power by 2020" Greenpeace/ European Wind Energy Association (2003) available at www.ewea.org.

California.[27] The study concludes that generating electricity from renewable energy provides more jobs than traditional energy sources in California. The study collected data from renewable energy industry and natural gas utilities on direct and indirect jobs, and using a simple analytical model, estimated that building 5900 MW of renewable energy capacity would lead to the equivalent of 28,000 year-long construction jobs and 3,000 permanent operations and main jobs. The study finds that wind and solar photovoltaic (PV) create 40% more jobs per dollar of investment than coal.

The research report by the Renewable Energy Policy Project "Putting Renewables to work: how many jobs can the clean energy industry generate" (2001) is another important attempt to measure the employment generated by renewable energy technologies (see footnote 22). The report estimates the total hours required for manufacturing, installing and servicing wind power and solar photovoltaic (PV) systems. For biomass, it estimates the hours needed to collect, transport and process biomass to fuel a portion of a power plant primarily fueled by coal. The study used extensive surveys of firms and finds that on an energy capacity basis, photovoltaic employs the most workers among the renewable sectors examined in this report followed by wind and biomass. However, the study does not calculate employment multiplier effects.

The research study by the University of California Berkeley, "Putting renewables to work: How many jobs can the clean energy industry generate" (2006) estimated a broad range of scenarios for renewable energy and concludes that the renewable energy sector generates more jobs than fossil-based energy sector per unit of energy (see footnote 22). The study finds that the employment rate in fossil-related industries has been declining. It shows that supporting renewable sources with a comprehensive energy policy that supports energy efficiency and sustainable transportation will be effective for employment generation. The study emphasizes the importance of generating local employment through local sustainable energy technologies and developing a renewable energy industry for export. This will make the renewable energy sector internationally competitive. The report concludes that transitioning from a fossil fuel-based economy to a renewably powered one will spur economic growth and provide more employment opportunities. The report suggested a

[27] "Renewables work: Job growth from renewable energy development in California," report prepared by Brad Heavner and Susannah Churchill for the CALPIRG (California Public Interest Research Group) (2002) available at www.policyarchive.org.

number of policy implications for clean energy technology; for example, a commitment to purchase green products and services from local providers, tax incentives and rebates for green buildings and infrastructure policies to support green manufacturing companies.

The literature review shows that clean energy technology is not only good for energy self-sufficiency but has a significant positive effect on employment. The studies employ a wide range of methods and analyze the economic and employment impacts of clean energy in the United States and Europe. These studies show that the greater use of clean energy technologies provides economic benefits through investment in innovation and new job creation. The literature shows that the renewable energy sector generates more jobs per megawatt of power installed per unit of energy produced and per dollar of investment then the fossil-based energy sector. Most of the studies on clean energy technology conclude that policies such as energy efficiency, green building standards and sustainable transportation greatly enhance net positive impacts on the economy, employment and the environment.

It is important for Connecticut to utilize its clean energy technology sources. We designed this study to cover the important aspects of clean energy technology in Connecticut and its purpose is twofold. First, we highlight the economic importance of clean energy technologies for Connecticut and neighboring Northeast states. We provide a preliminary assessment of the potential for clean energy technology in Connecticut and an overview of the clean energy policies in the New England states. Second, we present above the economic impact of the RE/EE industry sector on Connecticut and provide the number of jobs that may be directly and indirectly attributable to the existence of this industry group in Connecticut.

Clean Energy and the New England States

Each New England state is implementing strategies to promote clean energy policies by addressing the problem of climate change and developing incentive programs to promote clean energy use and green jobs. We examine below clean energy policies in each New England state.

1. Connecticut Clean Energy Policies:

Connecticut has been awarded a "Gold Star" standard along with California, New Jersey, New York, Oregon, Rhode Island and Washington.[28] "Gold Star" states are those states that continue to innovate by looking for new opportunities to reduce energy use, strengthen building codes and appliance standards, promote renewable energy and lower global warming emissions from cars. Connecticut's "Gold star" standard award applies in four categories including the Renewable Energy Portfolio Standard, clean car program, energy efficiency program and appliance efficiency program. The Renewable Energy Portfolio (RPS) is a public policy designed to increase the use of renewable energy resources. It requires that states should increase their use of clean renewable energy from wind, sun, crops and other sources. In addition, it requires a specific percentage of electricity sold to retail customers come from renewable energy resources. Connecticut established the RPS in 1998 and requires each electric supplier and electricity distribution company to demonstrate that no less than 5% of its total output or services originate from qualifying renewable energy resources by January 1, 2006. This requirement will increase to 23% by 2020.

Separate Renewable Portfolios Standards are required for energy sources classified as "Class I", "Class II" or "Class III".[29] Class I sources include solar, wind, new sustainable biomass (no construction and demolition debris), landfill gas, fuel cells, ocean thermal power, wave or tidal power, and run-of-river hydropower facilities with a maximum capacity of five megawatts (MW).

Class II sources include trash-to-energy facilities, biomass facilities not included in class I, and older hydropower facilities under 5MW. Class III sources include customer-sited combined heat and power (CHP) systems with a minimum operating efficiency of 50% installed at commercial or industrial facilities on or after January 1, 2006. Electricity savings created at commercial and industrial facilities from the conversion and load management program began on or after January 1, 2006. These RPS policies intend to influence the demand in the market place for electricity generated from renewable energy. They

[28] "America's Clean energy Stars: State Actions leading America to a New Energy Future," a research report prepared by Environment America Research & Policy Center (2007). Downloaded from www.environmentamerica.org .
[29] DSIRE: Database of State Incentives for Renewables & Efficiency. Downloaded from www.dsireusa.org.

encourage Connecticut to develop new renewable energy resources and to maintain existing ones.

Connecticut adopted a clean car program (see footnote 28) that sets a tailpipe emissions standard for global warming pollutants for cars and light trucks, requires the sale of advanced-technology vehicles, and reduces emissions of smog-forming pollutants for cars and light-duty vehicles. Connecticut along with California, Massachusetts, Maryland, Maine, New Jersey, New York, Oregon, Rhode Island, and Vermont has adopted a clean car program. Connecticut is allocating more than 2% of electric utility revenue to energy efficiency programs and incorporating energy efficiency in the Renewable Energy Portfolio (RPS). Connecticut is among 12 states in the country that have adopted mandatory minimum energy-efficiency standards for residential and commercial appliances.

Connecticut established the Connecticut Clean Energy Fund (CCEF) in 1998 to provide continuous support for clean energy technologies. The CCEF supports community programs for clean energy and provides clean energy funding. The CCEF community-supported programs include the distribution of educational materials, renewable energy exhibits and programs to increase public awareness about clean energy. Clean energy funding includes financial and developmental assistance; for example, solar PV rebates, long-term contracts, the solar release program, and others. CCEF funding arises from a surcharge on Connecticut ratepayer's utility bills. Connecticut Innovations, Inc. administers the CCEF, which provides strategic capital and operational insight to promote energy, biotechnology and photonics' industry growth. Connecticut Innovations is undertaking statewide efforts to provide state residents with clean energy alternatives through CCEF. The Connecticut Clean Energy Fund has begun to implement public education and marketing campaigns for renewable energy. The program, called the 'smart power project', aims to motivate electricity customers to purchase renewable energy. It is the first publicly funded, large-scale, renewable energy education and marketing effort in the nation. The smart power project is an innovative, multiparty coalition that brings together community and faith-based organizations, business leaders and institutions to help improve Connecticut air quality through renewable energy purchases.

Connecticut educational institutions are taking particular interest in promoting clean energy options. For example, the Institute for Sustainable Development at Eastern

Connecticut State University focuses on matters relating to energy education, energy policy, energy efficiency and renewable energy. Similarly, the Connecticut College Renewable Energy Club (REC) meets weekly to find ways to reduce energy consumption through renewable technologies. The People's Action for Clean Energy (PACE) is a group of volunteer organizations promoting energy efficiency and conservation in Connecticut. The University of Connecticut (UConn) formed the Biofuel Consortium in 2005 as an interdisciplinary team to advance the UConn biodiesel research initiative for the greater good of the environment, and to help gain national energy independence.[30]

In June 2008, Connecticut Governor M. Jodi Rell signed a bill that requires the state to reduce its greenhouse gas emissions to 10% below 1990 levels by 2020 and by 80% below 2001 levels by 2050. Connecticut is part of the Regional Greenhouse Gas Initiative (RGGI)[31] that is establishing a cap and trade program for GHG emissions for much of the Northeast. The transition to clean energy technologies will help Connecticut to achieve these goals.

Connecticut has the distinction of being the only New England state to house more than one nuclear reactor. Both of these clean and safe nuclear reactors are located at the Millstone plant and generate half of Connecticut's electricity.

2. Massachusetts Clean Energy Policies:

Massachusetts is among the world leaders in renewable energy technologies. The state is characterized by its emerging "clean energy industry cluster" with world-class universities and entrepreneurial expertise in clean energy technologies. Massachusetts has a competitive advantage in clean energy technologies.[32] For example, the Massachusetts photovoltaic sector accounts for more than one third of U.S. production. However, Massachusetts like Connecticut has not fully tapped its wind sector potential. In other areas such as fuel cells, bio energy, hydro and ocean power, Massachusetts is trying to harness its resources. Massachusetts is poised to develop as a clean energy leader due to its technology base, entrepreneurial talent, access to capital and proactive environmental policy.

[30] See http://biodiesel.engr.uconn.edu/aboutus.html.
[31] See www.rggi.org.
[32] "Energy Efficiency, Renewable Energy and Jobs in Massachusetts," research report prepared by Massachusetts Technology Renewable Energy Trust (2007). Downloaded from www.masstech.org.

Massachusetts was the first state in New England to sign the Renewable Energy Portfolio Standards (RPS). The qualifying resources under Renewable Energy Portfolio include solar, wind, hydropower under 30 MW, geothermal, ocean thermal, biomass including landfill methane, biogas and bio-diesel, biomass co-firing and fuel cells. Massachusetts offers a personal income tax deduction for income received from the sale of a patent or royalty deemed beneficial for energy conservation or alternative energy development. The Massachusetts Technology Collaborative (MTC) is the state administrator of renewable energy programs and offers loans to support renewable energy.

The Massachusetts Renewable Energy Trust Fund, established in 1997, operates programs in four categories including a clean energy program, green buildings, and industry and investment policies. The Massachusetts Technology Collaborative (MTC) administers the Fund. Thus far, the clean energy policies have been highly successful in Massachusetts.

3. New Hampshire Clean Energy Policies:

New Hampshire is the only New England state that does not have a Renewable Portfolio Standards (RPS).[33] However, New Hampshire allows other incentives to increase the use of clean energy technology. New Hampshire allows cities and towns to offer an exemption from residential taxes in the amount of assessed value of a renewable energy system on the property value. The New Hampshire Electric CO-OP provides incentives for its residential members to increase the efficiency of their homes through several rebate programs. The New Hampshire Business Resource Center offers renewable-energy and energy-efficiency business loans. Although New Hampshire has not established a renewable energy fund, the state has a system benefit charge of $0.003 per KWH that generates $35 million annually through which the state is making a significant investment in energy efficiency.

[33] "Economic Impact of a New Hampshire Renewable Portfolio Standards," Research report prepared by Ross Gittel and Matt Magnusson (2007). Downloaded from www.policyresearch.darmouth.edu.

4. Rhode Island Clean Energy Policies:

Created in 2002, the Rhode Island State Energy Office (RISEO) administers the Rhode Island Renewable Energy Fund (RIREF). The programs under this fund manifest in three key areas including education and outreach, renewable energy funding and support of the voluntary renewable energy markets. Rhode Island law allows cities and towns to exempt renewable energy system from property taxation. Certain renewable energy systems and equipment sold in Rhode Island are exempt from the state sales tax. These products include solar electronic systems, solar thermal system, geothermal heat pumps and wind turbines and towers (see footnote 22).

5. Vermont Clean Energy Policies:

Vermont is a national leader in biomass energy.[34] Vermont has the nation's most innovative and successful energy efficiency program. Vermont passed legislation in 2005 that established the Vermont Clean Energy Fund. This Fund seeks to promote the development and deployment of cost-effective and environmentally sustainable electric power resources. Unlike other clean energy development funds in New England, the Vermont Clean Energy Fund is funded by Entergy, an investor-owned electric utility operating in Vermont. The fund encourages Vermont utilities to secure long-term connections with Vermont renewable energy services. Vermont allows municipalities the option of offering an exemption from real and personal property taxes for certain renewable energy systems.

6. Maine Clean Energy Policies:[35]

Maine is a state rich in natural resources and it is paying particular attention to promote clean energy technologies. Maine started a program called "Clean Energy Maine" to introduce Mainers to clean electricity from renewable resources. Maine has the nation's strongest Renewable Energy Portfolio (RPS), requiring 30 percent of the state's electricity to come from renewable energy. Maine passed (RPS) legislation in 1999 that requires 30% of retail customers' load come from renewable energy. The qualifying resources include fuel

[34] See http://publicservice.vermont.gov/energy/ee_renewables.html.
[35] See http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=ME&RE=1&EE=1.

cells, tidal power, solar, wind, geothermal, hydroelectric, biomass and municipal solid waste in conjunction with recycling. Maine developed the Renewable Resource Matching Fund in 1998 that provides grants of up to $50,000 for each renewable energy project. This fund is supported through voluntary contributions allowing customers to support the clean energy market by making a contribution of $1, $2, or $10 or other on their monthly electricity bill. Maine has traditionally used hydroelectric and biomass power for clean energy generation and invests significantly in energy efficiency.

Policies to Promote Clean Energy Technology in Connecticut

By 2020, the Governor's Energy Vision intends that 20% of all energy used and sold in Connecticut will come from clean energy resources.[36] The Vision intends that by 2020, state fossil fuel consumption will be reduced by 20% and all commercial transportation fuel sold in the state will be required to include a mixture of 20% alternative fuels and a 20% reduction in electric peak consumption.

Connecticut has an incentive program to promote the construction of bio-fuel production and distribution facilities.[37] In addition, Connecticut requires all state and school construction projects to incorporate energy-efficient technology. Connecticut policy intends to eliminate the state sales tax and property tax on residential renewable energy projects. Further, Connecticut is allowing a sales tax exemption on weatherization products until June 2010. Connecticut is expanding the use of net metering for renewable energy sources such as wind and solar PV systems. The state is paying particular attention to energy efficiency programs; for example, the installation of efficient heating equipment and weatherization program. Connecticut requires all state building and school construction projects to use energy-efficient technologies and is providing a broad range of grants and low-interest loans to promote clean energy policies.

[36] "Connecticut's Energy Vision for a Cleaner, Green State," Governor Jodi Rell's Energy Plan (2006). Downloaded from http://apps1.eere.energy.gov.
[37] See http://www.ct.gov/governorrell/cwp/view.asp?A=3293&Q=428590 for a recent press release.