

# CT Renewable Energy / Energy Efficiency Economy Baseline Study

Phase 1 Deliverable: Full Report

March 27, 2009

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## Content of Report

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### **Assignment and Purpose**

The analysis herein was performed by Navigant Consulting, Inc. (NCI) under the direction of the Connecticut Clean Energy Fund (CCEF) and Connecticut Energy Efficiency Fund (CEEF). The goal of this part of our study – which is one part of a larger strategic assignment – was to estimate jobs, employment income, and revenue of renewable energy and energy efficiency companies operating in Connecticut.

### **Context and Limitations**

The work presented in this report represents NCI's best efforts based on the best information gathered by NCI and others at the time the report was prepared. NCI prepared this report from January through March 2009. It is important to acknowledge the uncommon economic environment during this period. Many companies were in a state of flux with some reorganizing their operations, others closing their operations and even some who were expanding their operations. Thus, the information presented in this report is from a snapshot in time.

### **Inquiries**

We encourage any questions or comments about this document. They should be addressed to Kim Stevenson, Manager, New Technologies, Connecticut Clean Energy Fund, 860-257-2890.

## Contributors

This study was conducted by Navigant Consulting Inc. (NCI) in collaboration with CCEF, CEEF, DECD and utilities CL&P and UI.



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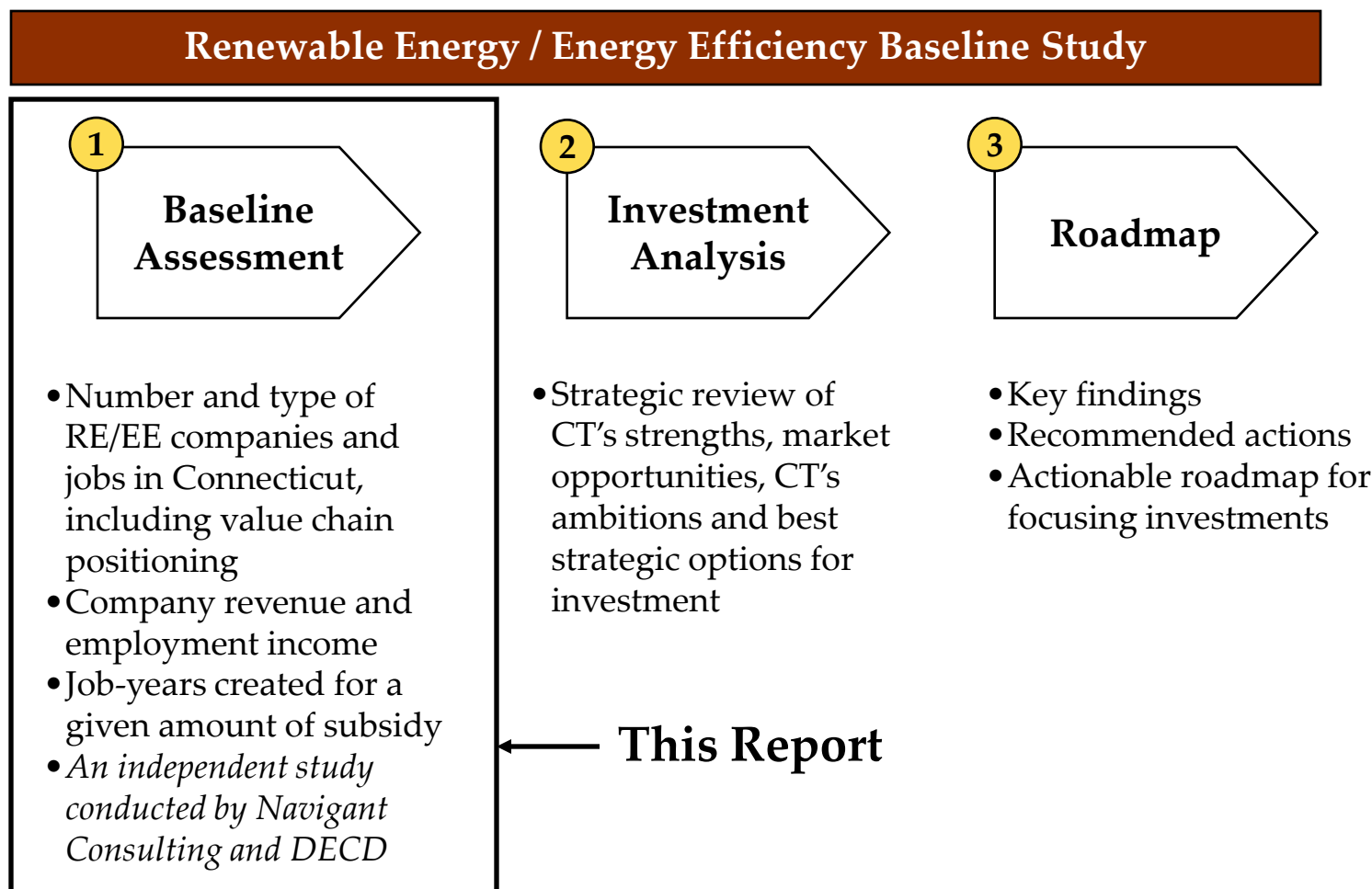
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**This report includes a baseline assessment of renewable energy (RE) and energy efficiency (EE) companies, jobs, revenue and employment income in Connecticut (CT).**

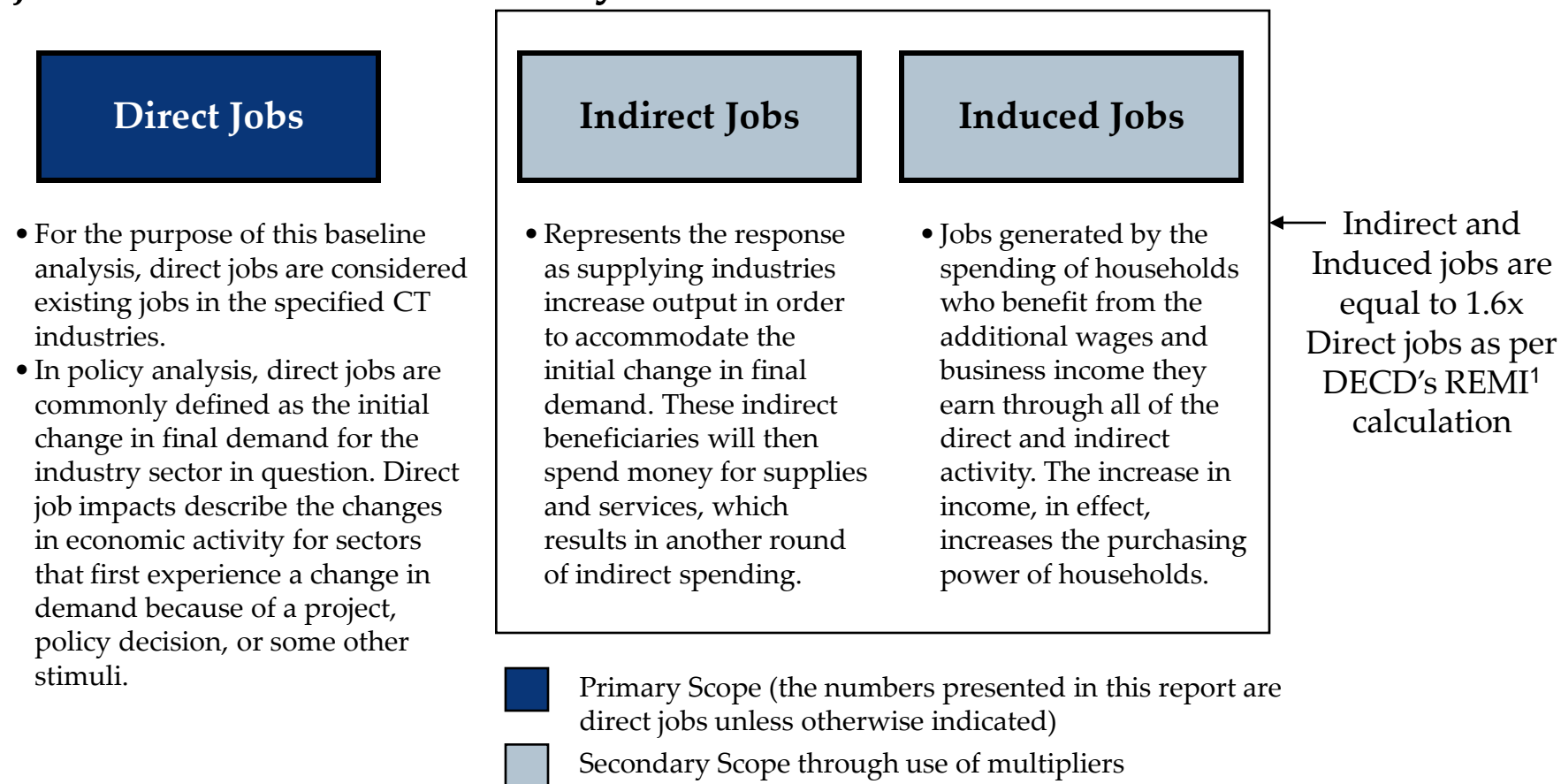
### Phase 1 Overview

- This report presents Phase 1 of a three-phase RE/EE Economy Baseline Study for the State of Connecticut. The purpose of the three-phase study is to identify effective ways to support and accelerate growth of the RE/EE industry in Connecticut, including a critical analysis that will guide effective investment strategies by the Connecticut Clean Energy Fund (CCEF).
- This study was commissioned by CCEF, working in partnership with Connecticut Energy Efficiency Fund (CEEF) and the Department of Economic and Community Development (DECD).
- Phase 1 of the study, included in this report, identifies the number of RE/EE companies in Connecticut, the number and types of RE/EE jobs, revenue and employment income generated by this sector.
- Findings for Phase 1 are drawn from interviews and follow-up conversations with executives and key stakeholders from companies and institutions in CT. Data was also provided by local utilities and industry associations, DECD and the Connecticut Department of Labor.

Phases 2 and 3 of this study are scheduled to be completed in Mid April and Mid May 2009, respectively.



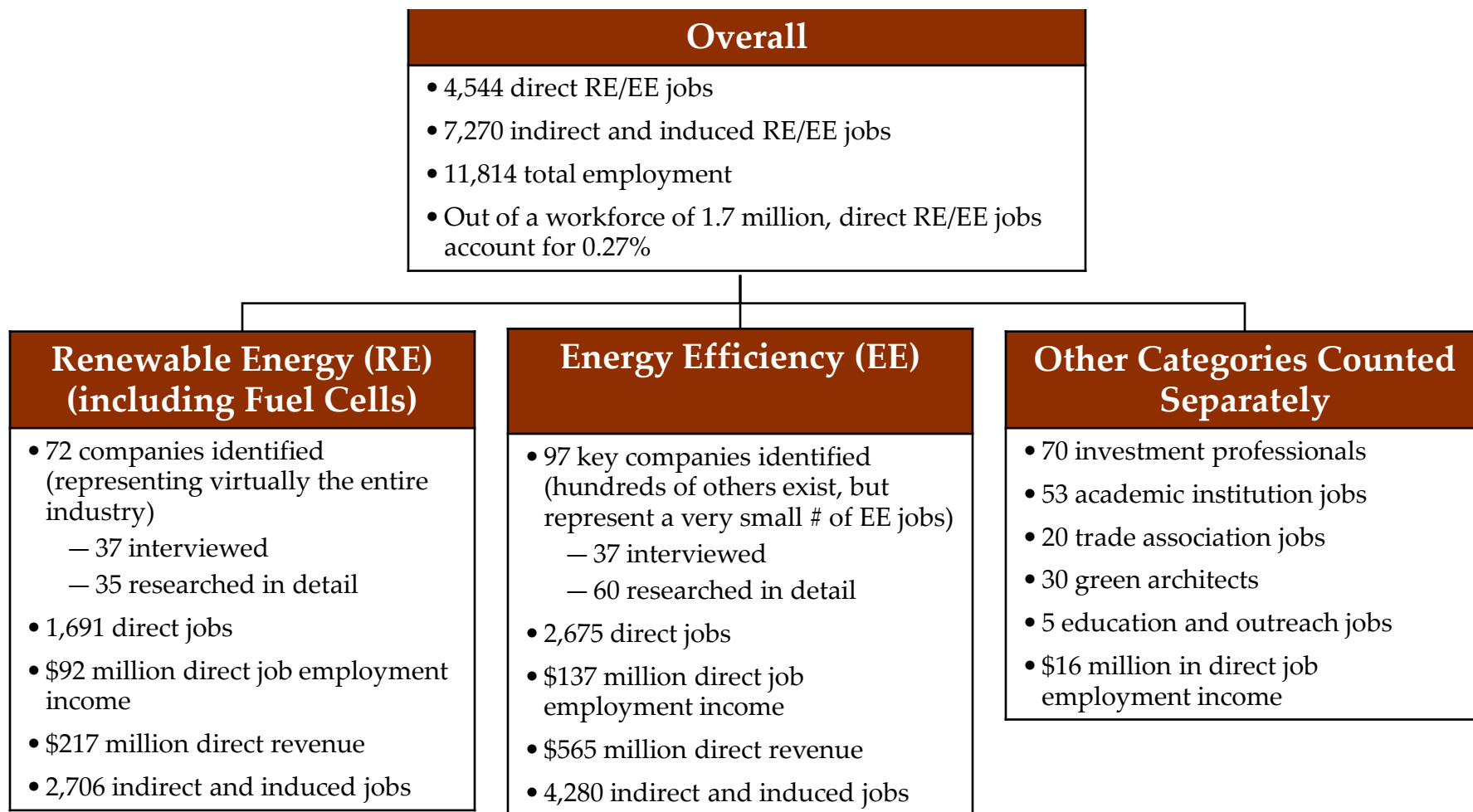
## The baseline assessment considers direct, indirect, and induced jobs in CT's RE/EE economy.



Source: S. Grover, "Energy, Economic, and Environmental Benefits of the Solar America Initiative", August 2007, NREL/SR-640-41998.

1. The REMI model is an analytical tool developed by Regional Economic Models, Inc.

**Overall, this analysis estimates CT has 4,544 direct jobs in the RE/EE sector, which is about 0.27% of the overall CT workforce of 1.7M.**



## **NCI employed a “bottom-up” approach based on primary research.**

- Over 300 companies, institutions, and organizations were identified as active players in the renewable energy and energy efficiency economy.
  - 74 key RE/EE companies were interviewed
  - 95 additional key RE/EE companies were researched in detail
- Rigorous cross-checking was conducted using DECD resources, Navigant Consulting internal databases, and CT industry experts.
- All RE companies identified were analyzed.
- Key EE companies were identified and analyzed, with the overall market size estimated by extrapolation. Assumptions were verified with ECMB, Connecticut Light & Power, and United Illuminating.
- Analysis included only those jobs specific to RE or EE, resulting in lower overall numbers relative to studies that tally by industry code (e.g., while other analyses might include all HVAC installers, we include only those specializing in EE.)

**This comprehensive and detailed analysis presents a snapshot of the RE/EE economy during a difficult economic recession.**

**DECD simultaneously employed a “top down” approach to build an economic model of RE/EE impact. The NCI study and the DECD model were used to mutually complement and verify one another.**

### Key DECD Economic Modeling Activities

- Mutual comparison/validation of Connecticut RE/EE economic impact estimates
  - Revenue
  - Employment
- DECD used the REMI<sup>1</sup> model and data from the Connecticut Department of Labor.
- Navigant generated employment and revenue estimates based on direct interviews
- The Navigant estimate falls within the range of outcomes generated by the DECD modeling effort

1. The REMI model is a well-known economic analysis tool developed by Regional Economic Models Inc.

**The study focused on RE electricity generation and EE, and does not include biofuels or the transportation industry.**

**Renewable Energy**

Technology	Markets
<ul style="list-style-type: none"> <li>• Fuel Cells</li> <li>• Solar (PV &amp; Solar Hot Water)</li> <li>• Wind</li> <li>• Geothermal</li> <li>• Hydro (&lt; 5MW)</li> <li>• Hydrogen</li> <li>• Biomass</li> <li>• Storage</li> <li>• Power Grid Infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Residential</li> <li>• Commercial &amp; Industrial (C&amp;I)</li> <li>• Utility</li> <li>• Independent Power Producers</li> <li>• Government and Military</li> </ul>
<ul style="list-style-type: none"> <li>• Concentrating Solar Power, Tidal, Wave</li> </ul>	<ul style="list-style-type: none"> <li>• Transportation</li> </ul>

**Energy Efficiency**

Technology	Markets
<ul style="list-style-type: none"> <li>• High Efficiency Heating, Ventilation and Air Conditioning</li> <li>• Efficient Lighting</li> <li>• Efficient Home Appliances</li> <li>• Water Heating</li> <li>• Commercial Refrigeration</li> <li>• Pumps, motors and drives</li> <li>• Building Envelope</li> <li>• Demand Response</li> </ul>	<ul style="list-style-type: none"> <li>• Residential (including Low Income Weatherization)</li> <li>• Commercial &amp; Industrial (C&amp;I)</li> <li>• Small Business</li> <li>• Retail Products / Appliance Retirement</li> <li>• Government and Military</li> </ul>



Included



Excluded - limited relevance in CT or beyond scope

## The analysis specifically targets Connecticut-based jobs, and revenues generated by Connecticut companies.

Jobs
<ul style="list-style-type: none"><li>• Companies that employ people who are based in CT</li></ul>
<ul style="list-style-type: none"><li>• Companies with staff outside of CT that do work in CT</li></ul>



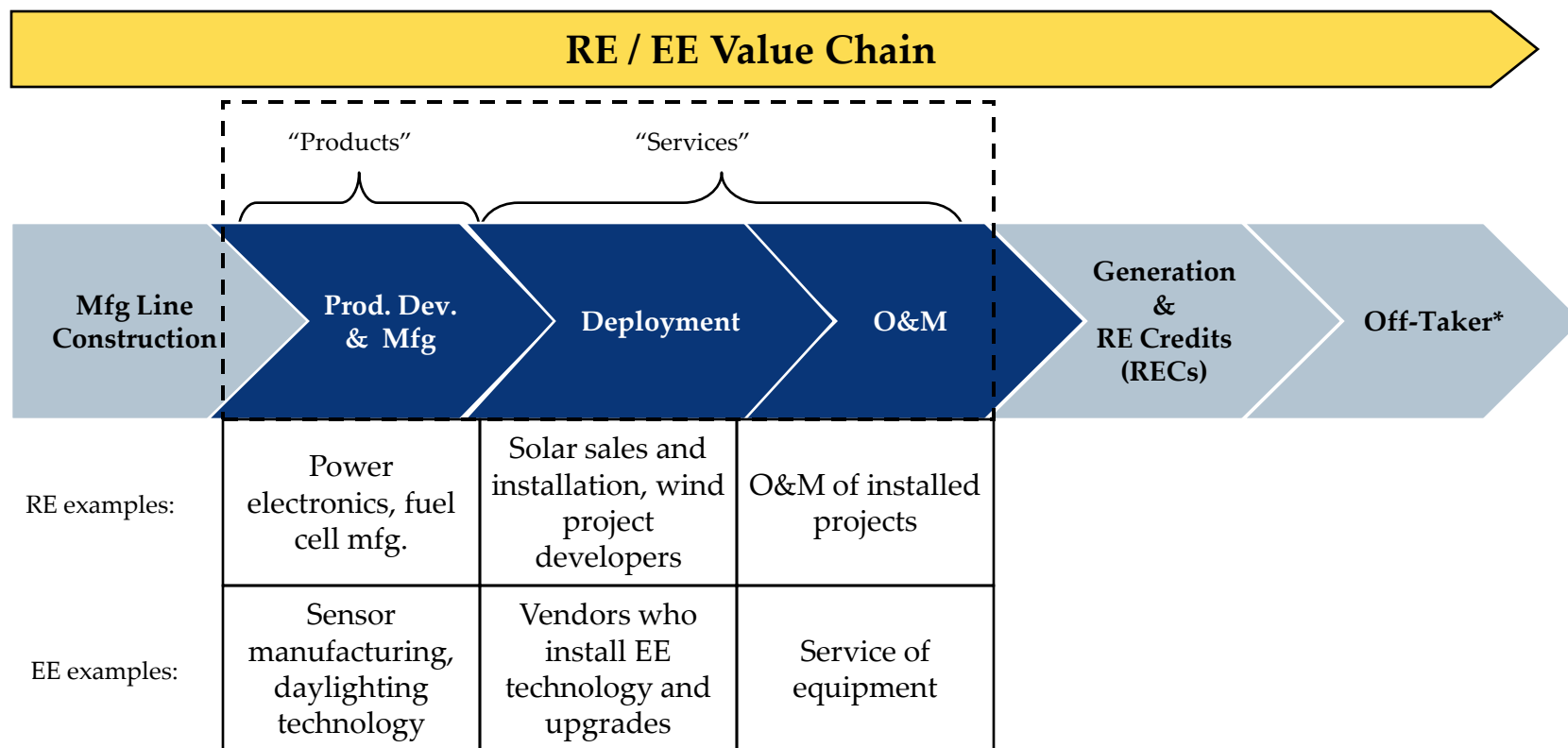
Included



Excluded. Does not directly build the CT RE/EE economy.

Revenues
<ul style="list-style-type: none"><li>• Revenue from products that are manufactured in CT and sold anywhere worldwide</li><li>• Project and/or operations and maintenance (O&amp;M ) revenue produced by CT-based companies</li><li>• Retail and wholesale suppliers</li></ul>
<ul style="list-style-type: none"><li>• Project and O&amp;M revenue from outside CT</li><li>• Revenue from products manufactured outside of CT</li><li>• Revenue from all component suppliers (i.e. “pass through” revenue)</li></ul>

**NCI focused on sections of the value chain where the majority of direct jobs are generated.**



- Included - the majority of direct jobs occur here
- Excluded - skills are generic and/or jobs are limited

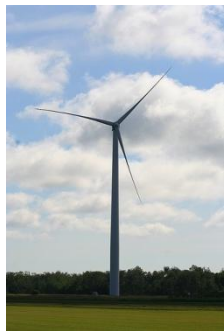
\*Note: An off-taker is an entity that purchases electricity or RECs from an independent power producer or marketer

# Examples of activity in the renewable energy and energy efficiency economy.

## Renewable Energy



Solar installation



Wind project development



Fuel cell research and manufacturing

## Energy Efficiency



Building envelope, residential new construction and retrofits



Appliance and lighting sales and install



Commercial and industrial energy efficiency contracting



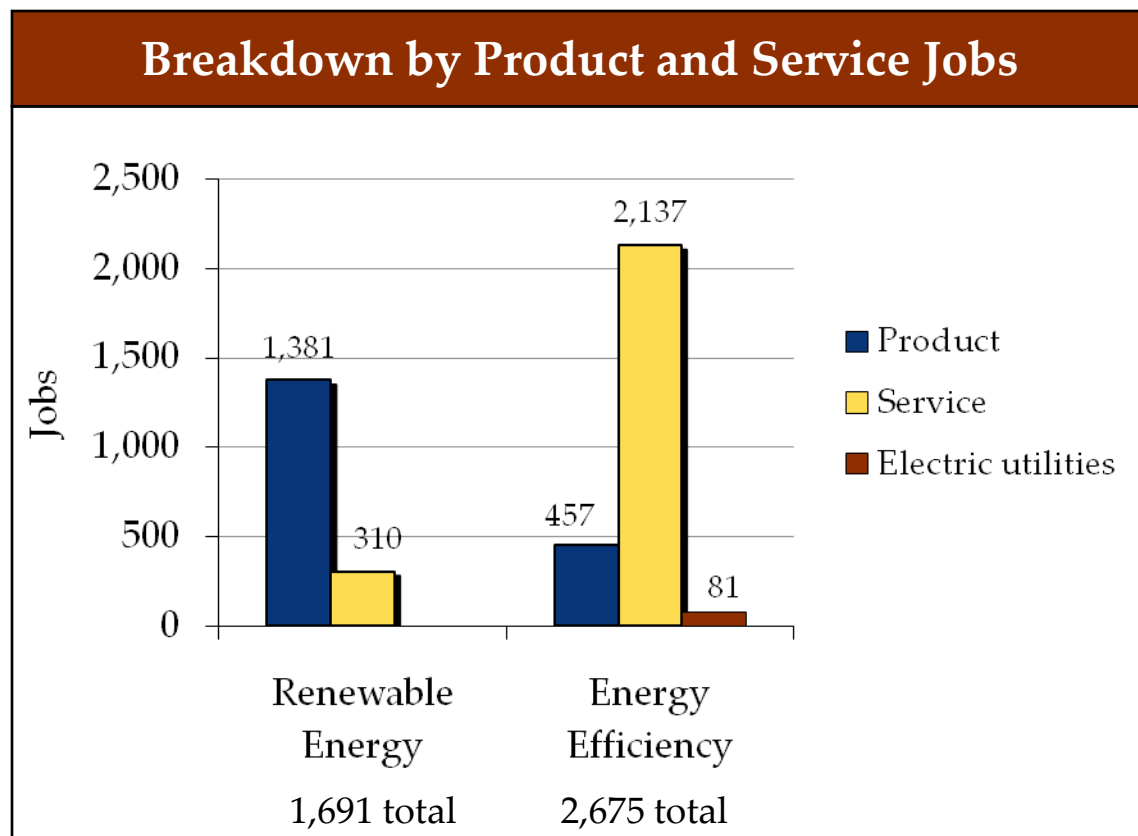
Weatherization

## A number of key findings emerged from our assessment of CT's current RE/EE economy.

### Key Findings

- **Significant growth potential** – The CT RE/EE economy today directly employs 4,544, or 0.27% of its total labor force (or 0.69% including indirect and induced jobs). The overall RE/EE economy is expanding globally, presenting substantial long term growth opportunities.
- **Industry undergoing significant tumult** – Although the RE/EE industry has significant upside potential, in the current economic downturn, many companies are going through a period of uncertainty and pain. Many companies interviewed were reorganizing operations and some were closing operations. Industries undergoing significant difficulty included fuel cells, solar and biomass. The reasons for this difficulty varied from loss of subsidy to overall economic conditions.
- **Top 10 employers accounted for roughly half of the RE / EE jobs and revenues** – The top ten RE / EE employers in Connecticut account for roughly half of the direct jobs and total revenues (46% and 43% respectively) as defined by this study.
- **Fuel cells aside, the CT RE / EE economy is mostly focused on services** – Fuel cells aside, about 80% of jobs are service jobs. There is limited RE/EE manufacturing in CT at present. Excluding the fuel cell companies, we counted less than fifteen RE/EE companies that manufacture in CT.
- **The dominant RE areas – fuel cells & solar – developed in CT due to strong subsidies** – Fuel cells & solar have been heavily subsidized and will remain dependent on subsidy for the foreseeable future.
- **Targeted subsidies create jobs** – Assuming average subsidies today, \$1 million in subsidy funds creates between 11-39 direct job-years (a job-year is one full-time equivalent working for one year) and is driven by the labor intensity of the jobs (vs. material intensity), depreciation burden, and job wage.

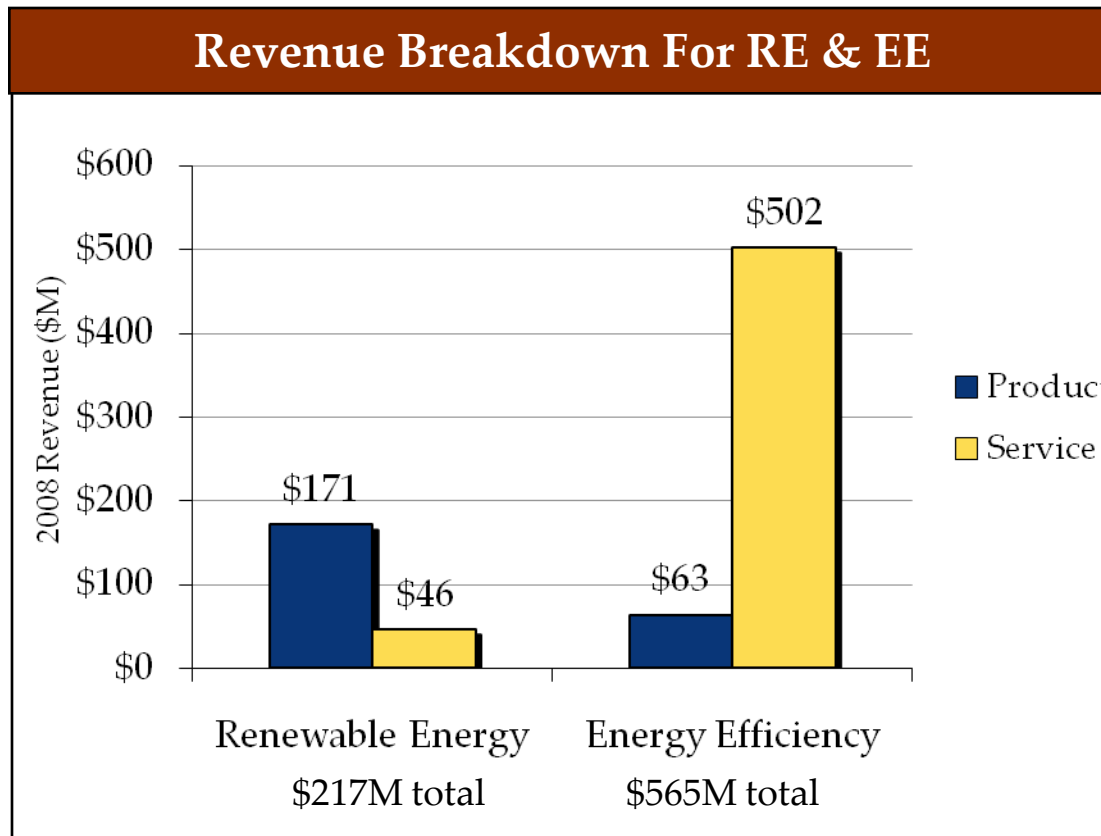
**Product jobs dominated in RE (82% of total RE jobs) while most jobs in EE were from service companies (80% of total EE jobs).**



- RE sector jobs are dominated by product companies, primarily in the fuel cell sector (1,200 jobs) and solar sector (80 jobs)
- RE services jobs are primarily solar (217 jobs out of 310 services jobs)
- EE sector is mostly service jobs (2,137 of total EE jobs)
  - EE installation, retail/wholesale, and management account for about 1,555 EE of total direct jobs

Note: The “Electric Utilities” category includes 81 utility EE program administration jobs within UI and CL&P.

**Connecticut RE industry revenues total ~\$217M. EE industry revenues total ~\$565M, most of which comes from project services.**



- Fuel cells account for \$165M of the total \$217M RE revenues. The majority of fuel cell revenue comes from R&D contracts and demonstration units, rather than commercial products.
- Solar is the next largest RE revenue category, accounting for \$44M.
- EE service companies account for \$502M, half of which (~48%) is from the large commercial and industrial (C&I) sector projects.
- EE product companies have a limited presence in CT and account for the remaining \$63M of total revenues.

**The top 10 RE / EE companies with the most employees in CT account for 46% of direct jobs and 43% of direct revenues in this study.**

### Top Ten RE / EE Employers

- United Technologies Corp. (UTC)
  - Carrier Building Services
  - UTC Power
  - Pratt Power
- FuelCell Energy, Inc.
- Sensor Switch
- Schuco USA
- US Insulation Corp.
- Home Depot
- Trane
- Noble Environmental Power
- Alliance Energy Solutions (AES)
- Wal-Mart

- 2,010 RE / EE jobs in CT (46% of total)
- \$337 million of CT-based RE / EE revenue within the scope of this study (43% of total)

## A \$1 million investment has a varying impact on job creation, depending on job type.

Job-Years Created Per \$1 Million Invested					
Occupation	Labor	Materials	Average Wage	Fully Burdened Employee Cost	Direct Job-yrs/ \$1M invested
<b>Renewable Energy</b>					
Fuel Cells – Mfg – Low Skilled	50%	50%	\$30,000	\$42,900	11.7
Fuel Cells – Mfg – High Skilled	50%	50%	\$50,000	\$71,500	7.0
Renewable Energy R&D	90%	10%	\$70,000	\$95,500	9.4
Solar Installation – Commercial	20%	80%	\$40,000	\$52,520	3.8
<b>Energy Efficiency</b>					
Residential	85%	15%	\$50,000	\$65,650	12.9
Small business	60%	40%	\$50,000	\$65,650	9.1
C&I (new construction/retrofit)	50%	50%	\$50,000	\$65,650	7.6
<i>EE Weighted Average</i>	60%	40%	\$50,000	\$65,650	9.1

- Job-yrs outcome depends on wages and % labor associated with the type of work.
- For example, with solar installations, 80% of the project cost is equipment and 20% is labor. When funds are invested, fewer jobs are created in comparison to other RE sectors, as they primarily flow to equipment suppliers and manufacturers.
- Lower wages and high labor % result in more job-yrs created.

Note: Assumed values have been based on consultation with CCEF, DECD, and ECMB

## Project subsidies leverage private funds, increasing the number of direct, indirect, and induced jobs created.

Job-Years Created Per \$1 Million Subsidy					
Occupation	Direct Job-yrs/ \$1M invested	Average Subsidy Today	Adjusted Direct Job-yrs/ \$1M subsidy	Indirect and Induced Jobs	Total Job-Yrs
<b>Renewable Energy</b>					
Fuel Cells – Mfg – Low Skilled	11.7	60%	19.4	31.1	50.5
Fuel Cells – Mfg – High Skilled	7.0	60%	11.7	18.6	30.3
Renewable Energy R&D	9.4	75%	12.6	20.1	32.7
Solar Installation – Commercial	3.8	35%	10.9	17.4	28.3
<b>Energy Efficiency</b>					
Residential	12.9	70%	18.5	29.6	48.1
Small business	9.1	60%	15.2	24.3	39.5
C&I (new construction/retrofit)	7.6	60%	12.7	20.3	33.0
<i>EE Weighted Average</i>	9.1	65%	14.1	22.6	36.7

- Lower wages associated with low skilled fuel cell manufacturing yields the highest job creation.
- The high labor percent associated with Residential EE yields high job numbers despite high subsidy.
- Indirect and induced jobs are calculated using an economic multiplier of 1.6.

Notes:

1. Assumed subsidy values were provided by CCEF and ECMB. DECD provided multiplier of 1.6 for indirect and induced jobs.
2. For fuel cell projects going forward, the project subsidy levels are 25% to 50%

**RE / EE markets will continue to be an excellent investment in the near term for Connecticut.**

### Why Is Investment in RE/EE Important?

Other studies have also linked significant job creation to renewable energy development

The Stimulus Package combined with state RE/EE incentives will help ensure economic attractiveness

President Obama has made renewable and clean energy one of his main platforms

European and Asian investors are coming to the U.S. as the market opportunities are significant

The U.S. RE/EE industry will continue to see double digit growth, in spite of the economic downturn

Implementation of RE/EE technologies will reduce carbon dioxide and other emissions

- Job Creation
- Expected Strong Returns
- Continued Growth
- National Visibility
- Reduced Emissions
- Energy Security

## Contact Information

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6	Value Chain
7	Methodology
8	DECD Summary

## A number of key findings emerged from our analysis of RE in CT.

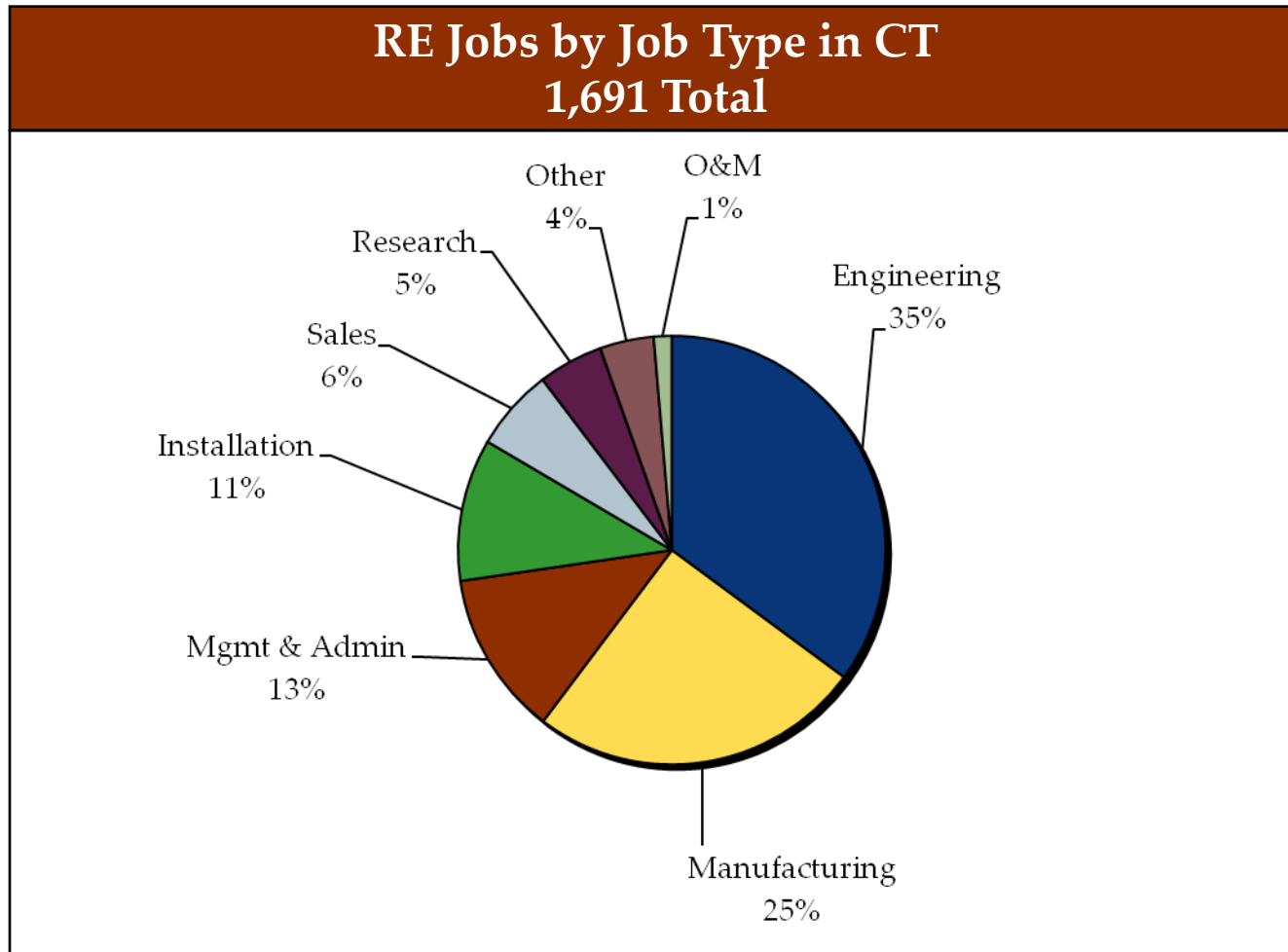
### Key Findings

- Engineering, manufacturing and management jobs account for the lion's share of RE jobs, driven mostly by fuel cell companies.
- Fuel cell jobs and employment income are concentrated in manufacturing and engineering (product development; process eng.).
- The fuel cell industry accounts for 71% of jobs followed by solar at 18% and wind at 5%.
- The fuel cell industry accounts for 72% of employment income followed by solar at 17% and wind at 5%.
- Engineering, manufacturing and management jobs, mostly in the fuel cell industry, account for the majority of RE employment income.
- Renewable energy industry revenues in Connecticut total roughly \$217 million.

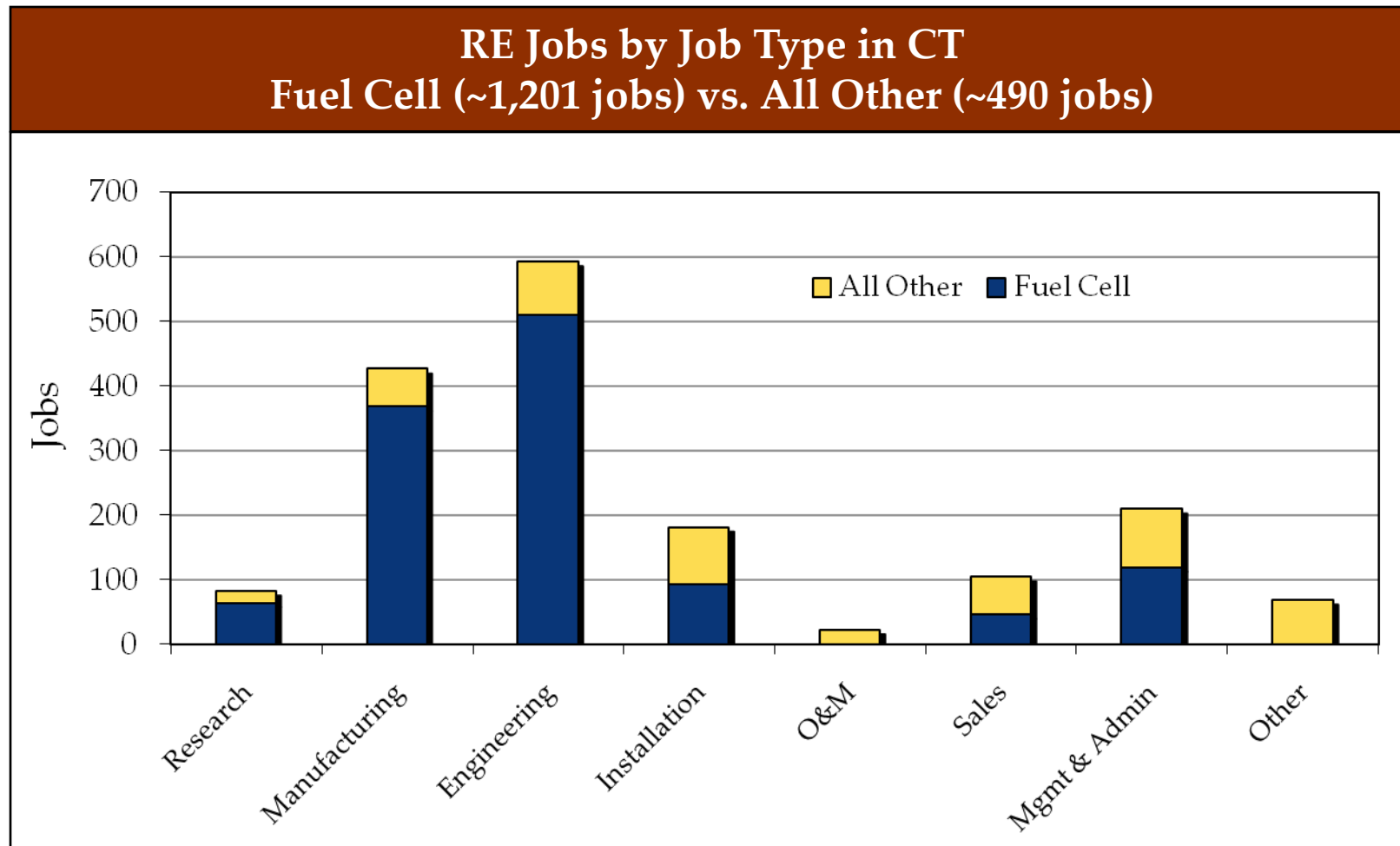
### Fast Facts

- 72 companies identified (representing virtually the entire industry)
  - 37 interviewed
  - 35 companies researched in detail
- 1,691 direct jobs
  - 82% products
  - 18% services
- \$92 million from employment income
- \$217 million revenue
- 2,706 indirect and induced jobs

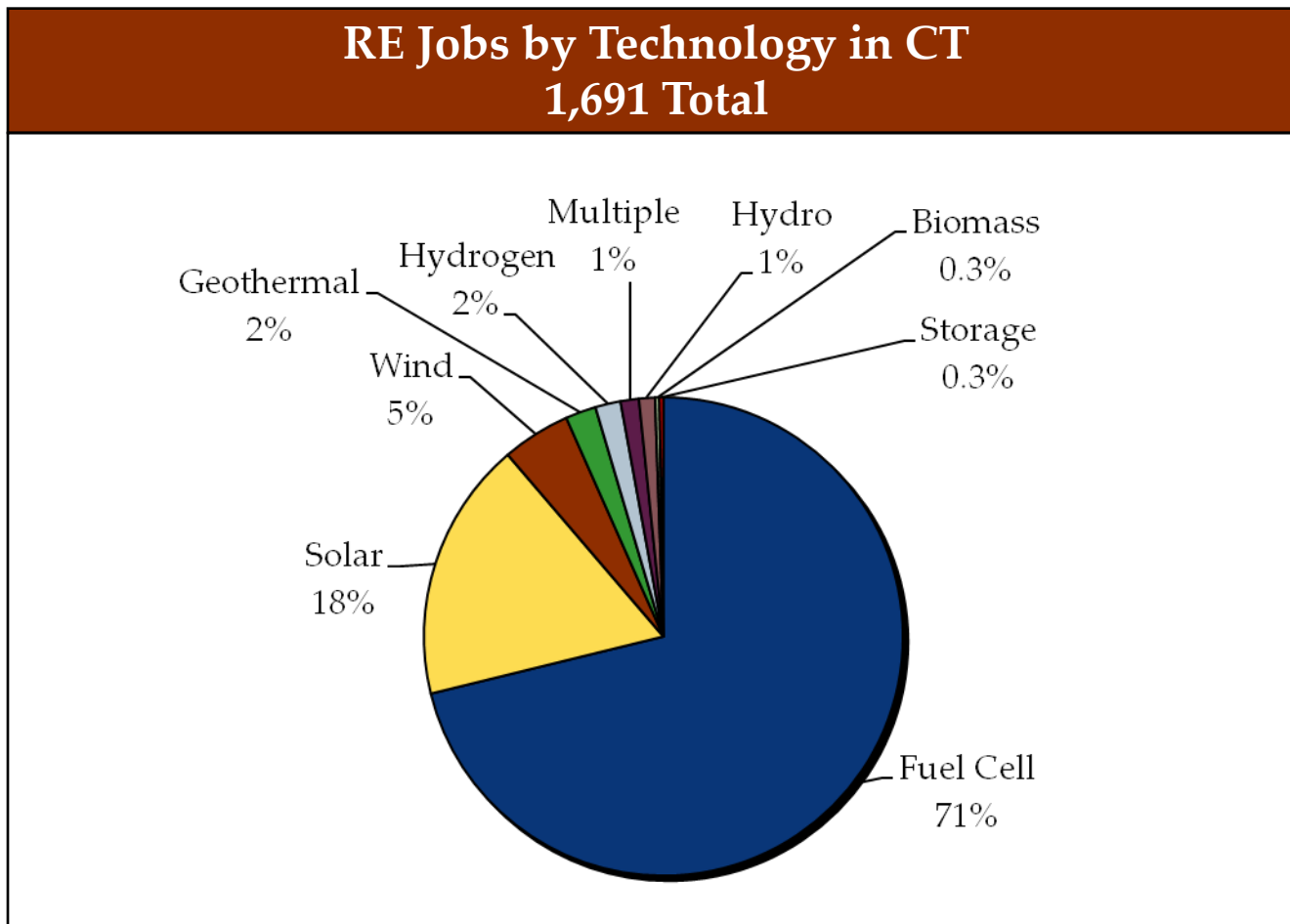
Engineering, manufacturing and management jobs account for the lion's share of RE jobs, driven mostly by fuel cell companies.



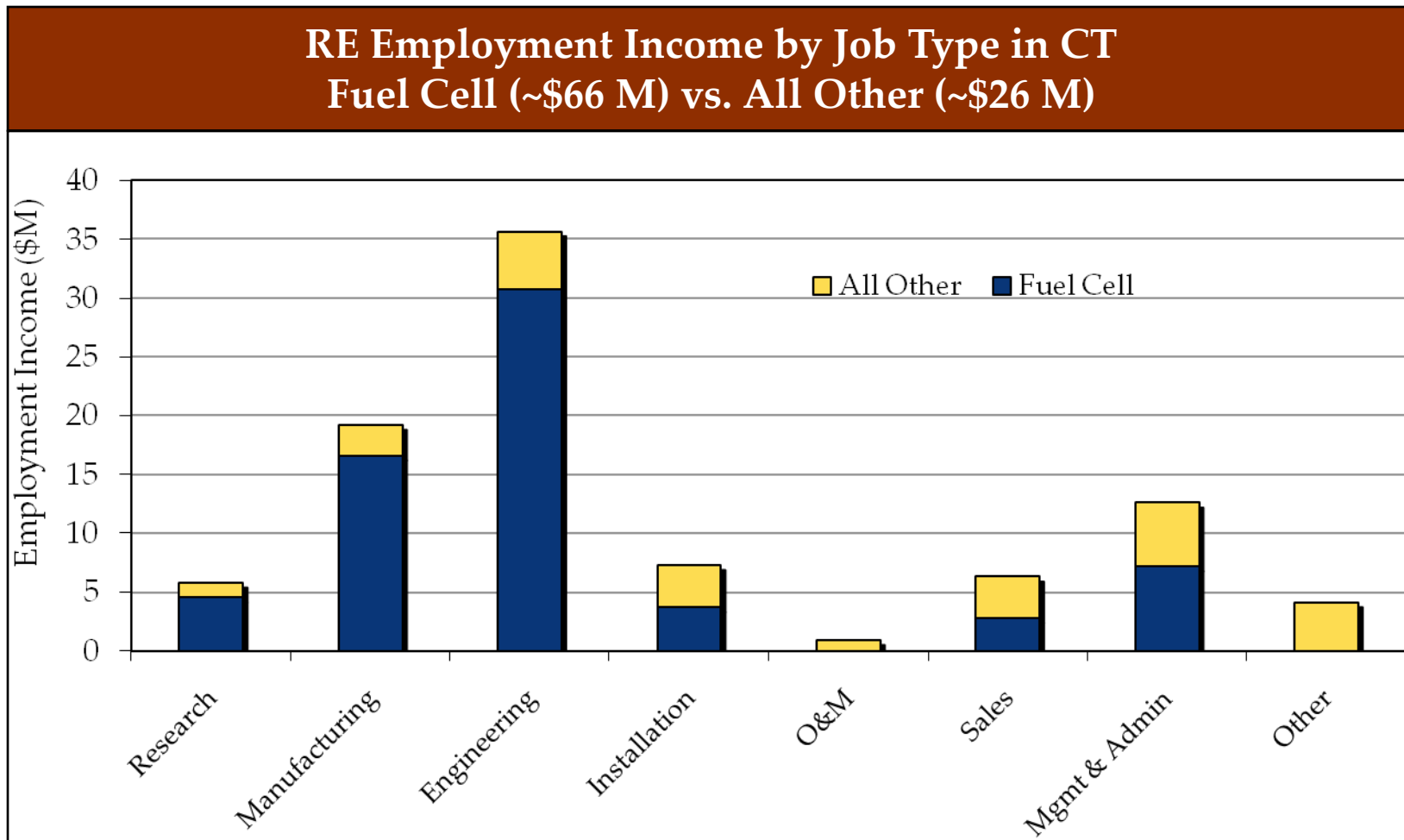
**Fuel cell jobs account for 71% of RE jobs, and are concentrated in manufacturing and engineering (product dev. and process engr.).**



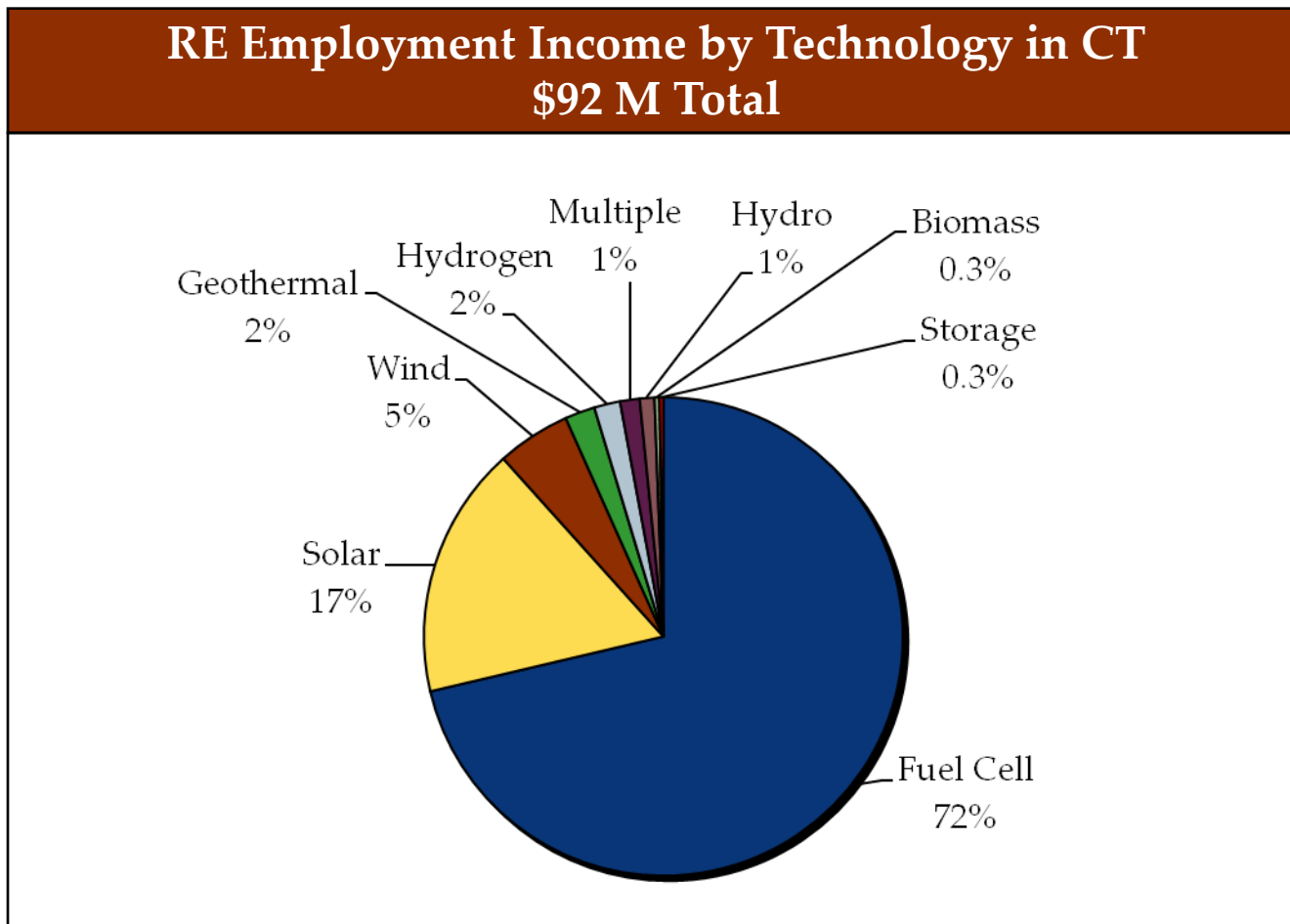
The fuel cell industry accounts for 71% of RE jobs followed by solar at 18% and wind at 5%.



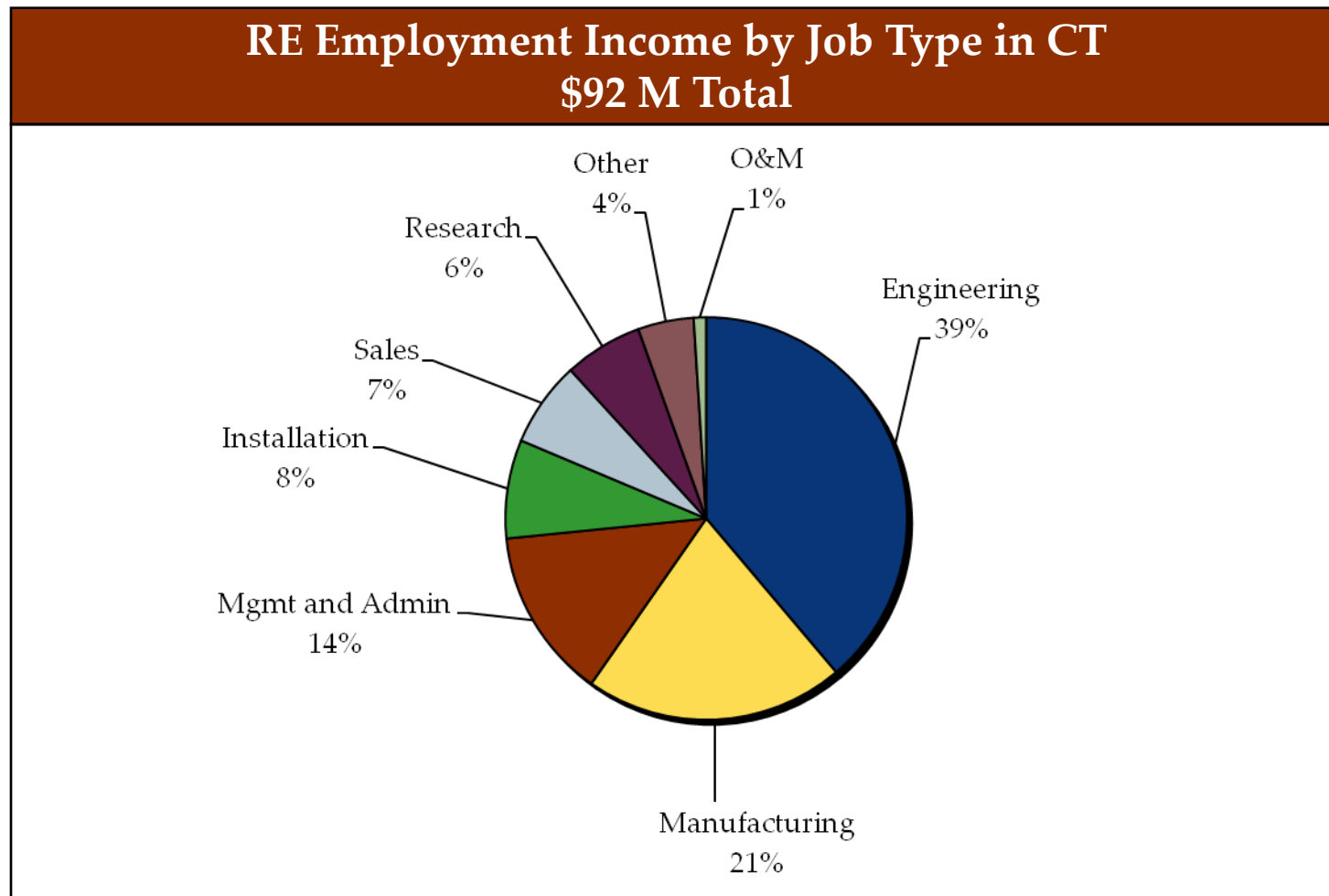
**Fuel cell employment income accounts for 72% of RE employment income, concentrated in manufacturing and engineering.**



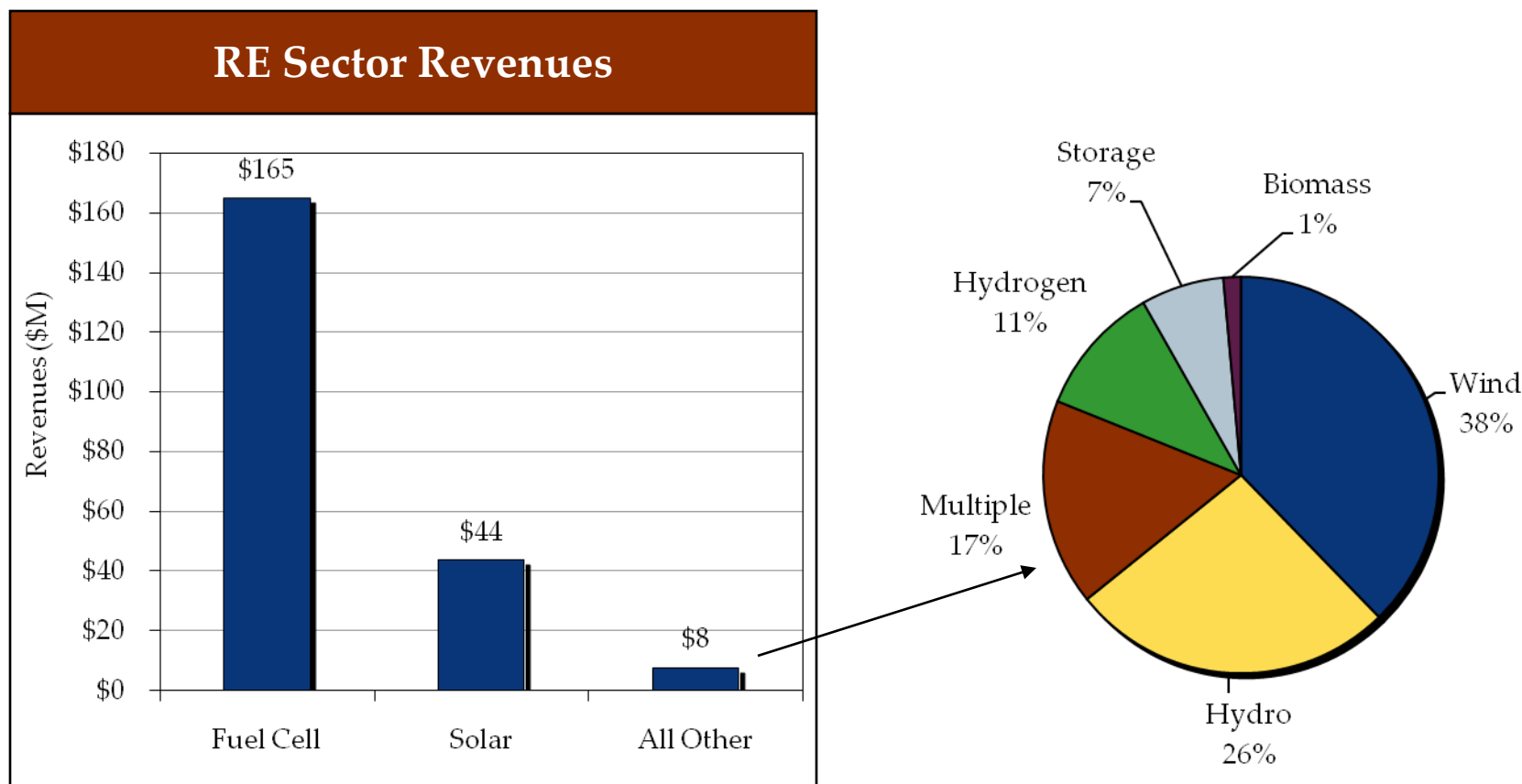
The fuel cell industry accounts for 72% of RE employment income followed by solar at 17% and wind at 5%.



**Engineering, manufacturing and management jobs, mostly in the fuel cell industry, account for the majority of RE employment income.**



# Renewable energy industry revenues in Connecticut total roughly \$217 million.



Notes:

1. The majority of the fuel cell revenue comes from either R&D contracts or demonstration units, not commercial products
2. Geothermal is not depicted as the geothermal companies identified had negligible revenue in CT.

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## A number of key findings emerged from our analysis of EE in CT.

### Key Findings

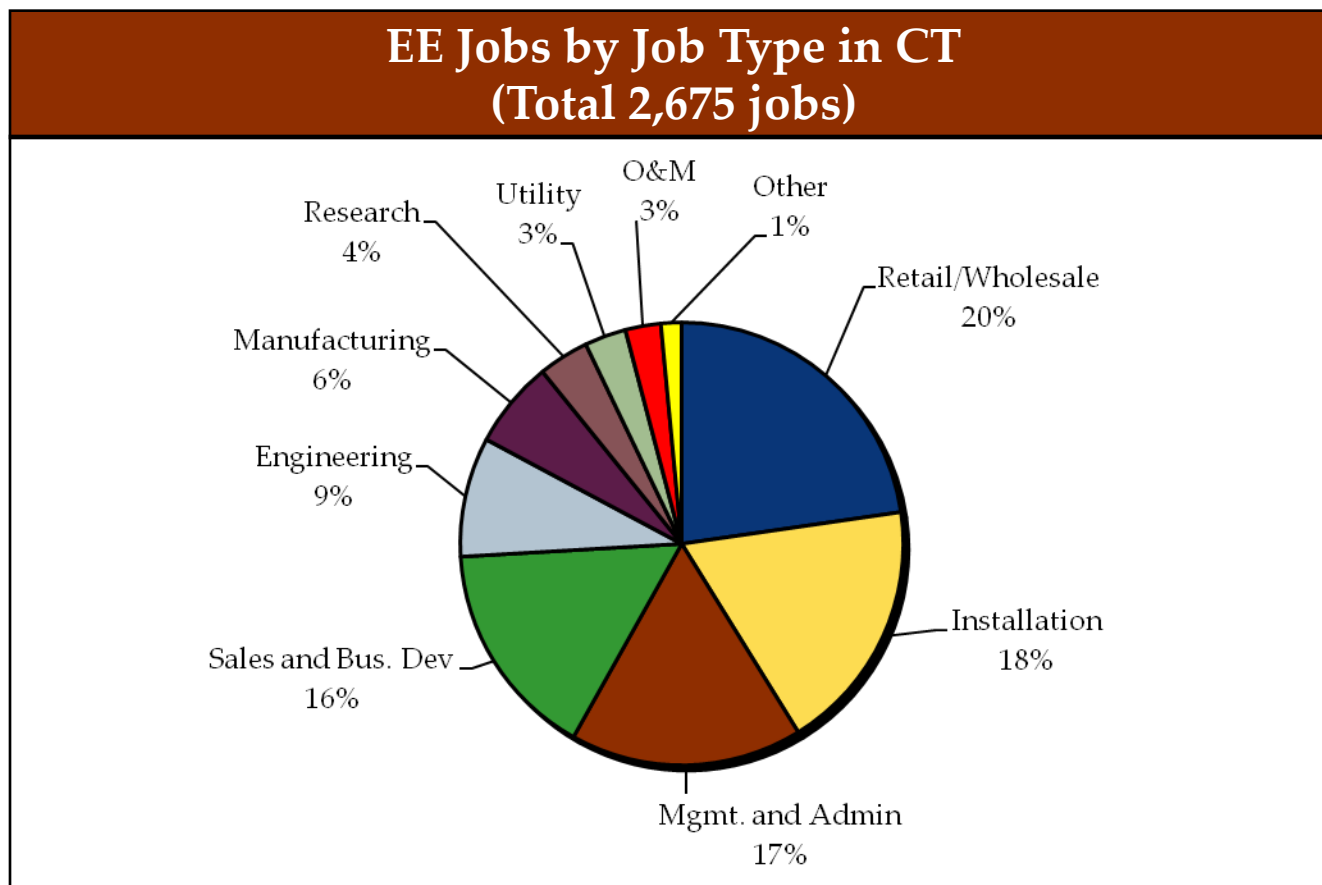
- Retail/wholesale, mgmt. and admin., sales, and installation jobs each account for roughly 1/5 of the energy efficiency jobs in the state.
- Jobs in the commercial and industrial sector account for 52% of energy efficiency jobs in CT, followed by the residential sector at 16%.
- Retail/wholesale, mgmt. and admin., and sales jobs account for over half of the employment income in CT.
- The majority of CT's EE industry revenues come from the services sector which account for \$502 million in revenues.\*

### Fast Facts

- 97 key companies identified (hundreds of others exist, but represent a very small number of EE jobs)
  - 37 interviewed
  - 60 researched in detail
- 2,675 direct jobs
  - 80% services
  - 17% products
  - 3% utility
- \$137 million direct job employment income
- \$565 million from direct revenue
- 4,280 indirect and induced jobs

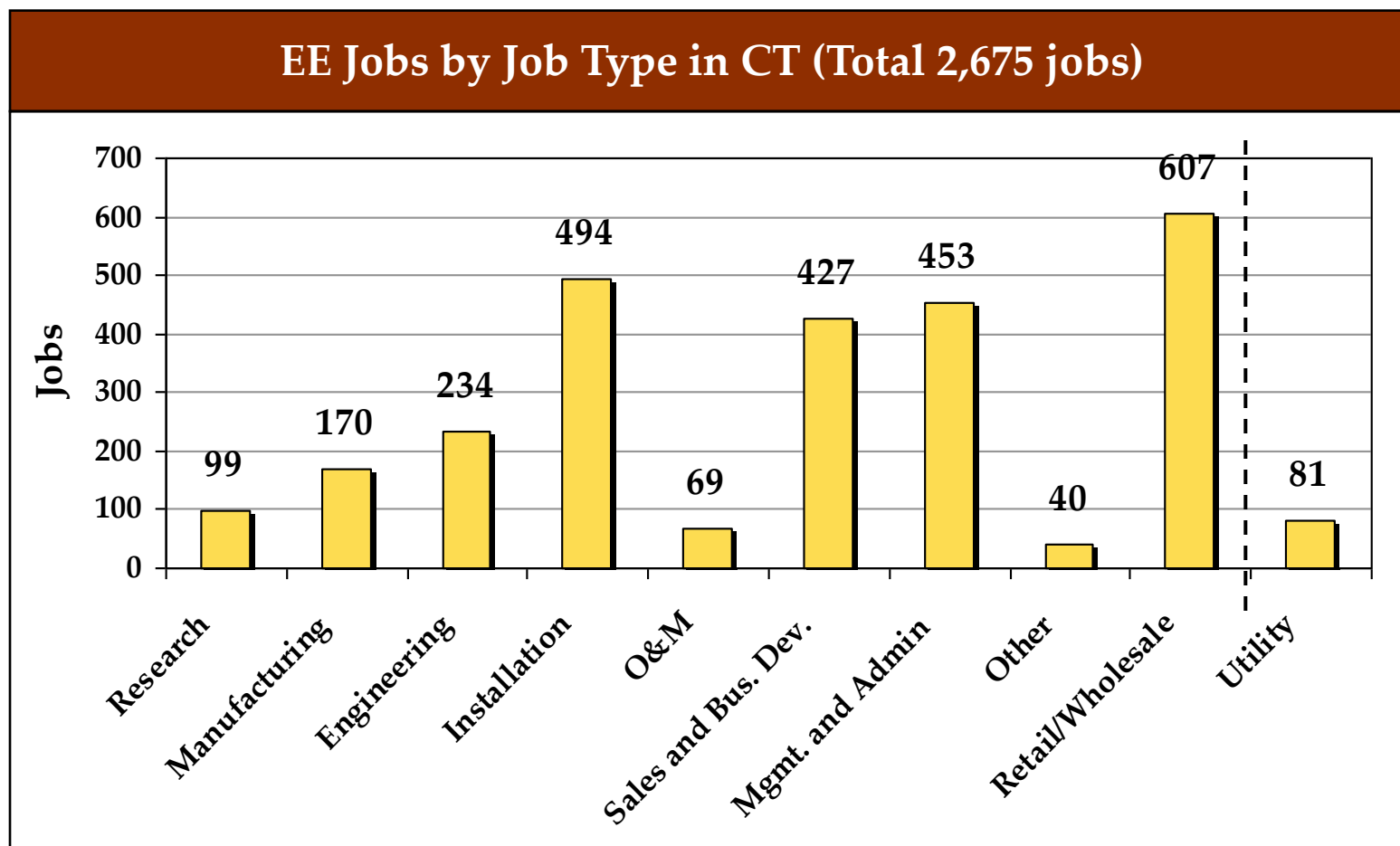
\*Note: In-house energy managers (e.g. facility managers) are not counted in this study, but contractors are included.

**Retail/wholesale, mgmt. and admin., sales, and installation jobs each account for roughly 1/5 of the energy efficiency jobs in the state.**



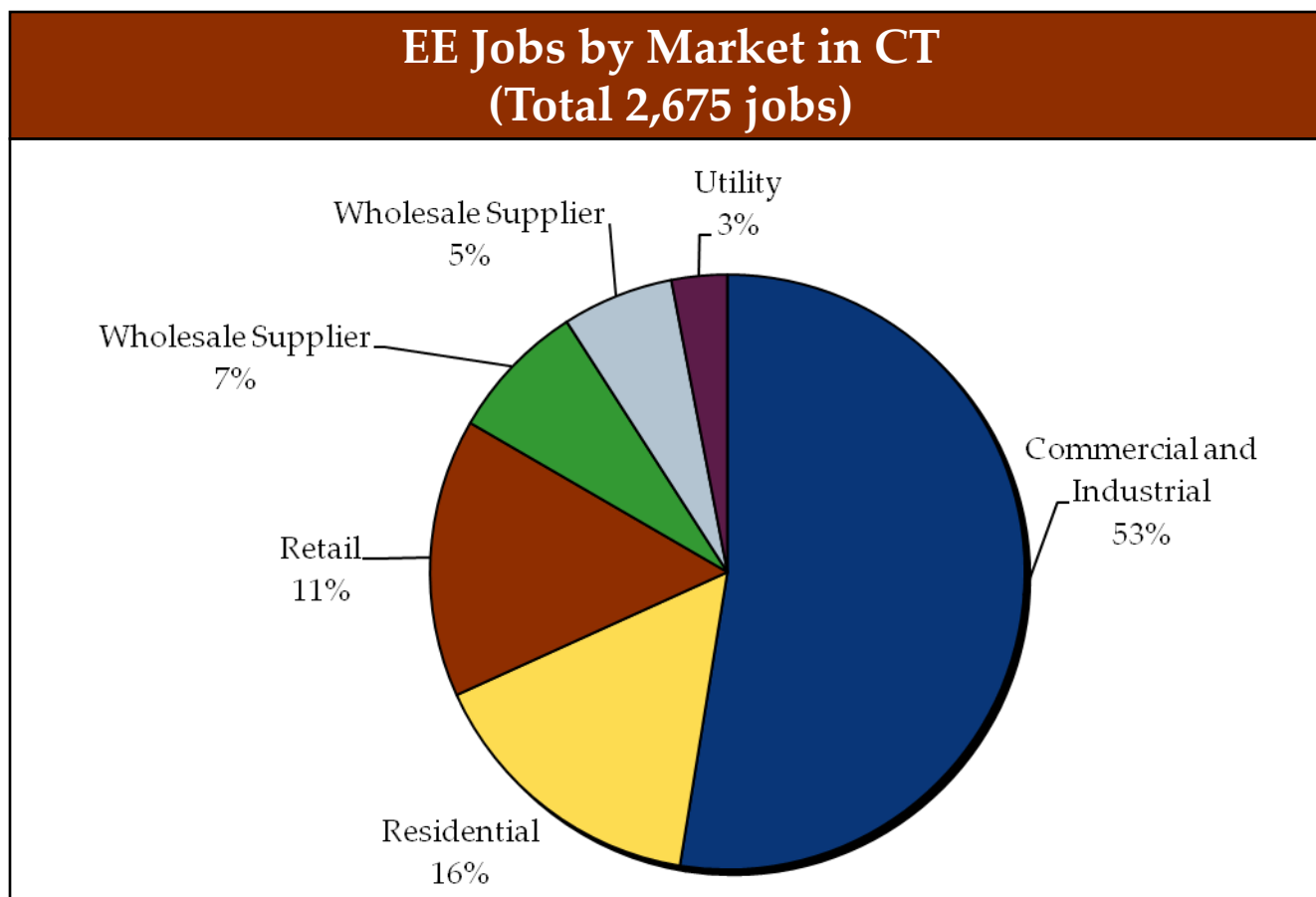
Note: the *Retail/Wholesale* category combines job data from Retail and Wholesale Supplier companies. The *Utility* category includes utility program admin. employees.

Retail/wholesale, mgmt. & admin., sales, and installation jobs account for the majority of energy efficiency jobs in the state of CT.



Note: the *Retail/Wholesale* category combines job data from Retail and Wholesale Supplier companies;  
The *Utility* category includes utility program admin. employees.

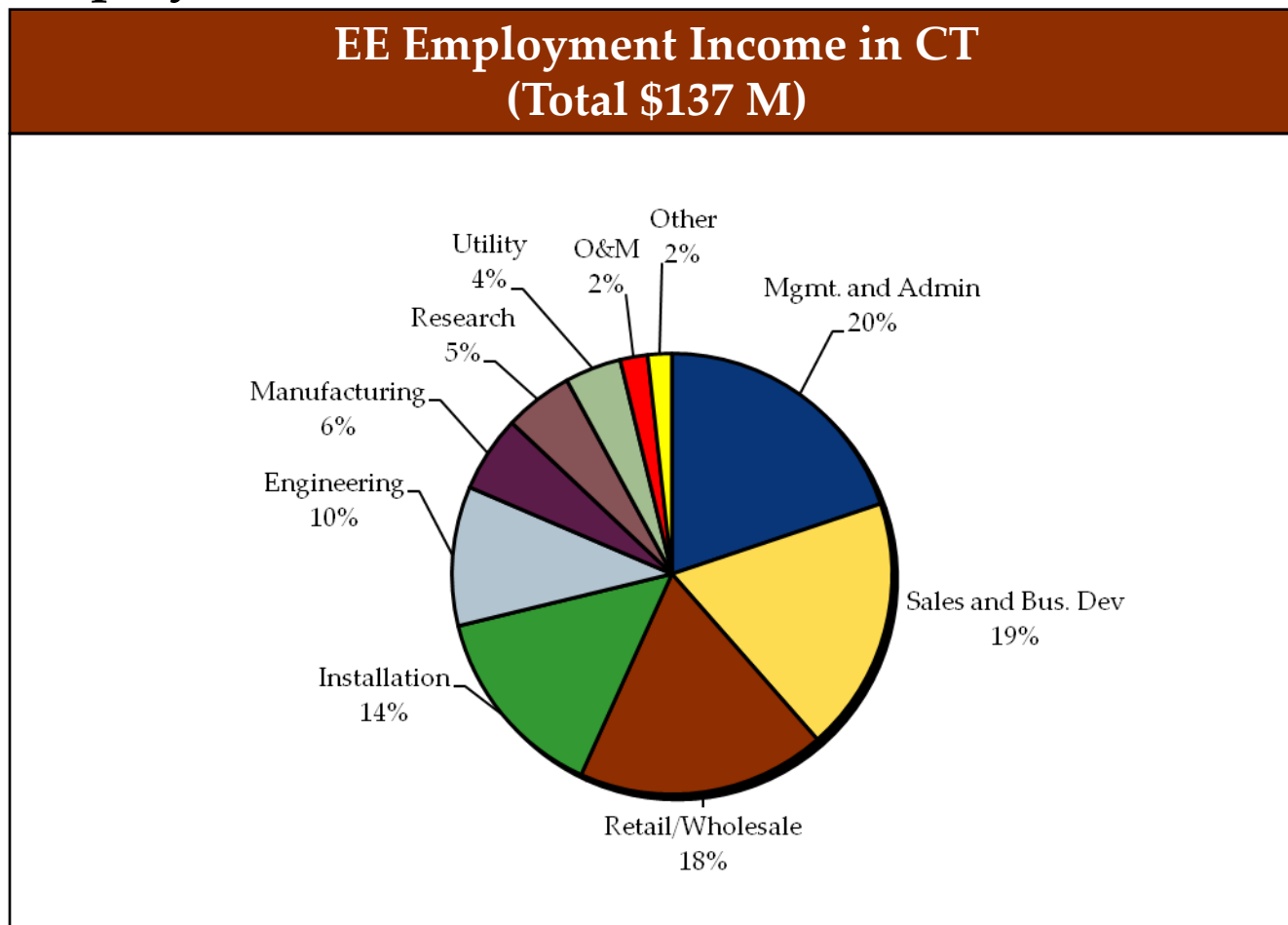
**Jobs in the commercial and industrial sector account for 53% of energy efficiency jobs in CT, followed by the residential sector at 16%.**



Note: *Retail* includes retail and appliance recycling companies;

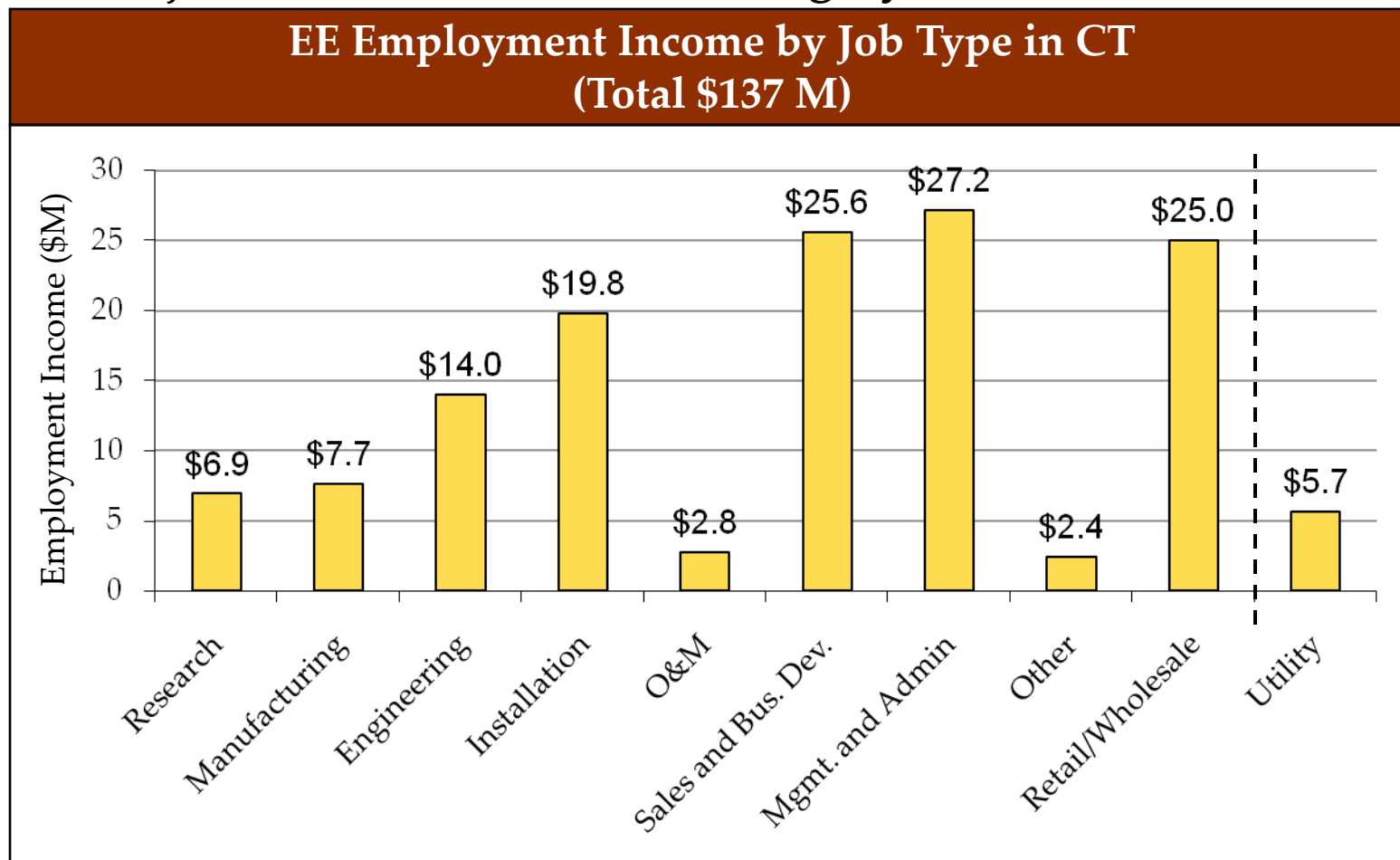
*Residential* refers to the residential sector companies including home energy services, new construction, and low income, but does not include companies in education and outreach.

## Mgmt. and admin., sales, and installation jobs account for over half of the EE employment income in CT.



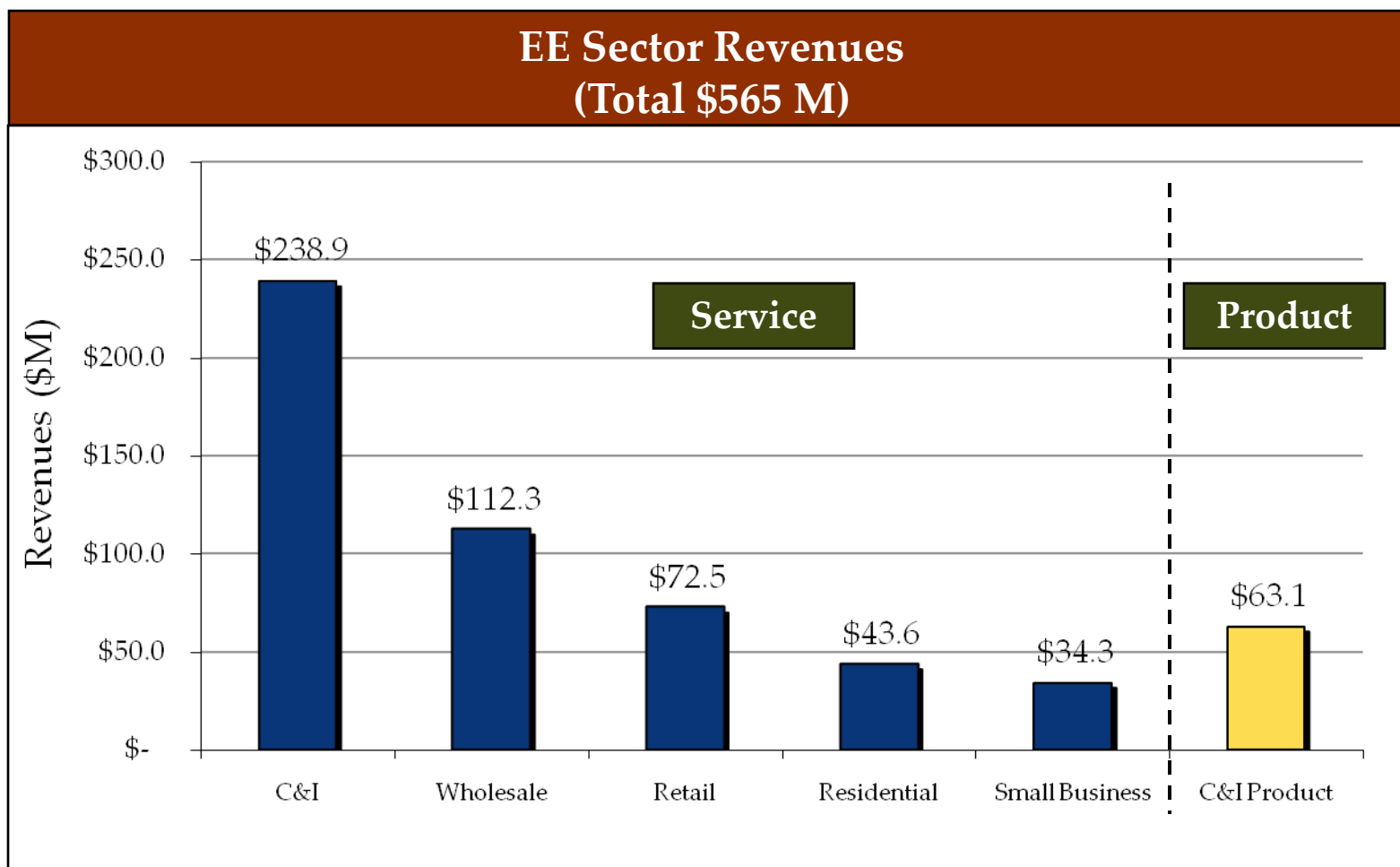
Note: the *Retail/Wholesale* category combines job data from Retail and Wholesale Supplier companies; The *Utility* category includes utility program admin. employees.

**Together, retail/wholesale, management & administrative, installation and sales jobs account for \$98M, or roughly 70% of total EE income.**



Note: the *Retail/Wholesale* category combines job data from Retail and Wholesale Supplier companies;  
The *Utility* category includes utility program admin. employees.

The majority of CT's energy efficiency industry revenues come from project based and distribution services, roughly ~\$502M in revenues.



Note: Retail includes retail and appliance recycling companies.

Residential refers to residential sector companies including home energy services, new construction, and low income.

C&I Product includes mainly manufacturing companies.

**This study does not count in-house energy managers , but it does include contractors.**

### Energy Managers at Industrial and Institutional Plants

- Industrial plants and large institutions like hospitals and universities usually have a facilities manager who doubles as the energy manager
- Energy managers (and their staff) are constantly seeking ways to reduce energy consumption without sacrificing plant availability / up-time
- These energy manager jobs were not counted as energy efficiency jobs because they are a cost center and don't directly contribute to revenue; furthermore, the facilities manager often doubles as an energy manager which makes it difficult to count
- Contractors such as Trane, Carrier BSS, Siemens, EMCOR, and Johnson Controls are counted as energy efficiency jobs and they often work for these large companies and institutions on a contract basis as follows:
  - Performance contracting
  - Energy efficiency improvements
  - O&M

### Heavy Industrial Energy Users (Representative List)

- Colt (Hartford)
- Covidien (New Haven)
- Kimberly Clark (Milford)
- Pfizer (Groton)
- United Technology Corp. (Various divisions, locations)

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**Categories that didn't fit neatly into the value chain definitions were counted separately in the analysis, and were not included in some summary tables.\***

**Other Categories Counted Separately  
(178 Total Jobs)**

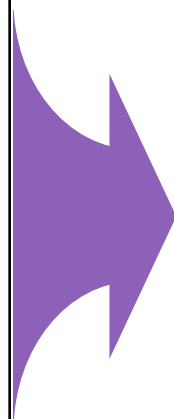
- 70 investment professionals
- 53 academic institution jobs
- 30 trade association jobs
- 20 green architects
- 5 education and outreach jobs
- \$16 million direct job employment income

\*Note: There are a few emerging RE/EE roles, which were not included in the results. For example, emerging roles such as municipal energy managers and corporate sustainability officers. In reality, these and similar roles are primarily in the conceptual stage; our research identified very few entities in Connecticut that have these positions.

## Connecticut has about 70 RE/EE investment professionals.

### Investment Firms in CT involved in RE/EE Investments

- GE Energy Financial Services (Stamford)
- GE Equity (Norwalk)
- MissionPoint Capital (Norwalk)
- FE Clean Energy Group (Darien)
- First Reserve (Greenwich)
- Plainfield Asset Management (Greenwich)
- Canaan Partners (Westport)
- Endeavor Capital Management (Westport)
- Pegasus (Cos Cob)
- Oak Investments (Westport)
- Trident Capital (Westport)
- Whitney & Co. (Stamford)
- Launch Capital (New Haven)
- US Trust Company (Stamford)
- Asia West Environment Funds (Greenwich)
- CT Innovations (Rocky Hill)
- Starwood Energy Group (Greenwich)



- 70 investment professionals
  - \$150,000 base salary + bonus + carried interest
- 12 administrative assistants
- Most organizations are partnerships and do not have corporate revenue that is taxable; revenue is taxed at the individual level; GE is the exception
- While some insurance companies are tax equity players (i.e. MetLife, New York Life, John Hancock), none are located in CT

**CT has the full time equivalent of ~30 green architects, not including several RE/EE-specific employees counted in the main study analysis.**

### CT Architecture Firms with a Green Building Focus or Project Experience

- Main Firms with Green Focus/significant Leadership in Energy and Environmental Design (LEED) experience:
  - Amenta/Emma (Hartford)
  - BPC Green Builders (Georgetown)
  - Centerbrook Architects (Centerbrook)
  - Fletcher-Thompson, Inc. (Shelton and Hartford)
  - Pickard Chilton Architects (New Haven)
  - Rountree Architects (Westport) (See note at right.)
  - S/L/A/M Collaborative (Glastonbury)
  - Steven Winter & Associates (Norwalk) (See note at right.)
- A number of additional architecture firms with LEED project history and LEED-accredited architects were included in the analysis.

- 20-30 full-time-equivalent green architects
  - \$65,000 salary an average of architects and architectural drafters combined.
- While there are over 175 LEED-accredited architects in the state, it is estimated that only a portion of their work total overall work is dedicated to LEED projects.
- Note: Some employees at Steven Winter & Associates and at Rountree Architects are not accounted for in the number reported here, as they have already been accounted for in the body of the study.

Salary estimates based on interviews and "CT Occupational Employment & Wages Statewide," CT Dept. of Labor, 2008.

## Connecticut has the equivalent of about 53 full time professionals who focus on RE/EE research and post-secondary teaching.

### Academic Institutions in CT with RE/EE Research and Teaching

- Central Connecticut State University (New Britain)
- CT Community Colleges
- Eastern Connecticut State University (Willimantic)
- Fairfield University (Fairfield)
- Saint Joseph College (West Hartford)
- University of Bridgeport (Bridgeport)
- University of Connecticut -Storrs (Storrs)
- University of Hartford (West Hartford)
- Yale University (New Haven)
- Additional institutions contribute a small number of additional Full-Time-Equivalents to the statewide tally.



- 53 professionals
  - \$75,000 research professor salary
  - \$50,000 non-research professor and post-secondary vocational salary
- The CT Global Fuel Cell Center at the University of Connecticut – Storrs accounts for the majority of these professionals.
- At the remainder of the institutions, professionals may devote a portion of their time to relevant research or teaching.
- Several universities and community colleges have plans under way to grow their EE/RE course offerings and/or degree offerings.

Salary estimates based on interviews and “CT Occupational Employment & Wages Statewide,” CT Dept. of Labor, 2008.

## Connecticut has about 20 professionals in the RE/EE non-profit sector and non-academic roles at university centers with an RE/EE focus.

### Main Organizations with Non-Profit, Non-Academic RE/EE Professionals in CT

- Clean Energy Institute (West Hartford-University of Hartford)
- CT Center for Advanced Technology (East Hartford)
- CT Global Fuel Cell Center (Storrs-UConn Storrs Campus)
- CT Green Building Council (Rocky Hill)
- Institute for Sustainable Energy (Willimantic-Eastern CT State University)
- Solar Connecticut (Higganum)
- Solar Energy Association of Connecticut (Hartford)

- 20 professionals  
— \$50,000 average salary
- Connecticut Center for Advanced Technology, Connecticut Global Fuel Cell Center, and Institute for Sustainable Energy at ECSU account for the majority of these positions.
- Many of the associations rely on volunteer leadership. Professionals who hold a full time job and serve as an unpaid volunteer member of relevant organizations were not included in this analysis.

\*Salary estimates based on interviews and "CT Occupational Employment & Wages Statewide," CT Dept. of Labor, 2008.

## Connecticut has about five education & outreach professionals.

### Education & Outreach Organizations in CT

- eesmarts
- Connecticut Science Center
- Stepping Stones Museum for Children
- Institute for Sustainable Energy

- 5 professionals  
—\$50,000 salary
- One FTE under the Institute for Sustainable Energy is already accounted for in the Trade Association/Non-Profit offline employee count, and so is not included here.
- The eesmarts employee count includes the Outreach Coordinator, but does not include the participating K-8 teachers.

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6	Value Chain
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## Jobs Impact Based on Dollars Invested

**Subsidy in areas with high labor content and low wages yield the highest jobs.**

### Job-Years Created Per \$1 Million Invested

	Labor	Materials	Total	Average Wage	Fully Burdened Cost/Employee	Depreciation Burden	Fully Burdened Cost/Employee net of Depreciation Burden	Job-years / \$1 MM subsidy	Subsidy (% of project)	Job-years / \$1 MM subsidy	Employment Income	Indirect & Induced Jobs	Total Jobs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Calculation	Assumed Value	Assumed Value	(1) + (2)	Assumed Value	(4) x Fringe Benefits	Assumed Value	(5) x (1 + (6))	\$1 million x (1) / (7)	Assumed Value	(8) / (9)	(4) x (10)	(10) x Indirect + Induced multiplier	(10)+(12)
<b>Renewable Energy</b>													
Fuel Cells - Mfg - Low Skilled	50%	50%	100%	\$30,000	\$39,000	10%	\$42,900	11.7	60%	19.4	\$582,751	31.1	50.5
Fuel Cells - Mfg - High Skilled	50%	50%	100%	\$50,000	\$65,000	10%	\$71,500	7.0	60%	11.7	\$582,751	18.6	30.3
Renewable Energy - R&D	90%	10%	100%	\$70,000	\$91,000	5%	\$95,550	9.4	75%	12.6	\$879,121	20.1	32.7
Solar - Installation	20%	80%	100%	\$40,000	\$52,000	1%	\$52,520	3.8	35%	10.9	\$435,208	17.4	28.3
<b>Energy Efficiency</b>													
HES /RNC/ LI	85%	15%	100%	\$50,000	\$65,000	1%	\$65,650	12.9	70%	18.5	\$924,818	29.6	48.1
Small Business	60%	40%	100%	\$50,000	\$65,000	1%	\$65,650	9.1	60%	15.2	\$761,615	24.4	39.6
C&I New construction / retrofit	50%	50%	100%	\$50,000	\$65,000	1%	\$65,650	7.6	60%	12.7	\$634,679	20.3	33.0
Weighted EE average	60%	40%	100%	\$50,000	\$65,000	1%	\$65,650	9.1	65%	14.1	\$703,029	22.5	36.6
Fringe benefits	30%												
Indirect + Induced multiplier	1.6												

**CT's small manufacturing industry means that jobs with a higher ratio of labor to materials result in more jobs for CT citizens as less subsidy is passed on to out-of-state manufacturing.**

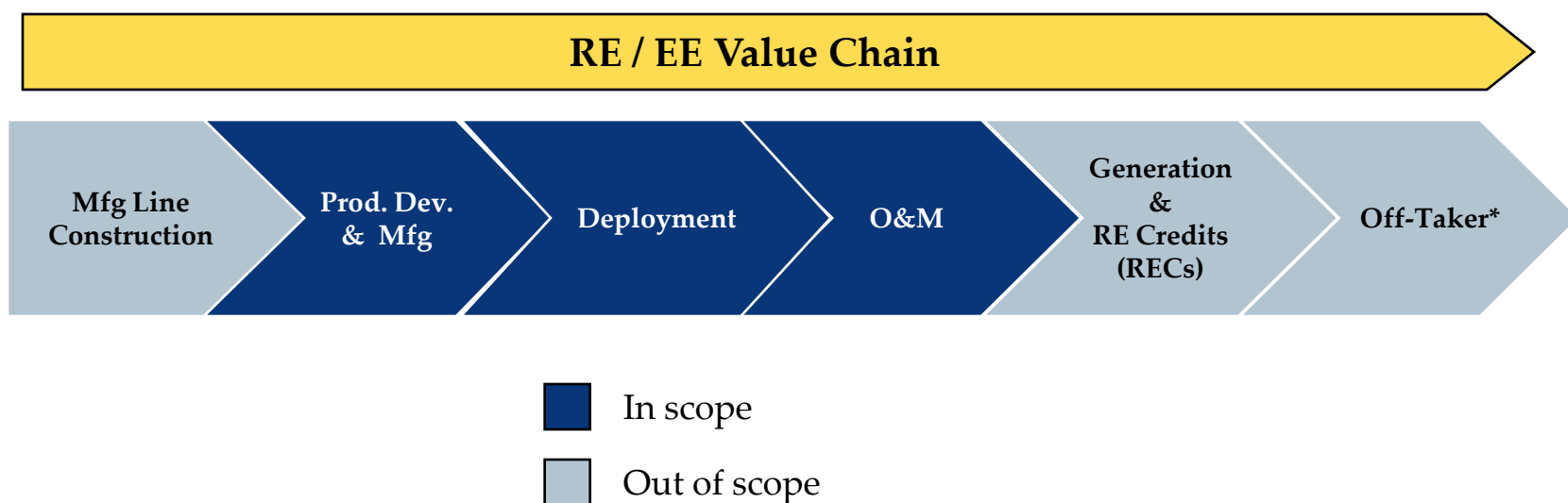
Notes:

1. Assumed values have been based on consultation with CCEF, DECD, and ECMB
2. For fuel cell projects going forward, the projected subsidy levels are 25% to 50%

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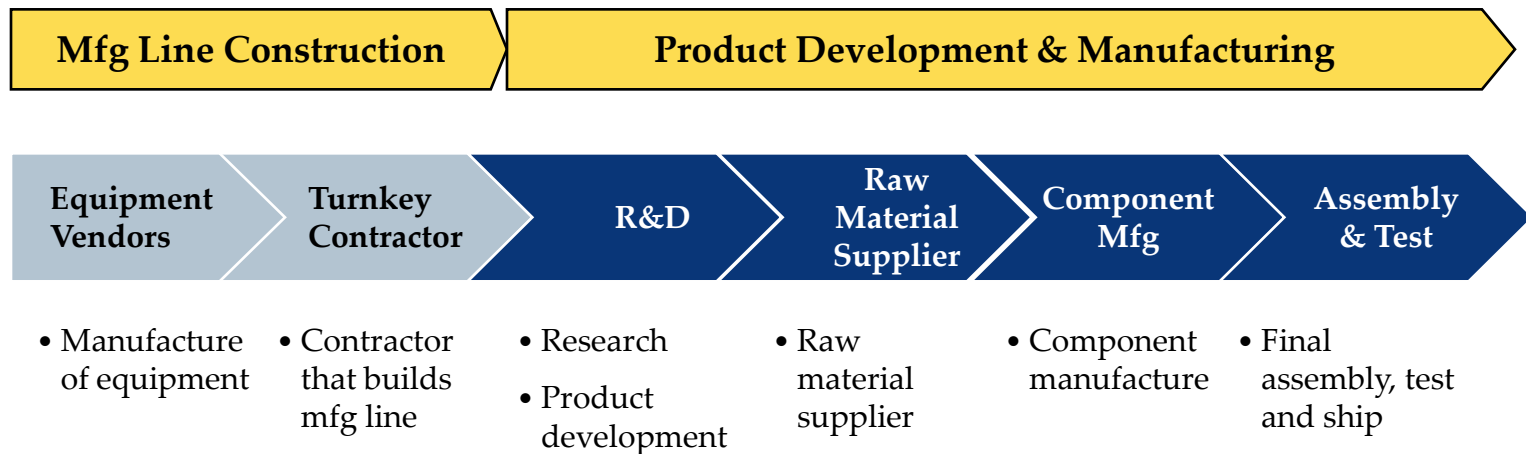
For reference, the following section breaks-down the RE/EE value chain.



Each of these chevrons are discussed on subsequent pages.

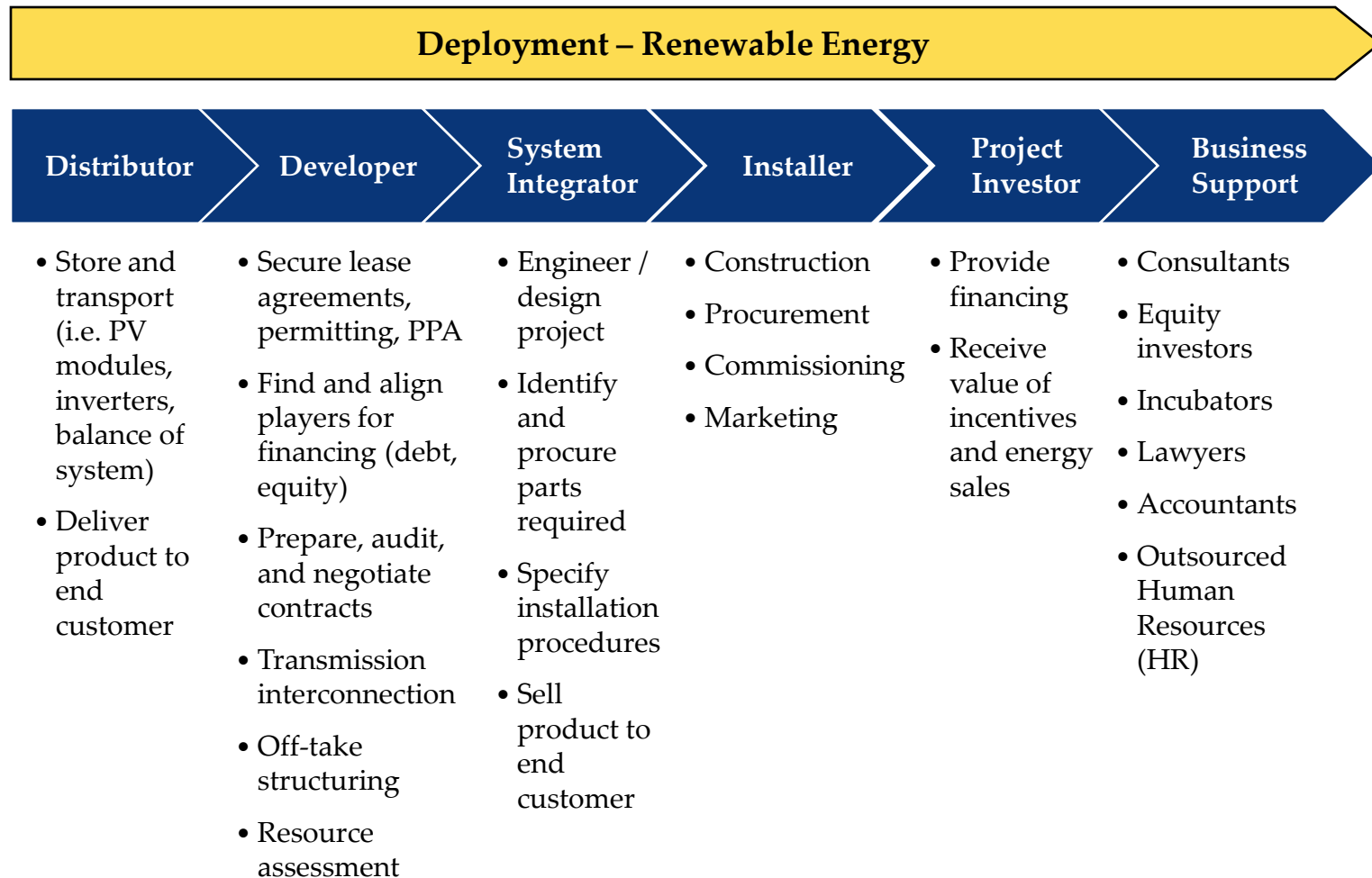


**RE and EE have similar value chains for manufacturing line construction and product development & manufacturing.**



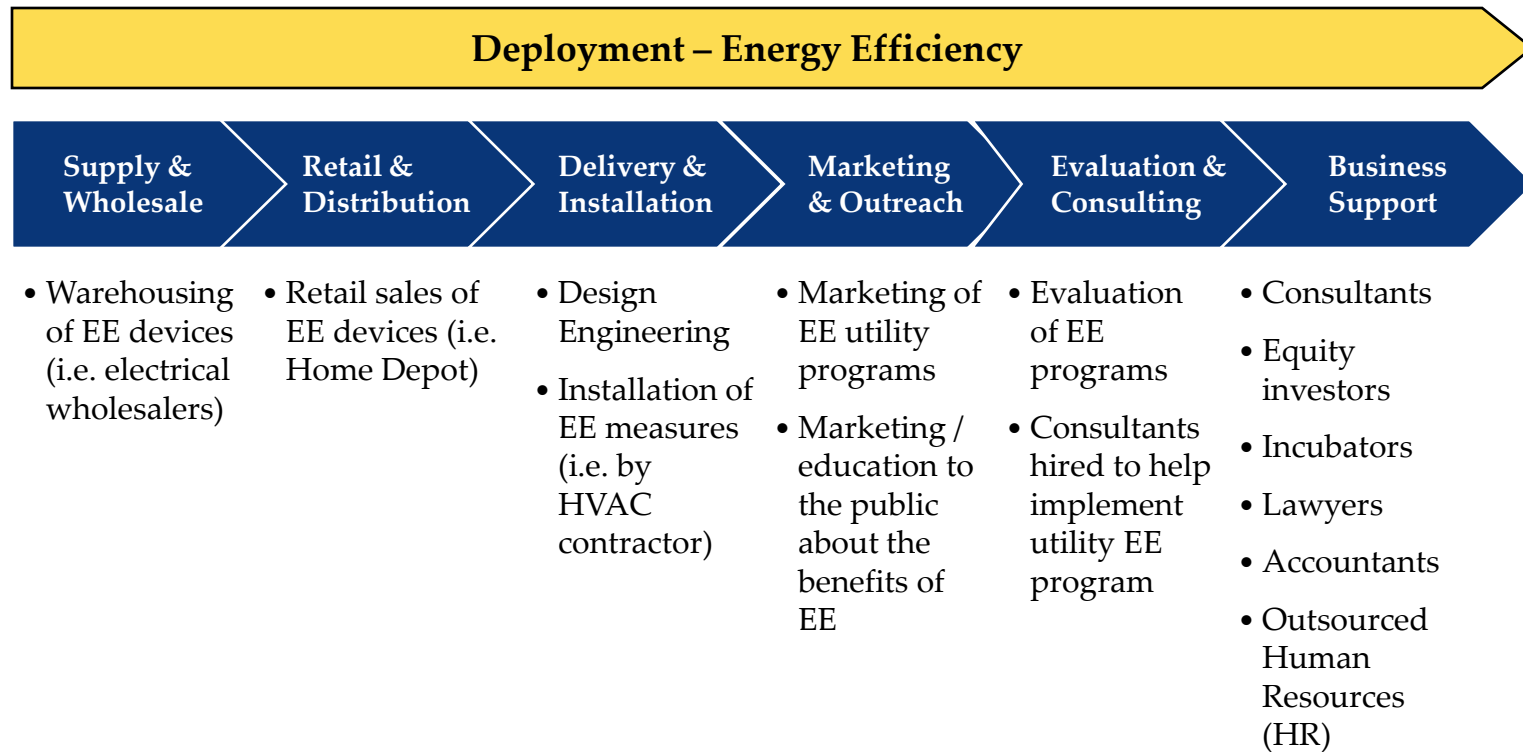


The RE deployment value chain has six main steps outlined below.





The EE deployment value chain also has six main steps outlined below, but most differ compared with the RE industry deployment.





**Operations & Maintenance for RE/EE can be conducted either in-house or through a third party.**

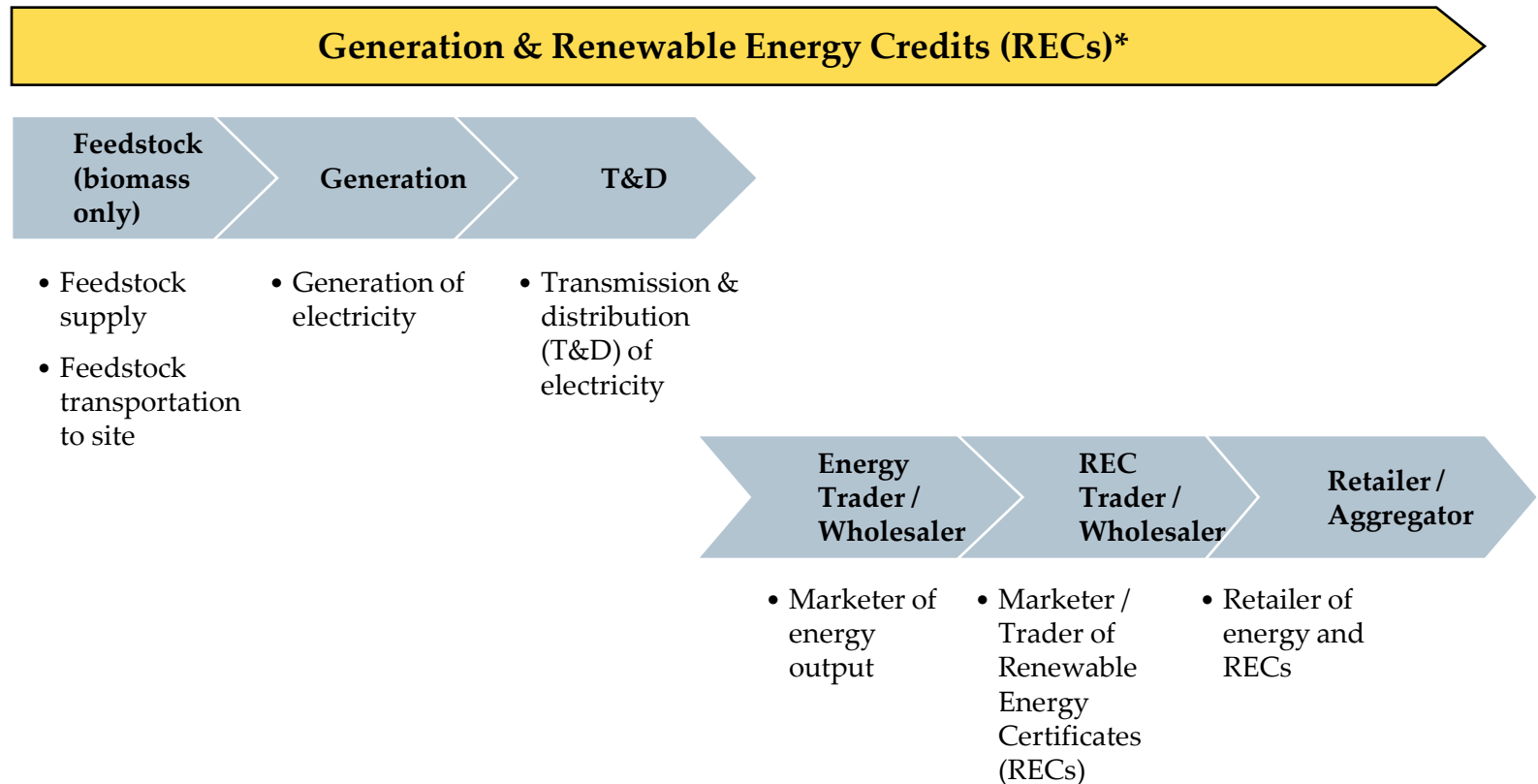
**Operations and Maintenance**



- Monitor
- Inspect onsite
- Maintain & clean
- Sell / provide spare parts
- Bill & report performance



**Electricity generation and distribution and capturing value associated with the environmental benefits of RE is also part of the RE value chain (but not part of this analysis).**



\*Note: Renewable Energy only

The supply base varies by technology and value chain position (e.g. manufacturing, deployment or O&M).

### Typical fuel cell manufacturing supply base

- Precious metals (i.e. nickel, platinum)
- Electronic components
  - Controller
  - Power
  - Conversion
  - Harness
- Mechanical components
  - Enclosures
  - Fan assemblies
  - Heat exchangers
  - Temperature switches
  - Water pumps
  - Check valves
- Contract manufacturing

### Typical solar deployment supply base

- Modules
- Inverters
- Racking / mounting systems
- Wiring / cabling
- Other electrical and mechanical components
- Sub-contractors

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**This section defines the scope of the analysis and provides detail regarding the analytical approach.**

- Scope defined
  - What defines Connecticut companies and revenue
  - Value chain elements or categories
  - Technologies and markets
  - Sectors (private, not-for profit and public)
  - Direct vs. indirect vs. induced jobs
- Interview and modeling methodology
- RE/EE interview guides and company lists
- Additional industry players accounted for in summary

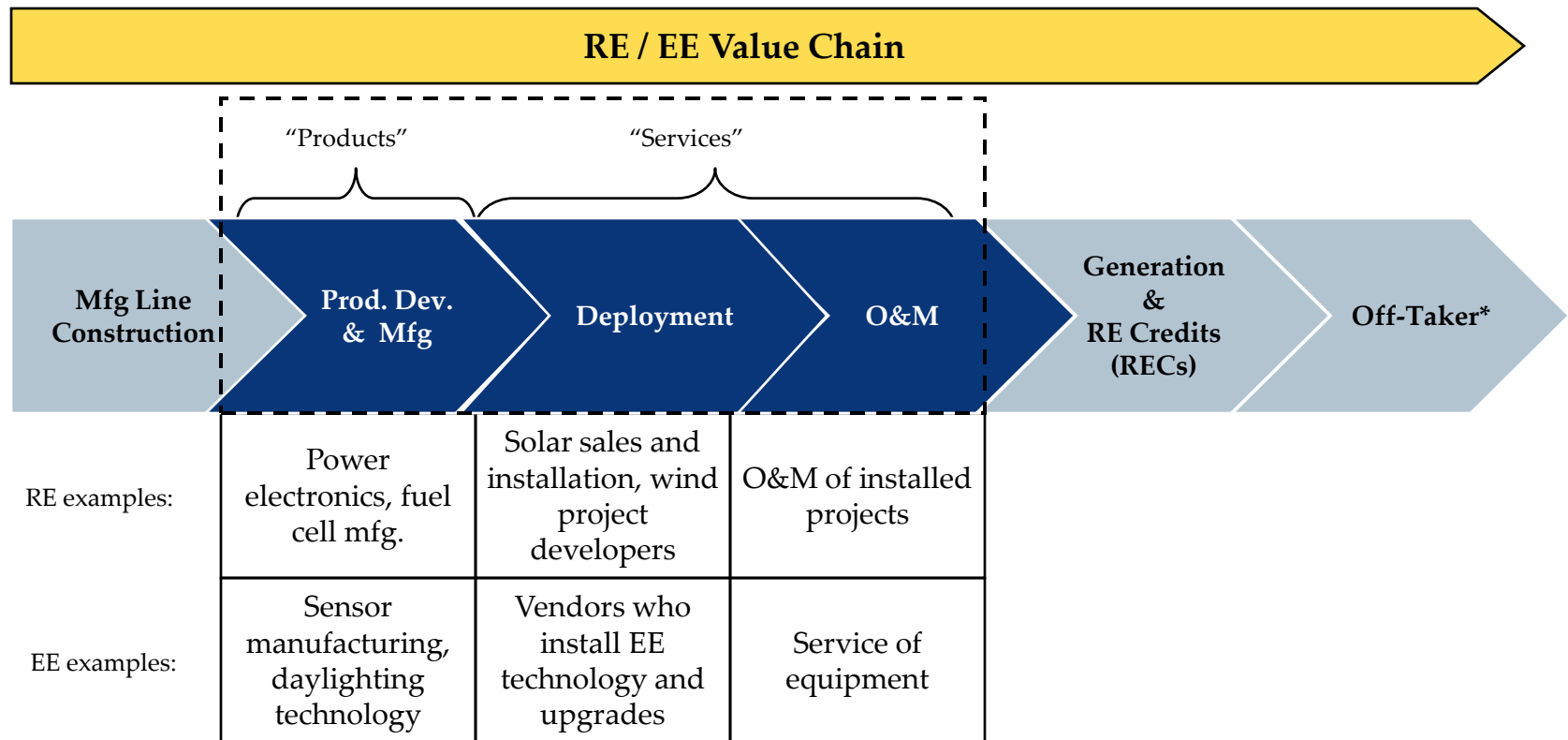
## CT-based RE/EE jobs and revenue generated from manufacturing and construction activity in CT was included in the economic impact analysis.

Jobs
<ul style="list-style-type: none"><li>• Companies that employ people who are based in CT</li></ul>
<ul style="list-style-type: none"><li>• Companies with staff outside of CT that do work in CT</li></ul>

-  Included
-  Excluded. Does not directly build the CT RE/EE economy.

Revenues
<ul style="list-style-type: none"><li>• Revenue from products that are manufactured in CT and sold anywhere worldwide</li><li>• Project and/or operations and maintenance (O&amp;M ) revenue produced by CT-based companies</li><li>• Retail and wholesale suppliers</li></ul>
<ul style="list-style-type: none"><li>• Project and O&amp;M revenue from outside CT</li><li>• Revenue from products manufactured outside of CT</li><li>• Revenue from all component suppliers (i.e. “pass through” revenue)</li></ul>

# Product development & manufacturing, deployment (new construction/retrofit) and O&M are in the scope of this analysis.



- Included - the majority of direct jobs occur here
- Excluded - skills are generic and/or jobs are limited

\*Note: An off-taker is an entity that purchases electricity or RECs from an independent power producer or marketer



This study focused on renewable electrical power and energy efficiency, and excluded biofuels and transportation.

**Renewable Energy**

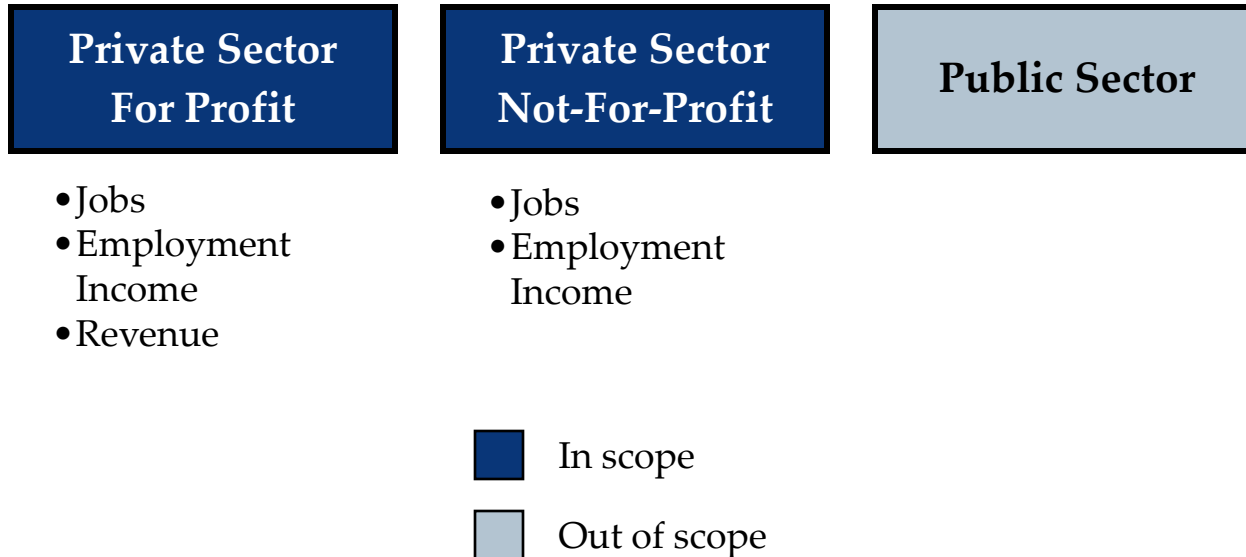
Technology	Markets
<ul style="list-style-type: none"> <li>• Fuel Cells</li> <li>• Solar (PV &amp; Solar Hot Water)</li> <li>• Wind</li> <li>• Geothermal</li> <li>• Hydro (&lt; 5MW)</li> <li>• Hydrogen</li> <li>• Biomass</li> <li>• Storage</li> <li>• Power Grid Infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Residential</li> <li>• Commercial &amp; Industrial (C&amp;I)</li> <li>• Utility</li> <li>• Independent Power Producers</li> <li>• Government and Military</li> </ul>
<ul style="list-style-type: none"> <li>• Concentrating Solar Power, Tidal, Wave</li> </ul>	<ul style="list-style-type: none"> <li>• Transportation</li> </ul>

**Energy Efficiency**

Technology	Markets
<ul style="list-style-type: none"> <li>• High Efficiency Heating, Ventilation and Air Conditioning</li> <li>• Efficient Lighting</li> <li>• Efficient Home Appliances</li> <li>• Water Heating</li> <li>• Commercial Refrigeration</li> <li>• Pumps, motors and drives</li> <li>• Building Envelope</li> <li>• Demand Response</li> </ul>	<ul style="list-style-type: none"> <li>• Residential (including Low Income Weatherization)</li> <li>• Commercial &amp; Industrial (C&amp;I)</li> <li>• Small Business</li> <li>• Retail Products / Appliance Retirement</li> <li>• Government and Military</li> </ul>

-  Included
-  Excluded - limited relevance in CT or beyond scope

**Our research included companies and organizations in the private sector, not the public sector.**



## This analysis looked at direct jobs as well as indirect and induced jobs (by way of multipliers).

### Direct Jobs

- For the purpose of this baseline analysis, direct jobs are considered existing jobs in the specified CT industries.
- In policy analysis, direct jobs are commonly defined as the initial change in final demand for the industry sector in question. Direct job impacts describe the changes in economic activity for sectors that first experience a change in demand because of a project, policy decision, or some other stimuli.

### Indirect Jobs

- Represents the response as supplying industries increase output in order to accommodate the initial change in final demand. These indirect beneficiaries will then spend money for supplies and services, which results in another round of indirect spending.

### Induced Jobs

- Jobs generated by the spending of households who benefit from the additional wages and business income they earn through all of the direct and indirect activity. The increase in income, in effect, increases the purchasing power of households.

← Indirect and Induced jobs are equal to 1.6x Direct jobs as per DECD's REMI calculation

Source: S. Grover, "Energy, Economic, and Environmental Benefits of the Solar America Initiative", August 2007, NREL/SR-640-41998.

- Primary Scope (the numbers presented in this report are direct jobs unless otherwise indicated)
- Secondary Scope through use of multipliers

## Below is the interview methodology used by Navigant Consulting.

### Interview Methodology

- 1. Build the initial company database.** We developed a company contact list using contact lists/information from CCEF, ECMB, Connecticut Light & Power, United Illuminating, Energy Source Guides (energy.sourceguides.com), Northeast Sustainable Energy Association (NESEA), Solar Energy Industries Association (SEIA), Solar Energy Business Association of New England (SEBANE), Cooler Planet (coolerplanet.com), the American Council on Renewable Energy (ACORE), as well as companies known to Navigant.
- 2. Research primary contact information.** Missing e-mail addresses and telephone numbers were researched through online searches and phone calls.
- 3. Create, test, and revise the interview questions.** The interview question set was refined several times with the goal of making it flow nicely and capturing information that was of greatest interest (see pages at the end of this section).
- 4. Conduct interviews.** Navigant Consulting managed the interview process and conducted the interviews. Connecticut Light & Power also conducted some interviews. We conducted 73 formal interviews of the most important RE/EE companies in Connecticut. We contacted and met with numerous stakeholders in this sector to augment the information that we collected from the formal interviews. In total, we interviewed by phone or in person 250-300 people for this assignment.
- 5. DECD input-output model.** Simultaneously, DECD built an input-output model that was used to cross-check and supplement the primary research analysis done by Navigant. This economic input-output model of the CT RE/EE industry was built using the NAICS codes and Department of Labor data. We made sure that we were tracking the same industry categories and jobs.
- 6. Estimate full time equivalents (FTEs), employment income & revenue for those companies that are not 100% in RE/EE.**
- 7. Estimate missing data.** Where data was not available, Navigant built a model that was used to extrapolate CT jobs and revenue data for these companies. DECD provided data from the D&B Selectory Database for selected companies.
- 8. Review and clean the data set.** Navigant Consulting, DECD and CCEF extensively reviewed and checked the analysis and results for accuracy and completeness, following up to verify and correct information as needed.

## Below is the modeling methodology used by Navigant Consulting.

### Modeling Methodology to Identify Job Counts, Employment Income and Revenue

- 1. Allocate jobs and revenue.** Navigant Consulting allocated CT-based job and revenue data from the interviewees to the following categories:
  1. Jobs by function
  2. Jobs by technology/market
  3. Revenue by function
  4. Revenue by technology/market
  5. Portion of the value chain the company serves, product vs. service.
- 2. Extrapolate to get the entire market size.** Navigant Consulting made estimates of what percentage of the market it had captured with the companies identified. We then extrapolated to get the entire market size. For the purpose of RE, we assumed that we captured the entire market.
- 3. Estimate average wage for each job type and calculate estimated employment income.** Navigant Consulting made estimates of average wage data by job type based on data from interviews, DECD, CCEF, the Department of Labor and others sources. We calculated estimated employment income by multiplying number of jobs by average wage.
- 4. Estimate breakdown between labor and materials for key RE/EE areas.** In some instances, this was required to get accurate revenue numbers.
- 5. Assess results and pull out key findings.**

The following average annual wage assumptions were used to calculate employment income.

Annual Salary Assumptions by Job Category (\$)	
Job	Average Wage (\$)
R&D	\$70,000
Manufacturing	\$45,000
Engineering	\$60,000
Installation	\$40,000
O&M	\$40,000
Sales and Business Development	\$60,000
Corporate Management and Admin.	\$60,000
Utility Program Administration	\$70,000
Retail Sales Employees	\$30,000
Other	\$60,000

Source: Estimates based on interviews, Department of Labor, and in consultation with DECD

# The RE interview questions are below:

### Your Company

1. Please tell us a little about yourself and your role in the company.
2. Describe your overall business. What are your primary products/ services?
3. Describe your RE business.

### Customers

4. Who are major customers for your RE products/services?
5. How many (or what percentage of) RE customers are: (1) in CT, (2) in the US but outside CT, (3) international.

### Supply Chain

6. Who are the major suppliers for your products/ services? Where are they located?
7. Do you have CT suppliers? Who are they and how important are they to your business?

### Current Jobs and Revenues

8. How many employees did you have in 2008?
  - a. Overall
  - b. In CT
9. How many RE employees did you have in 2008?
  - a. Overall
  - b. In CT
10. What portion of your CT RE employees are in
  - c. R&D
  - d. Manufacturing
  - e. Engineering
  - f. Installation
  - g. O&M
  - h. Sales and business development
  - i. Corporate management and administration
  - j. Other (please specify)(Note – total should be 100%)

12. What were your total revenues for 2008?
  - a. Overall
  - b. In CT
13. What were your RE revenues in 2008?
  - a. Overall
  - b. In CT

### Perspective on CT Current and Future Industry

14. As a CT business, what do you view as CT's greatest strengths and weaknesses as they relate to the RE sector? What is most critical for building sustained growth of this sector?
15. What are the strengths/weaknesses of Connecticut's labor market vis-à-vis the RE industry? Can you find the ideal people you need to grow your business? If not, what skills and expertise is missing?
16. Do you anticipate growth in the RE activity at your company in the coming years? For what products, services and markets do you see your biggest growth opportunities? Based on what drivers?
17. What factors do you believe will most significantly impact your company and the renewable energy industry over the next 10-15 years? (e.g., policy, disruptive technologies, commodity prices, climate change regulation, economies of scale, etc)?

### Other

18. How are you presently networked within the RE industry (e.g., do you attend RE/EE conferences, belong to trade associations)? Are these helpful? Why or why not?
19. Do you have any other thoughts or comments you would like to share?
20. Is there something you expected me to ask, that I didn't ask?

## NCI identified a total of 72 renewable energy companies in CT.

Number	Interviewed	Company Name	RE Related Resource/Category
1	*	1st Light Energy	Solar
2		4 Elements Group	Multiple
3	*	Aegis Electrical Systems	Solar
4	*	Agni Gencell (previously called Gencell Corp)	Fuel Cell
5	*	Akeena Solar	Solar
6	*	Alteris Renewables	Solar
7		Alternative Energy Solutions, LLC	Multiple
8	*	American Carrera Tech LLC (ACT)	Solar
9	*	American Solar Roof	Solar
10	*	Anderson Electric Power Systems	Solar
11	*	Apollo Solar, Inc.	Solar
12		Avalence Hydrogen	Hydrogen
13	*	Axiome Advisors	Fuel Cell
14		Burrington's Solar Edge	Solar
15		C Solar LLC	Solar
16		Cataelectric Corporation	Fuel Cell
17	*	Consulting Engineering Services	Solar
18	*	Electric Technologies Co.	Solar
19	*	Elyon	Solar
20		ENECO Texas LLC	Multiple
21	*	Enel North America	Hydro
22		Essex Partnership	Hydro
23		Evergreen Energy LLC	Multiple
24	*	Exulans	Wind

Note: This list excludes biofuels but otherwise represents the entire RE industry as defined by this project's scope.

## NCI identified a total of 72 renewable energy companies in CT (cont'd).

Number	Interviewed	Company Name	RE Related Resource/Category
25		Firstlight Power Resources	Hydro
26		FuelCell Energy, Inc.	Fuel Cell
27		Habco	Fuel Cell
28		Imperial Electronic Assembly, Inc.	Fuel Cell
29	*	Infinity Fuel Cell	Fuel Cell
30	*	Lite Trough, LLC	Solar
31	*	Lynco Industries Inc. and AL Group (left RE 2009)	Biomass
32		Mercury Solar Systems LLC	Solar
33	*	Midstate Battery	Storage
34	*	Morningstar Enterprises, Inc.	Solar
35	*	Noble Environmental Power	Wind
36		North American Windpower Magazine	Wind
37	*	On Stat Power	Storage
38	*	Opel International	Solar
39	*	Optical Energy Technologies, Inc.	Solar
40		Optiwind	Wind
41		Pacific Capital Resources, LLC	Multiple
42		Parker Hannifin	Fuel Cell
43		Plainfield Renewable Energy	Biomass
44		Pratt Power	Geothermal
45	*	Proton Energy Systems, Inc.	Hydrogen
46	*	Purepoint Energy	Multiple
47		Putnam Green Power	Hydro
48	*	PV Squared	Solar

Note: This list excludes biofuels but otherwise represents the entire RE industry as defined by this project's scope.

## NCI identified a total of 72 renewable energy companies in CT (cont'd).

Number	Interviewed	Company Name	RE Related Resource/Category
49	*	Reflexite	Solar
50	*	Ross Solar Group	Solar
51		Saft America	Storage
52	*	Schuco USA	Solar
53	*	Shoreline Green Power	Solar
54		Shoreline Mechanical, LLC	Solar
55		Solar and Thermal Systems Inc.	Solar
56		Solarbrite	Solar
57		Sonnenschein Batteries	Storage
58		STR Solar	Solar
59		Summit Hydro LLC	Hydro
60		Sun Electric LLC	Solar
61	*	Sunlight Solar Energy, Inc.	Solar
62	*	Symvoulos	Solar
63	*	Tamarack Energy (division shut down in 2009)	Biomass
64		Theis Precision Steel	Solar
65	*	Trinity Solar	Solar
66		Ulbrich Stainless Steel and Special Metals	Solar
67	*	UTC Power	Fuel Cell
68		Waldo Renewable Electric LLC	Solar
69	*	Westport Solar Consultants	Solar
70		WildWaterPower	Hydro
71		Windham Automated Machines	Hydro
72		Yarde Metals	Solar

Note: This list excludes biofuels but otherwise represents the entire RE industry as defined by this project's scope.

# The EE interview questions are below:

### Your Company

1. Please tell us a little about your role in the company.
2. Describe your overall business. What are your primary products/services?
3. Describe your EE business.
4. What EE products and services do you offer?
5. How do you define EE products? (any criteria, Energy Star, etc)

### Customers

6. Who are the major customers for your EE products/services?
7. How many (or what percentage of) your EE customers are: (1) in CT, (2) in the US but outside CT, (3) international.

### Supply Chain

8. Who are the major suppliers for your products/services? Where are they located?
9. Do you have CT suppliers? Who are they and how important are they to your business?

### Current Jobs and Revenues

10. How many employees did you have in 2008?
  - a. Overall
  - b. In CT
11. How many EE employees did you have in 2008?
  - a. Overall
  - b. In CT
12. What portion of your CT EE employees are in
  - c. R&D
  - d. Manufacturing
  - e. Engineering
  - f. Installation
  - g. Operations & maintenance
  - h. Sales and business development
  - i. Corporate management and administration
  - j. Other (please specify)(Note – total should be 100%)

13. What were your total revenues for 2008?
  - a. Overall
  - b. In CT
14. What were your EE revenues in 2008?
  - a. Overall
  - b. In CT

How much of these revenues came from the utility weatherization program and how many FTEs are associated with that support?

### Perspective on CT Current and Future Industry

15. As a CT business, what do you view as CT's greatest strengths and weaknesses as they relate to the EE sector? What is most critical for building sustained growth of this sector?
16. What are the strengths/weaknesses of Connecticut's labor market vis-à-vis the EE industry? Can you find the ideal people you need to grow your business? If not, what skills and expertise is missing?
17. Do you anticipate growth in the EE activity at your company in the coming years? For what products, services and markets do you see your biggest growth opportunities? Based on what drivers?
18. What factors do you believe will most significantly impact your company and the EE industry over the next 10-15 years? (e.g., policy, disruptive technologies, commodity prices, climate change regulation, economies of scale, etc)?

### Other

19. How are you presently networked within the EE industry (e.g., do you attend EE conferences, belong to trade associations)? Are these helpful? Why or why not?
20. Do you have any other thoughts or comments you would like to share?
21. Is there something you expected me to ask, that I didn't ask?

## NCI identified 97 key energy efficiency companies in CT.

Number	Interviewed	Company Name	Major EE Sub-Area
1		A&M Compressed Air	Commercial and Industrial
2		A&P Supermarkets	Retail/AR
3	*	Access Community Action Agency	Residential (HES/RNC/LI)
4	*	Accurate Electrical Contractors, LLC	Commercial and Industrial
5	*	Action for Bridgeport Community Development	Residential (HES/RNC/LI)
6		Air Compressor Engineering Company	Commercial and Industrial
7	*	Alliance Energy Solutions (AES)	Commercial and Industrial
8		Amaresco	Commercial and Industrial
9	*	American Carrera Tech LLC (ACT)	Small Business
10	*	Appliance Recycling Centers of America, Inc.**	Retail/AR
11		Applied Proactive Technologies (APT)	Retail/AR
12		Automated Building Systems	Commercial and Industrial
13		B V H Integrated Services Inc	Commercial and Industrial
14	*	B&D Controlled Air	Commercial and Industrial
15		Best Buy	Commercial and Industrial
16		Big Y Supermarkets	Retail/AR
17		BJ's Wholesalers	Retail/AR
18	*	Carrier Corp.	Commercial and Industrial
19		Celtic Energy	Commercial and Industrial
20	*	Climate Partners	Residential (HES/RNC/LI)
21	*	Community Action Agency of New Haven	Residential (HES/RNC/LI)
22		Community Renewal Team (CRT)	Residential (HES/RNC/LI)
23	*	Competitive Resources	Residential (HES/RNC/LI)
24	*	Con Serv	Small Business
25	*	Consulting Engineering Services	Residential (HES/RNC/LI)

\*Retail includes retail and appliance recycling companies;

Residential refers to the residential sector companies including home energy services, new construction, and low income weatherization, but does not include companies in education and outreach.

\*\*This is the only appliance recycling company identified in this study.

## NCI identified 97 key energy efficiency companies in CT (cont'd).

Number	Interviewed	Company Name	Major EE Sub-Area
26		Costco	Retail/AR
27		CVS Pharmacy	Retail/AR
28	*	D&M Manson	Commercial and Industrial
29	*	EarthMint	Residential (HES/RNC/LI)
30	*	Eco-Logic Energy Solutions	Commercial and Industrial
31	*	EDM	Commercial and Industrial
32	*	Efficient Lighting	Small Business
33	*	Electric Technologies Co.	Small Business
34		Electric Wholesalers Inc	Wholesale Supplier
35	*	EMCOR (New England Mechanical Services)	Commercial and Industrial
36		Energy Federation Incorporated	Residential (HES/RNC/LI)
37		Energy Resource Group	Residential (HES/RNC/LI)
38		Energy Solutions LLC	Commercial and Industrial
39		Energy Vectors	Commercial and Industrial
40		Engineered Alternatives, Inc.	Commercial and Industrial
41		Evergreen Energy LLC	Residential (HES/RNC/LI)
42		Geissler's Supermarkets	Retail/AR
43		George Ellis Co	Commercial and Industrial
44	*	Grainger	Wholesale Supplier
45		Graybar	Wholesale Supplier
46	*	Green Energy Solutions (aka Tomasko Electric)	Small Business
47		Harry Grodsky	Commercial and Industrial
48	*	Home Depot	Retail/AR
49		Intell Energy	Commercial and Industrial
50	*	Johnson Controls International	Small Business

\*Retail includes retail and appliance recycling companies;

Residential refers to the residential sector companies including home energy services, new construction, and low income weatherization, but does not include companies in education and outreach.

## NCI identified 97 key energy efficiency companies in CT (cont'd).

Number	Interviewed	Company Name	Major EE Sub-Area
51		K-Mart Stores	Retail/AR
52	*	LightStat, Inc.	Commercial and Industrial
53		Lowe's	Retail/AR
54	*	New England Conservation Services	Residential (HES/RNC/LI)
55		New England Energy Management	Small Business
56		New Opportunities of Waterbury	Residential (HES/RNC/LI)
57		Nutmeg Mechanical	HES/RNC
58	*	Nxegen, Inc	Commercial and Industrial
59		Ocean State Job Lot Stores	Retail/AR
60	*	Paquette Electric Co.	Commercial and Industrial
61		PPL Savage Alert, Inc	Commercial and Industrial
62		Practical Energy Solutions LLC	Commercial and Industrial
63		Price Chopper Supermarket	Retail/AR
64	*	Rexel CLS	Wholesale Supplier
65	*	Rise Technologies	Commercial and Industrial
66		Rite-Aid Pharmacy	Retail/AR
67		Sam's Club	Retail/AR
68		Sartron, LLC	Commercial and Industrial
69		Scales Air Compressor Technologies	Commercial and Industrial
70	*	Schuco USA	Commercial and Industrial
71	*	Sears	Retail/AR
72		Sebago Energy Conservation Corp	Commercial and Industrial
73		Sensor Switch	Small Business
74		Shaw's Supermarkets	Retail/AR
75		Shoreline Mechanical, LLC	Residential (HES/RNC/LI)

\*Retail includes retail and appliance recycling companies;

Residential refers to the residential sector companies including home energy services, new construction, and low income weatherization, but does not include companies in education and outreach.

## NCI identified 97 key energy efficiency companies in CT (cont'd).

Number	Interviewed	Company Name	Major EE Sub-Area
76		Siemens	Commercial and Industrial
77		Southport Engineering Assoc.	Commercial and Industrial
78		Staples	Retail/AR
79	*	Steven Winter & Associates	Residential (HES/RNC/LI)
80		Strategic Building Solutions	Commercial and Industrial
81		SunPort	Commercial and Industrial
82		Systems Air Supply	Commercial and Industrial
83	*	TechniArt, Inc.	Retail/AR
84		Trane	Commercial and Industrial
85		Traver Electric Motor Company	Commercial and Industrial
86		Tri-Town Supermarkets	Retail/AR
87	*	Tychon Energy Systems LLC	Small Business
88	*	US Insulation Corp.	Residential (HES/RNC/LI)
89		Van Zelm	Commercial and Industrial
90	*	Vial Electric & Company, Inc.	Wholesale Supplier
91		Viridian Energy and Environmental LLC	Commercial and Industrial
92		Walgreen's Pharmacy	Retail/AR
93		Walmart	Retail/AR
94		Wattsaver Lighting Products	Retail/AR
95		WESCO	Wholesale Supplier
96		Whole Foods Stores	Retail/AR
97		Zerodraft of CT	Residential (HES/RNC/LI)

\*Retail includes retail and appliance recycling companies;

Residential refers to the residential sector companies including home energy services, new construction, and low income weatherization, but does not include companies in education and outreach.

**NCI identified 17 financial investment companies with a portion of their business in clean-tech investments.**

Number	Company Name
1	Asia West
2	CT Innovations
3	Canaan Partners
4	Endeavor Capital Management
5	FE Clean Energy Group
6	First Reserve
7	GE Energy Financial Services
8	Launch Capital
9	Marshall Street Management
10	MissionPoint Capital Partners
11	Oak Investment Partners
12	Pegasus
13	Plainfield Asset Management
14	Starwood Energy
15	Trident
16	U.S. Trust Company
17	Whitney & Company

**NCI identified 20 firms with a significant green building history/LEED knowledge base. A number of LEED-trained architects exist at additional firms; a fraction of these were also included in the job count.**

Number	Architecture Firm
1	Aaron Pine Architects
2	Amenta/Emma Architects
3	Bianco Giolitto Weston Architects
4	BPC Green Builders
5	Centerbrook Architects
6	CK Architects
7	Crosskey Architects
8	Fletcher-Thompson, Inc.
9	Friar Associates
10	JCJ Architecture
11	Pelli Clarke Pelli
12	Perkins + Will
13	Pickard Chilton Architects
14	Rountree Architects
15	SLAM Collaborative
16	Steffian Bradley Architects
17	Steven Winter & Associates
18	Svigals + Partners
19	Tai Soo Kim Partners
20	Tecton Architects

Note: Certain dedicated EE/RE employees were accounted for in the online portion of the study.

**NCI identified 12 higher education institutions with employees engaged directly in EE/RE research and/or post-secondary teaching.**

Number	Institution	Type
1	Central Connecticut State University	University
2	Eastern Connecticut State University	University
3	UConn Storrs	University
4	Yale University	University
5	Fairfield University	College
6	Quinnipiac University	University
7	Saint Joseph College	University
8	University of Bridgeport	University
9	University of Hartford	University
10	Manchester CC	CC
11	Three Rivers CC	CC
12	Naugatuck Valley CC	CC

## NCI identified 8 trade associations/non-profits with an EE or RE-specific focus.

Number	Organization
1	Clean Energy Institute - University of Hartford
2	Connecticut Center for Advanced Technology
3	Connecticut Global Fuel Cell Center
4	CT Green Building Council
5	CT Hydrogen-Fuel Cell Coalition
6	Institute for Sustainable Energy at Eastern CT State University
7	Solar Connecticut
8	Solar Energy Association of Connecticut

Note: Only paid employees based in CT were included in the employee count. Volunteers in board members positions or any other unpaid position were not included.

## NCI identified 4 organizations involved in Education & Outreach.

Number	Organization
1	eesmarts
2	Connecticut Science Center
3	Stepping Stones Museum for Children
4	Institute for Sustainable Energy

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**DECD's charter was to estimate impact of RE/EE industries on the Connecticut economy using a widely accepted policy analysis tool.**

- **Task:** characterize and identify relevant RE/EE industries and economic impact
- **Methodology:** REMI dynamic input/output model
- **Input Data:** Estimated RE/EE employment levels within identified industry categories (NAICS)
- **Output:** Estimate of RE/EE economic and fiscal impact on Connecticut's economy
  - RE/EE jobs



**Navigant survey results fall within the range of employment estimates generated by the DECD.**

	<b>Low Job Estimate</b>	<b>High Job Estimate</b>	<b>Low Estimate: Fraction of State</b>	<b>High Estimate: Fraction of State</b>
Direct Employment	3,661	5,830	0.23%	0.36%
Indirect + Induced Employment	6,002	8,937	0.38%	0.56%
Total Employment	9,663	14,767	0.60%	0.92%

Indirect & induced employment = new jobs created through B2B activity and paycheck spending.

**The DECD study indicates that the relative impact of the RE/EE industry is currently modest**



**The DECD took a “top-down” approach to estimating the economic impact of RE/EE. Total RE/EE employment was calculated using the estimated proportion of RE/EE jobs in identified industry categories.**

- DECD identified 53 industry categories (NAICS) in which RE/EE firms operate.
- The industry categories and proportion of RE/EE employment were estimated using frameworks adapted from other studies, Navigant research results, and DECD professional judgment.
- Included 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.
- Industry categories not relevant to Connecticut, or too small to have a material impact now, were not included. For example, DECD do not include geothermal, ocean wave, tidal, or solar concentrator power generation industries, transportation-related RE/EE industries, consumer electronics manufacturing and distribution industries, recycling, remanufacturing or reuse industries.
- Other states’ studies, notably Colorado and California, include these industries in their RE/EE taxonomy.



## DECD Methodology: RE/EE Industry Mapping to 13 Aggregate Sectors

### RE/EE employment is found in a broad range of NAICS industry segments.

REMI 70-Sector Model NAICS Aggregation	REMI NAICS Sectors	RE/EE Jobs 2007		# Establishments 2007	# Jobs 2007	Payroll 2007
		Low Est.	High Est.			
Forestry and logging; Fishing, hunting, and trapping	113, 114	1	3	10	10	\$293,049
Construction	23	313	805	2,035	16,870	\$944,883,336
Wood product manufacturing	321	19	36	14	74	\$3,368,059
Nonmetallic mineral product manufacturing	327	113	192	18	360	\$13,123,185
Fabricated metal product manufacturing	332	161	251	20	584	\$34,293,651
Machinery manufacturing	333	270	564	53	3,314	\$270,342,179
Computer and electronic product manufacturing	334	89	174	52	2,601	\$175,557,102
Electrical equipment and appliance manufacturing	335	1,530	1,867	83	4,464	\$422,597,479
Plastics and rubber products manufacturing	326	191	267	10	381	\$22,669,380
Wholesale trade	42	470	824	665	7,340	\$711,120,950
Retail trade	44-45	390	577	652	5,814	\$274,880,915
Professional and technical services	54	36	101	180	720	\$62,896,956
Waste management and remediation services	562	80	169	26	411	\$28,990,149
Totals		3,661	5,830			
Average of High-Low Job Est.		4,746				

Data from CT DoL; job estimates from 6-digit detail on following slides

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
238222	Nonresidential 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%	123	184
238221	Residential 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%	101	151
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%	10	40
238312	Nonresidential 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%	48	288
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%	47	93
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%	9	19
333611	Turbine& Turbine Generator Set Units Manuf.	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%	91	181

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	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%	1203	1375
335314	Relay and Industrial Control Mnf	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%	42	84
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%	161	323
334511	<a href="#">Cabin environment indicators, transmitters, and sensors manufacturing</a>	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%	8	40
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%	11	33
238162	Nonresidential 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%	11	43

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Direct Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
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%	1	5
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%	1	4
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%	380	532
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%	36	101
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%	34	68
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%	6	13

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Direct Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
334413	Semiconductor and Related Device Manufacturing	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%	29	58
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%	57	57
238161	Residential 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	5-10%	30-70%	8	39
335110	Electric Lamp Bulb/Parts Mnf	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%	282	395
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%	112	168
238311	Residential 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%	11	66

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Direct Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
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%	2	12
326150	Urethane and Other Foam Product (except Polystyrene) Manufacturing	This industry comprises establishments primarily engaged in manufacturing plastics foam products (except polystyrene).	50-70%	100%	191	267
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%	83	162
332913	Faucets, plumbing, manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing metal and plastics plumbing fixture fittings and trim, such as faucets, flush valves, and shower heads.	50-70%	100%	158	221
333319	Ovens, commercial-type, manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing commercial and service industry equipment (except automatic vending machines, commercial laundry, drycleaning and pressing machines, office machinery, optical instruments and lenses, and photographic and photocopying equipment).	10-30%	100%	30	90
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%	74	145

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Direct Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
333411	Air Purification Equipment Manufacturing	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%	65	126
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%	49	97
333414	Heating equipment, hot water, (except hot water heaters) manuf.	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%	48	95
332410	Power Boiler and Heat Exchanger Manufacturing	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%	1	26
333415	Heat pumps manuf. + Heating & air conditioning combo units manuf.	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%	31	60
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%	6	24

# DECD Methodology: RE/EE Industry Mapping: 53 RE/EE Industries' Direct Job Estimates

NAICS	NAICS Description	Detailed Description	RE/EE Industry Share	RE/EE Job Share	Low Job Est.	High Job Est.
334512	Temperature controls, automatic, residential and commercial-types, manufacturing + Building services monitoring controls, automatic, manufacturing	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%	52	72
332420	Digesters, industrial-type, heavy gauge metal, manufacturing	This industry comprises establishments primarily engaged in cutting, forming, and joining heavy gauge metal to manufacture tanks, vessels, and other containers.	5-10%	50%	2	4
321911	Wood window & Door manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing window and door units, sash, window and door frames, and doors from wood or wood clad with metal or plastics.	50-70%	50-70%	19	36
327993	Mineral Wool Manufacturing	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%	30	30
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%	1	3

- Further Reading (literature review, detailed industry and REMI analysis):

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



March 2009

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With Research assistance from Shadab Qaiser and Jesse Kalinowski

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- Connecticut Business & Industries Association (CBIA)
- Connecticut Clean Energy Fund (CCEF)
- Connecticut Light & Power (CL&P)
- Department of Economic & Community Development (DECD)
- Eastern Connecticut State University Institute for Sustainable Energy
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