“Green” Jobs in the Hydrogen Industry

Hydrogen and Fuel Cell Technical Advisory Committee

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Connecticut Center for Advance Technology, Inc

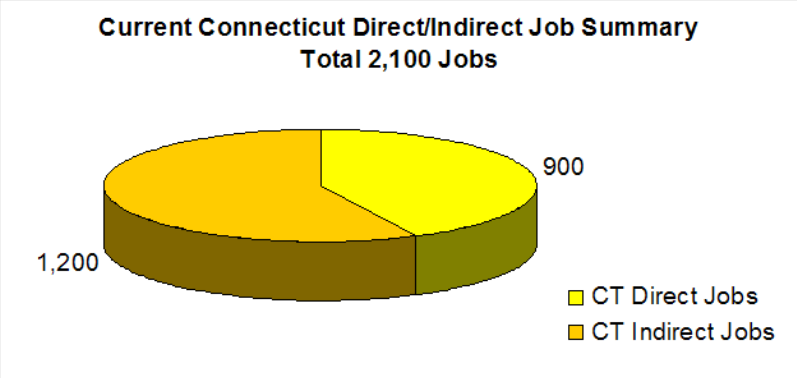
Joel M. Rinebold – Director of Energy Initiatives, CCAT

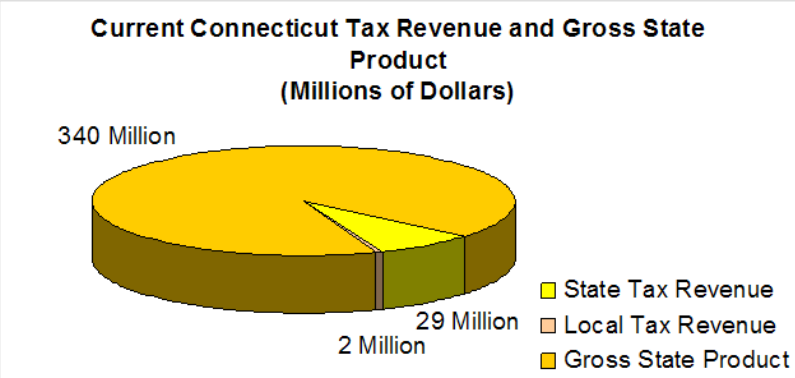
Drivers for Market Growth

- World electric consumption is projected to more than double between 2003 and 2030.
- Transportation demands for petroleum currently exceed domestic supply. Alternative fuels will be required for energy security.
- Increased energy efficiency for transportation and electric generation will be required by all global consumers as traditional fuel prices increase, i.e. oil prices per barrel increases over $150.
- Reduced emissions of GHG and primary air pollutant mandates for mobile and stationary applications.

Connecticut Market Growth

- In 2006, there were over 900 jobs associated with research and development and manufacture of equipment.
- Over 1,200 indirect jobs in 2006.
- The industry contributed $29 million in local tax revenue, and over $340 million in gross state product in 2006.





Industry Employment

Industry Employment			
	2006	2007	2010 (Estimated)
Direct Employment	927 Jobs	1,156 Jobs	1,635 Jobs
Indirect Employment	1,214 Jobs	1,514 Jobs	2,142 Jobs
Total Employment	2,141 Jobs	2,670 Jobs	3,777 Jobs

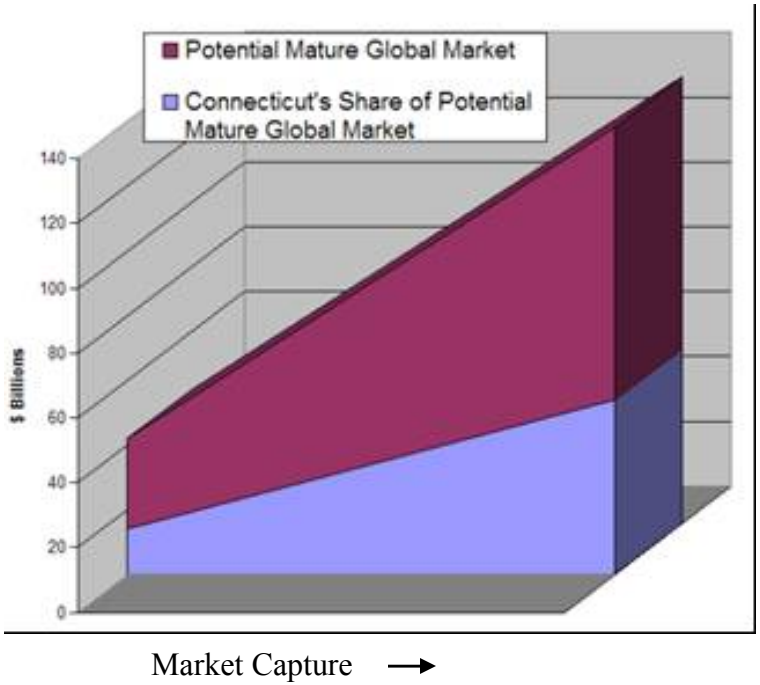
- Job growth directly associated with the industry is estimated to grow in Connecticut by over 700 jobs between 2006 and 2010, however such growth would be modest compared to potential applications of a mature market.
- Connecticut's hydrogen and fuel cell industry presently employs 1,156 employees, an increase of 229 jobs since early 2006.
- Direct and indirect jobs would increase form 2,141 in 2006 to over 3,700 by 2010.

Economic Multipliers

Economic Multipliers			
	Employment	**Industry Revenues**	**Employee Compensation**
Multiplier	**2.31**	**1.84**	**1.72**

- For each job the hydrogen and fuel cell industry directly supports, an additional 1.31 jobs are indirectly supported elsewhere in Connecticut.
- For every $1.00 of revenue generated by industry, and additional 84 cents of revenue is received by the state of Connecticut.
- For every $1.00 paid to industry employees, an additional 72 cents is paid by other employers in the supply chain.

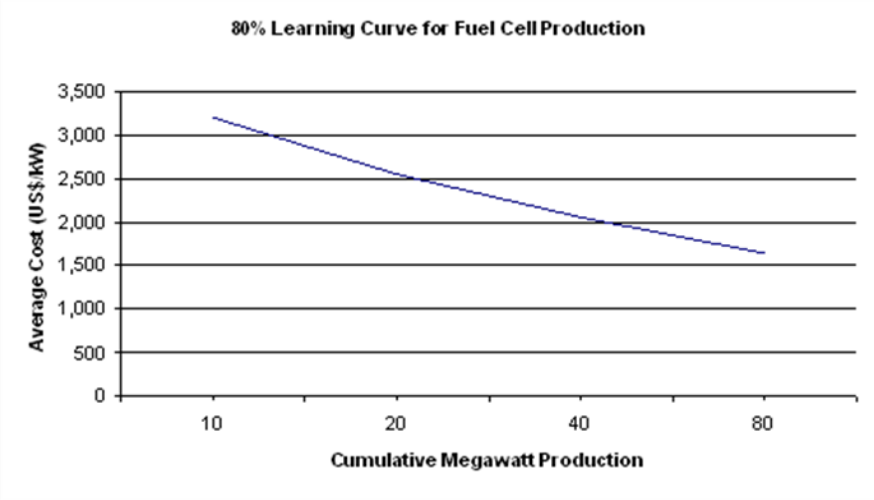
Potential Mature Global Market



- Fuel cells could capture approximately 6,700 MW of the global distributed generation market annually. Additionally, fuel cells could also capture 7,000 MW of demand for distributed generation in the U.S. between 2010 and 2020.
- A mature global market could generate between $43 and $139 billion annually.
- In the transportation market, assuming movement toward a mature market, total global fuel cell revenues could be between $11 and $45 billion annually.
- A mature market would require an employment base of tens of thousands.

Reducing Production Cost

- Increased production rates and improved design and technology will reduce unit costs.
- An increase in production from 10 MW per year to 40 MW per year could drop unit costs from $3,200 per kW to ~$2,000 per kW.
- Hydrogen and fuel cell industries can reduce unit costs and capture a larger market share of the global market with a minimum investment to produce 40 MW to 80 MW of fuel cell capacity, annually.



Connecticut Supply Chain

- There are opportunities for further supply chain development for fuel cell manufacturing.
- Many companies have the capability to be part of the fuel cell supply chain to provide materials for the manufacture of fuel cells and hydrogen equipment.
- The future state of a hydrogen and fuel cell supply chain can conceivably consist of hundreds of suppliers and tens of thousands of employees.

Connecticut OEM Activities	
What do Connecticut OEMs currently do?	**What do Connecticut OEMs currently make?**
• **Manufacture** • **Repair** • **Refurbish** • **Test** • **Assemble** • **Install**	• **Turn-key fuel cell systems** • **Fuel cell stacks** • **Fuel cell plates** • **BOP equipment** • **Hydrogen production equipment**

Supply Chain (Jobs) Summary

- Based on approximately 2,400 jobs associated with the current production of approximately 10 MW in Connecticut:

  A relationship of 240 jobs per MW exists; production of 50 MW would involve approximately 12,000 jobs.

- Based on an existing $340 million in gross state product per 10 MW of production and 2,400 jobs in Connecticut:

  A relationship of $34 million of gross state product exists per MW; approximately $1.7 billion of gross product would be generated for an output of 50 MW.

- Based on a state tax revenue of $29 million and local tax revenue of $2 million and a current production of approximately 10 MW in Connecticut:

  A relationship of $3,100,000 of state and local tax revenue exists per MW; approximately $155 million of state and local tax revenue would be generated with an output of 50 MW.

Conclusion

- Favorable market conditions for investment and the creation of jobs in the hydrogen and fuel cell industry.
- Support for an annual minimum development of 40 to 50 MW of fuel cell power facilities would create 12,000 jobs and $1.7 billion of gross domestic product.
- Government investment in a block of fuel cell capacity would create “green jobs” while simultaneously producing needed “green energy” to both stimulate the economy and protect the environment.
- Timing to move forward with an investment initiative is appropriate to capture early markets for future global market penetration.

Joel M. Rinebold

Telephone: (860) 291-8832

Email: jrinebold@ccat.us

Web: www.ccat.us

Connecticut Center for Advanced Technology (CCAT)