ECONOMIC IMPACT OF THE CONNECTICUT HYDROGEN AND FUEL CELL INDUSTRY

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The Northeast Electrochemical Energy Storage Cluster (NEESC)[1] completed a REMI economic analysis of the hydrogen and fuel cell industry in Connecticut and a second IMPLAN[2] economic analysis of the region's hydrogen and fuel cell industry to assess the growth and trends of the industry since it was last analyzed in 2012. The region consists of the Northeast states from Maine to New Jersey. The supply chain for the hydrogen and fuel cell industry includes original equipment manufacturers (OEMs) and suppliers. The studies' findings suggest that the hydrogen and fuel cell industry in the Northeast region experienced growth since 2012 based on several factors including employment, revenue and investment, labor income, and state and local tax revenue.

Connecticut's hydrogen and fuel cell supply chain had a significant bearing on the local and regional economy contributing over $726 million in revenue and investment to the regional economy of $1.4 billion; more than 3,406 direct, indirect and induced jobs to the regional employment base of 6,558; and $340 million in labor income to the regional income level of approximately $620 million.[3] The growth of the hydrogen fuel cell industry in 2015 for Connecticut and the region is shown below:

	CT Economic Indicators	Northeast Economic Indicators
OEMs	**10**	**30**
Supply Chain Members	**611**	**1,231**
Direct Jobs	**1,133**	**1,806**
Total Rev & Investment ($M)	**$726**	**$1,421**
Total Jobs	**3,406**	**6,558**
Total Labor Income ($M)	**$340**	**$620**

[1] NEESC is a cluster network of industry, academic, government and non-governmental leaders focused on the innovative development, production, promotion and deployment of hydrogen and fuel cell products. The cluster is based in the New England States, New York and New Jersey. The NEESC program is funded through the US Small Business Administration's Innovative Economies Initiative. The Connecticut Center for Advanced Technology administers NEESC and the Connecticut Hydrogen-Fuel Cell Coalition.

[2] An IMPLAN is an economic impact analysis tool that combines databases concerning economic factors, multipliers and demographic statistics with modeling software. IMPLAN allows the user to develop input-output models that can estimate the economic impact of certain activities, including the direct, indirect and induced impacts by sector using industry-specific multipliers, local purchase coefficients, and income-to-output ratios. The REMI model is a dynamic forecasting and policy analysis tool that integrates several modeling approaches to inform and improve the quality of public policy decisions.

[3] This IMPLAN analysis was completed in late 2016 and based on the most recent 2015 data to update the 2012 IMPLAN analysis. Revenue, jobs, and income includes direct, indirect, and induced impacts.

Key State and Regional findings from the IMPLAN economic analysis include:

- The Connecticut hydrogen and fuel cell industry has a total economic impact of an estimated $726 million in revenue and investment and $340 million in labor income.

- Within the Northeast region, the industry's largest impacts are felt in Connecticut (e.g., total employment impact of 3,406 workers), New York (e.g., total employment impact of 1,618 workers), and Massachusetts (e.g., total employment impact of 1,138 workers).[4]

- Several states in the region, e.g., Connecticut, Massachusetts, New Jersey, and New York, are among the top locations for the hydrogen and fuel cell industry, based on their current activities or potential for future growth.

Key Connecticut REMI findings include:[5]

- The fuel cell industry, in which Connecticut is a leading player, is expected to grow rapidly. Global Market Insights projects sales of $25.5 billion by 2024 with double-digit annual growth in virtually all markets.[6]

- The fuel cell industry would be a major contributor in restoring Connecticut's economic vitality, particularly in retaining high tech research and advanced manufacturing jobs, generating increased investments, and delivering more tax revenue.

Key National findings:

- Connecticut is ranked third for US fuel cell patents for the period from 2002 to 2015.[7]

- Approximately 30 percent of the nation's fuel cell jobs are located in Connecticut.[8]

The studies identify the geographic concentration of OEMs and supply chain companies in the Northeast and confirms Connecticut as the hub of the region and a global leader in the hydrogen and fuel cell sector with all of the hallmarks of a vibrant and strong cluster. This cluster provides benefits to its companies (including suppliers) and workers, and the entire region. The proximity of the OEMs and supply chain companies in this cluster has provided a competitive advantage for research, design, development, manufacturing, and export of commercial products to national and international markets.

The ultimate drivers for business development and markets for commercial deployment can be divided into a stationary market for fuel cell distributed generation (DG) and a transportation market for fuel cell electric vehicles (FCEVs) and fuel cell electric buses (FCEB) with hydrogen refueling.

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[4] Recent reductions in the OEM workforce in 2016, estimated at 400 direct jobs, have not been determined to be either temporary or permanent, and have not been assessed for impact on the entire supply chain.
[5] Connecticut Center for Economic Analysis (CCEA); "Projecting the Economic Impact of an Expanding Connecticut Fuel Cell Energy Sector 2017 -2042;" November 10, 2016.
[6] Global Market Insights; http://www.globalinsights.com/index.php/design-and-features; November 2016.
[7] Clean Energy Patent Growth Index (CEPGI) - 2015 Year in Review, published by the Cleantech Group at Heslin Rothenberg Farley & Mesiti P.C.
[8] Excludes "Motor Vehicles" employment. U.S. Energy and Employment Report, p. 62 and 2015 IMPLAN Study, 2015 Northeast employment data. Employment data for remainder of US estimated.

Locations where stationary fuel cell installations for DG are both technically and economically viable include a wide range of private, state, and federal buildings for offices, energy intensive industries, data management, education, food sales and services, lodging, in-patient healthcare, and public order and safety. Similarly, fuel cell installations are potentially viable at wastewater treatment plants, landfills, telecommunications towers, seaports, high traffic airports, and for electric grid service. This configuration will also increase local end user reliability, which is of high value for business and industry. NEESC has identified the near term potential to install 170 megawatts at over 1,100 potential stationary fuel cell sites located in Connecticut. The market potential for stationary fuel cell deployment with clean, reliable, cost effective, and on-site generation is substantial and is projected to grow.[9]

Potential Stationary Fuel Cell Sites

- Education
- Data Management
- Food Sales & Services
- Inpatient Healthcare & Lodging
- Public Order and Safety
- Large Retail
- Energy Intensive Industries
- Government Operated Buildings
- Telecommunication Towers
- Wastewater Treatment Plants & Landfills
- Airports & Ports / Military

Locations for FCEVs and hydrogen refueling would be technically and economically viable in urban areas where fleets, early market adopters, and hydrogen producers exist. Similarly, fuel cell powered material handling equipment, aircraft tugs, and street sweepers would be technically and economically viable at warehouses, airports, construction sites, manufacturing plants, and wholesalers. Concentration of early market adopters and fleets could serve as pilot locations for FCEV and FCEB deployment with hydrogen refueling. NEESC has identified over 11,725 registered fleet vehicles and approximately 921 transit buses in Connecticut for near-term replacement with 591 FCEVs, which would include 548 passenger fleet vehicles and 43 transit/paratransit buses. NEESC recommends six to seven hydrogen refueling stations be developed initially to support FCEVs and FCEBs. The deployment of zero emission FCEVs and FCEBs is expected to grow as hydrogen infrastructure is developed.[10]

Potential Hydrogen Refueling Sites

- Current Gasoline Stations
- Alternative Fueling Stations
- DOT Owned Sites
- Distribution Center/Warehouses
- Ports/Airports

Registered Fleet Vehicle Inventory

- Private Fleet Vehicles
- Federally Owned Passenger Cars
- Directly Operated Transit Buses

Hydrogen and fuel cell technology provides an opportunity for Connecticut to more fully utilize its renewable energy industry using hydrogen and fuel cells for transportation, energy storage, and production of power at consumer sites. Moreover, the local supply chain industry provides Connecticut an opportunity for economic development using locally manufactured clean energy technology to improve energy reliability and environmental performance. Such use continues to make the state a showcase for renewable energy while reducing greenhouse gas (GHG) emissions as new jobs are created.

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[9] NEESC had previously identified approximately 1,804 sites in Connecticut that could support the development of 420 MW – 460 MW of power capacity for the industry sectors over the long term using an aggressive adoption algorithm. The more aggressive adoption algorithm that includes a higher percentage of penetration for potential stationary fuel cell sites would expand the market potential from 170 MW at 1,139 sites to 420 MW – 460 MW at 1,804 sites.

[10] Proton OnSite has announced the upgrade of its hydrogen refueling station in Wallingford, CT, and Air Liquide has announced locations for four (of twelve) hydrogen fueling stations planned for the Northeast region of the United States. These locations for hydrogen stations will be located in Hartford, CT, Braintree, MA, Mansfield, MA, and Bronx, NY.