H₂USA

Siting Refueling Stations in the Northeast

Overview

Fuel cell electric vehicles (FCEVs) are advanced zero-emission vehicles with the promise to improve energy security, eliminate urban air pollution, and reduce greenhouse gas emissions. FCEVs can refuel to a range of 300-350 miles in only 3-5 minutes. While several FCEV models are commercially available today, most retail hydrogen stations in the United States are located in California. FCEV sales are therefore limited to customers with access to hydrogen stations in California. As of April 2017, there were 6 private hydrogen stations operating in the Northeast, only some of which can be accessed with automaker approval.[1] A network of 12 new fully public retail stations is currently under construction in the Northeast and will be operational by the end of 2018.

To achieve cost-effective deployment of both FCEVS and hydrogen stations, the number of vehicles and public stations must grow together in areas of highest demand. But where will demand be highest? And which station locations will best serve that demand? Fortunately, the Northeast can build on California's pioneering hydrogen deployment activities by employing computer simulation tools to align projected fuel supply and FCEV demand. This fact sheet introduces two advanced modeling tools and presents preliminary analysis of the hydrogen refueling station locations needed to support early consumer demand for FCEVs in the Northeast.

Station Growth over Time

Figure 1 shows a projected growth trajectory for publicly available hydrogen refueling stations in the Northeast, based on discussions with H2USA stakeholders about regional FCEV deployment. A more rigorous approach would replace such discussions with automaker deployment volume surveys and additional detailed analyses along the lines of the process used in California (described below). For this preliminary projection, however, about 50 stations are established by 2022 and about 250 stations are established by 2027. For simplification, discussions in the following sections address hydrogen station installations at these two projected levels of FCEV market growth.

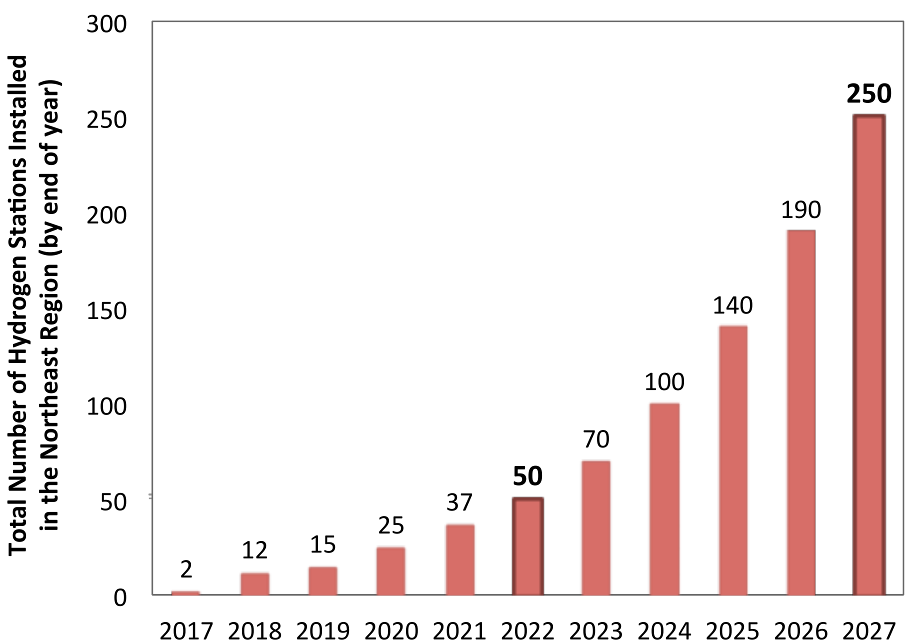

Figure 1. Preliminary projected growth of publicly available hydrogen refueling stations in the Northeast

[1] For current information on hydrogen and other alternative fuel stations, see the U.S. Department of Energy's Alternative Fueling Station Locator on the Alterative Fuels Data Center (AFDC) website: http://www.afdc.energy.gov/locator/stations

Modeling Hydrogen Refueling Station Deployment with STREET and SERA

For hydrogen refueling station deployment locations in California, state agency policymakers have relied on the Spatially and Temporally Resolved Energy and Environment Tool, or STREET model. This model, developed at the University of California—Irvine, optimizes the number and placement of stations needed to enable commercial-scale FCEV introduction, as well as the resulting environmental impacts. Its optimization routine considers an area's existing road infrastructure and household driving patterns to determine the driving times required for FCEV drivers to reach proposed hydrogen station locations. These drive time results are a measure of station network convenience for potential consumers in a given city or neighborhood. During the early years of introducing FCEVs, convenience for early adopters is of primary concern. For FCEV introduction to be successful, a consumer-friendly hydrogen station network is necessary to give drivers confidence in the availability of convenient refueling locally and regionally.

California stakeholders used automaker deployment volume surveys, market and consumer-behavior analysis, and STREET modeling to identify 68 initial station locations that would enable FCEV introduction within and between five of the state's major urban clusters. This station roadmap then helped inform station and vehicle subsidy and investment decisions. Subsequently, another round of automaker deployment volume surveys and STREET analysis identified the need for additional stations, which were incorporated into the roadmap. This iterative process continues to guide California's policymakers, FCEV manufacturers, station developers, and other stakeholders to optimize the use of public and private resources. This same process can be relied upon to help guide the introduction of FCEVs and hydrogen stations in the Northeast.[2]

Another tool for optimizing hydrogen refueling station placement is the Scenario Evaluation, Regionalization and Analysis (SERA) model, developed by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). The SERA model determines the most cost-effective hydrogen infrastructure supply options to satisfy projected vehicle demand over time, drawing upon detailed cost analyses of a broad range of hydrogen production and delivery systems and network configurations. SERA also estimates convenience to consumers based upon a station placement algorithm, and is linked with a powerful suite of additional analytical tools, including financial analyses and estimates of life cycle greenhouse gas emissions.[3] Both the STREET and SERA models have been developed specifically to address hydrogen station placement questions and infrastructure cost analyses. An example of an empirically-based, commercial capability serving the private-sector gasoline station market is the suite of tools offered by Kalibrate, including detailed station location analyses, competitive market assessments, and fuel pricing algorithms (see website link below). The STREET and SERA model results presented in this fact sheet draw from these valuable learnings.

Modeled Distribution of Hydrogen Refueling Stations across the Northeast

The first map in Figure 2 shows placement results for 50 hydrogen stations in 2022, based upon a combination of station locations generated using the STREET and SERA models. In this early stage, the stations concentrate in major metropolitan areas: New York, Washington DC, and Boston. In addition, three connector stations (shown as green dots) support travel along three corridors: Northeast Inland, Mid Atlantic, and Norfolk. Four stations provide FCEV owners access to a select number of remote destinations (red dots), and two early market stations (blue dots) are projected for Philadelphia and Providence, targeting neighborhoods with high concentrations of early adopters. Thirteen existing or planned stations are also indicated (yellow dots).

The second map in Figure 2 shows placement results for 250 stations in 2027. The major metro areas still account for most of the stations: New York, Washington DC, Baltimore, Boston, and Philadelphia. Now, however, 20 connector stations complete three additional corridors (Northern, Western, and Southern) and provide a higher level of refueling availability across the region. The number of early market stations has increased, providing early adopters with access to local stations in Rochester, Albany, Hartford, Providence, Richmond, and Virginia Beach. Destination stations are located in Burlington and State College. These maps represent a synthesis of modeling results for high-priority hydrogen station locations, resulting in a convenient and consumer-friendly network of hydrogen stations for early FCEV customers.

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[2] The most recent results from the California annual automaker survey were published in June 2016, and are available online: http://www.arb.ca.gov/msprog/zevprog/ab8/ab8_report_2016.pdf

[3] The SERA model's financing capabilities are consistent with H2FAST, an online tool that can be used to estimate the cost of hydrogen under a range of cost inputs and financial assumptions: http://www.nrel.gov/hydrogen/h2fast/

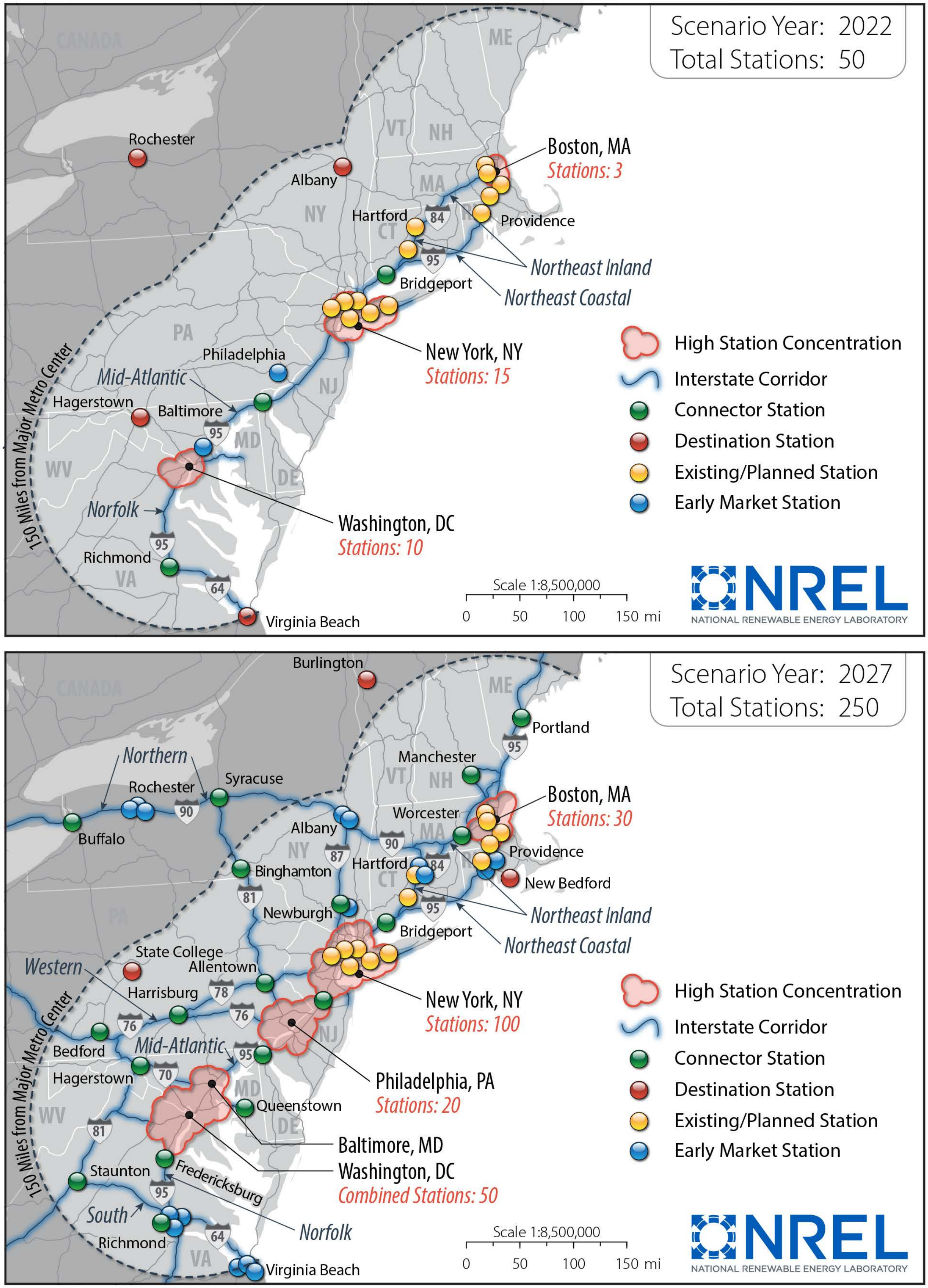

Figure 2. Average of STREET and SERA hydrogen station placement results in 2022 and 2027

Deployment in Fleets

It should be noted that in addition to the retail consumer market, FCEVs can also be sold into commercial and government fleets. The Connecticut Center for Advanced Technology Inc. (CCAT), working with the US Small Business Administration (SBA) supported Northeast Electrochemical Energy Storage Cluster (NEESC), has developed a 2016 Northeast Regional Economy "Fuel Cell Electric Vehicle Fleet Deployment Plan" (Northeast Regional Fleet Plan). This plan for deploying commercial and government FCEVs shows the concentration of potential market opportunities in Northeast urban centers. For a comprehensive discussion of station requirements and opportunities for FCEVs in commercial and government fleets, see the CCAT Northeast Regional Fleet Plan (http://neesc.org/publications/).

Station Clustering Example: New York

Given the regional discussion above, below is an example of station clustering in the New York region. At a detailed level, early hydrogen stations are concentrated in early adopter clusters within major metropolitan regions. To illustrate, Figure 3 shows four early clusters in the New York region around 2021, after after 5 years of developing the East Coast network (orange clusters). In about 2027, two additional clusters are developed (purple clusters), for a total of six clusters and ~100 hydrogen stations to cover the New York Region: Long Island (25), Manhattan (16), Bergen County, NJ (27), Stamford, CT (14), Hazlet-Tinton Falls, NJ (11), and the Lower/Mid-Hudson region (7). These results are indicative of the types of detailed location analyses used to plan hydrogen station rollout dynamics in California. Links to additional resources on location models and H2USA are provided below.

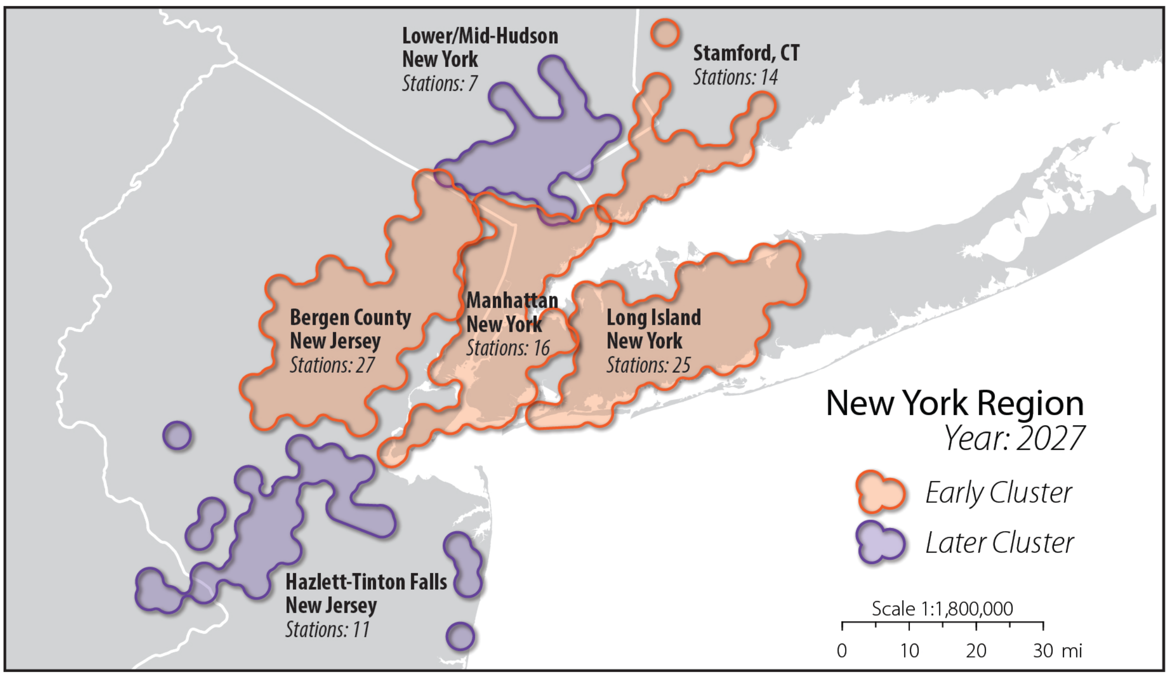

Figure 3. Clusters from STREET and SERA station placement results for the New York region in 2027

H2USA is a public-private partnership to promote the commercial introduction and widespread adoption of hydrogen fueled fuel cell electric vehicles across America. H2USA's mission is to address hurdles to establishing hydrogen fueling infrastructure, enabling the large scale adoption of fuel cell electric vehicles.

H2USA

More Information

For more information about the STREET model or to explore the potential for custom analyses, contact the Advanced Power and Energy Program at the University of California–Irvine via www.apep.uci.edu/3. For the SERA model, contact NREL's Systems Analysis group via www.nrel.gov/hydrogen/proj_analysis.html. For more information about Kalibrate, visit: http://www.kalibrate.com. For more information about H2USA visit the website at http://h2usa.org.