**Final Scientific Report**

**Government FY2012 Q1**

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## I. Executive Summary

Under the leadership of the Department of Energy's Hydrogen and Fuel Cells program, Clean Energy States Alliance (CESA) educated and worked with state leaders to encourage wider deployment of fuel cell and hydrogen technologies. Through outreach to state policymakers, legislative leaders, clean energy funds, energy agencies, and public utility commissions, CESA worked to accomplish the following objectives of this project:

1. Provide information and technical assistance to state policy leaders and state renewable energy programs in the development of effective hydrogen fuel cell programs.
2. Identify and foster hydrogen program best practices.
3. Identify and promote strategic opportunities for states and the Department of Energy (DOE) to advance hydrogen technology deployment through partnerships, collaboration, and targeted activities.

Over the three years of this project, CESA, with our partner National Conference of State Legislatures (NCSL), was able to provide credible information on fuel cell policies, finance, and technical assistance to hundreds of state officials and other stakeholders. CESA worked with its membership network to effectively educate state clean energy policymakers, program managers, and decision makers about fuel cell and hydrogen technologies and the efforts by states to advance those technologies. With the assistance of NCSL, CESA gained access to an effective forum for outreach and communication with state legislators from all 50 states on hydrogen issues and policies. This project worked to educate policymakers and stakeholders with the potential to develop and deploy stationary and portable fuel cell technologies.

The outputs of this project included:

(1) Educational materials, case studies, reports, technical overviews, and analysis regarding current state efforts, opportunities, best practices, and funding assistance mechanisms in use to advance fuel cell and hydrogen applications and markets.

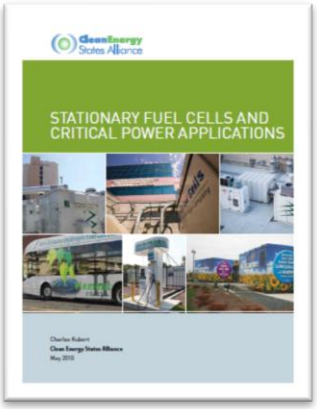
(2) Webinars with audiences of more than 250 people on fuel cell and hydrogen applications and markets, and the ways in which states can best advance the commercialization of fuel cell and hydrogen technologies.

(3) Recommendations regarding the creation and promotion of effective policies, programs, and financing mechanisms to promote fuel cell project deployment at the state level.

(4) Extensive communication among CESA member states, Clean Energy Group, the National Conference of State Legislatures, DOE, and various organizations working to advance fuel cells at the state level.

(5) A fuel cell and hydrogen webpage and listserv for CESA members and state leaders for posting of current information on state hydrogen activities, trends, and program elements.

Deliverables under this project included a report produced by Tim Lipman on *An Overview of Hydrogen Production and Storage Systems with Renewable Case Studies* as well as five (5) CESA briefing papers that were disseminated to state policymakers. The briefing papers covered the following topics:




- **Fuel Cell Technology: An Overview**
- **Advancing Fuel Cells through State Policies**
- **Hydrogen Production and Storage**
- **Fuel Cells and Critical Power Applications**
- **Fuel Cells for Supermarkets**

In addition to electronically sending the report and briefing papers to a large list of state policymakers and fuel cell stakeholders, CESA developed a printed compilation booklet that contained all of the papers. CESA then circulated it widely to state clean energy funds, state clean energy offices, and public utility commissions in all 50 states. This publication provides state policymakers with a handy reference work specifically designed for them that includes essential background information on fuel cells. More than 400 state policymakers received the booklet, including ones distributed by our partner, the National Council of State Legislatures.

Other deliverables included more than 10 webinars, periodic conference calls among DOE's fuel cell grantees, and case studies, most of which were incorporated into briefing papers and reports, as well as a free-standing one on the state of California's support for an installation at Gills Onions.

The impacts of this project included:

1. More than 1,000 state policymakers became more informed about fuel cell technologies, especially the advances in fuel cell performance and reliability in recent years. This should make them more likely to be interested in providing support for fuel cell development and installations in the future.

2. CESA convinced specific policymakers from CESA-member states and others to give additional consideration to fuel cells and to explore new fuel cell policy initiatives.

3. CESA's leadership of monthly calls with DOE's fuel cell state grantees and outreach to 10 individual grantees encouraged greater cooperation and collaboration among those grantees.

4. The Fuel Cells for Supermarkets webinar stimulated more than 20 end users to contact NYSERDA to learn more about its fuel cell programs and to explore opportunities to install fuel cells.

## II. Summary of Goals, Accomplishments, and Products

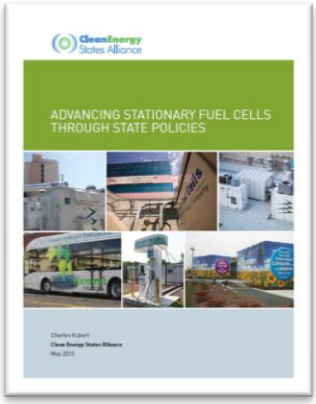
**(**Links to the major deliverables under this grant can be found on the Clean Energy States Alliance web site at: http://www.cleanenergystates.org/projects/hydrogen-and-fuel-cells/hydrogen-and-fuel-cell-resource-library/**)**

### (1) Task 1 – Identification and Promotion of Best Practices

CESA surveyed existing state hydrogen and fuel cell programs to identify and promote best practices and to develop case studies of exemplary programs.

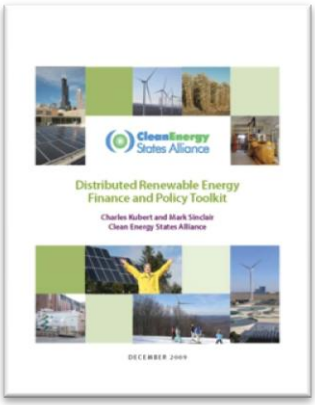
***Subtask 1.1: State Fuel Cell and Hydrogen Programs Survey.***
CESA surveyed current fuel cell and hydrogen programs of CESA member states and other innovative programs from non-member states. This review included topics such as funding mechanisms (including for example, tax incentives and subsidies), feedstock specifications, renewable portfolio standards (RPS) set-asides, standby charges, public-private partnerships, and other significant programmatic components that may help or hinder the development and deployment of fuel cell technologies. The following reports were the results of those activities.

- **"Stationary Fuel Cells: Current Status and Policy Efforts to Promote Further Commercialization."** (Draft report, by CESA consultant Tim Lipman, submitted to DOE, October 2009) (CESA did not finalize this report as a similar report was developed by Fuel Cells 2000).




- **Fuel Cells: Briefing Papers for State Policy Makers** (August 2011). This collection of the five briefing papers prepared by CESA, details best practices by state programs and highlighted major fuel cell installations around the country that were supported by state policies and incentives. In particular, "Advancing Stationary Fuel Cells through State Policies" provides an overview of how targeted policies can play an important role both in increasing fuel cell installations and in growing the fuel cell manufacturing industry.

***Subtask 1.2: Recommendations Report*.**
Using the information obtained by the Task 1.0 survey, CESA worked with CESA state members with advanced hydrogen and/or fuel cell programs (for example, California, Connecticut, New York, and Ohio), DOE, and other state leaders to identify and promote the adoption of best practices and innovative state hydrogen and fuel cell policies and programs. As part of this task, CESA identified and provides recommendations to DOE and states on model state incentive programs and other funding and policy mechanisms to advance markets for hydrogen and fuels cell technologies. CESA worked to identify new strategies for fuel cell incentives and other programmatic activities state policy makers could take to help the overall costs of fuel cell deployment. Key findings were summarized and shared with CESA members and DOE HFCIT staff and posted on a fuel cell and hydrogen web page (see Subtask 3.2).



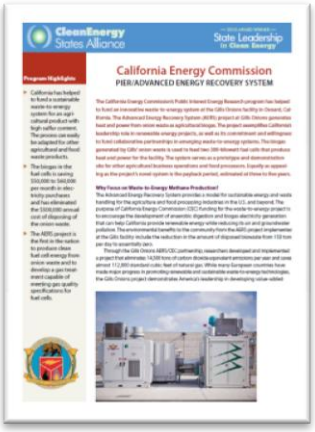

- **Distributed Renewable Energy Finance and Policy Toolkit**,(December 2009) This report describes the many financing options available to state energy offices, municipal governments, and other state energy agencies for utilizing public funds for clean energy project support, including fuel cells.

***Subtask 1.3: Preparation of Case Studies.***
CESA prepared and distributed case studies of leading state fuel cell and hydrogen programs. These case studies identified best practices for state decision makers

interested in developing effective hydrogen and fuel cell programs. Case studies will be posted on the CESA website's section for this Hydrogen Education State Partnership Project.

- Short case studies of fuel cell installations were included in the various briefing papers. Longer case studies related to renewable hydrogen were included in the report on An Overview of Hydrogen Production and Storage Systems with Renewable Case Studies and focused on:

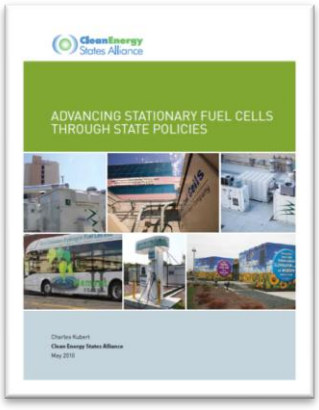
    a. Honda's Solar Photovoltaic Hydrogen Electrolysis Station
    b. Fuel Cell Energy and Air Products and Chemicals, Inc. Hydrogen and Electricity "Tri-generation" System
    c. Napa Wine Company – Hydrogen Production by Microbial Electrolysis




- CESA produced a special case study of the waste-to-energy fuel cell system at Gills Onions. The California Energy Commission's involvement in this project won a CESA *State Leadership in Clean Energy Award* in 2010.

***Subtask 1.4: Sample Policies and Programs***

Following up on the Recommendations Report and Case Studies, CESA, with NCSL assistance, prepared and distributed sample "best practice" policies and programs outlining the components of effective state hydrogen and fuel cell policy and incentive strategies. CESA and NCSL highlighted policy and program measures that could be considered for supporting effective state hydrogen and fuel cell initiatives, including state funding, tax incentives, technology support efforts, and targeted market efforts such as inclusion of fuel cells in public facilities for power quality and reliability. CESA also examined how programs and policies could help develop niche market applications, such as use in critical infrastructure facilities, and economies of scale for fuel cell technologies.




- CESA's briefing paper, **Advancing Stationary Fuel Cells Through State Policies** (May 2010) offers many examples of state policies, programs, and incentives that states can adopt to support fuel cell and hydrogen technologies.

- **Fuel Cells: State Funding and Policies to Support Fuel Cell Deployments** (October 2010, CESA membership meeting, Washington, DC). This workshop, attended by state and municipal clean energy fund managers, discussed the fuel cell program and lessons learned from NYSERDA and the Long Island Power Authority. It also provided a briefing regarding state and federal policies supporting fuel cells.

- CESA's partner, NCSL, developed a webpage, **Fuel Cells – Clean and Reliable Energy,** which lists state programs for fuel cell incentives and support.

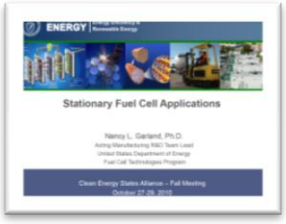

## (2) Task 2 - State Policymaker Technical Assistance

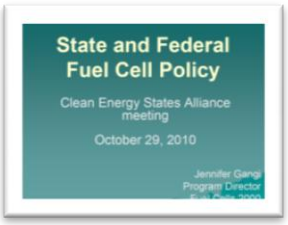
CESA provided state clean energy fund managers, and state legislatures (through NCSL), with information and targeted outreach materials to educate key state decision makers on the merits, opportunities, policies and programs proven effective for advancing fuel cell and hydrogen deployment. CESA developed and conducted the following education and outreach efforts.

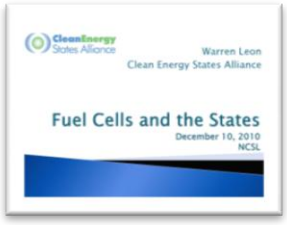
***Subtask 2.1: Fuel Cell Workshops.***

In partnership with NCSL, CESA included fuel cell workshops in two national membership meetings. These dedicated workshops identified best practices and new strategies to develop and expand effective state hydrogen and fuel cell joint projects. DOE representatives were invited to participate to highlight hydrogen education development activities and opportunities. CESA enlisted staff from the leading state hydrogen and fuel cell programs (e.g., Connecticut Clean Energy Fund, California Energy Commission, Long Island Power Authority) to make presentations at several of these workshops.

- **Fuel Cells: Reality Check – Economics, Barriers, and Opportunities**
  (CESA membership meeting, New Haven, CT, June 2008,)
- **State/Regional Hydrogen and Fuel Cells Initiative Workshop**
  (NHA Conference, Columbia, SC, March 2009)
- **Hydrogen & Fuel Cell Activities Regional Briefing**
  (Northeast Commerce Association, Westborough, MA, July 2010)
- **Fuel Cells: State Funding and Policies to Support Fuel Cell Deployments**
  (CESA membership meeting, Washington, DC, October 2010)
- **Fuel Cells and the States**
  (National Conference of State Legislatures Fall Forum, Phoenix, AZ, December 2010)
- **Stationary Fuel Cell Power Technologies**
  (Stationary Fuel Cell and Investment Summit, San Diego, CA, May 2011)








***Subtask 2.2: Bi-Monthly Webinars with DOE and NHA***

Through Clean Energy Group, which manages CESA, CESA coordinated with DOE and NHA to co-host bi-monthly webinars on state and regional hydrogen fuel cell initiatives. These informal, informational calls cover various topics to assist state and regional hydrogen initiative leaders network together, share lessons learned, and discuss useful information about fuel cell and hydrogen projects and reports. These events were used to both gather and disseminate information on hydrogen fuel cell programs, best practices, and partnership opportunities. CESA's hydrogen education list serve allowed staff to pass along webinar information to interested stakeholders.

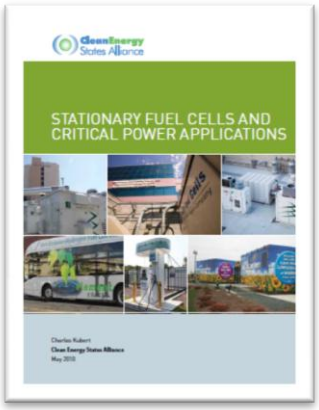
- CESA worked with DOE and the National Hydrogen Association (now the Technology Transition Corporation) to develop a series of "brown bag" webinars on current topics. These webinars included:

  **"Financing Fuel Cell Installations**
  Moderator, Warren Leon, Senior Advisor, Clean Energy States Alliance, Financing Fuel Cells Speakers: Paul Rescsanski, Business Finance Manager, UTC Power, Fuel Cell Financing Options and Ed Graham, Global Strategic Sales Director, ClearEdge Power, Corporate Overview. (Download the webinar recording). (August 30, 2011).

  **"Hydrogen and First Responders"**
  Co-hosted by Virginia Clean Cities and Clean Energy States Alliance
  Speakers: Dr. Peter Sunderland, Associate Professor, University of Maryland Department of Fire Protection Engineering and Kelly Wolfe, Hydrogen Program

Director, International Association of Fire Chiefs. Download the webinar recording (Windows Media Player file). (June 30, 2011)

**"Fuel Cells and Renewable Portfolio Standards"**
This webinar focused on a policy mechanism that states are using and can use to promote the commercialization of stationary fuel cells. Download the webinar recording (Windows Media Player file). (June 9, 2011).




**"Fuel Cells for Supermarkets"**
This webinar highlighted fuel cell deployment at supermarkets in four different states. Download the webinar recording (Windows Media Player file). (April 4, 2011).

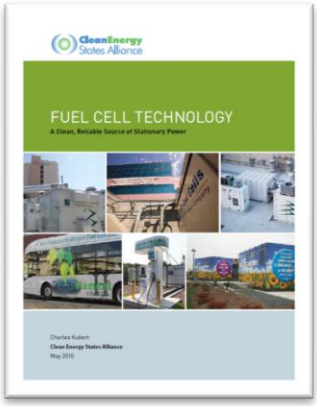
**"Hydrogen Production and Storage for Fuel Cells"**
Presentation by Tim Lipman, co-director of the Transportation Sustainability Research Center at UC-Berkeley and director of the Department of Energy's Pacific Region Clean Energy Application Center. Lipman described the findings of a new report, *An Overview of Hydrogen Production and Storage Systems with Renewable Hydrogen Case Studies*. Download the Webinar recording (Windows Media File). Download the Presentation (pdf). (Feb. 2, 2011).

**"State and Regional Initiatives Informational Call and Meeting Series Relaunch Introduction" (December 14, 2010)**
Presenters:

- Warren Leon, Senior Advisor, Clean Energy States Alliance
- Patrick Serfass, Vice President, Technology Transition Corporation.

The webinar series began in 2008 and a complete list of webinars, with links to recordings, can be found at http://www1.eere.energy.gov/hydrogenandfuelcells/education/call_archive.html

***Subtask 2.3: Technical Overview of Fuel Cell Technologies***
CESA prepared and distributed briefing materials providing a general technical overview of fuel cell technologies for state officials describing, among other things, feedstock flexibility, niche market applications, environmental attributes and benefits relating to air quality and noise pollution, flexibility in the size of fuel cell installations, distributed power generation, grid independence and energy security applications, the use of fuel cell primary and standby power for high-tech enterprises.



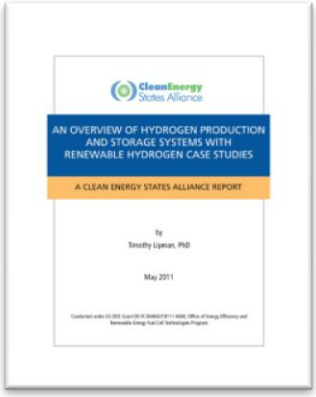

- **Fuel Cell Technologies: A Clean, Reliable Source of Stationary Power**
  (May 2010) This CESA briefing paper provides information on fuel cell technologies, economics, and stationary power

applications. It includes an overview comparison of different fuel cell types, the costs for installation, and the benefits to both the facility and the public.

***Subtask 2.4: Overview of Fuel Cell Applications for Critical facilities***
CESA will prepare and distribute an overview of the energy security applications of fuel cells. We will examine secure and reliable primary power for high-tech critical industries such as data processing centers and standby power for hospitals, emergency shelters, police and fire stations, and telecommunication facilities. CESA will identify state and federal policies and programs that could be targeted to promote the use of fuel cells for emergency preparedness and security.

- **Stationary Fuel Cells and Critical Power Applications** (May 2010) This CESA briefing paper explains how fuel cell technology can be used to supply back-up or standby power (as well as primary load power) to critical facilities. Since fuels cells are a form of distributed energy, they run separately from the grid and are not vulnerable to grid-related power outages. The paper offers examples of fuel cell installations for telecommunications, first responder centers, hospitals and airports.

***Subtask 2.5: Technical Overview on Hydrogen Production and Storage Technologies***
CESA will prepare and disseminate to CESA members, NCSL constituents, and other key decision makers technically accurate and objective educational materials about the use of hydrogen as an energy carrier.




- **An Overview of Hydrogen Production and Storage Systems with Renewable Hydrogen Case Studies**, by CESA Consultant Tim Lipman, May 2011.

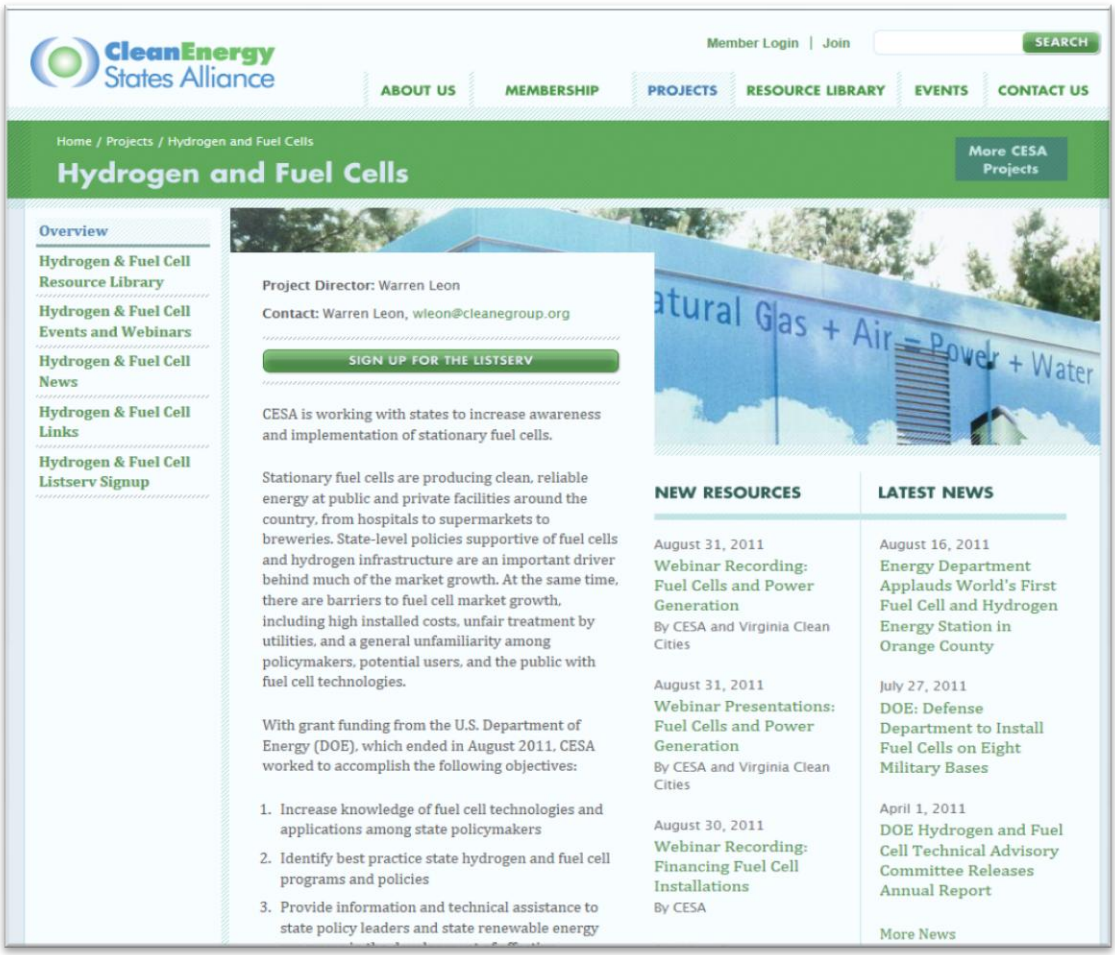
## (2) Task 3 – Communications and Outreach

***Subtask 3.1: Project Steering Committee***
CESA hosted and led monthly conference calls for other DOE hydrogen outreach and education grant recipients over the three-year period. The purpose of the calls was to share resources, strategies, and lessons learned from the various organizations' initiatives. On the last call, DOE staff decided that they would convene and host the future calls.

***Subtask 3.2: Fuel Cells and Hydrogen Web page and Listserv***
To help with the communication, education, and network development components of this project, CESA developed and maintained a fuel cell and hydrogen web page and listserve for CESA members and other state leaders identified during this project. The web page provides current information on state hydrogen and fuel cell activities, trends, program elements, etc. The listserve enables CESA effectively communicate state progress on hydrogen issues, identify high-priority opportunities for action, and share this information with its network of CESA members, NCSL members, and other interested parties. The webpage is used as a distribution resource and clearinghouse for fuel cell and hydrogen reports and briefing memoranda that are produced by CESA staff and others during this project timeframe and beyond.

- CESA maintained a webpage on its website dedicated to hydrogen and fuel cells. The reports and webinars prepared under this grant can be found in the Hydrogen and Fuel Cell Resource Library.

- CESA developed a listserv distribution list for instant email communication with the more than 600 members of the list from state agencies, industry, other NGOs, and interested stakeholders.




***Subtask 3.3: Collaborative Opportunities***
CESA explored how states could collaborate with each other and/or with industry to enact effective hydrogen and fuel cell policies and to share perspectives.

- CESA actively encouraged collaboration among DOE's fuel cell state outreach grantees by facilitating monthly conference calls among those grantees that included discussion of ideas for collaboration and sharing information.

- CESA provided significant assistance to Virginia Clean Cities, one of DOE's other fuel cell state outreach grantees with two webinars: "Hydrogen and First Responders" (June 30, 2011) and "Fuel Cells and Power Generation" (August 31, 2011, which had presentations from representatives of Gills Onions and Sierra Nevada Brewing Company.

- National Conference of State Legislatures (NCSL), CESA's partner on this project, distributed educational materials to its members, including CESA's fuel cell briefing papers and several fuel cell publications that NCSL produced. NCSL also developed a web page, "Fuel Cells – Clean and Reliable Energy."
- **NCSL/CESA Webinar:** *Hydrogen Fuel Cells - State Policies and Technology.* This webinar explored the current state of fuel cell technology, cost trends and state policies that have been effective in promoting fuel cell use. Listen to the Webinar (Windows Media Player format) (September 2010.
- CESA held discussions with representatives of several state agencies on ways in which they can cooperate on the performance monitoring of fuel cell installations.

***Subtask 3: Other Outreach Activities***

- **"Fuel Cells: Briefing Papers for State Policy Makers,"** containing all five reports, was printed and sent to every state energy office in the country, as well as to all state clean fund managers and to many members of public utility commissions. The report was also distributed to NCSL members, and is posted on the CESA website.

- CESA-hosted webinars and respective recordings included*:*

  Webinar Recording: Fuel Cells and Power Generation
  August 31, 2011 by CESA and Virginia Clean Cities

  Webinar Recording: Financing Fuel Cell Installations
  August 30, 2011 by CESA

  Webinar Recording: Fuel Cells and Renewable Portfolio Standards
  June 9, 2011 by CESA

  Webinar Recording: Fuel Cells for Supermarkets
  April 4, 2011 by CESA

  Webinar: Hydrogen Production and Storage for Fuel Cells
  February 2, 2011by CESA, Featuring Tim Lipman, UC-Berkeley.

## III. Summary of the project activities for the entire period of funding

### (1) Approaches

The foundation for CESA's work on this project was a solid understanding of the perspectives and needs of state policymakers. For that reason, we maintained ongoing contact with key state policymakers—both from states that have provided financial support for fuel cells and from those that have not—through interviews, informal group discussions, and monitoring of relevant developments at the state level. From this intelligence gathering, we identified the specific reasons why state policymakers have not been taking more aggressive action to promote fuel cells. We then crafted messages and materials designed to encourage action. Those messages were delivered through well-attended webinars

(some of which had well more than 100 participants), widely circulated briefing papers, conference presentations, a webpage (www.cleanenergystates.org/projects/hydrogen-and-fuel-cells), a project listserv, outreach by the National Conference of State Legislatures, and other means. We produced case studies of model projects and identified targeted actions that can appeal to state policymakers.

As the project progressed, we developed a better sense of the fuel-cell-related actions that state policymakers are most likely to find appealing and most likely to implement. We then focused special attention on those actions, such as the use of fuel cells by supermarkets and the inclusion of fuel cells in RPSs, and encouraged state policymakers to adopt them.

We also made sure that our work was well coordinated with the work of other DOE state-related fuel cell grantees by facilitating monthly coordination conference calls and maintaining regular one-on-one contact with those grantees.

## (2) Problems Encountered

This project faced two very different problems:

**1.)** ***Difficult climate for state action on fuel cells***. A variety of economic and financial factors made state policymakers less able to implement concrete policies and activities to support fuel cells than at the time this project was conceived. To the extent that policymakers had latitude to implement such activities, they were less interested than we expected. In particular:

a. The downturn in the economy and slow recovery left many state clean energy funds with significantly reduced budgets, but rising demand for their existing programs. That made it difficult for them to initiate new activities.

b. Political leaders and the public in many states pushed state energy officials to focus their clean energy efforts on the least expensive and most easily implemented technologies.

c. Competing technologies, especially photovoltaics, declined in cost and increased in public appeal, encouraging state policymakers to direct their funding and staff resources towards those technologies.

d. Many state policymakers, especially those connected to state clean energy funds, turned out to have residual skepticism towards stationary fuel cells. Some of those funds had supported fuel cell installations in the first few years of the current century, but were disappointed by the performance of those fuel cells. They felt that the technology was either too expensive or too unreliable, and that fuel cell manufacturers had exaggerated the market-readiness of that technology.

**2.)** ***Staff losses***. At several points in the project, staff departures caused difficulties and slowed work on the project. The most notable—and tragic—staff loss took place when project director Charles Kubert was first debilitated by cancer and then unexpectedly died. This loss affected other project staff members emotionally and the suddenness of his passing meant that there was no opportunity for Charlie to pass information and ideas on to his successors on the project. But, after several months of a difficult transition, it was possible for the project to begin to move forward efficiently and pick up momentum.

### (3) Departure from Planned Methodology

Overall, the project proceeded generally as planned, but some changes were necessary, both to adjust to the problems encountered and for other reasons. In particular:

a. Because state policymakers were more skeptical of the appropriateness of using their agencies' available financial resources for fuel cell installations, CESA gave less attention to working with policymakers directly on implementation projects and more attention to specific educational activities that would overcome the perceptual barriers to fuel cell support by state governments.

b. CESA added specific activities such as the briefing paper and webinar on supermarkets and the webinars on "Fuel Cells and Renewable Portfolio Standards" and "Financing Fuel Cell Installations" that would propose specific actions that state policymakers might be able to take even during the current financially constrained political climate.

c. The program's survey report, "Stationary Fuel Cells: Current Status and Policy Efforts to Promote Further Commercialization," was not finalized, because a similar report was developed and produced by another DOE grantee, Fuel Cells 2000.

### (4) Assessment of Impacts from Results

The project had a variety of positive impacts, including:

a. The project's objective, informative briefing papers and other publications were widely distributed to state policymakers providing them with valuable reference materials. This made them more comfortable with fuel cell technologies and helped them to understand the advances in fuel cell performance and reliability in recent years. This should make them more likely to be interested in providing support for fuel cell development and installations in the future.

b. The project identified the actions that state policymakers would be most able to take and most likely to take to support fuel cells in the several next years. By promoting those actions through webinars, publications, conference presentations, and discussions with individual policymakers, we were able to convince specific policymakers from a variety of states to give additional consideration to fuel cells and to explore new fuel cell policy initiatives.

c. CESA's leadership of monthly calls with DOE's fuel cell state grantees and outreach to individual grantees encouraged greater cooperation and collaboration among those grantees.

d. The Fuel Cells for Supermarkets webinar stimulated several supermarket chains to reach out to state policymakers to explore opportunities to install fuel cells at some of their supermarkets.

## IV. Possible Next Steps with Continued Funding

If we are able to secure funding for additional work with states on fuel cells, we would want to undertake the following activities:

- Work with states that have begun collecting fuel cell performance data or might be interested in collecting data. We would encourage them to share and harmonize data collection methodologies and standards. The states to focus on would include California, Connecticut, New York, and Oregon. We would also seek to bring the Pacific Northwest National Laboratory into discussions on this topic, since it is involved in a fuel cell performance monitoring project. One goal would be to widely disseminate fuel cell performance results in order to show policymakers and potential end users that there is solid data on fuel cell performance. Hopefully, that data would suggest that fuel cells are sufficiently cost-effective to warrant state-level support and promotion.

- Conduct additional outreach to encourage states to include fuel cells as an eligible distributed generation technology in their renewable portfolio standards. This would include making contact with individual policymakers in selected states to suggest that they consider this matter and to advise them on how to proceed.

- Reach out to states with clean energy funds to encourage them to establish rebate or other incentive programs for residential-scale fuel cells. We would suggest that these incentives be made parallel to and comparable to the existing state-level incentives for photovoltaic installations. For those states that turn out to be receptive to this change, we would work with them on the specific program design for fuel cell incentives.

- Host additional webinars and produce additional briefing papers to keep states informed of technological advances, relevant business developments, and important policy issues.