STATE COLLABORATIVE ON ADVANCED GAS TURBINES & HYBRID SYSTEMS

CRITICAL ISSUES, NEEDS AND OPPORTUNITIES IN THE WESTERN STATES

Final Report

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Between

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FINAL REPORT

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Acknowledgements

The National Association of State Energy Officials (NASEO) is pleased to have led this critical effort in identifying the issues, needs and opportunities facing advanced gas turbine and hybrid systems as they find their place in the extraordinary transition of the electric generation industry from very large central power plants to smaller, and often cleaner, distributed energy resources. The work that the US Department of Energy, through its National Energy Technology Laboratory (NETL) as well as its Office of Energy Efficiency and Renewable Energy, is conducting in advanced gas turbines, micro-turbines, and hybrid systems is the leading edge for the more rapid acceleration of these technologies into the marketplace.

The report is organized into three main parts:

The first part provides the context of the project. Under the ***Introduction*** and ***Scope of the Project*** sections, the reader is familiarized with the reasons the project was initiated in the 16 western states and the methods used to gather the information from a diverse group of players in the states, federal government, and private sector.

The second part of the report under ***Findings from the Workshops*** details the most critical issues, needs and opportunities identified in each of the three workshops. By comparing the findings in each workshop, we then identified the issues, needs and opportunities that are common to all three workshops. These are considered the highest priority items to resolve or implement in order to most effectively accelerate the technology into the marketplace. Specific findings related to the High Efficiency Engine and Turbine program are included herein.

The third part of the report, ***Potential Collaborative Opportunities and Next Steps***, details recommendations resulting from the synthesis of the discussions and ideas that occurred during the workshop sessions. General and specific collaborative opportunities are identified in this section. The specific next steps described are ones that NETL should take if it intends to meet its objective of accelerating advanced gas turbines and hybrid systems into the marketplace.

Finally, NASEO recognizes the challenging, and productive exchanges that ensued during the open discussion forums in the three workshops. NASEO also acknowledges the excellent work of all those who participated in the three workshops:

> *Brian T. Castelli*, who successfully organized and facilitated the three workshops, is singled out for his excellent authorship of this report.
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State Collaborative on Advanced Turbines and Hybrid Systems

Information, Objectives, and Issues

Executive Summary

NASEO, in concert with the State Energy Offices in the western region, worked with the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) to identify collaborative research, development, demonstration, and deployment (RD^3) issues, needs and opportunities for accelerating into the marketplace advanced gas turbines and hybrid systems in the states served by the Western States Coordinating Council.

This Final Report concludes the second task of the project and presents the most critical issues, needs and opportunities that were identified by the representatives of the western states participating in the three workshops conducted under Task 1b. The substance and finding of these workshops are fully examined in the body of this report. Recommendations for actions that NETL could take to accelerate the advanced gas turbines and hybrid systems in the states are explored in the final section of this report. Agendas, presenters, attendees, presentations, and other relevant information are detailed in the Appendices.

The project was initiated with 16 western states divided into three distinct groupings. The groupings were based in part on geographic location and/or similar situations regarding electricity generation and systems. This permitted the states and their respective stakeholders that share common ground to identify and examine the issues, needs and opportunities that most impacted their particular group. Under Task 1a, the states provided a preliminary identification of such issues, needs and opportunities. These findings were then used as the basis for the initial discussions in the three workshops that were conducted under Task 1b of the project. The workshops explored the findings in detail and expanded upon them. The workshops concluded with a plenary session in which the highest priority issues, needs and opportunities were identified.

Under the ***Findings of the Workshop*** section of this report, the findings are arrayed in three tables, corresponding to the three groups of states, with each issue, need and opportunity discussed in detail following each table. These findings provide an interesting perspective of the challenges and opportunities that states face in trying to accelerate advanced turbines and hybrid systems into their states' marketplace. Some of the findings concerning advanced gas turbines and hybrid systems were common among all three groups of states, others were common only to a single group, and still others were specific to a single state. Therefore, a fourth Table has been prepared which identifies those common issues that were determined to be of the highest priority across all three groups of states. Where possible, it is this set of findings that should be the primary focus of future collaborative activities that NETL undertakes with state energy offices and other interested stakeholders (manufacturers, utilities, municipalities, environmental agencies, etc.).

Issues
The highest priority "Issues" among all three groups of states include, *Interconnection Standards*, *Transmission Impacts*, *Environmental Issues* and *Consistent RD^3 Funding and Access to Financing*. The participants in the workshops saw resolution of these issues as most critical to accelerating the deployment of turbine/hybrid systems. They also noted that NETL, which could play a role in resolving some of the issues, might not be the appropriate entity to deal directly with issues such as interconnection standards and transmission impacts (which affect the utility industry as a whole as well as the ability to accelerate turbine/hybrid systems into the marketplace). Nevertheless, where technical or physical issues impact interconnections or transmission, it was felt that NETL's turbine/hybrid system research programs might provide the credible and objective technical assistance needed to resolve specific issues.

Environmental issues were identified in the three workshops as a major driver for the development of cleaner advanced turbine/hybrid systems. Federal, state and local environmental regulations or ordinances were seen as likely to require replacement of highly polluting diesel or new coal fired fossil generation in many instances. Participants also saw lower carbon emissions and potential carbon credits as a driver for cleaner distributed technologies. It was suggested that NETL could be a partner that would assist in the research and documentation of the environmental performance of the turbine/hybrid systems.

The final common, but critical issue, identified in the workshops related to consistent RD^3 funding and access to financing. Inconsistent funding for research and lack of adequate financing for turbine/hybrid systems was often attributed to the lack of good data and information about projects. NETL was seen as a leading advocate for research funding in this area and also was recognized as the entity that could help develop the data and information that would make financing of such projects more readily available.

Needs
The highest priority "Needs" among the three groups include *Information-general/specific*, *Comprehensive Case Studies and Data Analyses*, *Business Decision Models*, *Expansion of State and University Research Programs*, and *Modifications to the HEET Program*. Fulfilling each of these needs was seen as critical to the more rapid deployment of turbine/hybrid systems. Participants in the workshop also recognized that NETL could provide credibility concerning the information and data identified as a critical need. By teaming with others in the deployment of the technologies and providing technical assistance and support for documenting the performance of the systems (including engineering, project costs, environmental, power outage costs, life cycle benefits, gas supply, fuel source flexibility, and the permitting process) through case studies and/or business decision models, participants believed that NETL could play a leading role in more rapidly accelerating these technologies into the marketplace.

Expanding State and University research programs to include hybrid systems was seen as critical to a comprehensive and integrated advanced turbine research program. Many of the attendees in the three workshops noted that leveraging state funding with Federal funding (and private funding where available) could increase the success of advancing the technologies into

the marketplace. Furthermore, the agreement[1] between the Association of State Energy Research and Technology Transfer Institutes (ASERTTI), the National Association of State Energy Officials (NASEO), and the DOE's Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy was seen as an excellent means to expand state and university research programs on advanced turbine/hybrid systems. Participants agreed that NTEL's support of this joint research agreement is critical to its success.

"Modifications to the HEET Program" was the final common need identified in the workshops. Modifications suggested included (1) hybrid systems research (e.g., fuel cells combined with gas turbines), (2) adding renewables, particularly biomass fuel sources, and (3) incorporating demonstration projects with "real" customers. Attendees felt that these modifications would allow the HEET program to be more robust and comprehensive in its scope – and therefore achieve better results in getting the technologies into the marketplace.

Opportunities

The highest priority "Opportunities" identified across all three groups included *Demonstrations*, *State and Federal Building Demonstrations*, and *State, Federal and Utility Financial Incentives*.

Project demonstrations across a broad range of turbine/hybrid systems was seen as a major opportunity for NETL to create collaboratives among state, federal, industry and consumers that would leverage larger projects (with state RD^3 support) and more rapidly diffuse the technologies. Participants at the workshops indicated that finding common and transferable applications for these demonstration projects is crucial.

It was also noted that state and federal buildings could provide an opportunity to (1) test the advanced turbine/hybrid system technologies and applications, (2) develop collaborative partnerships with the state energy offices, other state entities, and private developers or utilities, and (3) serve a post-9/11 national security need by providing on-site and secure power.

Finally, participants at all three workshops identified state, federal and utility financial incentives that could provide myriad opportunities to fund both research and demonstration projects for turbine/hybrid systems; e.g., state public benefit funds, state tax credits (such as Oregon's Business Tax Credit for clean energy technologies), and utility incentives, particularly where transmission or environmental constraints impede conventional generation. Participants suggested that NETL should support projects that combine many funding sources and leverage the highest amount of funding possible.

Under the ***Potential Collaborative Opportunities and Next Steps*** section of this Final Report, NASEO has identified 16 general opportunities and 12 specific opportunities that workshop participants indicated were potential areas where collaboratives could be formed to demonstrate or deploy advanced gas turbines/hybrid systems. The 16 general opportunities that participants in the workshops discussed could, with a state, federal and private sector collaborative, be narrowed down to specific projects in the more general field identified in the workshops. These general opportunities to deploy advanced gas turbines/hybrid systems

[1] The "State Technologies Advancement Collaborative (STAC) Partnership", See;. http://www.naseo.org/news/2002_11.htm for further information.

include, among others; small producing oil fields, rural farms, power parks, waste water and solid waste facilities, and relieving transmission bottlenecks.

The 12 specific opportunities identified by workshop participants reflected current projects (or at least a specific type of project, customer, and/or partner) that are in the formative stages of implementation. These specific project opportunities to deploy advanced gas turbines/hybrid systems are, to name a few; the City of Torrington, WY, Stapleton Airport In-fill (Denver, CO), Montana State University, and the Coors Brewery in Golden, CO.

Based upon the discussions in the workshops, NASEO also recommends a number of actions and programs that can be initiated to successfully accelerate advanced gas turbines/hybrid systems into the marketplace. These next steps include the following actions/programs:

1. Work closely with NASEO to develop collaboratives among state, federal, industry and consumers that would more rapidly diffuse the advanced gas turbines/hybrid systems technologies into the marketplace.
2. Support the STAC partnership and provide funding for advanced turbine/hybrid system projects under it.
3. Support E2I's partnerships with state, federal and private sector partners, particularly in their Distributed Energy Research (DER) area.
4. Modify the HEET program to include hybrid systems and renewable fuels (i.e. biomass) research.
5. Commission the development of a business decision model that incorporates a full life cycle cost analysis of the technologies.
6. Support the development of 10 case studies of advanced turbine/hybrid systems that would illustrate the resolution of issues that have slowed the diffusion of the technology into the market.
7. Conduct three advanced turbine/hybrid systems workshops per year, tied into DOE's Regional Office meetings with the states in their regions.

Introduction

NETL's Strategic Center for Natural Gas (SCNG) is charged by the DOE to be the focal point on natural gas "from the borehole to the burner tip." A significant part of SCNG's mission is to lead the RD^3 effort on natural gas utilization for accelerating advanced gas turbine technologies and hybrid systems[2] that "efficiently and economically us[e] natural gas while maintaining environmental quality in both new and existing markets."[3]

In order to advance such technologies, SCNG determined that it is necessary to initiate new collaborative partnerships with states and the various private and public (including federal and local as well as state). Consequently, SCNG staff contacted the National Association of State Energy Officials (NASEO)[4], whose members are officials from the State and Territory Energy Offices (and include affiliate members from the private and public energy sectors). For more than a decade, NASEO, which maintains a network of state energy officials who closely work with private and public entities in their states, regularly offers forums for energy officials, policymakers and others to exchange information and discuss issues with regional and national implications. Therefore, NASEO leadership on this project was determined to be critical to meeting the needs of SCNG in advancing turbines/hybrid systems.

Discussions between SCNG and NASEO staff resulted in a decision to initiate a project to understand:

- the needs of the states (related to the turbine/hybrid technologies);
- issues surrounding barriers to the initiation of RD^3 projects; and
- opportunities in the states to develop collaborations that advance the turbine/hybrid system technologies.

Since many of the State Energy Offices have a stake in advancing gas turbine technologies and hybrid systems, the proposed project would ensure that SCNG receives data and information concerning the issues and opportunities that will help it meet its goal of advancing these critical distributed generation technologies throughout the United States. A description of the project scope is detailed in the next section.

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[2] "advanced gas turbines and hybrid systems" is shortened and referred to as "turbine/hybrid systems" for the remainder of this report – they include a broad category of equipment, from large advanced gas turbines, to small microturbines, various hybrid systems, and combined heat and power systems (CHP).

[3] "Overview – What is SCNG", NETL website http://www.netl.doe.gov/scng/index.html

[4] Affiliated with the National Governors' Association, NASEO, a nonprofit organization, was created by the governors as an "instrumentality of the states" to improve the effectiveness and quality of state energy programs and policies, and to be a repository of energy-related information. See, http://www.naseo.org/about/default.htm

Scope of Project

During discussions between NETL and NASEO it was agreed that the project should first focus on the western region[5], which had experienced significant capacity and transmission difficulties during the past two summers. The western states selected are those states that are part of the Western States Coordinating Council (WSCC)[6] and Nebraska, Alaska, and Hawaii. It was determined that these states, in general, are ideal candidates to be part of the project as they are located in an electric reliability council area that experienced region wide problems or shared common interests in distributed energy technologies, particularly in turbine and hybrid system technologies.

In those discussions, it was also determined that advanced turbine and hybrid systems could be defined to include any of the following gas turbine technologies or systems:

- combined cycle turbines in excess of 20MW;
- hybrid systems, such as small micro-turbines with fuel cells; or
- micro-turbines.

By allowing the definition of the turbine technologies to be broadly inclusive, it is expected that a wide variety of collaborations can be formed to advance the technologies. This will benefit all the advanced turbine technologies as well as hybrid systems that might be employed as a distributed energy resource in the western states.

In addition, because the definition was broadened to include smaller scale gas turbines, NETL staff also agreed that the DOE's Office of Energy Efficiency and Renewable Energy (EERE) should be invited to participate in the workshops. EERE's Office of Distributed Energy and Electric Reliability Program[7] is responsible for distributed energy resources (DER). DER is defined as a variety of small, modular power-generating technologies that can be combined with energy management and storage systems and used to improve the operation of the electricity delivery system, whether or not those technologies are connected to an electricity grid. DER systems range in size and capacity from a few kilowatts up to 50 MW. The relevant distributed technologies for this project include: Industrial Gas Turbines, Microturbines, Gas Fired Reciprocating Engines and Hybrid Power Systems.

EERE staff did participate in the workshops. This included EERE headquarters staff as well as staff from both the Seattle and Denver Regional Offices. In fact, the Denver Regional Office hosted one of the workshops in their new facility.

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[5] In a discussion on October 19, 2001 with Abbie Layne, the Product Manager for Advanced Turbine and Engine Systems at SCNG. It was also noted that NETL may wish to expand the scope to include mid-western and/or eastern states in the future.

[6] The WSCC has merged with the Western Transmission Association (WRTA) and the Southwest Regional Transmission Association (SWRTA) to create the Western Electricity Coordinating Council (WECC) on April 18, 2002.

[7] A recent EERE reorganization renamed the office (it formerly was known as the Office of Distributed Energy Resources), See, EERE's website http://www.eren.doe.gov/deer.html.

Task 1a: The first task was to gather relevant data from the western states to determine the needs, issues and opportunities that could help identify collaborative opportunities between NETL and state entities. NASEO contacted the state energy officials who, as part of their mission, are focused on a variety of electricity issues, including those involving policy, analysis, and RD^3 related to distributed energy technologies such as advanced gas turbines and hybrid systems. Therefore, in late October 2001, at their annual winter meeting, NASEO informed its members that it had undertaken this task and would begin contacting their western state members to elicit the information needed. In November, 2001, NASEO sent a written information request[8] to those energy offices asking that they detail issues, needs and opportunities that would help identify potential turbine/hybrid system collaborations.

Upon receipt of the information, NASEO agreed to provide a report to SCNG organizing the comments and information received from the states so that it can be used to facilitate three regional workshops with the western states. That report was entitled "*STATE COLLABORATIVE ON ADVANCED TURBINES & HYBRID SYSTEMS – INFORMATION, OBJECTIVES, AND ISSUES*", May 2002.

Task 1b: NASEO and SCNG determined that the second task of the project would be for NASEO to facilitate three NASEO-NETL workshops. These workshops focused on discussions with State and Territory Energy Officials, regional private-sector and federal government stakeholders, and other state officials to evaluate issues of concern, research and development needs, demonstration and deployment potential, and opportunities for collaborative activities between these entities and NETL. The discussions at each workshop were one-half day and initially focused on the particular needs, issues and opportunities that were identified in the information gathering effort under Task 1a described above.

The goal of the workshops, however, was to clarify, and expand upon, the initial findings of the information gathering task. By involving the federal, state and private stakeholders in an open forum on the issues, needs and opportunities for advanced gas turbines/hybrid systems, the exchanges of information among the participants resulted in a thorough identification of the most important topics impacting the states in the region. Based upon those discussions, judgments were then made about the relative priority of each. The resulting priorities (detailed in the Tables under the ***Findings from the Workshops*** section below) will help SCNG determine how best to meet its goal of advancing gas turbine/hybrid systems.

Workshops were held in a major city in each of three selected western sub-areas. Sites, dates, and participating states selected for each of the workshops is listed below:

- Portland, OR – July 22, 2002 – States included Alaska and States that are members of the Northwest Power Planning Council (Washington, Oregon, Montana and Idaho);
- Denver, CO – August 15, 2002 – States included Colorado, Wyoming, Utah, South Dakota, Nebraska and Texas; and
- Palo Alto, CA – September 5, 2002 – States included Arizona, California, Nevada, New Mexico, and Hawaii.

[8] See, Appendix I

Each workshop was co-hosted by the appropriate state energy office, facility owner, NASEO and/or DOE regional office. The workshop co-hosts (and their individual representatives) are listed below:

Portland, OR – **Oregon Office of Energy** (OEO), William Nesmith, Division Administrator
Northwest Power Planning Council (NWPCC), Dick Watson, Division Director
NASEO, Brian T. Castelli, NASEO Facilitator

Denver, CO – **Governor's Office of Energy Mngt. & Conservation**, Rick Grice, Exec.Director
DOE's Denver Regional Office, William S. Becker, Director
NASEO, David Terry, Managing Director

Palo Alto, CA – **California Energy Commission** (CEC), Mike Batham, PIER Program Manager
Electricity Innovations Institute (E2I), TJ Glauthier, President
NASEO, John Nunley, III, Chairman (and Wyoming Energy Office Director)
DOE's Seattle Regional Office, Kathy Pierce, Director

Each of the Workshops lasted five and a half hours and followed a basic agenda. First, a short Welcome by each of the co-hosts was followed with an Introduction by the facilitator that updated the workshop participants of the findings from the data gathering task and then delineated the specific purposes and goals of the workshop.

This was then followed by three panels; one on *Issues Impacting Advanced Gas Turbines/Hybrid Systems*, a second on the *Needs Related to Advanced Gas Turbines/Hybrid Systems*, and a third on *Opportunities for Advanced Gas Turbines/Hybrid Systems*. Each panel was designed to be facilitated by a state energy office director and include two other formal presenters. The three facilitator/presenters represented a wide variety of interests in advanced gas turbines/hybrid systems including state energy officials, federal environmental officials, electric and gas utility representatives, university research professors, turbine manufacturer representatives, national laboratory researchers, and personnel from other research centers.

Each panel consisted of three formal presentations limited to 10 minutes each. The remaining 30 minutes of each panel was used as an open, interactive forum in which all participants questioned and/or discussed issues related to the panel topic and presenters.

At the conclusion of the three panels, all workshop attendees participated in a plenary session[9] to prioritize the most critical *Issues*, *Needs*, and *Opportunities* impacting the acceleration of advanced gas turbines/hybrid systems into the marketplace. The plenary sessions in each of

[9] This hour and one-half plenary session was originally set up to be three separate breakout sessions (one for Issues, one for Needs, and one for Opportunities) and is reflected as such on the workshop agendas. However, after the panel presentations and discussions, participants in the first workshop requested that we modify the agenda to hold the last session as a plenary so that they could all participate in helping to prioritize all three topical areas. We agreed and all three workshops held a plenary session to determine priorities, rather than the breakout sessions originally intended.

the workshops proved to be highly successful as participants discussed, argued, and eventually came to a consensus on which of the items were most critical. The three Tables and accompanying narrative in the ***Findings from the Workshops*** section below detail the results of the plenary session in each workshop. A fourth Table shows the critical items that were common to all three workshops.

Task 2: The final task of the project is the development of a final report that summarizes the results of the meetings and identification of the most critical issues, needs and opportunities. It also includes, for each workshop, a detailed meeting agenda and an attendees' list that includes state contacts/meeting participants, title and organization, address, telephone number, fax number, and email and any other appropriate information. (See, the ***Findings from the Workshops*** section below and the Appendices.)

In addition, the final report under the ***Potential Collaborative Opportunities and Next Steps*** section focuses on potential collaborative turbine and hybrid system opportunities between NETL and state partners in the areas of research, development and demonstration in the major states served by the WSCC. The collaborative opportunities and recommendations identified include such items as; specific projects, proposed new NETL turbine program initiatives, methods for cost sharing projects, structure of collaborative efforts and types of partners, and potential funding sources with the states. This section of the report also lays out a number of steps, which if undertaken by NETL, depicts a viable pathway to best exploit the opportunities that could be implemented with the states.

Findings from the Workshops

The workshops conducted during the summer and fall of 2002 confirmed the initial general findings from the information gathering task: myriad near term challenges exist for increasing the use of advanced gas turbines and hybrid systems. In fact, a number of the participants at the workshops expressed the concern that many of the challenges could threaten the long-term viability of the technologies. However, they and others present acknowledged that despite the challenges, opportunities do exist for these clean, distributed energy technologies today. The key will be in overcoming the barriers that currently thwart widespread application; many not attributable to the technology itself, but to more general barriers that inherently prevent rapid changes in the existing gas and electric generation and transmission industry.

Furthermore, the workshop participants confirmed that collaborative efforts among federal, state, local and private sector players may well prove to be the most effective way to overcome many of the barriers and accelerate the technologies into the generation mix. Workshop participants also confirmed the initial impression from the data gathering task – a need does exist for collaborative RD^3 on some specific turbine technologies and hybrid systems. However, a critical need also exists for research and analysis of the technologies in "real world" demonstrations to overcome issues or barriers in areas as diverse as potential fuel sources, interconnection standards, engineering design and best practices, permitting and zoning, environmental performance, and grid effects.

Participants at the workshops also concurred that "good data is hard to find". Relevant, accurate and up-to-date data and information upon which one can base decisions to utilize turbine/hybrid systems (as opposed to other alternatives) was found to be lacking by attendees at all three workshops. Recommendations by the participants focused on the development of case studies and business decision models that could easily be used by developers, facility managers, utilities and regulators. In addition, better information dissemination was seen as a key to aiding the industry, particularly as case studies and business decision models become available. The participants generally concurred that NETL (SCNG) could be a significant partner in needed public-private collaboratives involving state agencies, manufacturers, and developers that would address many of the issues, needs and opportunities identified herein.

Shown on the following pages are four tables, three of which represent the highest priorities identified in each of the specific workshop sub-regions identified above. Each of the three tables displays the highest priority issues, needs and opportunities identified by the workshop participants in that sub-region. A narrative highlighting and explaining each of the items displayed in the table follows each table.

Table 4 represents a compilation of the highest priority items[10] that are common among the three sub-regions. Arraying the data in this fashion more easily allows us to identify the items that are the highest priority across all 16 western states, helps lay a path for the design of options for NETL to address the most important issues, needs and opportunities in its future

[10] Issues, needs and opportunities identified as being of "Secondary Priority" are listed in Appendix V. These items were seen by workshop participants as important, but not the highest priority to developing collaboratives that could accelerate the technologies into the marketplace.

RD3 program, and enables us to craft a program(s) for NETL to collaborate with state public and private partners that would lead to an acceleration of advanced gas turbines and hybrid systems into the market place.

TABLE 1 – Portland, OR Workshop[11]

HIGHEST PRIORITY ITEMS

ISSUES	NEEDS	OPPORTUNITIES
Interconnection Standards	Information	State, Federal and Utility Financial Incentives
Transmission Congestion	Analyses of power quality	R&D Demonstrations
Low Efficiency	Comprehensive Case Studies	Siting & Technical Assistance
High Gas Price	Business Decision Model	
CO2 Emissions	Demonstrations	
Financing		

Table 1 -- ISSUES:

Interconnection Standards: The lack of a common interconnection standard seems to be one of the most significant issues that creates a barrier to accelerating distributed energy technologies (e.g., advanced gas turbines) into the marketplace.

This issue is recognized across the country as a major impediment to accelerating distributed energy technologies.[12] It is also recognized that it is not technical issues that are the problem, but in general it is business practice issues. Furthermore, E2I notes that much of the interconnection work does not include integration with the existing electric power supply system.

Three states, California, New York and Texas, have developed interconnection standards and approximately 20 other states are in some stage of a process looking at developing interconnection standards. Gerry Galinato, a workshop presenter, noted that 15 states have completed interconnection standards for small renewables and five have completed rules for interconnection standards for distributed generation. He also noted that Wisconsin had drafted guidelines, Colorado passed an interconnection bill for electric cooperatives and Idaho's Public Utility Commission is developing an interconnection tariff. However, the presenters also noted that even where standards have been developed, not all issues have been addressed.

From a national perspective, the Institute of Electrical and Electronics Engineers (IEEE) Standards Coordinating Committee 21 continues to develop a Draft Standard for Distributed Resources Interconnected with Electric Power Systems (IEEE P1547). This standard, when

[11] Includes the states of Idaho, Montana, Oregon, Washington and Alaska
[12] From the Electric Innovation Institute's (E2I) draft paper, *Distributed Resources Public Private Partnership Prospectus*, March 15, 2002, pgs. 9, 16 and 17, for a more detailed discussion.

approved and adopted, is expected to be a key milestone in the quest for a standardized and appropriate interconnection standard for the U.S. power industry.[13]

The objective of the current work is to establish minimum technical criteria and requirements for interconnection of distributed resources with the electricity delivery grid to achieve the ultimate goal of development of a uniform standard for electrical interconnections. The standard will address conditions necessary for optimum performance, operation, testing, safety and maintenance of interconnected distributed resources.[14]

The issue of ensuring a common basis for a national interconnection standard was a theme noted[15] in this workshop. There was concern that significant inconsistencies might ensue since states and national organizations were both developing (or have developed) standards. The need for a common standard was seen as critical, but it was also recognized that such a common standard would need to be flexible enough to accommodate local or regional needs.

Costs of interconnection is also an issue, but as the project size increases, the $/kw base decreases. Consequently, smaller turbine or hybrid systems are at a cost disadvantage. In the breakout session, it was noted that the real cost issue is for systems that are less than 1 MW in size[16].

Workshop presenters also reiterated E2I's comment that safety and technical issues were not the problem with interconnection standards, but that the business practice issue was the main barrier. Some of this problem was attributed to the differences between how utilities view small versus large distributed generation systems.

Regulatory issues were also seen as barriers to accelerating advanced gas turbines and hybrid systems into the market place. These issues include; applications and fees, liability insurance levels, certification requirements, and simplified procedures and agreements. In addition, on small systems, installers can run into issues related to building code compliance, particularly since electric generating systems are not commonly found in local building codes.

Clearly, this is one of the critical issue areas that needs to be addressed if advanced gas turbines and hybrid systems are to be accelerated into the market place.

Transmission Congestion: This issue was considered a critical one by the states in this workshop. The issue is centered on the ability of the transmission and distribution utility (T&D utility) to manage line loads when the distributed generation may be fed into the system at a time when the lines are carrying high loads. Transmission and distribution congestion is an issue that the industry is wrestling with from many distinct viewpoints. The impact of additional distributed loads into a dynamic system is another complexity for T&D utilities to consider, plan for, and technically implement controls.

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[13] See, the Institute for Local Self Reliance's website, entitled "The New Rules Project", http://www.newrules.org/index.htm
[14] ibid.
[15] by both Gerry Galinato of the Idaho Energy Division and Marty Stipe of the Oregon Office of Energy
[16] Gerry Galinato and Chris Galati of Northwest Natural Gas.

Low Efficiency for Small Turbines: In the information gathering task, micro-turbines were cited as having a low electrical generating efficiency, thereby making them less cost competitive than conventional generation[17]. During the workshop presentations and in the plenary sessions, attendees agreed that the low efficiency of small turbines, particularly when compared to utility grade turbines, and when coupled with project cost issues and *low electric and high natural gas prices*, is a technical issue that confounds attempts to move turbine/hybrid systems into the marketplace.

High Natural Gas Price: During the information gathering task, this group of states found this issue to be unique to their particular situation. First, these northwestern states find that they have a relatively low price of electricity, due in part to a significant portion of the generating mix being low cost hydropower. Second, when the low electricity price is then coupled with a relatively high price of natural gas, (due in part to last year's price spike still being fresh in everyone's mind), these turbine/hybrid systems technologies are often dismissed as being a viable option. In addition, one state notes "Because of the relatively small amount of gas purchased by most operators of microturbines they will buy it through [a local distribution company (LDC) at a] $0.17/therm premium."[18]

At the workshop, both Gerry Galinato and Chris Galati noted that this was a key problem in accelerating the advanced gas turbines and hybrid systems into the northwest. It is particularly problematic for small systems as these systems are often supplied by retail suppliers (local distribution companies) whose price per mcf is much higher than that for industrial (utility) customers. The meeting attendees, during the plenary session to identify critical issues, agreed that this pricing issue could prove to be problematic to accelerating turbine/hybrid systems in the northwest region.

Carbon Dioxide (CO_2) Emissions: The issue related to CO_2 emissions was explored during the workshop. The need to link lower CO_2 emissions from advanced gas turbines and hybrid systems with financial incentives associated with future carbon offsets markets was considered a positive impact on the acceleration of the technologies into the marketplace. The Climate Trust of Oregon was given as one example of a way to add value to a turbine/hybrid project by incorporating the value of the lower CO_2 emissions in a future credit trading market into the overall project financing.

However, attendees also noted that much work, aside from the educational/marketing aspect, still needs to be done to make this a viable driver in the market. Monitoring and verification of the emission reductions needs to be integrated into the overall project (an additional project cost). Also calculating the reductions from either generation being replaced (e.g., diesel fired generation) or displaced (possibly a problem to get emission reductions in a community where hydropower is a major portion of the electric generation mix) needs to be done in a manner that is credible. Nevertheless, this issue was seen as critical for the industry over the long-term.

Financing: The workshop attendees saw this issue as one of the most critical to accelerating turbine/hybrid systems into the marketplace. In many cases, this issue is tied into all the issues detailed above (e.g., interconnection costs, gas price stability, emission reduction

[17] ibid.
[18] from the state of Washington response in the information gathering task.

values). In addition, utility, project developers and state officials all agreed that the ability to finance turbine/hybrid system projects is hampered by lack of knowledge and only a few case studies. Furthermore, a lack of viable business models and practices also stymies turbine deployment.

Table 1 -- NEEDS:

Information: In the initial task of this project, information was seen as an all-inclusive need expressed by the states. They pointed to a lack of good, accurate and understandable information about turbine/hybrid systems that leads to wrong, or no, decisions being made.

During the workshops phase of this project, the presenters and attendees agreed that quality information might be the greatest need for more turbines/hybrid systems to be deployed into the marketplace. In fact, providing better and more credible information about turbine/hybrid systems can lead to overcoming the "…fear of change"[19] associated with foregoing current practices and/or products and adopting new technologies or products. In addition, better and more widely disbursed information could overcome misinformation that can adversely impact the deployment of these technologies into the marketplace, for example, it was noted that "…an [un-named] major utility in Oregon tells people that gas turbines do not work"[20].

The specific needs discussed below (*Analyses of power quality*, *Comprehensive Case Studies*, *Business Decision Models*, and *Demonstrations*) describe the necessity for better information concerning all aspects of turbine/hybrid systems, whether its technical research information or guidance on the process to deploy such systems.

***Analyses of Power Quality*:** This issue has to do with the need to develop accurate data on costs that are often overlooked in making "go/no go" decisions on deploying turbine/hybrid systems. In the initial information gathering task of this project, Oregon state officials expressed the need to better understand, and express, the value of power quality when developing a turbine/hybrid system project:

> "Assessment of the value of lost service or product quality variation is not consistently applied in the projects we have been involved in."

Presenters and attendees at the workshop session agreed with this view. The need to develop a clear and concise protocol for valuing the benefit of increased power quality provided by turbine/ hybrid systems, and a means to disseminate examples highlighting the benefits, was seen by the workshop attendees as a critical need that must be fulfilled.

Comprehensive Case Studies: As in the initial data gathering task, workshop attendees resoundingly noted that a series of comprehensive case studies is seen as a means to fill the information and analytic gaps identified in many of the issue areas already discussed. The attendees indicated that case studies should be broadly based while addressing different sectors of the marketplace (e.g., utility sector, industrial users, and commercial operations).

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[19] Robert Steele, Vice President, Ramgen Power Systems
[20] ibid.

Workshop attendees felt that case studies, or success stories, need to provide details concerning all the major elements of a project, including but not limited to the following; problem being addressed, permitting, siting, design assistance, equipment selection, installation, operations, maintenance, and detailed financial aspects (from capital outlays to operating costs to rates and tariffs). The audience for these case studies also needs to be broad; the attendees felt that the case studies must be written for the end users as well as the utility representatives dealing with distributed generation.

Dissemination of the information contained in the case studies also needs to be broadly distributed according to comments in the workshop. A number of attendees also indicated that more workshops, similar to the ones conducted in this project, would be a good venue to distribute and discuss the studies.

Business Decision Models: Workshop attendees and presenters were unanimous in expressing the view that a critical need for this industry are solid business decision models that can help utilities, developers, and end users make the proper go or no go decision. Analyses of the explicit economic drivers and externalities needs to be developed. A full life-cycle approach needs to include ways of assessing the value of risk avoidance better. That value needs to be incorporated into decision making in other than anecdotal or indirect ways. A comprehensive decision model assisting business and industry in project decision making would be extremely useful. A business model that specifically incorporates a financial payback element is critical to deploying turbine/hybrid systems.

Demonstrations: The participants at the workshop saw the need for more demonstration and pilot projects as one of the very critical needs to move the industry forward in deploying turbine/hybrid systems. The need for public sharing of information about such projects and development of case studies about them was recognized as an important means[21] to get more units deployed. In the initial data gathering task it was noted that independent third party evaluation is seen as very important to the credibility of efforts to deploy turbine/hybrid systems. One comment[22] summed it up very well:

> In the development of the demonstration projects…Independent or national labs could have a role in monitoring and evaluation to yield credible documentation or project results.

Many of the participants in the workshop expressed the opinion that collaborations involving utilities, developers, the end user and state or federal agencies could initiate demonstration projects that would best serve the whole industry.

Table 1 -- OPPORTUNITIES:

State, Federal and Utility Financial Incentives: Financing of projects that incorporate advanced gas turbines and hybrid fuel cell systems was identified as one of the key issues that prevented these technologies from being more rapidly introduced into the marketplace. Consequently, participants agreed that where incentives existed for implementing clean

[21] Marty Stipe, Oregon Office of Energy
[22] State of Oregon response in initial data gathering task.

energy technologies, like advanced gas turbines and hybrid fuel cell systems, opportunities abound for accelerating the technologies into the market place. One of the most oft-cited examples of a financial incentive that worked well was the Oregon Business Energy Tax Credit, which permits a 35% tax credit[23] for clean energy technologies, such as advanced turbines in combined heat and power (CHP) applications. Participants also indicated that where a state had enacted a Public Benefits Fund, projects involving turbines and hybrid systems were more likely to be implemented.

The participants also noted that federal tax credits are a way to minimize the financing risks associated with these technologies. Federal task credits for fuel cells and combined heat and power systems that incorporate advanced gas turbines or hybrid fuel cell systems[24], coupled with a reduction in the regulatory burden and a resolution on interconnection costs could provide an enormous boost to these technologies. In fact, the American Council for an Energy Efficient Economy (ACEEE) estimated that such tax credits for these technologies could add 50,000 MW of power capacity in the U.S. by 2010[25]. Workshop participants indicated that should an Energy Bill be passed that includes tax credits for these technologies, many more opportunities for installing these technologies will occur, particularly for on-site power generation or as a grid based distributed energy resource.

R&D Demonstrations: Workshop participants cited research, development and deployment projects as opportunities to create collaboratives among state, federal, industry and consumers that would more rapidly diffuse the technologies. For example, in the initial data gathering task, the state of Washington indicated that they "…can provide support [for turbine/hybrid systems] through research and development…". In discussions at the workshop, coupling this type of support with federal R&D support (e.g., from the Department of Energy's national laboratories) was seen as an excellent opportunity to leverage larger projects that could also serve as models for other projects and/or case studies that could provide valuable insights to others developing similar projects.

In its initial response to the data gathering task, Oregon suggested that a series of demonstration projects would help pave the way for additional installations of turbine/hybrid systems:

> A series of demonstration projects across the country with well publicized decision making, design, permitting, system performance and operations details will be useful in accelerating CHP adoption.…Finding common and transferable applications for these demonstrations is crucial.

This sentiment was echoed in the workshop – participants believed that an excellent opportunity exists for developing such R&D demonstrations, if federal and state governments would work in concert with the industry and developers to initiate such projects. It was

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[23] For more details on this tax credit, go to http://www.energy.state.or.us/bus/tax/taxcdt.htm

[24] These tax credits were included in various House and Senate energy bills as well as the Energy Bill which died in the 107th Congress; similar legislation is also pending in the 108th Congress.

[25] Quinlan, P., Geller, H., and Nadel S., October 2001, *Tax Incentives for Innovative Energy-Efficient Technologies (Updated)*, ACEEE Report Number E013, Washington, DC: American Council for an Energy Efficient Economy.

suggested that the federal government could lead a broad demonstration effort, which could result in a rapid upsurge in turbine/hybrid system installations.

Siting and Technical Assistance: Siting and technical assistance were noted to be an area where collaboration between the federal and state governments could provide opportunities to resolve many of the issues that have hampered the diffusion of these technologies, particularly those that are related to regulatory or bureaucratic burdens. Siting a turbine/hybrid system is generally a state issue (not a federal issue), and often local jurisdiction make the final determinations[26]. The collaborative opportunity in this area was focused on resolving the need for common policies so project developers would be able to minimize changes to standard turbine or hybrid products. Creating a national information exchange could help jurisdictions establish common policies and developers create a standard product installation model.

Because siting is varied, complex and involves issues as diverse as air quality, water resources and noise pollution, another collaborative opportunity exists for creating a technical assistance service that would provide information and a roadmap to ease siting complexities. Workshop participants concluded that almost any technical assistance in this area would be welcome by the industry and could result in significant increases in accelerating these technologies into the marketplace.

> ***NOTE***: The above three opportunities were judged by the participants in the Portland, OR workshop to be the highest priority in developing collaboratives. However, in the initial data gathering task, a number of specific collaborations were suggested (e.g., methane producing waste water facilities, CHP applications at specified state universities) as well as more general areas to collaborate (e.g., projects in rural areas or for emergency shelters). These were highlighted in the previously cited Task 1a report (May 2002) and were discussed and noted as secondary opportunities by workshop participants.

[26] For example, Marty Stipe of the Oregon Office of Energy noted that the state's Facility Siting Council was responsible for facilities in excess of 25 MW, but that the local jurisdiction had responsibility for siting of facilities of 25 MW or less.

TABLE 2 – Denver, CO Workshop[27]

HIGHEST PRIORITY ITEMS

ISSUES	NEEDS	OPPORTUNITIES
Interconnection Standards	Business Decision Model	Project Collaboration with State Energy Offices
State and/or Federal Permitting	Hard Data Analyses and Case Studies	Aggregating Small DG Loads e.g., Power Parks
Environmental Issues	Best Engineering Practices	State & Federal Building Demonstrations
	Expand and coordinate ASERTTI RD[3]	Credits for Projects in SIP
	Training for 3rd Party Engineering Verification	Pilot A STAC project

Table 2 -- ISSUES:

Interconnection Standards: Many of the interconnection issues identified in Table 1 – ISSUES, were also discussed in this sub-region. The lack of a common interconnection standard seems to be one of the most significant issues that creates a barrier to accelerating distributed energy technologies (e.g., advanced gas turbines) into the marketplace. Colorado and Nebraska both consider it to be the major issue in attempts to increase turbine/hybrid systems in their state.

Costs of interconnection is also an issue, and as noted in the data gathering task report, as the project size increases, the $/kw base decreases. Consequently, smaller turbine or hybrid systems are at a cost disadvantage. Consistent pricing for interconnection was noted as an issue in the workshop and a National Renewable Energy Laboratory representative[28] noted that there are also no consistent business models or rules for interconnections either.

Non-technical issues related to interconnections, such as building codes, were also identified in the workshop as a problem that inhibited turbine/hybrid applications. The workshop attendees concurred that the large variety of issues surrounding interconnection made this a very critical issue. It was noted that continued demonstration projects that highlighted relevant data, and included information dissemination, would help move the technologies into the mainstream.

State and/or Federal Permitting: Permitting to meet state and local emissions standards, as well as the zoning (or siting) of a turbine/hybrid system, are issues commonly recognized as problems across the western states that can restrict turbine/hybrid system development. The Environmental Protection Agency representative[29] noted that New Source Review standards are different for attainment and non-attainment areas, with tougher requirements for the latter.

[27] includes the states of Colorado, Wyoming, Utah, South Dakota, Nebraska and Texas
[28] Tony Schaffhauser, Director of the Distributed Energy Resource Center
[29] Meridith Bond, PE, Office of Air and Radiation, Region 8

This can lead to situations where a turbine/hybrid system might qualify for permitting in one area, yet not for another.

However, permitting issues, as well as siting or zoning issues, extend beyond air quality requirements. Workshop attendees noted that state or local permits may be required for siting turbine/hybrid systems for such items as noise levels or fuel tanks. Local building and/or fire codes can also complicate siting of a turbine/hybrid system. And these complications can be very different in contiguous localities making it very difficult for developers (utilities, private concerns) to install a needed system. Workshop participants indicated that additional information or case studies on the installation of turbine/hybrid systems could serve as models and provide a more consistent application of requirements for other states or local jurisdictions that deal with permitting and siting issues.

Environmental Issues: The issues surrounding the environmental impacts noted in this region are inextricably linked to the permitting and siting issues described above. Some discussions ensued concerning the potential to increase turbine/hybrid installations by changing rules on emission controls. One participant noted that if emission caps were recognized on a ton/kwh produced, rather than a flat annual tonnage cap, more efficient turbine/hybrid systems would be brought into the marketplace, particularly when they are used as a combined heat and power application.

In addition, workshop participants noted that regulatory treatment often provides disincentives for turbine/hybrid systems, as well as hampering installation of those systems in places such as power parks. As with many of the issues and needs, most workshop attendees believed that more demonstrations of specific turbine/hybrid systems, coupled with careful documentation of operational data and wide-spread dissemination, would greatly increase the deployment of the technologies.

Table 2 -- NEEDS:

> Note: in the spirit of western "plain speaking", one participant declared that a critical need was for "…more funding for NETL to do more R&D on turbine/hybrid systems". That suggestion was loudly applauded.

Regulatory Business Decision Model: A number of the workshop participants noted that in many cases it was not so much the rules that impeded turbine/hybrid systems, but the regulator. This need echoed the comments heard in the *Issues* section above that more detailed data on turbine/hybrid systems must be developed and disseminated to those who are responsible for making decisions regarding these technologies. It was noted that any such model would need to determine the full value of the turbine/hybrid system on both sides of the meter. It was suggested that the development of a business model, which incorporated algorithms, templates and screening tools, is a critical need for the industry and the regulators as well.

Hard Data Analyses and Case Studies: This identified need is one that was echoed in the comments made in all three of the western regional workshops. In the Denver workshop, case studies were seen as a major means to educate regulators and utilities about the many

applications for turbine/hybrid systems of all sizes. Project cost information was seen as an important element of the case studies. However, in this workshop many other elements were discussed and identified as needing specific attention; power outage costs, life cycle benefits, gas supply, and fuel source flexibility. The participants also identified myriad gaps in analytical data concerning many aspects of turbine/hybrid systems.

Best Engineering Practices: Workshop participants saw this as a critical need. It was noted that the best way to bring down engineering costs would be to develop a "best practices" manual that would help standardize engineering practices for different applications. A handbook that highlighted such practices would serve as a "How to" manual and would prove very valuable to those who were installing, or making decisions about installations of, turbine/hybrid systems.

Expand and Coordinate RD^3: Many of the workshop attendees noted that a coordinated research, development, demonstration and deployment (RD^3) program would result in more turbine/hybrid systems getting deployed. Leveraging state funding with Federal funding (and private funding where available) was seen as a means to increase the success of advancing the technologies into the market. In fact, workshop attendees noted that and NASEO, ASERTTI, and the DOE's Offices of Energy Efficiency & Renewable Energy and Fossil Energy were in the process of completing an agreement to jointly plan, fund, and oversee cooperative Federal-State research, demonstration, development and deployment in clean energy technologies. This agreement is known as the State Technology Advancement Collaborative[30].

Training for Third-party Engineering Verification: This need was identified because a number of participants noted that there was a continuing skepticism by some user and utility decision makers about the costs, benefits and full value of the technologies. By having third party verification of the turbine/hybrid system, from installation through operation, it was felt that such skepticism would be eliminated and more deployments of turbine/hybrid systems would occur.

Table 2 -- OPPORTUNITIES:

Project Collaboration with State Energy Offices: The workshop participants concurred that the opportunity to partner with State Energy Offices on deployment of turbine/hybrid systems could be the key to accelerating the technology into the market. It was noted that State Energy Offices can provide a key facilitation step in moving technologies from the laboratory and into the market by utilizing their close relations with businesses and communities in the state. It was also noted that the State Energy Offices work with businesses and communities that need either large- or small-scale turbine/hybrid systems, therefore, a single program from DOE focusing on all sizes of advanced turbine/hybrid systems would help move the technologies along the development and deployment curve.

A number of specific opportunities to work with the state were explored. Two examples follow:

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[30] The State Technologies Advancement Collaborative (STAC) was signed Nov 14, 2002. See; Footnote 1 for further references.

1.) A sugar beet factory with a 15 MW load will need to provide its own power starting in 2006 (as the current utility provider will not provide power to the factory after 2005)[31]. Consequently, the state is working with the factory to help determine a generation package and an advanced turbine/hybrid system which could utilize an alternative fuel (e.g., waste heat, ethanol, gasified coal, etc.). This is a clear opportunity for deploying these technologies and a lead time to plan for it.

2.) Recently a 30kW micro turbine project was put in place at a hog farm in SE Colorado where the methane from an anaerobic digester is being burned to produce 35% of the farm's electricity and 50% of peak power[32]. This farm project represents the first micro turbine in the US to successfully operate in an agriculture setting utilizing a digester. It was felt that the lessons learned from this installation and operation should be documented and used as a successful example of state partnerships. The project could also serve as a model for others to replicate.

Aggregating Small DG Loads e.g., Power Parks: The aggregation of many small loads into a single larger load was seen as an opportunity to use advanced turbine/hybrid systems. Workshop participants noted that such loads could readily be found in two specific areas common in many communities: commercial industrial parks and university campuses. Power quality for industrial parks is also a major consideration and self generation with advanced turbines/hybrid systems could provide the additional reliability needed to ensure power is available when needed.

State and Federal Building Demonstrations: Workshop participants noted that state and federal buildings could provide an opportunity to test the advanced turbine/hybrid system technologies and applications. Federal buildings, military bases, state buildings, and state schools could provide the test bed for the technologies and an opportunity for collaborative partnerships with the state energy offices and other state entities.

Credits for Projects in SIP: Workshop participants noted that there were a number of areas in the western states that are required to comply with a cap on a variety of criteria pollutants (NO_x, SO_x, particulates). Recently, the EPA encouraged states to "set-aside" 5-15% percent of their allowed NO_x emissions for qualified efficiency and renewable programs when submitting their State Implementation Plan (SIP). Consequently, states and local communities can now earn credit for efficiency projects that reduce NO_x. If states, in their SIP, permit cleaner and more efficient power generation to earn such credits, opportunities will significantly be increased for on-site advanced turbine/hybrid systems which produce lower emissions than a central generating station.

Pilot a STAC project: The STAC partnership agreement, noted in the NEEDS section above, was seen as an opportunity for collaboration among the federal and state research organizations to test applications of advanced turbine/hybrid systems. The attendees of the

[31] Major General Scott B. Smith, CEO of Western Research Institute, discussing a state of Wyoming opportunity.
[32] Rick Grice, Director of the Colorado Office of Energy Management and Conservation discussing an opportunity to replicate a successful project in other states and localities.

workshop noted that such agreements could provide the financial leveraging needed to overcome the initial risks that are often associated with new technologies that are entering a market. DOE was encouraged to fully support the agreement.

TABLE 3 – Palo Alto, CA Workshop[33]

HIGHEST PRIORITY ITEMS

ISSUES	NEEDS	OPPORTUNITIES
Interconnection Standards	Information, general/specific	Relieve Transmission Bottlenecks
Regulatory Incentives	Case Studies, gen'l & specific	Relieve Supply Shortages
Environmental Compliance	Life Cycle Benefit Analyses	Relieve Peak Demand
Transmission Impacts	Clean Power Generation	Hybrid Biomass/Gas Turbine Systems
Standby/Exit Fees	Include Renewables in HEET	With Stranded Fuels (e.g., Oil Patch Demonstrations)
Partnering with OEMs	More Systems Integration & Gasification in HEET	National Lab or Air Force Demonstrations
Adequate and Consistent RD^3 Funding	More RD^3 on Controls and Sensors	Demonstrations for Specific Business Applications
	Hybrid University Research Program	With Departments of Forestry
	National Interconnection Std.	

Table 3 -- ISSUES:

Interconnection Standards: This issue has been thoroughly discussed in the *Issues* section following both Table 1 and Table 2. In this particular workshop, the presenters and the facilitator noted that the uncertainty about, and the long time it takes to resolve, interconnection issues is a major impediment in developing distributed energy projects using advanced gas turbines. In fact, one panelist noted that the uncertainty and time delay in the siting, permitting and interconnection process often "…kills projects"[34].

An interesting perspective on interconnection issues came from the utility industry by Tom Dossey of Southern California Edison. He acknowledged that the interconnection process is too slow and expensive, that there is little consistency in handling interconnection issues among utilities and that some do "…place artificial barriers" to customer generation. However, he also noted, in defense of the utility industry, that there are physical problems to integrating customer generated electricity into the existing grid (e.g., most grids were established to run at high voltage with electricity running in only one direction), that the generating technologies and interconnection issues are new to many of the key engineers in

[33] includes the states of Arizona, California, Nevada, New Mexico and Hawaii
[34] Leslie Witherspoon, Manager of Environmental Programs at Solar Turbines, Inc.

the utilities, and rate design needs to be developed to determine whether the customer generator or non-generators pay for the interconnection costs.

The ensuing discussions focused on the need for both state and federal regulatory bodies to develop consistent rules to speed up the interconnection process and balance the interests of the ratepayers with the generators and the utilities.

In the initial response to the data gathering task of this project, a number of the states[35] in this sub-region noted it as a major issue as well. New Mexico may have stated it in the clearest fashion possible: "…adoption of a workable, cost-effective interconnection standard is probably among the most important [issues]" that confront the acceleration of advanced turbine/hybrid systems into the marketplace.

Regulatory Incentives: Attendees noted that one issue hampering the acceleration of turbine/hybrid systems is the development of "real" incentives for the adoption of environmentally sensitive technologies. These incentives, though not specified, could include financial benefits, process time decreases, simplification of rules, etc. that govern generation and transmission aspects of customer generated electricity.

Environmental Compliance: As noted earlier, the issue here is to ensure that turbine/hybrid systems do not produce environmental impacts greater than what already exists. It is critically important that, "…technologies need to demonstrate sufficient…emissions [benefits] to have widespread acceptance…[and]…must have acceptable net air quality effects".[36] Participants in this panel noted that technical research, development, demonstration and deployment issues exist (it was noted that California won't even allow a demonstration project unless its NO_x emissions are less than 2.5 ppm[37]). Another issue cited in this panel was the lack of output based regulations (also noted in the Denver Workshop) – and which was seen as another problem that needed to be resolved before increased deployments would occur.

Transmission Impacts: This issue was touched upon in the narrative under the *"Interconnection Standards"* issue section above, as well as in the "Transmission Congestion" issue section of Table 1 of the Portland Workshop. Participants in this workshop also noted that there are a number of issues concerning "micro-grids" (small grids tying into a main grid at a single point but relying on power generated within the smaller grid area). Most of these are regulatory issues and concern questions about ownership and responsibility, but until resolved these issues can have a dampening effect on turbine/hybrid system growth.

While the transmission comments in the three workshops generally related to the electric transmission issues, a comment expressed in the data gathering task, brought forth an issue related to gas transmission issues: "…transmission constraints are a concern -- population growth and new generation are outpacing construction of needed electric and gas transmission infrastructure. There may be opportunities for advanced turbines to relieve transmission bottlenecks, if the gas transportation issue can be resolved."[38]

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[35] states of Hawaii, New Mexico and California
[36] presentation to DOE DER conference, Mike Batham, California Energy Commission, November 28, 2001
[37] Leslie Witherspoon, Manager of Environmental Programs at Solar Turbines, Inc.
[38] state of Arizona

Standby/Exit Fees: The issue here is focused on the lack of certainty regarding the actual costs for self generation. Participants in this workshop touched upon this issue in the section on *Interconnection Standards* where rate design was mentioned. How these fees are handled can have either an adverse, or positive, impact on turbine/hybrid system projects, but uncertainty and inconsistency among utilities and/or regulators can make a project very hard to develop and finance.

Partnering with OEMs: Workshop attendees felt that developing creative partnerships with a variety of organizations could accelerate the technology into the marketplace. One issue noted was the "lack of trust" between manufacturers and utilities. However, it was noted[39] that the California Energy Commission does develop partnerships with both manufacturers and utilities and that NETL could develop a similar public/private partnership program. Issues surrounding more research teaming with universities were also discussed at this workshop. The discussions were summed up well by Rick Counihan[40] who noted that public/private partnerships "…may be right for NETL and the western States".

Adequate and Consistent RD^3 Funding: The issue here was expressed by many participants as how to ensure a constant stream of funding for critical RD^3 projects. It was noted that inadequate or uncertain funding commitments adversely impacted critical research needed to accelerate turbine/hybrid systems into the marketplace.

Table 3 -- NEEDS:

Information, general/specific: Information dissemination is recognized by most states as being critical for decision makers to have the data required to make sound investment decisions. In the information gathering task, California suggested that it is necessary to "Implement a national outreach program to educate people on DER issues and technology." This sentiment was consistently heard in all three workshops, and the State of New Mexico noted that "…any projects that provide high-quality case studies of permitting processes and emissions performance would be useful."

Under the Portland Workshop narrative (See: Table 1 – Needs), information needs were fully discussed. There was a general consensus that there is a great need for better information concerning all aspects of turbine/hybrid systems, whether it be technical research information or guidance on the process to deploy such systems. In addition, participants noted specific needs that were discussed in the sections entitled; *Analyses of Power Quality*, *Comprehensive Case Studies*, *Business Decision Models*, and *Demonstrations*.

In the Denver Workshop narrative (See: Table 2 – Needs), "information" was not listed per se, however there were three separate needs cited, all related to the need for better information. These included; a *Regulatory Business Decision Model* (to assist the industry and regulators in valuing turbine/hybrid systems), *Best Engineering Practices* (a "best practices" manual to standardize engineering practices for different applications), and *Hard Data Analyses and Case Studies.* This latter need is one that was specifically identified in all three of the western regional workshops; in the Denver workshop, while project cost information was seen as an important element of the case studies, many other elements were discussed and identified as

[39] Mike Batham, Public Interest Energy Research Program Lead, California Energy Commission
[40] Vice President, Research Programs, Electricity Innovation Institute

needing specific attention; power outage costs, life cycle benefits, gas supply, and fuel source flexibility.

The participants in the Palo Alto workshop also identified the above information needs as being critical to the acceleration of turbine/hybrid systems into the marketplace. Carl Linvill[41] summed up much of this discussion by noting that the need for a "…common information base [which could] become a common frame of reference" for turbine/hybrid systems would go a long way in helping the industry. He also noted his belief that NETL should lead the effort to address this information need and the issues common to the technology and its deployment.

Life Cycle Benefits Analyses: As noted in the initial data gathering task[42] and in the prior workshops (See: the information need above), analyses of the full life cycle benefits of turbine/hybrid systems was seen as an important need to be filled. Discussions in the Palo Alto workshop noted that environmental "cradle to grave" analyses are critical for fair comparisons with alternative (conventional) power generation. The participants in Palo Alto also noted that analyses of the full benefits of distributed generation (e.g., reduced transmission costs) should be used when comparing costs to conventional centralized electric generation.

Clean Power Generation: In the report on the initial information gathering task, it was noted that in states such as California, clean power generation is needed to replace or offset old polluting or new high emission generating units due to stringent air quality requirements. This sentiment was echoed in the Palo Alto workshop as the participants noted that the turbine/hybrid systems provide clean, low emissions power.

Include Renewables in HEET: Participants in the Palo Alto workshop indicated that NETL's High Efficiency Engine and Turbine (HEET) program should incorporate research in biomass fuel sources into its overall turbine/hybrid systems program.

More Systems Integration & Gasification in HEET: More systems integration was a need described by the participants in Palo Alto as key to successful deployment of turbine/hybrid systems. The systems integration discussed was broad in its scope; it included physical systems and components from fuel systems, to control components and systems, to grid connection systems, to metering components. The need to integrate these systems was seen as the means to ensure economically viable and successful deployments.

More gasification of fossil fuels (e.g., coal) and biomass (e.g., forest waste) was also seen by the participants as a means to provide cleaner fuel sources and the consequent lower emissions. It was also seen as a means to mitigate environmental pollution associated with conventional burning of coal and wild fires in the western states.

More RD^3 on Controls and Sensors: A number of participants noted that more research and demonstrations on a wide variety of controls and sensors for turbine/hybrid systems is still a basic need for improving both combustion and environmental performance. As an example,

[41] Director, Nevada State Energy Office
[42] Hawaii described a need for analyses of life cycle benefits studies that address a comparison between turbine/hybrid systems and conventional central utility station systems.

Dr. Robert Cattolica[43] noted that the current NO_x sensor technology is 40 years old, but a new and more accurate infrared diode laser technology exists today, and research is continuing on the next generation of laser measurement tools. It was suggested that NETL should continue to support research in these areas.

Hybrid University Research Program: Participants suggested that NETL should continue its current university research program on advanced turbines, but should also sponsor research on hybrid systems at the university level.

National Interconnection Standard: While interconnection standards have been fully discussed under the prior *Issues* sections (in all the workshops), the participants in Palo Alto also believed it is necessary to identify it as a critical need.

Table 3 -- OPPORTUNITIES:

Relieve Transmission Bottlenecks and Relieve Supply Shortages: As noted in the report for the data gathering task, the states involved in the Palo Alto workshop have had a number of past outages partially attributable to transmission bottlenecks (California's Path 15 is a striking example). Replacing high polluting installed back-up generation, which now cannot be called up under existing air permits, with efficient, low-pollution generation could provide the State with a resource that could be called upon when needed.[44] It was also noted that if tariffs were redesigned, the utilities could then call upon these clean, turbine/hybrid systems when the wholesale price of electricity exceeded the cost to run these turbines.[45]

In the workshop, participants discussed the need for clean, low emission generation that could be located near the point of use. The latter point addresses the difficulties with transmission capacity and ensuing bottlenecks in the western states and the benefit that turbine/hybrid systems could provide. In addition, since the deployment of turbine/hybrid systems is often sited and permitted much quicker than large centralized power generating station, the turbine/hybrid systems can be used to more quickly relieve areas that are experiencing supply shortages. The general consensus of the attendees was that these attributes make the turbine/hybrid technologies a viable opportunity for significant deployments in the western states.

Relieve Peak Demand: Because a number of the western states have experienced severe constraints in achieving peak demand levels, turbine/hybrid systems provide an excellent opportunity to more quickly deploy such systems. It was suggested that NETL work with the states to identify areas that have difficulty in meeting peak and provide technical assistance for projects that could be deployed in those areas.

Hybrid Biomass/Gas Turbine Systems: In the report for the data gathering task, New Mexico indicated that a significant amount of forest thinning activities will occur over the next few years, due primarily to the Cerro Grande fire which destroyed 400+ homes in Los Alamos. This large amount of biomass materials may provide considerable feedstock for potential

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[43] Associate Director, Department of Mechanical and Aerospace Engineering, University of California, San Diego (UCSD).
[44] State of Arizona
[45] ibid.

projects such as hybrid gasification/turbine systems. In the workshop, the use of forest waste or forest thinning product was seen by nearly all the states in this region as a major opportunity to implement turbine/hybrid systems in the region.

The participants in the meeting also discussed the opportunities for fuel sources for these systems from agriculture waste. It was noted that more research into cellulosic biomass should be undertaken, particularly in the demonstration phase. The participants agreed that utilizing biomass fuel can be a financial boon to the agriculture industry, by cutting waste disposal costs and providing another source of income (i.e. fuel sales).

With Stranded Fuels (e.g., Oil Patch Demonstrations): This opportunity was described in the report on the initial data gathering task. Turbine/hybrid systems could be sited near both producing and non-producing oil/gas fields. Utilizing waste gas from producing fields or utilizing gas injected in wells no longer producing oil, turbine/hybrid systems could provide needed electric power. Participants in the workshop noted that there would be a number of opportunities to demonstrate the efficacy of the systems in an oil/gas field setting.

National Lab or Air Force Demonstrations: With the heightened security at both national laboratories and defense facilities since "9/11", on-site power generation with turbine/hybrid systems could ensure that power for these critical facilities would be much more difficult to disrupt. Opportunities abound throughout the western states; New Mexico believes that its two National Laboratories, several Air Force bases, and a large DOE complex offer promising candidate sites for demonstrations of turbine/hybrid systems. In the workshop, it was also noted that the Navy Base in Ventura is developing a biodiesel project that is expected to provide secure and reliable power with lower emissions, important for California's air quality. Attendees felt that there were many such opportunities for such deployments throughout the region.

Demonstrations for Specific Business Applications: Attendees at the workshop indicated that there are many opportunities for demonstrations of different turbine/hybrid systems in different business applications. A number of the participants noted that NETL should participate more actively in the public/private partnerships that have been deploying these technologies. Helping to document the results of the projects would be beneficial to moving these technologies more rapidly into the market.

With Departments of Forestry: This opportunity is related, in large part, to the *Hybrid Biomass/Gas Turbine Systems* opportunity described above. State Departments of Forestry, as well as the federal Bureau of Land Management (BLM) and the lands under control of the Department of the Interior (DOI), have access to virtually limitless biomass fuel sources and a need to provide electric power in some very remote areas. Consequently, the participants indicated that teaming with state and federal "forestry" agencies could provide viable demonstration projects for turbine/hybrid systems.

TABLE 4 – Consolidated Workshop Findings[46]

HIGHEST PRIORITY ITEMS – COMMON TO ALL WESTERN STATES

ISSUES	NEEDS	OPPORTUNITIES
Interconnection Standards	Information, general/specific	Demonstrations
Transmission Impacts	Comprehensive Case Studies and Data Analyses	State & Federal Building Demonstrations
Environmental Issues	Business Decision Model	State, Federal and Utility Financial Incentives
Consistent RD^3 Funding and Access to Financing	Expansion of State and University Research Programs	
	Modifications to HEET Program	

Table 4 above lists the critical issues, needs and opportunities that were common to the 16 states that comprised all three workshops. It is these issues, needs and opportunities that dominated discussions in the three workshops. From the discussions in all the workshops, it became apparent that the items listed above should be addressed first to obtain the biggest impact across the largest number of states. Consequently, any program that NETL proposes to further accelerate advanced turbine/hybrid systems into the marketplace should address these critical, but common, issues, needs and opportunities.

Issues Common to the Three Workshops:

Under the *Issues* common to all the states, the lack of a common interconnection standard and the rules governing interconnections, were seen as major impediments to moving the technologies into the market. However, it was also recognized that NETL might not be the appropriate partner to help develop the standards or rules. Nevertheless many participants at the workshops saw NETL as a partner that could help develop and disseminate the information necessary for others to make decisions on installing turbine/hybrid systems. In addition, where technical or physical issues impact interconnections, it was felt that NETL might provide the credible and objective technical assistance needed to resolve such issues.

Transmission issues discussed in the workshops identified transmission congestion found in many areas as a major driver to develop non-central plant options (such as turbine/hybrid systems) for generating electricity. Corollary issues include grid control impacts from adding distributed sources of generation to an existing grid (e.g., managing new line loads) and micro-grid impacts to the existing system (e.g., point of entry into the existing grid). It was suggested that NETL sponsor demonstration projects that could help resolve these latter issues.

[46] from the three workshops held in Portland, OR, Denver, CO, and Palo Alto, CA.

Participants in the workshops identified environmental issues as another major driver for the development of cleaner advanced turbine/hybrid systems. These systems were seen as a likely replacement for highly polluting fossil generation in many instances (e.g., replacing diesel generation or new coal fired central plant generation). Some participants also saw lower carbon emissions and potential carbon credits as a driver for these cleaner distributed technologies. It was suggested that NETL could be a partner that would assist in the research and documentation of the environmental performance of the turbine/hybrid systems.

The final common, but critical issue, identified in the workshops related to consistent RD^3 funding and access to financing. Inconsistent funding for research was considered a major impediment to the technologies. Lack of adequate financing for turbine/hybrid systems was often attributed to the lack of good data and information about projects. NETL was seen as a leading advocate for research funding in this area and also was recognized as the entity that could help develop the data and information that would make financing of such projects more readily available.

Needs Common to the Three Workshops:

Under the *Needs* common to all the states, accurate, reliable and credible information was seen as the greatest need. The information and data needed was quite broad in scope, encompassing virtually everything from technical research data, to project cost estimates, to the process steps required for deploying turbine/hybrid systems. It was believed that lack of such information was impeding the deployment of the technologies in the marketplace.

Participants at the workshops identified the need for comprehensive case studies, detailing a cradle-to-grave approach that would provide a path for others to follow. While project costs were seen as a critical part of any case study, other data and information were seen to be very important as well; power outage costs, life cycle benefits, gas supply, and fuel source flexibility.

The participants also suggested the development of business decision models that incorporate a full life-cycle approach (and detailing economic drivers and externalities) would help utilities, developers, and end users make the proper go or no go decision. Suggestions were made that NETL could play a role in the support for the development and dissemination of such information and data, particularly in the development of case studies and business decision models.

The “Expansion of State and University Research Programs” was a need that participants identified as a potential means to further accelerate the technologies into the marketplace. While the research conducted under the HEET program by universities was considered critical to the solving advanced turbine problems, a number of participants believed that the university program should be expanded to also include hybrid systems. It was felt that the absence of hybrid systems research in the HEET program produced a gap in the research needed to get turbine/hybrid systems into the marketplace.

Also, under the above identified need, many of the attendees in the three workshops noted that a coordinated research, development, demonstration and deployment (RD^3) program would result in more turbine/hybrid systems being deployed. Leveraging state funding with Federal

funding (and private funding where available) was seen as a means to increase the success of advancing the technologies into the market. As noted previously, workshop attendees cited the ASERTTI and NASEO agreement[47] with the DOE's Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy as an excellent means to expand state and university research programs on advanced turbine/hybrid systems. NTEL's support of this joint research agreement is needed for it to succeed.

"Modifications to the HEET Program" was the final common need identified in the workshops. As noted in the prior need above, one such modification would be the inclusion of hybrid systems research in the HEET program (e.g., fuel cells combined with gas turbines). Another suggested modification included adding renewables, particularly biomass fuel sources, to the areas covered under the HEET program. It was also noted that the HEET program should incorporate demonstration projects with "real" customers as part of its normal course of business. Attendees felt that these modifications would allow the HEET program to be more robust and comprehensive in its scope – and therefore achieve better results in getting the technologies into the marketplace.

Opportunities Common to the Three Workshops:

Under the *Opportunities* common to all the states, project demonstrations across a broad range of turbine/hybrid systems was seen as a major opportunity for NETL to create collaboratives among state, federal, industry and consumers that would more rapidly diffuse the technologies. A number of states indicated that they could provide support for turbine/hybrid systems through research and development programs. At the workshops, participants noted that coupling this type of support with federal R&D support (e.g., from the Department of Energy's national laboratories) was seen as an excellent opportunity to leverage larger projects that could also serve as models for other projects and/or case studies. Such models could provide valuable data and information for others developing similar projects. Finding common and transferable applications for these demonstrations is crucial.

Participants at the workshops noted that state and federal buildings could provide an opportunity to test the advanced turbine/hybrid system technologies and applications. Federal buildings, military bases, state buildings, and state universities could provide the test bed for the technologies and an opportunity for collaborative partnerships with the state energy offices, other state entities, and private developers or utilities. Participants also noted that heightened security at state and federal offices as well as military installations (as a response to "9/11") provides a great opportunity to demonstrate these technologies and serve a national security need at the same time.

Finally, participants at all three workshops identified state, federal and utility financial incentives that could provide myriad opportunities to fund both research and demonstration projects for turbine/hybrid systems. Many states[48] have enacted public benefit funds for clean energy technologies and could provide incentives for the development of turbine/hybrid systems. Tax credits at the state level, such as Oregon's Business Tax Credit for clean energy

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[47] The "State Technologies Advancement Collaborative (STAC) Partnership".

[48] Twenty four (24) states have some form of public benefit funds. See, Brian T. Castelli PowerPoint presentation entitled "*Role of State Public Benefit Funds in Climate Initiatives*" at the World Wildlife Fund's annual Climate Savers Conference, March 12, 2003

technologies, were also seen as a means to drive the technologies into the marketplace. Utility incentives, particularly where transmission or environmental constraints impede conventional generation also could provide financing for projects. Participants suggested that NETL should support projects that combine many funding sources and leverage the highest amount of funding possible.

HEET Program Regional Input (Boston and Chicago Regions)

During 2002, NETL, through the South Carolina Institute for Energy Studies (SCIES), conducted four other meetings specific to the HEET program. These meetings focused mainly on technical issues and generally followed technical conferences held in the region. The meetings, and the workshops conducted by NASEO, were arranged to get separate input from each of the DOE-defined Regions in the U.S (all states were covered, though the regional meetings and workshops did not strictly conform to the states in each region).

SCIES ran the meetings for the Atlanta Region, the Philadelphia Region and held small meetings in the States of Connecticut and Louisiana following technical conferences that were held in those states. Combined with the workshops that NASEO had already scheduled to conduct for NETL in the Denver Region and the Seattle Region, only states in the Boston and Chicago Regions were not covered by the meetings and workshops. Consequently, NASEO was asked to assist SCIES in identifying the relevant state energy and regulatory officials, as well as industry and utility officials. NASEO also assisted in collecting and summarizing regional input from these two regions. This was accomplished through e-mailed questionnaires supplemented by telephone contacts with the respondents.

The results of the meetings conducted by SCIES can be found in their entirety in the Final Report completed in February 2003[49]. Excerpts of the results from the cited report on the Boston and Chicago region are noted below.

- Boston and Chicago respondents felt more strongly than respondents in other regions that the HEET goals in both the intermediate and long-term were reasonable. This may be due to their reliance on coal for electricity generation.
- In responding to questions concerning both the (i) development and field testing of advanced gas turbines and hybrid systems, and (ii) conducting R&D on "non-standard gas", such as biomass, to make it compatible for the turbine and hybrid systems, the respondents in Boston and Chicago strongly supported both items. This support is probably due to biomass resources in those regions and the current interest state partners have in biomass gas as an alternative to natural gas supplies.
- Boston and Chicago respondents were very positive in supporting cost competitive "near zero" emission coal gasification combined cycle turbines. Some of this support may be due to these regions' worry about natural gas supply.
- Strong support was also generated from these two regions for highly efficient (>60%) hybrid systems and generally agreed that achievement of the HEET program goals could help address the natural gas supply issue.

[49] See; *High Efficiency Engines and Turbines (HEET) Program: Input from Stakeholders in Different Regions of the U.S.*, Final Report, February 2003

- On-site coal gasification was not seen as particularly critical but the capital cost of such distributed generation systems was seen as critical to accelerating these technologies into the marketplace.
- Interestingly, the respondents in these two regions only showed moderate support for accelerated programs for university research (e.g., re: syngas or ultra low NO_x), though they very strongly supported providing host sites for both small scale hybrid systems and coal gasification combined cycle plants with ultra low emissions.
- In the final questions related to getting adequate federal funding for the HEET program, respondents from the Boston and Chicago region strongly supported educational efforts with the Governors' offices on the public benefits of the program and utilizing the universities to educate congressional delegations on the same issue.

Comments received from the respondents also expanded upon many of the issues supported above. The respondents were supportive of involving more private sector parties in collaboratives and raised issues on natural gas that went beyond its use as a fuel for advanced gas turbines (e.g., supply, distribution and cost). They also commented on environmental and interconnection issues. The respondents from these states also commented on potential state and federal collaboratives and shared funding opportunities.

Finally, the SCIES report summarized the results of its findings on the HEET program from all the regions, including the workshops conducted by NASEO. The summary results from that report are listed below:

- Integrated Gas Combined Cycle (IGCC) plants are worthwhile in states that use coal for power generation. For IGCC plants in those states:
  - The intermediate and long term goals are worthwhile, but they are a stretch, particularly the timing
  - ICGG plants must have low capital cost ($/kW) to compete with pulverized coal plants

- We should develop turbines for a wide range of non standard fuels in addition to coal gas, e.g., biomass gasification

- All states, even those not interested in coal, are interested in biomass. This suggests that we should link research and development efforts of the HEET Program which deals with syngas from coal, with those of the biomass gasification program.

- Small hybrid systems, fueled with natural gas or coal-derived liquids, fit with almost all state and regional distributed generation (DG) plans

- There is strong support in all regions for development and field test of systems that show incremental improvements toward the long term goal.

- We need to educate state and federal governments on the public benefits of HEET
  - Better define the scope and structure of HEET
  - Get the importance of HEET understood so it gets full funding

In general, the findings from the SCIES and NASEO information gathering in the Boston and Chicago regions were consistent with the findings from the three western workshops.

Potential Collaborative Opportunities and Next Steps

In the three workshops conducted by NASEO, a number of general and specific collaborative opportunities to accelerate advanced gas turbines/hybrid systems into the marketplace were identified (some have already been discussed earlier in the report). Participants in the workshops discussed these potential collaborations and generally agreed that they are critical to the ultimate deployment of these technologies on a large scale in a near term time frame. The next two subsections provide a comprehensive listing of the most critical "general" and "specific" collaborative opportunities identified in the workshops.

Potential Collaborative Opportunities – General

1. Small Producing Oil Fields – These were considered a potential collaborative opportunity as the need to drive pumps and other equipment can be done more efficiently and more environmentally benign with gas fired advanced turbines or hybrid systems. The Wyoming Energy Office noted that a partnership with NETL, equipment manufacturers, and the state could help implement these systems in the oil patch. Representatives from New Mexico also noted the opportunity in oil fields for a public (state and federal) and private sector collaborative demonstration. In the Palo Alto workshop, participants also noted that opportunities to implement a turbine program exist where there are "stranded" fuels, such as in the oil patch.

2. Rural Farm Applications - These were seen to be another area where collaboratives could be successful. Colorado Energy Office representatives discussed a demonstration pilot in which micro-turbines could be placed on farms that have access to anaerobic digester gas, which could be used as the fuel. Idaho Energy Office representatives also noted that anaerobic digester gas as a turbine fuel provides opportunities to site advance turbines/hybrid systems in rural areas with a large population of cows. In addition, Idaho participants also noted that the opportunity for collaboratives is driven by the need to avoid expensive new transmission lines to serve rural communities.

3. Power Parks - Using advanced gas turbines/hybrid systems in the development of "Power Parks" was seen as an ideal opportunity to develop a state-federal collaborative. Power Parks are generally defined as commercial developments that attract businesses that require high levels of electric reliability and power quality. Participants in the Denver workshop noted that as the economy continues to move to a "digital society", the quality of the power delivered is often as critical to the operation of the business as is the reliability. Small fluctuations in line voltage can damage extremely sensitive digital equipment so on-site generation is considered as a viable means to resolve this problem. It was also noted that aggregating small business to such parks has the added benefit of building electric demand that matches the output of larger advanced gas turbines.

4. Environmental Issues - Denver workshop participants also noted that collaborative opportunities for deployment of advanced gas turbines/hybrid systems exist as a means to deal with environmental issues. Allowing emissions credits in State Implementation Plans for higher efficiency advanced turbines could provide an incentive for deploying more of these technologies in non-attainment areas. State and federal officials could work together to identify potential applications for such deployment. In addition, it was noted that the need to meet "regional haze" emission limits would also be a driver for such collaboratives to form.

5. Home Builders - Another opportunity for deployment of advanced gas turbines/hybrid systems was also identified in the buildings community. It was proposed in the Denver workshop that working with state and regional homebuilders could provide a market for these technologies, particularly in large residential and commercial developments.

6. Relieve Transmission Bottlenecks - In the Palo Alto workshop, both the state energy offices and the utility representatives saw advanced gas turbines/hybrid systems as one means to relieve transmission bottlenecks. Collaborative partnerships that develop a pilot demonstration could resolve bottleneck problems in the west and prove its replicability for other regions of the country.

7. Relieve Peak Demand - Another related area where advanced gas turbines/hybrid systems could serve as a solution to a problem that impacts nearly all electric systems is the need to relieve or manage peak demand. Participants at the workshops saw deployment of these technologies as a way to meet peak demand or to replace dirty (i.e. high emission producing generation, such as diesels). The potential to collaborate with utilities and/or large commercial/industrial consumers was considered a viable opportunity.

8. Coalfield Methane - Methane from coalfields was seen by many of the Denver workshop participants as a driver for deploying advanced gas turbines/hybrid systems. An often-wasted fuel (methane) can be gathered from coalfields and be used with these turbine/hybrid systems. It was noted that additional benefits from collecting the methane include safer mining conditions and fewer greenhouse gas emissions to the atmosphere.

9. Wastewater/Solid Waste Methane - Methane from both wastewater and solid waste facilities was also identified as a driver for deploying these technologies. Montana representatives at the Portland workshop noted that this source of methane is located in nearly all urban areas and could provide needed electricity and heat to operate the facilities. Public and private sector collaboratives, including state and federal partners, were seen as a way to deploy the technology at a much faster rate than currently experienced.

10. R&D Demonstrations - The Hawaii and Washington representatives saw R&D demonstrations for specific applications as a key area for potential collaborations. The need for siting and technical assistance is something that the energy offices can provide and would help deploy the technologies. Technical assistance from

the federal labs and universities can also be of great assistance in such demonstrations. The potential for collaboration in this area was seen as a critical element to deploying advanced gas turbines/hybrid systems.

11. Commercial Demonstrations – At the Portland workshop, numerous discussions identified demonstrations of advanced gas turbines/hybrid systems in commercial applications as a means to "prove" the viability of the technology. These demonstrations were considered to offer a solid platform for collaboration between state, federal and private sector partners. Assistance with design, permitting, and siting a turbine system provides opportunities for the collaboration to form. The Oregon Office of Energy noted that it could even provide some state funding for such a demonstration.

12. Financing Opportunities - Oregon representatives explained the state's Business Energy Tax Credit of 35% that can help provide funding for specific projects. Advanced gas turbines and hybrid systems would qualify in many instances. In a collaboration where federal and private sector partners can also bring some funding, the opportunity for success was generally thought to be high.

    A number of other potential funding sources were also discussed at the Portland workshop. One such source identified was public benefit funds (also known as wire charges) that in many instances could be used to help finance an advanced gas turbine/hybrid system project. Another source was the federal production tax credit that could provide some funding for gaseous fuels produced from biomass or animal waste. These funding sources were seen as being able to provide the basis for a public-private collaborative.

    Denver workshop participants identified the EPA's Supplemental Environmental Project program as another source of funding to finance advanced gas turbines/hybrid systems. This program utilizes money collected as fines by the EPA from companies that have broken environmental laws or rules. The funding can be used on projects that improve environmental conditions, such as the installation of high efficiency, clean power generation equipment (e.g., advanced gas turbines/hybrid systems).

13. NETL and SEO Collaboratives - In all three workshops, participants noted that development of collaboratives between NETL and the state energy offices should be pursued more aggressively. It was generally felt that the state energy offices did not have the same close "connection" with NETL (and USDOE's Office of Fossil Energy) as they did with the National Renewable Energy Laboratory (and USDOE's Office of Energy Efficiency and Renewable Energy). Participants agreed that collaboratives between NETL and the state energy offices could be instrumental in accelerating advanced gas turbines/hybrid systems into the market.

14. Collaborations with Other Federal or State Agencies - Collaborations between NETL and other agencies were also discussed. Participants in the Palo Alto workshop noted that many opportunities exist for advanced gas turbines/hybrid systems in agencies responsible for federal lands, such as the Department of Interior and the Bureau of Land Management. State Departments of Forestry were

also seen as potential collaborative opportunities for NETL. Many of these federal and state lands lack the transmission and distribution infrastructure for powering facilities. Use of advanced gas turbines/hybrid systems are seen as a possible solution.

In addition, participants at all the workshops noted that federal defense facilities (e.g., army bases, naval facilities, etc.) could serve as ideal test beds for initiating demonstration projects.

15. Collaboration with the Western Interstate Energy Board – This was seen as a key collaborative opportunity for NETL and advanced gas turbines/hybrid systems since this Board represents many of the western states on critical regional energy issues.

16. State Technology Advancement Collaborative (STAC) - The STAC was developed as a collaborative effort between NASEO, ASERTTI, and DOE. Both DOE's Office of Fossil Energy and Office of Energy Efficiency and Renewable Energy are participating in STAC. Participants in the workshops felt that NETL should look to participate in this collaborative and that it could serve as a means to implement a variety of advanced gas turbines/hybrid systems projects throughout the United States.

Potential Collaborative Opportunities – Specific

The participants in the three workshops identified a number of potential specific collaborative opportunities. Some are on the path to implementation, others are at the concept stage, but all could benefit from adding federal, state or private sector partners to the collaborations. In many instances, participants felt that NETL could contribute to the collaborations.

1. City of Torrington, WY – This potential opportunity was identified by the Wyoming Energy Office representatives. The City is starting to look for a way to supply 15 MW of electric power that will be needed to serve a customer (a sugar beet factory) in 2007. The sugar beet factory is not a prime utility customer and has been notified that it will not be provided power after 2006. Consequently, the City is considering an advanced gas turbine or hybrid system to provide the needed power. The City is considering either a biomass fuel or a gasified coal fuel to power the turbine. It also believes that it could use the waste heat in a corn to ethanol process. Furthermore, it was suggested that a case study on the City's solution should be written so that the analysis and methodology of the project could serve as a model for other western communities. Both John Nunley, the Director of the Wyoming Business Council (and Chairman of NASEO), and General Scott Smith, CEO of the Western Research Institute, discussed this project and the need to develop a state, federal, private sector collaborative to achieve its goals. Both suggested that NETL should consider working with small western towns as similar opportunities to demonstrate and deploy turbine/hybrid systems exist.

2. K-12 School Microturbine – John Nunley also described opportunities for demonstrating microturbines/hybrid systems at K-12 schools. These were also described as excellent opportunities for a combined heat and power system as the waste heat would be recovered for supplementing (or replacing) the heating system in the school. Although no specific school was specified, John was willing to work with other partners to identify likely candidates and create the needed collaboration that would demonstrate the system.

3. Stapleton Airport Project – This project involves 80 to 100 apartments or condo units at Denver's Stapleton Airport. It is a very large in-fill project and is looking to provide power and domestic hot water from a 60 kW microturbine. Rick Grice, the Executive Director of Colorado's energy office identified this project as an ideal demonstration site that could be replicated in transmission/distribution constrained urban areas anywhere in the U.S.

4. Colorado School of Mines – Rick Grice also identified the Colorado School of Mines as a potential collaborative partner, particularly in the area of R&D concerning gaseous fuels produced from coal. However, the university was also identified as a potential site to deploy advanced gas turbines/hybrid systems since it offers the opportunity to aggregate the loads of many co-located facilities, such as buildings for offices and classes, laboratories, auditoriums, etc. It was suggested that NETL work with the Colorado energy office to identify a specific project to be carried out at the School of Mines.

5. Utah State Implementation Plan (SIP) – Various participants in the Denver workshop discussed the potential to try to include high efficiency advanced gas turbines/hybrid systems as an allowable measure in a state's SIP. By classifying these technologies as allowable measures under the SIP, they would be eligible for credits under the plan. This can be a powerful incentive to deploy advanced gas turbines/hybrid systems. It was noted that Utah is currently in the process of developing their SIP. It was suggested that NETL could collaborate with Utah state agencies involved in the plan development.

6. Senior Citizen's Living Quarters – The Colorado representative described a retrofit project which employs an 80 kW microturbine project at a senior citizen's facility. The system, which provides all the facilities needed electric power, also provides heating and hot water for the facility. The overall efficiency of the system is rated at 85%. This system could be replicated at other similar centers anywhere in the U.S.

7. Coors Brewery – Rick Grice noted that the Coors Brewery in Golden, CO was in the process of determining the feasibility of utilizing an advanced gas turbine and fuel cell hybrid system at their facility. In addition, a conversion of the facility's biomass material to a gas could be used as a fuel for both the turbine and fuel cell. It was suggested that NETL might want to be a partner in this effort as it has applicability throughout the brewery industry.

8. Electric Innovations Institute – Rick Counihan, Vice President of Research for the Electric Innovations Institute (E2I), suggested that NETL could collaborate with

E2I's many partners and projects. E2I is an affiliate of EPRI and has been established as a non-profit, public-benefit organization to conduct strategic, breakthrough R&D in energy-related science and technology. Its goal is to bring together public and private resources, and participating stakeholders to support and direct science and technology innovation in electricity supply, delivery, and utilization to address the socio-economic needs of the U.S. in the future. Rick indicated that many of the research areas that NETL is pursuing, including advanced gas turbines/hybrid systems, could provide valuable assistance in the partnerships E2I has created.

9. Montana State University (MSU) – In the initial response from the Montana state energy office, MSU was identified as a potential project site for an advanced combined cycle gas turbine project, which would also be looked at for a combined heat and power application. It was suggested that NETL could partner with the state energy office in developing many of the technical aspects of the project.

10. Cerro Grande, NM – This potential project site was first identified in the initial response of the New Mexico energy office. The response indicated that the fire which destroyed 400 plus homes in the Los Alamos area had increased forest thinning activities that would continue for a number of years. Participants at the Palo Alto workshop discussed forest thinning activities that were increasing in most of the states and the amounts of biomass materials that would be available to provide a gaseous feedstock for turbine/hybrid systems. It was suggested that NETL's R&D programs should focus on a variety of feedstocks for advanced turbines.

11. Casinos – Carl Linvill, the Director of the Nevada energy office, identified casinos as an ideal customer for advanced gas turbines/hybrid systems, particularly as a means to meet peak demand needs. While Nevada has a special interest in serving this sector, more casinos are being built throughout the U.S., so projects conducted at Nevada casinos have significant replicability. Demonstrating advanced gas turbines/hybrid systems at specific casinos or aggregating the electric demand for a group of casinos (to justify a utility scale turbine) would be an ideal pilot for this sector.

12. Sandia or Los Alamos National Laboratories – In its initial response to this project, New Mexico energy officials indicated that either of the two national laboratories in the state would be ideal candidates to pilot advanced gas turbines/hybrid systems. The need for large amounts of power, reliability and power quality at the labs are elements that make the labs an excellent site to showcase these technologies.

Next Steps

In order for NETL to take advantage of the general and specific collaborative opportunities that were identified in the workshops, the laboratory should consider adopting a number of the steps identified below. NASEO reviewed the suggestions that were made in the workshops and based upon those suggestions, NASEO recommends that the following steps be undertaken:

1. NETL should work closely with NASEO to develop collaboratives among state, federal, industry and consumers that would more rapidly diffuse the advanced gas turbines/hybrid systems technologies into the marketplace.

   NETL should support a "Collaborative Development Team" from NASEO to initiate three highly leveraged demonstration projects that take advantage of state level opportunities identified in this report. NASEO would work with its state representatives to develop collaboratives that would demonstrate the efficacy of the technologies through projects with broad applications. These could include projects with a state facility or a federal facility located in that state.

2. NETL should support the STAC partnership and provide funding for advanced turbine/hybrid system projects under it.

   The STAC partnership is a means to leverage state funding with private and federal funding for clean energy technologies, like advanced turbines/hybrid systems. NETL's support for this partnership would help diffuse the technologies into the market.

3. NETL should support E2I's partnerships with state, federal and private sector partners, particularly in their Distributed Energy Research (DER) area.

   E2I's public-private partnerships are intended to separate fact from fiction concerning DER technologies, including advanced gas turbines/hybrid systems. E2I's partnerships cover topics such as harmonizing inconsistent standards, analyzing market structures and price effects on technologies, and identifying the value of the resulting environmental benefits from clean DER technologies. NETL could provide valuable support and technical assistance in the collaborations that are forming to address these issues. This presents NETL with the opportunity to utilize its R&D expertise to ensure that technology and policy are moving in tandem.

4. NETL should modify the HEET program to include hybrid systems and renewable fuels (i.e. biomass) research.

   A broader, more integrated approach would be instrumental to advancing the technologies into the market while garnering a larger support base for the technology program. NETL should also conduct research on the advanced gas turbines to ensure that they can utilize a variety of gaseous fuels. In addition,

more research should be conducted on a variety of biomass feedstocks that can be converted to a useable gaseous fuel in the turbines.

5. NETL should commission the development of a business decision model that incorporates a full life cycle cost analysis of the technologies.

   Using accurate and reliable data from case studies and other sources, a turbine/hybrid system business decision model could be constructed and utilized as a valuable tool for decision makers who need to determine their power generation options. The need for accurate and reliable data is critical to the industry (as detailed in all the workshops). Putting that data into a format or tool that can be used by utilities, project developers, etc. to make a go or no-go decision can help accelerate the technology into the marketplace.

6. NETL should support the development of 10 case studies of advanced turbine/hybrid systems that would illustrate the resolution of issues that have slowed the diffusion of the technology into the market.

   The 10 case studies should include both large and small advanced turbines as well as hybrid systems. The case studies should also be representative of different regions of the country. They should also include a cost/benefit analysis of the overall impact of the project. These case studies would be a valuable step up on the learning curve for those who are involved in projects to install turbine/hybrid systems.

7. NETL should conduct three advanced turbine/hybrid systems workshops per year, tied into DOE's Regional Office meetings with the states in their regions.

   These workshops would continue to pursue needed outreach to the utility, building, and industry sectors as well as the university and state research institutes to ensure that the technologies are accelerated into the marketplace. It would also ensure that NETL is keeping current with the issues that can impact (either positively or negatively) the deployment of the advanced gas turbines/hybrid systems in the states. By tying the workshops into scheduled DOE Regional Office meetings with the states, state energy representatives will be available for the meetings and will be able to attract critical players (e.g., utilities, project developers, manufacturers, etc.) from their respective states.

Appendices

Appendix I

Sample e-mail text sent to Western State Energy Officials

Greetings all. We wanted to follow up on the recent announcement that NASEO is assisting DOE's National Energy Technology Laboratory (NETL) on an advanced turbine project. The project involves working with Western states and territories to identify collaborative turbine research, demonstration, development, and deployment opportunities that include the states, NETL, and the private sector as partners. Under this NASEO-NETL project, we are defining advanced turbines as micro-turbines, hybrid systems (e.g., small micro-turbines with fuel cells), and combined cycle turbines in excess of 20 megawatts.

In order to begin the project, we need your help in identifying ***Issues***, ***Needs***, ***Opportunities***, and ***Information*** relevant to advanced turbines. The types of information we seek are described in detail under "Step One" below. Your assistance is extremely important in moving forward with NETL to implement new advanced turbine opportunities and programs with the states.

Step One—Issues and Needs: The first step is for NASEO to gather information from the State and Territory Energy Offices on issues, needs, and opportunities for collaborative work in the advanced turbine area. Issues can include permitting, interconnection standards, environmental compliance, infrastructure problems, etc. Needs of the states can include information, technical assistance, clean power generation equipment to respond to supply constraints, or reduction of grid constraints or other assistance for solving energy problems. And, opportunities can include any niche markets, industries, development initiatives or other partnerships that could lead to joint efforts between state entities and NETL. In addition, any information that you can provide concerning the above (e.g.,, website materials, regulatory proceedings, planned or existing state programs) would be useful. This information is needed no later than December 3, 2001.

Step Two—Workshops: The second step includes three NASEO-NETL workshops focused on discussions with State and Territory Energy Officials, regional private-sector and federal government stakeholders, and other state officials to evaluate issues of concern, research and development needs, demonstration and deployment potential, and opportunities for collaborative activities between these entities and NETL. The discussions at each workshop would be one-half day and would be located in each of the three major western sub-areas. Potential sites include Phoenix, AZ, Denver, CO, and Portland, OR in late January, February and March 2002.

Step Three—Recommendations on Specific Opportunities: The final step in the project is preparation of a report that identifies collaborative turbine opportunities between NETL and state partners in the areas of research, development, demonstration, and deployment in the Western states. The report will describe the results of both the meetings and the research on opportunities and will include a plan for how the opportunities could be implemented. The report will recommend collaborative opportunities, NETL turbine program initiatives, methods for cost sharing, collaborative structures, and potential funding sources.

Please review the activities described above, in particular those under Step One, and assist us by identifying ***Issues***, ***Needs***, ***Opportunities***, and ***Information*** relevant to advanced turbines. Information specific to your state or region will be greatly appreciated. In addition, any comments you have concerning the implementation of this project would be helpful.

Please provide us with the requested information under Step One no later than _____. You can e-mail me at _____or send the information to my attention at NASEO's office at 1414 Prince Street, Suite 200, Alexandria, VA 22314; Fax: 703-299-6208

Thank you.

APPENDIX II

Agendas for the three Western Regional Workshops

Advanced Gas Turbine Opportunities Workshop

(High Efficiency Engines and Turbines Program)

Preliminary Agenda – July 22, 2002

851 SW 6th Avenue, Portland, OR 97204-1348

Telephone: 503 222-5161

12:00 pm **Welcome** – William Nesmith, Oregon Office of Energy
Dick Watson, Northwest Power Planning Council
David Terry, National Association of State Energy Officials

12:15 – 12:30 **Introduction** – Brian T. Castelli, NASEO

Brief update on the project and specific purpose and goals of workshop

12:30 – 1:30 **Panel 1 – Issues impacting advanced gas turbines/hybrid systems**
Facilitator – David Stewart-Smith, Division Administrator
Energy Resources
Oregon Office of Energy
Panel Members – Gerry Galinato, Energy Specialist Principal
Idaho Energy Division
Marty Stipe, P.E., Industrial Energy Specialist
Oregon Office of Energy

The panel members will review and discuss the most significant issues raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

1:30 – 2:30 **Panel 2 – Needs related to advanced gas turbines/hybrid systems**
Facilitator – Robert W. Hoppie, Administrator, Idaho Energy Division
Panel Members – Robert Steele, Vice Prsident, Ramgen Power Systems
J. Garrett Smith, P.E., President, Cogentech, Inc.

This panel will review and discuss the most significant needs raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

2:30 – 2:45 **Break**

2:45 – 3:45 **Panel 3 – Opportunities for advanced gas turbines/hybrid systems**
Facilitator – Tony Usibelli, Director, Washington Energy Policy Office
Panel Members – William H. Day, Manager for Outreach
South Carolina Institute for Energy Studies (SCIES)
Rick Counihan, Vice President, Research Programs
Electric Innovations Institute (E2I)

This panel will review and discuss the most significant opportunities raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

3:45 – 4:45 **Breakout Session**

This session will separate the attendees into three topical groups; an Issues group, a Needs group, and an Opportunities group. The corresponding Panel facilitator will lead each group. The group will be charged with discussing the specific topical area in order to develop a prioritization and a list of possible actions (by NETL or others) that could help accelerate the advanced turbine and hybrid systems into the market place and establish collaborative partnerships.

4:45 – 5:15 **Report-Out by a representative from each Breakout Session**

Each group will designate a person to report out to the plenary on their recommendations.

5:15 – 5:30 **Next Steps and Closing Remarks**

William Nesmith, Oregon Office of Energy
Dick Watson, Northwest Power Planning Council
David Terry, National Association of State Energy Officials

Advanced Gas Turbine Opportunities Workshop

(High Efficiency Engines and Turbines Program)

Agenda – August 15, 2002

1617 Cole Boulevard, MS-1521 Golden, CO 80401

Telephone: 303 275-4826

12:00 pm **Welcome** – Rick Grice, Governor's Office of Energy Management & Conservation
William S. Becker, USDOE's Denver Regional Office
David Terry, National Association of State Energy Officials

12:15 – 12:30 **Introduction** – Brian T. Castelli, NASEO

Brief update on the project and specific purpose and goals of workshop

12:30 – 1:30 **Panel 1 – Issues impacting advanced gas turbines/hybrid systems**

Facilitator – Rick Grice, Gov's Office of Energy Management & Conservation

Panel Members – Meredith Bond, P.E.
US EPA Region 8, Office of Air & Radiation

George King, Director, Energy Group
Houston Advanced Research Center

The panel members will review and discuss the most significant issues raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

1:30 – 2:30 **Panel 2 – Needs related to advanced gas turbines/hybrid systems**

Facilitator – Patti Case, P.E.
Vice President, etc Group, Inc

Panel Members – Merwin L. Brown, PHD, Market Manager
Electric & Natural Gas Sectors, NREL
(formerly Director R&D at Pacific Gas & Electric)

Judah S. Moseson, P.E., Project Manager/Global Product Collaboration
TXU Energy

This panel will review and discuss the most significant needs raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

2:30 – 2:45 **Break**

2:45 – 3:45 **Panel 3 – Opportunities for advanced gas turbines/hybrid systems**

Facilitator – John F. Nunley III, Director, Energy Program, Wyoming

Panel Members – William H. Day, Manager for Outreach
South Carolina Institute for Energy Studies (SCIES)

Robert Gee, Vice President, Development & Partner Relations
Electricity Innovations Institute

This panel will review and discuss the most significant opportunities raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

3:45 – 4:45 **Breakout Session**

This session will separate the attendees into three topical groups; an Issues group, a Needs group, and an Opportunities group. The corresponding Panel facilitator will lead each group. The group will be charged with discussing the specific topical area in order to develop a prioritization and a list of possible actions (by NETL or others) that could help accelerate the advanced turbine and hybrid systems into the market place and establish collaborative partnerships.

4:45 – 5:15 **Report-Out by a representative from each Breakout Session**

Each group will designate a person to report out to the plenary on their recommendations.

5:15 – 5:30 **Next Steps and Closing Remarks**

Rick Grice, Governor's Office of Energy Management & Conservation
William S. Becker, USDOE's Denver Regional Office
David Terry, National Association of State Energy Officials

Advanced Gas Turbine Opportunities Workshop

(High Efficiency Engines and Turbines Program)

Agenda – September 5, 2002

3412 Hillview Avenue, Palo Alto, CA 94304-1395

Telephone: 650-855-2100

12:00 pm **Welcome** – Terry Surles, PIER Program Manager
California Energy Commission

T.J. Glauthier, President
Electricity Innovation Institute (E2I)

John Nunley, III, Vice Chairman
National Association of State Energy Officials (NASEO)

Kathy Pierce, Director
U.S. Department of Energy (DOE), Seattle Regional Office

12:15 – 12:30 **Introduction** – Brian T. Castelli
NASEO

Brief update on the project and specific purpose and goals of workshop

12:30 – 1:30 **Panel 1 – Issues impacting advanced gas turbines/hybrid systems**

Facilitator – Steve Alber, Energy Planner and Program Manager, Distributed Energy
Hawaii Energy, Resources, and Technology Division

Panel Members – Leslie Witherspoon, Manager, Environmental Programs
Solar Turbines, Inc.

Tom Dossey, Contract Manager, Customer Generation
Southern California Edison (SCE)

The panel members will review and discuss the most significant issues raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

1:30 – 2:30 **Panel 2 – Needs related to advanced gas turbines/hybrid systems**

Facilitator – Carl B. Linvill, Director
Nevada State Office of Energy, Governor's Office

Panel Members – Dr. Robert Cattolica, Associate Director, Department of
Mechanical and Aerospace Engineering
University of California, San Diego

Dr. Jack Brouwer, Associate Director
National Fuel Cell Research Center (NFCRC)

This panel will review and discuss the most significant needs raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

2:30 – 2:45 **Break**

2:45 – 3:45 **Panel 3 – Opportunities for advanced gas turbines/hybrid systems**

Facilitator – Terry Surles, PIER Program Manager
California Energy Commission

Panel Members – William H. Day, Manager for Outreach
South Carolina Institute for Energy Studies (SCIES)

Rick Counihan, Vice President, Research Programs
Electricity Innovations Institute

Stephanie Hamilton, Manager
Southern California Edison (SCE)

This panel will review and discuss the most significant opportunities raised in the information gathering task from their perspective. An open interactive forum will follow the presentations.

3:45 – 4:45 **Breakout Session**

This session will separate the attendees into three topical groups; an Issues group, a Needs group, and an Opportunities group. The corresponding Panel facilitator will lead each group. The group will be charged with discussing the specific topical area in order to develop a prioritization and a list of possible actions (by NETL or others) that could help accelerate the advanced turbine and hybrid systems into the market place and establish collaborative partnerships.

4:45 – 5:15 **Report-Out by a representative from each Breakout Session**

Each group will designate a person to report out to the plenary on their recommendations.

5:15 – 5:30 **Next Steps and Closing Remarks**

Terry Surles, PIER Program Manager
California Energy Commission

T.J. Glauthier, President & CEO
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John Nunley, III, Vice Chairman
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Kathy Pierce, Director
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Appendix III

Workshop Attendee Lists

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Advanced Turbine Opportunities Workshop
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Appendix IV

Presentations at the Workshops (on CD)

Appendix V

Second Priority Issues, Needs, and Opportunities

The following items were considered by the participants at the three western regional workshops to be important, but not the most critical priorities, to accelerating advanced turbines and hybrid systems into the marketplace. In some instances, these items were discussed in the priority issues, needs and opportunities sessions in the workshops and listed in Tables 1 through 3. However, in the plenary session in ranking the highest priority item, the ones listed below were considered to be of secondary importance.

Secondary Issues:

1. **Project Cost Creep**: An issue that was recognized as a potential barrier to deployment of the turbine/hybrid systems, and often linked to a lack of information and conflicting standards.
2. **Design Specifications and Best Practices**: This issue was recognized as important to controlling costs and contributing to a "standardized" product.
3. **Peak Load Management**: Noted often as a partial solution and an additional benefit to utility system needs, on-site generation by these technologies was rarely accorded a "monetary value" to reflect the benefit provided.
4. **Lack of Infrastructure to Use Heat and Steam**: Participants noted that the lack of infrastructure to utilize heat and steam from turbine/hybrid systems lowered the potential value and efficiency that could be achieved from deploying these technologies.
5. **Permitting and Zoning**: This issue was often discussed in the workshop sessions and generated much interest in its resolution. Because permitting and zoning is often a state level and local level issue, with contiguous jurisdictions having differing standards, the participants recognized its importance, but felt other issues were generally of a higher priority.
6. **Net Metering Rules**: This issue was seen as a means to provide an additional incentive to get turbine/hybrid systems deployed, but differing rules in differing jurisdictions make it difficult to standardize deployments/installations.
7. **Utility Connection Standards**: The issue centers on the many different standards for different utilities for connecting distributed generation technologies to the utilities' systems. (It was suggested that a "How to Connect" handbook would be very helpful.)
8. **Clean Coal**: The western states noted the importance of coal to their economies and the need to utilize it in a more environmentally benign fashion. Research in gasification and use in the turbine/hybrid systems was seen as an important side benefit to deployment of these technologies.
9. **Cost**: The issue on reducing costs of deploying systems is critical to deployment, but has generally been seen as the ultimate outcome in discussions of other issues (e.g., standardizing engineering costs or permitting), needs and opportunities.
10. **Lower Cost Share and More Match Flexibility**: This issue was seen as necessary to lower the "entry fee" for deploying newer technologies, such as turbine/hybrid systems.
11. **Increase Commercial User Base**: A strong industry partnership base was seen as a way to increase deployments and lower the overall cost of deploying these technologies.

12. **Natural Gas Availability**: Whether natural gas is available near an installation site is seen as important to deployment potential. The corollary issues of natural gas supply and price was also recognized as a factor in determining future deployments.
13. **Reliability and Quality**: Getting better data and disseminating it on these two factors is important for developing and financing turbine/hybrid systems projects.
14. **Utility Dispatch and Control**: Interactions with existing utility systems is seen as a developing issue that must be addressed, particularly as deployments become concentrated in a particular electric system.
15. **Infrastructure**: Building the infrastructure to support the industry (e.g., training, operations, maintenance, etc.) is another issue that must be addressed as deployments become more common.

Secondary Needs:

1. **Subsidized Design Assistance to Customers**: This was seen as a need that could be fulfilled by a state and federal collaboration. The need for subsidizing third party evaluations was also seen as important to lowering project risk and increasing the credibility for commercial financing.
2. **Design Assistance for Utility Staff**: This was seen as necessary for utility staff who have generally been involved only in utility generation and have not yet made the transition to working with on-site distributed energy projects, particularly those involving turbine/hybrid systems.
3. **Identify Thermal Load Applications**: This is important as the sale of the thermal load can often make the monetary difference as to whether a project can obtain financing.
4. **Training to Operate Turbines**: Participants noted that many building or industrial plant facility energy managers have not had any training on operating electric generating turbine/hybrid systems and therefore training is critical for these employees. The training also can ensure long-term performance of the systems at the design characteristic levels.
5. **Models for Statewide Permitting & Standards**: Work in this area is needed as fewer differences in standards leads to lower deployment costs.
6. **Third Party Commissioning**: Training is needed for engineers to be able to commission (and later re-commission) the turbine/hybrid systems installations.
7. **Better Characterization of Fuel Sources**: Participants at the workshop sessions identified the need for characterizing alternative fuel sources for turbine/hybrid systems. Many opportunities exist to use gaseous fuels other than natural gas.
8. **Getting Advanced Technologies into Code Books**: The need to have advanced technologies, like turbine/hybrid systems, integrated into code books can dramatically reduce the time needed to deploy the technology. An oft-cited example is that most building codes do not even acknowledge electric generation equipment being located in a building (e.g., commercial or residential buildings) and therefore expensive delays are not uncommon.
9. **Investment in Natural Gas Infrastructure**: Additional investment in natural gas infrastructure was seen as an important need.
10. **Value of Distributed Generation**: The need to recognize the "whole" value of distributed generation was seen as necessary to increase financing options. The whole value was meant to include monetary values for benefits not generally monetized for these systems, e.g., environmental benefits, peak shaving benefits, reliability benefits, etc.

11. **Elimination of "Perverse" Regulations**: Participants recognized that current regulations or standards might inadvertently discriminate against introduction of newer technologies. Consequently, they felt that identifying and working to eliminate such regulations could benefit deployment opportunities for turbine/hybrid systems.
12. **Working with Unions**: This was identified as important, particularly in developing trained and efficient workers to install and operate the new technologies.
13. **Market Studies**: Participants believed that new market studies should be conducted to help identify niche and general market opportunities to deploy turbine/hybrid systems.
14. **Back Up Power**: Participants indicated that more information is needed about the potential for turbine/hybrid systems to deliver high quality, reliable electric power, particularly in back up situations.

Secondary Opportunities:

1. **Clean Emergency Back Up Power**: Participants at all three workshops discussed back up power as one of the many opportunities that turbine/hybrid systems could fulfill.
2. **Template for Design Features**: An opportunity exists to develop a template for standardizing the designs and features of turbine/hybrid systems to reduce manufacturing and installation costs.
3. **Partnerships with National Builders**: Many participants at the workshops saw the development of mixed residential and commercial communities as an opportunity to deploy turbine/hybrid systems as an integral part of the communities energy system.
4. **Integrating Energy into Sustainable Development Plans**: Opportunities exist to influence state and community sustainable development plans so that they include turbine/hybrid systems.
5. **Supplemental Environmental Projects (SEP)**: The EPA SEP program in which civil fines are used to develop clean energy projects can be a source of funding to deploy clean turbine/hybrid systems.
6. **Deployment at "Prior Success" Customer Site**: Discussions ensued concerning the potential to look first at customers that have already successfully deployed advanced technologies. It was surmised that such customers would be more receptive to new technologies and more likely to participate in collaboratives to deploy turbine/hybrid systems.
7. **Spinning Reserve**: Participants felt more work should be done to explore the potential for turbine/hybrid systems to act as part of a utility's "spinning reserve" requirements. The need to work with the utility, the regulators and the project developers were all seen as critical to moving forward in this area.
8. **Long Term Research**: Participants felt that continuing the university research collaborations was important to the long term research needed to support future gains in efficiency of the systems and lowered costs.