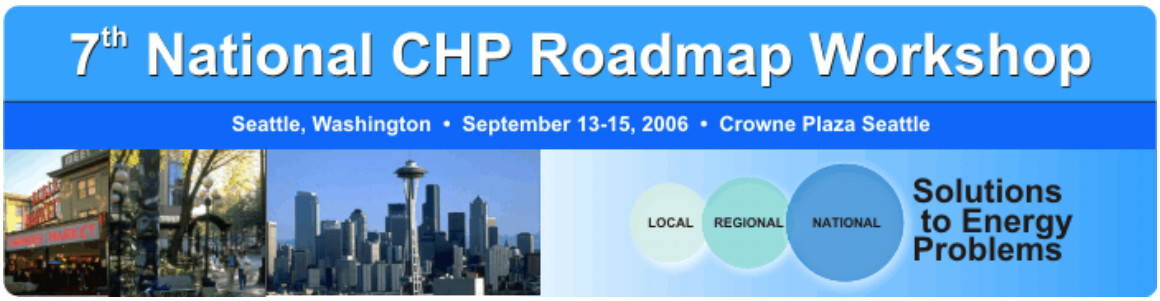

FINAL DRAFT

2006-2007 Combined Heat & Power Action Plan
Positioning CHP Value: Solutions for National, Regional and Local Energy Issues

Prepared for the 7th Annual CHP Roadmap Workshop
Seattle, WA

September 2006

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2006-2007 CHP Action Plan
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Introduction

Recognizing the pivotal role Combined Heat and Power (CHP) could have in our country's energy policy, the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), the United States Combined Heat and Power Association (USCHPA) and others issued the CHP Challenge and signed the CHP Compact in 2000, setting the goal of increasing CHP capacity to 92 GW by the year 2010. Throughout the course of the past seven years, we have witnessed that achieving this goal requires the commitment of a wide array of stakeholders in a coordinated public-private partnership.

Each year since the publication of the *National CHP Roadmap*, annual workshops have been held to revisit the progress and to identify needed additional action items. In preparation for the 2005 Roadmap Workshop a *CHP Action Agenda* was developed to provide participants with a situational analysis document. That document described what we, the CHP community, have done to enhance CHP, the actions identified at the prior roadmap workshops to achieve goals, the status of those actions items, and a possible reprioritization of action items given the current and expected market conditions between 2005 and 2010.

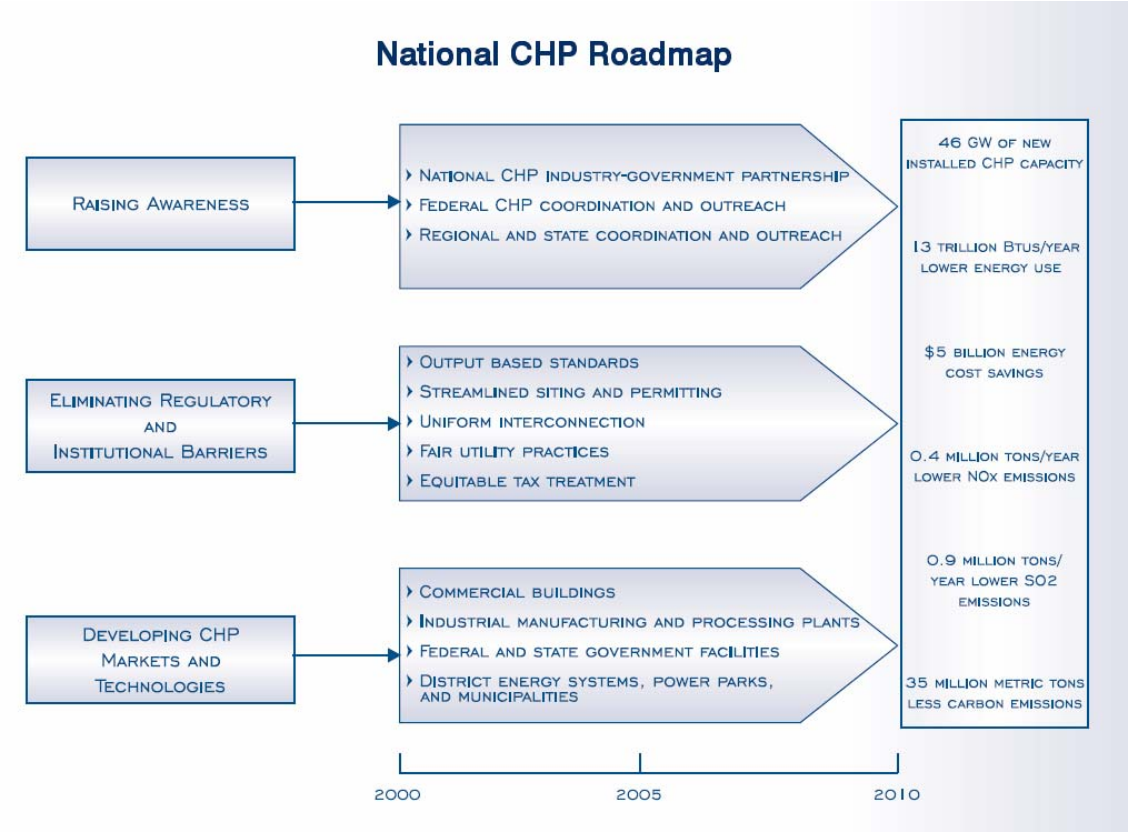
Consistent with last year's document, this *2006 Action Agenda* is intended to provide the situational context in which we will set our priorities for the upcoming year and complete our goals. The CHP community has accomplished many notable achievements and the ultimate goal 92 GW of CHP capacity is in sight. Last year we noted that in our final stages of the journey, we found ourselves in a different set of market conditions than when we embarked in 2000. In 2006, we face an even greater set of opportunities and challenges,

Recent natural disasters, power outages, environmental concerns, national security and energy reliability are driving the need for fundamental changes to our energy supply and delivery structure and increasing interest in fuel diversity and domestic energy alternatives. Regional and voluntary greenhouse gas initiatives are creating opportunities for renewables and energy efficiency, and local economic and business concerns are increasing interest in local energy solutions. As we develop our collaborative action agenda, we have to position CHP as one of the compelling solutions to our most pressing national, regional and local energy issues.

National CHP Roadmap

The *National CHP Roadmap* set the course for achieving 92 GW of CHP capacity in the U.S. This goal is expected to result in estimated energy savings of 2.4 quadrillion Btu per year and a reduction of 276 million tons of CO_2 per year compared to separate electricity and thermal energy generation.[1]

The *2001 National CHP Roadmap* and the all subsequent industry roadmaps break down action items into the categories of "Raising CHP Awareness", "Eliminating Regulatory and Institutional Barriers", and "Technology and Market Development". Figure 1 from the *Roadmap* illustrates the CHP industry's priorities from the *2001 National CHP Roadmap*. The goals of that document are re-stated below.



Source: National CHP Roadmap

Figure 1: 2001 National Roadmap Priorities

[1] The estimated annual energy and emissions benefits resulting from 92 GW of CHP capacity were calculated using the same methodology used by the *2001 National CHP Roadmap* authors to calculate the benefits stated in the 2001 *Roadmap* document with some different assumptions. The proportional split between industrial and commercial CHP capacity is assumed to be the same in 2010 as it is in 2005 (82% industrial and 18% commercial). Industrial capacity factors are calculated based on 6500 hours per year utilization at an average of 85% rated capacity. Commercial capacity factors are calculated based on 6500 hours per year at an average of 60% rated capacity. Natural gas is the assumed fuel with CO_2 emissions based on 117 lbs. per MMBtu fuel input. CHP efficiency is assumed to be 70%. Electric utility efficiency is assumed to be 31%. Displaced boiler efficiency is assumed to be 80%.

Raising Awareness Goals from 2001 Roadmap

Raising awareness goals and actions laid out in the *National CHP Roadmap* by 2010:

- Implement industry coalitions
    1. Form formal multi-trade group CHP coalition
    2. Expand USCHPA product and service offerings to include outreach activities to states
    3. Develop unified points of view on issues related to development and deployment of CHP
    4. Continue active support for industry-government RD&D partnerships in development of next generation CHP systems
- Implement federal coordination
    1. Expand DOE RD&D programs (EERE) that effect CHP (advanced turbines, microturbines, reciprocating engines, fuel cells, TAT, interconnection systems, power electronics, advanced materials, and communication and controls)
    2. Continue DOE CHP education and outreach (CHP website, CHP registry)
    3. Through the DOE FEMP expand efforts to identify candidate CHP installations at federal facilities and obtain funding for projects
    4. Continue EPA efforts to promote output-based BACT standards and develop state guidance
    5. Implement an EPA outreach program to facilitate CHP project development (CHP Partnership) by offering technical assistance, permitting guidance and public recognition
    6. Provide support to EPA to develop and disseminate information on CHP environmental benefits relative to other energy supply options
    7. Promote and encourage potential candidates for EPA/DOE CHP EnergyStar Awards
- Implement regional and state coordination
    1. Build state and regional information exchange networks on CHP issues
    2. Obtain financial assistance from state and federal sources for CHP education and awareness activities
    3. Address top priority regulatory and institutional barriers

Regulatory/Institutional Barriers Goals from 2001 Roadmap

Eliminating barriers goals and actions laid out in the *National CHP Roadmap* by 2010:

- Implement uniform grid interconnection standards
    1. Support streamlined interconnection procedures instate restructuring implementation
    2. Propose federal legislation for interconnection of DE and CHP

3. Support IEEE uniform interconnection standards that cover CHP

- Implement fair and competitive utility practices
    1. Develop standard commercial practices and business terms between utilities and DE/CHP developers
    2. Develop and disseminate model utility principles, tariffs and legislative provisions for DE and CHP
    3. Develop analysis tools, data and case studies of value of CHP to electric and natural gas utilities
    4. Establish dispute resolution processes and capabilities for CHP projects
- Implement output-based emissions standards
    1. Analyze alternative technical approaches to output-based standards and their impact on CHP
    2. Provide technical assistance and information to EPA to encourage use of output-based standards for Clean Air Act compliance
    3. Provide technical assistance and information to states to develop and use output-based standards in SIP's
- Implement streamlined siting and permitting
    1. Develop CHP permitting guidance and protocols for state environmental officials (including pre-certification)
    2. Conduct national campaign to develop code changes for model code agencies
    3. Develop siting and permitting guidelines and tool kits for CHP designers, developers and installers on a state-by-state basis
    4. Develop pre-certification and permits-by-rule provisions for certain small facilities
- Implement Equitable tax treatment
    1. Support efforts to revise U.S. tax code and define accelerated deprecation schedule for CHP systems

Market and Technology Development Goals from 2001 Roadmap

Market development goals and actions laid out in the *National CHP Roadmap* by 2010:

- New CHP Capacity Industrial Markets
    1. Demonstrate CHP and energy efficiency best practices in most promising industrial sectors
    2. Promote output-based emissions standards in key states
    3. Develop fair model utility access and exit fees
    4. Conduct cost-shared industrial CHP RD&D projects (black liquor/biomass gasification, materials, combustion, power electronics, sensors and controls)
- New CHP Capacity in Buildings Markets
    1. Conduct an outreach campaign (architects, building designers, engineering firms)

2. Support standards development for buildings CHP(address state and local codes)
3. Conduct const-shared RD&D (packaged systems, communications/controls, prime movers, TAT)

- New CHP Capacity in District Energy Markets
  1. Launch an outreach campaign (municipal and community governments, colleges/universities, military bases)
  2. Expand technical assistance to potential CHP users on assessment and implementation
  3. Conduct more demonstrations of CHP (brownfield, redevelopment, public housing, and power parks)
- New CHP capacity in Federal Facilities Markets
  1. Develop new funding sources for CHP installation and operation
  2. Compile an inventory of potential federal CHP sites
  3. Establish requirement for assessment of CHP before facility modifications
  4. Engage DOE FEMP in providing CHP technical assistance
  5. Develop case studies of CHP at federal facilities

Drilling Down to State and Local Levels

As the CHP community has progressed along the path presented in the original *National CHP Roadmap* and continually updated/revised its priorities through the annual road mapping process, we have seen the significance of regional and state/local level leadership and action. Those experienced in CHP have long realized that the patchwork of state and local policies and regulation is simply a reality of the market. The state and local levels have been where the "rubber hits the road" for many of the institutional, utility and regulatory barriers to a fully developed CHP market. State incentive and rebate programs often play an important part in the commercialization of new energy technologies and products. The CHP community has always tried to make of the most of its limited resources to both proactively approach state/local officials through thoughtful education and outreach initiatives as well as reactively deploy as many resources as it can to address legislative and regulatory issues that often arise on short notice.

Regional Application Centers (RACs) are now established and operating to assess market opportunities and support CHP project implementation. In addition, RACs have been a valuable resource to educate state public utility commissions (PUCs) and other state entities on the benefits of CHP to a particular state. In some regions, CHP Initiatives have also been established. An advocacy/outreach partner to the RACs, the Initiatives support the implementation of the CHP Roadmap goals. RACs and Initiatives (in the regions where they have been established) have assembled regional stakeholders to create their own CHP roadmaps mirroring the goals of the national roadmap but adding a region-specific advantage. Each RAC region now has its own unique roadmap. Because the Initiatives are largely private sector driven and non-federally funded, they can operate more directly to influence the regulatory processes in the individual states. As the focus turns steadily toward making progress in the regions and states, these operations are going to become more active in meeting the challenge of increasing CHP in the US.

Regional CHP Initiatives and the U.S. Combined Heat and Power Association (USCHPA) are making state advocacy a priority. EPA's CHP Partnership currently has monthly calls to share information on emerging state activities. State level activities involve rapidly responding to public utility commissions (PUC) as issues, rate cases, and filings develop on their agendas. Typically, specific individuals or organizations have taken it upon themselves to respond to PUC requests and ensure that the interests of the CHP community are represented in hearings.

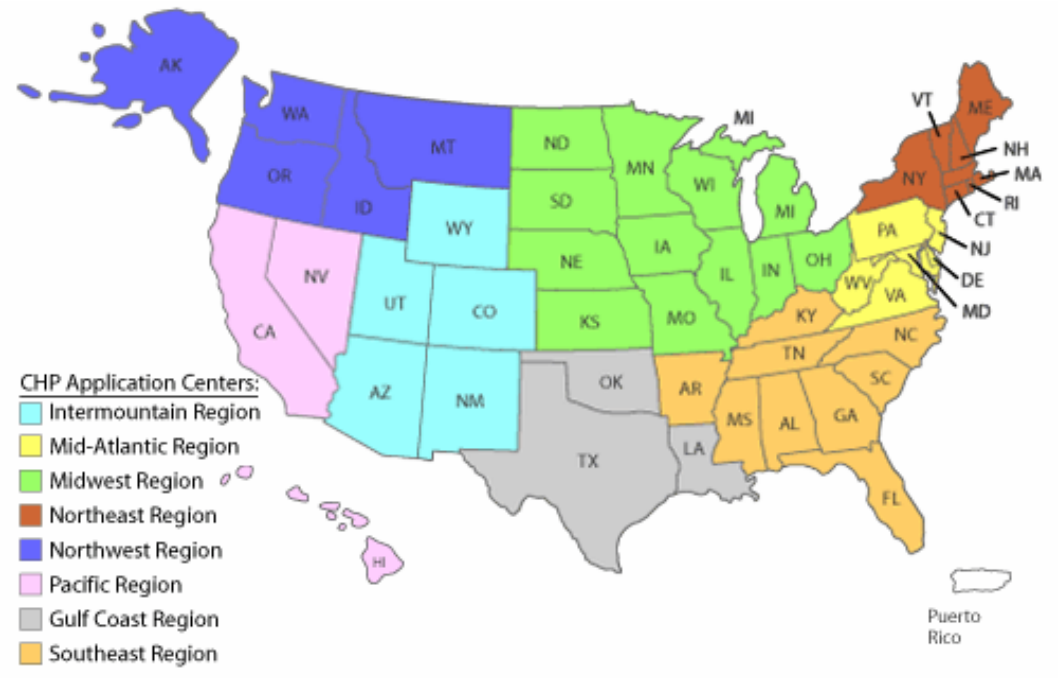


Figure 2: CHP Regions by State

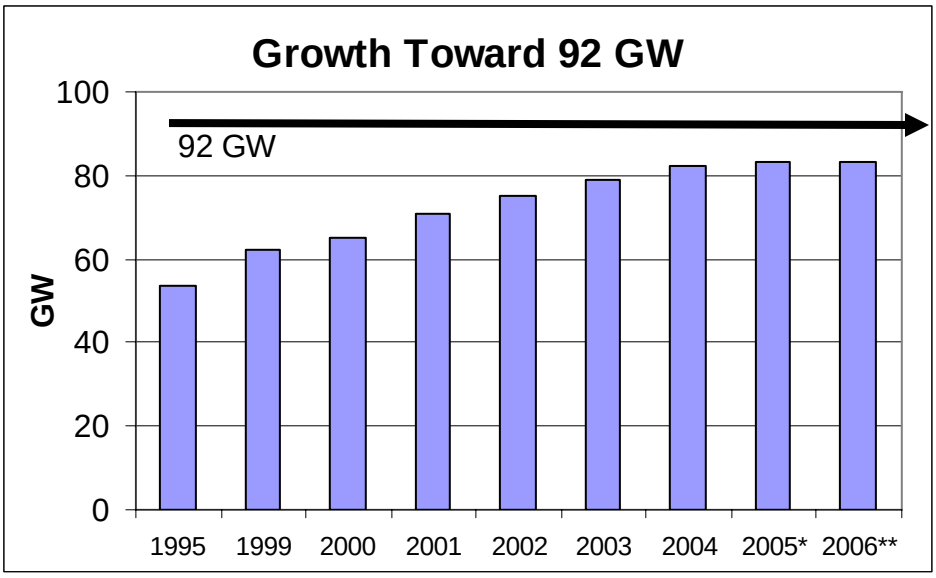
CHP stakeholders have responded to state interconnection requirements hearings, utility tariffs and rate cases, and have monitored Renewable Portfolio Standards (RPS) issues as they have developed to ensure CHP interests are addressed during key hearings. Using approaches that have proven to be successful, such as supporting materials, case studies, expert testimony, position papers, a regulatory "toolbox", and strategic analysis is a key part of efficient industry-wide coordination.

In recent years, state and local officials across the country have begun to go beyond their traditional roles and to adopt ambitious energy and environmental policies. These usually have come in the form of state or city-specific energy initiatives addressing the unique energy supply/demand circumstances of a particular state or regional alliances that acknowledge that some issues like the environment or climate change extend beyond state boundaries. These state and local led actions are often launched with the hope that they will form the basis for broader national action.

Accomplishments and Progress

Progress toward 92 GW

The DOE-supported EEA CHP Installation Database has been the primary source for tracking progress toward the 92 GW Challenge goal. The EEA database currently has 3,179 operating sites representing over 83.3 GW of capacity. Figure 3 highlights the growth of CHP in the U.S. from 1999 to 2005. Since the development of the Roadmap, the most significant growth period was in the 2000-2003 timeframe. The past two years have seen a relatively low growth rate in CHP capacity.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.
* Updated 2005 data
** Partial year 2006 data

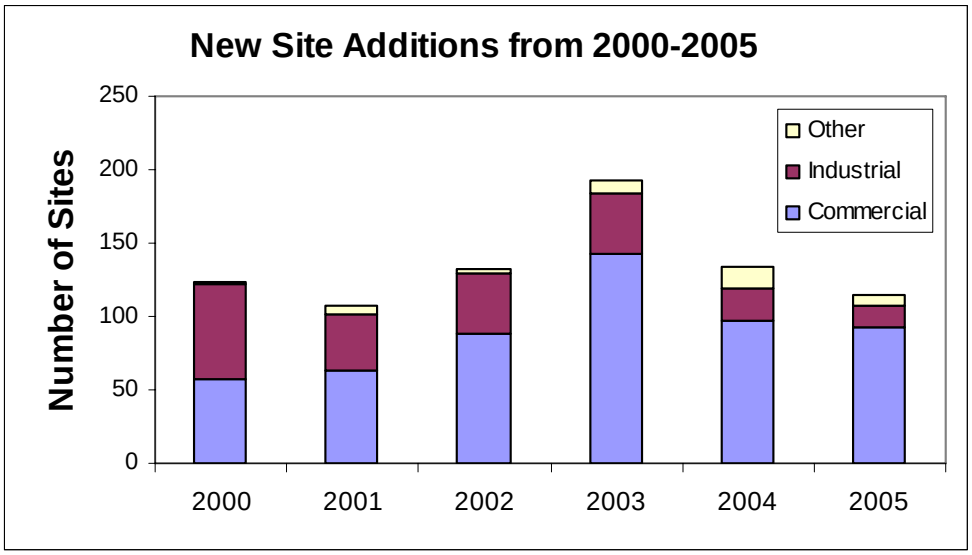
Figure 3: Progress toward 92 GW of CHP Capacity

CHP Growth Trends

Between 2000 and 2005[2], 805 sites representing 22.6 GW were actually installed. During the same timeframe 203 sites representing 1.46 GW were retired, leaving a net addition to the database of 602 sites and 21.2 GW. Figures 4 and 5 illustrate growth in the 2000-2005 timeframe by commercial, industrial, and other applications by both site and capacity additions. The "other" applications pertain primarily to agricultural and mining applications (non-manufacturing and non-commercial market sectors). Annual CHP site

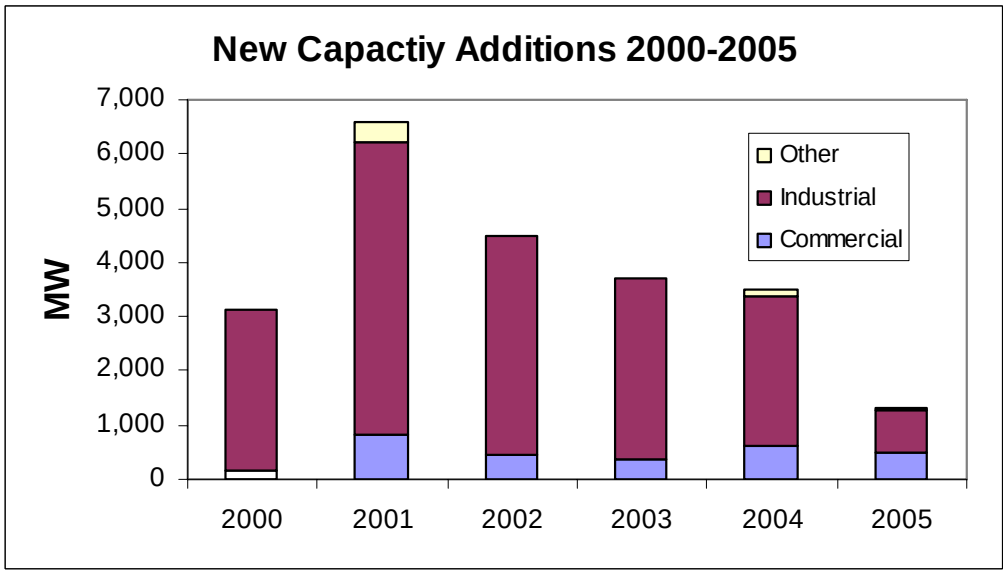
[2] Only trends through 2005 are detailed; 2006 data is incomplete at this time. Partial 2006 data includes an incremental six sites and approximately 50 MW of capacity.

additions increased from 2001 to 2003 and then have decreased in 2004 and 2005. There has been a decrease in CHP capacity additions every year since 2001. While commercial applications make up the majority of new CHP sites, capacity (MW) additions are dominated by industrial applications.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

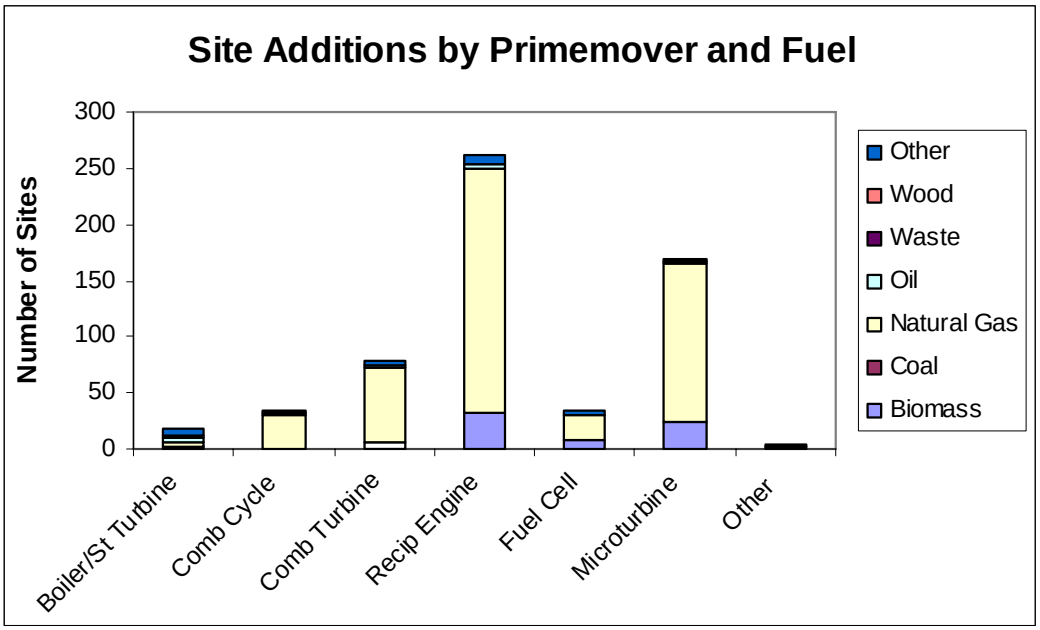
Figure 4: New CHP Site Additions 2000-2005



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

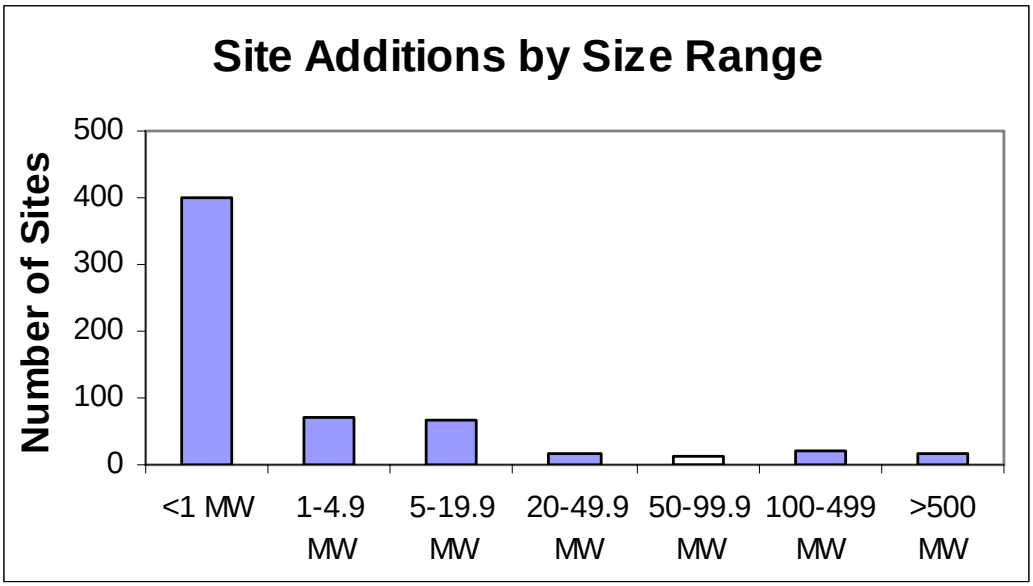
Figure 5: New CHP Capacity Additions 2000-2005

The majority of site additions in the 2000-2005 timeframe have been natural gas-fired reciprocating engines less than 1 MW. Figures 6 and 7 show the breakdown of new 2000-2005 CHP sites by prime mover, fuel and size. The updated 2005 data contains an increase of 27 biomass sites and approximately 90 MW of increased biomass capacity.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

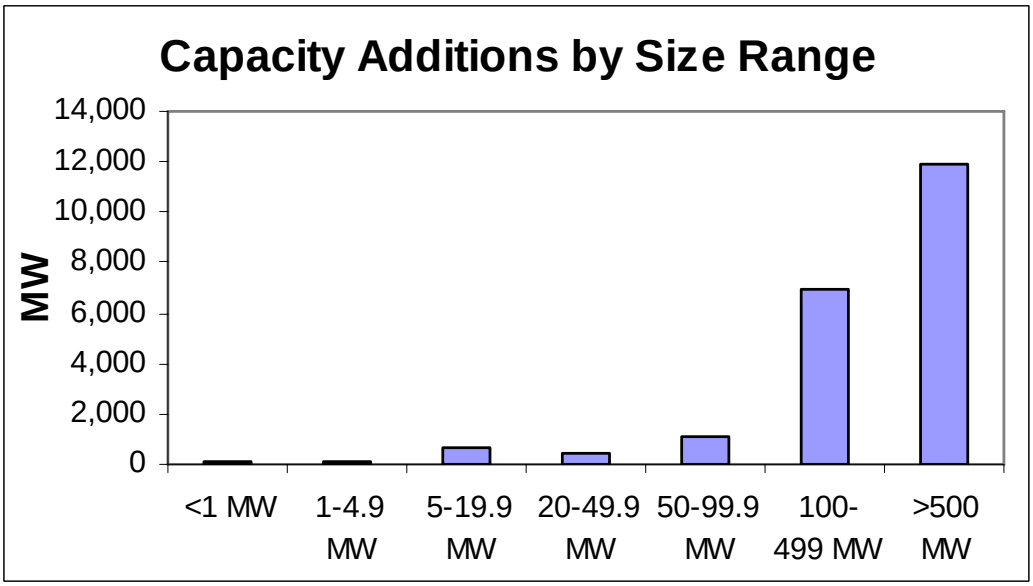
Figure 6: New CHP Site Additions 2000-2005 by Prime Mover and Fuel



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

Figure 7: New CHP Site Additions 2000-2005 by Size Range

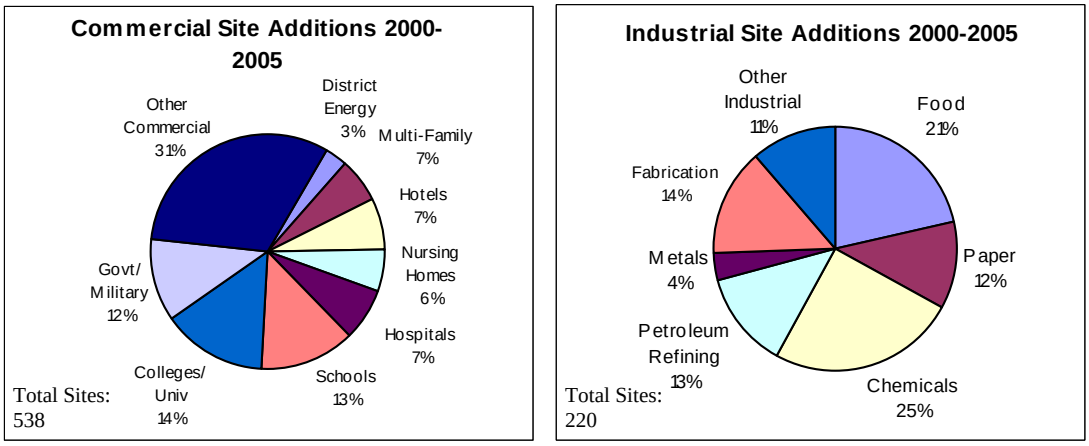
The distribution of newly added CHP capacity by size range is shown in Figure 8. It shows that the vast majority of CHP capacity additions have come from very large projects.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

Figure 8: New CHP Capacity Additions 2000-2005 by Size Range

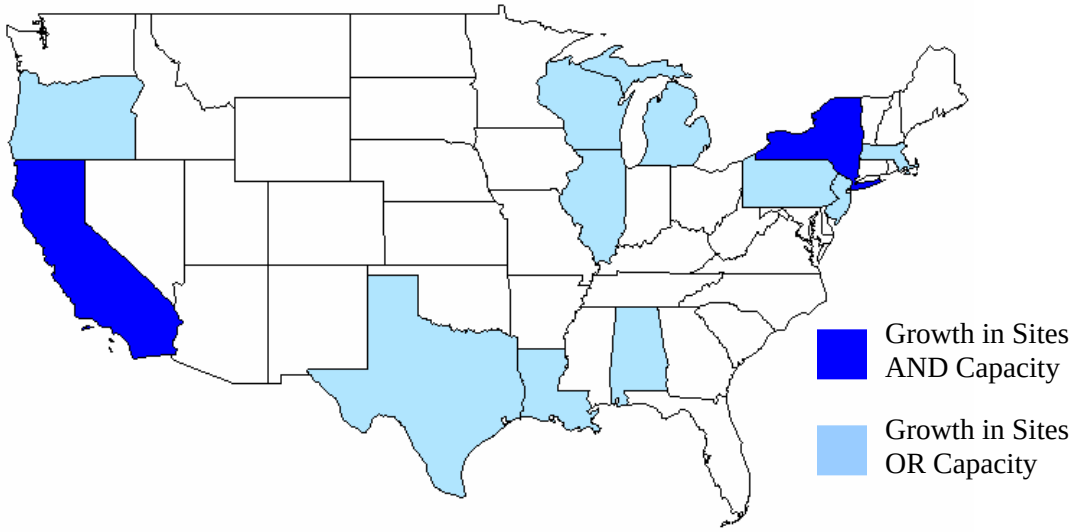
Figure 9 illustrates the breakdown on new site additions by market sector for both commercial and industrial applications.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

Figure 9: New CHP Commercial and Industrial Site Additions 2000-2005 by Market Sector

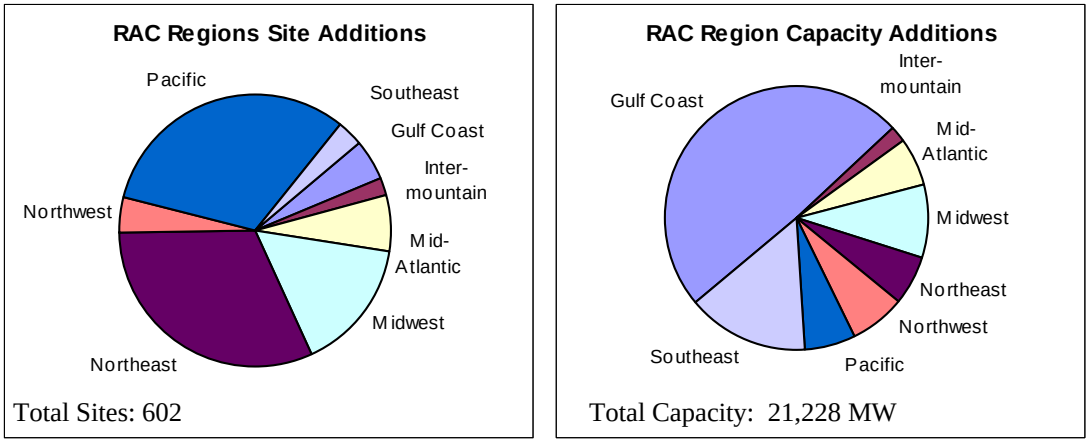
With regard to geographical trends in new CHP, growth tends to be concentrated in the Northeast, Midwest, Gulf Coast, and West Coast. Figure 10 illustrates states with growth in CHP. Favorable spark spreads and incentives for CHP have facilitated growth in California and New York. Pennsylvania has been added to states identified in last year's report.



Source: *"EEA CHP Installation Database Progress Report – July 2006"*, Energy and Environmental Analysis, Inc, preliminary report to Oak Ridge National Laboratory.

Figure 10: 2000-2005 CHP Growth by State

CHP site additions and capacity additions by region are shown in Figure 11. This clearly shows the high project activity in the Midwest, Northeast, and Pacific regions and the large share of capacity additions due to very large CHP projects in the Gulf Coast.



Source: *"Profile of Existing CHP in the United States – 2005"*, Energy and Environmental Analysis, Inc, Draft report to Oak Ridge National Laboratory, September, 2005.

Figure 11: 2000-2005 CHP Growth by Region

2005-2006 Accomplishments

During 2005-2006, the collaborative efforts of the CHP community resulted in the successful completion of a number of notable accomplishments that are consistent with the *CHP Vision and Roadmap* and that will help enable us to achieve our goal of 92 GW of CHP capacity by 2010. The following paragraphs describe just several of these accomplishments and activities of the CHP community. Consistent with the theme of the 2006 CHP Roadmap Workshop, these accomplishments are summarized in the context of national, regional and state/local impact.

As evidenced by the preceding data on CHP market growth trends, the national CHP roadmap process and the CHP community's coordination with regional and state programs have been successful. While the CHP Challenge goal includes CHP installations of all sizes and all market sectors, the DOE Distributed Energy Program's CHP activities have primarily emphasized technology and applications research, development and demonstration (RD&D) in the commercial sector. In spite of high natural gas costs, both site additions and new capacity in the commercial sector remained steady in 2004 and 2005. This is in contrast to the reduction in industrial market activity during that same period. It should also be noted that the less than 1 MW size range, to which most of the DOE reciprocating engine and microturbine RD&D has been applied, has site additions during 2000-2005 that are far larger (by an order of magnitude in some cases) than all other size ranges. The 1-20 MW size range, where most of the gas turbine based integrated CHP packages are targeted represents the next biggest contributor to site additions.

CHP's Energy Reliability Value Demonstrated During 2005 Hurricane Season

Catastrophic events of the fall 2005 hurricane season exposed the vulnerabilities of our energy infrastructure and the loss of life, adverse business impact and damage to property that can result from them. Reliable power is critical under normal conditions, but it is especially vital in crisis situations since facilities like hospitals, fire stations, and shelters must be able to continue operations. One way to avoid these failures in critical mission operations is through the use of well-designed CHP systems. This was clearly demonstrated during the 2005 hurricane season. For example, the CHP plant in operation at Baptist Memorial Hospital enabled it to be the only hospital in the Jackson, Mississippi metropolitan area to remain nearly 100 percent operational during Hurricane Katrina and its immediate aftermath. This hospital was able to provide service and care when people in the area needed it most and took in patients that were being sent away from other non-operational facilities.

In addition to this healthcare example, other mission critical networks and industries can increase their resiliency and maintain continuity of operations with well-designed CHP systems. Regional or local conditions, such as a proven susceptibility to natural disasters or local economic development driven by mission critical enterprises requiring high reliability of energy supply, should motivate the consideration of CHP systems capable of operating in the case of a long term failure of the electric grid.

Regional CHP Applications Centers - Leading the Implementation of Real Solutions to Local Energy Problems

With DOE support, CHP Regional Application Centers (RAC) have been established and are operating in all regions of the country to facilitate deployment of CHP technologies through:

- Educating regional players on benefits of CHP technologies, while reducing perceived risks
- Providing project-specific support
- Providing feedback to DOE and industry regarding future RD&D program needs
- Interacting with states to encourage a favorable policy environment for CHP

The RACs demonstrated that federal support can help provide clean, efficient and secure energy solutions at the state and local level. Each RAC is providing technical support, focused on the technology transfer and deployment of advanced CHP technologies. By providing support to specific project sites, RACs have helped projects get equipment in the ground. In 2005-2006, targeted end-user outreach activities and workshops were conducted for municipal utilities, hospitals and healthcare, federal facilities, manufacturing, commercial buildings, multi-family housing, agriculture, waste water treatment plants, waste heat to power, methane recovery to power at livestock operations, and State Energy Assurance departments. Concurrent with the targeted market sector outreach activities held throughout the year, workshops were also held in coordination with regional A/E firms, state energy agencies, and gas utility user groups.

RACs, Regional CHP Initiatives, and USCHPA have led and coordinated interactions with state PUCs and legislatures for education and to influence pro–CHP activity in several states. In 2005-2006 this included the following states: Arizona, California, Connecticut, Louisiana, Massachusetts, Montana, New York, Ohio, Oregon, Rhode Island, Texas, Utah, Vermont, and Washington. Mid-Atlantic Distributed Resource Initiative (MADRI) efforts, involving the Mid-Atlantic RAC, have served to develop a model interconnection standard now being implemented in Pennsylvania. The RACs and Regional Initiatives developed and submitted a CHP White Paper to the Western Governors Association (WGA). The recommendations of the CHP White Paper were accepted by WGA and included in its Clean and Diversified Energy Initiative. As described in the following USCHPA section MADRI, the Mid-Atlantic RAC and USCHPA are working to develop model business practices.

DOE Distributed Energy Technology Development and CHP End-Use System Integration and Interface Program Results

The DOE Distributed Energy (DE) Program provided positive results from its CHP initiatives on distributed generation (DG) technology development and end-use system integration and interface. The DE Program results of the past year, highlighted by ongoing development of integrated energy systems at sites in target sectors (Healthcare, Lodging, Education, and Energy Operations), materials and combustion R&D, CHP Regional Application Centers, and CHP Outreach, Education and Market, were rated very high at its annual DE Program Peer Review in December 2005. Specific Peer Review positive comments and feedback on 1) the effectiveness of program's

private/public partnerships, 2) the ability to successfully manage a regionally-focused approach to energy needs at the federal level, and 3) the critical need to address barriers and market outreach in order to meet broader DOE goals provide a solid basis for continuation of the program goals and objectives in the Office of Electricity Delivery and Energy Reliability (OE).

OE's mission is to lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from energy supply disruptions. Within that mission, CHP and other clean DE options should be included along with grid-based technology alternatives as they can help achieve energy security goals while preventing or deferring the capital-intensive expenditures of unnecessary new generation, transmission lines, and distribution infrastructure.

The Oak Ridge National Laboratory (ORNL)-led information and education research and technology assessment program has been successful in transforming an extremely vast set of data into information and knowledge upon which those in the CHP community rely and are using to transform the market for CHP at the state, local project levels. A prime example of this is the work done to characterize the market for CHP using "opportunity fuels". This market opportunity was identified "ahead of the curve" before the rapid run-up of natural gas prices in 2005. These renewably-fueled CHP sources often provide the basis of many environmentally-preferred alternative energy systems that have caught the attention of the investment/economic development, rural development, environmental/sustainability, and energy security communities.

EPA CHP Partnership and Clean Energy Programs – A Track Record of Success

EPA's Clean Energy Programs are designed to help energy consumers in all sectors, state policy makers and energy providers improve their knowledge about Clean Energy technology and policy options by providing objective information, creating networks between the public and private sector and providing technical assistance. Additionally, other programs in the Climate Protection Partnerships Division have worked jointly to remove barriers to clean energy including CHP, clean DG, renewable energy and energy efficiency.

The EPA CHP Partnership continued market transformation efforts through direct project assistance outreach to the CHP community and public recognition for notable projects. In 2005, the Partnership continued strategic market development within the ethanol and hotels/casinos markets through strategic analysis and hands-on work with the community. 2005 publications included the *Hotels and Casinos Market Analysis Report* as well as the *Assessment of Energy Savings Potential from CHP at Dry Mill Ethanol Plants*. The Partnership has worked closely with the biomass and biorefinery community to provide trainings and direct project assistance for CHP applications, and with states in the Midwest and Northeast to provide outreach on output-based emission standards to encourage efficient distributed generation and CHP in their states

In addition, in 2005 EPA initiated direct assistance to state utility commissions in identifying and evaluating policies and programs that promote/support the deployment of clean DG. This assistance is focused on state utility commission rules and policies that

significantly affect the deployment of customer-sited clean DG: interconnection standards, partial load rates, and eligibility requirements of Portfolio Standards. For example, EPA is currently assisting Oregon with their process to develop an interconnection standard.

Through the Clean Energy-Environment State Partnership Program and the *Guide to Action* publication, EPA has worked directly with states on policies and programs to encourage clean energy. The Clean Energy-Environment State Partnership currently has 14 state Partners, which receive EPA help to advance clean energy policies that achieve economic, public health, and environmental goals.

USCHPA Advocacy Leadership and Coalition Building on National, Regional and State CHP Issues

The USCHPA served as the primary advocacy organization of the CHP community. Results and actions of the association at the national level included its critical leadership in seeking pro-CHP provisions in EPACT 2005 and then subsequently addressing the many regulatory and administrative processes and studies required by it that affect CHP. They included Public Utilities Regulatory Policies Act (PURPA) rule changes in standards and process for certifying new Qualifying Facilities (QF), the Section 1817 Distributed Generation Benefits Study, the Section 1221 Transmission Congestion Study, and the obligation of utilities to purchase from QF's if competitive market conditions allow wholesale market access.

EPACT 2005 authorized $730 million for Distributed Energy (DE) over the next three years. However, Fiscal Year 2007 appropriations for DE fell woefully short of that amount. In the course of the appropriations process, USCHPA filed testimony with House and Senate appropriations subcommittees in coordination with the Coalition of Local Distributed Energy Solutions. The USCPHA also coordinated Congressional outreach efforts to protect and maintain the DE program at historical levels of funding. Although ultimately unsuccessful, lessons learned will strengthen future strategic efforts in annual appropriations battles.

USCHPA coordination with other industry groups ensured that EPACT 2005-mandated PURPA rule changes in standards and processes for certifying new QF's remained reasonable with regard to thermal efficiency requirements and self-certification.

The association engaged in coalition building activities with two key state-focused associations, the National Association of Regulatory Utility Commissioners (NARUC) and National Association of State Energy Officials (NASEO). NARUC members had prominent roles in the 2006 CHP Policy Conference and the 2006 Roadmap workshop will be held in conjunction with the NASEO annual meeting.

At the regional and state level, USCHPA worked with the Mid-Atlantic RAC to propose to state commissioners involved with the Mid-Atlantic Distributed Resources Initiative (MADRI) that a CHP incentive pilot program should be initiated. This program would create a mechanism by which CHP users who directly pay for CHP systems would be compensated for a portion of public benefits they provide. The USCHPA and the CHP Regional Initiatives also provided support to CHP-related regulatory and legislative activity in the states of California, Connecticut, Ohio, and Rhode Island.

NYSERDA Leads in Demonstration of CHP Value and Coordinated State Activities

The NYSERDA Distributed Generation and Combined Heat & Power (DG-CHP) program supports the development and demonstration of distributed generation (DG) systems, components and related power systems technologies, and combined heat and power (CHP) application in industrial, municipal, commercial and residential markets. The DG-CHP program has resulted in extensive characterization of the New York State CHP market, the development and demonstration of clean and efficient CHP technologies in innovative applications, the verification and documentation of actual performance and practical lessons learned from an extremely broad set of CHP projects in various end-user sectors. NYSERDA leadership through the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) was critical to the development of laboratory and field performance testing protocols for DG systems, including those used in CHP applications.

Increased Interest in Clean Decentralized Energy Systems

Due to the convergence of environmental, energy security, and national security issues, renewable energy and energy efficiency technologies have been the subject of renewed and substantial interest. Energy, and virtually all aspects of its supply, delivery and usage, is becoming a national imperative, and alternative energy is attracting an unprecedented array of supportive groups. An unusual alignment of environmental interest groups, private industry, agricultural industry, defense/security and energy-independence proponents may signal we are approaching a possible tipping point for sustainable energy technologies and approaches like CHP. Venture capitalists, hedge funds, investment banks, public pension funds, and others members of the financial community have begun sinking billions of dollars in clean energy with the expectation that renewable energy and other advanced alternative energy technologies (e.g., wind, solar, and biofuels) will make up a large enough portion of the nation's $1.6 trillion energy market to give clean-energy investing legitimacy as part of a diversified portfolio.

The CHP community's efforts in support of state renewable portfolio standards (with CHP inclusion) and the U.S Department of Agriculture's (USDA) Renewable Energy and Energy Efficiency Improvements Program (Section 9006 of the Farm Bill which provides loans and grants to farmers, ranchers and rural small businesses to purchase energy systems and make energy efficiency improvements) has helped stimulate interest in the development of local bio-energy systems. Under the right conditions and with current federal and state incentives, bio-energy technologies can make economic sense. A key benefit of bio-energy projects is that they offer the opportunity of using local and secure resources to literally fuel the local economy and wealth creation.

This trend is being felt on a global scale. According to the most recently released World Alliance for Distributed Energy (WADE) *Annual Decentralized Energy Survey*, 24% of electricity output from newly installed plants in 2005 was derived from decentralized energy.[3] This is up from 13% in 2002.

[3] The WADE published *World Survey of Decentralized -2006* defines DE technologies as the following forms of power generation systems that produce electricity at or close to the point of consumption: 1) High

While our ultimate goal and objectives are yet to be met, the progress made to date and the significant accomplishments we have achieved since our original CHP Summit and Roadmap are proof that the coordinated efforts of the CHP community have been successful.[4] As we move forward, we all realize that it requires a coordinated and continual effort to ensure energy reliability, provide energy security, enable maximum energy efficiency, lead environmental stewardship and foster economic development.

efficiency cogeneration/CHP, 2) On-site renewable energy systems, 3) Energy recycling systems, including the use of waste gases, waste heat and pressure drops to generate electricity on-site. WADE classifies such systems as DE regardless of project size, fuel or technology, or whether the system is on-grid or off-grid.

[4] For a more exhaustive list of accomplishments since 2000 and CHP projects/resources refer to the 2005 CHP Action Agenda (http://www.energetics.com/7thchproadmap/PDF/action_agenda.pdf) and the 2004 CHP Action Agenda: A Status Report (http://www.energetics.com/5thchpworkshop/pdfs/action_agenda.pdf)

Situational Analysis 2006-2010

All players in the energy industry are coping with fuel supply and price uncertainties, new and evolving federal and state energy policies, and the emerging need for new power infrastructure (generation and transmission). All of these factors contribute to the competitive positioning of CHP.

The CHP community finds itself facing a unique window of opportunity where many forces are converging to drive a complete re-evaluation of how energy is traditionally supplied, delivered and used. Because of the capital-intensive nature of electricity supply and transmission, the consequences of the decisions that national and state officials will make on technical approaches, private-public sector partnerships, environmental cost-benefit tradeoffs, portfolio of supplies, and financing and cost-recovery are those that we will be living with for decades. The CHP and broader clean distributed energy (DE) community needs to present a clear vision of how the value of what we offer addresses national, state and local energy issues and how our proposed alternative should fit in the evolving energy model.

The portfolio of clean DE technology options is diverse and its potential applications broad. For instance, DE technologies be used sporadically when system conditions warrant, such as during needs for emergency power and demand response (tens to hundreds of hours per year), used regularly when fuel sources warrant such as for landfill gas (hundreds to thousands of hours per year), or run almost continually for fuel cells and combined heat and power systems (several thousand hours per year).

This future energy infrastructure model may include integrated networks of decentralized energy systems that are supplied by CHP and clean DE as an alternative to the current inefficient system dominated by large, remote central power plants and an expensive and vulnerable transmission network. In this model energy performance (efficiency and management) is optimized at the local level. We are not completely dependent on central generation and transmission assets. The bulk power infrastructure is integrated and available to optimize the local network energy performance rather than the reverse.

Key Issues/Challenges

All indication are that we are well on our way to arriving at the 92 GW goal presented in the *National CHP Roadmap*. Like so many journeys, the last steps often seem the most challenging as conditions are very dynamic. This section summarizes significant events and emerging trends that affect the CHP/Clean DE market. Energy issues that state and national officials must address have critical bearing on CHP/Clean DE markets including:

- Natural Gas Prices and Supply
- Power Markets/Wholesale Electricity Prices
- Retail Electric Rates and the End of Rate Freezes
- Renewable Energy Development
- Greenhouse Gas Emissions

- EPACT 2005 Implementation
- Homeland Security
- Disaster Preparedness and Response
- Economic Development
- Research and Technology Development

Even outside of the network of energy suppliers, delivery utility companies, equipment and service providers, regulators, technology developers/researchers and policy makers these issues are associated with the new energy paradigm and are having visible impacts. Energy management has become a strategic operating issue for just about every company. Issues for which the CHP community can provide value and solutions include:

- Energy Supply Uncertainty
- Budget Uncertainty
- Operational Risk
- Environmental Compliance
- Potential Business Opportunities (Green is Green)
- Resources to Address Issues

Energy Prices

The economics of CHP, for natural gas fueled-CHP as well as other alternatives, are greatly influenced by natural gas prices, wholesale power prices, and retail electric rates.

Natural Gas Prices

The current natural gas price situation is noticeably different from the price at this point last year. Figure 12 illustrates the change in the Henry Hub spot natural gas price since then. During a period of continued increased use of natural gas for power generation, there has been significant price volatility. Despite recovering from last fall's high prices (i.e. >$12/MMBtu) and a mild 2005-2006 winter, current "moderate" natural gas prices at $7/MMBtu are relatively high compared to the recent historical prices of $3-4/MMBtu. A relatively warm winter weather and the large difference by which prices for future delivery contracts for the 2006-2007 winter months have exceeded spot prices account for much of the current high storage levels. Spot Henry Hub natural gas prices, which averaged $8.86/MMBtu in 2005, fell to an average $6.36/MMBtu in July 2006. The warm summer weather and natural gas demand for electricity generation have pushed prices back up slightly. Barring extreme weather for the rest of the year, DOE's Energy Information Administration's (EIA's) Short-Term Energy Outlook projects the Henry Hub spot price to average $7.69/MMBtu in 2006. It is generally expected that the price of natural gas will remain relatively high.[5] Forward gas prices are in the $7-10/MMBtu range through 2010.[6] Even with current high storage levels, supply and demand balances are tight. This indicates another price spike is possible if there are drastic supply or

[5] The August 2006 EIA Short-Term Energy Outlook can be found at http://www.eia.doe.gov/emeu/steo/pub/aug06.pdf .
[6] Scott Madden Consulting *Energy Industry Update*

demand changes, e.g., a major hurricane in the Gulf of Mexico or a severe 2006-2007 winter.

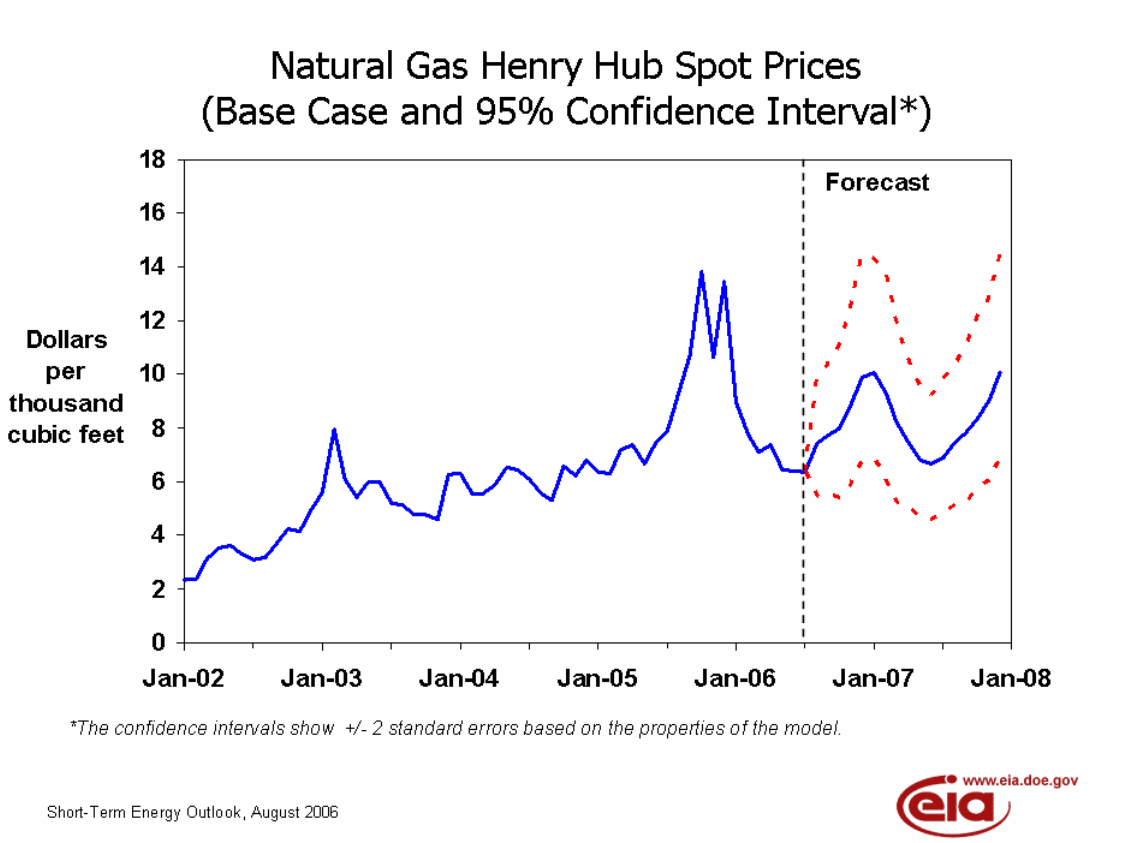


Figure 12: Henry Hub Natural Gas Spot Prices

Wholesale Power Prices

Wholesale power prices are greatly impacted by natural gas prices. While natural gas fueled generation accounts for a relatively small percentage of US electricity generation (i.e. GWh), natural gas exerts a disproportionate influence on electricity prices in the wholesale markets because it represents the incremental generation in the most high demand hours. As price of the purchased wholesale power and retail real-time prices are increasingly based on spot power markets, the marginal cost of the most expensive marginal generation unit that sets the hourly price has a very significant effect on both hourly prices and long-term power contracts. As shown in Figure 13, natural gas units are on the margin for a significant amount of time in Texas, Florida, California and the Northeast. This proportion is expected to grow. While this may provide an opportunity for high efficient CHP, it has also caused many federal and state officials to increasingly focus on fuel diversity (e.g., clean coal, renewable energy and even nuclear) and some uncertainty on where spark spreads will ultimately be.

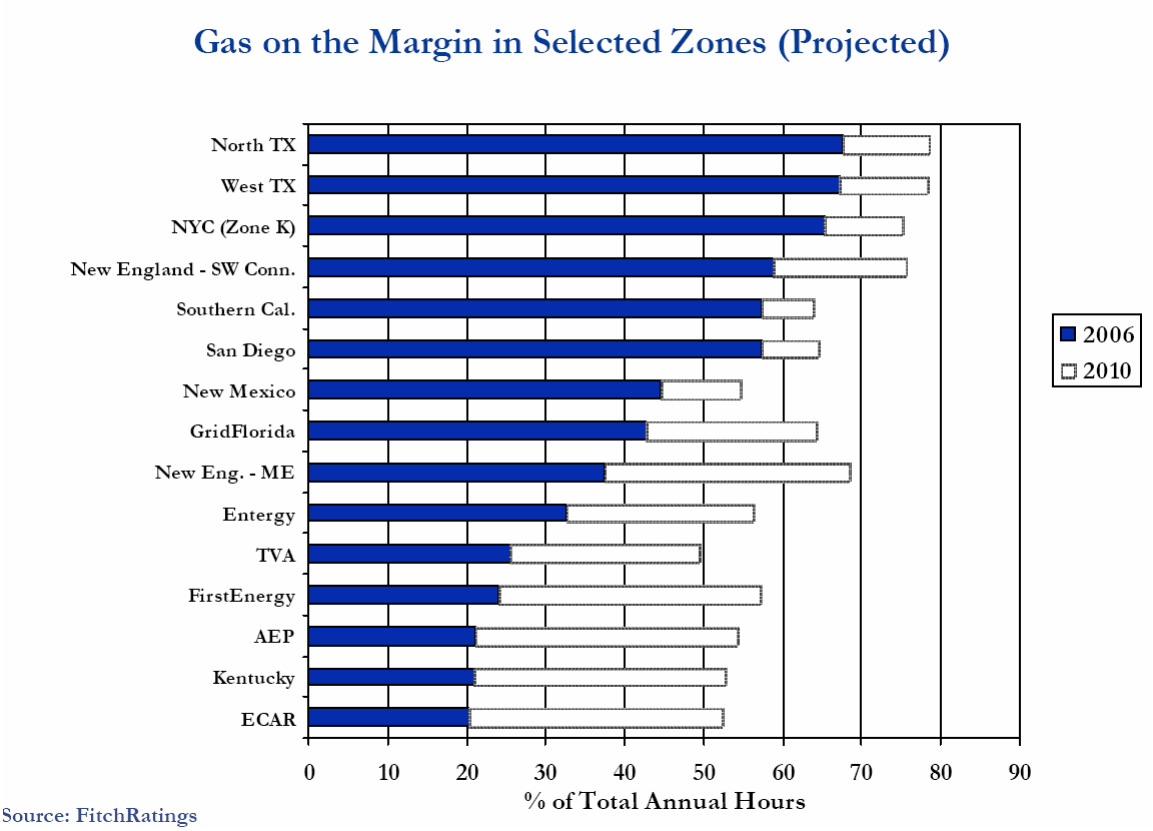


Figure 13: Percentage of Time Natural Gas Generation is the Marginal Generation Unit

Retail Energy Rates

The end of electricity rate freezes in states that have gone through restructuring has produced some interesting results and high profile political battles. State legislatures and PUCs have proposed ways to mitigate the impact of the pending increases such as "phase-ins", forestalling rate freeze expiration dates and "re-regulation". Table 1 presents a sampling of new or pending rate increases.

State	Utility
Connecticut	NU subsidiary proposes 22% increase in rates
Delaware	Delmarva seeks 59-117% rate increase
District of Columbia	PEPCO seeks 12% residential rate increase
Illinois	Ameren and Comed seek 21% rate increase
Maryland	BG&E seeks 72% rate increase; PEPCO seeks 35% retail rate increase
Ohio	AEP, First Energy rate freezes to end in 2006
Texas	TXU rates have increased 80% since restructuring

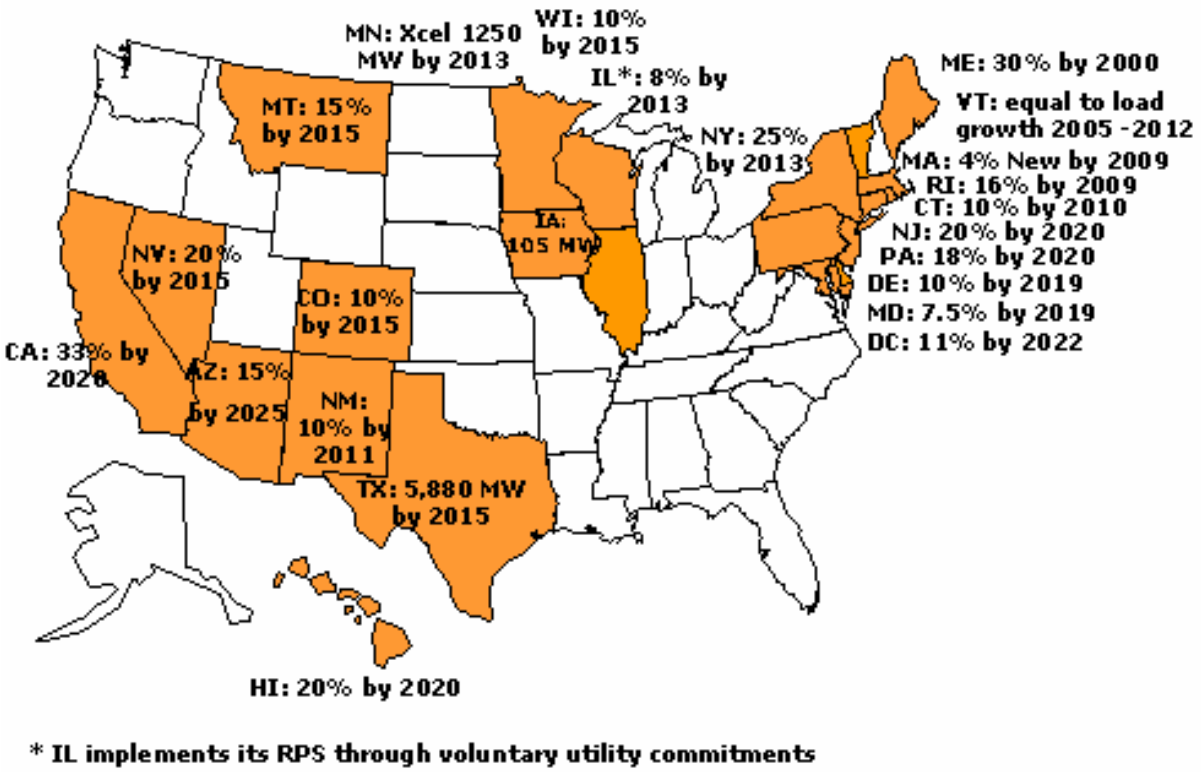
Sources: Scott Madden Consultants, Discovery Insights LLC

Table 1: Sampling of Electric Rate Increases

Renewable Energy

The high energy price scenario described above may also provide incentive to implement renewable and alternative fueled technologies that have typically been too expensive. Concerns about fossil fuel supply depletion, climate change, energy reliability and resiliency, and national security has resulted in broad interest in alternative energy. Although dependent on various subsidies and incentives, there are now workable business models for which previously uneconomic energy technologies are now viable. EPACT 2005 extended production tax credits for qualifying renewable resources through 2007. There is an unusual alignment of environmental interest groups, private industry, agricultural industry, defense/security and energy-independence proponents that may signal we are approaching a possible tipping point for renewable energy and energy efficiency technologies and approaches like CHP.

Twenty-two states and the District of Columbia have set standards specifying that electric utilities generate a certain amount of electricity from renewable sources. Most of these requirements take the form of renewable portfolio standards (RPS), which require a certain percentage of a utility's power plant capacity or generation to come from renewable sources by a given date. The standards range from modest to ambitious, and definitions of renewable energy vary. Figure 14 shows those states with some form of RPS. The CHP community can coordinate to ensure CHP and DE interests are addressed in the development and implementation of RPS programs. For example, included in Pennsylvania's Tier II sources of alternative energy are "distributed generation systems," which are defined as small-scale generation of electricity and useful thermal energy.



Source: Pew Center on Global Climate Change

Figure 14: States with Renewable Portfolio Standards

On the federal level, the U.S Department of Agriculture's (USDA) Renewable Energy and Energy Efficiency Improvements Program (Section 9006 of the Farm Bill) provides loans and grants to farmers, ranchers and rural small businesses to purchase energy systems and make energy efficiency improvements. This financial assistance has helped stimulate interest in the development of local bio-energy systems. Under the right conditions and with current federal and state incentives bio-energy technologies can make economic sense. A key benefit of bio-energy projects is that they offer the opportunity of using local and secure resources to literally fuel the local economy and wealth creation.

Regional Greenhouse Gas Initiative

Northeast states formed the Regional Greenhouse Gas Initiative (RGGI), a voluntary multi-state cap and trade program for green house gas emissions. The seven states participating in RGGI include Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York and Vermont. Observers in the program include the District of Columbia, Massachusetts, Pennsylvania, Rhode Island, the Eastern Canadian Provinces and New Brunswick. The first compliance period will begin in January 2009. The initial phase of the program will allocate and trade CO_2 allowances to power sector sources only. The program applies to generators of 25 MW or greater. Large industrial CHP or merchant power CHP projects are eligible.

EPACT 2005 Implementation

CHP provisions in EPACT 2005 included requirements that states consider upgrading interconnection policies, revise QF provisions in PURPA and offer tax credits for certain renewable energy and DE technologies.

In addition, DOE is required to conduct two notable studies under EPACT 2005 with CHP/DE relevancy. These studies are described below.

National Transmission Congestion Study

Section 1221(a) of the Energy Policy Act of 2005 updates Section 216 of the Federal Power Act and requires DOE to issue a national transmission congestion study for comment by August 2006 and every three years thereafter. DOE issued the *National Electric Transmission Congestion Study* in early August with a 60-day comment period. Regions of congestion identified are summarized in Table 2.

Critical Congestion Areas	Congestion Area of Concern	Conditional Congestion (if new generation is developed w/o transmission)
• Atlantic Coast from New York to Northern Virginia • Southern California	• New England • Phoenix-Tucson Area • Seattle-Portland Area • San Francisco Bay Area	• Montana-Wyoming • Dakotas-Minnesota • Kansas-Oklahoma • Illinois, Indiana and Upper Appalachia • Southeast

Table 2: Areas of Congestion Identified in National Transmission Congestion Study

Areas of transmission congestion that are identified in the study could be used to target locations for field testing and demonstrations of new advanced CHP and DE systems. During the comment period, the CHP community should provide input on CHP value in addressing transmission constrained regions and how it should be considered in resource planning to avoid unnecessary and costly transmission infrastructure.

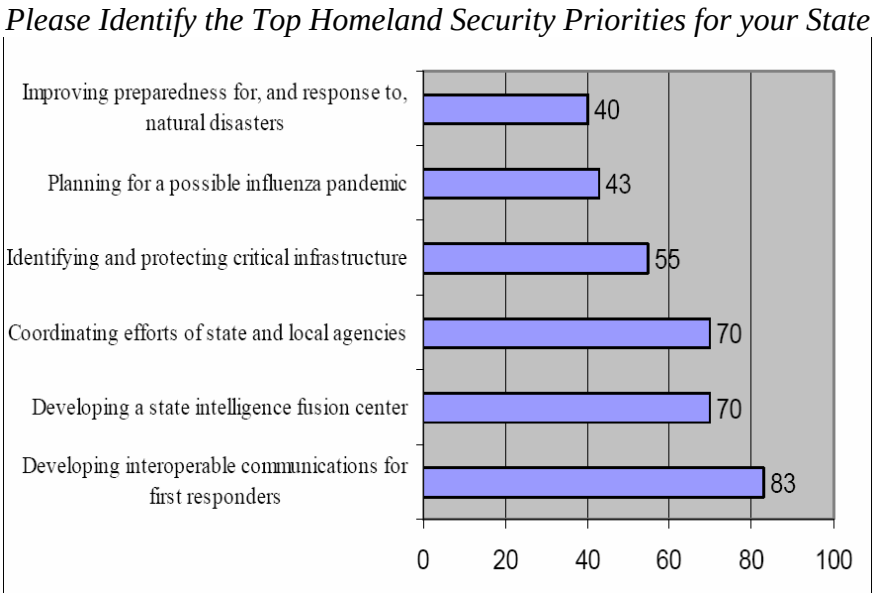
Benefits of Distributed Generation Study

EPACT requires that no later than 18 months after enactment, DOE, in consultation with FERC, must complete a study on the benefits of cogeneration and small power production. That activity has been initiated. The results of the study can support future actions. DOE's Distributed Energy Program, through the National Energy Technology Laboratory (NETL), solicited public input from stake holders, such as utilities, cogeneration developers, small power producers, original equipment manufacturers, local and state regulatory bodies, trade associations, etc., for the study of the potential benefits of distributed generation. Interested parties were asked to relate experiences, convey

data, communicate results of case studies or analyses, or provide other information pertaining to the planning, installation, commissioning and operation of cogeneration or small power production systems.

Homeland Security and Defense

Homeland security is a complex challenge that demands collaboration among local, state and federal governments and integration with the private sector. Coordinated homeland security strategies and disaster response plans increasingly have focused on the need to sustain electricity grid and reliability. The September 11 attacks demonstrated that intentional disruptions of the electric grid and other critical elements of the energy infrastructure must be within the scope of contingency planning. CHP can play a role in both preparedness and recovery. Potential target CHP/DE applications that fall within homeland security strategies include energy operations/facilities in locations with supply and/or deliverability vulnerabilities, remote power (e.g., military installations), critical mission infrastructures (e.g., police, fire, emergency response, hospitals, communications and water treatment), and critical centers of economic development. In addition to the US Department of Homeland Security (DHS), each of the states now has its own office of homeland security. This is to ensure a comprehensive preparedness strategy that reflects unique characteristics and needs of each state. In 2006, the National Governors Association (NGA) conducted a survey of state homeland security directors.[7] The priorities of state directors are shown in Figure 15.



Source: National Governors Association

Figure 15: State Homeland Security Directors Priorities

[7] The NGA report, *2006 State Homeland Security Directors Survey*, can be found at http://www.nga.org/Files/pdf/0604HLSDIRSURVEY.pdf#search=%22State%20%22homeland%20Security%22%22

The Department of Defense (DOD) has increased its public activities in energy utilization and efficiency for its own facilities and to enhance alternatives to petroleum based distillate logistic fuels. While the primary DOD energy focus is on transportation applications, several defense-related activities initiated this year have relevancy to CHP and clean DE.

- The Army Corps of Engineers issued a report *Energy Trends and Their Implications for U.S. Army Installations*. The report included numerous recommendations related to increased energy efficiency measures and utilization of CHP and DE at military facilities. It recommended allocating funds to modernize facilities to a state-of-the-art level with regard to energy use and management technologies.
- DOD's Office of Force Transformation has held Monthly Energy Conversations. The conversations have created a very good government inter-agency learning opportunity. To date there has been an impressive list of speakers with topics including energy efficiency and conservation, peak oil, hydrogen economy, renewable bio-fuels, and nuclear energy.
- A bipartisan Defense Energy Working Group (comprised of members of Congress and advisors) has been initiated to be led by James Woolsey, former CIA Director.
- The Air Force purchased more renewable energy than any other member of the Environmental Protection Agency's Green Power Partnership last year, according to a report released in early 2006 by the EPA. This is the second year in a row that the Air Force has topped the list. In 2005, the Air Force purchased 1,066,397 MWh of renewable energy. That represents 11% of all electrical usage by the Air Force in 2005. Besides being the biggest purchaser in the green power partnership, the Air Force is also the leading purchaser of renewable energy in the federal government, accounting for nearly 50% of all green power purchases by the federal government.

Disaster Response and Business Continuity

CHP and DE can provide a valuable alternative in disaster preparedness/recovery strategies and ensuring business continuity for those enterprises that face unacceptable financial losses in the case of business interruptions.

National Disaster

Reliable power is critical under normal conditions, but it is especially vital in crisis situations since facilities like hospitals, fire stations, and shelters must be able to continue operations. One way to avoid these failures in facilities supporting critical mission operations is through use of CHP systems. This was clearly demonstrated during the 2005 hurricane season.

Regional or local conditions, such as a susceptibility to natural disasters or local economic development driven by mission critical enterprises requiring high reliability of

energy supply, should motivate the consideration of CHP systems capable of operating in the case of a long term failure of the electric grid.

Business Continuity

The fundamental day-to-day business operations for most commercial, institutional and industrial energy consumers are now based on an increased reliance on computer-based information systems for financial management, the advanced logistics of quick-responding global supply chains and electronic systems for product distribution/support. Businesses have grown to be critically dependant on a continuous supply of clean, reliable power.

Almost all businesses are preparing new business continuity and disaster recovery plans in which they identify specific costs, exposure, and risks of business interruption. They are re-evaluating their insurance industry strategies and practices in light of these new risks and considering the role onsite power systems like CHP will play in ensuring continuity of operations. New legal precedents are also changing the nature of business continuity-related liability and risk. The market for systems that ensure the availability of power is undergoing a fundamental change as businesses take into account new risks and value solutions from a new enterprise-wide perspective

State and Local Economic Development

Locally developed, owned and operated energy systems offer an environmentally responsible alternative to the current wasteful centralized electricity system. They typically incorporate clean fuels (such as biogas, biomass, natural gas, or propane), energy efficiency, renewable technologies or recovered/recycled energy. A compelling attribute of local energy solutions is that they are often community or municipality driven and controlled. This allows communities to become direct stakeholders in their own energy supply by producing fuel, electricity, or heat. Involvement in energy projects empowers individuals, companies, and communities and keeps wealth within the local economy. This encourages innovation and entrepreneurship.

Most states have a strategic interest in supporting clean energy projects that are fueled by local resources. In short, money that might otherwise go to out-of-state entities stays within the state economy. Successful local energy projects create new economic opportunities for urbanized areas and rural communities alike. Technology leadership, coupled with informed tax and economic development policies, can stimulate the development of local industries and job creation.

Technology Development and System Application

It is technology development that has helped enable CHP to have the impact it has had. CHP utilizes a range of distributed energy technologies including gas turbines, fuel cells, microturbines, and reciprocating engines. In addition to clean and efficient generation technologies, CHP also involves power electronic interfaces, communications and control devices for efficient dispatch and operation of single generating units, multiple system packages, and aggregated blocks of power. Heat recovery and utilization technologies such as thermally activated absorption cooling and desiccant dehumidification are also critical in achieving the high energy efficiency that CHP has to offer.

The primary fuel for many CHP systems has been natural gas, but high prices and tight supplies have stimulated increased interest in renewable opportunity fuels. Renewable fuels such as biomass and landfill gas are becoming increasingly economic and emissions control technology is improving the emissions signature of waste and biomass projects.

Continued research, development and commercialization of CHP technologies with private industry, federal and state government agencies, and our colleges and universities is needed ensure that the energy and environmental benefits of CHP are realized.

US Department of Energy Distributed Energy Program

The DOE Distributed Energy Program has historically been the leading supporter of CHP/DE RD&D in the following areas:

- Components
- Systems
- Reliability
- Efficiency
- Environmental Impact

The Distributed Energy Program has moved to the Office of Electricity Delivery and Energy Reliability (OEDER or OE) from the Office of Energy Efficiency and Renewable Energy (EERE). There are CHP related activities in the Industrial Technologies Program., the Building Technologies Program, and the Biomass Program of EERE.

OE's mission is to lead a national effort to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from energy supply disruptions. The mission of OE results in a shift in CHP and DE technology development emphasis away from distributed generation and thermal energy utilization **component and system research and development** and toward **integration of distributed systems with the next generation of electric grid systems.**

This shift in priorities is reflected in the Five Year Program plan for Fiscal Years 2008-2012 for Electric Transmission and Distribution Programs, prepared as a requirement of EPACT 2005.[8] The report identifies the following technical challenges with regard to distributed systems:

- Making the transition from distributed devices that are designed to serve individual consumers to distributed systems that are designed to serve aggregations of consumers and local utility distribution systems
- Integrating communications and control systems to enable different types of distributed devices and software (e.g., energy storage, distributed generation, and distributed intelligence and controls) to work together and interconnect with local utilities in a seamless manner (interoperability)

[8] The report, *Five Year Program Plan for Fiscal Years 2008-2012 for Electric Transmission and Distribution Systems* can be found at http://www.oe.energy.gov/DocumentsandMedia/Section_925_Final.pdf#search=%22EPACT%20925%20Program%20Plan%22.

- Enabling information technologies to make available the time-varying value of electricity to customers and to empower their participation in demand response
- Enabling control and optimization technologies for industrial, commercial, and residential equipment to respond to price signals and system instability (e.g., under-voltage and under-frequency events, reactive power imbalance, etc.)
- Finding lower cost ways to use distributed systems to manage peak demands and reduce "upstream" congestion on transmission and distribution systems
- Finding lower cost ways to use distributed systems to reduce the costs and inconveniences of power outages and power quality disturbances for consumers
- Finding lower cost ways to boost the utilization of electric distribution assets such as feeder lines, transformer and capacitor banks, and substations
- Developing data, computer models, and analysis tools that estimate the technical and financial value of distributed systems for use by grid planners and operators in resource planning and system operations

Activities in the DOE OE Fiscal Year 2007 budget request for Distributed Systems include:

- Completion of research projects that have successfully improved the energy efficiency, costs, and environmental performance of a portfolio of distributed generation devices, including turbines, microturbines and reciprocating engines
- Completion of advanced integrated energy system and combined heat and power demonstration projects for healthcare, education, food services, and lodging sectors
- Completion of the EPACT 05 Section 1817 requirement for a "Study of Distributed Generation"
- Continuation of the design and implementation of a framework to enable and guide the development of true interoperable software both within the utility enterprise and across other sectors integral to the electric infrastructure
- Continuation of investigations into distributed generation, combined heat and power, and electric system integration, including interconnection, real and reactive power assessments and applications in microgrids and local energy networks
- Continuation of technology transfer and education on combined heat and power technologies through regional applications centers
- Continuation of investigations into technology and business issues for advanced operational concepts such as, microgrids and local energy networks
- Continuation of collaborative energy storage demonstration projects with the California Energy Commission and the New York State Energy Research and Development Authority for monitoring and data collection of utility-scale applications
- Continuation of development of monitoring and control technologies to enable load management by both utilities and customers

The key planned activities for FY 2008-2012 for integrating a portfolio of distributed systems with electric system planning and operations include:

- Distributed systems integration projects that prove to key stakeholders the benefits of distributed systems integrated with the electric system
- Advanced operational strategies such as micro-grids or local energy networks that build on experience with multiple distributed energy devices both connected and unconnected to the grid including IEEE 1547 standards development supporting these operational modes
- Enabling technologies for real-time load monitoring and load management that will make more cost effective and readily available price-based and incentive-based demand response programs
- Modeling and analysis of distributed systems for assessing market barriers and potential impacts on utilities and consumers
- Energy storage research to achieve dramatic reductions in capital, installation, and operations and maintenance costs for existing storage systems in a variety of types and size ranges.
- Technology transfer and education for accelerating technology readiness and market acceptance and development of industry consensus standards through standards development organizations such as the IEEE.

These near and mid-term priorities represent a significant change in program emphasis as well as future CHP/DE technology development support.

State and Local Technology Development and Commercialization Programs

State incentive and rebate programs often play an important part in the commercialization of new energy technologies and products. Complementing federal technology development and RD&D initiatives are state energy programs. While focusing on the unique energy priorities of each state, the larger state programs often provide benefits to the nation as a whole and virtually all state programs rely on federal co-funding to accomplish objectives.

California Energy Commission

The California Energy Commission (CEC) sponsors research and provides incentives for distributed energy resources. The primary research arm within the Energy Commission is the Public Interest Energy Research (PIER) Program. The PIER Program provides funding to public and private entities for energy research, development, and demonstration (RD&D) activities that advance science and technology and improve the quality of life in California. The goal of the PIER Program is to bring environmentally safe, affordable, and reliable energy services and products to the marketplace, while creating state wide environmental and economic benefits.

Distributed generation is one of several focus areas of the PIER program, representing approximately 25 percent of all funding since the program's inception in 1998. As of March 2004, 108 distributed generation projects totaling over $94 million had been completed. These projects are spread across the all six program areas of PIER. The six program areas include:

- Environmental Preferred Advanced Generation (EPAG)
- Renewable Generation
- Energy System Integration (ESI)
- Energy-Related Environmental Research
- Industrial/Agricultural/Water End-Use Energy Efficiency (IAW)
- Residential and Non-Residential Buildings End-Use Energy

Most of the portfolio is focused on reducing environmental impacts and reducing the cost of generating electricity. The most diverse range of projects, however, is found under the Energy Systems Integration (ESI) program area, with projects focusing on interconnection issues, market integration, grid effects, and market structure.

New York State Energy Research and Development Authority

The New York State Energy Research and Development Authority (NYSERDA) Distributed Generation and Combined Heat & Power (DG-CHP) Program supports the development and demonstration of distributed generation (DG) systems, components and related power systems technologies, and CHP applications in industrial, municipal, commercial and residential sectors.

The DG-CHP program has addressed power generation, availability, reliability, and quality needs of New York State while emphasizing energy efficiency and environmental quality. NYSERDA projects are expected to result in direct energy, environmental, and economic benefits such as peak electric demand reduction, higher fuel-use efficiency, emissions reduction, lower energy costs, job creation, and product sales. Eligible projects have included:

- Development and commercialization of power systems technologies, including DG and CHP systems or components manufactured in New York State;
- Demonstrating DG and CHP feasibility, cost-effectiveness, reliability, and replicability at New York State sites;
- Building DG or CHP applications that demonstrate innovative generation or distribution of electrical and thermal energy;
- Industrial CHP applications that demonstrate innovative use/recovery of thermal energy in a manufacturing process;
- Feasibility studies to evaluate CHP applications, technologies, and market transformation;
- CHP technologies and applications that are commercially underutilized.

Other State Incentive Programs

While California and New York are two of the largest state supporters of CHP and DE, many other states are actively promoting distributed energy resources. These other programs are often not technology and RD&D programs in the pure sense. They typically provide value to the commercialization of alternative energy technologies by providing rebates on purchases of environmentally preferred or renewably fueled CHP-DE equipment, low interest loans, grants, or tax incentives. Other state programs include

but are not limited to Alabama, Alaska, Connecticut, Idaho, Indiana, Kansas, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, New Mexico, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, and Wisconsin.

New Partnerships and Alliances

The preceding situational analysis section clearly indicates that this is a period of transition for the CHP community. This period of transition presents both opportunities and pitfalls. Information is needed to support decisions with lasting consequences at the national, state and local levels on important energy issues. Our coordinated advocacy, outreach and education activities are crucial at this point. We have to develop a clear message on the value and benefits of CHP and DE. Our targeted audiences should expand beyond our traditional partners to include other organizations with whom new alliances can be built that are mutually beneficial and strengthen our current core foundation. Potential new coalitions can be pursued with the following:

- Providers of technology/equipment/services enabling the modernization of the electric grid
- State and local rural and economic development officials
- State and local homeland security offices
- US Department of Agriculture
- US Department of Defense
- US Department of Homeland Security
- Public and cooperatively-owned utilities
- Investment community
- Business continuity and risk management communities

The goal of these new partnerships should be to develop new and innovative approaches to supporting technology development, CHP promotion, incentives for CHP, and ultimately the installation and utilization of CHP to meet the needs discussed in this report and at the Roadmap Workshop.

With our current energy, environmental and national security concerns, a future energy infrastructure consisting of integrated clean distributed energy systems powered by diverse fuels, providing energy in the form of electricity, heat, lighting and space conditioning in proximity to its use and configured to optimize redundancy and robustness has unquestionable appeal.

Our success depends on our ability in the coming years to get our message out to policy makers at all levels (national, state and local) and to work among a broad set of equipment providers, technology developers/researchers, energy project developers, progressive thinking energy users, fuel suppliers, publicly and cooperatively owned utilities, renewable bio-fuel companies, non-government organizations, universities, financial/investment community, and entrepreneurs to continually offer innovative solutions to their energy challenges.

Review of 2005 New York Workshop and Café Action Items

2005 marked the sixth year that a national workshop on combined heat and power had been sponsored by the Department of Energy, the Environmental Protection Agency, the U.S. Combined Heat and Power Association, and numerous national, state, regional, and local government organizations, private companies, research institutions, and non-profit associations. Each year since the first CHP workshop – the *CHP Summit* in 1999, at which the CHP Challenge was established – CHP stakeholders have gathered to discuss both the progress of CHP development in the country as well as the barriers that remain.

In 2005, this annual meeting was combined with the 6th Annual World Conference on Decentralized Energy and CHP, sponsored by the World Alliance for Decentralized Energy (WADE). Combining the two meetings provided an opportunity for attendees to learn about the world market for CHP, technical advances in CHP and DE technology and systems, and policy, regulatory, economic, and environmental issues that still need to be addressed throughout the US and the world for a robust CHP market.

Two-hundred and fifty-six (256) delegates and speakers attended the International DE and CHP Conference; approximately 165 of them stayed to participate in the 6th Annual Roadmap Workshop. Delegates from outside the United States hailed from:

- Brazil
- Scotland
- Canada
- Portugal
- Turkey
- Australia
- The Netherlands
- France
- Finland
- Japan
- China
- Korea
- Belgium
- Sweden
- India
- New Zealand
- Czech Republic
- Nigeria
- Lithuania

National CHP Roadmap Workshop

The 6th National CHP Roadmap Workshop focused on the market for CHP today in the US, and on the opportunities and actions needed to improve that market during 2006. A "situation analysis" was presented to Roadmap Workshop participants in the form of a *CHP Action Agenda*, in which the strides made since 1999 were described and the changes in technology, market development, policies, regulations, and education and outreach activities were outlined. All eight Regional CHP Application Centers (RACs) provided short updates on their activities, illustrating the breadth and depth of CHP activities in regions throughout the country. Delegates to the workshop then contributed their thoughts about activities undertaken in their communities and/or organizations during the last year.

The workshop then continued with the *CHP Café.* This facilitated series of conversations on CHP was designed to engage participants in small group discussions on CHP issues that they thought would have the most impact on their organizations' successes; on what and where the best opportunity for deployment of CHP was; and what might be needed to improve or expand those opportunities.

CHP Café Process

In the café process small groups we given several questions to consider and discuss. This was intended to stimulate discussion, share perspectives and collaboratively develop insights on the priorities actions of the CHP industry.

Focus Questions

The focus questions of the Café were:

- **Focus Question 1**. *What issue or topic do you think will have the most impact on your organization's success and why? How can you apply this knowledge to improve your organization's success?*

- **Focus Question 2***: What and where is our best opportunity to increase the deployment of CHP today and in the immediate future? Why is it the best opportunity?*

- **Focus Question 3.** *What is most needed to improve or expand that best opportunity? How should we enlist others in this needed effort? How can we collectively address this need?*

- **Focus Question 4.** *What change is most likely to improve or expand our success in the future? How could that change affect us? What do we need to learn in order to adapt and capitalize on this change?*

Making Connections and Sharing New Insights

Following the focus question session, a period of open discussion was facilitated to "Make Connections and Share New Insights". Three questions were posed.

- *What is the most important thing you have heard during these Café conversations?*
- *What do we need to learn more about?*
- *What do we need to do next?*

Finally, the workshop participants were asked to complete the open-ended question, *"What if…?"*

CHP Café Results and Follow-up

The Café process resulted in conversations on the following topics:

- Target markets for CHP
- Utility inter-relationships
- Economics of CHP
- Monetizing CHP value
- Strategic issues, such as climate change, grid connections, and environmental externalities
- Regulatory environment
- Technology deployment

The conversations were captured on "butcher-block" paper, recorded, and categorized in the above-noted topic areas. The next step is to analyze these conversations and convert them into activities and actions that might be addressed by national, state, regional, and local CHP stakeholders and advocates.

Among the preliminary issues of interest and the best opportunities for deployment of CHP were the following:

Target Markets for CHP

Targeted region-specific markets include New York City, Southwest Connecticut, and the Midwest. Target vertical markets include hospitals; supermarkets; hotels; wastewater treatment plants; nursing homes; federal, state, and municipal government buildings; agricultural environments where waste heat can be captured; high-end residential buildings; and police, fire, and other critical infrastructure facilities that operate 24/7.

Among the issues of concern are the need for customer stability in terms of energy supply, and their normal risk-averse behavior. Customers are concerned with security for critical loads, in hospitals, water treatment, and communications. The major messages for these markets include valuable energy efficiency resulting from installation; reliability; and economic benefits.

Demographics are critical to assessing the markets for CHP. Such issues as local, constrained grids, non-attainment areas, high-priced electricity; gas prices, and household/business income are drivers as well.

Utility Inter-Relationships

Key issues include convincing utilities of the use of CHP as a customer retention strategy; addressing utility opposition to microgrids because they are seen as competitive to the utility business; and analysis of the utility requirement to "serve all customers" which leads to large back-up capacity requirements and fees for distributed generation. Other key topics include the need to provide incentives for utilities to adopt CHP, simplifying our message; and allowing utilities to make money on DG, rather than purely through-put.

Economics of CHP

Key issues include local electric rates (spark spread is poor in some geographic locations); high first costs, which in turn lead to subsidies; high gas prices; financing constraints; the need to value reliability, energy efficiency, and environmental impacts of CHP; and the need for packaged systems to reduce installation costs. Payback costs continue to plague the economic viability of CHP. Industry looks for 2-3 year paybacks, while the real value of CHP takes more than 2 years to produce.

Strategic Issues

Energy has become a national issue – a major topic of conversation. Among the key issues are grid reliability and stability, *vis a vis* combined heat and power and distributed energy; inclusion of CHP in renewable portfolio standards; valuing and accounting for externalities; monetizing the environmental and energy efficiency benefits of CHP; selling CHP projects and framing the risk of not investing in CHP and DE; and acting on "pain", e.g., using national disasters to our advantage by underscoring the value of CHP and DE in these situations. There is a need for more effective national leadership on energy in general, and CHP in particular.

Regulatory Environment

The regulatory environment for CHP continues to be uneven across the country. Key issues for action include involvement with FERC and standard interconnection proceedings both nationally and at the state level; and educating regulators about the benefits of DE and CHP, particularly when the power grid is being re-built or expanded.

Technology Development

The primary need is development of reliable packaged systems, using off-the-shelf products and systems that can be assembled off-site and installed as a package, or modular, system on site.

Follow-Up Actions

A review and analysis of the Café results identified primary needs for action:

- **CHP Benefits** - Articulate and identify resources supporting the value and benefits of CHP
- **CHP Outreach** - Identify the target audiences of our tailored messages and develop a comprehensive communications plan that positions the value of CHP as a solution to that target audience's priority issues
- **CHP Advocacy** – Develop a set of policy priorities and engage officials at federal (Congress, Administration agencies, and FERC) and state levels (state PUCs, governors' offices, and state legislatures) to ensure CHP competes on a "level playing field"
- **CHP Technology Development** – Develop a strategy to maintain RD&D support at federal level and increase state role in technology development and commercialization to ensure key CHP technical and RD&D issues are resolved
- **CHP Market Development** – Develop market development strategies and project development support tools in targeted state/local and customer sector markets; Build coalitions to address market specific issues

2006 CHP Action Plan and Roadmap Workshop Context

As we develop a set of consensus priority actions at this *7th National CHP Roadmap Workshop,* consider the energy market conditions we face as we proceed forward.

- Energy delivery reliability
- Energy price stabilization
- Load management/demand response
- Energy efficiency/conservation
- Energy supply
- Energy security
- Business continuity/disaster response
- Fuel diversity
- Renewable/alternative energy sources
- Competitive market design
- Air quality and emissions regulations
- Climate change/greenhouse gas emissions

For which energy needs do you feel CHP offers the most compelling value proposition? Why? Are there other issues? What can the industry do to see that the potential of CHP is fulfilled? How?

Possible actions consistent with the original roadmap include:

- Raising Awareness – Repositioning of message and development of corresponding communications plan; develop federal and state advocacy plans
- Technology Development – Resolving key technical and RD&D issues
- Regulatory/Institutional Barriers – Pursue pro-CHP/Clean DE policy agenda
- Market Development –Segmentation on state/local basis and targeted-market sector, building coalitions to address target audience/customers

References

Supporting Documents

National CHP Roadmap - http://uschpa.admgt.com/CHProadmap.pdf

2004 CHP Action Agenda: A Status Report - http://www.energetics.com/5thchpworkshop/pdfs/action_agenda.pdf

5th Annual CHP Roadmap Workshop Breakout Group Reports - http://www.eere.energy.gov/de/pdfs/conf-05_chp_roadmap_wkshp/roadmap_results.pdf

2005 CHP Action Agenda

http://www.energetics.com/7thchproadmap/PDF/action_agenda.pdf

EPA Clean Energy-Environment Guide to Action

http://www.epa.gov/cleanrgy/pdf/gta/guide_action_full.pdf

Distributed Energy: Local Solutions for a National Crisis

http://uschpa.admgt.com/DistributedEnergyCoalition2pager.pdf#search=%22DOE%20Distributed%20Energy%22

Green Peace Report Decentralizing Power: An Energy Revolution for the 21st Century

http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/7154.pdf#search=%22GreenPeace%20Decentralising%20POwer%22

National Action Plan for Energy Efficiency

http://www.epa.gov/cleanrgy/pdf/ActionPlanReport_PrePublication_073106.pdf

EPA 2005 CHP Partnership Update

http://www.epa.gov/chp/pdf/chp_partupdate05.pdf

2001 National Energy Policy Report and Climate Change Plan

http://www.whitehouse.gov/energy/National-Energy-Policy.pdf

Websites

CHP Regional Application Centers - http://www.eere.energy.gov/de/chp/chp_applications/chp_application_centers.html

DOE Distributed Energy Program - http://www.eere.energy.gov/de/

DOE National CHP Case Study Database - http://www.eere.doe.gov/de/case_studies_ir.html

Energy Information Administration - http://www.eia.doe.gov/

EPA State and Local Clean Energy Programs

http://www.epa.gov/cleanrgy/stateandlocal/guidetoaction.htm

EPA CHP Partnership - http://www.epa.gov/chp/

IDEA - http://www.districtenergy.org/

NYSERDA DG-CHP Program - http://www.nyserda.org/programs/dgchp.asp

Oak Ridge National Laboratory - http://www.ornl.gov/sci/engineering_science_technology/cooling_heating_power/

USCHPA - http://uschpa.admgt.com/