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DESCRIPTION OF ACTIVITIES AND SELECTED RESULTS FOR THE U.S. DEPARTMENT OF ENERGY'S CLEAN ENERGY APPLICATION CENTERS: FISCAL YEAR 2010

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) sponsors a set of Clean Energy Application Centers that promote the development and deployment of clean energy technologies. There are eight regional centers that provide assistance for specific areas of the country plus a separate center operated by the International District Energy Association that provides technical assistance on district energy issues and applications to the regional centers. The original focus of the centers was on combined heat and power (CHP) alone but, beginning in fiscal year 2010, their scope expanded to include district energy systems and waste heat recovery. At that time, the official name of the centers changed from CHP Regional Application Centers (RACs) to Clean Energy Application Centers, and their number was expanded to include the previously-mentioned center focusing on district energy.

Oak Ridge National Laboratory (ORNL) has performed two previous studies of RAC activities. The first one examined what the RACs had done each year from the initiation of the program through fiscal year (FY) 2008 and the second one examined RAC activities for the 2009 fiscal year. The most recent study, described in this report, examines what was accomplished in fiscal year 2010, the first year since the RACs expanded their focus and changed their name to Clean Energy Application Centers.

All eight regional Clean Energy Application Centers were asked to provide information on the full range of their FY 2010 activities, using a data collection spreadsheet prepared by ORNL for that purpose. The information provided by the individual Clean Energy Application Centers was summed to produce totals for all centers combined for each metric examined. In addition, data on CHP and district energy installations were obtained from databases created and maintained by ICF International and the International District Energy Association (IDEA). It is important to note that this study, like the two previous ORNL studies, focused on identifying and describing key center activities and was *not* designed to measure how those efforts influenced clean energy installations or other outcomes.

The Clean Energy Application Centers' FY 2010 undertakings can be grouped into the following major categories: education and outreach activities; outreach materials produced; policy-related activities and policies enacted; and technical assistance and associated projects. Brief highlights from each of these broad areas are presented below.

A large number of different education and outreach activities were carried out by the Clean Energy Application Centers to inform potential end-users, policy-makers, and other stakeholders about the benefits and applications of clean energy technologies. These include: targeted workshops, webinars, and training sessions; conferences; partnership meetings; college courses; media interviews; e-mail blasts; website activity; and involvement in State Energy Office activities. In fiscal year 2010, the Clean Energy Application Centers hosted 67 targeted workshops, webinars, and training sessions with a total of nearly 1,300 targeted attendees and almost 3,200 attendees in total. Most of those events addressed CHP technologies alone or in conjunction with other clean energy technologies, but some focused on either district energy or waste heat recovery alone. The most common topics addressed were clean energy fundamentals, clean energy opportunities, and clean energy policy. The Clean Energy Application Centers also helped plan 21 conferences involving more than 4,800 participants, led 11 conferences, sponsored 16 conference booths, and made more than 30 conference presentations for almost 3,300 attendees. The most common targeted sectors included: commercial facilities; general industry; architects and engineers; agricultural applications (including animal and dairy farms); and colleges/universities. The centers were involved in 77 partnership meetings involving nearly 900 participants and conducted three college courses. In addition, Clean Energy Application Center websites hosted more than 140,000 unique visitors who downloaded more than 876,000 items. The three most frequently downloaded materials were conference presentations, project profiles, and application guidebooks. In general, most of

the centers' education and outreach activities increased in number form FY 2009 to 2010. The greatest growth reported was for e-mail blast recipients, downloads from center websites, and involvement in State Energy Office activities, while the most notable decline was in the number of website views.

In FY 2010, the Clean Energy Application Centers also produced a broad array of outreach materials related to the use of clean energy technologies. Those materials included 36 fact sheets, 22 newsletters, 15 project profiles, and 11 market analyses and databases. In total, the number of materials produced in FY 2010 was nearly double the number from 2009.

In addition to the targeted workshops and webinars mentioned above, the Clean Energy Application Centers held 15 policy-related workshops and 116 policy-related meetings in FY 2010 with a total of more than 1,700 attendees. The most common topics addressed were an overview of clean energy policy options and specific policies such as emissions rules, energy efficiency resource standards, and incentive programs. The centers also engaged in a wide variety of policy-related communications such as e-mails, conference calls, individual phone calls, and the issuing of comments, recommendations, and white papers. During this same period, a number of clean energy-related rules, standards, and other policy instruments were implemented by various states; these included new policies that were put in place for the first time as well as improvements to existing policies (Table ES.1). The most common subjects addressed were loan and grant programs, tax credits, renewable portfolio standards, interconnection rules, and incentives. Altogether, 24 new and 31 improved policies were enacted by the states in FY 2010. From FY 2009 to 2010, the number of policy-related activities conducted by the centers increased substantially as did the number of clean energy-related policies enacted by the states.

Table ES.1 Type and number of new and improved state policies established, FY 2010

Policy type	Number New	Number Improved
Loan/grant program	10	1
Tax credit	6	2
Energy efficiency resource standard	2	0
Bond financing	2	0
Renewable portfolio standard	1	7
Incentives	1	2
Permit requirements	1	1
Utility rates	1	1
Interconnection rule	0	4
Net metering rule	0	2
State energy plan	0	1
Government facility rule	0	1
Emission rules	0	1
Rule on wheeling	0	1
Standby rates	0	1
Other utility policy	0	2
Other funding	0	2
Other policy	0	2

The Clean Energy Application Centers reported performing 82 technical site evaluations and making just over 3,300 other technical support contacts of various types in FY 2010. Altogether, 57 clean energy projects with 262 megawatts (MW) of capacity were under consideration, 73 projects with just over 510 MW of capacity were under development, and 16 projects with 387 MW of capacity went online in FY 2010 following technical assistance efforts provided by the Clean Energy Application Centers in that or a previous year (Table ES.2). Of those 146 projects, about two-thirds were CHP alone, approximately one in nine were CHP in conjunction with district energy or waste heat recovery, another one in nine were

waste heat recovery by itself, and about one-twelfth were district energy alone. Overall, there were more projects under consideration and development, with a greater combined capacity, in FY 2010 than in the previous year.

Table ES.2 Number of clean energy projects and capacity associated with technical assistance provided, FY 2010

Project status	Number	Installed capacity (in MW)
Project under consideration following technical site evaluation or other technical support	57	262.4
Project under development following technical site evaluation or other technical support	73	510.5
Project on line following technical site evaluation or other technical support	16	387.4

In 2010, 105 CHP systems were installed in the U.S. with just over 560 MW of total capacity. This is slightly greater than the number and capacity of installations made in 2009. Three of the systems that went online in 2010, accounting for about 10% of total installed capacity, were developed in conjunction with district energy systems. It is estimated that a little more than $840 million was invested in the 2010 projects and that they resulted in annual energy savings of more than 18 trillion source BTUs and carbon emissions reductions of nearly 2.2 million metric tons. Based on the aforementioned capital investment, it is estimated that nearly 3,400 new jobs were created. While it is likely that the Clean Energy Center activities detailed in this report influenced those outcomes, this study was not designed to establish and quantify a causal relationship between center activities and CHP installations.

As of this writing, 627 district energy systems are operating in the U.S., possessing very substantial thermal and cogeneration capacity. For those systems combined, the electric generating capacity alone is nearly 9,300 MW. Of those 627 systems, a little more than half are some combination of CHP, district heating, and district cooling. Slightly fewer than one in three have both district heating and district cooling systems in place, but no CHP. About one in eight provide district heating only and one in 37 provide district cooling only. Existing district energy systems that currently provide only heating and/or cooling, without CHP, are strong near-term candidates for the adoption of large scale CHP due to the magnitude of their aggregated thermal load. In two recent cases, a combined total of nearly 100 MW of electric generating capacity was developed in conjunction with district energy systems that had formerly provided thermal energy only.

This study, like those performed previously, was designed to catalogue Clean Energy Application Center activities and not to establish how they influenced the installation of clean energy systems. Accordingly, our ability to make recommendations about future program operations is limited because we do not have quantitative findings regarding how specific center activities affect the adoption of clean energy technologies. As in the last two reports, we do suggest that each Clean Energy Application Center consider the feedback it has received from its region's stakeholders concerning the services provided and make near-term decisions based on that input. The establishment of a nationally-coordinated effort to solicit input from stakeholder groups regarding desired services could facilitate the collection of information on the needs of the Clean Energy Application Centers' constituents.

Future studies to explore possible relationships between Clean Energy Application Center activities and key outcomes could be helpful in informing management decisions about center operations. Specifically, we recommend that studies be undertaken to test for possible relationships between: (1) the centers' targeted education/outreach activities and the adoption of clean energy technologies; (2) the centers'

policy-related activities and state policies enacted; and (3) state policies enacted and the implementation of CHP, district energy, and waste heat recovery projects. The findings generated by these studies will help quantify the effects of center-sponsored activities and achievements. This information should prove helpful to policy-makers and center managers in deciding what types of efforts to support and services to provide in the future.

1. INTRODUCTION

1.1. BACKGROUND

The U.S. Department of Energy (DOE) sponsors a set of Clean Energy Application Centers that promote the development and deployment of combined heat and power (CHP) technology, district energy systems, and waste heat recovery (U.S. Department of Energy 2011a). There are eight regional centers that provide assistance for specific areas of the country (see figure 1.1) plus a separate center operated by the International District Energy Association that provides technical assistance on district energy issues and applications to the regional centers.

Figure 1.1. Geographic areas served by regional Clean Energy Application Centers

This effort started with a pilot program in the Midwest in 2001 and grew to include eight regional centers covering the entire country by 2005. Each center concentrated on providing services that fit the specific needs and market conditions of its particular geographic region (Bronson and Orlando 2009). The original focus of the centers was on CHP technologies but, beginning with fiscal year (FY) 2010 (which started on October 1, 2009), their scope expanded to include district energy systems and waste heat recovery. At that time, the official name of the centers changed from CHP Regional Application Centers (RACs) to Clean Energy Application Centers, and their number was expanded from eight to nine to include the International District Energy Association.

Key services provided by the Clean Energy Application Centers include a multitude of targeted education and outreach activities and project-specific technical assistance (U.S. Department of Energy 2011b). The centers also engage in a variety of efforts to support the creation and adoption of public policies and incentives favorable to the adoption and use of clean energy technologies.

Oak Ridge National Laboratory (ORNL) began providing support for the CHP Regional Application Centers when they were first established and has continued that support throughout the years. ORNL led an effort in 2007, involving DOE and CHP industry stakeholders, to establish metrics for quantifying

RAC accomplishments. That effort began with the development of a detailed logic model that identified how the program operated and provided a basis for determining which specific activities and accomplishments should be examined over the life of the program (Schweitzer 2010).

ORNL has performed three studies of center activities, using the metrics identified through the previously-mentioned effort. The first study (Schweitzer 2009) focused on what the RACs had done each year from the initiation of the program through fiscal year 2008. The second study (Schweitzer 2010) examined RAC activities for the 2009 fiscal year. The third study, described in this report, examines what was accomplished in fiscal year 2010, the first year since the RACs expanded their focus and changed their name to Clean Energy Application Centers. In addition, all three reports contain information on regional CHP installations from a state-by-state database maintained for DOE by ICF International. The current report also presents key information on district energy facilities throughout the U.S. from a database developed by the International District Energy Association (IDEA). All of the studies mentioned here, including the one documented in this report, focus on identifying and describing key center activities and were *not* designed to measure how those efforts influenced clean energy installations or other outcomes.

1.2. SCOPE OF REPORT

The remaining chapters of this report will address how the study of FY 2010 Clean Energy Application Center activities was performed and the key findings resulting from that effort. **Chapter 2** presents a brief discussion of the research methods used in this study. **Chapter 3** discusses the education and outreach activities undertaken by the Clean Energy Application Centers in FY 2010 and **Chapter 4** describes the specific outreach materials produced by those efforts. **Chapter 5** addresses the policy-related activities undertaken by the centers and the policies enacted by various states during the study period. In **Chapter 6**, we discuss the technical assistance services provided by the Clean Energy Application Centers and the number and size of the projects associated with center assistance. **Chapter 7** describes the CHP installations made during 2010 and also characterizes the state of existing district energy facilities. Finally, **Chapter 8** synopsizes the major findings from this study and presents some recommendations concerning the path forward.

2. METHODS

As in the two previous RAC metrics studies, ORNL staff developed a data collection spreadsheet specifying all of the information needed on the Clean Energy Application Centers' activities for the study period, in this case FY 2010. This spreadsheet was similar to the ones used in the previous studies but contained some refinements to facilitate the ease of completion. As in the past, the requested information addressed the full range of center activities.

In late December, the data collection spreadsheet, along with instructions for how to complete it, was posted on a share point site maintained by ORNL for the exchange of information by the Clean Energy Application Centers. The centers were asked to complete the spreadsheet and all of them did so by February, 2011. ORNL staff reviewed each completed spreadsheet and conducted follow-up interviews with center staff to obtain any clarification or additional information that was needed. The follow-up interviews were completed in May and a final database, containing all the information provided by the centers, was completed in July. That database, which was used to develop the current report, summed the information provided by each individual Clean Energy Application Center to yield totals for all the centers combined for each activity described.

In addition to the information provided by the centers on their clean energy-related activities, we also collected data on all CHP installations made during 2010 and on the state of existing district energy facilities nationwide. The information gathered on CHP can help track progress toward realizing the vision of generating 20 percent of U.S. electricity with CHP by 2030, which would involve increasing installed capacity to 241 gigawatts (U.S. Department of Energy 2009). While this study was not designed to establish a causal link between the centers' activities and the clean energy installations made, it is still considered important to document the current state of CHP and district energy facilities in the U.S.

Data on CHP installations made during the 2010 calendar year were provided in June, 2011 by ICF International from a state-by-state database that the company maintains for DOE. In addition to the number of installations, the data provided by ICF included the capacity of CHP installations made in 2010 and the estimated capital investment, energy savings, and carbon emissions reductions associated with those installations.

Data on existing district energy facilities were provided in June, 2011 by the International District Energy Association. About half of the systems contained in that data base have a CHP component in addition to a district energy component. The other half of the district energy systems are either district heating or district cooling alone or the two types of systems operating in tandem.

3. EDUCATION AND OUTREACH

DOE's Clean Energy Application Centers performed a wide variety of education and outreach activities in FY 2010, as in past years, to help build market awareness of clean energy technologies. Major activities included: presenting targeted workshops, webinars, and training sessions; leading, planning, or taking some other active role in clean energy-related conferences; sponsoring and participating in partnership meetings; teaching college courses; taking part in media interviews; sending e-mail blasts to key stakeholders and other relevant parties; developing and maintaining websites containing pertinent information on clean energy technologies, including educational materials for downloading; and assisting in specific State Energy Office activities. Each of these topics is discussed in more detail below.

3.1. TARGETED WORKSHOPS, WEBINARS, AND TRAINING SESSIONS

Table 3.1 presents key information on the target market workshops, webinars, and training sessions provided by all the Clean Energy Application Centers, in combination, during FY 2010.

Table 3.1. Key information on Clean Energy Application Center-supported workshops, webinars, training sessions, FY 2010

Type of event	Number held	Number targeted attendees	Total number attendees	Number customer surveys given	Number attendees requesting information	Number presentations viewed/ downloaded
Target market workshops	28	937	1,364	8	205	7,010
Webinars	21	24	938	4	22	691
Training sessions	18	330	872	3	-	-

All eight regional Clean Energy Application Centers sponsored targeted workshops in FY 2010. A total of 28 such workshops were held, serving 937 attendees from targeted sectors and 1,364 attendees in total. The majority of the workshops addressed CHP technologies, either alone or in conjunction with other clean energy technologies, while a smaller number focused on either district energy or waste heat recovery alone. Many of the workshops targeted all major end-use sectors, while a substantial number targeted either the industrial or commercial sectors alone. The most common topic was clean energy fundamentals, followed by clean energy opportunities and financial or funding issues. Eight customer surveys were distributed during those events, 205 attendees requested additional information, and at least 7,010 presentations from those events were viewed or downloaded afterwards from the centers' websites.

Six of the eight regional Clean Energy Application Centers plus the International District Energy Association reported holding webinars in FY 2010. Altogether, there were 21 webinars held during this period, with at least 24 attendees from targeted sectors and 938 attendees overall. Nearly all of the webinars dealt with CHP, either alone or in conjunction with other clean energy technologies. Many of the webinars targeted either government buildings or the commercial sector. The most common topic was clean energy fundamentals, followed by clean energy policy and the use of CHP in critical infrastructure. Four customer surveys were distributed, 22 webinar participants requested additional information, and 691 presentations from those events were subsequently viewed or downloaded.

Four regional centers reported holding a total of 18 targeted training sessions in the 2010 fiscal year. Those sessions served 330 targeted attendees and 872 attendees in total. Most of the training sessions

addressed CHP alone or in conjunction with district energy or waste heat recovery, but a few dealt with district energy or waste heat recovery by themselves. The most commonly targeted sector was architects/engineers, followed by general industry and the agriculture/forest products sector. Frequent training topics were clean energy opportunities, clean energy fundamentals, clean energy policy, facility site evaluation, and market conditions.

The total number of workshops, webinars, and training sessions held in FY 2010 was slightly larger than the number held in FY 2009, but the cumulative number of attendees was lower.

3.2. CONFERENCES

During FY 2010, all of the Clean Energy Application Centers were involved in at least some of the types of conference-related activities shown in Table 3.2, below. During that period, the centers reported leading 11 conferences and planning (or helping plan) 21 conferences. This includes two large national conferences held by the International District Energy Association. In addition, the centers led five clean energy sessions, gave 33 presentations, and sponsored 16 booths at conferences. Five surveys were prepared and distributed to conference attendees, and 175 requests for additional information were received. The attendance numbers shown in Table 3.2 cannot be summed to yield a cumulative total because there were instances where a center led and/or planned a conference and also led a session, gave a presentation, or sponsored a booth at the same event. However, it should be noted that the number of people attending center-planned conferences *alone* was just over 4,800. It should also be noted that at least some of the numbers given below undercount actual attendance because a few centers could not provide numbers of attendees for all the conferences with which they had been involved.

Table 3.2 Conference participation and attendance, FY 2010

Event	Number of events	Number of attendees
Conferences led	11	1,854
Conferences planned	21	4,817
Clean energy sessions led	5	324
Presentations given	33	3,290
Conference booths sponsored	16	1,215
Customer surveys given	5	515
Attendees requesting information	26	175

Nearly all of the above-referenced conferences addressed either CHP alone or in conjunction with district energy and waste heat recovery. Only a few of the conferences reported by the Clean Energy Application Centers dealt with district energy or waste heat recovery by themselves. The most common end-use sectors targeted were commercial facilities, general industry, architects and engineers, agricultural applications (including animal and dairy farms), and colleges/universities. The topics that were most frequently addressed were clean energy opportunities, clean energy policy, case studies, clean energy legislation, market conditions, and clean energy fundamentals.

The number of conferences led and planned in FY 2010, as well as the number of presentations given and booths sponsored, were all greater than in the previous year. However, the centers led slightly more clean energy sessions, with considerably more attendees, in FY 2009 than in 2010.

3.3. PARTNERSHIP MEETINGS

In FY 2010, the Clean Energy Application Centers were involved in 77 partnership meetings involving 887 participants, as shown in Figure 3.1. Seven of the eight regional centers were involved in such meetings. Most of the partnership meetings focused on CHP, either alone or in conjunction with district energy and/or waste heat recovery. About a dozen of the partnership meetings, however, dealt with district energy and waste heat recovery only. The key topics addressed were clean energy opportunities, clean energy regulations and legislation, clean energy policy, market conditions, sustainability issues, small scale clean energy facilities, and financial issues. The numbers of partnership meetings and attendees were larger in FY 2010 than in 2009.

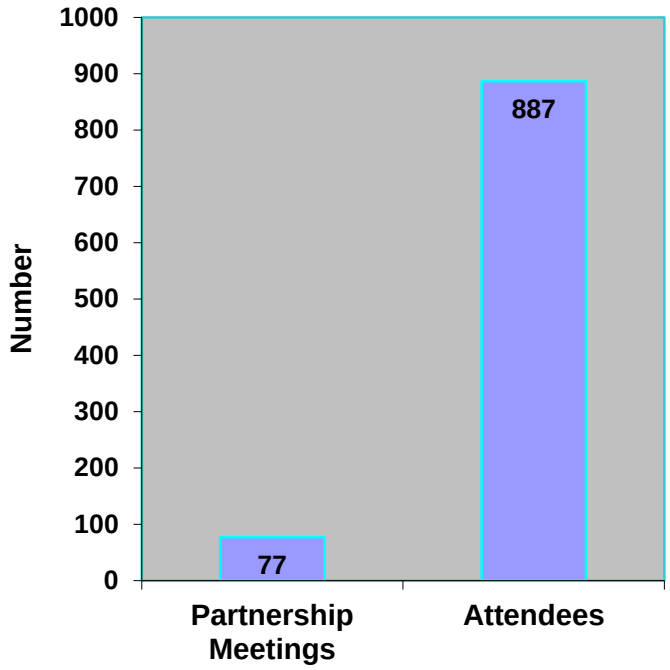

Figure 3.1. Number of partnership meetings and attendees, FY 2010

3.4. COLLEGE COURSES

Two Clean Energy Application Centers taught clean energy-related college courses in FY 2010, as shown in Figure 3.2. Altogether, three courses were taught, the same number as in FY 2009, with a total of 54 students. One of the courses focused on CHP alone, one addressed CHP and district energy, and one dealt with CHP, district energy, and waste heat recovery. The most common topics were clean energy fundamentals and opportunities.

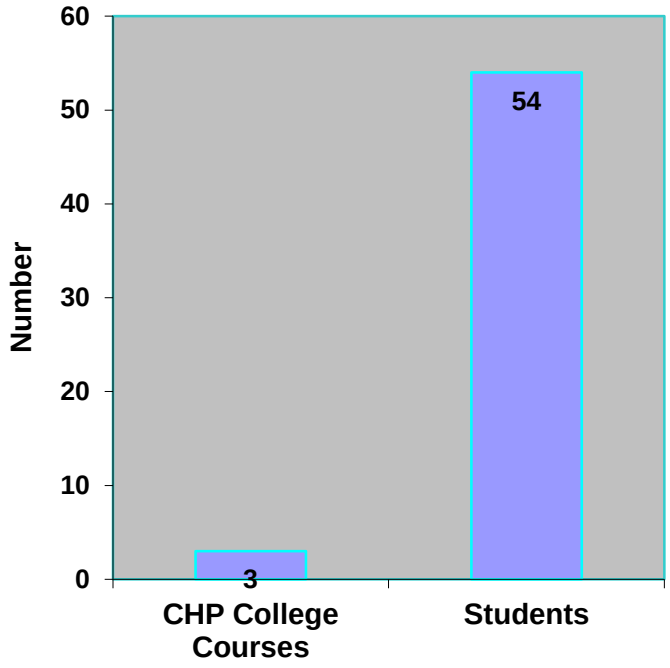

Figure 3.2. Number of clean energy college courses taught and students attending, FY 2010

3.5. MEDIA INTERVIEWS

Five regional Clean Energy Application Centers reported doing a total of seven interviews with media outlets in FY 2010, representing a substantial increase over the previous year. Three of them focused on CHP alone, two addressed CHP and waste heat recovery, and two dealt with CHP, waste heat recovery, and district energy. Four of the interviews were with magazines and journals, one was with TV, one with a newspaper, and one with an online publication. The most common topics were sustainability issues and clean energy opportunities, but many other topics were also addressed, such as clean energy opportunities, financial incentives, and market conditions.

3.6. E-MAIL BLASTS

E-mail blasts are typically announcements or news bulletins pertaining to clean energy technologies that are distributed to a Clean Energy Application Center's stakeholders. In FY 2010, four centers reported sending out 38 such communications, which went to a total of 65,503 recipients (see Figure 3.3). Most of those e-mail blasts dealt with CHP, either alone or in combination with district energy and/or waste heat recovery. However, at least seven of the 38 dealt with waste heat recovery by itself. Most commonly, the e-mail blasts were used to announce workshops, webinars, or training sessions. However, a substantial number also dealt with incentives and funding opportunities, barriers to clean energy use, or clean energy regulations and legislation. The numbers of e-mail blasts and recipients were both much larger in FY 2010 than in 2009.

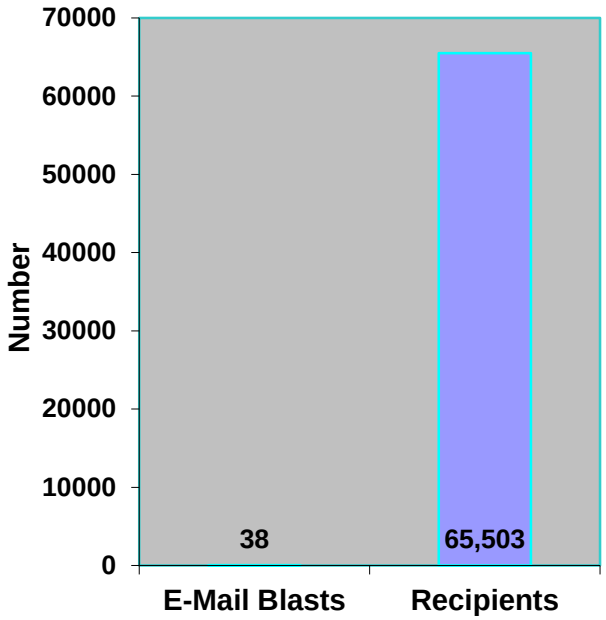

Figure 3.3. Number of e-mail blasts and recipients, FY 2010

3.7. WEBSITE ACTIVITY

Six regional Clean Energy Application Centers reported the number of views and unique visitors to their websites for FY 2010. As shown in Figure 3.4, the totals reported for all centers were 581,682 views and 141,374 unique visitors. These numbers are substantially lower than what was reported in FY 2009.

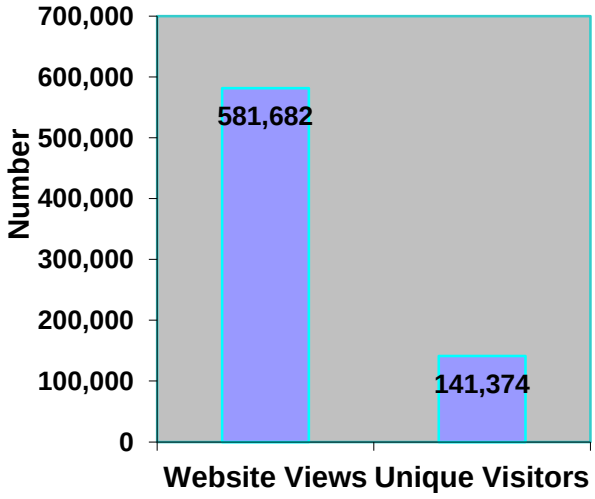

Figure 3.4. Number of Clean Energy Application Center website views and unique visitors, FY 2010

Table 3.3 shows the number and type of materials downloaded from Clean Energy Application Center websites in FY 2010. Two of the eight regional centers did not have accurate records on this, so the numbers below represent an under-counting of actual activities. For the reporting centers, the three most frequently downloaded materials were conference presentations, project profiles, and application guidebooks. The category of "other" documents consisted largely of archived materials, CHP directories, biographies, fact sheets, conference proceedings, project status reports, and meeting agendas.

Table 3.3 Downloads from Clean Energy Application Center websites, FY 2010

Type of material	Number of downloads
Conference presentations	188,396
Project profiles	127,531
Application guidebooks	70,764
Market analyses	51,299
Tools	31,517
Technical papers	22,289
Regional roadmaps	7,590
Other documents	377,102
Total	876,488

The total number of downloads was much greater in FY 2010 than in 2009, with large increases for conference presentations, project profiles, and other documents.

3.8. INVOLVEMENT IN STATE ENERGY OFFICE ACTIVITIES

Six Clean Energy Application Centers reported being involved in a total of 32 specific clean-energy related State Energy Office (SEO) activities, as compared to nine such activities in 2009. Approximately half of the FY 2010 activities had to do with CHP alone and about a third dealt with all three types of clean energy with which the centers are involved: CHP, district energy, and waste heat recovery. The specific types of SEO activities supported by the centers included: promoting specific legislation; providing assistance to policy makers; giving technical assistance to end-users; providing outreach to potential users of clean energy technologies; and hosting meetings on various clean energy-related topics.

4. OUTREACH MATERIALS PRODUCED

A wide variety of outreach materials were developed by the Clean Energy Application Centers in FY 2010 to help encourage and facilitate the use of clean energy technologies. As shown in Table 4.1, those materials consisted of: fact sheets; newsletters; project profiles; market analyses and databases; regional roadmaps and state action plans; technical papers; and application guidebooks. The total number of outreach materials produced in FY 2010 was almost double that of the previous year, with large increases in the number of fact sheets and newsletters. Each type of outreach material is discussed briefly in its own separate section, below.

Table 4.1 Outreach materials produced by Clean Energy Application Centers, FY 2010

Type of material	Number produced
Fact sheets	36
Newsletters	22
Project profiles	15
Market analyses and databases	11
Regional roadmaps/State action plans	7
Technical papers	7
Application guidebooks	2

4.1. FACT SHEETS

Three of the regional Clean Energy Application Centers reported developing a total of 36 fact sheets. About two-thirds of those fact sheets dealt with clean energy applications for all end use sectors, with the remainder focusing on the industrial and commercial sectors.

4.2. NEWSLETTERS

In FY 2010, three Clean Energy Application Centers produced 22 different newsletters, which were sent to a total of more than 35,000 recipients (Figure 4.1). More than half of the newsletters provided announcements of workshops, webinars, or training sessions, and a substantial number also addressed clean energy regulations and legislation. Other common topics were clean energy policy, funding opportunities, financial incentives, and market conditions.

4.3. PROJECT PROFILES

Five of the eight regional centers developed a total of 15 project profiles or case studies in FY 2010. Most of them focused on manufacturing facilities or some other type of industrial application, while a few addressed clean energy use by universities and colleges.

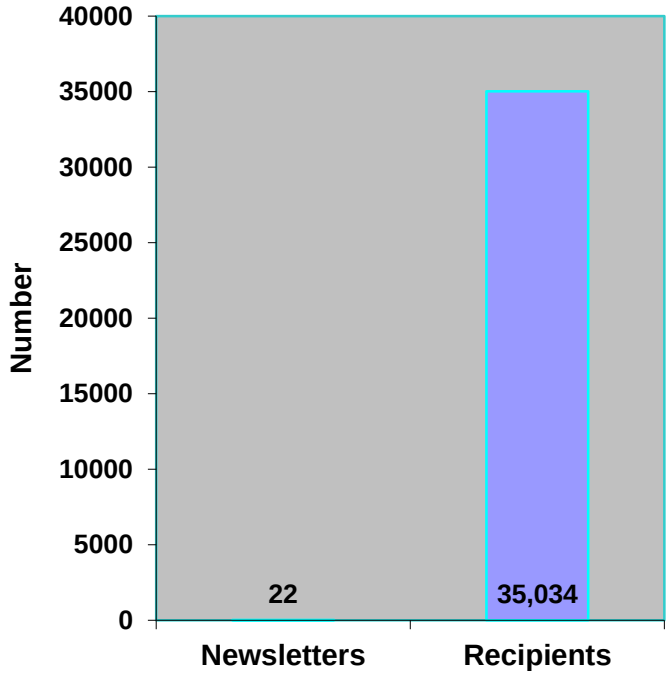

Figure 4.1. Number of newsletters and recipients, FY 2010

4.4. MARKET ANALYSES AND DATABASES

Five of the regional Clean Energy Application Centers produced a total of 10 market analyses and another center developed its own market database. A number of the market analyses focused broadly on all major end-use sectors, while others addressed specific areas, most commonly commercial facilities and hospitals/health care. The one market database that was developed dealt with the industrial sector.

4.5. REGIONAL ROADMAPS/STATE ACTION PLANS

In FY 2010, four Clean Energy Application Centers produced a total of seven regional roadmaps and state action plans to help guide the development of clean energy applications in their respective regions.

4.6. TECHNICAL PAPERS

Altogether, four Clean Energy Application Centers wrote seven technical papers addressing a variety of topics. The most common subjects were the use of biomass fuels, financial incentives, pricing, and resources for implementation and evaluation.

4.7. APPLICATION GUIDEBOOKS

In FY 2010, a single Clean Energy Application Center produced two application guidebooks, focusing on clean energy use in hospitals, universities, and government buildings.

5. POLICY-RELATED ACTIVITIES AND POLICIES ENACTED

During the 2010 fiscal year, the Clean Energy Application Centers engaged in a variety of policy-related activities to support the enactment of regulations and statutes that facilitate clean energy technology use. The centers held a number of policy-related workshops and meetings and also engaged in a substantial number of other communications addressing key policy issues. Those center activities, as well as the specific policies enacted by the state during this study period, are described in more detail below.

5.1. WORKSHOPS/MEETINGS

All eight regional Clean Energy Application Centers sponsored policy-related workshops in FY 2010. As shown in Figure 5.1, 15 such workshops were reported, with a total of 683 attendees. Almost every workshop provided an overview of clean energy technologies and policy options as well as addressing specific policy options such as emissions rules, permitting issues, and incentive programs.

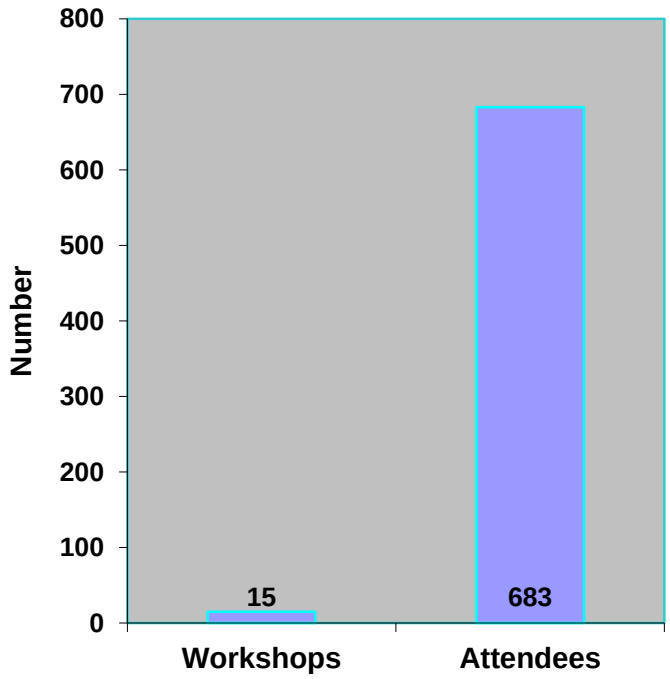

Figure 5.1. Number of policy-related workshops and attendees, FY 2010

The Clean Energy Application Centers were asked to report the number and type of key public officials attending their policy-related workshops in FY 2010. As shown in Table 5.1, the most common attendees reported by the centers were State Energy Office directors or staff, state legislators or their staff, and Public Utility Commissioners or staff. It should be noted that only five of the centers provided data on the types of attendees at their policy-related workshops, so the numbers presented in Table 5.1 are probably low.

Table 5.1 Type and number of selected attendees at the Clean Energy Application Centers' policy-related workshops, FY 2010

Type of attendee	Number
State energy office director or staff	10
State legislator or staff	7
PUC commissioner or staff	6
Governor, lieutenant governor, or staff	3
Regional EPA staff	2
State environmental official	2

The Clean Energy Application Centers held substantially more policy-related meetings than workshops in FY 2010. Altogether, the eight regional centers reported a total of 116 policy-related meetings in that year with 1,048 attendees (see Figure 5.2). The most common topics were an overview of clean energy policy options and various specific policies such as energy efficiency resource standards, incentive programs, and interconnection rules.

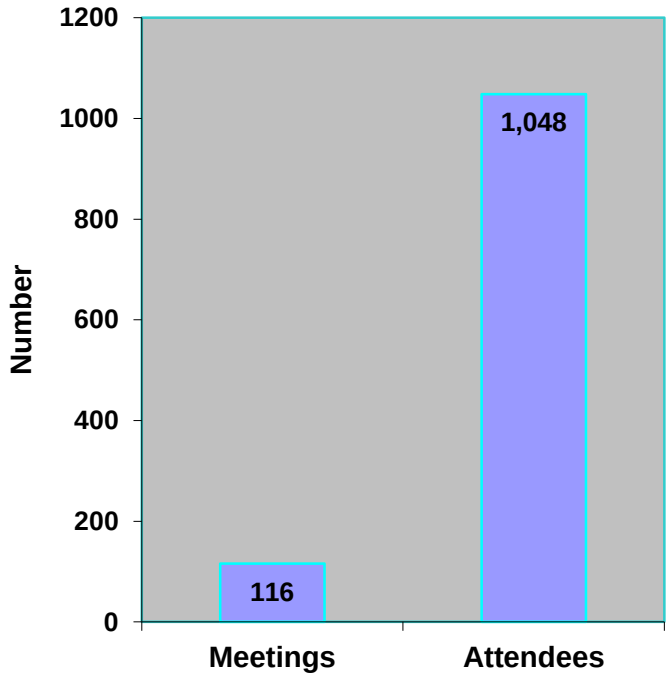

Figure 5. 2. Number of policy-related meetings and attendees, FY 2010

Table 5.2 shows that the most common attendees at policy-related meetings were: State Energy Office directors or staff; Public Utility Commissioners or staff; representatives of the governor's or lieutenant governor's office; and state environmental officials. Four centers reported the presence of very high ranking public officials at some of their meetings. The attendees in question include PUC chairmen and commissioners, members of the state House of Representatives and Senate, a lieutenant governor, and a member of the U.S. House of Representatives.

Table 5.2 Type and number of selected attendees at the Clean Energy Application Centers' policy-related meetings, FY 2010

Type of attendee	Number
State energy office director or staff	57
PUC commissioner or staff	53
Governor, lieutenant governor, or staff	46
State environmental official	37
U.S. senator, representative, or staff	14
State legislator or staff	13
Regional EPA staff	2
Other key official	4

There were about twice as many policy-related workshops and meetings in FY 2010 as there were in 2009.

5.2. POLICY-RELATED COMMUNICATIONS

In FY 2010, the Clean Energy Application Centers addressed policy issues through a number of channels in addition to the workshops and meetings described above. All eight regional centers reported engaging in at least some of these additional policy-related communications, which include e-mail, conference calls, individual phone calls, comments, recommendations, white papers, and testimony (see Table 5.3). The most common topics addressed were specific policy options, followed by an overview of possible clean energy policy options. The total number of policy-related communications was many times greater in FY 2010 than in 2009.

Table 5.3 Type and number of policy-related communications, FY 2010

Type of communication	Number
E-mail	35,160
Conference call	1,544
Phone calls	121
Comments	22
Recommendations	20
White paper	18
Testimony	11
Other	52
Total	36,948

5.3. POLICIES ENACTED

Figure 5.3 shows the number and type of clean energy-related rules, standards, and other policy instruments implemented by the states in FY 2010. The figure shows both "new" policies that were put in place for the first time as well as "improved" policies that upgraded existing policies on the same topic. The most common subjects addressed were loan and grant programs, tax credits, renewable portfolio standards, interconnection rules, and incentives. However, as shown in Figure 5.3, a large number of other types of policies were also enacted by the states in the 2010 fiscal year. In total, 55 separate policies were enacted: 24 new ones and 31 improvements to existing policies. This represents nearly twice as much activity as took place in FY 2009.

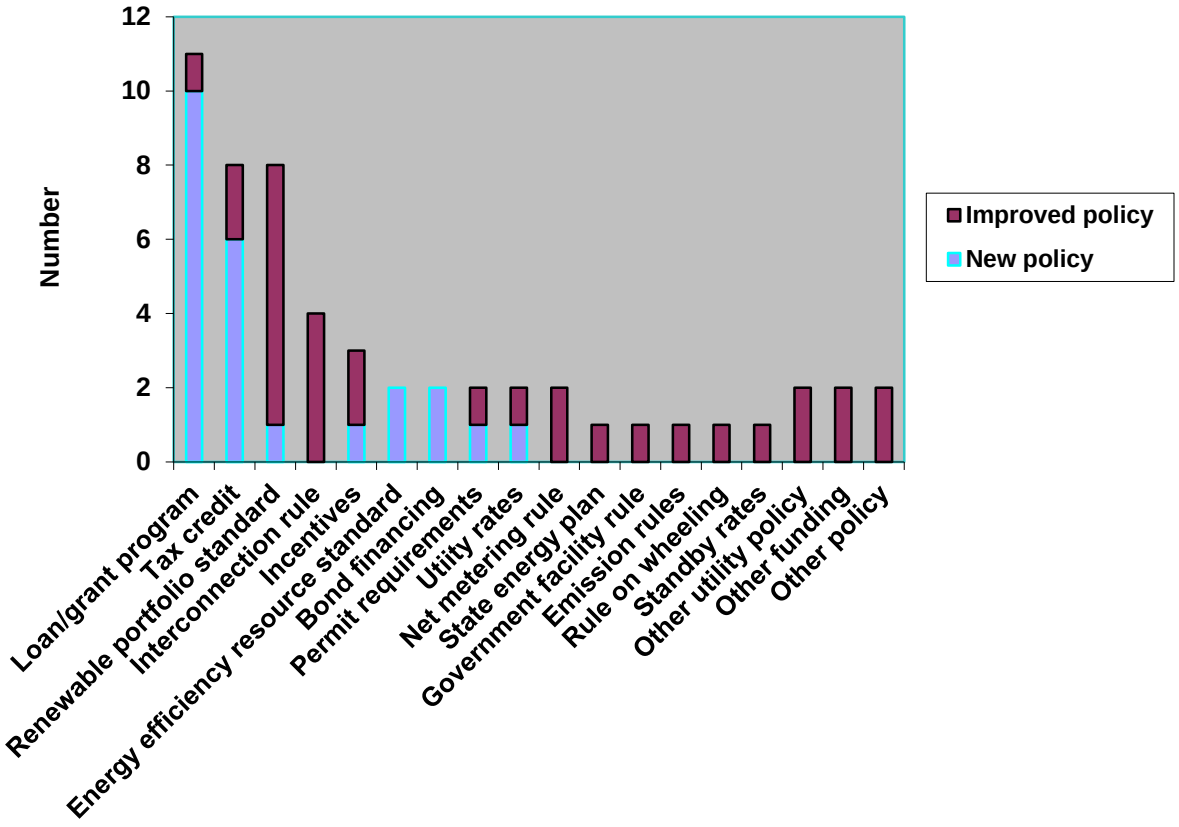

Figure 5.3. Number and type of policies enacted, FY 2010

6. TECHNICAL ASSISTANCE AND RESULTS

All of the regional Clean Energy Application Centers provide project-specific technical assistance to current and prospective users of clean energy technologies. This assistance falls into two broad categories: (1) technical site evaluations and (2) other technical support contacts such as government/utility funding information and financial/business advice. The assistance provided in each of these general areas is discussed separately below.

6.1. TECHNICAL SITE EVALUATIONS AND ASSOCIATED PROJECTS

Table 6.1 shows the number of technical site evaluations of all kinds performed in FY 2010. It also displays the number and megawatt (MW) capacity of all clean energy projects that were recommended, under consideration, under development, or newly on-line in FY 2010 following evaluations done that year or in a previous one. Because the project life cycle for clean energy installations is often three to five years, there can be a substantial time lag from when a technical site evaluation is performed until a project finally goes online.

Table 6.1 Technical site evaluations and associated projects and capacity, FY 2010

Project status	Number	Clean energy capacity (in MW)
Technical site evaluation performed	82	---
Project recommended following technical site evaluation	36	224.0
Project under consideration following technical site evaluation	28	179.2
Project under development following technical site evaluation	25	38.6
Project online following technical site Evaluation	6	2.9

In FY 2010, 82 technical site evaluations were performed by all eight regional Clean Energy Application Centers combined. Fifty-two of them were Level 1 evaluations (screening analysis), 29 were Level 2 (conceptual/financial analysis), and one was Level 3 (investment-grade engineering analysis). About three-fourths of those evaluations were for CHP facilities alone, about one-eighth of them were for waste heat recovery projects, and the remainder was for district energy projects alone or for CHP in conjunction with district energy or waste heat recovery. The most common market sectors addressed were food processing, manufacturing, and hospitals/health care.

Thirty-six clean energy projects with a combined capacity of 224 MW were recommended in the 2010 fiscal year, following site evaluations performed then or in a previous year. Twenty-eight projects with a total capacity of 179.2 MW were under consideration in FY 2010 and 25 projects with 38.6 MW of capacity were under development in the same year. Finally, six clean energy projects with a capacity of 2.9 MW went online in FY 2010, following previously-performed technical site evaluations. Of those 95 projects, 73 were CHP alone, 11 were CHP in conjunction with district energy or waste heat recovery, 8 were waste heat recovery by itself, and 3 were district energy alone. The most common market sectors addressed were manufacturing, government buildings, hospitals/health care facilities, food processing, offices, waste water treatment facilities, and schools.

The numbers of site evaluations performed, projects recommended, and projects under consideration were all greater in FY 2010 than in 2009, as was the capacity associated with those projects. However, the number of projects under development was down slightly and the capacity represented by those projects was substantially less than in the previous year.

6.2. TECHNICAL SUPPORT CONTACTS AND ASSOCIATED PROJECTS

As shown in Figure 6.1, many different types of technical support were provided by the Clean Energy Application Centers in support of the project design and development process in FY 2010. By far the most frequent type of support provided was telephone or email advice, followed by "other" technical support, government or utility funding information, regulatory advice, financial or business advice, system and equipment advice, meetings with key parties, design assistance, vendor information, and power calculation assistance. Altogether, 3,305 technical support contacts of all kinds were provided by the centers, which is essentially the same as in the previous year. Some of the most common types of support falling in the "other" category were addressing interconnection and permitting issues, addressing clean energy basics and benefits questions, helping with feasibility studies and technical presentations, providing economic advice, and assessing a project's carbon footprint.

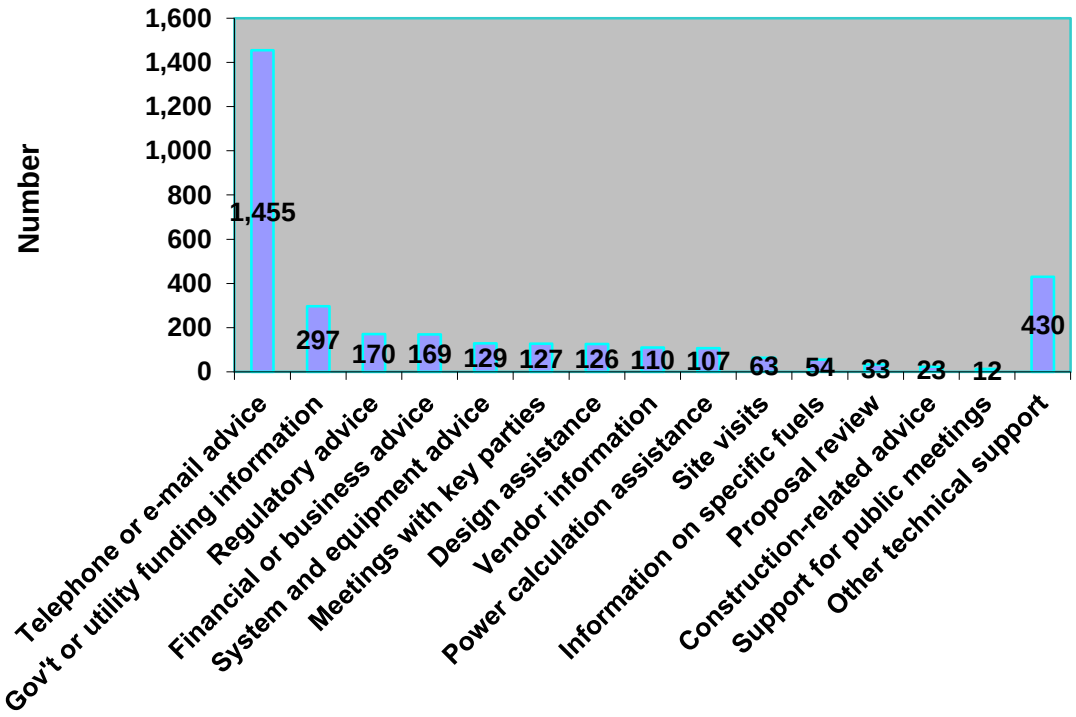

Figure 6.1. Number and type of technical support contacts, FY 2010

As shown in Table 6.2, 29 clean energy projects with a combined capacity of 83.1 MW were under consideration in FY 2010 following technical support provided by the Clean Energy Application Centers in that or a previous year. Forty-eight projects with 471.9 MW of capacity were under development in that same year. Finally, 10 projects with 384.5 MW of capacity went online in FY 2010, following technical support provided previously by the Clean Energy Application Centers. Of these 87 projects: 56

were CHP alone; 11 were CHP in conjunction with district energy, waste heat recovery, or both; 9 were district energy alone; 9 were waste heat recovery only; and 2 were unspecified. The most common market sectors addressed were general industry, forest products, universities/colleges, animal and dairy farms, and hospitals/health care.

Table 6.2 Projects and capacity associated with technical support contacts, FY 2010

Project status	Number	Clean energy capacity (in MW)
Project under consideration following technical support	29	83.1
Project under development following technical support	48	471.9
Project online following technical support	10	384.5

The numbers of projects under consideration and development following center-provided technical support were substantially greater in FY 2010 than in 2009, but the capacity associated with projects under consideration was lower than in the previous year.

Summing the numbers for technical site evaluations *and* other technical support shows that 57 clean energy projects with 262.4 MW of capacity were under consideration, 73 projects with 510.5 MW of capacity were under development, and 16 projects with 387.4 MW of capacity went online in FY 2010 following technical assistance provided by the Clean Energy Application Centers. Overall, there were many more projects under consideration and development in FY 2010 than in 2009. The capacity associated with projects under consideration was less in 2010 than in 2009 but the amount of capacity under development in 2010 exceeded that of the previous year.

7. CHP AND DISTRICT ENERGY INSTALLATIONS

While the previous chapters focused on specific activities undertaken by the Clean Energy Application Centers, as reported by the centers themselves, this chapter provides a description of CHP and district energy installations nationwide without attempting to link them to the centers' undertakings. The information gathered on CHP can help track progress toward realizing the vision of generating 20 percent of U.S. electricity with CHP by 2030, which would involve increasing installed capacity to 241 gigawatts (U.S. Department of Energy 2009). Although it is probable that actions taken by the Clean Energy Application Centers over the years have influenced CHP and district energy installations, this study was not designed to establish and quantify a causal relationship between center activities and the scope of clean energy development.

A national database of CHP facilities is maintained by ICF International for DOE (ICF International 2011). That database provides an inventory of CHP installations in every state, containing basic information on each facility such as location, operational capacity, system type, application, and fuel. It tracks installations by calendar year (January through December) as opposed to the federal fiscal year (October through September) for which the Clean Energy Application Centers report their activities. ICF has also developed estimates of the dollar investment, energy savings, carbon emissions reductions, and job creation associated with each CHP installation.

The International District Energy Association has developed a database of district energy facilities throughout the U.S. (IDEA 2011). About half of the systems contained in that database have a CHP component in addition to a district energy element. The other half of the district energy systems are either district heating or district cooling alone or the two types of systems operating in tandem. The database provides essential information on the installations such as their location, thermal capacity (in terms of steam, hot water, and chilled water), cogeneration capacity, fuel type, and application (e.g., university, health care facility, downtown area). For many facilities, the district energy database also shows the first year of plant operations and the first year of cogeneration operations (where applicable).

Descriptions of CHP installations and district energy facilities taken from the above-mentioned databases are discussed in separate sections below.

7.1. CHP INSTALLATIONS

As shown in Table 7.1, 105 CHP facilities with a combined capacity of just over 560 MW were installed in the U.S. in calendar year (CY) 2010. These are facilities that have been completed and are operational, and do not include projects that are currently under development. Three of the CHP systems that went online in 2010 were developed in conjunction with district energy systems. These CHP/district energy systems accounted for 56 MW, or about 10%, of the total capacity installed in 2010.

Table 7.1 Description of CHP installations in U.S., CY 2010

Number of installations	CHP capacity installed (MW)	Investment in CHP installations (million $)	Annual energy savings (million source BTUs)	Annual Carbon reduction (metric tons)
105	561	841.4	18,187,808	2,184,932

The facilities described in Table 7.1 are located in 26 different states within the geographic area served by all eight regional Clean Energy Application Centers. The number of installations and their capacity were slightly greater in CY 2010 than in the previous year.

The estimated investment associated with the 105 CHP systems installed in CY 2010 is a little more than $840 million, based on the average capital cost for mid-sized CHP systems of $1,500 per kW (ICF International 2008). A recent ORNL report (Shipley et al. 2008) noted that four jobs are created for every $1 million of capital investment in CHP facilities. Accordingly, the 2010 investment in CHP facilities described here can be expected to create nearly 3,400 new jobs.

CHP systems can save substantial amounts of energy compared to more traditional technologies by utilizing the thermal energy that is normally wasted when electricity is produced at central generating stations. Also, by locating CHP facilities at or near the point of consumption, electric transmission and distribution losses can be greatly reduced (Shipley et al. 2008). It is estimated that over 18 trillion source BTUs were saved by the 105 CHP facilities installed in the U.S. in CY 2010. That number was calculated using typical hours of operation, power-to-heat ratio, and heat rate for each new installation, based on its system type and application (ICF International 2008).

The energy savings described above are associated with a reduction in carbon emissions. Based on average CO_2 emission rates for the displaced fuels in each state (ICF International 2008), the *CHP Installation Database* (ICF International 2011) calculated the magnitude of the carbon reduction. As shown in Table 7.1, it is estimated that annual carbon emissions were reduced by nearly 2.2 metric tons as a result of the 2010 CHP installations.

7.2. DISTRICT ENERGY FACILITIES

Unlike the information given above on CHP facilities, which is only for systems installed in 2010, the data presented in this section on district energy facilities describes *all* district energy systems in operation in the U.S. as of this writing. This approach is taken because system start-up dates are not available for nearly a third of the cases and very few of the plants for which we *do* have data came online in 2010. Rather than limit this discussion to a very small portion of the district energy population, it makes sense to provide a fuller picture and include all existing district energy systems. As shown in Table 7.2, 627 such systems are currently operating in the U.S., possessing very substantial thermal and cogeneration capacity. The electric generating capacity alone is nearly 9,300 MW.

Table 7.2 Description of all district energy facilities in U.S. as of June 2011

Number of facilities	Thermal capacity – steam (lbs./hr.)	Thermal capacity – hot water (million Btu/hr.)	Thermal capacity – chilled water (tons)	Cogeneration capacity (MW)
627	180,084,607	7,653	3,833,317	9,294

District energy systems are present in all 50 states and the District of Columbia. Of the 627 systems currently in operation, 333 of them are some combination of CHP, district heating, and district cooling. Another 199 systems have both district heating and district cooling systems in place, but no CHP. Seventy-eight systems have district heating only and 17 have only district cooling. It is important to note that slightly over half of the district energy systems described in Table 7.2 have a CHP component, so much of the capacity shown there can also be credited to CHP facilities.

Existing district energy systems that currently provide only heating and/or cooling, without CHP, are strong near-term candidates for the adoption of large scale CHP due to the magnitude of their aggregated thermal load. Currently there are 294 such thermal-only district energy systems operating in virtually every state in the nation. Two hundred twenty of them are located at colleges and universities, 52 are characterized as "downtown/utility" systems, and most of the remainder serve airports and health care facilities. Between them, these 294 district energy systems have a thermal capacity of over 55 million pounds per hour of steam, 5.5 billion BTUs per hour of hot water, and nearly 2 million tons of chilled water. Two recent examples of thermal-only district energy systems that evolved into large CHP systems are a 48 MW system that went online at a health care facility in 2010 and a 50 MW system that was deployed at a university in 2011.

8. SUMMARY AND RECOMMENDATIONS

8.1. SUMMARY OF FINDINGS

The following key elements of the Clean Energy Application Centers' FY 2010 activities and associated events were discussed in the previous chapters: education and outreach activities; outreach materials produced; policy-related activities and policies enacted; and technical assistance and associated projects. In addition, CHP installations made in calendar year 2010 were described along with the current population of district energy systems. Brief highlights from each of those broad areas are presented below.

A large number of different education and outreach activities were carried out by the Clean Energy Application Centers to inform potential end-users, policy-makers, and other stakeholders about the benefits and applications of clean energy technologies. These include: targeted workshops, webinars, and training sessions; conferences; partnership meetings; college courses; media interviews; e-mail blasts; website activity; and involvement in State Energy Office activities. In fiscal year 2010, the Clean Energy Application Centers hosted 67 targeted workshops, webinars, and training sessions with a total of nearly 1,300 targeted attendees and almost 3,200 attendees in total. Most of those events addressed CHP technologies alone or in conjunction with other clean energy technologies, but some focused on either district energy or waste heat recovery alone. The most common topics addressed were clean energy fundamentals, clean energy opportunities, and clean energy policy. The Clean Energy Application Centers also helped plan 21 conferences involving more than 4,800 participants, led 11 conferences, sponsored 16 conference booths, and made more than 30 conference presentations for almost 3,300 attendees. The most common targeted sectors included: commercial facilities; general industry; architects and engineers; agricultural applications (including animal and dairy farms); and colleges/universities. The centers were involved in 77 partnership meetings involving nearly 900 participants and conducted three college courses. In addition, Clean Energy Application Center websites hosted more than 140,000 unique visitors who downloaded more than 876,000 items. The three most frequently downloaded materials were conference presentations, project profiles, and application guidebooks. In general, most of the centers' education and outreach activities increased in number from FY 2009 to 2010. The greatest growth reported was for e-mail blast recipients, downloads from center websites, and involvement in State Energy Office activities, while the most notable decline was in the number of website views.

In FY 2010, the Clean Energy Application Centers also produced a broad array of outreach materials related to the use of clean energy technologies. Those materials included 36 fact sheets, 22 newsletters, 15 project profiles, and 11 market analyses and databases. In total, the number of materials produced in FY 2010 was nearly double the number from 2009.

In addition to the targeted workshops and webinars mentioned above, the Clean Energy Application Centers held 15 policy-related workshops and 116 policy-related meetings in FY 2010 with a total of more than 1,700 attendees. The most common topics addressed were an overview of clean energy policy options and specific policies such as emissions rules, energy efficiency resource standards, and incentive programs. The centers also engaged in a wide variety of policy-related communications such as e-mails, conference calls, individual phone calls, and the issuing of comments, recommendations, and white papers. During this same period, a number of clean energy-related rules, standards, and other policy

instruments were implemented by various states; these included new policies that were put in place for the first time as well as improvements to existing policies. The most common subjects addressed were loan and grant programs, tax credits, renewable portfolio standards, interconnection rules, and incentives. Altogether, 24 new and 31 improved policies were enacted by the states in FY 2010. From FY 2009 to 2010, the number of policy-related activities carried out by the centers increased substantially, as did the number of clean energy-related policies enacted by the states.

The Clean Energy Application Centers reported performing 82 technical site evaluations and making just over 3,300 other technical support contacts of various types in FY 2010. Altogether, 57 clean energy projects with 262 MW of capacity were under consideration, 73 projects with just over 510 MW of capacity were under development, and 16 projects with 387 MW of capacity went online in FY 2010 following technical assistance efforts provided by the Clean Energy Application Centers in that or a previous year. Of those 146 projects, about two-thirds were CHP alone, approximately one in nine were CHP in conjunction with district energy or waste heat recovery, another one in nine were waste heat recovery by itself, and about one-twelfth were district energy alone. Overall, there were more projects under consideration and development, with a greater combined capacity, in FY 2010 than in the previous year.

In 2010, 105 CHP systems were installed in the U.S. with just over 560 MW of total capacity. This is slightly greater than the number and capacity of installations made in 2009. Three of the systems that went online in 2010, accounting for about 10% of total installed capacity, were developed in conjunction with district energy systems. It is estimated that a little more than $840 million was invested in the 2010 projects and that they resulted in annual energy savings of more than 18 trillion source BTUs and carbon emissions reductions of nearly 2.2 million metric tons. Based on the aforementioned capital investment, it is estimated that nearly 3,400 new jobs were created. While it is likely that the Clean Energy Center activities detailed in this report influenced those outcomes, this study was not designed to establish and quantify a causal relationship between center activities and CHP installations.

As of this writing, 627 district energy systems are operating in the U.S., possessing very substantial thermal and cogeneration capacity. For those systems combined, the electric generating capacity alone is nearly 9,300 MW. Of those 627 systems, a little more than half are some combination of CHP, district heating, and district cooling. Slightly fewer than one in three have both district heating and district cooling systems in place, but no CHP. About one in eight provide district heating only and one in 37 provide district cooling only. Existing district energy systems that currently provide only heating and/or cooling, without CHP, are strong near-term candidates for the adoption of large scale CHP due to the magnitude of their aggregated thermal load. In two recent cases, a combined total of nearly 100 MW of electric generating capacity was developed in conjunction with district energy systems that had formerly provided thermal energy only.

8.2. RECOMMENDATIONS

This study, like those performed previously, was designed to catalogue Clean Energy Application Center activities and not to establish how they influenced the installation of clean energy systems. Accordingly, our ability to make recommendations about future program operations is limited because we do not have quantitative findings regarding how specific center activities affect the adoption of clean energy technologies. As in the last two reports, we do suggest that each Clean Energy Application Center consider the feedback it has received from its region's stakeholders concerning the services provided and make near-term decisions based on that input. The establishment of a nationally-coordinated effort to solicit input from stakeholder groups regarding desired services could facilitate the collection of information on the needs of the Clean Energy Application Centers' constituents.

Future studies to explore possible relationships between Clean Energy Application Center activities and key outcomes could be helpful in informing management decisions about center operations. Specifically, we recommend that studies be undertaken to test for possible relationships between: (1) the centers' targeted education/outreach activities and the adoption of clean energy technologies; (2) the centers' policy-related activities and state policies enacted; and (3) state policies enacted and the implementation of CHP, district energy, and waste heat recovery projects. The findings generated by these studies will help quantify the effects of center-sponsored activities and achievements. This information should prove helpful to policy-makers and center managers in deciding what types of efforts to support and services to provide in the future.

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