Federal Strategies to Increase the Implementation of Combined Heat and Power Technologies in the United States

John (Skip) Laitner, U.S. Environmental Protection Agency
William Parks, U.S. Department of Energy
Jennifer Schilling, Energetics, Inc.
Richard Scheer, Energetics, Inc.

ABSTRACT

Recent interest in combined heat and power (CHP) is providing momentum to efforts aimed at increasing the capacity of this highly-efficient technology. Factors driving this increase in interest include the need to increase the efficiency of the nation's electricity generation infrastructure, DOE Assistant Secretary Dan Reicher's challenge to double the capacity of CHP by 2010, the success of DOE's Advanced Turbine Systems Program in supporting ultra-efficient CHP technologies, and the necessity of finding cost-effective solutions to address climate change and air quality issues.

The federal government is committed to increasing the penetration of CHP technologies in the United States. The ultimate goal is to build a competitive market for CHP in which policies and regulations support the implementation of a full suite of technologies for multiple applications. Specific actions underway at the federal level include technology strategies to improve CHP data collection and assessment and work with industry to encourage the development of advanced CHP technologies. Policy strategies include changes to federal environmental permitting procedures, including CHP-friendly strategies in federal restructuring legislation, supporting tax credits and changes to depreciation requirements as economic incentives to CHP, working with industry to leverage resources in the development of advanced CHP technologies, educating state officials about the things they can do to encourage CHP, and increasing awareness about the benefits of CHP and the barriers limiting its increased implementation.

Introduction

As we approach the new millennium, the need for clean, efficient and low-cost electric generation technologies is leading a surge in the demand for combined heat and power (CHP) systems. Ironically, the idea of a system that generates both heat and power from a single energy resource is nothing new. In fact, at the turn of the century, many manufacturing plants operated their own CHP facilities. In the 1950's, however, many of these facilities were abandoned in favor of more convenient utility-generated electricity.

Some industries, including pulp and paper and petroleum refining operations, have continued to operate on-site CHP facilities to meet their large demand for steam. Very often they were able to use the fuel by-products from their industrial processes to drive the CHP systems. The 1978 Public Utilities Regulatory Policy Act (PURPA) gave further impetus to CHP systems with measures to encourage their increased implementation. As a result, by 1996, the United States had an estimated 51 gigawatts (GW) of installed CHP capacity, representing six percent of total electric generation capacity (EIA 1998). The majority of current CHP systems are used in large industrial

applications. Until very recently, most analysts predicted that CHP capacity would continue to grow at very modest levels. At most, their projections indicated that only another 6 GW of CHP capacity would be added by 2010 (EIA 1998). A new study supported by the Environmental Protection Agency (EPA) indicates otherwise — perhaps reflecting a more accurate profile of the many recent developments in CHP technologies. The EPA analysis suggests that by 2010, CHP capacity could increase by about 31 GW (EPA 1999). This finding supports the conclusion of a group of experts convened by the Department of Energy (DOE) and EPA in 1997 to develop a consensus on the achievable potential for CHP in 2010 (EIA 1998).[1] The result of this panel review indicated that the market potential for CHP could easily double the forecasted capacity by 2010 (DOE 1997).

One of the most compelling drivers for this renewed interest in CHP technology is a desire to improve the efficiency of power generation in the United States. Conventional electricity generation converts only about a third of the fuel's potential energy into useable electricity. The amount of waste heat from our power plants (approximately 23.6 quads) is greater than Japan's total energy use, which totals about 21.4 quads. It is also greater than the total energy consumed in both Central and South America and the Middle East, about 17.7 and 14.6 quads, respectively (Laitner, 1998a). More importantly, however, this level of efficiency has not improved since the 1960's, as seen in figure 1 below (EIA 1996). By comparison, CHP systems can reach total efficiency levels of 60-80 percent or greater. The higher levels depend on how well the electric and thermal needs are balanced. Clearly, CHP systems offer a huge opportunity to improve the efficiency of the nation's electricity generation infrastructure.

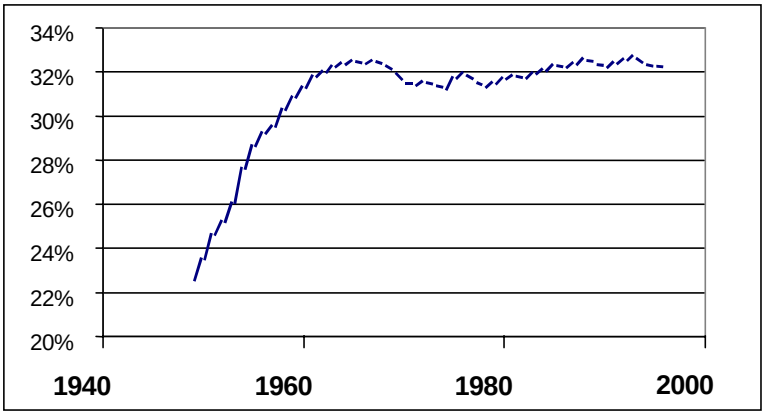

Figure 1. Stagnant Fossil Electric Generating Efficiency (At Plant, Without T&D)

On December 1, 1998, Dan Reicher, DOE's Assistant Secretary for Energy Efficiency and Renewable Energy added further momentum to the recent drive for CHP when he issued a challenge

1. The panel of experts included Steve Bernow, Tellus Institute; Joel Bluestein, Energy and Environment Analysis; Peter Carroll, Solar Turbines; Keith Davidson, Onsite Energy; Neal Elliott, ACEEE; Mark Hall, Trigen; Tina Kaarsberg, Northeast Midwest Institute; Skip Laitner and Joe Bryson, EPA; Mark Spurr, International District Energy Association; and John Atcheson, David Bassett, and Bill Parks, DOE.

to the U.S. CHP industry, calling for a doubling of the capacity of power generated with CHP by 2010. According to Assistant Secretary Reicher, "Other goals will call attention to the role of combined heat and power in reducing air pollution by 40 million metric tons of carbon — the equivalent of eliminating 40 million cars from U.S. roadways — and helping to improve local economic development" (DOE 1998). Members of Congress and representatives of EPA's Office of Air and Radiation have also proclaimed their support for CHP.

Recent technology advances have been another major driver fueling interest in CHP. Improvements to existing technologies such as boilers and steam turbines have greatly expanded the range of cost-effective CHP applications. A major force supporting these developments has been DOE's Advanced Turbine Systems (ATS) Program. The goal of the ATS Program is to complete the development and demonstration of ultra-high efficiency natural gas turbine systems. The ATS initiative will benefit electric utilities, independent power producers, and industrial end users. In fact, improved ATS technologies have already led to the development of CHP systems with ultra-high efficiency and low nitrogen oxide (NO_x) emissions.

One final driver generating interest in CHP is growing concern over climate change. Carbon dioxide, an emission of fossil fuel combustion, is the most significant "greenhouse gas" contributing to global warming. With their inherent efficiencies, CHP technologies can play a pivotal role in any strategy that seeks cost-effective carbon emission reductions. The current availability of reliable, low-cost CHP technologies makes CHP an excellent opportunity for early reductions in domestic carbon emissions. The projected 31 GW increase in CHP capacity by 2010, for instance, will result in a carbon emission reduction of 14 million metric tons (EPA 1999). Moreover, the nation's response to climate change will take place within the context of its effort to support pollution prevention at all levels. For example, according to the Pollution Prevention Act of 1990, it is the policy of the United States that pollution should be prevented or reduced at the source whenever feasible. By increasing overall energy efficiency, CHP systems will clearly contribute to pollution prevention.

Federal Strategies for CHP

The federal government is committed to increasing the penetration of CHP technologies in the United States. In this effort, the administration is following the lead of President Clinton who, in October 1997, stated that, "today, two-thirds of the energy used to provide electricity is wasted. We can do much, much better" (Clinton 1997). The ultimate goal is to build a competitive market for CHP in which policies and regulations support the implementation of a full suite of technologies for multiple applications.

Technology Strategies

Data collection and assessment. The availability of reliable data on CHP systems is an essential component of the nation's CHP strategy. First, we must understand where we are today in terms of total capacity and use by application and technology. Second, we must assess this data to gain a better understanding of the potential for CHP in various markets and set targets for future market gains. Effective use of data can also help increase awareness about CHP and the opportunities it presents.

Currently, CHP data is collected through independent efforts by multiple federal and state

agencies and private organizations. The largest collection effort is conducted by DOE's Energy Information Agency in two separate mechanisms. The first is an annual survey of non-utility generators with electricity generation capacities greater than 1 Megawatt (MW). The second is a survey of sample manufacturers conducted every four years. Two industry associations, the Edison Electric Institute and the Gas Research Institute and a number of private organizations also collect limited CHP data. The federal government has an important role to play in coordinating and documenting the various data collection efforts. This will ensure that all necessary data is collected in the most efficient and credible manner possible.

Supporting CHP Technologies. The federal government is committed to working with industry partners to support research and development in advanced technologies with the potential for significant national benefits. With respect to CHP, the government's largest effort to date has been DOE's ATS Program. The program's objectives are to boost system efficiency to 60 percent or greater for utility combined cycle systems and achieve a 15 percent improvement in existing industrial systems, reduce the cost of electricity by 10 percent compared to conventional systems, increase fuel flexibility and NO_x emissions to less than 10 parts per million (ppm). In 1998, the ATS Program budget was $700 million, supplemented by $450 million in industry cost-share contributions. These resources have resulted in the development of improved turbines that will produce annual energy savings of 0.4 quads in 2010 (DOE 1999a). These machines offer the potential for ultra-efficient power generation when used in CHP applications. Currently, two demonstration sites of ATS-supported technologies are CHP systems. Efforts are currently underway to expand the scope of the ATS program by incorporating microturbine technology. The Office of Industrial Technologies is also working with other DOE offices and industry partners to explore opportunities for supporting the development of reciprocating engines and fuel cells for industrial distributed generation applications.

ATS Case study. Rochelle Municipal Utilities (RMU) is a power, water and steam utility located about 75 miles west of Illinois. In the early 1990's, RMU was confronted with increased electricity demand from new and existing industrial customers. At the same time, transmission constraints and an aging generation infrastructure required a system upgrade. For that reason, the utility began exploring the option of upgrading its facilities with distributed resources. It was about this time that RMU first heard about DOE's ATS Program. In particular, RMU learned that the Department and its industry partner Solar Turbines were looking for a demonstration site for the highly efficient Mercury 50 turbine developed as a part of the ATS Program. In 1998, RMU decided to take them up on their offer. Scheduled to be installed in mid-1999, the 4.2 MW Mercury 50 turbine will be sited near RMU's largest industrial customer, a Hormel meat packing plant. The system will be able to provide peak power during periods of high demand. It will be available to supply power to Hormel and its other industrial neighbors in the event of a power outage. The utility will derive even greater benefit from the new turbine when it connects it to existing equipment in order to generate process steam for sale to Hormel and its neighbors. It is estimated that the combined system will be 80 percent efficient. Just as important, NO_x emissions will be reduced to less than 9 parts per million of heat input.

Environmental Permitting Strategies

Output Based Standards. As a part of its overall pollution prevention strategy, the federal government is actively working to increase the efficiency of electricity generation in the United States. Historically, emissions have been based on the amount of fuel required as an input into the generation of electricity. Nitrogen oxide emissions, for example, might be measured as the pounds of NO_x per million Btus of heat input — regardless of the efficiency in generating the electricity. To illustrate how this standard weakens energy efficiency standards, consider two plants with equal capacity and operating conditions. The less-efficient unit will have higher emissions because it uses more fuel to produce the same amount of electricity.

One method supported by many for its effectiveness in encouraging energy efficiency improvements is the use of output-based standards. Such standards determine emissions levels based on the amount of electricity generated. In effect, output-based standards require the less-efficient unit to account for those emissions that result from the added fuel needed to produce the same amount of electricity as the more efficient power plant. These standards support improved efficiency without regard to the type of fuel or technology used to achieve that improvement. Thus, the switch to output-based standards supports the use of highly efficient CHP systems.

The federal government has expressed its commitment to output-based standards and has taken a number of steps to encourage their implementation. The Clean Air Act requires that each state develop a State Implementation Plan (SIP) detailing the steps they will take to achieve national air quality goals. The EPA has recently finalized a rulemaking known as the "SIP Call" designed to address the transport of pollutants from one state to another by requiring 22 states and the District of Columbia to submit revised SIPs which meet established individual state budgets for NO_x emissions that are substantial reductions from present levels.

As a part of the SIP Call, EPA has proposed a NO_x budget trading program that would establish a multi-state trading system for NO_x allowances that permit the holder to emit a ton of NO_x. Currently, the Agency is working with a wide range of government and industry stakeholders to develop guidance for the states instructing them on how they can use output-based standards to allocate their NO_x allowances. The EPA hopes to have a proposal developed by the middle of 1999, and a final guidance document in place by 2000 that states could then use as a basis for future allocations.

In September 1998, EPA took another step in support of output based standards by issuing a revision of the New Source Performance Standards (NSPS) for NO_x emissions from new utility and industrial steam generators. Required by the Clean Air Act, NSPS ensures that emissions from newly built or reconstructed facilities meet strict limits. The new standards lower the acceptable NO_x emissions levels from utility and industrial boilers to reflect the availability of improved emissions reduction technologies. When issuing the new standards, the Agency decided to require output-based standards as a way to promote energy efficiency and pollution prevention.

Clean High-Efficiency Technology Standards. Analysts in the federal government are also exploring the development of a Clean High-Efficiency Technology (CHET) standard or its equivalent. This would be a new mechanism to encourage the implementation of small-scale CHP systems (Laitner 1998b). As currently conceived, a CHET standard would be applied to turnkey small-scale CHP systems at the manufacturing level. If such a standard were adopted, and once the manufacturer had proven that its product met the resulting performance benchmarks, the company

would be allowed to install the system without the facility needing to obtain additional environmental permits. In effect, it would be assumed that the CHP system met all best available control technology requirements. Possible CHET standards include 60 percent system efficiency, NO_x emissions of less than 0.3 pounds per megawatt-hour (MWh), sulfur dioxide emissions less than 2.5 pounds per MWh, and carbon emissions less than 210 pounds per MWh. All emission rates are expressed as pounds per MWh output and assume a 60 percent system efficiency.

New Source Review. The Clean Air Act requires industrial facilities obtain a permit before beginning construction of a new facility or significantly increasing emissions at existing ones. This process is known as New Source Review (NSR). The permitting process is slightly different depending on whether the facility is located in an area in which pollutant levels exceed the national air quality standards (non-attainment areas). The Prevention of Significant Deterioration (PSD) Program applies to facilities in attainment areas. The PSD requirements include the application of a "best available control technology" analysis on a case by case basis. The purpose is to determine the maximum achievable reduction for the facility. In non-attainment areas, facilities must also obtain emission reductions to offset any increases.

The EPA first proposed changes to the NSR Program in July 1996 in an effort to streamline and simplify the permitting process. Included in this proposal was a provision to set a voluntary limit on a facility's total emissions based on historical records. This limit provides flexibility for a facility to make modifications without triggering NSR requirements provided emissions remain under the limit. In July 1998, the Agency continued this effort by seeking additional comment on reforming a number of NSR procedures.

The issue of NSR reform has major implications for CHP. For example, suppose that an industrial facility now maintains a separate heat and power configuration — purchasing electricity from the grid while generating steam on-site. Should the facility decide to replace it with an on-site CHP system, it could trigger NSR/PSD requirements. This is because, by switching to CHP technology, the facility may increase its on-site emissions. Although a recent EPA triggering analysis (see below) indicates this may not often occur, should on-site emissions increase, there is no way to reflect the emissions displaced from the less efficient grid-supplied electricity. Thus, even though total system emissions are less with the new CHP configuration, the facility may be required to take additional steps to reduce on-site emissions further.

New Source Review Triggering Analysis. In a separate action, EPA supported an analysis to determine the extent to which industrial and commercial CHP conversions might be impacted by NSR requirements. Specifically, the analysis examined data from the nation's 62,000 stand-alone boilers. It calculated how many CHP conversions would trigger NSR requirements by calculating NO_x emissions before and after the change. The analysis accounts for factors such as boiler size and whether or not the boiler is located in a nonattainment area. In general, the results show that the vast majority of existing boilers could be retrofitted into CHP systems without triggering federal NSR requirements.

As a result of the study, EPA has decided to undertake an educational campaign to combat the perception that converting to CHP in industrial and commercial facilities will automatically trigger NSR. To this end, the Agency is in the process of creating a NSR handbook that will present these results and educate facility managers about how they can implement cost-saving CHP technologies without triggering the potentially costly and time consuming NSR requirements.

Education and Outreach. One of the federal government's most important roles is to raise awareness of the energy, environmental and economic benefits of CHP and promote innovative thinking about ways to accelerate the use of CHP. With respect to environmental permitting, the majority of regulations are generated at the state level, especially as a part of state implementation plans. Thus, it is essential that states understand the ways in which their regulations can serve to encourage or inhibit CHP.

In October 1998, DOE launched its CHP Challenge Initiative. The two goals of the Initiative are to raise awareness about the benefits of CHP and to identify and remove the barriers limiting the implementation of CHP technologies in the United States. The Initiative is particularly interested in working with state and local government officials to help them understand the many things they can do to promote CHP. By developing educational materials and conducting state workshops, the Initiative is working to help states understand how their existing environmental regulations may be changed to encourage CHP.

Electric Power Industry Restructuring-Related Strategies

Since 1996, fourteen states have enacted major electricity restructuring legislation and four others have issued comprehensive electricity restructuring orders. In addition, fourteen additional states ended their 1998 legislative sessions with electricity restructuring bills pending. As a result, about 30-40 million customers in six states are currently able to choose their retail electricity supplier.

These activities by the states have led to increased pressure on the federal government to establish nation-wide ground rules for opening electricity markets to competition. In the 105th Congress, 36 electricity bills were introduced by Republican and Democratic sponsors. The Clinton Administration also introduced its electricity restructuring proposal in the 105th Congress. A new version was recently revised by Energy Secretary Richardson and is currently in the inter-agency review process in preparation for introduction in the 106th Congress.

Restructuring of electricity and natural gas markets could lead to enhanced use of CHP systems, but only if the new laws and regulations governing utility energy services are structured properly. Several of the federal electricity restructuring bills, including the one being developed by the Administration, contain provisions that would have potentially favorable impacts on CHP. These provisions include a public benefits fund, renewable portfolio standards, uniform interconnections for certain facilities and information disclosure requirements.

The public benefits fund is a mechanism for raising funds through a surcharge on electricity generation to create a pool of resources to support eligible "public purpose programs." The fund would provide financial assistance for advanced electricity generation technologies, such as CHP, that have significant energy efficiency and/or environmental benefits. For example, advanced CHP systems that use fuel cells or microturbines might qualify for financial assistance for field testing or technology validation studies from the fund.

The renewable portfolio standard (RPS) is a concept that establishes a "minimum purchase requirement" for certain types of renewable generation technologies, including wind, solar, geothermal, and biomass. Under this approach, renewable electricity suppliers would receive "tradeable credits" that could be exchanged or sold to non-renewable suppliers to meet the RPS requirement. The Pulp and Paper industry, for example, which uses wood wastes to produce power from on-site CHP facilities, would receive credits under the RPS, and could use the added revenues

to develop additional CHP capacity. It may also be possible to expand the definition of technologies that would apply under the RPS to include energy-efficient generation options such as CHP.

Standardized interconnection provisions are intended to address one of the major barriers to the use of CHP and other distributed power options. On-site power facilities require hook-up to the utility grid for back-up capacity and off-site sales of excess generation. However, each utility has its own procedures and equipment requirements to ensure worker safety and the security of grid operations. Non-standard approaches mean that CHP developers have to address interconnection on a case-by-case basis. Furthermore, utilities that view CHP as a competitive threat can use the interconnection process to slow down CHP development.

Information disclosure is a consumer protection provision being used to ensure that buyers have knowledge of the electricity they are using, including prices, fees, the types of fuels used, and the environmental emissions. These provisions for the basis of the "green marketing" strategies being used by some of the new electricity retailers to differentiate their products and tap into consumer demand for environmentally-friendly technologies. Some proposals include disclosing the "energy efficiency content" of the power which would enable electricity generated from CHP facilities to be tagged as green power by retailers.

State-level restructuring bills also include many of these provisions, although none of the enacted legislation mentions CHP specifically. With respect to citing, several of the eighteen states that have either passed comprehensive electricity restructuring legislation or have issued regulatory orders on restructuring have exempted on-site generation from being assessed fees associated with stranded cost recovery. The states that have done this include: Massachusetts, Maine, California, Illinois, and New Hampshire. The Massachusetts electricity restructuring legislation is the most CHP-friendly of the all of the states. The law includes provisions exempting CHP systems that have energy efficiency levels of at least 50% from exit fees and also exempts certain CHP facilities from taxes.

Financing Strategies

Investment tax credit. As a part of its 2000 budget request, the Administration has included an investment tax credit to encourage the increased application of CHP systems. The proposal would establish an 8-percent investment credit for qualified CHP systems with an electrical capacity in excess of 50 kW. A qualified CHP system would be required to produce at least 20 percent of its total useful energy in the form of thermal energy and 20 percent in the form of electrical or mechanical power and would also be required to satisfy an energy-efficiency standard. For CHP systems with an electrical capacity in excess of 50 MW, the total energy efficiency of the system would have to exceed 70 percent. For smaller systems, the total energy efficiency would have to exceed 60 percent. The credit would apply to investments in CHP equipment placed in service after December 31, 1999, but before January 1, 2003. If adopted, the credit could provide a tangible incentive for facilities considering the addition of CHP technologies. The impact of the tax credit is expected to be greatest for smaller systems because they generally face the greatest barriers.

Depreciation Allowances. According to current tax law, CHP property falls into several tax categories with depreciation periods based on its use and capacity. Systems larger than 500 kW have a cost recovery of 15 years if the electricity is used onsite and 15 to 20 years if the electricity is sold. In contrast, a similar engine used to power airplanes or equipment would have only a 5 to 7 year tax

life. The federal government is currently considering ways to standardize depreciation tax life and to provide a depreciation schedule that better reflects the 7-10 year operating life of the equipment.

Support for CHP Technologies. Through a number of different mechanisms, the federal government is working with industry partners to finance the development of cutting edge CHP technologies and increase their penetration in the marketplace. These activities are the result of coordinated efforts both within DOE's Office of Energy Efficiency and Renewable Energy and between DOE, EPA and other federal agencies. Mentioned above, DOE's ATS Program is one example of how the government is leveraging its financial resources to support the development of advanced CHP systems.

Depreciation Case Study. In 1989, Solar Turbines installed six Mars 90 combustion turbines with auxiliary-fired heat recovery steam generators, steam turbines and ancillary equipment in a Pennsylvania facility. The total system capacity was 60 MW. The plant has been operating since June 1989. Through the first 7.5 years of operation, the costs incurred for capital improvements, maintenance and overhauls been 85 percent of the original cost. This is without the benefit of introducing technologies to improve the overall efficiency or performance of the facility. These and other case studies indicate the economic life of CHP systems falls with a 7-10 year period.

As a part of its education and outreach efforts, DOE's CHP Challenge Program is working with industry partners to increase awareness about the potential of advanced CHP technologies. Through workshops, presentations and publications, CHP Challenge provides information on the full suite of both currently available and emerging technologies. The Program places particular emphasis on demonstrating how different technologies can be used to optimize benefits for particular applications.

In a related effort, DOE's Office of Building Technology, State and Community Programs has recently organized the Combined Cooling, Heating and Power for Buildings (CCHP) Initiative. The aim of this effort is to focus building industry research, development and commercialization towards on-site fuel conversion, making it possible to combine power generation and HVAC system optimization and integration with other innovative building technologies to maximize energy efficiency. The initiative is currently supporting the development of an industry-defined roadmap to guide research and development activities in the area of CCHP equipment and system technologies.

As the nation's largest energy consumer, the federal government has tremendous opportunities to support energy efficient technologies in its facilities. The Federal Energy Management Program is charged with helping government agencies take advantage of these opportunities by creating partnerships, leveraging resources, transferring technology and providing training and support. The Program attempts to set an example for the nation by sharing the experience gained at the federal level with state and local governments and the private sector.

Economic Development

As a result of its significant economic and resource savings, CHP can play a central role in the economic development strategies of state and local governments. First, CHP can increase the

profitability of an area's industrial and commercial businesses by saving money on energy bills. The potential for savings is especially notable in regions with high cost grid electricity. Local governments that have policies to encourage CHP at industrial and commercial facilities are responsive to the needs of industry. Second, CHP offers a reliable, efficient, low emission alternative to building new, central station power plants and transmission infrastructure. Using CHP as a part of an overall distributed generation strategy, local governments can develop their infrastructure in a way that is consistent with local needs. Third, regions with poor air quality can have difficulties attracting new business. As a result of its high efficiency, CHP can play an important role in improving local air quality and making it possible to site additional industrial facilities without exceeding regional emissions limits. The CHP Challenge Initiative at DOE is actively working with state and local government officials to encourage the implementation of CHP-friendly policies and regulations at a part of their overall economic development strategies.

FEMP case study. The Naval Petroleum Reserve No. 1 (NPR-1) CHP facility is a 1996 FEMP Federal Energy Showcase winner. The facility began operation in November 1994 and continues to meet all electricity and steam needs at the Elk Hills oil field in Tupman, California. The use of CHP technology at NPR-1 has eliminated federal purchases of approximately 30 MW of electricity from the local utility at a monthly cost of about $1.1 million. The facility is approximately 45% more efficient than the fossil-fuel-generated grid electricity it replaces. Steam generated by the CHP facility is used at natural gas processing plants, allowing NPR-1 to shut down less efficient gas heaters and steam boilers (DOE 1999b).

The Future of CHP Policies

Concerted action to reduce or eliminate the policy-related barriers to CHP development can make a real difference in the marketplace. Greater coordination between agencies at the federal, state, and local levels will not be easy to achieve, but the opportunity is great and the timing is right. Electricity restructuring legislation is in the process of being implemented and is at a point where provisions that assist CHP development can be introduced. State Implementation Plans for clean air rules are under development and there is a process underway for reviewing national clean air standards.

The existence of policy-related barriers is likely to be one of the biggest factors limiting the increased use of CHP over the next 20 years. How much CHP would be installed if those barriers were to be eased or eliminated?

Imagine a future where CHP facilities are exempt from stranded cost recovery fees, where interconnection protocols are standardized across the country, where federal, state, and local environmental officials are on the same page and looking for ways to increase the use of CHP systems, and where each state has one-stop-shop permitting process in place for expediting CHP installations. Table 1 below contrasts today's practices with possible CHP-friendly policies for the future.

Such policy changes could have real financial implications for CHP developers. A recent comparative analysis, for instance, shows a substantial economic impact as a result of changing the back-up rate for CHP facilities by plus or minus 15 percent, depending on the state in which the

facility was sited (Davidson 1999). Implementation of these policy mechanisms can greatly increase the attractiveness of CHP for potential users.

Table 1. Possible Policy Changes to Address Barriers to CHP

CHP BARRIERS	TODAY	THE FUTURE
Stranded Cost Recovery	Exit fees or competitive transition charges	Exemptions for new CHP facilities
Utility Resistence	- Non-standard interconnection - Expensive back-up rates	Standard interconnection protocols, back-up rates cost justified
Restructuring Uncertainty	Customers delaying decisions, "wait and see"	Federal legislation eliminates most inconsistencies
Permitting Headaches	- Case-by-case - Multiple agency approvals	One-stop permitting in every state
Environmental Requirements	- Vary by region - Federal, state, local differences - Moving target	Output-based standards, federal/state/local encouragement of CHP
Federal Procurement	Case-by-Case	Preferred Procurement

Conclusion

Interest in the potential of CHP technology is growing dramatically. This recent interest is driven by factors including the need to increase the efficiency of the nation's electricity generation infrastructure, DOE Assistant Secretary Dan Reicher's challenge to double the capacity of CHP by 2010, the success of DOE's ATS Program in supporting ultra-efficient CHP technologies, and the necessity of finding cost-effective solutions to address climate change and air quality issues.

The federal government is actively working to build on this momentum by taking specific steps to encourage a competitive market for CHP characterized by policies and regulations that enable the implementation of a full suite of technologies for multiple applications. These activities include a range of technology and policy strategies aimed at encouraging the increased implementation of CHP.

A future in which end users are aware of the advantages of highly efficient CHP systems and are fully able to take advantage of the associated economic and environmental benefits is well within our reach. Working together with its many partners in industry and state and local government, the federal government is committed to making full implementation of CHP a centerpiece of its vision for clean and sustainable energy generation.

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