SUMMARY TESTIMONY OF PAUL D CHAMBERLIN

ASSOCIATE VICE PRESIDENT FOR FACILITIES

UNIVERSITY OF NEW HAMPSHIRE

Before the

JOINT SUBCOMMITTEE ON ENERGY AND POWER AND SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS HEARING ENTITLED "THE AMERICAN ENERGY INITIATIVE"

Prior to 2005, the University of New Hampshire was purchasing electricity from the local utility and heat was generated in the form of steam in an aging central boiler plant and distributed to campus buildings via a district heating system. Rather than investing in an upgrade of the central boiler plant, in 2005 UNH installed a $20 million cogeneration system that would meet campus heating needs and provide electric power to meet the growing campus needs. This system has resulted in several benefits; the total cost to provide utilities to the campus is lower (an estimated $3 million savings in 2011), air pollutant emissions were reduced, greenhouse gas emissions were reduced, and the more efficient cogeneration system reduced the demand placed on the regional energy systems.

In 2009, UNH placed in operation our ECOLine system, a $49 million project to process and transport landfill gas to the campus for use as the primary fuel in the cogeneration plant. Landfill gas is now providing nearly 70% of the total energy used by the campus and is nearly 80% of the fuel energy consumed by the cogeneration plant. We believe our campus is unique in higher education in using landfill gas as our primary source of energy for the campus.

The UNH experience shows that efficient cogeneration installations with balanced thermal and electric energy loads but can result in dramatic improvement in the efficiency with which fuel energy can be transformed into useable electric and thermal forms. However, widespread application of cogeneration technology has implications for management of the power grid and application of regulatory requirements that should be addressed.

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ASSOCIATE VICE PRESIDENT FOR FACILITIES

UNIVERSITY OF NEW HAMPSHIRE

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JOINT SUBCOMMITTEE ON ENERGY AND POWER AND SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS HEARING ENTITLED "THE AMERICAN ENERGY INITIATIVE"

Mr. Chairman and distinguished Committee Members, I am privileged to appear before you to share the experience of the University of New Hampshire in the installation of a Cogeneration Plant to provide both electric power and heating to the University's main campus in Durham, New Hampshire. I hope that our experience will help inform the committee's deliberations.

The University of New Hampshire is the state's flagship public research university, providing comprehensive, high-quality undergraduate and graduate programs of distinction. Its primary purpose is learning: students collaborating with faculty in teaching, research, creative expression, and service. The University of New Hampshire has a national and international agenda and holds land-grant, sea-grant and space-grant charters. From its main Durham campus and its college in Manchester, the University serves New Hampshire and the region through continuing education, cooperative extension, cultural outreach, economic development activities, and applied research.

The University of New Hampshire is distinguished by its commitment to high quality undergraduate instruction, hand-picked excellence in graduate education, our emergence over the past decade as a significant research institution and our location in a beautiful and culturally rich part of the New England seacoast. Our comparatively small size allows us to cultivate a strong sense of commitment to serving the public good and we maintain high level of responsibility for our special place in New Hampshire.

The dedication of our faculty to the highest academic standards infuses all we do with the excitement of discovery.

The University's main campus currently includes 5.6 million square feet of space. Utility costs have always been a significant element in the cost to operate the campus; exceeding $10 million annually for over a decade.

COMMITMENT TO ENERGY EFFICIENCY AND SUSTAINABILITY

The University has a well-established and broadly based energy efficiency program. As the result of efforts over the last three decades the University has implemented a campus-wide building automation system, or BAS, that enables centralized monitoring and control of building heating, ventilation and air condition systems in a majority of our major buildings. Using this system we can adjust temperature settings and monitor and adjust system performance. Utilizing our construction and repair standards, we require building designs that will provide durable structures. We also require the installation of efficient lighting, variable speed drives and efficient electric motors and maximize the use of heat recovery systems. The recent renovation of our natural sciences building achieved LEED Gold[1] certification and we are targeting the same level for the new Peter Paul School of Business and Economics building currently under construction. Whenever possible we seek to minimize the life cycle cost of our facilities and not just the initial cost. The results of these efforts were reflected in a survey of higher education campuses performed by the US Department of Energy in 2001 that ranked UNH in the highest 5% of our peers in energy efficiency (based on energy use per square foot of building space.) In 2006 the University received the first Department of Energy EnergyStar building label for one of its

[1] The U.S. Green Building Council has established widely accepted standards and a certification process known as LEED (Leadership in Energy and Environmental Design) for assessing building construction and renovation projects as Certified, Silver, Gold or Platinum

residence halls. Importantly, this recognition was based on data gathered and analyzed by students interested in energy issues. The University also has an active Energy Task Force that is comprised of representatives from students, faculty and staff that has actively developed policy recommendations, supported student awareness activities and serves as the campus focal point for achieving the campus Climate Change Commitment goals. UNH was also among the first institutions to establish a revolving Energy Efficiency Fund, or EEF. Initially seeded by a grant of ARRA funds, the EEF invests in energy efficiency improvements. The savings which are captured through a surcharge on campus energy costs which replenishes the EEF and allows additional investments. The initial investment of $650,000 will yield over $4 million in savings over the next 10 years. In today's severe funding climate, this revolving funding strategy assures steady investment in energy efficiency.

The University also has a commitment to sustainability. Grassroots momentum led to the establishment of the Office of Sustainable Programs in 1997 through a generous gift by a visionary University alumnus, now the oldest endowed, university-wide sustainability program in US higher education. This commitment has led to the cross discipline development of campus initiatives centered on curricula, operations, research and the environment, or CORE. The University was an early signer of the national American College and University President's Climate Commitment by which UNH has committed to specific targets to reduce greenhouse gas emissions. In conjunction with Clean Air/Clean Planet, based in Portsmouth, NH, UNH created a greenhouse gas inventory methodology tailored to colleges and universities that is now used at over 400 campuses across the country. The UNH sustainability efforts are more fully documented in a book titled "The Sustainable Learning Community: One University's Journey to the Future" published in 2009.

MEETING INSTITUTIONAL ENERGY NEEDS

For nearly a century, college campuses have purchased electric power from the local utility and produced their own heat. Many larger campuses like UNH installed central heating plants that supplied either steam or hot water through a district heating system to heat the campus buildings. Others used individual building heating systems, but few obtained their heat from an off-campus source. The electric generation plants operated by the utilities have also had a single purpose: converting fuel energy to useable energy in the form of electric power. Technology limits the efficiency of the conversion of fossil-based fuels (coal, oil and natural gas) to electric energy to about 35%. In other words only about 35% of the energy in the fuel is converted to electrical energy. The rest is lost in the process, typically as hot exhaust gas. Similarly, the campus central heating plants, with their large boilers also had one purpose: to produce heat in the form of either steam or hot water. These boilers are more efficient and convert roughly 80% of the fuel energy into heating energy in the form of steam or hot water. Thus, the norm was for a campus to be supported by energy systems that made a combined use of less than 50% of the fuel energy consumed. This was the state of affairs at the University at the beginning of the new millennium. The University campus purchased electric power from Public Service of New Hampshire, the local electric utility, and generated steam for heating the core campus buildings in a vintage single purpose heating plant. The University has had a central heating plant since it moved to the present campus location in the 1890's. The current plant was originally constructed in the 1930's and included four large boilers that initially operated on coal. In the 1950's these boilers were converted to heavy oil and in the 1990's, the ability to also operate on natural gas was added. However, the basic technology and much of the equipment dated back to the 1950's. By the late 1990's these aging units could no longer reliably provide the necessary steam to support the campus. Concurrently, the University undertook a program to increase the percentage of our undergraduate population housed on campus and initiated a major upgrading of our science and engineering buildings. It was clear the resulting construction would outstrip the capacity of the boiler plant to provide heat and that a major investment

would be necessary in order to provide a reliable source to meet the campus heating needs. Estimates at the time placed the cost at a minimum of $17 million to upgrade the existing heating plant to provide the reliability and capacity needed.

CONSIDERING COGENERATION

Rather than invest in boiler technology from the 1950's, the University initiated a study to consider the applicability of cogeneration as a method for meeting campus energy needs. A fully utilized cogeneration system can improve the overall efficiency of fuel energy to energy produced to over 85%. Through this study we also learned that for our heating and power loads, a cogeneration plant based on turbine powered generators rather than internal combustion engine based systems would be the most efficient. This study and our subsequent experience highlight two key factors that influence the suitability of cogeneration.

The first consideration is sizing of the cogeneration system. Our experience and the data from turbine manufacturers shows that the efficiency of a turbine drops quickly when the turbine is operated at less than full output. This efficiency measurement, called heat rate, is the fuel energy measured in British Thermal Units (BTU) per KWH of electricity produced. In other words, as the amount of fuel to produce a KWH increases the total KWH output drops. For a typical turbine, the change is significant. If the turbine is expected to normally operate at or near its rated capacity, the heat rate variation isn't a major consideration. However, at a college or university campus and in many other possible applications, the electric load can vary widely. At UNH our campus electric load varies from less than five megawatts (5MW) to as high as 13 MW seasonally and can vary 4MW to 5MW on a daily basis. With such a variable load, sizing a turbine generator to be able to handle the maximum predicted load will result in the

turbine operating much of the time at less than full output and thus in a much less efficient range. After considering the UNH electric load profile, a turbine in the 8 MW range was determined to provide the best compromise between generating the greatest percentage of campus power and fuel efficiency. Both Siemens and Solar[2] offer turbines in this size range. Ultimately a Siemens SGT300 turbine was selected as the best fit for the campus load profile.

An outcome of the sizing decision was that the campus would remain connected to the local electric utility and would not be self-sufficient. While this added a level of technical complexity and regulatory involvement (ISO New England, NE Pool and even the Federal Energy Regulatory Commission) it also meant that the campus had access to the grid as backup for the turbine generator during scheduled and unscheduled shut downs. This access comes at a price, however, as the utility charges the campus a capacity or standby charge that is based on the maximum demand the campus places on their system. This capacity charge is in addition to the charge for consumed power and covers the cost for the utility to be accessible if the cogeneration unit trips offline. Also as a result of the decision to remain connected to the grid, the University was required to fund an interconnect study by the local utility and to install the protective devices and controls determined by that study to be necessary to insure a fault in the campus system did not disrupt the local distribution or transmission systems. It is my expectation that most institutions and industrial applications would have variable load profiles similar to ours and would end up optimizing the size of their cogeneration system at some level below their maximum electric load and choose to remain connected to the grid.

A second key consideration is the heating load profile. In Northern New England we have a significant winter heating load but little to no need for heating in the summer. Prior to the cogeneration project,

[2] Solar Turbines-A Caterpillar Company

the summer steam load was limited to a few locations where steam was used to make hot water in dorms and dining halls. Only Rudman Hall, our biological sciences building, had steam absorption chillers for creating chilled water for air conditioning. This seasonal imbalance challenges the effective use of the steam that can be produced by a cogeneration system. Frankly, we underestimated the steam that would be available in the summer months and in the first few years of operation we could not use the steam the plant produced. Fortunately, our recent building projects required the installation of chillers to generate chilled water for air conditioning. Rather than using the more common electric chillers, we have used steam absorption chillers. These units use energy from steam rather than from electricity as the primary input in the production of chilled water. This has had a double benefit: not only do we avoid increasing the campus total electric consumption but we take advantage of the very steam energy that was otherwise being wasted and is very economical to produce.

In other parts of the country, particularly in the southeast, cooling, not heating, dominates. In these locations, steam absorption technology can provide an effective use for the steam generated in a cogeneration plant during the summer, but creating a winter steam load may be the challenge. At industrial locations, the need for thermal energy may dominate. Cogeneration is still applicable as it may be economically feasible to export electric power to the grid from a cogeneration system while using the thermal energy produced on-site.

I hasten to add that the University of New Hampshire is not alone among colleges and universities in moving to cogeneration. According to the Department of Energy, more than 200 higher education institutions have some form of cogeneration supporting their campuses.

MOVING FORWARD WITH COGENERATION

Rather than invest in out of date boiler technology, and after careful consideration of the cost implications, the University chose instead to invest in cogeneration technology as the most cost effective and efficient means of meeting campus energy needs. At the risk of oversimplifying what was a detailed analysis, the major elements taken into consideration were:

- Cost per Kilowatt Hour (KWH) for purchased electricity in New Hampshire (which is relatively high by national norms)
- Amortization of the investment alternatives for either upgrading the heating plant or constructing a cogeneration facility
- Campus heating and electrical load profiles
- Comparison of the likely operation and maintenance cost for an updated central heating plant vs. a combined heat and power plant
- Efficiency of the turbine and heat recovery steam generator

After weighing these factors the University, with the concurrence of our Board of Trustees, decided to move forward with installation of a cogeneration system and in 2003, UNH contracted with EMCOR Energy Services for the design and construction of a Cogeneration Plant to be co-located and interconnected with the existing central heating plant. A Siemens SGT300 DLE dual fuel turbine generator with a rated output of 7.9 megawatts (7.9MW) was selected as the power generator. The hot exhaust gasses from the turbine pass through a Heat Recovery Steam Generator (HRSG) which reduces the exhaust gas temperature from roughly 1000 °F to 300 °F and produces 40,000-45,000 pounds per hour of steam. (For comparison, on a windy January day when classes are in session and temperatures are in the single digits, the campus heating system uses about 100,000 pounds per hour of steam.) Our system is also equipped with a duct burner that adds additional fuel into the turbine exhaust gas which

increases the steam production to 95,000 pounds per hour. The Siemens turbine was designed to operate on both natural gas and #2 oil (essentially home heating oil) with the cleaner burning natural gas being the preferred fuel. The project, which included a building to house the system, the turbine, heat recovery steam generator and other auxiliary equipment and the necessary electric switchgear, cost $20 million. The project was financed through a combination of internal funds and a lease purchase contract for the major equipment. The system was placed in operation in 2005.

SYSTEM PERFORMANCE

The impact of the University's investment in cogeneration can be measured in a number of ways, but the following are considered most illustrative.

Average energy consumed per square foot of building space. Figure 1 shows two trends; the lower line is the energy used by the campus buildings as an average per square foot.

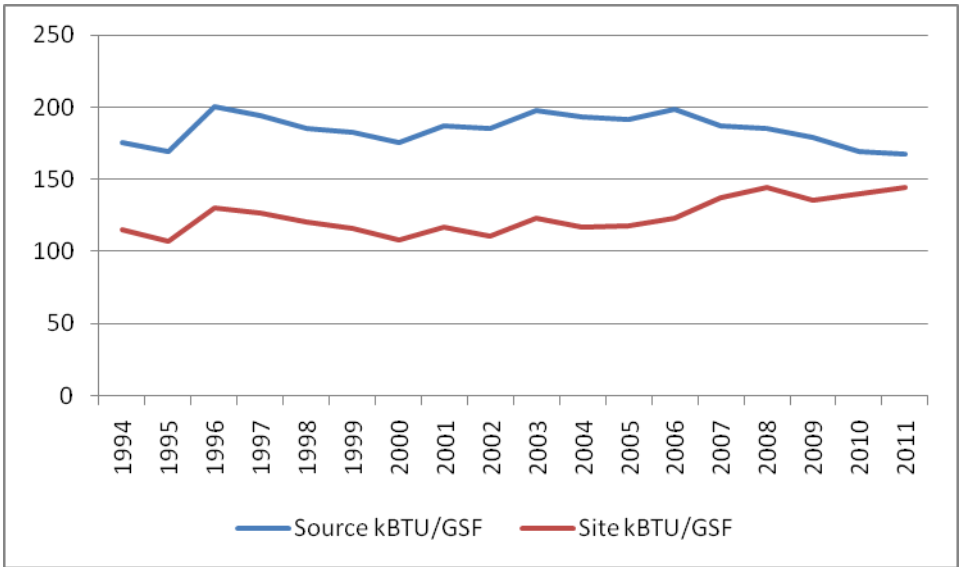

Figure 1 Source versus Site Energy Density

This energy "density" has increased at the University over the past decade principally as a result of our science and engineering building modernization projects that have added air conditioning and code compliant ventilation systems to what were buildings with only basic heating. However, the upper line reflects what the Department of Energy calls "Source Energy;" that is the total estimated fuel energy consumed to create the electric or heat energy actually used. In the case of the University, this is a combination of the estimated fuel energy used to create the electricity purchased from the utility and the fuel energy used by the campus. Note that since 2005 the trend for this line is down. Despite the increasing energy density of our buildings, the source energy density has declined. In regional or even national terms, this means the campus is placing less demand on the overall energy supply per square foot of space yet still meeting an increasing energy need. This is directly and solely due to our cogeneration system.

Greenhouse Gas Emissions. The University has established a clear commitment to reduce the emission of greenhouse gasses associated with operation of the campus. As noted above, the University has pioneered development of a standard methodology for inventorying the greenhouse gas emissions associated with a college or university campus. This methodology takes into account not only the direct emissions from campus activity but the emissions associated with electric generation by the local utility. The emission of greenhouse gasses, measured as carbon dioxide equivalents (CO2e), is a parallel indicator of how efficiently energy is being produced and used. Prior to the cogeneration project, the University's greenhouse gas emissions were estimated at 86,000 tons per year. With the cogeneration system, that level has dropped to 67,000 tons per year or a reduction of 19,000 tons per year.

Air Pollution. Unlike greenhouse gas emissions, regulated air pollutant emission is measured and regulated at the source or site and the regulations do not take into account the net positive regional

impact that cogeneration can have. For example, prior to the cogeneration project, the University used 350,000 mmBTU's of fuel energy on site to create steam for heating. With the cogeneration system in operation, the University is now using 800,000 mmBTU's to create both power and electricity.

Nitrous Oxides (NOx) are the principle pollutant of concern in the northeast. By selecting a turbine designed for low NOx emissions and with the switch from heavy oil to natural gas as the primary fuel, we were able to reduce our total NOx emissions from 70 tons per year pre-cogeneration to 50 tons per year with cogeneration despite more than doubling the fuel used on campus. Additionally, we are drawing far less electric power from the utility. For other locations where natural gas may already be the primary fuel, adding cogeneration will most likely increase NOx emissions beyond current permitted levels. Under current New Hampshire regulations, there is no way to take into account that the more efficient cogeneration system is not only continuing to meet heating needs, but is meeting much of the electrical needs and thus reducing the power that must be generated by the utility. We estimate that the regional NOx emission reduction associated with electric power the campus no longer imports to be 67 tons per year The regulatory framework in New Hampshire does not recognize or give credit to the offset in the emissions from utility power plants. While not a factor for the University, this could be a barrier for others considering cogeneration systems.

Similarly, Sulfur compound emissions (SOx) were reduced from roughly 260 tons per year to only 20 tons per year, a dramatic decrease which reflected the switch from heavy oil to the cleaner natural gas as well as less reliance on our local utility. Similar to NOx, we estimate the regional SOx reductions to be roughly 400 tons per year due to the reduced power demand on the grid.

Clearly, moving to cogeneration has important implications for regional air quality.

Financial Performance. At the risk of over-simplification, a comparison of the current cost for the combined electricity and heat energy used by the campus versus the estimated cost had we not invested in the cogeneration system can be made. In 2011, the campus used a total of 784,000 mmBTU energy in the form of electricity or heat. The total cost to create or purchase that energy including operation of the cogeneration system was $10,500,000. Had the campus continued to purchase all electricity and run the central boiler plant to create heat, it is estimated that the total cost would have been $13,431,000[3] an estimated savings of $3 million.

USING LANDFILL GAS RATHER THAN NATURAL GAS AS COGENERATION PLANT FUEL

While the cogeneration plant was still under construction the possible use of landfill gas from a large landfill approximately 8 miles from the campus as fuel for the cogeneration system was suggested. Located in Rochester, New Hampshire and owned and operated by Waste Management of New Hampshire, the landfill was producing more gas than could be used for power generation on site[4]. The excess gas was being burned or "flared" to break down the methane and destroy the odor causing components in the gas. In a cooperative effort, University and Waste Management officials explored the concept in a two year due diligence effort, and ultimately a fully developed project concept was presented to the University System of New Hampshire Board of Trustees for approval.

Landfill gas is a naturally occurring by-product of the breakdown of organic material deposited in a landfill. Once the oxygen is consumed, which happens quickly, and anaerobic conditions exist, methane producing bacteria can flourish and the gas produced contains methane, or CH_4, which is also the

[3] This calculation requires a number of assumptions the principle of which is the level of investment that would have been necessary to increase the central heating plant capacity and improve reliability.
[4] Regulatory and physical limits precluded the installation of additional power generation at the landfill.

primary constituent in natural gas. Landfill gas also contains malodorous volatile organic and sulfur compounds. Under Clean Air Act regulations, operators of large landfills must install gas collection systems to capture the gas being generated within the landfill material before it escapes into the atmosphere. Initially required as an odor control measure, we now recognize that methane is a potent greenhouse gas that has twenty times the impact of carbon dioxide. Preventing the release of methane has become an equally important function of the gas collection systems.

These gas collection systems place a vacuum on the landfill material to draw the gas into the collection system before it reaches the surface. The system can also draw air from the landfill surface, so the captured gas is a mix of gas from the landfill mixed with air from the atmosphere. As a result, the constituents will vary from landfill to landfill. At Rochester, the gas is roughly 50% methane with the balance being nitrogen, carbon dioxide and oxygen. Also present are the volatile organic and sulfur compounds mentioned earlier, a family of silica based compounds called siloxanes, and moisture.

Through the due diligence process, the University determined that the raw landfill gas was incompatible with the Siemens SGT300 turbine. Although designed to operate on natural gas, Siemens advised that they could modify the turbine combustion system and controls to operate on gas with a lower percentage of methane than natural gas, but not as low as 50% and that the contaminates, particularly siloxanes, were potentially harmful.

Ultimately the ECOLine, as the project is called, consisted of five major elements;

- The landfill and landfill gas control system owned and operated by Waste Management,
- A University owned and operated gas processing plant that removes contaminates, moisture and CO_2 from the raw landfill gas to produce a dry gas that is 70% - 75% methane,

- A 12.6 mile pipeline connecting the landfill and the campus,
- Modification to the existing cogeneration plant and turbine to use the processed landfill gas, and
- Installation of a second turbine optimized for power production to insure available landfill gas was productively used when campus demands were low.

In June 2007, the University System Board of Trustees approved a $49 million project to create the ECOLine system to bring processed landfill gas to the campus for use as the primary fuel for the Cogeneration Plant. In July 2009, the turbine was fully operational on landfill gas and the system has been in operation since.

A particularly unique aspect of the ECOLine system was the creation of a gas blending system that allows us to add natural gas to the processed landfill gas when necessary to assure the minimum requirements of the Siemens turbine can be met. This system can also augment the quantity of landfill gas if necessary to permit the turbine to run at maximum output. This system allows us to continue to use the available landfill gas even when the quality or quantity may be not fully meet the fuel requirements of the turbine.

Clean Air Act regulations were also a factor in the ECOLine project. Regulators concluded that the pipeline connection between the campus and the gas processing plant at the landfill made the processing plant an extension of the campus and that the emissions from the plant would fall under the campus air permit. Since the processing plant included two generators to produce power to operate the plant as well as flares to destroy any unused gas and we were installing a second turbine, there would be an increase in total emissions on the University's permit. Regulators were aware of and appreciated

the fact that there would be a decrease in the emissions under the landfill's air permit, particularly in sulfur compound emissions, and thus a regional benefit, but they lacked the flexibility to take this offset into account in addressing the University's permit. This required an increase in the University's air permit levels and only through the willingness of the State of New Hampshire to donate retired credits it held to the University's project did the University avoid having to purchase credits.

In selecting a second turbine, the University's goal was to insure all available landfill gas was productively used. We selected a 4.9 MW Solar M50 turbine generator that was designed to operate on our processed landfill gas without needing any augmentation. At present, this is a single cycle installation that only produces power but is designed to allow later installation of a heat recovery boiler should campus steam loads warrant.

At design capacity, the ECOLine system is capable of meeting 85% of the campus energy requirements from landfill gas. However, the economic slowdown also affected the volume of material being deposited in the landfill with an associated reduction in gas production. Despite this, during the past 12 months gas from the landfill provided 68% of the total campus energy and comprised 79% of the fuel energy used in the Cogeneration Plant. To our knowledge, this is the greatest use of non-fossil fuel at any college or university in the country.

LESSONS LEARNED AND OBSERVATIONS

A key factor for the University in realizing the full efficiency of our cogeneration system has been the use of steam absorption chillers rather than the more commonplace electric chillers. Unfortunately, steam absorption chillers have both a higher initial cost and are not available from domestic manufacturers.

Based on the University's experience, using steam absorption chillers or other team-driven chillers to meet air conditioning needs will be a key factor in more widespread installation of cogeneration systems as they can provide a summertime use of the steam that cogeneration systems can produce. Incentives that would encourage the use of steam absorption cooling or other waste heat driven equipment as part of a cogeneration system may spur wider application of these systems.

The optimal application for cogeneration is where there is a balanced need for both electric energy and thermal energy. Ideally, these loads are constant and the system can be sized to meet the predicted load. Industrial applications may have such conditions. However, highly variable loads will be the norm for many potential applications. In such applications, it is likely that decision-makers will conclude, as we did, that the system should be sized below the maximum load in order to achieve the greatest efficiency and will rely on the grid for supplemental and backup electric power. This likelihood creates additional questions. For example, if distributed cogeneration systems become commonplace, it may be safe to assume some percentage of the systems would always be operating. How will the utilities be required to size their generation and distribution systems to assure reliability of the grid and availability of electric power? To what degree is it safe to assume that only a portion of the cogeneration systems might not be operating at any given time with those users meeting their power requirements from the grid? How do rate structures recover the cost for the utilities to maintain the level of standby capacity determined to be necessary yet be kept low enough so as to not disincentive investment in cogeneration systems? Resolving such questions can contribute to wider implementation of cogeneration technology.

As described above, the current Clean Air Act regulations may not be able to recognize the impact of distributed cogeneration system installations on regional pollutant emissions. Regulatory focus may be on the individual site where the installation of a cogeneration system may increase the level of

emissions for an existing permit holder. However, the regional impact may be a net reduction in total emissions, surely a positive benefit that needs to be considered.

CONCLUSIONS

Cogeneration offers the opportunity to dramatically improve the efficiency with which fuel energy is converted to useable forms as heat or electricity. Settings where both forms of energy are needed such as such as college or university campuses, industries that need both heat and power, cities that have central heating districts or military installations are well suited for cogeneration application. Locations where there is a large thermal energy need and the ability to connect to the grid also offer an opportunity for cogeneration to meet local thermal needs with electric energy being exported to the grid. In all cases there is a beneficial effect on the grid by decreasing the need for peaking power plants necessary to meet system demand. Cogeneration also offers much greater efficiency in the way fuel energy is converted into useable forms of heat and electrical energy and thus reduces the demand on our energy supply. The technology is mature and the equipment is highly reliable. Based on our experience at the University of New Hampshire, I strongly believe cogeneration systems should be encouraged as a matter of sound business and good public policy.

For this reason, I am pleased to lend my support for Section 203 of Representative Bass' Smart Energy Act, which calls for a doubling by 2020 of the production of electricity through the use of combined heat and power (CHP) and waste recovery, and the development of a strategic plan to achieve these energy efficiency objectives, within the industrial sector. As the Committee examines this set of issues, it should be noted that widespread application of cogeneration technology has distinct implications for management of the power grid and application of regulatory requirements, and it is essential that these

issues be addressed comprehensively in order for the nation to fully exploit the energy efficiency and environmental benefits of cogeneration systems.

Thank you for this opportunity to share the University of New Hampshire experience in the installation and operation of a cogeneration system and our unique ECOLine landfill gas system.