WHITE PAPER

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SMART HEAT: THE NEXT STEP IN CLEAN ENERGY

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SUMMARY

The concept of 'smart energy' dominates discussion about the future of the energy industry. However, the emphasis is almost entirely on technologies for the electric grid. This paper posits that our focus is too narrow; we must encompass smart heat, as well, if we are to achieve energy independence.

SMART ENERGY VS. GREEN ENERGY

The adjective 'smart' clearly has eclipsed 'green' in describing the most cutting edge energy technologies available today. Industry journals are replete with articles about smart grid, smart meters, and smart lighting. The 'smart' moniker even finds its way increasingly into consumer publications and television commercials.

In its purest form, the term 'smart' energy refers to technologies that bring digitalization and two-way electronic communications to the electric grid. Smart meters are the most common example. They allow the utility and building to electronically 'talk' together to best manage electricity use and costs. But the energy industry now uses the word 'smart' even more broadly to describe an array of advanced products and processes that enhance energy efficiency, and therefore reduce energy use and costs and improve a building's environmental profile. For example, occupancy sensors in office buildings often are described as 'smart,' as are light-detecting windows.

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SO WHY IS 'SMART' OVERTAKING 'GREEN' IN FORWARD-THINKING DISCUSSION ABOUT ENERGY?

First, unlike green or renewable energy, smart energy's primary value proposition is economic. We pursue energy efficiency to gain more productive output from each dollar spent on energy. Further, energy efficiency investments have a multiplier effect. For example, a study by Environment Northeast found that spending $16.8 billion on electric efficiency over 15 years in the six New England states would increase economic activity by $162 billion.[1] More broadly, the US economy could net $1.2 trillion by investing $520 billion to become more energy efficient, according to a study by McKinsey & Company.[2] Renewable energy, on the other hand, in most cases remains more expensive than conventional energy, and we must make a more complicated argument to maintain public support. Generally, we justify renewable energy based on its environmental attributes, its ability to replace fossil fuels, and its potential as a jobs builder and domestic resource. Energy efficiency offers these benefits too, but in addition promises a quick reduction in energy costs. Every $1 spent on energy efficiency generally results in $3-$4 in direct savings, according to Environment Northeast.[3] This benefits the bottom line for your building or business, as well as the larger economy by freeing up money for investment that would otherwise be spent on energy.

SMART ENERGY IS RESOURCE AGNOSTIC

You can favor smart energy and still be for or against fossil fuels, for or against nuclear power and for or against offshore wind farms, since smart energy represents the best intelligence that underlies all forms of energy. Smart energy is a set of technologies that lets us produce and consume any form of energy most efficiently. Therefore, it is a brand that is able to secure widespread political and industry support.

So it is easy to see why arguments in favor of smart energy have gained traction in today's difficult economy. However, a gaping hole exists in the nation's

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[1]Environment Northeast, "Energy Efficiency: Engine of Economic Growth," October 2009, http://www.env-ne.org/resources/open/p/id/964

[2]McKinsey & Company, "Unlocking Energy Efficiency in the US," July 2009, http://www.mckinsey.com/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy.aspx

[3]Environment Northeast, "The Energy Efficiency Opportunity: Connecticut Experience & Policy Options," http://www.env-ne.org/public/resources/pdf/ENE_CT_SpeakersTaskForce_EE_111706.pdf

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By neglecting heat in our smart energy pursuit, we continue to forfeit domestic, efficient and inexpensive fuels in favor of polluting and pricey foreign imports.

discussion about smart energy. Most of the talk focuses on electric power, and neglects thermal applications. Yet, we use a great deal of energy to heat and cool buildings, heat and chill water, and undertake thermal-driven industrial processes. In fact, thermal applications account for more than 30 percent of all U.S. energy consumption, according to Environmental and Energy Study Institute.[4] Moreover, a great deal of that thermal load relies on imported fuels in an era when we are attempting to shift to domestic supply. For example, oil continues to be the primary residential heating fuel in some of our most highly populated regions, such as the Northeast, the biggest single heating oil market in the US, according to the US Department of Energy.[5] We also continue to rely on oil for commercial buildings. In New York, alone, 10,000 of the city's largest buildings use residual oil, considered a dirty fuel. (Eighty-six percent of the city's soot comes from the burning of residual oil.)[6] By neglecting heat in our smart energy pursuit, we continue to forfeit domestic, efficient and inexpensive fuels in favor of polluting and pricey foreign imports.

REDUCE ENERGY WASTE

As important as the heat we use, is the heat we waste – heat that we should convert into productive energy. Unfortunately, the US throws away two thirds of the heat left over from power production, which is more heat than all of the energy used in Japan.[7] We also waste more than half of the heat byproduct created during industrial processes. Yet many good uses exist for this thermal

[4]Environmental and Energy Study Institute, "How We Can Tap Renewable Energy and Waste Heat," September 2010, http://www.eesi.org/how-we-can-tap-renewable-thermal-energy-and-waste-heat-16-sep-2010

[5]US Energy Information Administration, Demand, http://fossil.energy.gov/programs/reserves/heatingoil/

[6]New York City's Office of Long-Term Planning and Sustainability, "PLANYC Update," April 2011, http://mikebloomberg.com/index.cfm?objectid=78C29DB8-C29C-7CA2-F7DD16EB597E3DC5

[7]Natural Capitalism, Amory Lovins, http://www.abc.net.au/science/slab/natcap/

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energy. As discussed below, combined heat and power (CHP) or cogeneration, reuses this byproduct to heat and cool the air and water for hotels, schools, universities, nursing homes, hospitals, fitness centers, apartment buildings and other facilities that deeply benefit from getting the most out of each unit of fuel they use.

Moreover, CHP systems replace the use of oil and coal in energy production, since CHP typically uses natural gas. This is an important and beneficial fuel shift because natural gas is an inexpensive, clean, abundant and domestic fuel source. And the US is the second largest producer of natural gas in the world behind Russia.[8] A recent Wall Street Journal article points out that the US has a 100-plus year supply of natural gas, which means "natural gas prices will remain reasonable, giving energy-dependent American manufacturers an edge in competing for global business."[9] In short, natural gas is a smart fuel choice.

WHAT EXACTLY DO WE MEAN BY SMART HEAT?

We would define it as heating technologies and processes that produce, consume or manage heat and hot water for the best and most efficient use. Here are examples of smart heat, some which represent new technologies and others tried-and-true approaches not used to their full potential in our nation's energy portfolio.

- **SMART HEATING, VENTILATION AND COOLING (HVAC) CONTROLS**
  These devices adjust temperature and air flow based on occupancy or other parameters in a room, often using automatic or remote mechanisms. Occupancy sensors, for example, might sense when an office empties or fills and then wirelessly signal to a thermostat to adjust heat or air conditioning accordingly. Smart thermostats use wireless technology to help building managers work from a central portal to track and control heating, cooling, humidity and fan settings for multiple locations within the building.

- **EFFICIENT WATER HEATING/COOLING/REFRIGERATION**
  These products cover a broad range from building hot water heaters through industrial processes. Many utilities, for example, now offer demand-side management programs for hot water heaters.

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[8]ConocoPhillips, http://www.conocophillips.com/EN/about/energy/energytypes/pages/naturalgas.aspx

[9]Wall Street Journal, "Natural Gas Can Put Americans Back to Work," October 25, 2011, http://online.wsj.com/article/SB10001424052970204346104576637282988036502.html?mod=googlenews_wsj

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When prices spike on the electric grid, the utility remotely turns down the temperature of the hot water, saving the customer money. Businesses also can now install super high efficiency hot water heaters that use advanced thermodynamics to extract energy from the environment. A cutting edge natural gas engine, combined with heat pump technology, supplies highly useful heat and hot water in a compact package. The system is more than twice as efficient as a conventional gas-fired boiler and emits significantly less emissions.[10] It's very important to achieve maximum energy efficiency in heating water because it represents the second largest use of energy in most buildings, exceeded only by space heating.[11]

→ CHP AND INDUSTRIAL WASTE HEAT RECOVERY

These systems recover the heat produced in either the manufacture of electricity or from an industrial process, and then put it to good use. About two-thirds of the fuel that power plants use produce heat that serves no purpose. As a result, the US' fleet of centralized generation is only about 33 percent efficient, according to the US Environmental Protection Agency.[12] CHP systems, on the other hand, achieve efficiencies of 70-90 percent because they reuse the heat produced directly in a building. Additionally, since CHP systems are installed on site, they avert electricity line losses that occur when power travels over transmission lines. CHP is a tried-and-true technology that goes back to Thomas Edison. But it is now experiencing a strong renaissance with state, federal and utility backing, in part because of the growing refinement in installation practices and better sizing of systems in recent years. The US Department of Energy has set a goal to boost CHP capacity from today's 85 GW to 241 GW by 2030. Installing this much CHP would save 5.3 quadrillion Btu of fuel annually, equal to nearly half of the total energy used by U.S. households per year.[13] CHP holds strong appeal for businesses because it can save them money immediately.[14]

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[10] Ilios High Efficiency Water Heater, http://www.iliosdynamics.com/IliosDataSheet.pdf

[11] American Council for an Energy Efficient Economy (ACEEE), "Emerging Hot Water Technologies and Practices for Energy Efficiency as of 2011," October 2011,http://www.aceee.org/research-report/a112

[12] US Environmental Protection Agency CHP Partnership, Efficiency Benefits, http://www.epa.gov/chp/basic/efficiency.html

[13] Combined Heat and Power: A Decade of Progress, US DOE, August 2009, http://www1.eere.energy.gov/industry/distributedenergy/pdfs/chp_accomplishments_booklet.pdf

[14] ACEEE, "A Look at CHP Markets Across the Country: Sometimes Supportive Policies Aren't Enough," Anna Chittum, September 28, 2011, http://www.aceee.org/blog/2011/09/look-chp-markets-across-country-somet

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ATTRACTIVE FINANCIAL OPTIONS

The industrial sector has long understood the value of heat efficiency. And now the commercial sector is becoming increasingly aware of its importance, a campaign enhanced by the federal government's call for a 20 percent reduction by 2020 in the energy use of commercial buildings. Underscoring this advocacy are a range of state, federal and utility financial incentives that make CHP, heat pumps and other efficient heating and cooling technologies more affordable. (The EPA's CHP Partnership provides a frequently updated list of incentives on its website: http://www.epa.gov/chp/funding/funding.html.) Equally important, the CHP and efficiency industries have developed a range of financing options, such as an on-site utility program, that spare the customer upfront costs, operating responsibilities, fuel costs and other risks, so that they can see immediate energy savings and positive cash flow from installing CHP.

WHAT'S THE NEXT STEP?

The time has come for business and building owners to investigate thermal efficiency and make it an important part of their energy portfolio. Whether your goal is to save money, improve your environmental profile, or contribute to US energy independence, your heating and cooling systems are as important as your electrical systems. As you consider ways to improve your energy profile, take a close look at your building's thermal applications. And consider the opportunity to capture and reuse waste heat. It is the smart thing to do.

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American DG Energy Inc. (www.americandg.com) and our subsidiary, EuroSite Power Inc. (www.eurositepower.co.uk), are the leading On-Site Utility offering clean electricity, heat, hot water and cooling to many types of businesses in the United States and Europe. We sell the energy produced on-site as an alternative to the outright sale of energy equipment. We design, install, own, operate, maintain and optimize complete combined heat and power (CHP or cogeneration), chiller cooling systems, and advanced hot water heating systems tailored to a customer's specific site requirements. With the largest installed base of packaged systems, we uniquely combine energy savings that improve the environment with exceptional economics.

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