Plant Success Energy Leadership Series
Dayton, Ohio -- 19-21 May 2009
A Synopsis

Introduction

Over the past 10 years, PlantSuccess (www.PlantSuccess.com) has brought executives and other decision makers with leaders in oil & gas and chemicals manufacturing together at 20+ conferences in the North American manufacturing centers of Philadelphia, Houston and Calgary. The conference theme is "Best Practices Driving Plant Performance"; the focus is leadership and other key requirements for achieving Operational Excellence.

With energy a leading issue and the need for leadership even greater, we saw a good opportunity for the USAF and industry to use the PlantSuccess format to can share the experience and benefits of "Best Practices". Working with Ken Eickmann, Lt. Gen. USAF (Ret.), and Jim Porter, recently retired as DuPont's Chief Engineer and vice president of engineering & operations, we organized the launch of our Energy Leadership Series and we're very pleased with the results.

This conference focused on information exchange between leaders, primarily from industry and academia steeped in energy knowledge and good practices, and U.S. government representatives, primarily Air Force, hoping to capitalize on that know-how to make their operations and facilities more efficient from an energy-usage standpoint. The proximity to Wright-Patterson Air Force Base was not coincidental as WPAFB is engaged in important energy-related projects (e.g., alternative fuels for aircraft), and its leaders are looking to the possibility of achieving a future "net-zero" energy state for the installation.

Levels of interest other than Wright-Patterson were served by this gathering. The topics and practices addressed had applicability to the growing energy awareness and concerns of all-service military forces and facilities world-wide plus U.S. civil establishments across the globe. More specifically, notions of sustainability and resilience apply to both military and civil institutions (e.g., industrial plants), and at the core of those notions are reliable, secure, and affordable energy supplies. By one estimate, roughly two-thirds of the operating costs at plants whose leaders talk about processes involve energy!

The conference agenda identifies the speakers, their topics, and the executive panels. The presentations will be available for downloading at www.EnergyLeadershipSeries.com. This overview is intended to do nothing more than highlight the key messages that emerged during the conference. These messages aligned into major themes, which cut across the agenda. Using this framework, the themes below are:

- Energy: It's a Big Deal
- Energy Supplies (Including Alternatives)
- Best Practices
- Paths to Solutions and Issues

Energy: It's a Big Deal

New global realities facing the United States include unpredictable energy prices, dependence on imports, climate-change legislation, under-invested energy infrastructure, China and India as major new energy customers, and blackouts (caused by nature or man-made). U.S demand constitutes about one-

fourth of global energy demand, and our nation pays almost a fourth of the world's cost for energy ($1.5 trillion out of $6.5 trillion). World energy demand is expected to double by 2030, and the days of "cheap" U.S. energy use are over. Three fears are aligned -- a perfect storm: volatile prices, availability, and climate change. Welcome to Europe in 1968 [Europe entered this crisis much earlier and got a head start improving efficiencies, using renewables, and cutting emissions when compared to the United States]!

Much of current U.S. energy is "waste" heat; only a relatively small amount of generated energy gets to the final product. So, how well is the United States spending its $1.5 trillion? The "dirty secret" is U.S. buildings, which consume large amounts of energy and could be made much more efficient. U.S. priorities should include efficiency, heat recovery, co-generation, renewables, and investing in utilities where it makes sense. Planning and implementing improvements for installations and communities could bring substantial efficiency increases.

Strategic drivers for the Department of Defense (DoD) include reducing dependence on foreign oil, security of supplies, concern about economics and price volatility [DoD energy costs have doubled since 2006 even with less consumption], not inhibiting operations because of scarcity of fuel, logistics of moving fuel, and increasing use of energy by military systems. Goals include reducing installation energy demand (especially at forward bases), increasing resilience, making energy a part of business processes and planning, and establishing and monitoring energy metrics.

Air Force energy use in 2008 cost about $9 billion (8/9 for aviation and ground equipment, the rest for facilities). The vision is to make energy a consideration in all we do -- reduce demand, increase supply, and change the culture. The goal is to certify the fleet on alternative fuel by 2011 and, by 2016, to have half of domestic fuel use be alternatives. Wright-Patterson is a good place to examine to bring a lot of initiatives and considerations together (e.g., large research and development complex [some parts witnessed by conference participants], large power user, historic buildings, landfills, hospital, old coal-fired steam plant, past nuclear license, user of off-site generated power [but what about its vulnerability?], role for smart grid, role for national security grid on military bases).

Macro-trends seen by industry include energy use and availability, population growth, growing desire to achieve sustainability, and climate-change concerns [U.S. legislation on carbon is coming; cap-and-trade likely by 2012]. Some common themes are saving energy (or water); using salvaged, recycled, or "waste" materials (e.g., making new glass or insulation from recycled products requires much less energy, and there is no such thing as "waste" heat -- heat is a utility); conserving natural resources; avoiding toxic emissions; and contributing to safety. U.S. buildings and approximately 80 million under-insulated U.S. homes are large potential gains if "best practices" were employed. Unfortunately, home-building industry is resistant to change because of the desire to keep initial prices low.

Energy Supplies (including Alternatives)

Half of total U.S energy is generated by coal, about a fifth by nuclear, and another fifth by gas. The United States is the "Saudi Arabia" of coal. However, coal usage in individual U.S. regions is much more diverse (e.g., small to large percentages, depending on location), so the views of people in those regions on the importance of coal and on regulations controlling the use of coal varies. Burning coal means CO_2 output, so coal plants cause concerns about climate change. Carbon is now a key determinant of what new plants to build. Many new natural gas plants were built in the 1999 to early 2000s time frame, and more may be built in the future because of concerns about coal. Wind is promising, but how to store

energy from wind plants in the mid-U.S. and along the coasts and transmit it to other populated areas is an issue. [Operators can work around the periodicity of wind when it is predictable, as in California.] Solar is best in the Southwestern U.S.; the cost of solar is coming down.

More nuclear plants are another future alternative, but relatively few utilities are able to build and operate nuclear plants. One nuclear venture, Hyperion (28 megawatts electric), was discussed; a first unit was claimed to be available in 2013. The Air Force has considered the possibility of nuclear plants on bases, and the CEO of Hyperion Power Generation Inc offered to give two plants to the Air Force. The Army would likewise be willing to consider nuclear plants on bases. Licensing could be an issue for such plants, and their near-term deployment to war zones was judged unlikely. [Note: recycling used fuel and using breeder reactors, as in other nations, can make use of most of what is now called nuclear "waste."]

Biomass represents an interesting alternative for the Southeast U.S. Logging, switchgrass, and poplar would be the sources for making biofuels (ethanol). Switchgrass, the current preference, requires relatively little use of chemicals and fertilizers; its production is similar to hay. The State of Tennessee, partnering with Oak Ridge but led by the University of Tennessee, has committed $70 million over five years to a pilot biofuels capability slated for completion by the end of 2009. Commercial-scale production would be 250,000 gallons of "grassoline" per year by about 2012 or 2013. [Land yield of ~10 tons per acre and 100 gallons per ton, so ~1,000 gallons per acre, for which farmers would get $450 per year; overall switchgrass yield is factor of ~10 for energy in versus energy out -- much better than corn.] Feedstock availability and cost are the biggest future issues. An integrated business supply model is needed for storage and seed production.

"Smart" grids were discussed at various times. One goal expressed was to have nearly all nodes able to use nearly all sources of energy supply. The current U.S. grid is very complicated, and utilities are concerned about changing to a more distributed system because of changes that might make to the overall system. Some favor looking to more regional structures for control and getting away from long transmission lines.

Best Practices

Several speakers at the conference described best practices, the sharing of which is a strength of the PlantSuccess conferences. One speaker repeated another company's phrase "only use what you need, when you need it, in the amount needed." He also emphasized a different company's criterion for heat: If an effluent stream leaves a plant at greater than room temperature that’s a failure. "Worst" practices also should be shared so others can learn! Share from site to site without funneling through headquarters.

A manufacturing company representative focused on global energy management with the elements common to Six Sigma: Define, Measure, Analyze, Improve and Control. Monthly meetings with all global sites are held to address energy matters and share experiences; a major focus is on heat recovery. Similarly, another company representative indicated that energy management is a major business focus of his firm, which has dozens of manufacturing plants around the world. The most important aspects are people, organization, relationships, and networking, through which the most efficient plants are to help the least efficient! Collect global metrics and install meters. Recognize that energy is not a fixed cost; rather, it is one of the biggest costs. Elements of a plan are to establish goals, have a champion for energy, empower teams, conduct assessments, conduct projects, communicate about energy, and

reward successes. Consider technology options for the future (e.g., when old equipment breaks, buy new, more efficient equipment). In short, people relationships are the most important; new technologies will help; we have the know-how to improve; and we can be profitable and energy efficient at the same time.

Another speaker described a "footprint" technique for measuring how well her company was doing on several fronts. The seven-sided footprint addressed key energy parameters (e.g., energy use, green-house gas emissions, water use, and waste-to-landfills). The footprint shape and size would change over time with progress, or lack thereof, on each parameter. A good visible indicator, both for goals and for progress in meeting those goals!

Three big "buckets" for corporations are an energy management plan, sustainability goals, and a carbon value. These will increase shareholder value while decreasing the energy footprint and energy costs. Give corporate decision makers data on energy when they consider other steps, such as mergers and acquisitions. Leadership must learn, teach, and learn; a positive attitude is critical. This one is never over; we're all in the energy business now.

Energy models (and related metrics) will become increasingly important, and best practices are relevant here as well. Energy modeling can be "gamed" (e.g., 13 different assessments of green-house gases yielded results differing by a factor of three), so rules and tools must be clear to everyone. Guidance is needed and, recognizing the need for consensus among analysts, regulators, etc., the Air Force has come up with a stakeholder agreement document for green-house gas emissions from aviation fuels. What's next ... perhaps agreement on metrics for net-zero for Wright-Patterson?

Paths to Solutions and Issues

Solutions are systems, not single golden BBs; must make all the pieces work together. This is systems engineering, a grand challenge (e.g., figure a way to use carbon rather than sequestering it back into the earth). Profit motives drive industry. Integration of facilities is very important. Don't be afraid of big targets. Need substantial, sustained attention to the problems, people staying involved for long periods, in order to bring about persistent gains -- decades of consistent commitment, years of consistent execution. Also, must create an energy-knowledgeable work force. Understanding processes and how energy is being used are key; it’s back to basics! In addition, consider technology demonstrations through pilot projects and explore net-zero applications.

If you don't have a plan, you don't know where you are going. The Air Force has a plan. The pillars are to improve current and future infrastructure, expand renewables, and manage costs. The law mandates reducing use of fossil fuels. Although it appears fairly well defined what the Air Force wants to do, changing the mind-set will be the biggest challenge. The Army has an energy strategy as well, with goals to reduce consumption, increase efficiency, increase renewables and alternatives, assure access to meet mission requirements, and create a culture of energy awareness. Both the Air Force and Army have projects underway at various locations (e.g., solar arrays at Nellis and Fort Irwin, alternative fuels for aircraft, reduced drag for aircraft and lighter weight materials, small engine efficiencies for unmanned aircraft, replacing 4,000 vehicles with electrics, geothermal, biomass, foam insulation for tents, energy management for future aircraft). Also, there are opportunities for energy improvements when existing systems go into depots for repair or retrofit.

The entire DoD needs a department-wide strategic plan, but that is not yet published. Whatever goals

and objectives emerge need to be turned into best practices and measurable results. Energy education for officers and enlisted personnel is also needed.

A senior commander told the attendees that national security and energy security are entwined. However, the attendees recognized that the military faces several issues in connection with energy. For example: What is energy security worth? Where will the funds come from? Will energy matters be directed by the Office of the Secretary or by individual services? What about state and federal regulatory environments, such as limits on green-house gases? Also, some believe more metering is needed at military bases. If a plant were to make synthetic fuels for the military, an issue is how to guarantee that plant a continued demand (or a guaranteed price) even if the market price of fuel collapses.

For particular bases (e.g., at Wright-Patterson), can one obtain data to permit looking first at "low-hanging fruit? [At least one Air Force representative was not comfortable with the data now available, not having seen deep mining and trends. But a different view was that data is not the issue; rather it is the way it is bench-marked and consistent.] An Air Force base is like a small city, so perhaps look at how a town in Europe would build a 30-year energy plan. Why not let the government be a first adopter? Build a model at a base, then replicate it across the United States at garrison operating locations as well as overseas (e.g., in Afghanistan). The military could be used as the "tip of a spear" to push new energy ideas; renewables on military bases are a tremendous opportunity.

Big lessons learned from a base commander's past experiences: we must work together to be sure of communicating clearly and unambiguously, sharing information, collaborating effectively, and moving ahead in a coordinated fashion to achieve the desired results. Also, information must be put into a usable form for presentation. Another speaker with past government experience urged everyone to contribute to the military missions, whether it be on Summer Studies or writing articles or actually serving.

Energy has not been a primary driver for the military in the past and visionary leadership on energy is needed. This means substance, wisdom, and strategy, plus the guts to do it. Set the bar high! Also necessary are continuous attention to detail and leaders who walk the talk. Leadership may have to use an energy "set-aside" if immediate cost returns from energy improvements are not evident [one speaker believed such set-asides are critical for the first five years]. With respect to acquisition, should energy requirements influence not only buildings but perhaps be included in critical performance parameters for new systems (e.g., fully burdened cost of fuel)?

We cannot let this process end here; the information must be shared and gotten out to all! For additional information, please contact: Carl.Howk@PlantSuccess.com or at 770-565-3282.