ABSTRACTS

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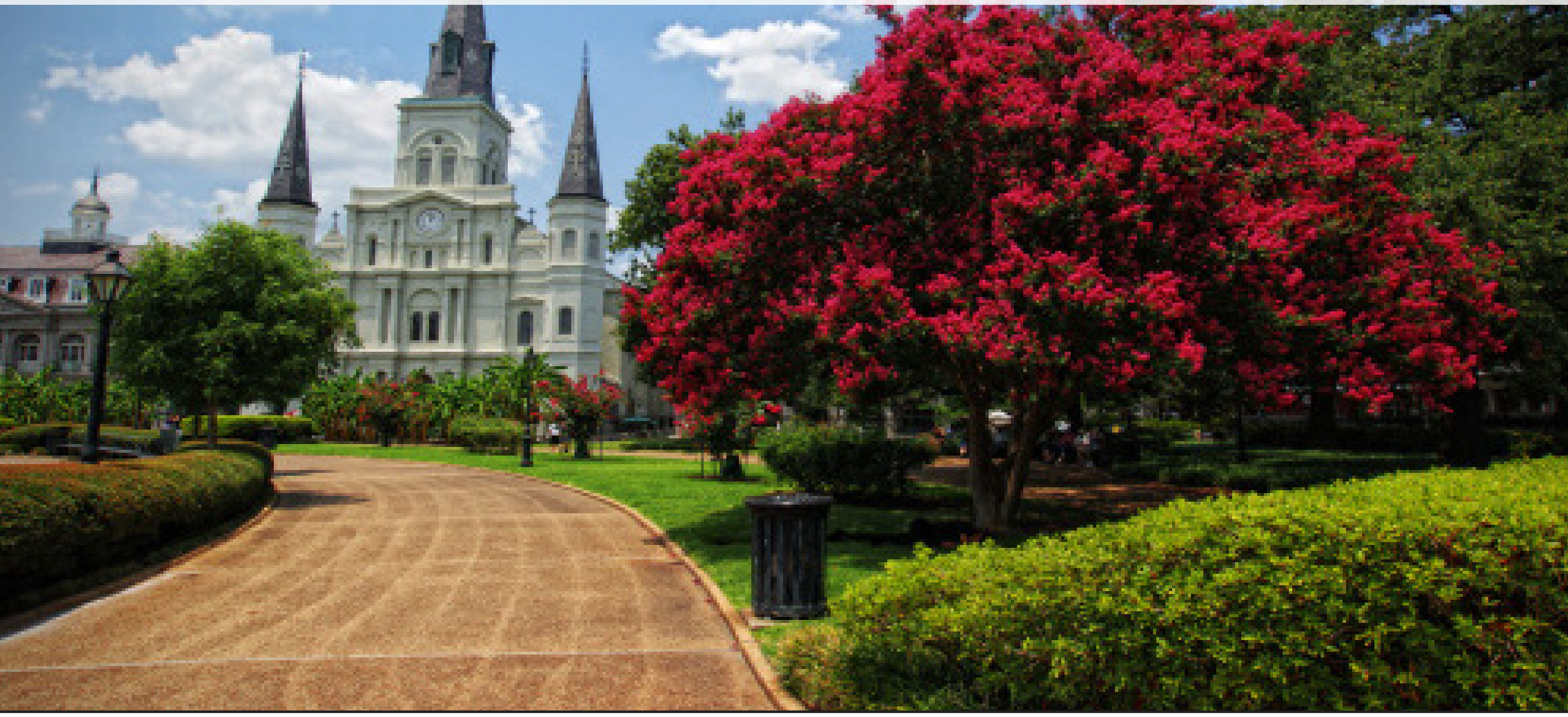

Energy Systems Laboratory

LOUISIANA DEPARTMENT OF NATURAL RESOURCES

MAY 21 - 24, 2013

ASTOR CROWNE PLAZA HOTEL

NEW ORLEANS, LOUISIANA

OVERVIEW OF INDUSTRIAL PROGRAM MODELS

Authors: Daniel Trombley, American Council for an Energy-Efficient Economy and Bob Taylor, Energy Pathways

As more governments and utilities begin to look to the industrial sector for energy savings, they will be looking for information not just on what types of programs to offer, but also on how to structure programs that target the industrial sector. Industrial energy efficiency programs at the state and provincial level in the U.S. and Canada have years of experience developing and supervising energy savings delivery systems under contract or regulatory frameworks. However, this wealth of experience is not broadly known.

This paper examines a number of industrial energy efficiency programs run by U.S. states, Canadian provinces, and energy utilities. While these programs all have the same goal of buying the greatest amount of incremental energy savings per dollar of public funds, the models used vary substantially. This paper discusses several key elements of the different institutional models and some pros and cons associated with them. Key research questions include:

1. What delivery institution should be used?
2. What funds should be used and how should they be managed?
3. What purchase targets should be set and through what process?
4. What type of contractual arrangements should be used?
5. What kind of monitoring and verification processes should be used, and who should be responsible?

The objective is to highlight as clearly as possible the lessons learned in program design and implementation in key states and provinces. These findings are presented for the practical consideration of other governments in their efforts to develop or upgrade their own industrial energy efficiency efforts.

INDUSTRIAL ENERGY EFFICIENCY TECHNICAL REVIEW GUIDELINES AND BEST PRACTICES

Author: Nick Dalziel, presented by Allan Dicion, Willis Energy Services

The role of technical review is to mitigate risk to DSM program administrators. If done effectively, technical review should aid the cost effectiveness of DSM programs by improving on targeted net-to-gross ratios and savings persistence. Ex-post impact evaluations of programs have detailed protocols for evaluators to follow, however those conducting the technical review of ex-ante projects have limited guidance material to follow. The objective of this paper is to assess the benefits and costs of ex-ante technical review for large, unique and, primarily, industrial projects to develop a framework for technical review practice that advises an appropriate approach and rigor for maximizing the cost-effectiveness of DSM programs.

Methodology and Scope of Research:

1. Empirical analysis of reported energy savings at the application, reviewed (contracted), measurement and verification (M&V) and evaluation stages for multiple industrial incentive programs.
2. Identify examples of appropriate approaches to technical review based on empirical results.
3. Develop methods to screen potential projects to maximize program cost effectiveness, considering the effective useful life, free-ridership (partial and deferred) and incremental savings and costs.
4. Develop stratified approaches and practices for performing base case, measure and cost analysis.

LEAN ENERGY AND SAVINGS: ENERGY IMPACTS OF LEAN MANUFACTURING

Authors: Richard Milward, Kim Brown, Chad Gilless, EnerNOC

Most utility energy efficiency programs for industry focus on replacing equipment with more efficient alternatives. A key reason for this is to increase confidence in the amount of resulting energy savings. Utility programs that focus on behavior, that is, using a piece of equipment more optimally, often suffer from a perceived inability to accurately quantify savings.

This situation is unfortunate because the last few decades have seen a proliferation of Lean Manufacturing practices across industry, where organizations focus on eliminating seven wastes: excess product transport, excess inventory, excess movement, waiting, overproduction, over processing, and defects. Energy can be a component of each of these wastes, but challenges in quantifying results have slowed the inclusion of Lean in utility energy efficiency programs.

In 2011, the Northwest Energy Efficiency Alliance completed the Manufacturing Extension Partnership (MEP) Energy Project, an effort that applied energy concepts within the MEP organizations of the Northwest. A critical component of this project was to quantify the energy savings from a Lean implementation at a food processing facility served by one MEP organization. The project team used a combination of top-down (facility-wide) and bottom-up (end-use) approaches to estimate the resultant energy savings. This paper will provide details on the project approach, results of the project, and next steps to refine and improve the approach for the future.

INDUSTRIAL ENERGY: COUNSELING THE MARRIAGE BETWEEN ENERGY USERS AND EFFICIENCY PROGRAMS

Author: Christopher Russell, American Council for an Energy Efficient Economy

Industrial energy users and the efficiency programs that serve them enjoy a long and storied partnership. Each partner operates with the best of intentions, but with agendas that are not always reconcilable. At best, this yields a marriage that is not as fruitful as it can be. At worst, it creates alienation and wastes the value that this union has the potential to generate.

Most marriages need periodic renewal, as the partners pause to take stock of their past progress and their future vision. The marriage of industrial energy users and programs is no different. The first decade of the 2000s witnessed shifts in industrial output and productivity. Add to this changes in global economic activity, and the stage is set for a renewal of domestic manufacturing, albeit for some industries more than others. This also implies an opportunity to evolve industry's relationship with energy programs.

If industrial energy efficiency is to reach its full potential, programs must evolve beyond a courtship based on the "low hanging fruit" of easy, low-cost improvements. What began as an effort to reduce utility bills can become a strategic partnership for boosting industry competitiveness and economic growth. This approach necessarily involves capital investment choices. Aside from the usual technical analyses, industry managers and program administrators will need to effectively navigate the procedures and politics of corporate investment. This suggests an evolution in energy program communications and conduct.

This paper compares the business-as-usual marriage between industry and energy efficiency programs. Drawing from a survey of stakeholders, we extrapolate lessons-learned and offer a vision for sustaining that marriage in the future. What are the opportunities and rewards? Equally important, how can the partners work together more productively? What does this vision imply for future program design and conduct? This paper, submitted for the 2013 Industrial Energy Technology Conference, will offer suggestions. A companion social media platform will invite readers to react with comments that will refine our basic vision. Our intent is that this document will evolve into a public discussion—one that we hope lasts far beyond the close of the conference.

RECENT DEVELOPMENTS IN CHP POLICY

Authors: Kate Farley and Anna Chittum, American Council for an Energy-Efficient Economy

The attractiveness of a combined heat and power (CHP) project is highly dependent on the policies of the state in which it is located. State regulations that address factors such as interconnection, net metering, standby rates, as well as availability of grants, loan guarantees, or other financial incentives, are all extremely important to project success. States with policies that are favorable to CHP are better positioned to support more of these successful, cost-effective CHP projects. In order to meet the goal of 40 GW of new CHP by 2020 set forth by President Obama in his Executive Order, many states will need to advance policies to better support increased CHP deployment.

This paper will provide an overview of state-level CHP policies across the country, with an emphasis on recent policy changes and improvements. Each year ACEEE assesses the status of these policies, and this paper will reflect overall findings from 2012 and identify new trends in 2013. State-level best practices in CHP policy development will be identified and described. This paper will also take a closer look at several particular states that are notable for implementing new and novel CHP-friendly policies, increasing their attractiveness to CHP developers. These states include Texas, California, and Ohio. We will look at lessons learned from these states and how similar policies could be applied in other states.

Additionally, this paper will consider the impact utility policies have on CHP deployment. Utilities have a disincentive to invest in CHP, as CHP, like all energy efficiency projects, reduces demand for grid-provided electricity. Several states have begun to implement policies that attempt to encourage utilities to invest in more CHP, by offering utilities a return on their CHP investments. We will also touch on the impact of lower natural gas prices and CHP deployment.

This paper will help facility managers, investors, policy makers, and regulators better understand and consider the policy options available to them to help hasten utility-led CHP deployment around the country.

TECHNOLOGIES TO RECOVER LOW TEMPERATURE WASTE ENERGY IN CHEMICAL PLANTS AND REFINERIES

Authors: Kathey Ferland, Texas Industries of the Future, The University of Texas at Austin, Jim Quinn, Institute for Industrial Productivity, and Riyaz Papar, Hudson Technologies.

The speaker will present the results of a Technology Forum held in May 2012. The need for technologies to recover low temperature waste energy in chemical plants and refineries was identified by the Texas IOF Chemical and Refining Advisory Committee. Low temperature was defined by the industry group as below 400° F. Their streams were also characterized as to state, flow rate, heat content, source and temperature. A review of available technologies was conducted and four technologies were targeted for further exploration at the Technology Forum: organic rankine cycle, fuel cells, kalina cycle, and absorption chilling. Each technology was characterized. Results from a prioritization process will also be presented, with an overview of the waste energy scoping tool requirements.

INNOVATIVE SELF-GENERATION PROJECTS

Author: Liam Kelly, Willis Energy Services

Objective: This paper presents innovative self-generation projects at three industrial facilities. The objective of this paper is to assess the costs and benefits of each project and provides an assessment of the potential for similar installations within North America.

The three projects:

Heat Recovery at a Cement Plant

- A waste heat recovery (WHR) system, which will involve the utilization of waste heat from the clinker production process.
- The recovered heat is expected to generate approximately 5 MW of electrical power.
- The waste heat will be used to produce steam, in a heat recovery steam generator (HRSG), which will be fed to a steam turbine generator, to produce electricity.

Quad-Generation at a Confectionary Manufacturing Facility

- The primary mover of the combined heat and power system is a natural gas fired turbine.
- The system is designed to supply the plant with electricity, steam, hot water and chilled water.
- The high temperature exhaust heat will be directed to a HRSG to produce steam for process use.
- The low temperature heat, downstream of the HRSG, will be used to supply hot water and fuel two absorption chillers.

By-Product Gas Generation at a Steel Mill

- A steam-driven turbine generator set using steam produced from the combustion of by-product gases from the steel-making process.
- Blast furnace and coke oven gas, previously flared to atmosphere, is expected to generate approximately 5 MW of electrical power.

Methodology: Benefits and Costs – The assessment of benefits and costs will be based on incentive application, technical review results and updated detailed design and commissioning information for each project, where available.

Industry Potential – The applicability of each project to various industries will be analyzed based on the likely availability of waste heat or gas and existence of various (high and low grade) thermal loads. The total potential will account for applicable industry size, as well as consider implementation barriers and enablers, such as regulations and existence of incentive programs for self-generation.

Results: The industry potential results will be presented as a spectrum of technical, economical and achievable potential.

INNOVATIVE ENERGY CONSERVATION THROUGH SCRAP PRE-HEATING IN AN ELECTRIC ARC FURNACE

Author: Allan Dicion, Willis Energy Services

Objectives: This paper will present an innovative energy conservation technology for scrap pre-heating in an Electric Arc Furnace that is being implemented in an industrial facility in Ontario. The objective of the paper is to examine the electrical and operational benefits of implementing this technology, as well as the challenges in accurately evaluating the project viability as part of an incentive program.

Highlights of the conservation measure are as follows:

- Recovery of heat from furnace off-gas to pre-heat scrap metal prior to charging in the ladle
- 10% reduction in specific electrical energy (measured in kilowatt-hour per ton of liquid steel)
- Reductions in oxygen, carbon and electrode usage
- Increased production rate due to decreased tap-to-tap time

Methodology and Scope of Research:

1. Similar technologies will be researched for comparison to this newer scrap pre-heating technology with regards to configuration, costs and benefits.
2. The assessment of the new technology's benefits as determined through the technical review process.

Results:

The results of the paper will present the evaluation of the potential benefits based on results from a planned implementation of scrap pre-heating in Electric Arc-Furnaces.

RECOGNIZING AND EVALUATING IMPROVEMENTS IN COOLING WATER TEMPERATURES

Authors: Peter Phelps, Phelps Engineering Company

In a cooling water system older cooling towers are often an overlooked source of major energy savings. Upgrading a tower is an option and it is often possible to improve a tower's temperatures by over 3F by the proper use of the high efficiency fill heat transfer media. Knowing how much improvement you are going to get and the cost for reaching that improvement are good first steps in a cooling water improvement project, but a major part of the evaluation is missing. The next important step is to put a value on what those degrees of colder water are worth to a plant. This will often be in terms of energy savings. We will look at a generic case study to show what sort of improvements would be possible for a plant with an older cooling tower, and then go through the process of placing a value to the plant for those improved temperatures. The purpose of this paper is help you recognize that the cooling tower and the whole cooling water system is a source of energy savings, to help you get an idea of the amount of cooling water temperature improvements that are available, and then go through an example of a tower user placing a value on how much those temperatures are worth. This paper is co-authored so you get expertise from the cooling tower industry and expertise from a chemical company's in-house engineering staff.

WASTEWATER RECYCLE: A SUSTAINABLE APPROACH TOWARDS DESALINATION

Authors: Arun Mittal and C.K. Tiwari, Aquatech International Corporation, USA

Rapid depletion of fresh water resources, ever increasing growth of industry and associated power requirement, wastewater recycle continues to gain prominence in the industrial desalination market. The other major driver for wastewater recycle is stricter discharge regulations limiting quantitative load of bulk pollutants e.g. TSS, BOD_5, COD etc. and having very low limits for select contaminants e.g. selenium, mercury, arsenic etc. Treating the wastewaters to achieve these stringent regulations provides reasonable economic justification to opt for the treated effluent recycle at fraction of additional cost. In fact, in certain cases, to meet low limits for select contaminants as identified above, it may be beneficial to go for zero liquid discharge (ZLD). Aquatech is one of the few select companies which can offer an integrated wastewater treatment, recycle and ZLD system not only complying with statutory requirements but also recovering high quality water with low dissolved salt content for recycle in industrial processes. This paper discusses various case studies on Aquatech's experience on providing recycle or ZLD systems for industrial applications such as power plant, refinery and petrochemicals. The paper focuses on the specific energy consumption for each case and compares with energy consumption for an equivalent seawater desalination system.

IMPROVING COOLING TOWER EFFICIENCY

Author: William Turpish, W. J. Turpish and Associates, PC

Two methods of improving cooling tower efficiency in process applications will be presented:
1) Improved splash bar fill which disperse the water more effectively to improve evaporation and therefore the cooling capacity of the tower.
2) Filtration of the process water to reduce circulating dirt and to reduce fouling in the cooling tower as well the process heat exchangers.
Presentation includes a discussion of the type and size of the dirt particles most commonly found in process towers.

THE WEF ENERGY ROADMAP: DRIVING WATER AND WASTEWATER UTILITIES TO MORE SUSTAINABLE ENERGY MANAGEMENT

Author: Barry Liner, WEF, and Lee Ferrell, Schneider Electric.

"Wastewater treatment plants are not waste disposal facilities but are water resource recovery facilities that produce clean water, recover nutrients (such as phosphorus and nitrogen), and have the potential to reduce the nation's dependence on fossil fuels through the production and use of renewable energy and the implementation of energy conservation." (WEF Renewable Energy Position Statement)

The Water Environment Federation (WEF) and industry leaders have identified the need for an energy roadmap to guide utilities of all sizes down the road to sustainable energy management through increased renewable energy production, energy conservation and focus on overall energy management.

This roadmap leverages the framework developed in the electric power sector to move to "Smart Grid" technology: The Smart Grid Maturity Model (SGMM). The basis of this material originated at a workshop of water and power industry leaders convened by WEF in North Carolina, in March 2012. Case studies were analyzed from successful utilities in Austria, Holland, Australia, and the United States. High level, strategic best practices were identified and organized into topic areas, which define the level of progression (enable, integrate and optimize) towards achieving energy sustainability. As a living document, the roadmap is always under review by dedicated groups of industry.

A number of utilities worldwide have already taken the leap and begun this transformation towards resource recovery and many more are peering over the edge. The WEF Energy Roadmap is intended to guide utilities of all sizes as they progress towards becoming the treatment plants of the future. While it is not practical for all wastewater treatment plants to become energy positive or neutral, all can take steps towards increasing energy sustainability.

On average, the energy content of wastewater (chemical, hydraulic and thermal) is greater than the energy required to treat it. However, becoming net energy positive is not the only goal. Optimizing overall sustainability may actually require using more energy or producing less energy onsite. Treating wastewater to higher standards is often more energy intensive. Similarly, using biogas as a transportation fuel reduces onsite power production and increased energy use is required to further process biosolids to maximize reuse potential and to recover nutrients and minerals (e.g., nitrogen, phosphorous, magnesium).

The balance between energy efficiency and resource recovery involves tradeoffs and can best be achieved through holistic process planning. The more resources are recovered, the less energy is available for generation or the more energy that is consumed. These tradeoffs must be understood and managed to achieve your utility's particular sustainability goals. There is no one model.

AN AUTOMATED PART TRACKING AND METROLOGY SYSTEM FOR INCREASING ENERGY AND PRODUCTION EFFICIENCY

Authors: Franco J. Morelli, Tyler R. Halbert, Micah J.R. Hignight, Zach D. Kell, Justin M. Lacy,
Texas A&M University

This paper presents a case study in the design of an automated part tracking and metrology systems for an industrial manufacturing system. A major productivity challenge of this facility is managing each batch of parts as it is formed, treated, and processed. Currently this is handled with paper forms that are transferred manually with each batch, resulting in scheduling problems, lost parts, and a general lack of ability to track orders through the production process. Problems in quality control also lead to significant waste. Required part measurements are taken and recorded manually, and are not considered reliable by plant management. The prototype design is an automated part tracking and quality control system to enhance productivity. The system uses RFID technology to identify parts, associate them with particular order, and giving management real-time information on the location of any product batch in the plant. In addition, part measurement quality control is enhanced with digitized calipers and scales, thus increases reliability of part measurement accuracy through human error reduction.

IMAGE RECOGNITION SYSTEM FOR AUTOMATED LIGHTING RETROFIT ASSESSMENT

Authors: Keele Venable, Robert Weiser, Deepak Bhatia, Ryan Coverick, Cassandra Gutierrez, Joseph Knight, Dylan McGarry, Kathryn McGee, Harsh Patel, Zachary Smith, Trevor J. Terrill, Brad Vanderford, Kimberly Wightman, Bryan P. Rasmussen, Texas A&M University Industrial Assessment Center

Buildings are responsible for approximately 40% of all US energy use and carbon emissions. Building HVAC and lighting systems comprise the bulk of this energy usage. Lighting technologies continue to evolve, leading to potential energy savings through retrofits of lighting systems. Building lighting systems is typically the first item evaluated by commercial and industrial energy auditors. This task is repetitive and relatively simple. This paper presents the first phase of a project to develop Unmanned Aerial and Ground Vehicles capable of conducting autonomous energy audits of commercial buildings. The paper presents a prototype system that can enumerate and classify the lighting in a building using an optical camera, spectrometer, and distance sensor. As the aerial vehicle navigates throughout a room, the prototype system captures images and collects frequency data of lighting. The system employs image recognition techniques to quantify lighting in each room. Using the unique frequency spectrum of each lighting type, the prototype system classifies the different types of lighting with the spectrometer. An accompanying software program then analyzes the quantity and type of lighting to recommend economical alternatives, or lighting retrofits.

IDENTIFYING EFFICIENCY DEGRADING FAULTS IN PACKAGED AIR CONDITIONING SYSTEMS

Authors: Trevor J. Terrill, Mathew L. Brown, Robert W. Cheyne Jr., Andrew J. Cousins, Brandon P. Daniels, Kira L. Erb, Pablo A. Garcia, Maximilian J. Leutermann, Andre J. Nel, Casey L. Robert, Sarah B. Widger, Austin G. Williams, Bryan P. Rasmussen, Texas A&M University Industrial Assessment Center

Buildings are responsible for approximately 40% of all US energy use and carbon emissions. Building HVAC and lighting systems comprise the bulk of this energy usage, and studies estimate that as much as 50% of packaged air conditioning systems operate in faulty conditions that degrade system efficiency. Common faults include: under- and over-charged systems (too much or too little refrigerant), faulty expansions valves (stuck valves, valve hunting, poorly tuned valve controllers), and fouled evaporators and condensers. Furthermore, air conditioning systems can often be adjusted to improve efficiency while continuing to meet cooling loads (adjusting system pressures, decreasing superheat setpoints). This study presents the design of a low cost device that can non-invasively measure system operating conditions, diagnose faults and estimate potential energy savings. Using external temperature measurements, the device potentially can detect and diagnose up to ten faults commonly found in HVAC systems. Steady state temperatures are compared to threshold values obtained from literature and HVAC manufacturers to determine the severity of faults. Preliminary tests reveal the potential for the device to detect and diagnose common efficiency-degrading faults in HVAC systems.

EXXONMOBIL BAYTOWN OLEFINS PLANT PROJECTS, MAINTENANCE AND OPTIMIZATION

Matt Neely, ExxonMobil Chemical Company

The Baytown Olefins Plant (BOP) is part of one of the largest petroleum/petrochemical complexes in the world. The complex strives to meet growing fuel and chemical demands while continuing to improve energy efficiency in the production of basic chemicals, many of which improve the energy efficiency of end use products.

The Baytown Olefins Plant continues to demonstrate a commitment to improving energy efficiency through projects, opportunistic maintenance, and unit optimizations. Building upon the success from previous years, the energy improvements made by the site in 2012 include:

1. Two major projects implemented during a unit turnaround: new efficient compressor installed and an existing compressor was re-rotored.
2. Opportunistic maintenance was identified and executed as part of a long term strategy to optimize maintenance expense and performance: turbine extraction valves were repaired, furnace radiant tubes were replaced, and towers and heat exchangers were cleaned.
3. Unit optimizations provided no cost energy improvements: optimized loads on turbine driven compressors in series, reduced boiler excess oxygen, and balanced pressure drops across the heat exchangers.

RAPID ON-LINE ACETYLENE ANALYSIS FOR HYDROGENATION REACTOR

Esteban Baquero, The Dow Chemical Company

Control and optimization of the acetylene hydrogenation section of an ethylene plant are critical to safe and efficient operation of large scale ethylene plants as well as to downstream consumers of ethylene. The control and optimization of hydrogenation reactors requires rapid analysis of acetylene (C2H2) in crack gas. However, this measurement has been a significant technology gap in the olefins industry for many years, including Dow. Currently, best practice in the industry relies on Gas Chromatography (GC) which is slow (90 seconds or slower) and unreliable.

Recently, Dow has jointly developed and commercialized a rapid acetylene analyzer based on tunable diode lasers that is capable of measuring acetylene faster and with better accuracy than gas chromatography. The development of this laser-based technology was funded in part through the U.S. Department of Energy.

Recognizing the opportunity for improving product quality and advanced process control, Dow implemented two of these improved on-line analyzer systems with stream-switching capabilities for rapid and improved accurate trace analysis of acetylene in a cracker located in Freeport Texas. In a multi-stream configuration, the new analyzer's increased speed of analysis provides a more accurate reflection of process conditions, relative to the GC analysis (over 5.6 minutes). The new online measurement significantly decreased this time down to 44 seconds. This reduction improved predictive modeling and allowed operations to decrease the number of unplanned events and to avoid sending product to flare.

DUPONT LAPORTE REFRIGERATION IMPROVEMENT INITIATIVE

Joel Foster, E. I. DuPont

DuPont LaPorte implemented a refrigeration optimization program, enabling the site to reduce operating costs by 30%. Refrigeration operating costs were perceived to be higher than needed and excess machines were often running. A DuPont LaPorte team analyzed refrigeration machine operation and found that excess machines were frequently in operation and process coolers were operated well beyond the recommended cleaning frequency. The team took a four-pronged approach:

1. An advisory computer program was developed to help operators evaluate the required number of refrigeration machines.
2. A heat exchanger fouling factor program was developed to advise when process coolers needed to be cleaned.
3. Operators were trained to recognize key machine operating parameters, enabling them to identify operating problems much more quickly.
4. A metric was developed to rack monthly machine usage vs. rate.

EXXONMOBIL CHEMICAL PENSACOLA SPECIALTY ELASTOMERS PLANT IMPROVED OPERATIONAL EFFICIENCY
Presented by: Tom Styranec, ExxonMobil Chemical Company

The ExxonMobil Chemical Pensacola Specialty Elastomers Plant achieved its most energy efficient manufacturing year in the history of the plant. Increased awareness of energy usage and potential energy savings opportunities led to a >5% improvement in energy savings for calendar year 2012 compared to 2011 and a 1.5% improvement in energy savings compared to the best year since 2002. Key improvements included:

1. Creation of the Energy Stewardship Team in January 2012 that included representatives from Operations, Engineering, and Maintenance,
2. Shutting down process pumps, fans, and compressors when not in use,
3. Reducing extruder temperatures during extended maintenance activities or planned shutdown events,
4. Improved awareness of energy efficient motors when replacing motors,
5. Improvements in the plant's steam usage practices and procedures.

PLANT ENERGY BENCHMARKING: A TEN YEAR RETROSPECTIVE OF THE ENERGY STAR ENERGY PERFORMANCE INDICATORS (ES-EPI)

Authors: Gale Boyd, Duke University, Department of Economics and Walt Tunnessen, US EPA

Over the past several years, there has been growing interest among policy makers and others in the role that benchmarking industrial energy efficiency can play in climate, air, and other potential regulatory actives. In addition to this policy interest, few companies operate enough similar plants to develop meaningful internal comparisons across facilities. Even those that do still may not be able to answer the question, *"Is my best plant's energy performance above or below average?"* when compared to its industry as a whole. Recognizing that rigorous industry-wide, plant-level energy benchmarking was missing for most industrial sectors in the U.S., the U.S. Environmental Protection Agency (EPA) began developing ENERGY STAR Performance Indicators (ES-EPI) to fill the void. For over ten years EPA has supported the development of ES-EPI. To date there are ES-EPI that are either completed or under development for a dozen industries. Within these industries, ES-EPI account for over two dozen sub-sectors and many more detailed product types. Newer versions, or "updates" for three of the industries' ES-EPI have been developed in recent years. This paper provides an overview of the approach that has been used in this research to develop these ES-EPI; summarizing the industry specific and general findings regarding the range of performance within and across industries. Observations about industrial plant benchmarking and lessons learned will be explored. In terms of the general approach, there are virtually no industries or sectors that are easily represented by a simple intensity, or "energy per widget" benchmark. The range of performance is often normally distributed, but not universally. In terms of general findings, less energy intensive sectors tend to exhibit a wider range of performance than energy intensive ones. However, changes over time in the level and range of energy performance of a whole industry, i.e. "the curve shift", exhibited for industries that have been updated do not reveal any clear pattern; each have unique characteristics. In one case, cement, the industry exhibits substantial "catching up" with low performing plants getting closer to best practice, while in another case, wet corn refining, it is the plants at the frontier of best performance) that are advancing. The third industry, motor vehicle assembly, is a mixture of the two phenomena.

THE ROLE OF VISUALIZATION SYSTEMS IN MANAGING THE ENERGY OF PRODUCTION SYSTEMS

Author: Robb Dussault, PEM, Schneider Electric

By now, the emergence of the "energy dilemma" is universally understood: The convergence of sustainability pressures, rising energy prices, and insatiable demand will have profound impact on our relationship with energy and its effect on the macroeconomy. Especially here in the USA, where 5% of the world's population consumes 25% of the world's energy, our hypersensitivity to this problem means that manufacturers must be the first to adjust in order to remain competitive with suppliers in emerging economies, where operating costs tend to be lower. Even today, there's no shortage of industrial users eager to turn crisis into future profits by taking the steps now to gain control over energy costs and consumption.

Such a strategy makes sound business sense, as the tools and processes associated with a credible Energy Management program not only can pay immediate dividends, but also serves to establish a significant competitive advantage on a global stage. For example, participating manufacturers of the DOE's Industrial Assessment Centers typically realize a payback time of only 1.1 years on energy efficiency investments, and even the most rudimentary energy mitigation initiatives can result in as much as 60% reduction in energy costs[1], which translates up to a 20% advantage in operating costs in certain industries[2].

All this promise has led to the expansion of the presence of energy visualization products, or energy management dashboards, which all claim to offer unique features and attributes that enable the superior management of energy resources. Many of these systems are designed to optimize the energy of building systems and utilities: HVAC, water distribution, pneumatics, boilers, etc. In a typical industrial process facility, however, these systems account for only 16% of the energy demand.

This paper highlights the potential of energy optimization of production systems, and defines five proven techniques, called "process demand functions", that can be leveraged to mitigate process energy. For each process demand function, the role of the visualization system will be highlighted.

[1] Typical savings from VFD conversion project in pumps (Energy Management HVAC and Pump Solutions)
[2] For water systems, energy is 34% of OpEx, and it is 28% for wastewater systems. Source is US EPA and EPRI

EARLY RESULTS OF ISO 50001 DEPLOYMENT BY UTILITY PROGRAMS

Authors: Kim Brown, Richard Milward, Chad Gilless, EnerNOC

Few industrial energy efficiency innovations in the past decade have received as much attention as the ISO 50001 standard for Energy Management Systems. The standard unites organizational business practices in a management system to drive persistent results, and since its release in 2011 numerous companies around the world have deployed it. At the same time, leading utilities have implemented resource acquisition programs that target business practices and management systems, but none have included ISO 50001 as part of that savings strategy.

In 2012, a utility program initiated two customer projects with three objectives: Assist clients seeking to achieve energy management practices to the ISO 50001 level; Attempt to deliver energy savings, as part of the ISO 50001 offering, at a level that meets robust resource acquisition requirements; Lastly, return findings to the utility program on how to refine and expand the ISO 50001 offering for future customers and potentially influence how SEM is deployed to the broader customer base. These projects will be finished in spring 2013. This paper will provide project results against these three objectives, and describe how the utility sees the projects' findings influencing future customer offerings.

IGATE-E (INDUSTRIAL GEOSPATIAL ANALYSIS TOOL FOR ENERGY EVALUATION)

Authors: Nasr Alkadi and Michael Starke Oak Ridge National Laboratory, Ookie Ma, US Department of Energy, Kevin Dowling University of Tennessee, Knoxville, Brandon Johnson University of Tennessee, Knoxville, Saqib Khan, University of Texas, Austin, Sachin Nimbalkar and Daryl Cox, Oak Ridge National Laboratory

Energy Professionals and Researchers are often challenged with initiating projects or performing analyses that are the basis for project approval with limited and/or unreliable information. The challenge is compounded since the energy consumption in industrial facilities is not a function of population densities, geography, or other parameters that are typically used for residential and commercial energy estimation models. Industrial energy consumption is heavily dependent on the type of manufacturing process, plant type, size, location, operational parameters, and many other parameters and is usually proprietary for each plant.

IGATE-E (Industrial Geospatial Analysis Tool for Energy Evaluation**)** is a new tool (currently under development) for industrial energy evaluation applying regression modeling to multiple publicly available datasets comprised of data at the geo-spatial resolution of zip code and using bottom up approaches. Within each zip code, the tool has been constructed to report information on the number of manufacturing plants, size of plants in square feet, number of employees, sales, and calculated energy consumption. Ongoing work in this tool will include process flow diagrams, process steps, and major energy intensive processes (EIPs). Within each SIC Code, the tool will be designed to provide cross cutting energy intensive processes, energy consumption of each process step, load curves, just to name a few. This tool would allow users to filter full datasets based on decision factors such as plants size, sales, number of employees, etc. and thereby limit potential problematic data. The tool estimates energy consumption of different industries based on NAICS and or SIC codes, using IAC and other manufacturing datasets to create regressions (either linear or non-linear) and provides validation against EIA US state level energy estimations. The tool also permits several other statistical examinations.

IMPLEMENTING AN ENERGY MANAGEMENT SYSTEM AT TOTAL PORT ARTHUR REFINERY

Authors: Guillaume Eveno, TOTAL Port Arthur refinery, Andy Hoyle, Senior Consultant, KBC, Guy Dabin, Alexander Proudfoot, Joseph Jacobs, KBC, Vincent Guimera,

Increased supplies of shale gas have driven down the price of Natural Gas and reduced the incentive for US refineries and petrochemical plants to invest in large scale energy conservation projects, such as installing air preheaters on furnaces. However, an energy efficiency improvement program at TOTAL Port Arthur refinery still paid dividends in constraint reduction, lowering carbon footprint and significantly reducing energy cost. The phased approach, from energy strategy development to planning and implementation, incorporated both the technical and organizational aspects of energy management.

A refinery can be considered an interlaced network of energy users and producers whose interactions can have a profound impact on the overall system performance. These interactions have to be considered during the technical analysis. For example, reducing steam usage in one area of the plant can impact a fuel constraint in another area of the plant and may impact yield. At TOTAL Port Arthur, a balanced approach to opportunity identification was taken, requiring proper application of tools and methods to assess the many interactions and determine a recommended course of action.

To support the successful implementation of opportunities and to support continuous performance improvement, an organization must be aligned with its energy management strategy. This involves enhancing the energy culture at the refinery through better communication, awareness, training and tools. One of the key elements at TOTAL Port Arthur was ‘Energy Management at the Point of Execution’ which involved developing an energy dashboard for the site, enabling operators to target energy influencing variables and allowing management to monitor energy consumption on a daily basis.

This paper illustrates the methods and tools used to improve and sustain overall system performance at TOTAL Port Arthur refinery which is comparable to the approach outlined in the international energy management standard ISO50001.

CEPSA: SITE-WIDE ENERGY MODEL EMPOWERS OPERATORS TO DRIVE SUSTAINABLE SAVINGS

Authors: Tyler Reitmeier, Marcos Kihn, Diego Ruiz, and Carlos Ruiz, Soteica Visual MESA LLC
Antonio García Nogales, CEPSA QUÍMICA S.A.

CEPSA operates a complex steam, fuel gas and hot oil network at its chemical complex that produces Purified Terephthalic Acid (PTA) at San Roque (Spain). The site also contracts with neighboring industrial facilities for the exchange of steam, water and fuel gas. The operation of such a complex energy network presents a significant challenge…How do operators find and maintain the optimal overall economic performance?
The CEPSA operators have many handles to consider in managing this challenge: manipulating the steam production of their own boilers, the export/import of steam, the fuel gas import and the choice between hot oil and steam for process heating. With the additional challenge of operating all within equipment, process and contractual limits presents an overwhelmingly difficult task to the operator.
An online model which takes into account the plant control strategies and the way the system will react to changes in the above-mentioned utilities was developed and deployed by Soteica Visual MESA LLC in order to give the plant operators at the control room direct advice allowing them to manage the utilities systems at minimum cost. The following will describe the aspects important to the implementation of the solution, such as control system analysis, real-time data acquisition, meter validation, optimization, and calculation of key performance indicators (KPIs), and display of model results.

SUCCESSFUL IMPLEMENTATION OF A SUSTAINABLE STEAM TRAP MANAGEMENT PROGRAM

Author: Jon Walter, TLV Corporation

Plants are typically focused on meeting safety, production and quality targets. The impact of steam traps on these areas is sometimes not fully understood, so traps may be neglected until energy prices rise or there is a serious incident resulting in a safety issue, expensive repair, environmental impact or plant downtime. With energy prices at historically low levels and no recent incidents, it might be tempting to ignore steam traps. However, there may be a significant cost penalty in delaying program implementation, especially if "carry over" trap failures are not addressed.

Plants typically embark on a trap management initiative by focusing on a survey, but fail to obtain the expected Return on Investment (ROI) by not executing improvements. There are three key areas that can help ensure sustainable benefits of a program:

1. Pre-implementation strategic planning
2. Onsite execution tactics
3. Ongoing program oversight

Before any work begins, it is essential to carefully plan and agree upon the strategy for completely implementing the trap management program. Successful planning may involve factors that may not always be obvious as well as items that may clearly impact the ability to overcome required ROI hurdles. Planning items that should be considered include trap operation diagnostic accuracy, steam trap performance, specific trap application challenges, the criteria for replacing failed traps, resource availability and budgets.

There are several common trap survey pitfalls that can negatively impact the trap management program. These should be anticipated and avoided to make sure the survey runs smoothly. This may require tactics for: finding and gaining access to the trap, accurate logging of trap information, and correct identification of whether the trap is really in service. When survey results become available it is important to correctly prioritize trap repairs or replacements and ensure a rapid maintenance response as both of these impact the program ROI. Procedures and support tools are also required to ensure the right replacement trap can be obtained from stores and correctly installed by operators, maintenance technicians or contractors.

The structure of the program should ensure it is self-sustaining and continually improving. A key part of ensuring ongoing success is to capture inspection results and maintenance activities. Annual results can then be used to clearly demonstrate improvements to ensure management support and funding. Program sponsors can also use this data to ensure that performance benchmarks are continually being achieved. Historical data can be used to identify frequent failures and root causes of poor performance, which can then improve the trap management program.

ENERGY DESIGN REVIEWS: THE END OF THE ENERGY AUDIT? INTEGRATING ENERGY MANAGEMENT IN ENGINEERING DESIGN

Author: Emily Thorn Corthay, Hatch Management Consulting

It is much more cost effective to correctly design an industrial plant upfront rather than retrofit an existing plant. Traditional design engineers and project managers focus on capital costs, not lifecycle costs, often ignoring substantial energy savings potential over the 20-50 year plant life. Hatch believes the key to long-term energy reduction is to systematically integrate energy management in industrial plant engineering design.

In a recent energy efficiency design review for a large oil sands project in Alberta, potential savings of 40% in annual energy spending relative to the "business as usual design" baseline were identified. Typically, energy assessments (i.e. audits) identify energy cost savings of 5-20% of energy spending, thus demonstrating the much larger savings potential of energy design reviews compared with energy assessments.

In a carbon-constrained world where fossil fuels are in limited supply, greenhouse gas emissions are being regulated and energy prices are on the rise, it is even more critical to ensure that energy be used as efficiently as possible.

ISO 50001 AUDITS

Author: Nazim Chowdhury, ABS Group Services Canada Ltd.

ISO 50001 is a voluntary international standard developed by the International Organization for Standardization (ISO) that provides organizations with a regulatory framework for energy management systems (EnMS). ISO 50001 was developed by the ISO/PC 242 energy management project committee and development of various national standards including EN 16001. ISO 50001 benefits large and small organizations in both the public and private sectors, in manufacturing and services, in all regions of the world. The standard establishes a framework that industrial plants; commercial, institutional and government facilities; and entire organizations can use in order to manage their overall energy consumption. ISO 50001 provides public and private sector organizations with management strategies that increase energy efficiency, reduce costs and improve energy performance. Energy efficiencies are achieved through energy management systems rather than new technology and offers organizations guidance, action and a framework for sustainability. This framework allows organizations to integrate energy performance into their management practices. The purpose of this international standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption. ISO 50001's implementation leads to reductions in greenhouse gas emissions, energy costs and other related environmental impacts through systematic management of energy. The benefits to organizations include bottom line results and cost savings, reliability of operations, positive effect on productivity and reduce exposure to rising energy prices. The standard is based on the 'Plan-Do-Check-Act' continual improvement framework and incorporates energy management into everyday organizational practices. ISO 50001 will be driven by companies seeking an internationally recognized response to regional and international energy and climate agreements, national cap and trade programs, and energy taxes, corporate sustainability/responsibility programs, increasing market value of green or environmental friendly methodologies, carbon trading schemes, and encouragement from their suppliers and stakeholders.
A highly experienced and trained ABS Quality Evaluations, Inc. lead auditor conducts EnMS assessments with a complete understanding of an organization's business, its energy requirements as well as the certification process. Our method is simple and includes a gap analysis (optional) and a two-stage certification audit.

THE FUTURE LANDSCAPE OF ENERGY PROCUREMENT
David Visneau, Champion Energy Services

Presentation will focus on the procurement of Energy (both electricity and natural gas). It will detail the current methodologies utilized by large and small energy users. The presentation will also project how energy will be procured in the future utilizing technology and the expected changes to the deregulated marketplace. Additionally – discussion will focus on the most advantageous current and proposed future techniques to procure energy for end use customers of all sizes.

ENERGY REDUCTION THROUGH UTILITIES ADVANCED CONTROL

Author: Christian Le Duff, ExxonMobil Chemical Company

Model Predictive Control is used in process control but it has not often been considered in Utilities systems. Through advanced control applications in utilities systems at two different sites, the fuel gas and steam systems were optimized. Using dynamic models and rigorous plant tests, the main variables were identified. Once relationships between the variables were established, an application was developed to manipulate the key variables, leading to more stable control and energy savings.

POTENTIAL FOR ENERGY AND PEAK DEMAND SAVINGS IN CALIFORNIA TOMATO PROCESSING FACILITIES

Authors: Alexander J. Trueblood, BASE Energy, Inc. and Ahmad R. Ganji, San Francisco State University

Tomato processing is a major component of California's food processing industry. Canned tomatoes processed in California comprise over 90% of the total tomato consumption of the United States and approximately 35% of the total tomato consumption of the world. Tomato processing is extremely energy intensive, with the processing season coinciding with the local electrical utility peak period. The main source of energy consumption in a tomato processing facility is in evaporation and sterilization through the use of steam. The energy consumption in a tomato processing facility will typically be approximately 82% natural gas usage in the steam boilers, with the remaining 18% as electrical energy consumption when converted to source energy. A typical tomato processing facility will consume approximately 15 million kWh of electricity and 8 million therms of natural gas during the three month processing season, with a peak electrical demand of approximately 7 MW. Energy costs comprise approximately 6% of a tomato processing facility's total expenses.

This paper details the potential electrical and natural gas efficiency measures that can be applied to tomato processing facilities. This is based on detailed assessments of 7 (over 33%) of the major tomato processing facilities in California. The results show:

- Electrical energy savings in the range of 400,000 kWh/yr to 2 million kWh/yr,
- Natural gas savings in the range of 2,500 therms/yr to 200,000 therms/yr,
- Peak demand reductions in the range of 250 kW to 600 kW, and
- Overall simple payback periods in the range of 1.2 years to 3.6 years.

ENERGY EFFICIENCY OPPORTUNITIES IN WINERIES FOR RETROFIT AND NEW CONSTRUCTION PROJECTS

Authors: Yin Yin Wu, P.E. and Sandra Chow, P.E., BASE Energy, Inc. and Ahmad R. Ganji, San Francisco State University

Modern wine making is an energy intensive process that mainly involves refrigerated cooling. Typically wine is stored at around 55 ˚F, and the conventional cold-stabilization for white wine is at approximately 28 oF. In addition, the fermentation process of wine is at about 85 ˚F, which requires cooling. According to the U.S. Census Bureau, the U.S. had 1,956 wineries in 2007, where 971 of the wineries were in California that produced about 85% of all U.S. wine. According to a Lawrence Berkeley National Laboratory (LBNL) study, the California winemaking industry consumed over 400 GWh of electricity annually, as the second largest electricity-consuming food industry in California, after fruit and vegetable processing. Thus wine industry is considered an effective target for application of energy efficient processes and equipment. Energy efficient opportunities can be implemented in retrofit, expansion as well as new construction.

This paper outlines typical winemaking processes for both white and red wines and the associated major energy consuming systems. The paper details the energy efficiency opportunities and the considered baselines in retrofit as well as new construction projects. The opportunities for small/medium wineries as compared to large wineries are discussed. The presented data is based on detailed assessments of 26 wineries in Northern California, including some very large wineries with over 25 MWh annual electrical consumption. Over 25 distinct energy efficiency opportunities were identified in all assessments. The evaluated energy efficiency opportunities could potentially result in an overall electrical energy savings of about 17%.

It is important to consider energy efficiency opportunities at the design stage of new construction as well as expansion projects. The premium cost of purchasing energy efficient equipment for new construction is significantly lower than the cost for retrofits. Application of energy efficient opportunities in new construction can be most beneficial in the lifetime of the plant. This paper also discusses applicable energy efficiency opportunities and the associated baselines in new construction based on our experience in evaluation of designs of 16 new wineries.

BETTER CRUDE PURCHASE DECISIONS: THE POWERFUL COMBINATION OF REFINERY PLANNING AND INBUILT ASSAY MANAGEMENT FOR INCREASED PROFITABILITY

Author: Mel Bernstein, Aspen Technology

As price volatility in the refining market continues, companies are evaluating new ways to increase efficiencies and reduce costs. AspenTech is a leading supplier of software that optimizes process manufacturing for refining & marketing and other industries that manufacture and produce products from a chemical process. Energy customers are better able to increase capacity, improve margins, reduce costs and become more energy efficient through the combination of industry best practices and superior technology.

Aspen PIMS, a planning optimization tool, supports these industry best practices. In this session, learn how Aspen PIMS new assay management technology supports better crude purchase decisions through two new capabilities:

1) enhanced property prediction based on the fundamental science of its patent-pending molecular characterization,

2) the amazing profit potential of its new spot crude evaluation functionality. Hear first-hand real client case studies and benefits achieved with these new features.

DOW CHEMICAL: ENERGY EFFICIENCY IMPROVEMENTS OF U.S. OLEFINS CRACKERS
Presenter: Jim Benton, DOW Chemical

DOW has a long heritage of improving energy efficiency. DOW's manufacturing energy intensity, measured in BTUs per pound of high value chemical (HVC) product, has improved more than 49% since 1990, saving the Company a cumulative of $24 billion and 5,200 trillion BTUs. This is roughly equivalent to the annual energy consumption of nearly 20 million households.

DOW's Global Olefins business includes 13 olefins crackers, 5 of which are located in the U.S. Given the significant economic and Sustainability impacts it has on the overall company, the Olefins business has long place a high emphasis on energy efficiency improvement.

Five years ago, DOW Olefins embarked on a modified multi-year energy efficiency strategy. One key change was a shift in focus towards opportunities requiring little/no capital, given the reality of severe capital funding restrictions for energy efficiency projects.

The strategy has paid off. The U.S. based Olefins crackers have experienced a continuous reduction in energy intensity during the 2008-2012 timeframe, averaging a 1.7% energy improvement per year. Specifically, 2012 saw a 1.46% improvement compared to 2011. These efficiency gains translate to a cumulative savings in energy costs of $57 MM vs. the 2008 baseline, for the five U.S. Olefins crackers.

The strategic approach employed consisted of two primary components:

1. Energy "Best Practices" deep-drills were developed at the global business level. These deep- drills focused on the highest energy-intensive portions of the crackers, and were aimed at opportunities in areas of operating discipline, maintenance practices, process control etc.
2. A business-wide team was formed with the specific charter to address energy efficiency improvement. Membership included a representative from each cracker. Monthly meetings included activities related to leveraging opportunities and practices across all crackers, business-wide energy efficiency initiatives, and data quality.

GEISMAR TDI STEAM PLANT OPTIMIZATION

Presenter: Meredith Bailey, BASF Corporation

BASF Corporation has an established process optimization program and a multifunctional team responsible for improving operational excellence at sites throughout the region. As part of this program a Process Optimization Workshop was conducted in 2011 at the BASF Geismar, LA TDI plant. Additionally, during this period a steam trap survey was conducted for the entire Geismar facility. Throughout these activities, a number of recommendations were developed to reduce steam consumption in the TDI plant. A comprehensive plan to address steam reduction recommendations was developed and implemented in 2012. As a result of these measures, steam consumption in the plant was reduced by 103,500 MMBtu/yr, and system maintainability was significantly improved.

MOMENTIVE PERFORMANCE MATERIALS DISTILLATION INTERCHANGER

Presenter: Tom Kotkoskie, Momentive Performance Materials Inc.

The distillation columns located at Momentive's Waterford New York site consumes large amounts of energy (steam generated from natural gas). Plant personnel designed, fabricated, and installed a new heat exchanger (aka "Interchanger") to use the waste heat from one distillation column to help drive operation of a second distillation column, thereby reducing steam consumption on the second column.

CORPORATE REPORTING OF BOILER MACT ENERGY ASSESSMENTS

Authors: Andy Rick, and Jim Robinson, DES Global, LLC

Energy assessments are a normal part of the corporate process for facility performance evaluation and energy project approval. Boiler MACT requires a onetime energy assessment of the facility utility system supplied from the affected steam sources. As part of MACT, should the facility choose to use energy efficiency credits to offset environmental constraints, an energy baseline is required for the efficiency credit calculations. This paper presents an automated approach to track assessment project status and results. The system is modeled after the DOE "Guiding Principles for Successfully Implementing Industrial Energy Assessment Recommendations."

IMPLEMENTATION OF ENERGY MANAGEMENT AND REPORTING SYSTEMS UNDER BOILER MACT

Cliff McClain, and Jim Robinson, DES Global, LLC

Energy Management and Reporting Systems (EMRS) have proven effective in reducing powerhouse cost and emissions. These cost reductions are provided through effective management of equipment operation, fuel allocation, and combustion optimization by a real time closed loop control system. Reporting is now required on a monthly interval by Boiler MACT to verify energy savings for energy efficiency credits that can be used to mitigate emission limits. This paper presents the methodology used to capture those savings and the reporting system to quantify the energy credits that may be used to offset emission limits.

OPTIMIZED DESIGN OF FURNACE COOLING SYSTEM

Authors: Franco Morelli, Ryan Bretschneider, Justin Dauzat, Michael Guymon, Joshua Studebaker, Texas A&M University Industrial Assessment Center

This paper presents a case study of optimized re-design of a furnace cooling system at a manufacturing facility. The bottleneck in the production process is the cooling of heat treatment furnaces. These ovens are on an approximate 24-hour cycle, heating for 12 hours and cooling for 12 hours. Pressurized argon and process water are used to expedite cooling. The proposed modifications are grouped into three fundamental mechanisms. The first is a recommendation to modify current operating procedures. This entails opening the furnace doors at higher than normal temperatures. A furnace temperature model based on current parameters is used to show the reduction in cooling time in response to opening the furnace doors at higher temperatures. The second mechanism considers the introduction of forced argon convection. Argon is used in the process to mitigate part oxidation. Cycling argon through the furnace during cooling increases convection over the parts and removes heat from the furnace envelope. Heat transfer models based on convective Nusselt correlations are used to determine the increase in heat transfer rate. The last mechanism considers a modification to the current heat exchanger. By decreasing the temperature of the water jacket and increasing heat exchanger efficiency, heat transfer from the furnace is increased and cooling time is shortened. This analysis is done using the Effectiveness-NTU method.

DESIGN AND PREDICTIVE CONTROL OF A NET-ZERO ENERGY HOME

Authors: Franco Morelli, Natalie Abbarno, Joshua Bullock, Erin Boese, Blake Carter, Ryan Edwards, Oluwaseyi Lapiete, Daniel Mann, Clayton Mulvihill, Malcom Stein IV, Evan Purcell, Texas A&M University Industrial Assessment Center

Economic stressors within the past 30 years have driven awareness for efficient energy usage. Environmental awareness of burning fossil fuels and the drive towards energy independence has many innovating on energy savings methods. Within the United States, Residential applications account for 22% of total electrical consumption. This paper analyzes two methods to reduce residential energy consumption for a Net -Zero home in Austin, Texas. The first method seeks to develop a control algorithm that actively engages environmental conditioning. The home must preserve a user-defined comfort level while minimizing energy consumption. By defining comfort as a function of several environmental factors, tradeoffs between indoor dry bulb temperature and other parameters can be made to reduce energy consumption. An optimization function governed by user input chooses the degree to which systems should be active to maintain the desired comfort level while minimizing energy usage. The second method reflects an analysis towards augmenting traditional home systems with modern and efficient counterparts. A geothermal heat pump enhanced with thermal ice storage exemplifies the potential to mitigate inherent losses of traditional home air conditioning. Electrochromic glass and thermal bridging considerations are likely candidates in attenuating heat transfer from outside the home envelope. A thermal chimney presents a passive option of removing heat from a home while increasing convection. Finally, replacing conventional incandescent lighting with compact fluorescent and LED lights can drastically impress upon energy expenditure.

BASF CORPORATE ENERGY PROCESS
Presenter: Ty Geiger, BASF Corporation

BASF Corporation has an established energy management process that has been applied to its manufacturing sites for many years. Significant enhancements made in 2012 included implementing LEAN principles to further support process optimization activities in North America. In addition, best practices were shared and implemented corporate wide. BASF Management continued to focus on sustainable improvement by raising previously set global targets to now increase energy efficiency in production by 35% and reduce specific greenhouse gas emissions by 40% by the year 2020, compared with 2002. To advance toward this goal in North America, an annual target of a 2% reduction in energy used per ton of product was set for 2012. Through various optimization efforts, BASF was able to achieve this target. A total of 67 projects were implemented at sixteen different production sites, resulting in a 2.0% reduction in Btu/Ton of product for all of BASF Corporation.

PROGRAMS FOR SMALL AND MEDIUM-SIZED MANUFACTURERS

Authors: Daniel Trombley, Ethan Rogers, Neal Elliott, American Council for an Energy-Efficient Economy

The industrial sector represents a diverse grouping of companies that very significantly in their size and how they use energy. Past experience has shown that the greatest energy savings results from energy efficiency projects that focus on process and practices rather than a focus on energy using equipment. As a result, industrial programs have focused their efforts on customized incentives that capture the unique energy efficiency opportunities at each facility. While this approach works well for larger firms, the transaction costs of identifying and proposing projects for small and medium-sized enterprises (SME) is frequently prohibitive. As a result, programs have tended to focus on prescriptive rebates for equipment that do not address a significant portion of the energy use in these firms. This paper will present the results of a survey of current practices for publically-funded SME industrial programs in the United States and Canada. This paper will explore programs that engage in a variety of activities, including:

- Offering quasi-prescriptive rebates and incentives;
- Supporting placement of energy managers;
- Working with large customer value chains to implement efficiency among suppliers;
- Working with industrial trade groups to provide value-added industrial energy efficiency services to members;
- Working with market allies to expand delivery of energy efficiency services.

The survey will be performed by reviewing both existing literature, interviewing program administrators and speaking with industrial managers. Some topics this paper will discuss include emerging trends, successful program elements, and recommendations for program administrators.