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ABSTRACTS

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Abstracts
2015 Industrial Energy Technology Conference

Session 1: American Chemistry Council Award Winners 1

LyondellBasell Completes a Major Plant Workover to Dramatically Improve Energy Intensity in LaPorte Texas

Nani R. Deole and Hans Stam, LyondellBasell.

The LyondellBasell LaPorte site implemented a project in 2014 to increase the olefin plant capacity. The project team took this opportunity to improve the energy intensity significantly by incorporating innovative technology, utilizing high efficiency equipment, and design concepts that are not obvious or commonly practiced but are applicable to significant segments of the chemical industry. The energy intensity improved by at least 6% from a 2013 full year average of 8,040 Btu/lb LHV to the September – December 2014 average number of 7,549 Btu/lb LHV. The energy intensity is still trending down and has gone below 7,000 Btu/b LHV in recent months. A methane expander that will generate electrical power and save energy in refrigeration systems is yet to be commissioned, and will further enhance the energy efficiency.

Occidental Chemical Corporation Alters the Geismar EDC Unit and Reduces Energy Usage by 50%

Alan Truver and Lynn Fink, Occidental Chemical Corporation

The OxyChem Geismar Plant operates both fixed catalyst bed reactors and fluidized bed reactors to produce1,2-Dichloroethane (EDC). Anhydrous HCl (aHCl), produced in another part of the facility, is used as a feedstock in the EDC process. This aHCl was preferentially utilized in the fluidized bed catalyst bed reactor, resulting in the ability to shutdown a portion of the fixed catalyst bed reactor system and associated air compressor.

DuPont Parlin Energy Conservation Team

Rich Derer, Mike Pollock, Bryan Mumink, Vee Guidry and Jimmy Kersch, E. I. DuPont.

DuPont Engineered Services and Energy Engineering worked with the Parlin Site to identify steam leaks on the main steam header and distribution branches. With the use of a DuPont engineering thermographic analysis, the conservation team identified zones of high energy loss.

The Parlin Site maintenance, reliability, and energy engineering teams collaborated in an effort to identify unused, energized steam lines towards isolation, de-energization and energy savings.

Session 2: Combined Heat & Power

Stabilized Co-Generation

K.A. "Bud" Leavell, Piller USA Inc.

Recent technological advances in natural gas production have reduced the price of natural gas dramatically, and along with coming EPA regulations, and growing grid instability, is likely to spur an increase in demand for natural gas fired co-generation systems.

These systems have been around for some time now, but have been limited to applications where they can remain connected to the grid, even in times of instability on the grid, and only provide a constant level of power known as the "Base Load". Among the reasons for focusing on the Base Load is the fact that the transient response of these generators to step and block loads is poor, and in order to get the greatest efficiency out of the plant, it needs to be running at or near its top capacity.

It is becoming more and more important to expand the application of these systems beyond the Base Load and start servicing the total load. In order to do that, there first must be a practical means of compensating for the poor transient response of these systems. The effective application of Newton's First Law of Motion to highly reliable Rotary Uninterruptible Power Systems promises to provide the stability and power quality required to overcome this challenge. By utilizing bidirectional inertial energy storage systems in concert with highly reliable synchronous machines, a high degree of stability can be achieved in both frequency, and voltage, harmonic mitigation and power factor correction, even in the presence of significant reactive step loads.

This program will explore how these systems function, and how to deploy them into either a grid connected or island environment.

Helping to Relieve Grid Stress

Scott Clark, Burns & McDonnell

The Electric Reliability Council of Texas (ERCOT) reported that summer demand on the Texas electricity grid had surpassed 60,000 MW for the first time in 2013. That's a lot of electricity! And since ERCOT expects electricity capacity to continue to be tight, that's all the more reason that TECO added a combined heat and power (CHP) plant. The natural-gas-fired CHP plant generates electricity, and the exhaust heat is used to help produce both chilled water and steam for the Texas Medical Center customers. For the last several years TECO has produced 100% of their own peak summer power requirements, including the electricity needed to run the largest chilled water plant in North America. Not only has the system supported the badly stressed ERCOT electricity grid, but has also saved on average $4 million per year by not purchasing from the grid during high price periods. This flexibillity, reliability and savings is exactly what TECO had in mind when they decided to implement the CHP plant. Now, they can weather any storm or energy challenge and grow along with the Texas Medical Center.

Combined Heat and Power in EPA's Clean Power Plan

Meegan Kelly, American Council for an Energy-Efficient Economy (ACEEE)

The Environmental Protection Agency's (EPA) Clean Power Plan (CPP) represents a strong driver for improving industrial energy efficiency. Combined heat and power (CHP) is a compliance option for achieving state energy savings goals and emission reduction targets, with the potential to provide a new revenue stream for CHP owners and operators who provide these reductions. The market for CHP has experienced recent growth independent of federal environmental regulations and now, EPA's Clean Power Plan signifies an opportunity for greater return for industrial stakeholders that choose to invest in CHP.

A recent ACEEE report found that more than 68 million MWh of U.S. energy could be saved in 2030 from installing highly cost-effective CHP, representing around 18 GW of avoided capacity. These energy savings would significantly reduce carbon emissions from the power sector, offsetting the need for about 36 power plants.
Industrial CHP hosts have the opportunity to carve out a revenue stream that goes beyond the direct savings from installing CHP by providing emission reductions to states as they develop 111(d) compliance plans. Sources with emissions below the state target rate or entities that contribute to end-use energy efficiency may generate credits or sell allowances depending on how states structure their plans. This paper addresses the role of CHP in EPA's 111(d) rule and provides guidance to industrial stakeholders in assessing CHP as a compliance mechanism.

Energy Savings Opportunities through Combined Heat and Power Systems Optimization Model Case studies

Mana M. Owaidh, Saudi Aramco Oil Company

In oil, gas, refining & petrochemical facilities the combined heat and power (CHP) optimization models were found to be very useful in understanding the interactions between energy supply and demands of various utilities and process major components. These components include boilers, cogeneration units, steam turbines, steam system network, process areas and equipment and BFW condensate system. The interactions between these components create areas for optimization that normally lead to significant energy savings and cost reduction of a plant. The techniques used here for optimizing CHP systems are being derived from unit commitment and economic dispatch techniques to solve both integer (binary) and linear optimization problems. The model has been deployed to all Saudi Aramco major facilities involving steam system. In this paper, our case study covers the results of several CHP optimization models at which the average energy savings potential exceeds 3%.

Global Collaboration on Energy Management

Graziella Siciliano, U.S Department of Energy

Energy management is a proven strategy for achieving clear energy, environmental, and economic benefits across industry—yet diverse barriers, risks, and challenges continue to limit broad adoption around the globe. An energy management system (EnMS) integrates energy management into existing business systems, enabling organizations to better manage their energy, sustain achieved savings, and continuously improve energy performance. Governments are now implementing various approaches to accelerate industry uptake of these systems, such as promoting compliance with the ISO 50001 energy management standard.

The Global Superior Energy Performance (GSEP) Energy Management Working Group (EMWG) advocates the increased adoption of EnMS or ISO 50001 in industrial facilities and commercial buildings. The 11 member countries of the EMWG include Australia, Canada, Denmark, the European Commission, India, Japan, Mexico, the Republic of Korea, South Africa, Sweden, and the United States [Secretariat]. These governments work collectively to strengthen the national and international efforts to make it easier for these sectors to adopt energy management as a key aspect of their operations. This paper describes the key activities of the EMWG and related EMWG resources available to governments and businesses.

Build the Business Case: Make the private sector aware of the business case for energy management and its value in maintaining competitiveness.

Energy Performance Database: Collecting energy performance data submitted by countries into a secure portal; analyzing to establish specific impacts, paybacks, and other findings to demonstrate the value of energy management and identify strategies for implementation.

EnMS Case Studies: Producing a suite of energy management system case studies to showcase early adopters and help develop a compelling business case based on real-world data and experiences.

Provide Support and Resources: Provide guidance and resources to support implementation of energy management in GSEP countries.

EnMS Practitioner's Toolbox: Developing in partnership with the Institute for Industrial Productivity (IIP) a toolbox containing a practical suite of proven and cost-effective energy management tools, measures, and activities.

Measurement and Verification: Developed multiple guidance documents to improve measurement and verification of energy management results.

Set Policy: Establish energy management as a key energy efficiency strategy for the industrial and commercial buildings sectors.

Implementing ISO 50001 & SEP – How ICT facitiltates Implementation

Mike Brogan, Enerit Ltd.

This paper will present results of how ICT can make implementation and management of an ISO 50001 and SEP energy management system more effective and cost efficient across a wide variety of sectors including pharmaceutical, automotive, medical devices, metals and plastics, universities & ICT.

US DoE has reported substantial extra savings with an EnMS approach compared to project based or "business as usual" energy efficiency programs and ISO 50001. However, there are a number of challenges to: getting started; and making continuous improvement with EnMS. The findings of the study by the DoE shows that the significant portion of the costs of implementing such programs is associated with internal staff costs and these costs can be reduced and even avoided while continuing to make savings.

This paper will present our experience and case studies on multi-standard (ISO 50001, OHSAS 18001, ISO 14001, ISO 9001) and multi-site implementations; experiences in implementation of superior energy performance (SEP) in USA; how costs of auditing can be reduced through the ability to carry out remote audits; and the experience of the benefits of ICT for customers working with energy management consultants giving them the ability to work remotely and cost effectively.

The paper will present high-level practical guidance on implementation of ISO 50001 and SEP and how to get started. Organizations have different drivers for implementing an EnMS and getting certified and this paper will show how these are successfully addressed through visualization tools such as; Sankey diagrams - to show energy flows for focusing & persuasion of upper management; gap analysis tools – to show scoring of EnMS "way of working"; and dashboards - for identifying, prioritizing and tracking of improvement opportunities and energy saving actions plans; setting and tracking of objectives and targets, management of audits and corrective actions and finding EnMS information easily. The integration of smart metering and building energy managements systems and practical examples will also be presented.

Finally, once the EnMS is in place how do you ensure that those sites continuously improve and how do you bring the less advanced sites up to the level of the leading sites? This paper discusses ongoing developments in Energy Management Maturity and models used to guide organizations along the path from start-up through to embedded continuous energy management improvement.

ISO 50001 Energy Management Standard as a vehicle to Sustainable Energy Management at 3M Company

Andrew J. Hejnar, 3M Canada Company

The presentation will introduce 3M Company to the audience and the company's environmental and energy conservation goals and results. It will talk about ISO 50001 and its benefits, how to justify ISO 50001 implementation through building a business case to win stakeholders' commitment, motivations, building blocks of successful Energy Management, ISO 50001 implementation process – examples of how 3M Canada plants executed the ISO 50001 Energy Management Standard, experience during this process, key players, gap analysis of one of the plants, key work plan activities, benefits of ISO 50001 Energy Management Standard, and implementation results. The presentation will focus on:

- Lessons learned from the implementation process
- Key success factors
- Implementation of ISO 50001 in manufacturing environment
- Energy Metering and Monitoring System (M&T) and how Energy Management Information Systems can help to make energy visible and easier to control
- Employee engagement, awareness and training.

Wisconsin's SEM Leaders Program: Meeting Industry's Needs for Strategic Energy Management

Timothy Dantoin, and John Nicol, Leidos Engineering, LLC

State and utility demand management programs have long provided industry with direct technical and financial support for energy conservation measures (ECMs) such as repairing compressed air leaks or installing variable speed drives. Direct support for ECMs is the most obvious and immediate way for programs to affect the energy efficiency of their customers and, in turn, meet the program's energy savings goals.

However, an increasing number of demand management programs are pursuing energy savings somewhat indirectly by helping customers apply continuous improvement principles to their energy management efforts. While bottom-line energy savings remains the ultimate goal for this type of support, the emphasis is not on technical improvement. Attention is directed instead toward management improvements that drive energy considerations into all aspects of organizational decision-making. Within the context of this more strategic approach to energy management, previously hidden, ignored, stalled or unfavorable energy improvement opportunities may come to light or be reinvigorated.

Most companies are familiar with continuous improvement principles and many, knowingly or unknowingly, already have some elements of strategic energy management (SEM) in place. For companies wanting to pursue SEM, an array of resources are available including case studies, guidance documents and software for tracking projects or analyzing energy data. Trained and certified consultants stand ready to help. Even for the most earnest companies, however, the usual suspects of lean staffing, limited capital and higher priorities prevent them from consolidating what they already have into a sustainable SEM program.

Initiated in January 2015, the Wisconsin SEM Leaders Program is a two year commitment of resources by Focus on Energy's Large Energy User (LEU) Program to support up to 30 facilities in implementing a fully integrated SEM program up to and including ISO 50001 certification or the Superior Energy Performance (SEP) designation. Participation is limited to large industrial energy users demonstrating a readiness and commitment to implementing a full SEM program.

With the Wisconsin SEM Leaders program, Focus on Energy is supporting industry efforts to improve long-term energy management while achieving near-term energy savings. This paper provides details on the design, delivery and early results of this initiative for both the Focus on Energy Program and Wisconsin SEM Leader participants.

Utility Assessments for Real Time Pricing and Demand Response Environments

James E Robinson, DES Global, LLC

Utility energy assessments are evolving to include energy contracts, Real Time Pricing (RTP) and demand response evaluations of the overall facility operations and process changes. Energy assessments are a fundamental part of the corporate business process for project identification, approval, implementation, and performance verification. The assessment process adjusts to satisfy the current business needs and is influenced by the changing regulatory environment. The current interest is to implement new utility demand response and efficiency initiatives in anticipation of the EPA Clean Power Plan (CPP). This paper will present approaches used to satisfy these new assessment requirements.

Facility Scale Energy Storage for Peak Demand Management and Demand Response

Jesse Remillard with Jeffrey N. Perkins, Energy & Resource Solutions

Demand response programs across the country have many large facilities considering the deployment of energy storage technologies. Technologies developed for facility- and campus-scale energy storage show promise for managing short-term demand peaks as well as longer period demand response events.

The paper's authors have investigated facility/campus-scale energy storage for efficiency program administrators in the US and recently completed a storage technology research report for an international consortium of utilities. This work has identified promising avenues for distributed storage. Currently, facility-scale storage has three primary uses:

1. Power quality – The monitoring and regulation of voltage fluctuations, frequency disruptions, and harmonic distortions (computer networks and data centers).
2. Bridging power – Short-term power supply for critical demands, often used to cover time periods in which emergency generators are powering up. Uninterruptible power supplies often perform these duties.
3. Energy management – Energy storage on a scale to support a facility/campus for extended periods of time. These systems can be responsive to utility demand programs and time-of-use rates to cut peak demand costs.

All three of these uses inform the development of strategies for utilizing distributed storage for the successful power continuity and demand management strategies.

This paper will present the technical properties of current storage systems, including flywheel, compressed air, various battery technologies, etc. The technical and market barriers associated with distributed storage, along with proposed paths for resolving said barriers, will also be discussed.

Demand Response and Peak Load Management, Programs, Products, and Technology

Andrew Barth, Links Energy Partners.

Smart Grid - You Are Not Alone

Dave Heitzer, EDF Trading North America LLC

Session 5: American Chemistry Council Award Winners 2

MeadWestvaco Specialty Chemicals 'Sons of Energy' Team's Projects Garner Plant Energy Intensity Reductions

Scott Crowell, MeadWestvaco

Employees at the MeadWestvaco Specialty Chemicals plant in Charleston, SC have formed an all voluntary, multi-disciplinary energy team called the "Sons of Energy" with a mission to reduce the energy consumption. In 2014, the team convinced upper management to implement specific energy goals, cascaded from the Plant Manager to each salaried employee. The result was a 5% reduction in energy intensity.

Ashland Inc. Installation of Heat Recovery Steam Generators Energy Savings Projects

Frank Stevens and Tim Whitaker, Ashland Inc.

The Ashland Calvert City Plant is Ashland's largest manufacturing facility, employing over 500 people. It produces a wide range of chemical products for the personal care, beverage, and pharmaceutical industries. The cost of compliance with ever tightening regulations on coal combustion combined with increasing maintenance costs on the site's 50 year old coal-fired boiler drove the search for a greener and more economical way to generate the high-pressure steam required for plant operations. After considering several options, the facility decided on installing gas-fired Heat Recovery Steam Generators (HRSGs). For maximum efficiency, HRSGs include fully integrated water preheaters, super heaters, evaporators, economizers and other innovations. They can also be upgraded, in the future, with turbines for electrical generation.

Session 6: Equipment Analysis One

Increase Energy Efficiency by Analyzing Cooling Water Systems

Peter Phelps, Phelps Engineering, and Todd Willman, EPI Engineering

Cooling water systems have traditionally not been studied in detail yet they have a large impact on your plant's performance and overall energy efficiency. Economical and effective ways of analyzing both the existing cooling tower and its piping distribution system and exchangers will be presented. With the latest advancements in cooling tower fill upgrades and software modeling of the piping distribution system, existing plant cooling water systems can be significantly improved at low cost with significant impact on plant profitability without purchase of additional cooling towers or cells. Case studies will be reviewed that demonstrate how analysis of cooling water systems is a low-cost, high-impact way to improve separation efficiency of distillation columns and the overall energy efficiency of chemical and refining facilities.

Major Energy Efficiency Retrofit Opportunities in Process Evaporation

Bryan Hackett, kW Engineering

Process evaporation is one of the most energy intensive unit operations used by the food industry. To achieve significant reductions in energy consumption, major system modifications such as installing additional effects or the use of vapor compression must be implemented. This paper will review the results from three case studies where major modifications were made improve the energy efficiency of process evaporation systems. Specific details of the system modifications, energy savings, cost savings, project costs, and fuel switching impacts will be discussed.

Simulating Energy Efficient Control of Multiple-Compressor Compressed Air Systems

Sean Murphy, EnerNOC, and Kelly Kissock, University of Dayton

In many industrial facilities it is common for more than one air compressor to be operating simultaneously to meet the compressed air demand. The individual compressor set-points and how these compressors interact and respond to the facility demand has a significant impact on the compressed air system total power consumption and efficiency. In the past, compressors were staged by cascading pressure bands for each compressor in the system. Modern automatic sequencers now allow more intelligent and efficient staging of air compressors. AirSim, a compressed air simulation tool, is now able to simulate multiple-compressor compressed air systems with a pressure band and automatic sequencer controls. AirSim can simulate a current compressed air system and a proposed system with changes to the equipment and/or controls. Thus, quickly and accurately users can calculate the energy and cost savings expected from many proposed compressed air system upgrades. This paper recaps previous work on simulating single compressors, explores in great detail simulating multiple compressors in theory and application, and presents a case study using AirSim to simulate an industrial multiple-compressor compressed air system.

Tracking and Trending Energy Surveys

James Nipper, Petro Chemical Energy

Utilizing Petro Chemical Energy's web based application you can now track your energy surveys and repairs in real time. Discover how to simplify the management of your energy surveys. Taking your companies surveys to the next level.

Session 7: Process Energy Efficiency

Comprehensive Energy Efficiency in the Process Industries

Alan P. Rossiter, Rossiter and Associates

Approaches to achieving industrial energy efficiency are changing. In the past ad hoc processes were the norm, looking for opportunities in a few key areas, and energy programs were "on-again, off-again" activities, driven by energy prices and geopolitical crises. However many companies now recognize energy efficiency as an essential business practice in an environmentally-conscious world. As a result comprehensive energy efficiency programs have been developed, with an emphasis on continuous improvement.

This presentation provides a brief overview the key elements of comprehensive energy efficiency programs in the process industries. These include techniques for increasing the efficiency of utility systems (e.g., steam and compressed air) and individual pieces of equipment (e.g., boilers, furnaces, pumps and motors), and also improving and maintaining the performance of the process itself. Success stories are included from several companies within the process industries.

Caught Between a Rock and a Hard Place -- How Lehigh Hanson Achieves Energy Success at Aggregate Plants

Stephen B. Austin, TenX Energy Corporation and Leroy Goree, Lehigh Hanson Incorporated

Lehigh Hanson is part of Heidelberg Cement, one of the largest building materials manufacturers in the world. Lehigh Hanson operates more than 200 aggregates plants in North America. True to their German heritage, Heidelberg Cement sets high energy efficiency standards for its North American subsidiary.

The aggregate industry is a rugged place. It is hard on people, equipment, and it is an equally tough place for energy savings. Typical savings opportunities like HVAC and lighting do not exist in the aggregate industry. These plants consume large amounts of electrical power (up to 15 MW) but have long been considered fallow ground for energy projects. Lehigh Hanson is reversing that stereotype. In 2011, Lehigh Hanson's Mission Valley plant became the first aggregate plant in the history of the EPA's Energy Star program to achieve the Energy Star Challenge for Industry. In the meantime, Lehigh Hanson has achieved an average of 8% annual savings at the top 12 plants, equivalent to more than $2.7 million. How did they do it? It is a combination of the latest in energy and utility tracking techniques, implementation of clever energy efficient technologies and strategies, and good old fashioned face-to-face interactions.

Lehigh Hanson's Energy Efficiency Program is administered from the corporate headquarters in Dallas, Texas. The top tier plants included in the Corporate Energy Program are in locations from New York to California. Each plant is conceptually similar, but is distinctly unique due to specific geology, geography, age, and processes. Therefore, it is important to have an extensive energy toolkit that can be applied to each custom configuration.

While the technical issues have been challenging, the real success of the program has been the ability to navigate the x-factors involved. The capabilities that are critical to developing successful programs, such as at Lehigh Hanson, include:

- Communicating with a wide range of personnel from Plant Operator to Managing Board Member
- Recognizing the specific plant, region, and corporate politics at play
- Ability to disassemble the "low hanging fruit" myth and convey the truth that nothing in these plants gets done without hard work
- Assembling and motivating a diverse, multi-disciplinary team that involves plant operations, maintenance, purchasing, finance, engineering, utility representatives, contractors, and vendors.
- Promoting a collaborative work environment, displaying a healthy sense of humor, and having a genuine enjoyment for the work
- Establishing credibility by recommending actionable, achievable, and realistic project

Steinway & Sons Upgrades Its Turn-of-the-Century Brick Kilns to a Quick-dry Partial Vacuum System

Ryan Bossis, Energy & Resource Solutions, Bill Rigos, Steinway & Sons

World-renowned piano manufacturer Steinway & Sons is currently in the process of upgrading their aging kiln system at their American production facility in Astoria, Queens, New York. Because the high-quality pianos require tight tolerances for wood board moisture, the drying process for the raw wood purchased by the facility must be carefully controlled. The existing process uses the plant's original turn-of-the-century brick masonry kilns. Although the structures are sealed, insulated, and well maintained, the process is inherently inefficient. Low-pressure steam – both live steam injection and dry heat via a steam coil – is used for heat and provided by two natural gas-fired boilers. Steam injection is required to prevent too steep a moisture gradient from forming within the wood, which can produce "checking" or, cracks that occur on the ends and surfaces of the lumber, rendering the board unfit for use. Ventilation dampers are used to discharge the warm air and humidity periodically, resulting in high thermal losses. The cycle of steam injection and ventilation can last for as long as 5 weeks depending on the wood type and product specifications.

The original kilns are being replaced by a partial vacuum kiln system manufactured in Warren, Vermont. The new modular system can fit on the back of a flatbed truck and is expected to reduce kiln-drying time to 4 to 5 days. The system creates a partial vacuum, reducing the heating requirements and increasing the speed of moisture removal. Heating inputs are so low that hot water can be used in place of steam for the drying process resulting in a step level increase in overall dry efficiency. Although the technology has been around for decades, it remains underutilized in the industrial market, with significant savings resulting from decreased energy use, increased product quality, and reduced labor.

This presentation will walk through the design, installation, and commissioning process for the new kiln system. It will focus on the challenges and lessons learned through each stage of the process, beginning with the retrofit options and decision tree leading to the partial vacuum system. The various design options and heat sources will also be discussed.

Use of a Comprehensive Utility Software for Optimal Energy Management and Electric Grid Failure Assessment in an Oil Refinery

Serge Bédard, Abdelaziz Hammache, Bruno Poulin and Etienne Ayotte-Sauvé, Natural Resources Canada, CanmetENERGY, Industrial Systems Optimization

Oil refineries contain some critical operations that cannot be instantly halted in case of an electric grid failure. In order to protect these operations, most oil refineries are equipped with steam driven pumps, fans and compressors to increase operational flexibility and reliability in case of a power loss.

A thorough analysis was made in an oil refinery. The main objectives were to identify the best operating strategies to reduce energy costs while maintaining operating flexibility in case of a grid failure; to evaluate steam availability to drive all the steam turbines is case of a grid failure; and to reduce the need for a new boiler. Even though the purchased unit price of electricity is relatively low for this refinery, approximately forty steam driven units are used. In most cases, combined electric motor/steam turbine dual drive systems are used for increased reliability and to reduce energy costs.

The first task in the study was to develop a site specific utility model embedding the key hardware, such as the boilers, the waste heat recovery boilers, the steam turbines and electric motors, as well as the main steam distribution and condensate recovery systems. The model was developed in a proprietary optimization software developed by CanmetENERGY. The software uses the GAMS environment for numerical optimization. All boilers were modeled using their main operating parameters and constraints (e.g, maximum and minimum capacities, fuel characteristics, part-load operating efficiency, boiler blow down, etc.). Similarly, the boiler fans and pumps were also modeled taking into account their part-load performance curves (efficiency and power). The forty steam turbines were also modeled with their part-load operating curve using a modified Willan's line approach which includes temperature correction. The modelling of the part-load operating conditions was critical for the success of this study as the projected overall turbine steam usage was found to be close to 20 t/hr lower than the value yielded by models with constant efficiencies.

The analysis showed that running steam turbines instead of electric motors was cost effective as long as the steam exiting the turbines can be recovered in the deaerator to heat boiler make-up water. When too many steam turbines are used, low pressure steam is vented which results in significant incremental operating costs for the plant compared to the use of electric motors. It was found that the excessive use of steam turbines resulted in an additional annual energy cost of $700,000.

Several scenarios were modeled including cases with electric grid failure (e.g.: total failure, failure of one of the two electric feed lines, winter/summer/spring conditions, etc.). It was found that not enough steam would be available in case of a total grid failure during the winter period as well as in the summer period when one of the boilers is under maintenance. The problem can also occur when a boiler is put on stand-by during summer months because running all boilers together under low demand conditions makes the operation at minimum firing rate difficult and inefficient. In most cases, by switching off non-critical steam users and starting the stand-by boiler, the pressure of the refinery steam headers can be restored after 10 to 20 min. However, simulations show that there is a shortage of steam in all cases in the first 5 minutes due notably to the speed at which the boilers can ramp up and the time required to stop/reduce steam usage for non-critical applications.

Several strategies were proposed to increase the steam availability in case of a grid failure. It was found that the implementation of a new boiler as originally planned by the plant personnel was not essential. It was rather proposed to install:

- high turn down ratio burners on two of the four boilers to increase operation flexibility under very low load conditions
- a boiler make-up preheat system by using waste heat from the crude and FCC units
- an economizer on each boiler to increase the efficiency and the steam production capacity of the boilers
- two oil-fired air compressors instead of the steam driven backup air compressors
- an advanced control system to determine the optimum number of turbines that should be running during normal operation
- an automatic control valve on the steam by-pass line at the deaerator, reducing the amount of uncontrolled steam

going to the deaerator.

- Considered as a whole, these measures can reduce energy costs by 5 M$ per year while considerably increasing the refinery operation reliability in case of a major grid failure without requiring a new boiler.

Session 8: American Chemistry Council Award Winners 3

BASF Corporate Energy Management Process

Ty Geiger, BASF Corporation

BASF Corporation has an established energy management process that has been applied to its manufacturing sites for many years. BASF management has continued to focus on sustainable improvement by working toward global targets to increase energy efficiency in production by 35% and reduce specific greenhouse gas emissions by 40% by the year 2020 compared to 2002. To advance toward this goal in the US an annual reduction in energy used per ton of product of 0.58% was achieved in 2014. BASF Corporation has achieved a total of about 12% reduction in energy used per ton of product since 2008, which was the first year that energy improvement projects were tracked.

BASF Geismar Site Steam System Optimization

Jason Gathright, BASF Corporation

As part of BASF's commitment to energy conservation and continuous improvement, the Geismar site utility team identified several opportunities for improvement in 2013 to pursue and install in 2014 that required interaction with multiple site business partners to achieve. Although utilities initiated the activities, it was only through site wide commitment that the documented savings were sustained and exceeded internal targets. The accomplishments include an increase in condensate return, steam vent and let-down reductions, boiler feedwater pump horsepower savings and subsequent reliability improvements. Combined, the BASF Geismar site was able to realize an overall 2.2% energy savings in 2014 as compared to 2013.

Session 9: Energy Analysis

Lean Analysis of Industrial Energy Assessments

Raul J. Viera, Jim Lee, and Sally Anne McInerny, Department of Mechanical
Engineering, University of Louisiana at Lafayette

Energy conservation is steadily rising on the list of priorities for companies around the world, and government mandates and restrictions are requiring businesses to become energy conscious. A typical energy conservation program like the Louisiana Industrial Assessment Center (LIAC) provide a useful service to industry leaders by creating Energy Management Plans (EMP) to help reduce energy consumption and increase productivity. These programs usually focus on improving the productivity and efficiency of other industrial facilities, but rarely shift their focus inward for self-improvement. This article examines how energy conservation programs develop an EMP and how this process can be improved with Lean techniques. Data from the LIAC procedure is first gathered and quantified so areas for improvement can be identified. Lean tools are then applied to these areas to estimate potential savings. Finally, the results are analyzed to evaluate the total potential for improvement.

Energy Savings Opportunity in Manufacturing Lightweight Structural Materials

Sabine Brueski, Energetics Incorporated

Lightweighting has been identified as a key strategy for achieving national manufacturing innovation goals, and along these lines high-strength, lightweight structural materials are increasingly being considered in the manufacturing sector for components and structures. The energy cost to manufacture these materials is one of the variables of comparison when evaluating applications in transportation, defense, infrastructure and commercial markets. In this study the energy consumed in manufacturing aluminum, titanium, magnesium, high-strength steel, carbon-fiber, glass-fiber, and aramid-fiber is represented with equivalent baseline parameters. Energy saving opportunities are considered for each of the materials studied, along with projections for production and energy consumption in the year 2030. Energy consumption for key process subareas is also determined to improve the understanding of process flow energy intensity and identification of opportunity areas. The findings of this study allow for uniform comparison of energy consumption for seven emergent lightweight structural materials.

Modern Visualization of Industrial Energy Use and Loss

Sabine Brueski, Energetics Incorporated

Understanding the flow of energy is a critical first step in improving energy efficiency in industry. And as important as it is to have correct representation of energy consumption and end use, it is equally important that the information is available and readily understood by technical and business managers alike. There is a trend in both the public and private sector towards data driven visualization products to aid in communicating energy data.

This paper will provide an introduction to the U.S. Manufacturing Energy Sankey Diagraming Tool that has been developed for the U.S. Department of Energy, Advanced Manufacturing Office. The tool is an evolution of the highly-referenced Manufacturing Energy and Carbon Footprints, produced for DOE by Energetics Incorporated. The footprints have been updated to reflect the most current Energy Information Administration energy data which has now been modeled in to both static Sankey images and most recently a dynamic/interactive Sankey diagraming tool that allows custom visualization. Energy flow data can be customized by sector, energy type, and end use detail depending on the audience. The dynamic visualization tool allows zooming in on energy use and loss data while maintaining the perspective of overall energy flow.

The newly released Sankey diagrams enable easy visualization of complex data. The benefits of this modern energy visualization approach described in this example macro-scale project are equally applicable for sector-, company-, facility-,and process-wide application.

Preparing for a Successful Energy Audit

Tom Theising, Sustainable Energy Solutions, LLC

Many details are available describing technical feasibility, third party financing, performance contracts, or the savings potential of various energy conservation opportunities. The organization and implementation of a do-it-yourself program is what the author will present. Having completed approximately 200 energy audits of industrial facilities he has developed a checklist approach to planning an energy audit, preparing the documents, details, schedule, and personnel necessary to perform the audit. In past presentations the author have shown the how-to of an audit and the details of tracking the “finished product”, the findings. The methods he has developed have allowed him to maintain an 18% of energy spending annual savings average with one-year payback opportunities. The audience will be shown the details of planning prior to an audit, scheduling during an audit and the common low/no cost items of recent audits.

Session 10: Water and Energy Issues

Developing a Corporate Water Management Strategy

Vestal Tutterow and Jackson Stubbs, Project Performance Company

Industrial facilities universally rely on water as a raw material for processing, cleaning, cooling, diluting and transporting products, and even as an energy source. The efficient use, treatment, and management of water is becoming increasingly important to companies in the U.S. as concerns over cost and access to clean and reliable water sources grow.

This paper will examine water use by manufacturers and identify key best practices in use by industry leaders, including companies participating in a pilot program within the U.S. Department of Energy's Advanced Manufacturing Office. The paper will highlight resources and tools from which facility managers, corporate sustainability professionals, and others can benefit as they seek to pursue water conservation opportunities, develop comprehensive water management plans, or incorporate water management into existing corporate sustainability programs. The paper will conclude with a look at emerging trends that manufacturers and corporations will want to follow.

Identifying Water Savings in Industrial Operations

Tom Theising, Sustainable Energy Solutions, LLC

Investigating water savings opportunities has often been overlooked in the past. The low cost and common availability seem to have been the primary factors. It wasn't that auditors failed to look at water opportunities; their primary focus was on higher spending such as fuel/gas, electricity, etc.

With today's, justified, focus on sustainability, and recent drought conditions throughout areas of the U.S. a new focus is being placed on this precious resource.

Having completed 10 such assessments in industrial facilities in 2014 the author will explain the process of conducting a water assessment. Determining what data to collect and how to organize and analyze it will be covered. The assessment process described involves panel discussion and field work. Multiple low and no cost opportunities having been found will be presented.

Evaluation of Impacts on Energy and Plant Profitability of Responses to Water Curtailment

Kathey Ferland, University of Texas, Peter Phelps, Phelps Engineering

The "Technology Forum: Sustaining Industrial Energy Efficiency in Process Cooling in a Potentially Water-Short Future", was convened on June 19, 2013 in Houston, Texas to bring together end-users in chemical plants and refineries with the developers of technologies that provide process cooling. The focus of the Forum was on the energy impacts of cooling applications that use less water.

A common concern across the board was that "water is cheap until it's gone", which makes it challenging to engage management and secure capital for technology investment before there is a crisis. One of the challenges is that there are no "apples to apples" comparison of what is at stake when curtailment occurs. Attendees identified the need to be able to compare the performance of wet, hybrid and dry cooling technologies based on capital and operating costs, water, and energy impacts. This report presents the results of this comparison.

Water Savings in Food Processing Plants – Potentials and Case Studies

Alexander Trueblood, Mark Ritchie, and Sandra Chow, BASE Energy and Ahmad R. Ganji, San Francisco State University.

There is a rising national and statewide concern in the relationship between energy and water usage, also known as the water energy nexus, especially in California. The drought in California has resulted in more focused attention to water savings and the associated embedded energy savings.

California's industrial sector uses about 1-5% (depending on the region) of water in the state, excluding the water used in power plants. Energy savings due to water conservation comes from reduced fresh water and sewer treatment, fresh water and sewer pumping, cooling, and heating. Many industrial processes, in particular food processing, are quite water intensive. Some examples are fresh and frozen vegetable processing, tomato processing, and wineries. The sources of excessive water use are excessive washing and rinsing systems, product conveyance systems, cleaning processes, and old (inefficient) or malfunctioning equipment.

This paper details the sources of water savings, the associated embedded energy savings, and analysis methods in quantifying and implementing different water conservation projects. These analysis methods have been developed from several comprehensive energy and water assessments of California food processing facilities. These facilities include wineries, fresh vegetable, tomato, and nut processing. Major water saving measures include eliminating single pass cooling, improving cooling tower water treatment, improving washing cycles, cascading water use, improving performance of falling film chillers, and returning steam condensate discharge. Examples of the potential savings are shown in the following table.

Sample of Water and Associated Energy Conservation in Selected Plants				
Plant	Water Savings (Million Gallons per Year)	% Water Savings	Energy Savings*	
			Electrical (kWh/ yr)	Natural Gas (therm/ yr)
Fresh Vegetable Processing	5.02	2.5%	375,000	N/A
Tomato Processing	43.9	14.2%	140,000	N/A
Winery	1.62	4.9%	33,000	N/A
Nut Processing	6.5	13.6%	12,000	50,000

* Energy savings per gallon of water varies greatly depending on the processes the conserved water goes through (i.e. cooling, heating, pumping-only, etc.)

Session 11: Program Evaluation

The Value Proposition of Industrial Energy Efficiency Programs

Ethan A. Rogers, American Council for an Energy-Efficient Economy

In some states large electricity consumers have been pushing to opt-out of energy efficiency programs. The primary justification for not participating in these programs is that, from the customer's perspective, the fees paid in are greater than value received. There may also philosophical objections to mandatory participation and to subsidization of other customers, some of whom may be competitors.

The challenge of large energy consumers opting out of utility sector programs are as follows:

1. Energy efficiency programs no longer have access to the low-cost savings from the industrial sector that can lower program portfolio cost of saved energy
2. Industrial consumers no longer have access to program technical assistance services and financial assistance that can facilitate the acquisition of savings beyond what they can accomplish on their own
3. Infrastructure investments, which are paid for by all customers, are not avoided through less expensive investments in energy efficiency
4. Commodity prices in wholesale markets are not influenced by the decrease in demand

It is possible that over the next few years, more states will exempt large industrial customers from mandatory participation in utility sector energy efficiency programs (EEPs). Efficiency programs will no longer be able to count on the fees collected from these customers nor the energy efficiency resources they can acquire. This is, unless they are able to convince these same customers that it is in their best interest to participate. A voluntary option satisfies the objection of a powerful constituency and mitigates the damage to needed investments in efficiency.

To accomplish this, the EEPs must provide significant value to large consumers and must be able to articulate that value. Both of these tasks will be challenging however the second will be more so as it will be necessary to overcome a commonly held belief that all efficiency programs do is collect and redistribute money.

This paper will discuss how to communicate that value and by extension, why they should voluntarily participate in utility sector efficiency programs.

Costs and Benefits of Capital Finance Through Energy Service Outsourcing

Christopher Russell, Energy Pathfinder Management Consulting, LLC

Energy service outsourcing is a business relationship that allows a large facility to transfer responsibility for one or more energy functions—such as steam, compressed air, water treatment, lighting, or other activities—to a vendor. A contractual agreement establishes an ongoing scope of work subject to periodic renewal. The service is typically intended to relieve host facilities of the cost and effort of sustaining reliable energy-related operations. As an ongoing relationship, outsourcing is distinct from energy performance contracts for the design and installation of energy improvement projects, where vendor involvement terminates as projects reach stabilized operation. Relying on outsourced energy services relieves the host facility of potential distractions from its core business priorities.

Perhaps the most intriguing aspect of energy service outsourcing is its potential to substitute for capital investment. In addition to providing energy, labor, and maintenance support, outsource vendors may also offer new assets to replace broken-down or otherwise inefficient equipment. If replacement assets are provided, capital cost recovery is a key component of energy service fee determination. Capital finance, energy and variable operating costs, and a profit margin for the vendor must be amortized together into a monthly fee. For the proposed deal to be acceptable to the host, this fee must be sufficiently below what it costs the host to attain equivalent service with its internal resources.

The audience for energy service outsourcing includes facility managers (service consumers), vendors (service providers), and energy program administrators who design and implement energy efficiency programs pursuant to utility regulation. The last instance describes those regulators who actively promote energy efficiency initiatives to consumers, as end-use efficiency can reduce or offset more costly investment in new utility generation and distribution assets. Outsourcing can potentially accelerate the implementation of energy efficiency measures by overcoming the capital cost hurdles that facilities so often endure.

Overcoming Conservative Payback Rules for Energy Efficiency Projects

Andre de Fontaine, Advanced Manufacturing Office, U.S. Department of Energy

Short payback requirements for energy efficiency projects—often two years or less—tend to be the norm within the U.S. industrial sector. While helpful from a risk management perspective, conservative payback thresholds can leave significant energy-saving opportunities on the table, especially in today's low energy price environment. The consequences of limiting investment to projects that pay for themselves in two years or less include: difficulty in achieving aggressive corporate energy savings targets; reduced employee morale as projects proposed by engineers and other staff are rejected; diminished competitive positioning as long-term energy savings streams are forfeited; and heightened reputational risk due to relatively higher energy-related greenhouse gas emissions.

Focusing on experiences from partners in the U.S. Department of Energy's Better Buildings, Better Plants Challenge, this paper will describe approaches leading companies have taken to either establish more permissive investment rules for energy efficiency projects or devise workarounds for existing conservative requirements. Examples cited in this paper may include:

- 3M's establishment of a capital set aside program that reserves a set amount of funds each year for energy projects that fall outside the company's normal payback requirements.
- GM's use of performance contracting to implement projects at no upfront cost to the company.
- Nissan's successful efforts to extend its payback requirements from one to three years.
- HARBEC's utilization of external financing, which allows it to implement all energy efficiency and renewable energy projects that pay for themselves over the projects' lifetimes.
- Volvo's investment guidelines for efficiency projects, which allow decision makers to factor in the risks of sharp increases in energy prices to justify projects.

The Better Buildings, Better Plants Challenge is the industrial component of the Better Buildings Challenge, a Presidential leadership initiative that is helping the nation save money on energy bills while reducing carbon emissions. Manufacturers in the Better Plants Challenge are openly sharing their innovative approaches to saving energy—including the examples cited above—so that others may follow their lead.

Employee Based Energy Management

Oluseun Osho, Jim Lee, and Sally Anne McInerny, Department of Mechanical Engineering, The University of Louisiana at Lafayette

This paper provides an employee based approach to implementing energy management plan using a six sigma. It provides a six phases to establishing energy management. These six phases' represents the procedure developed using the six sigma concept of DMAIC and additional 'C' to emphasis employee importance. The first phase discusses the creation of a policy and appointment of an energy manager. The second phase represents the added phase which addresses the issue of getting employee buy-in on the project. The third phase presents information on data gathering through energy audit. The fourth phase provides the framework for decision making on recommendations from the energy audit exercise. The next phase discusses how the system is improved through implementations based on decisions made. The last phase provides ways to sustain the gains of the energy management plan and unearth more energy savings opportunities.

The significant result of this approach is also presented to show the effect of active employee participation. The paper also provides data from the industry to validate the success of the approach.

The Impact of Quality Control Scrap and Rework Reduction on Energy Use

Paul T. Otis, U.S. Department of Energy Energy Information Administration,
Konstantinos P. Triantis, Virginia Tech-Northern Virginia Center, Industrial and Systems Engineering

Operations management in areas such as quality control, production scheduling, maintenance management, and supply chain optimization has the potential for substantial energy use reductions depending on the facility. The focus of this paper is on the energy savings associated with quality control to reduce the production of defective products that must either be disposed of as scrap or undergo additional processing to meet product quality standards.

Data for scrap and rework at the production process level over a 10 month period from a factory in the computer and electronic products industry is analyzed. Energy use data at the plant level is used to estimate potential energy savings from scrap and rework reductions. Cost data related to materials and labor is also analyzed to illustrate that energy savings though quality control may be justified based on savings other than energy. Nevertheless, reductions in scrap may be one of the most significant areas for reduced energy use. Reductions in scrap also save energy in the supply chain, but this paper is focused on energy savings at a manufacturing facility.

Energy audits are typically focused on managing existing equipment and identifying cost effective technology to improve energy efficiency related to areas such as heat loss for boilers, lighting, air leaks, and HVAC systems. Operations management areas such as quality control often require cross-cutting process improvements and months or even years to implement significant changes that reduce energy use. This may be outside the scope of an energy audit, but potential operations management projects to reduce energy use could be identified during an energy audit. Quality control is often implemented as part of lean six-sigma. A lean six-sigma approach may be used for energy management as well. To be ISO50001 certified organizations are required to consider a broad range of improvement opportunities in the design of facilities, equipment, systems, and processes. Operations management areas such as quality control are appropriate areas of concern for ISO50001 certification.

Session 12: Equipment Analysis Two

Help Avoid Danger, Damage, and Dollars Lost in Steam Systems

James R. Risko, TLV Corporation

Common site practice with regard to managing a steam trap population may focus on the identification and repair of failed steam traps according to a fixed budget. Correspondingly, the priority and implementation of a maintenance response may be reduced to a reactive /corrective status. In such programs, a site may experience significant - but avoidable safety, reliability, production, and energy issues. A different method – a paradigm shift - to analyze and improve the relative health of a steam trap population by focusing on critical threshold values can be useful to obtain an optimized steam system that provides best quality heat safely and reliably.

How to Diagnose, Triage, and Repair Damaged Thermal Insulation Using a Mobile Phone

John Williams, Aspen Aerogels, Inc.

The concept addressed in this paper is a system to diagnose, triage, and repair underperforming insulation on industrial piping and equipment. Wet, degraded insulation wastes 330 TBtu/yr in US industrial facilities (0.34% of all domestic energy consumption), and increases the risk of corrosion under insulation (CUI) and its associated safety, health, environmental, and economic costs. Using a system of QR-coded, geo-tagged stickers, a smart phone, and an online database, user facilities can quickly identify degraded insulation, prioritize and repair those areas with immediate payback, and develop an ongoing maintenance program to prevent future energy losses.

Development of an Automated Fault Detection Tool for Unitary Air Conditoners at Industrial Energy Audits

Priyam Parikh and Bryan P. Rasmussen, Texas A&M University

Industrial energy audits generally focus on optimization of manufacturing process systems but fail to focus on the non-process industrial HVAC systems. This is in spite of well-documented widespread prevalence of efficiency degrading faults affecting these systems. Auditors are limited by time and the information required by existing HVAC fault detection methods and tools; system specific models or manufacturer's map models are not easily available to energy auditors on a one-day audit. The proposed automated fault detection and diagnostic device for unitary air conditioners overcomes these challenges. It uses temperature and pressure sensors, along with easily obtainable nameplate or brochure data, to detect refrigerant undercharge, refrigerant overcharge, liquid line restriction, condenser fouling and evaporator fouling faults. It also predicts the related energy and cost saving for each fault. The developed device is tested for individual and multiple faults with systems using different expansion valves. Overall, it worked well for refrigerant line faults, and gave conservative estimates of energy and cost savings, which is usually preferred by energy auditors. Field tests confirmed that the device was low cost and could be easily installed in under 20 minutes.

What Problems can be Encountered when Efficiency Upgrades are Made to Fans and what Should the Approach be to Address those Problems?:

Vern Martin, FLOWCARE Engineering Inc.

This presentation would provide an overview of a wide variety of technical concerns that can occur when energy projects are conducted on fans… this would include both the mechanical and aerodynamic problems discussed in the above two suggested talks but would also briefly touch on others as well. The objective of this presentation would be to define the process by which upgrades should be conducted to ensure that the risk associated with implementing an efficiency upgrade is minimized to the most practical extent possible.

Progressive Vacuum Degredation within Pipestills and Vacuum Towers

Brian Kimbrough, Louisiana Steam Equipment Company

In many distillation process applications, high vacuum levels in pipe stills are required to meet hydrocarbon yield design points. In this process, shell and tube condensers are applied to induce the required vacuum required to extract hydrocarbons in a vapor state. In conjunction with the condenser, jet ejectors are applied to extract non-condensable gases from the condenser's steam space thereby maximizing the condenser's heat exchange efficiency.

When vacuum levels in a pipestill decline, significant production losses are a common phenomenon. In some processes a 1" HG vacuum reduction can exceed $20,000.00/ day in lost production. Consequently, the entire system must be brought down for routine maintenance as a loss avoidance strategy. Further, it is very difficult to determine what the cause of the vacuum loss really should be attributed to. Is it the fouling of the condenser? Is it the erosion within the nozzle of the jet compressor? This discussion addresses some simplistic steps that can be taken to identify the root cause of the vacuum loss i.e. condenser or Jet compressor.

Notes: