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The Center for the Management of Technological and Organizational Change
Gerald I. Susman, Director
Russell Barton, Associate Director

Starting the Lean to Green Journey

Roxanne Turner
Manager, Global Ethics & Compliance
Kennametal
Latrobe, Pennsylvania

Kennametal is a global leader in tooling solutions, engineered components, and advanced materials with a significant footprint around the globe. It is located in over 60 countries with 90 locations and a diverse, global workforce of over 14,000 dedicated employees. Kennametal is divided into two segments – Metalworking Solutions and Services Group (MSSG), with annual sales revenues of $1.8B, and the Advanced Materials Solutions Group (AMSG) with annual sales revenues of $915M. Kennametal is an innovative company with significant research and development investments – 47% of sales is on products released in the past five years. Kennametal's base customers include energy, chemical, power generation, mining, construction, automotive, transportation, aerospace, general engineering and machine tooling.

The company already engages in sustainable practices including: a full line of tools and services for supply chain management groups, called Kennametal complete, where tools are returned to Kennametal for reconditioning and re-tipping; quantification of waste through contract management; quantification of recycling; and scheduling adjustments at some plants to take advantage of off-peak energy rates. Kennametal wanted to go further and it felt that an energy conservation program was the next logical step.

In the first full year of its energy conservation plan implementation, Kennametal is taking the unique approach of adapting Lean to its energy conservation efforts. Lean is already part of its culture – employees understand the Lean toolkit and have a heightened awareness of the impact waste can have on its operations. Kennametal does not focus on Six Sigma, but it does use all of the other tools in the Lean toolkit. Kennametal required all executive management council members to have their Lean green belt by 2006, and their direct reports to have Lean green belts by 2008. The company allows black belts in individual Lean tools – as long as the employee can obtain the required expertise and develops proficiency in one of the Lean areas, then that employee can continue to contribute to the Lean journey at the next level.

Kennametal's Lean to green journey has challenges, including: quantifying the value of waste minimization; reducing landfill volume and controlled materials into the waste stream; risk avoidance for hazardous and/or controlled materials; reducing heat, mist and vapor emissions via recycling; seeing "cost avoidance" as a real savings – capturing the intangible value of costs yet to be incurred as a result of improving efficiencies; identifying a carbon footprint with minimal carbon emissions from operations and understanding the supply chain carbon footprint attributable to operations; quantifying the impact of reductions on the environment; and normalization – converting normalized data to one figure for the purposes of overall conservation percentages enterprise-wide from operations in over 60 countries.

Kennametal relies heavily on Single Page Plans (SPP) to define, measure, analyze, improve and control processes for its energy conservation program, which is a Six Sigma-style approach. It established a baseline of FY 2007 and a five year goal of a 15% targeted reduction enterprise-wide by FY 2012.

Example of a Single Page Plan (SPP):

Title: [Energy Conservation Plan]

[Location: [Site Name]

Date:

Project Leader: [Site Champion]
Champion: [Plant Manager]
Team Members: [Cross-Functional Site Team]

Background (Define) To achieve a 15% reduction in energy consumption by FY12 (normalized and as compared to FY07). Progress will be measured by reductions in usage as measured by kWh/[normalizing factor].

Initiative Statement: Develop and execute a plan to achieve environmental and business benefits related to energy conservation consistent with the goal noted above.

Initiative Scope: Plan, execute and measure progress associated with energy conservation initiatives. Move to further a conservation culture at the site. Complete projects that conserve energy. Use both low cost/no cost efforts and capital projects to achieve targeted reductions.

Customer(s): Kennametal and relevant stakeholders.

Future State (Improve)

Ideal State (describe):

- Site employees take energy conservation into account in all their activities on a daily basis. Energy conservation becomes a "business as usual" practice integrated into all site operating and functional processes.

Future State:

- [Generally identify what conditions will need to be satisfied to reach the 15% goal]
- [Identify tangible short term (i.e., next 6 months) accomplishments that are expected in moving towards the overall goal, if the site has an "early stage" energy conservation program the following list may be relevant].
- The site has a clear understanding of energy consumption rates and areas where greatest opportunities for conservation reside based on systematic assessments conducted at the facility.
- A Site Champion & Steering Committee are in place and driving conservation measures.
- Daily reinforcement is evident – LEAD Board visibility (progress on metrics/conservation ideas/recognition); use incentives and competitions to encourage conservation and generate new ideas.

Current State (Measure & Analyze)

Appropriate normalization factor (i.e., true measure of business activity) is [insert, e.g., machine hours, FTEs, etc.]. This factor is measured and auditable. Kilowatt hours is measured monthly by [describe]. In FY07 energy consumption was ___ kWh/[normalizing factor]. In FY08 energy consumption was ___ kWh/[normalizing factor] representing a __% [increase or decrease].

Presently, site energy usage is characterized by the following energy balance [insert site energy balance – example provided below]:

Energy conservation measures presently in place or previously applied include:

- [List each, affect on energy usage, how affect was measured/verified, measures in place to assure efficiencies sustained (e.g., continuous commissioning, operator training, etc.)]

Implementation Plan

- Validate/verify FY07 and FY08 usage and normalization factors by [date].
- Develop/update site energy balance and complete energy self assessment (using KMT's 6 keys tool or other comparable method) to identify and prioritize conservation opportunities by [date].
- Establish conservation goals, projects (based on identified priorities), schedules and progress measures by Department and/or area of facility by [date].
- Communicate and track progress on selected goals/projects by [date].
- Update SPP by 28 Feb 09:
  - Defining conservation actions for the following 6 months and associated success measures; and
  - Recalibrating broader reduction goals for FY09-FY12.
- As necessary, develop and implement Control Plans to ensure efficiency gains continue to be realized.

Metrics

- [List short-term (next 6 month) measures of success and how progress will be communicated].
- Presently, [site] envisions conservation measures planned to result reductions of the following: FY09 ; ___ kWh/[normalizing factor] FY10 ___ kWh/[normalizing factor]; FY11 ___ kWh/[normalizing factor]; and FY 12___ kWh/[normalizing factor], coupled together with FY08 conservation measures to achieve the 15% goal.

Define – Measure – Analyze – Improve – Control

Define, Measure & Analyze

From a Lean perspective, a five year plan is not realistic – Lean wants to see realization of goals in a shorter time frame – which means the SPP is updated every six months so that new projects that contribute to the 15% goal are captured. The scope of each SPP is limited to tangible actions which can be achieved over six month increments. Kennametal mandated that all plants produce an SPP for its facility and a new SPP for every project that will contribute to the goal. Goals must be SMART goals (Specific, Measurable, Attainable, Realistic, and Timely). If employees don't feel goals are attainable they won't be engaged to achieve them, and it becomes a disincentive to change.

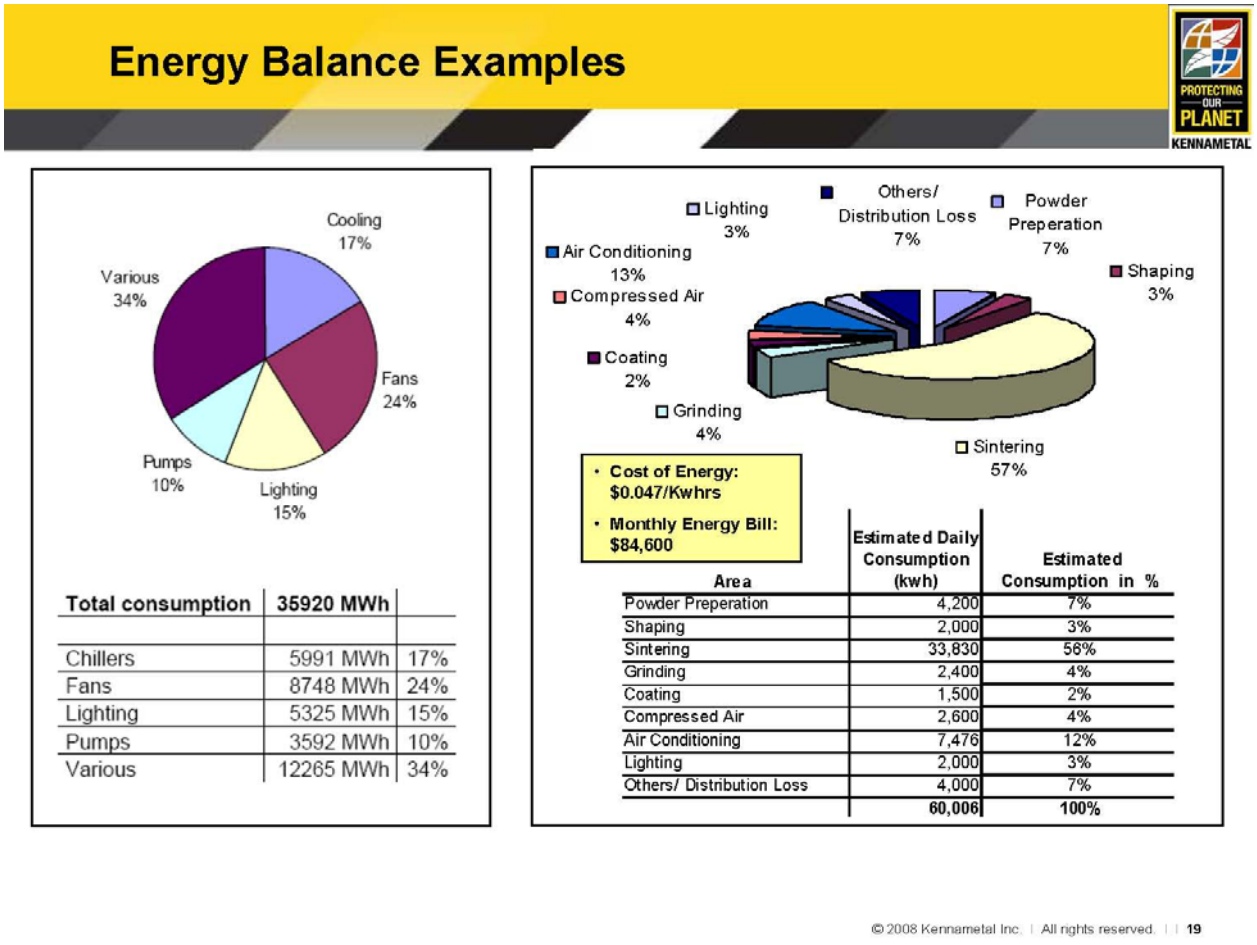
Kennametal measures and analyzes through normalization factors. For energy conservation measures, one key is to normalize the production to some energy savings (i.e., BTU's, kilowatt hours, gallons of water) to generate an overall savings for a facility or for the company. Normalization factors are non-bias, relevant, site-specific and representative of a facility. It measures the business activity and allows for a reasonable characterization of the impact conservation measures have made. Normalization factors are adjusted to account for variability in operations, are independent from automation level (manual work vs. automated work), and reflect the best product mix (e.g., small vs. big products).

Normalization is a particular challenge. Kennametal has 90 locations and they all do something different – one location may only produce powder that goes to another location that only produces the cutting tool inserts. The location that produces the powder is measuring in kilograms of powder. The location producing the inserts may be measuring in the number of inserts produced and shipped out. It's not a problem that they are different – they should be. But you can't measure powder by inserts or inserts by powder.

Kennametal initially chose the kilowatt hour as one of its overall factors, and allowed each facility to choose one factor it felt best represents its operations. For instance, an office building might choose full time equivalents (FTEs) because there is a conversion table to convert to kilowatt hours. A factory might choose kilograms of powder, number of inserts, or machine hours operating. Other factor examples include the number of sales orders, earned direct labor (EDL), hours, shipment dollars (US$), lines shipped, machine hours, man hours worked, pieces produced, shipment & standard costs, or square meter months. Kennametal provided guidelines on choosing a representative normalization factor to all its locations. Usage and normalization factors are validated and verified to assess the existing energy conservation measures to assure it is the right factor for that facility. Kennametal will ultimately use up to ten factors corporate-wide, but may use as few as five.

One tool for measuring and analyzing in an energy conservation program is an *energy balance*, which consists of gathering the energy bills for one year and identifying the major consumers. An energy balance includes a walkthrough assessment of your processes to determine what energy each process consumes. In an office building, you may have an electric bill for offices that makes up 50% of the total electricity costs, then heating and air conditioning can be another 30%, which may be metered separately from the lighting. In a production facility, some facilities need to maintain areas that are cool, and others do not have air conditioning. Some use a lot of fuel or natural gas, and some do not. All need to normalize to your normalization factor. Using

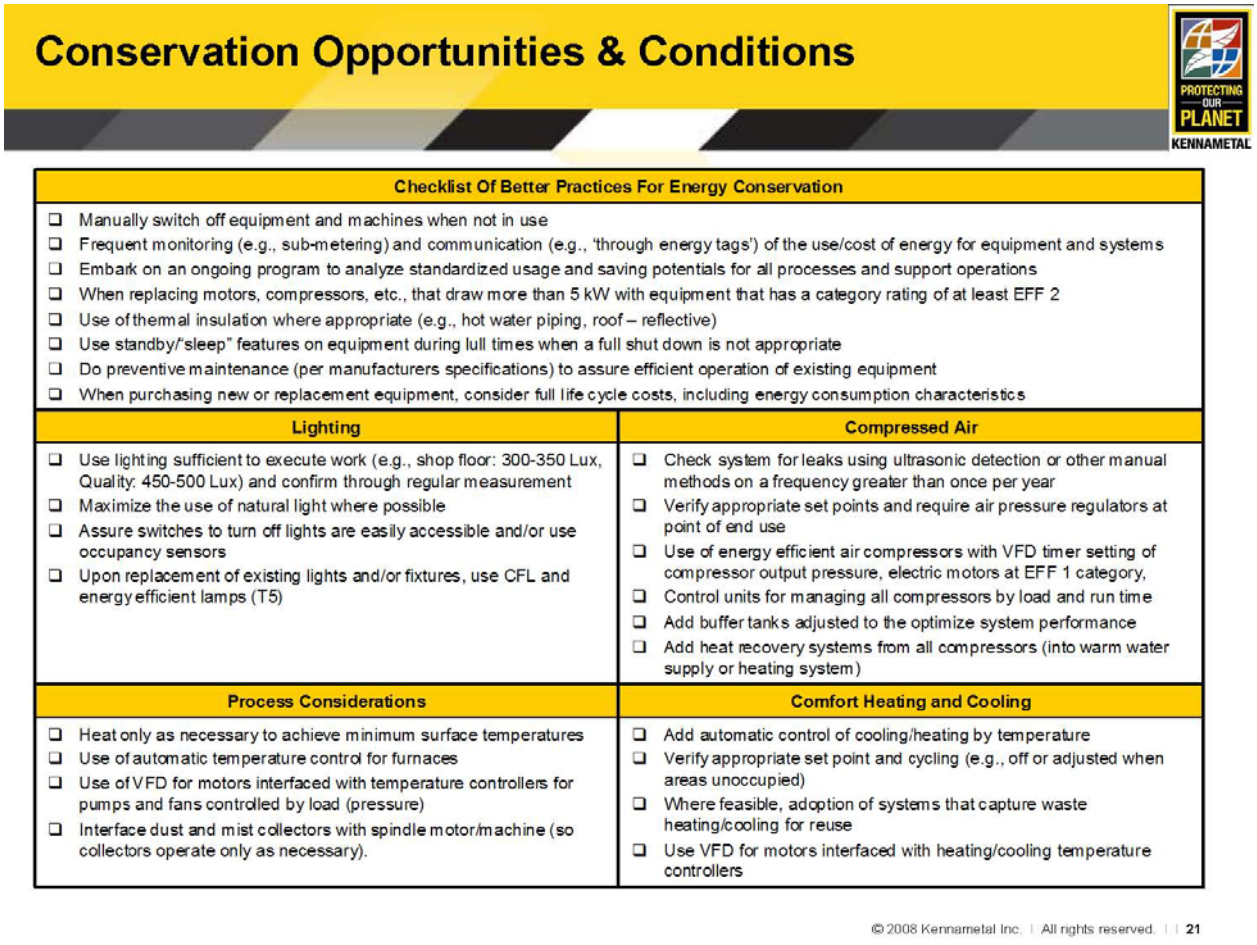
an energy conversion table or tool can be helpful – available online tools include: http://www.energystar.gov/ and http://www.onlineconversion.com/energy.htm.



The best way to do an energy balance is with sub-metering. This involves a financial outlay in the beginning, but pays back in multiples because you can capture energy use on a cell level. A good set of electricians and/or plumbers who can install on-site is useful. Sub-metering is a very instructive exercise that will give you a realistic snapshot of how much energy is being used, for what, why, when, during what shifts, and how. This is analogous to value stream mapping where you need to know who is doing what, and how much time it is taking them to do it. As an alternate, you can speak with engineers or operators to obtain estimated run hours and prepare estimates, but don't underestimate the value of installing sub-meters to gain accurate measurements of energy balance by operating cell of each functional unit.

Kennametal continued accounting for energy usage until it accounted for at least 85% of the total energy bill on the first pass. All data is input into a spreadsheet and output is generated, which generally consists of a pie chart and an associated table. An energy balance works like a decision tree that helps determine what to focus on first, and helps prioritize energy savings opportunities. It lays the groundwork for your energy conservation efforts and is useful for monitoring the improvements made via a conservation effort.

A "Checklist of Better Practices for Energy Conservation" can also identify opportunities:



Conservation Opportunities & Conditions

PROTECTING OUR PLANET
KENNAMETAL

Checklist Of Better Practices For Energy Conservation

- ❑ Manually switch off equipment and machines when not in use
- ❑ Frequent monitoring (e.g., sub-metering) and communication (e.g., 'through energy tags') of the use/cost of energy for equipment and systems
- ❑ Embark on an ongoing program to analyze standardized usage and saving potentials for all processes and support operations
- ❑ When replacing motors, compressors, etc., that draw more than 5 kW with equipment that has a category rating of at least EFF 2
- ❑ Use of thermal insulation where appropriate (e.g., hot water piping, roof – reflective)
- ❑ Use standby/"sleep" features on equipment during lull times when a full shut down is not appropriate
- ❑ Do preventive maintenance (per manufacturers specifications) to assure efficient operation of existing equipment
- ❑ When purchasing new or replacement equipment, consider full life cycle costs, including energy consumption characteristics

Lighting	Compressed Air
❑ Use lighting sufficient to execute work (e.g., shop floor: 300-350 Lux, Quality: 450-500 Lux) and confirm through regular measurement ❑ Maximize the use of natural light where possible ❑ Assure switches to turn off lights are easily accessible and/or use occupancy sensors ❑ Upon replacement of existing lights and/or fixtures, use CFL and energy efficient lamps (T5)	❑ Check system for leaks using ultrasonic detection or other manual methods on a frequency greater than once per year ❑ Verify appropriate set points and require air pressure regulators at point of end use ❑ Use of energy efficient air compressors with VFD timer setting of compressor output pressure, electric motors at EFF 1 category, ❑ Control units for managing all compressors by load and run time ❑ Add buffer tanks adjusted to the optimize system performance ❑ Add heat recovery systems from all compressors (into warm water supply or heating system)
Process Considerations	**Comfort Heating and Cooling**
❑ Heat only as necessary to achieve minimum surface temperatures ❑ Use of automatic temperature control for furnaces ❑ Use of VFD for motors interfaced with temperature controllers for pumps and fans controlled by load (pressure) ❑ Interface dust and mist collectors with spindle motor/machine (so collectors operate only as necessary).	❑ Add automatic control of cooling/heating by temperature ❑ Verify appropriate set point and cycling (e.g., off or adjusted when areas unoccupied) ❑ Where feasible, adoption of systems that capture waste heating/cooling for reuse ❑ Use VFD for motors interfaced with heating/cooling temperature controllers

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One of the key projects Kennametal has identified for its older facilities is lighting projects – new facilities generally have efficient lighting. Kennametal completed lighting inventories by counting CFL and metal halide bulbs and calculating the energy usage (i.e., "x" number of CFL bulbs (x w/kWh) x 8 hours/day x 340 days/year). Just by improving the lighting and updating the fixtures and bulbs, the company can see a 10% improvement. However, lighting companies may try to sell savings that may or may not materialize, so Kennametal is discussing lease options on lighting improvements where the lighting company is paid on the savings produced in lieu of an up-front outlay for the lighting upgrades. In addition, Kennametal has legacy equipment that still works well for what it does, which makes it challenging to find the ideal consumption rate per process. Improving processes or equipment may be another relatively easy way to achieve gains up-front.

Future State, Implementation Plan, and Metrics…

Determine what needs to be done to achieve conservation goals, including current state and the anticipated savings or energy reductions as measured by the normalization factor as a result of the process or procedural change. Use a structured approach to determine projects based on identified priorities, when it needs to be completed, and who needs to do it, and include implementation schedules and progress measured by department and/or area of the facility.

Leave nothing unassigned – to achieve results you need accountability, measurement, and audits to capture improvements. Include a means to measure and verify that the new process is carried out (e.g., the new process is to turn off a dust collector when not in use – how will a facility measure and verify that this activity is being done for auditing purposes?).

Identify conditions that need to be satisfied to reach the enterprise goal from the energy balance assessment and site conditions (i.e., there is heat loss, steam or mist generated in location "x", and I need heat in location "y" – can I convert the steam or mist into the heat I need in the other location to save oil in my boiler?). It is important to think creatively. Prioritize hot spots and significant energy draw opportunities identified during assessment and energy balance. Identify control measures to ensure the process and associated procedures continue to operate as intended. List measures and steps to be taken should and out-of-control situation occur. Recalibrate the SPP and energy balance assessment as each opportunity is realized or condition is met over the 6 month rolling period. Recalibrate for the idea state/long term view, use the lean metrics workbook to calculate (and recalculate) as each milestone is reached.

Finally, describe the method and means that will be used to communicate the plan, process changes, and goals to employees. Include updates as the processes, designs, measurements and control measures change. Constantly create metrics that are reported again and again to employees at all facilities, tell the success stories to all facilities, and communicate to employees as each milestone and every success is achieved. Simply by communicating where the flaws are, what the improvements could be, and keeping people on board with the process can make a significant contribution to the success of a plan.

Corporate Responsibility is Not an Intangible

Communities know it when they see a responsible company. They know it when a company takes care of its employees and the resources it consumes in its processes. Communities like to see that there is not wastewater discharge polluting waterways, and know that the company is a responsible neighbor that is not putting something out there for the community's children to suffer from – that is what corporate responsibility is about. Employees feel good because the company takes care of its employees and the community, whether or not they work for the company. It is intangible as energy conservation means measuring in a vacuum – measuring a negative because it is being reduced. However, every time a company can save in energy, it can add more resources that can be used for charitable giving, scholarships, volunteerism in the neighborhoods, and engagement with the United Way. Everything we do from an energy conservation perspective insures that there are resources for longer-term business operations, and for the community to use. The conservation measures that we undertake today ensure longevity not only for the company, but for the communities where we live and work.