It's not just for Energy: Repurposing a Corporate Energy Management System for Water Efficiency
Leveraging Energy Management to Address Water Conservation

Sharon L. Nolen, PE, CEM
Eastman Chemical Company
Manager, Worldwide Energy Program
A global, industry leader

- Fortune 500 specialty materials company with 2017 revenue of ~$9.5B
- Global manufacturer and marketer of advanced materials and specialty additives
- Four business segments
- Global team of ~14,500
- Serving customers in >100 countries
A diverse and attractive portfolio of businesses

Additives & Functional Products
• 2017 sales revenue: $3.3 B
• 35% of total Eastman sales

Advanced Materials
• 2017 sales revenue: $2.6 B
• 27% of total Eastman sales

Chemical Intermediates
• 2017 sales revenue: $2.7 B
• 29% of total Eastman sales

Fibers
• 2017 sales revenue: $852 M
• 9% of total Eastman sales
Drivers to address water issues

- Water has become a global macro trend
- Future supply (quantity and quality) concerns
- Customer inquiries
- Sustainability scores (i.e. CDP)
- Closing the gap in our sustainability story
- Public expectations of a large chemical company
Challenges

- Lack of data
- Low interest in manufacturing, particularly at sites with readily available water
- Need water treatment experience to evaluate water reuse opportunities
- Permit limits
Initial Objective

Develop an understanding of water issues and properly identify and manage water risks and opportunities so that Eastman is positioned to respond to manufacturing and customer needs and escalating issues.
Preliminary work to understand the problem and the potential

- Identify sites in water stressed areas
  - World Resources Institute’s Aqueduct Water Risk Atlas
  - World Business Council for Sustainable Development’s Global Water Tool

- Conduct site specific pilot
  - Selected because of cost of purchased water
  - Relied heavily on water treatment vendors for analytical information
  - Used as a training opportunity
  - Identified projects (examples):
    - Create closed loop systems rather than once-through cooling
    - Repair leaks
    - Study to determine optimum time to wash product
    - Eliminate cooling water to a building that is mostly empty
Building on the energy management program
Strategy

Employee awareness

- Energy program was originally only project-focused
- Program expanded to include employee engagement and awareness
- Energy fairs
  - Local utilities and retail stores manned booths showcasing energy efficiency products
- Green Teams
  - Geared toward sharing information with employees that have personal interests in preserving the environment
Strategy - **Water**

- Some may have to be convinced that it really is an issue
  - Water is plentiful and cheap in some parts of the world
- Some of the same methods of communication can be used
- Employees can be asked to relate issues at home to issues at work
- The same employees who are interested in conserving energy will likely be interested in saving water
- External surveys may enhance discussion and raise awareness
Strategy

Measures

- Critical to have a well-defined, auditable measure with meaningful goals
- **Water** measures could be based on amount withdrawn, consumed, or intensity or limited to specific sites
- Measures may establish targets (quantitative) or goals (qualitative)
- Measures may be more important for individual sites rather than the entire company
Strategy

External resources

- **ENERGY STAR®**
  - ENERGY STAR Guidelines for Energy Management used to identify gaps in the existing program
  - Review of the existing corporate energy program by knowledgeable, outside individuals
  - Available **WaterSense** resources

- **DOE**
  - On-site training
  - On-site assessments of utility systems
  - DOE **Water** Profiler

Both ENERGY STAR and the DOE hold meetings where partner companies share information both through formal presentations and networking opportunities
Strategy

Energy initiatives

- Potential identified for a centralized, standardized approach for other initiatives
  - Steam traps
  - Motors
  - HVAC
  - Condensate Return

- Evaluation
  - Questionnaire to assess the progress of each site in each area
  - Results serve to identify common areas of concern, needs for improvements, and best practices at individual sites for sharing
Strategy

Energy efficiency projects

- Database of potential projects is continually updated
- Best projects are identified
- Typical projects
  - Upgrades to more energy-efficient equipment
  - Heat recovery opportunities
- Project ideas are usually process-specific, but there is some potential to find common opportunity across the company
- $8M annual budget
Challenge: Energy projects often have good returns, water projects mostly do not

**Strategy - Water**

- Add water conservation to the energy surveys
  - Check meter accuracy and location
  - Capture project ideas in the energy project database for future consideration
- Consider water conservation in design
- Look for opportunities for water reuse (much like heat integration)
American Chemistry Council Energy Efficiency Awards – Example Projects

- **Hot Water Recycle Project** – Cooling water which was previously being sent to the sewer is now being recycled for use as feed to the washing process.

- **RB Condensate Coil Heat Recovery** – A reduction in dryer steam consumption was achieved by installing a new heat recovery system designed to re-use waste condensate which was previously being sent to the sewer.

- **Installation of a flash system** that utilized 600 psig condensate from columns eliminated sending 600 psig steam through valves to produce 300 psig steam.
Roles and responsibilities

Environmental Affairs
- Regulatory liaison
- Water measures
- Water risk tools

Energy Program
- Increase awareness
- Water reuse of appropriate source
- Infrastructure
- Water conservation
- Establish goals

Involve other organizations
- Sustainability
- Public and Community Affairs
- Corporate Communications
- LCA Team
Next Steps

- Complete second water conservation survey
- Working with Procurement to get more water cost data to direct efforts
- Developing a water measure and targets
- Adding water conservation to energy surveys and the engineering design checklist
Summary

- Many elements of an energy management program can be applied to natural resources other than energy.
- Eastman is leveraging its energy management program to address water conservation.
- Several internal and external drivers are escalating the importance of water.
- Eastman is currently focused on:
  - Identifying water conservation projects
  - Identifying water risks
  - Increasing employee awareness
  - Establishing water-related goals, targets and strategies
Questions?

Energy efficiency. It’s only natural.

Eastman is proud to be an ENERGY STAR® Partner of the Year for the seventh year in a row for our commitment to natural resource management.
Repurposing a Corporate Energy Management System for Water Efficiency

Alan Resnik
Director, Facilities & Operations
Environmental Management

August 23, 2018
Five operating segments

Cummins has a nearly 100-year-long track record of delivering leading power solutions. As we look ahead, we know our industries and markets will continue to change, and we are committed to bringing our customers the right technology at the right time.
J. Irwin Miller: A visionary

- Laid foundation for future global growth
- Embraced the stakeholder model
- Integrated values into the fabric of our business
HSE Policy Commitments

Cummins' leadership will facilitate this mission by providing the necessary resources and information to meet aggressive improvement targets in the areas of:

- illness and injury prevention;
- health and wellbeing promotion;
- pollution prevention; and
- natural resources conservation.
Enterprise Growth by Entity and Savings

- 372 Certified Sites
- More than $7.2 million avoided audit costs since 2004
HSEEnMS: Initiative Into Standard Practice

- Risk Assessment
- Compliance Obligations
- Strategy
- Objectives & Targets

- Risk Evaluation

- Corrective Actions
- Continuous Improvement (e.g. Global Action Plan, Hopper, Best Practices)
- New Goals

- Improvement

- Talent Management
- Training & Consultancy
- Internal & External Communication

- Support

- Implementation of Controls
- Management of Change
- Procurement
- Emergency Response

- Performance Evaluation

- Goal Achievement
- HSE Metrics
- Incident Reporting
- Internal & External audits
- Management Review

- Cummins Leadership and Employee Engagement

- Operations

- New Goals
- Goal Achievement
- HSE Metrics
- Incident Reporting
- Internal & External audits
- Management Review
Why Water, Why Cummins?

Notes: 1) Population includes employees plus contract workers; 2) Includes all Enablon reported sites in Q3 '12; 3) Includes only Non-DBU facilities (Manufacturing, Office, Warehouse); Map Source: IWMI.CGIAR.ORG
Water Stewardship at Cummins

Water Conservation

*Aspiration* – We will continually reduce the amount of water we use in our operations and improve the quality of the wastewater we discharge.

**2020 Goal:** Reduce the water use intensity (normalized to labor hours worked) in our facilities by 50% as compared to a 2010 baseline.

Community Water Engagement

*Aspiration* – We will work together with our communities to ensure that everyone has adequate, safe, and sustainable water supplies.

**2020 Goal:** Achieve water neutrality (off-set the water we use) for 15 facilities in India, China, Brazil, South Africa, and Mexico by doing water projects (water quality, conservation, sustainable supplies) with our communities.
Water Performance Roadmap

- Integrate water requirements into EEnMS (ISO 14001/50001)
  - PDCA approach
  - Energy Champion → Environmental Champion Program
  - Similar tools/toolkits: Metering, Energy Review/Water Balance
  - Sustainable and auditable controls
  - Media efficiency roadmaps via annual Objectives and Targets
  - Water/Energy nexus: Holistic approach
  - SEP statistical analysis for Energy and Water normalization factors

- Capital management process
  - All Media project hopper
  - Campaigns (metering, leaks, etc.)
  - Water capital projects look at risk/stewardship/goals beyond ROI

- Leadership Scorecards
Conservation: Make the Complex Simple

Prioritize | Consult | Achieve

Public

Cummins
Embedding Water Risk in Business Processes

- **Business Planning**
  - Site Selection
  - Visibility of Requirements in High Water Risk Areas

- **Product Design / Production Planning**
  - Material Selection Preferences
  - Supplier Requirements
  - Pursue Waterless Manufacturing

- **Manufacturing Design**
  - Non-Evaporative Cooling
  - Pursue Waterless Machining
  - Dry Filter Paint Curtains
  - Production Critical Storage
  - Contingency Plans

- **Facilities Design**
  - Core Water Efficiency Measures
  - Non-Evaporative Cooling
  - Eliminate Potable Water Irrigation
  - Water Storage Requirements
  - **Reuse Hierarchy**
    - Contingency Plans
    - Neutrality Pursuit

- **Gate Review**
  - Purchasing Leadership Product Design Leader
  - VP Supply Chain or Chief Manu. Officer
  - VP Supply Chain or Chief Manu. Officer
Assessing Supplier Water Risk

264 Critical suppliers evaluated using Maplecroft tool to determine water stress risk

- 17 at extreme or very high risk
  - Driving risk mitigation plans
  - Next steps; sharing CMI water tools and training
Water Neutrality

Ecosystem Recovery
Shanghai Houtan Park (2017)
Total benefit is 60 MG/yr.

Manjarsumbha, India Village Water Management Project (2012)
Tankers Not Needed First Time in 40 Years.
10,000,000 L Storage Added

Car & General /Cummins/Lions Club
Water Pan Project (2012)
Kenya – East Africa
5,000,000 L Reservoir

China Recon – Zhuji Middle School (2013)
Water purification systems to supply water to a middle school serving 2,982 students, an estimated 7.8 million liters.
Moving Forward

• Priority Opportunities
  - Single-pass operations
  - Irrigation (India)
  - Process optimization
  - Capture of clean water streams
  - Leak detection and mitigation
  - Wastewater treatment for reuse
  - Management of change

• Sustainability 3.0
  - No potable water for manufacturing
  - Water neutrality: all mfg. sites in stressed areas
  - Wastewater treatment for reuse
  - True cost of water and factor in risk
The Bridgestone Group Overview
History & Heritage

Positioning Bridgestone as Global Brand since its founding

1930: The first Bridgestone tire was created
1932: Started exports to overseas markets
1931: Established Bridgestone Tire Co., Ltd. in Japan
1967: Established a sales company in U.S.
1968: Received Deming Prize
1983: Acquired tire plant in Tennessee from Firestone Tire & Rubber Company
1988: Acquired Firestone Tire & Rubber Company for $2.6 billion
1997: Entered Formula 1 racing (until 2010)
2007: Acquired Bandag Inc., a leading U.S. retread company
2014: Became Official Worldwide Olympic Partner

Bridgestone founder
Shojiro Ishibashi
(1889 – 1976)

Shojiro named the company with an English variation of his name (the last name “Ishibashi” translates as “stone-bridge,” he reversed it to “Bridgestone”)
About The Bridgestone Group*

The world's largest manufacturer of tire and rubber products.

*Bridgestone Corporation and its consolidated subsidiaries.

- Established: 1931
- Headquartered: Tokyo, Japan
- Regional head offices: U.S., Belgium and Singapore
- Global Net sales: $33.05 Billion (2017)
- 144,000 employees
- 181 manufacturing and R&D facilities in 26 countries
- Operates business in 150 countries

Bridgestone Corporation (Tokyo, Japan)  Bridgestone Americas Inc. (Nashville, TN, U.S.)  Bridgestone Asia Pacific Pte. Ltd. (Singapore)  Bridgestone Europe NV/SA (Zaventem, Belgium)
Present Operating business globally to meet our customer’s demand everywhere in the world.

- Local production for local consumption
  To meet the market demand by the market

- From raw material to retail shop
  Not a point but with whole supply chain

**Over 181**
Manufacturing plants
And R&D facilities
Products and Operations (1)

Tires
- Passenger
- Trucks and bus
- Construction and Mining Vehicles
- Aircraft
- Others (Industrial machinery, Agricultural Machinery, Motorcycles), Retreading materials and services

Diversified Products
- Seismic Isolation Bearings
- Conveyor Belts
- Bicycles
- Sporting Goods
- Others (Polyurethane, Roofing material, High pressure hose, Seat pads for automobiles)

*Tsales by business: Sales to external customers.*
Products and Operations (2)

Solutions Business

Fleet Solutions

New Tires + Retread + Service + IT

Puncture Solutions

Run-Flat Technology

NVH Solutions

Bridgestone’s "Smart Siphon" enables drainage system adaptable, creating more underfloor space and plumbing distance.

Building Solutions

Bridgestone's "Smart Siphon" enables drainage system adaptable, creating more underfloor space and plumbing distance.

Mining Solutions

Industrial & Construction Machinery Solutions

Tires + Conveyor belts + Hoses + Service + IT

Agriculture Mobility Solutions

New Tires + Rubber Tracks + Service

Aircraft Tire Solutions

New Tires + Retread + Service
Focus on Technology & Innovation

• The Bridgestone Group will continue to advance innovative technologies with a strong commitment to supporting global communities.

Natural Rubber

Utilize and improve productivity of conventional sources

- Hevea rubber tree
- Guayule
- Russian Dandelion

Diversify into new sources

- Guayule
- Russian Dandelion

Fuel Efficiency

Improve fuel efficiency by moving beyond conventional tire designs

Tire & Road Surface Sensing Technology

Support safe driving through tire and road surface condition sensing technology

Hose for High-Pressure Filling of Hydrogen

Help popularize new clean fuel, hydrogen, and realize a hydrogen-based society

- Conventional tire
- Narrow tire
- Large diameter and high inflation pressure

*Bridgestone’s CAIS ™ (Contact Area Information Sensing) is a technology to classify road conditions in real-time, by using sensors attached to tires
Global Commitment to Corporate Social Responsibility

Our Way to Serve

Mission

Serving Society with Superior Quality

Vision
Understanding that Serving Society with Superior Quality is our heritage and our mission, and embracing our responsibility to future generations as a global leader in our industries, Bridgestone and its teammates around the world employ innovation and technology to improve the way people move, live, work and play.

Priority Areas

Enhancing Mobility
Smarter, safer, more accessible

Supporting People and Communities
Be supportive, approachable, comfortable

Advancing Environmental Stewardship
Be responsible

Management Fundamentals
Compliance, Fair Competition/Business Continuity (BCP), Risk Management/Human Rights, Labor Practices/Safety, Industrial Hygiene/Procurement/Quality and Customer Value
Corporate Citizenship Activities

Themes of Corporate Citizenship Activity

**Mobility**
- Examples;
  - Tire safety campaigns for consumers
  - Road safety seminars for children

**People and Communities**
- Examples;
  - Supporting a literacy development program
  - Supporting for areas impacted by natural disasters.

**Environmental**
- Examples;
  - Forest conservation activities by employees
  - Environment education programs for kids
The Bridgestone Essence Framework

Core & Vision

The Bridgestone Essence

Quality
- Creation of Customer Value

Safety
- Basis of Operation

Environment
- Creation of Social Value

Quality Mission Statement
Creating Customer Value & Trust

Safety Mission Statement
Safety First, Always

Environmental Mission Statement
To help ensure a healthy environment for current and future generations...
Bridgestone Americas Overview
Bridgestone Americas Headquarters

- Bridgestone is committed to and invested in Tennessee... in 2017, Bridgestone Americas is establishing a new corporate headquarters in downtown Nashville that includes the relocation of three of its business units from out of state.

- ~4,500 Employees
- 54 Retail Stores
- 2 Tire Plants
- 1 Industrial Products Plant
- 2 Distribution Center(1) & Distributor(1)
- 5 Retread Franchises

BSAM Headquarters
Americas Support Center
(Nashville, TN)
About Bridgestone Americas (BSAM)

The largest subsidiary in the Bridgestone Group

- 24 Tire and related product manufacturing plants
- 23 Diversified Products manufacturing plants
- 6 Raw material manufacturing plants
- 6 R&D facilities
- 11 Sister companies’ manufacturing plants

* Includes BPRC in Mesa, AZ

Consolidated Net Sales
By market (2017)

- Americas 48%
- EMEA 17%
- Japan 19%
- Others 16%

Others: Asia Pacific, Middle East, Africa and Russia
Bridgestone Americas - Diverse Business Portfolio

Bridgestone Americas Tire Operations

Bridgestone Retail Operations

Firestone Natural Rubber

Firestone Fibers and Textiles

Firestone Building Products

Firestone Industrial Products
Bridgestone Americas – Focus on Technology & Innovation

Bridgestone Americas contributes to the Bridgestone Group through its technology and innovation.

- DriveGuard Tire
- CoreGard Technology
- Guayule Research
- Mobile Tire Service
Water Savings projects
Projected Global Water Picture in 2025

Global Water Picture (2025)
Picture of Global Water Stress in 2040

Water Stress in 2040
in a business as usual scenario

Source: WRI, GADM

World Resources Institute

AQUEDUCT
Water Stress Picture in the USA

Water woes are magnified when drought strikes places like Plainview, Texas, where baseline water stress is extremely high.

NOTE
1. Baseline water stress is a measure of demand and supply for water in a given area and is calculated as the ratio of local water withdrawal over renewable water supply.

REFERENCES
Aqueduct methodology/aqueduct.water.org

<table>
<thead>
<tr>
<th>Arid &amp; low water use</th>
<th>Low</th>
<th>Low to medium</th>
<th>Medium to high</th>
<th>High</th>
<th>Extremely high</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ratio: withdrawals/supply)</td>
<td>&lt; 10%</td>
<td>10% - 20%</td>
<td>20% - 40%</td>
<td>40% - 80%</td>
<td>&gt; 80%</td>
</tr>
</tbody>
</table>
Cooling Tower Project

Before:

- The Joliette plant is one of the highest water consumption Plant in Bridgestone Americas.
- Process water circuit going to a cooling tower, but it provide services only for half of the plant.
- Major equipment of the power house like air compressors and dryers, as well as nitrogen exchanger are cooled with once through cooling process.

After:

- Installed a new cooling tower in the powerhouse area to provide a closed circuit cooling system that reduces plant water consumption.
- Heat recuperated from the water has been used to preheat boiler feed water and combustion air, before going to the cooling water.
Flow Diagram of New Close Loop System
Inside and Outside View of New Cooling Tower
Cooling Tower Project Benefits

– The installation of the cooling tower to cool the powerhouse equipment in a closed loop circuit has been reducing the plant water consumption by over 60% that equals to 116.2 Million Gallons of Water.

– 7.57% Reduction of total BSAM water usage

– A savings of $269,401/year.
Ontario, CA Distribution Center (DC)
Project Overview

- Removed existing 111,000 square feet of turf
- Added 4,615 plants on-site
- Installed 8,156 linear feet of drip irrigation
- Installed new and more efficient valves
- Added 413 yards of mulch
- Projected water savings will be 9,520,000 Gal/Year that equals to 46% of total water usage for the facility
- Project investment: $250,000 and annual savings will be $54,000
- Simple ROI: 4.6 Years
Aiken ORR Rain Water Harvesting
Process Overview

UV TREATMENT

RAINWATER HARVESTING

RAINWATER POND

BOILERS, TOILETS & IRRIGATION
AOR Rainwater Harvesting

Water from the green areas is collected and stored in a Firestone PondGard pond

Project Summary
- Design Capacity of 100 GPM
- Savings at 50 GPM
  • $13,388/yr.
  • 4.4 million gallons/Yr.
  • 13.2 million gallons (Total)
- Started: 4/7/2015

• 100 Gpm Capacity
• 6000 gallon storage
• Ultraviolet Biocide Chamber
• Sand Filtration
• Mechanical redundancy with Service Water

• Currently provides supply water
  • Boilers
  • Plant toilets
  • Cooling tower make-up
  • Irrigation
• Future
  • Curing hydraulic make-up
Rainwater Collection
UV Treatment Skid
Bridgestone Americas Energy & Environmental Strategic Fund (BAEESF) Funded 3 Water Saving Projects

- **Joliette Cooling Tower Project**
  - Water savings: 116,000,000 Gal/yr.
  - Financial savings: $269,401/Yr.

- **Ontario, CA Landscaping Project**
  - Water savings: 9,520,000 Gal/Yr.
  - Financial savings: $54,000/Yr.

- **Aiken, SC ORR Rainwater Harvesting Project**
  - Water Savings: 4,462,884 Gal/Yr.
  - Financial Savings: $13,388/Yr.

- Water Savings: 129,982,884 Gallons/Yr. (8.5% of total BSAM consumption)
- Combined Capital Spending for these 3 projects: $2,001,175
- Total Financial Savings from these 3 projects: $336,789
- Simple ROI: 5.94