SES

Sustainable Energy Solutions, L.L.C.

Back to Basics
10 Steps to Preparing for a Successful Energy Assessment

IETC May 24, 2016

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SES Service Offerings

Energy Optimization Services:

- Energy Efficiency Evaluation
- Energy Management Program Development
- Energy Maintenance Best Practices

Energy Reliability Services:

- Identify solutions to unscheduled utility outages
- Evaluation of interdependency of utility systems to avoid the “weak links”

Primary Costs within a Typical Industry:

- Raw Materials
- Energy
- Personnel
- Maintenance

Energy Assessment Preparation

1. Compute/confirm unit costs for all utilities
2. Trend recent energy consumption and costs for analysis
3. Compute energy per unit of product
4. Evaluate utility supply options
5. Develop utility balances
6. Review past energy activities considered but never implemented
7. Select members of core study team and facility area participants
8. Develop detailed study schedule
9. Complete surveys by outside parties (as necessary)
10. Be Organized for Success

Compute Unit Costs for Utilities

$$\text{Average Cost per kWh} = \frac{\text{Consumption Charge + Demand Charge}}{\text{Total kWh}}$$

$$\text{Average Cost per lb Steam} = \frac{\text{Fuel + Water + Chemicals + Elect, Comp Air, etc.}}{\text{Total lbs Steam}}$$

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GEORGIA POWER
A SOUTHERN COMPANY

Customer Name

Account Number

Please Pay By Jan 16, 2015

Total Due $ 43,388.58

Current Electric Service - Power and Light Large-Industrial

Service Period	Meter #	Reading Type	Meter Reading Current	- Previous	x Constant	= Usage
Dec 1 - Dec 31		Tot kWh				405,319.2
		Pk kW				798.72
		Onpk kW				0
		Pk kVar				564.96

Billing Period
Dec 1, 2014 - Dec 31, 2014

Rate Riders

Industrial Load Retention - B	
Off-Peak Rider	
Current Service	$ 35,497.62
Industrial Load Retention Credit	-150.78
Environmental Compliance Cost	2,326.70
Nuclear Construction Cost Recovery	2,071.23
Municipal Franchise Fee	432.50
Sales Tax	2,812.40
Total Current Electric Service	**$ 42,989.67**

Excess Facilities Ongoing Charge	$ 148.20
Excess Facilities Ongoing Charge	**$ 148.20**
Excess Facilities Ongoing Charge	$ 250.71
Excess Facilities Ongoing Charge	**$ 250.71**

Usage Information

Tot kWh	405,319
Pk kW	799
Seas Rtch kW 2	978
Excess Pk kVAR	299
Seas Ratch kW	978
Bill Demand	978

Annualized Unit Costs for Utilities

$/Hp-Yr (not accounting for motor load or efficiency, at $45/MWh):

1 Hp x 0.746 kW/Hp x 8400 Hr/Yr x 0.045 $/kWh = *$280/Hp-Yr*

$/klb-Yr (650 psig steam, at $4.05/MBTU methane):

1 klb x 8400 Hr/Yr x $6.092/klb = *$51,000/klb-Yr*

$/C SCF-Yr (compressed air):

(1 C SCF/1,000) x 8400 Hr/Yr x 60 Min/Hr x).16 $/K SCF =
$8,000/C SCF-Yr

Identify Energy Consumption Trends

- Monthly Energy Consumption Data
- Monthly Production Amount
- Annual Price Trends

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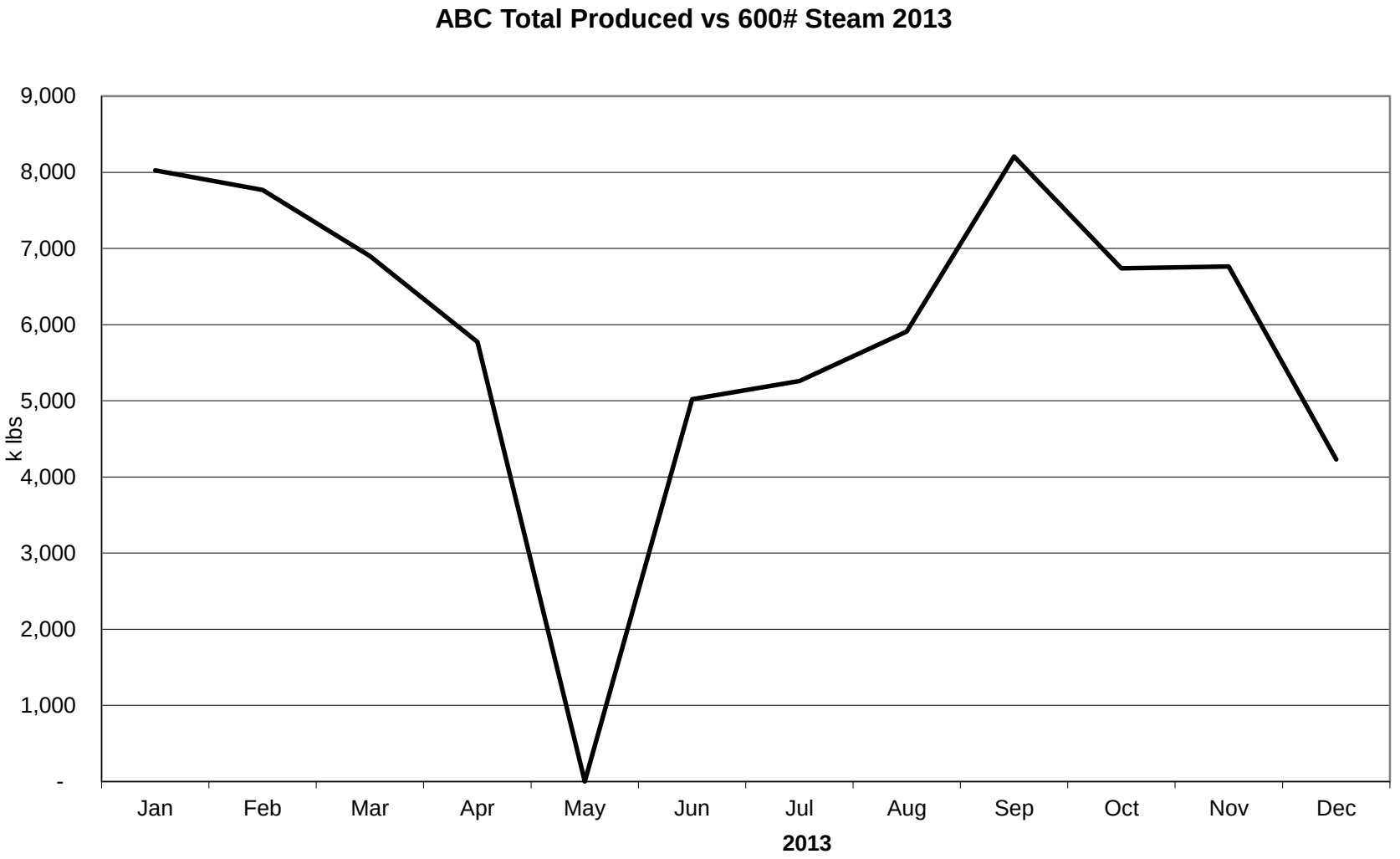

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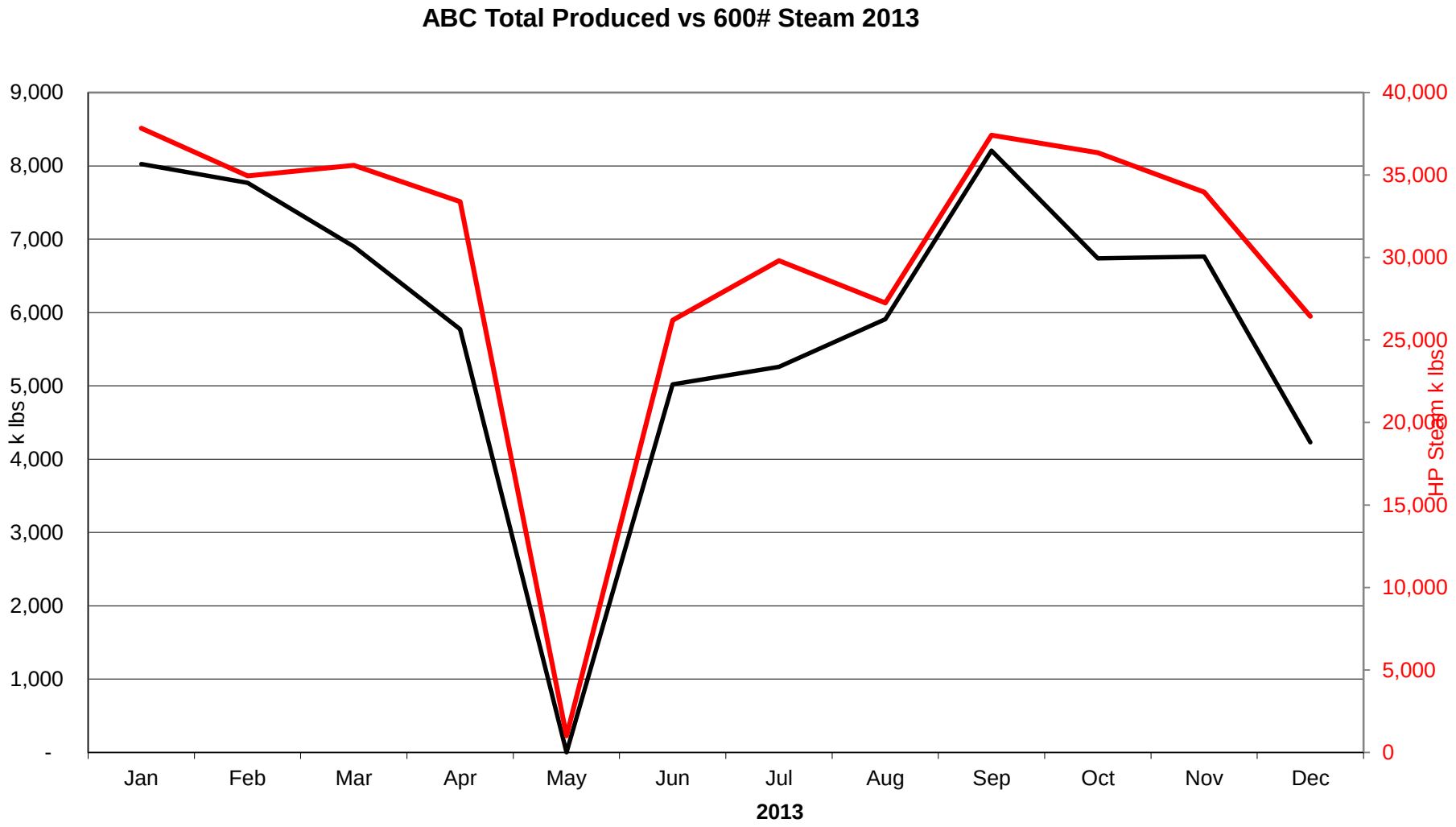

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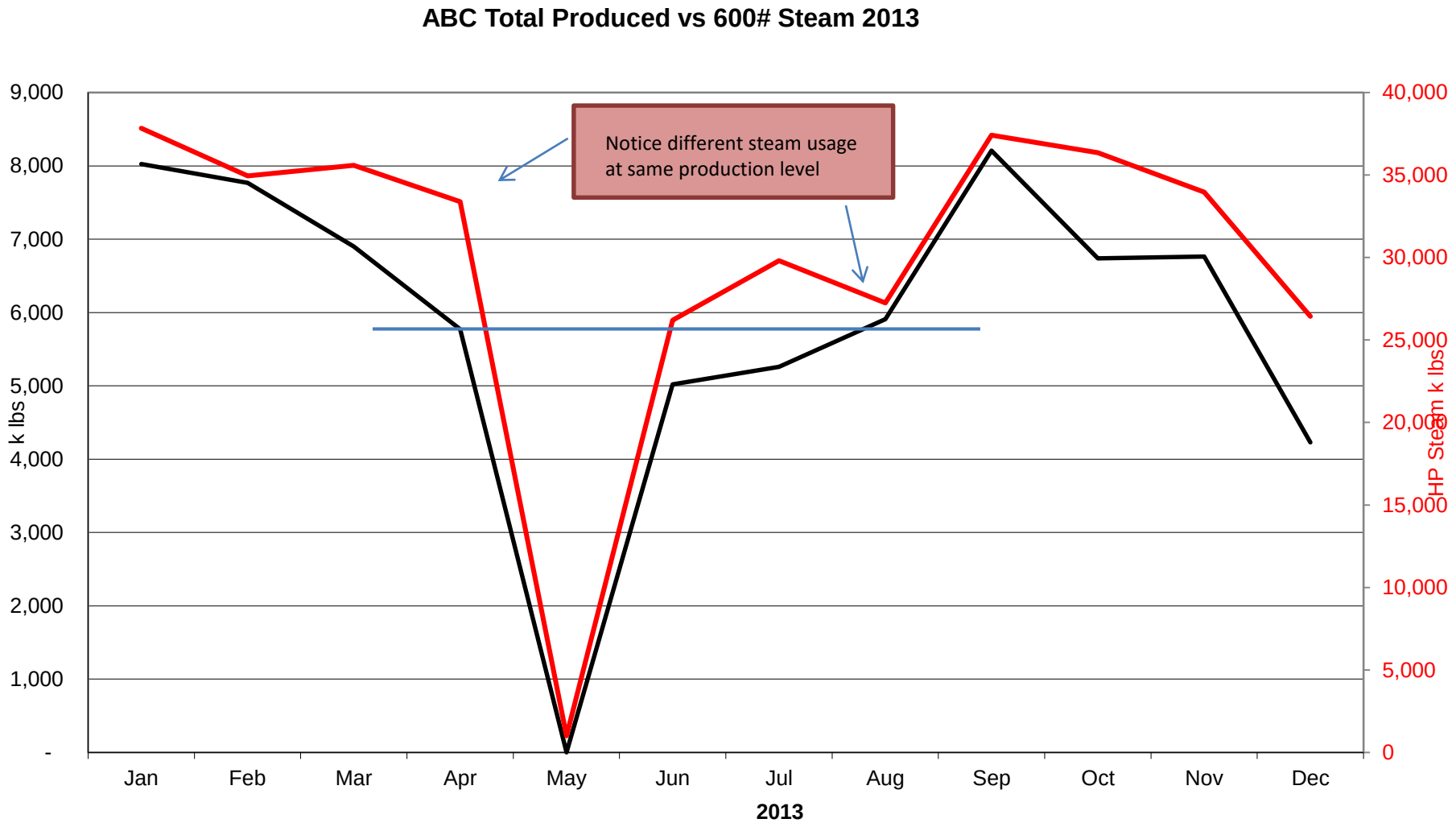

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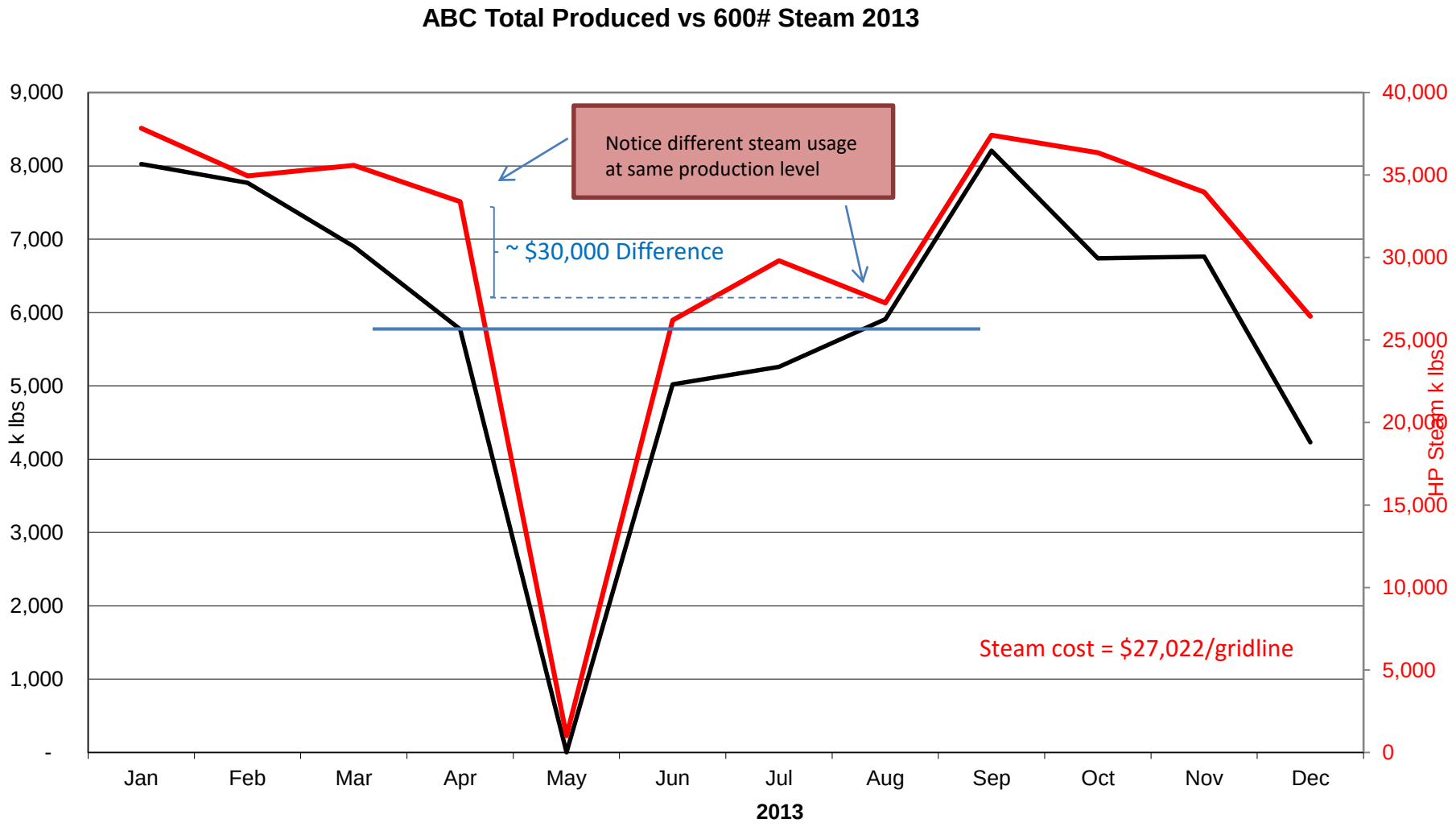

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A Dollar Not Spent on Energy
is a
Dollar of Increased Profit

Compute Energy Costs per Unit of Product

- Assists in understanding manufacturing costs
- Can reveal opportunities for improvements
  - Energy Conservation Measures (ECM)
- Use the data compiled for developing the trends
  - Annually, Monthly, Continuous

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rate	Units
Total Electricity (kWh)	7,512,985	###	###	###	###	###	###	###	###	###	###	8,020,325	90,083,610	**0.5535**	**kWh/lb**
Total Electricity ($)	503,667	###	###	###	###	###	###	###	###	###	###	471,408	6,765,923	0.0751	$/kWh
$/kWh	0.06704	###	###	###	###	###	###	###	###	###	###	0.05878			
Total Nat Gas (mmBTU)	137,940	###	###	###	###	###	###	###	###	###	###	129,272	1,409,834	**0.0087**	**mmBTU/lb**
Total Nat Gas ($)	653,559	###	###	###	###	###	###	###	###	###	###	641,559	6,966,394	4.94	$/mmBTU
$/mmBTU	4.74	###	###	###	###	###	###	###	###	###	###	4.96	4.94		
Nitrogen (k scf)	55,992	###	###	###	###	###	###	###	###	###	###	54,346	633,214	**0.0039**	**kscf/lb**
Nitrogen ($)	59,340	###	###	###	###	###	###	###	###	###	###	53,829	664,598	1.05	$/kscf
650# Steam (lbs)	80,668,581	###	###	###	###	###	###	###	###	###	###	71,972,059	852,348,396	**5.2372**	**lb/lb**
650# Steam ($)	647,143	###	###	###	###	###	###	###	###	###	###	373,654	5,405,369	6.34	$/klb
SGAC Finished Product	2,134,344	###	###	###	###	###	###	###	###	###	###	926,108	22,427,959		lbs
FIN ECH Finished Product	12,892,390	###	###	###	###	###	###	###	###	###	###	13,765,893	140,320,235		lbs
Total Produced	15,026,734	###	###	###	###	###	###	###	###	###	###	14,692,001	162,748,194		lbs

Calculated field

Evaluate Utility Supply Options

- Change tariff
- Revise contract terms
- Aggregate multiple supplies
- Negotiate refund for errors
  - Data miscalculations
  - Sales tax

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Incremental Prices

Electricity

Location Name	2015 $/kWh	2014 $/kWh	2013 $/kWh	2012 $/kWh
A	**$0.1216**	**$0.1433**	**$0.1131**	**$0.1279**
B	$0.1029	$0.1008	$0.1041	$0.0608
C	$0.0996	$0.1031	$0.1039	$0.0930
D	$0.0988	$0.1024	$0.1035	$0.0972
E	$0.0946	$0.1096	$0.1133	$0.1107
F	$0.0869	$0.0989	$0.1055	$0.0799
G	$0.0833	$0.0775	$0.0744	$0.0759
H	$0.0811	$0.0849	$0.0795	$0.0732
I	$0.0769	$0.0815	$0.0769	$0.0508
J	**$0.0745**	**$0.0758**	**$0.0792**	**$0.0792**
K	$0.0731	$0.0685	$0.0604	$0.0596
L	$0.0656	$0.0633	$0.0615	$0.0598
M	$0.0632	$0.0612	$0.0596	$0.0577
N	$0.0606	$0.0597	$0.0598	$0.0902
O	$0.0506	$0.0524	$0.0485	$0.0428
P	$0.0477	$0.0627	$0.0629	$0.0531

Develop Utility Balances

- Begin with spend and units consumed
- Brainstorm consumers
- Estimate loads
- Apply % estimates to spend and units

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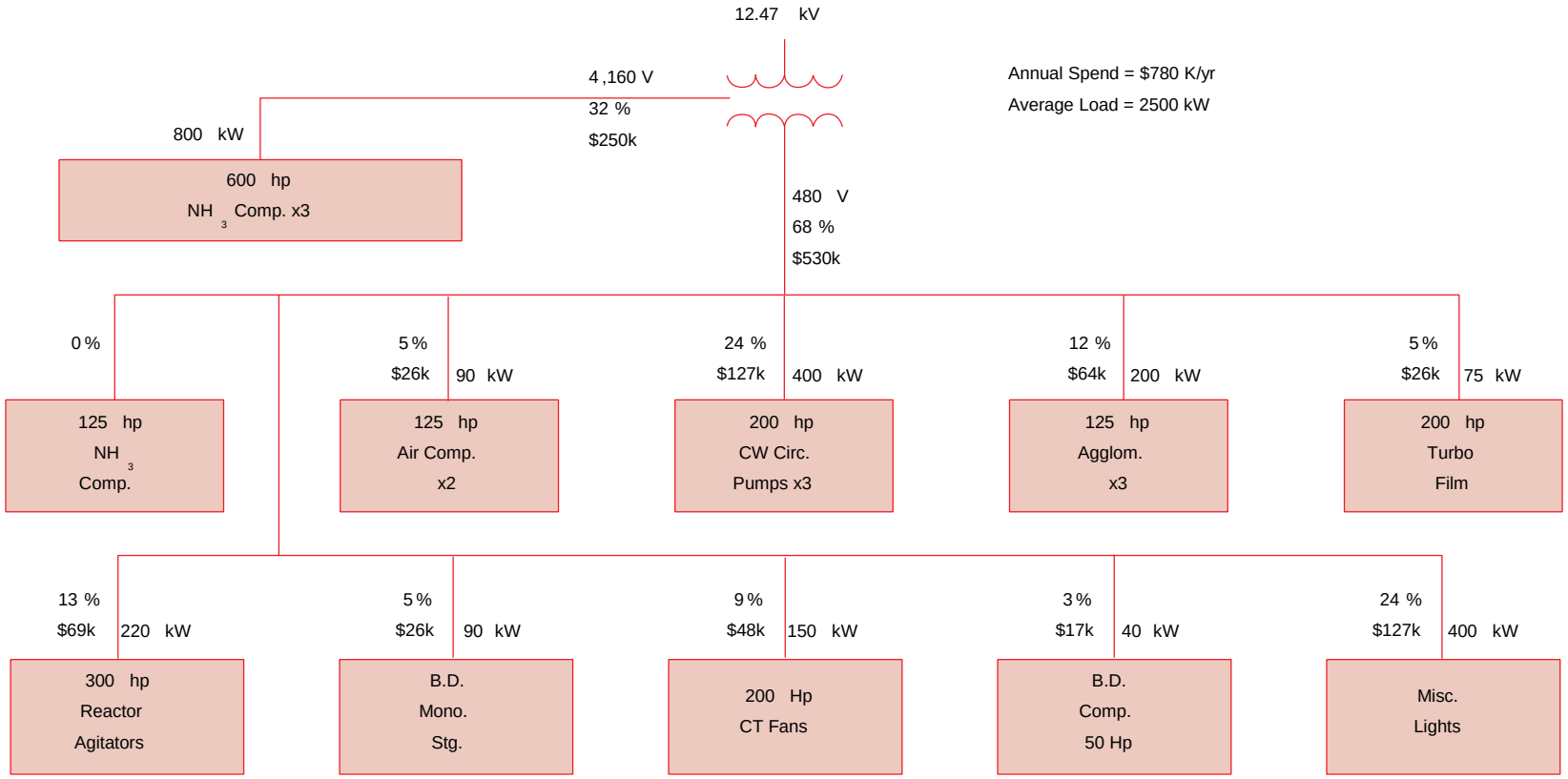
ABC Industries
Electricity Balance



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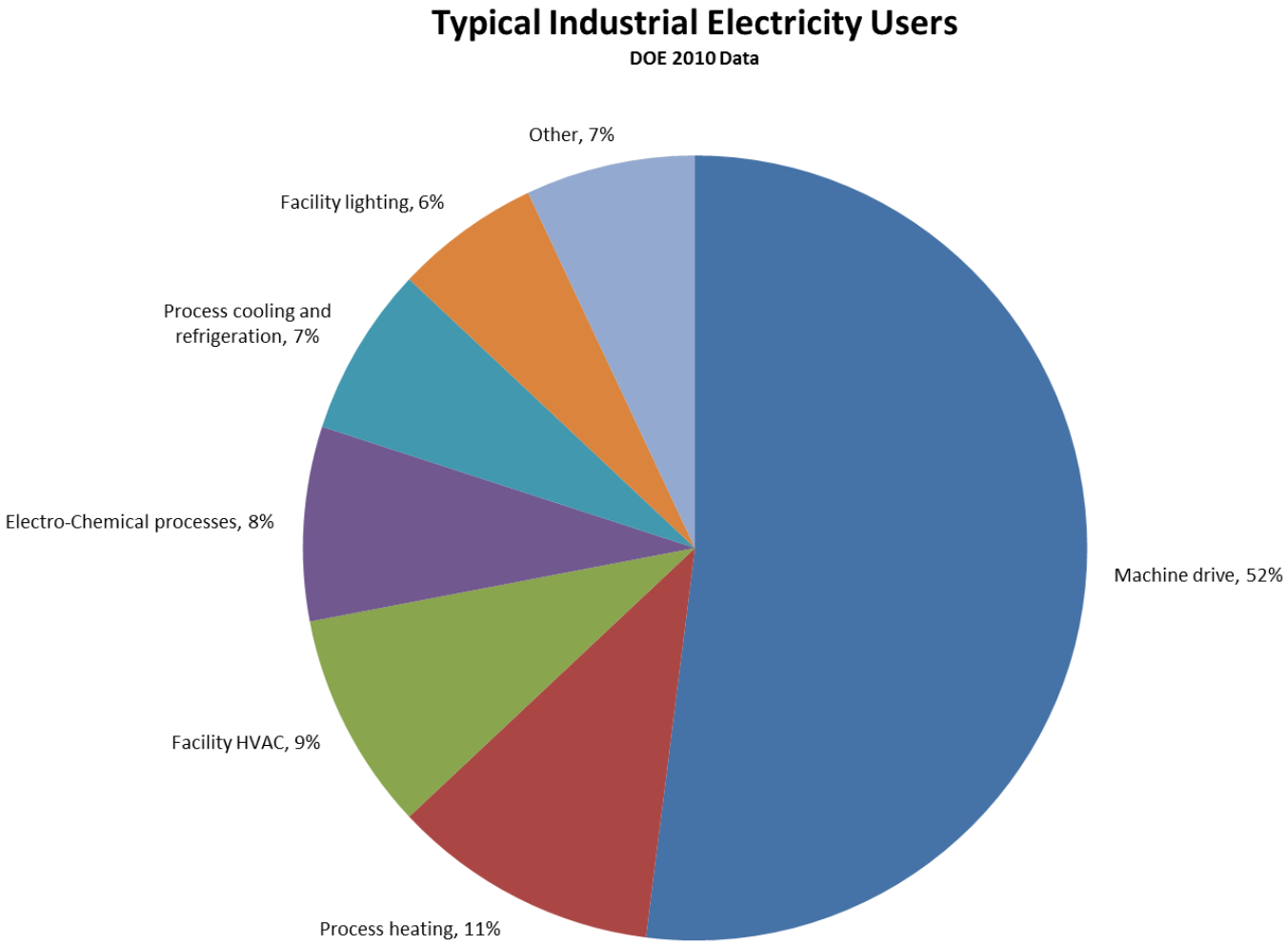

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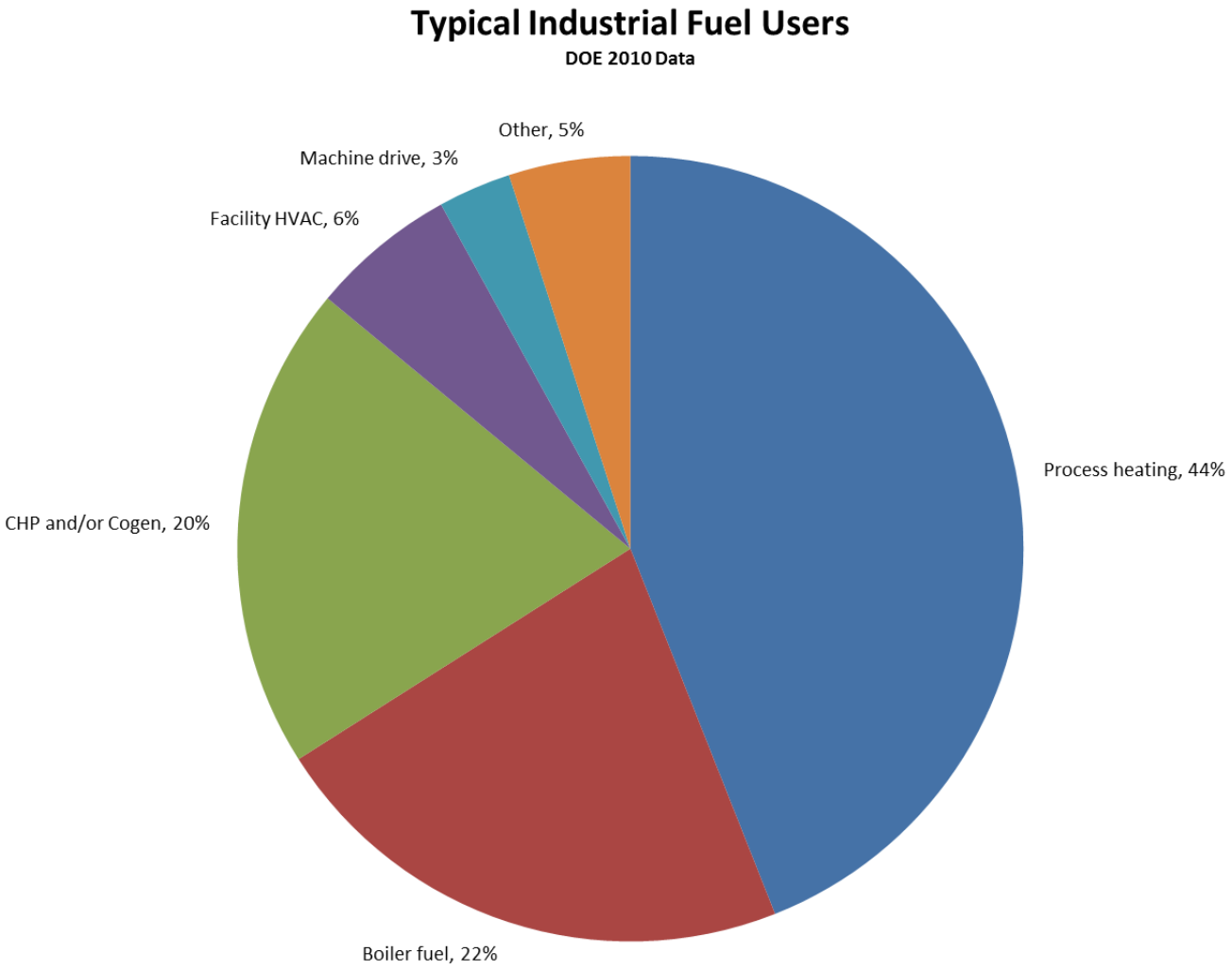

80% of the Opportunities can often be Identified Based on 20% of the Data

Review Past ECMs that were Not Implemented for Opportunity

- Previous assessment reports
- Recommendations may have been confusing
- Personnel change left items unaddressed
- Dust these off and apply current economics

Select Assessment Team Members

- Core representatives from:
  - Utilities
  - Production
  - Maintenance
  - Hands-On
- Supplier representatives
- Occasional representatives

Develop a Detailed Assessment Schedule

- Review:
  - Trend Plots
  - Incremental Prices
- Develop energy balance
- Discuss operating schedules and activities
- How to look for opportunities
- Idea collection

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Day/Date/Location	
8:00	**Opening Session** - Brief discussion of the site energy initiative - Understanding the assessment process - Assessment schedule - Unit energy costs - Energy consumption profiles - Brainstorming process - Production Process overview and operating schedules - Energy consumption general discussion - Energy consumption, where are the highest costs? - One line balances, for major energy spend
10:00	**Facility Inspection(s)** - Operating schedules - Energy use practices - Process loads - Major Energy Consumers - See Checklist of "Items to Remember When Auditing"
11:30	**Identify Energy Conservation Opportunities (ECM)** - Brainstorm, combine like items, and rank ECM - Quantify findings - Summarize results
12:00	**Lunch (in house)**
12:30	**Identify Energy Conservation Opportunities (ECM)** - Sample calculation of energy reductions - Development of sample ECM economics - Documentation
14:00	**Summarize Results** - Return to area for final collection of additional data - Collect data from resources outside assessment team - Organize closing presentation
16:00	**Closing Meeting**

Surveys by Outside Parties

- Ultrasonic leak detection, industrial gases
- Steam traps
- Compressed air and nitrogen systems
- Insulation
- Refrigeration
- Cooling towers
- Motors and drives

Be Organized for Success

- A great deal of information to keep track of
- Communicate repeatedly
- Makes notes
- Excel workbook
- Begin planning for implementation

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			Issues Offering Potential Opportunity															
Site	Initial Assessment	Sitewide Energy Assessment	Supply Contract	Electrical Demand Control	Compressed Air System	Compressed Air Leaks	Steam System	Steam Leaks	Boiler Economizer	Thermal Insulation	Process Equipment	Refrigeration/HVAC	Lighting Control	Water Systems	COG Belts	Power Factor Correction	Power Reliability
A	1-Feb-16	Warranted	IP			Q	N/A	N/A	N/A	N/A				C			
B	2-Feb-16	Warranted				Q											
C	3-Feb-16	Warranted				Q											
D	4-Feb-16	Can Be Addressed Remotely			★	Q	N/A	N/A	N/A	N/A							
E	22-Mar-16	Can Be Addressed Remotely	IP			Q										IP	
F	23-Mar-16	Warranted															
G	23-Mar-16	Not Needed					N/A	N/A	N/A				★		★		
H	29-Mar-16	Warranted				Q	N/A	N/A	N/A	N/A							
I	30-Mar-16	Can Be Addressed Remotely	IP				N/A	N/A	N/A	N/A							
J	30-Mar-16	Can Be Addressed Remotely				Q	N/A	N/A	N/A	N/A							
K	21-Apr-16	Can Be Addressed Remotely	C						N/A			N/A					

	Properly Addressed		Unaddressed Opportunity
★	Industry Best Practice	IP	In Progress
C	Recently Completed	Q	Quoted
	Minor Opportunity	TBD	To Be Determined

Any Questions?

Thank you for you attention!

For more information please contact:
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Managing PEOPLE, Managing ENERGY

Fred Schoeneborn, CEM
FCS Consulting Services, Inc.

IETC - 2016
New Orleans – May 24, 2016

WII –FM

Human-Nature Radio Station

Fred Schoeneborn, CEM

- President, FCS Consulting Services, Inc.
- 38-year career with Mobil Oil -- Global Energy Manager – Reported to 2 CEOs
- Worked in Mobil Oil Headquarters
- Mobil Energy Program Won 1 DOE & 3 EPA Awards
- Provides consultancy to Major Corporations
- Member of the Industrial Energy Technology Conference Advisory Board

Agenda

- **Why & How do companies join "outside" Energy Efficiency Efforts ?**
- **What Benefits / Risks do companies see in working with "outside" energy efforts ?**
- **What can YOU do to enhance participation ?**

Why Companies join --

- Companies focus on $ generation, always the next quarter (Reason for being) -----– EE not at the table.
- It takes a Wake – Up call - to see the EE message.
- Mobil – Business Week benchmarking showed cost per employee, compared to Oil Majors
- GM – On the brink of Bankruptcy
- Exxon – Merger with Mobil

How Companies join - Concerns

- What are OTHERS doing?
- Can we achieve the results, we signed up for?
- “Voluntary” is OK, but we still made a commitment.
- “Legal issue” by sharing with industry
- PR can become negative PR

Core corporate axiom of an Energy Program

Energy Costs are Controllable

They should be managed with the same expertise and passion used to manage other parts of the business

DuPont

Energy Efficiency Axiom

"There is no growth product we know that will give us the same return as:

***Energy Reduction*"**

Celanese

Energy Efficiency Axiom

"In today's business climate, commitment to sustainable energy reduction is critical to sustained operations."

ArcelorMittal

Energy Efficiency Axiom

" The most important element in the effort to get projects done may not be $ or resources,

IT IS THE Desire to make it happen"

Nissan

Energy Efficiency Axiom

*"Energy Efficiency is all about reducing **WASTE** ---and **WASTE** Is anything that we **can not sell**"*

Five Key factors while developing a program (from The Eastman corporate program)

- **Measurement.**
- **Thinking outside the box.**
- **Maintain momentum.**
- **Leveraging relationships.**
- **Maintaining the gain.**

Why Companies Engage - Benefits

- **Visionary - Leader Image, Stewardship, Part of industry, Award recipient**
- **Network of peer contacts, What are competitors doing, Where do we stand?**
- **Sustainability, Cost control**
- **Ability to reach government decision - makers- potential new contracts**

Why Companies Engage - Benefits

- Network with other energy managers
- Career development – “just in case”
- “Real – world” energy training
- R&D opportunities, not found at companies
- Recognition and awards, PR opportunities

Why Companies Engage - Concerns

- We now have a competitive advantage- But ..--
- What will participation cost?
- Is this another “Flavor of the month” Program?
  -- Is it an Ego-trip for program owner?
- What if we don’t reach goals of program?
- Do we have the staff? Are savings real?

How can you enhance participation?

- Always lead with $ benefits - Not features when selling. Avoid Tech Jargon !
- Use One-Pagers !! To make a point.
- Speak the language of the company— Production unit equivalent or $ (not BTUs)
- Leave behind a physical “Info give –away”.
- Avoid committee settings – do “one on ones”

How can you enhance participation?

- **Provide pass-along papers to their management.**
- **Show enthusiasm !!**
- **Prepare an “elevator speech” for all levels in the organization.**
- **Remember they are NOT an Energy Efficiency company – Value their time**

How can you enhance participation?

- Share real experiences
- Show your pedigree. Management wants to see it.
- Teach measuring opportunities - baselining.
- Energy is a-political in the corporate politics.
- TRAINING Is welcome in today's companies

Three Big Tips

- **Remember, the limited time you fight for with senior management – “Thank you for your time”**
- **Communication / marketing / selling – your biggest challenge. Teach the energy manager how to sell your ideas – they all have managers.**
- **CCs are the target – hidden - audience of a memo.**

Implementation

The Discipline of getting things DONE

"Everything depends on Execution --- Having just a Vision is no Solution"

Thank you

FCS CONSULTING SERVICES, INC.

Decreased Production Leads to Energy Efficiency Opportunities

Sharon Nolen, P.E., CEM
Manager, Worldwide Energy Program

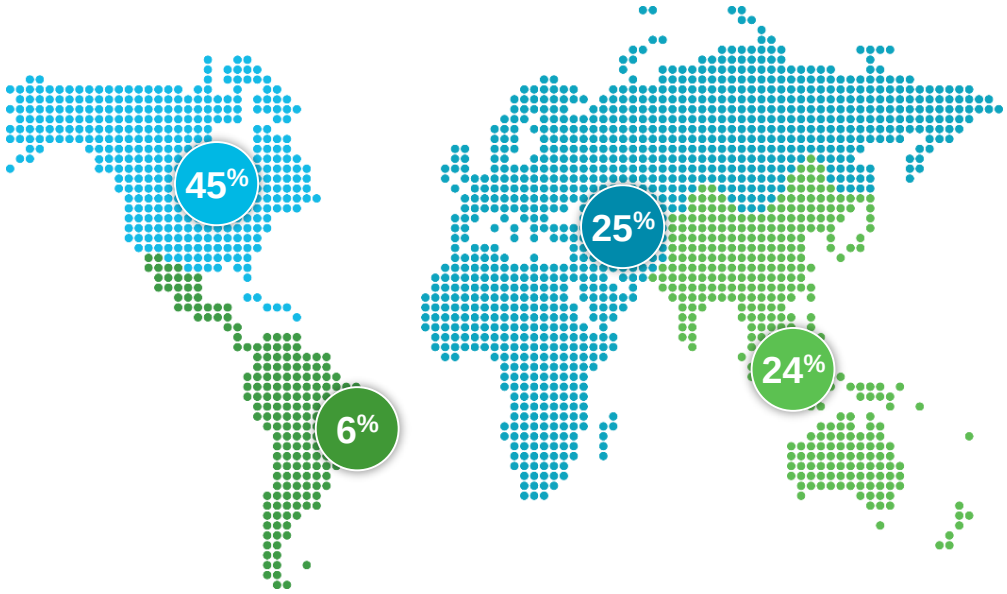
Who we are

- A global specialty chemical company headquartered in Kingsport, Tennessee
- Approximately 15,000 employees and 50 manufacturing sites around the globe
- Serving customers in approximately 100 countries
- A company dedicated to environmental stewardship, social responsibility and economic growth
- 2016 ENERGY STAR® Partner of the Year Sustained Excellence
- 2016 Ethisphere's World's Most Ethical® Companies
- 2016 Glassdoor Employees' Choice Best Places to Work (# 11)
- 2015 revenue of $9.6 billion

End-market and geographic diversity contribute to growth

2015 sales revenue by end market and geography

19%	Transportation
14%	Building & Construction
14%	Consumables
12%	Tobacco
8%	Durable Goods
8%	Industrial Chemicals & Processing
7%	Personal Care/Health & Wellness
6%	Food, Feed & Agriculture
6%	Other
3%	Energy, Fuels & Water
3%	Electronics

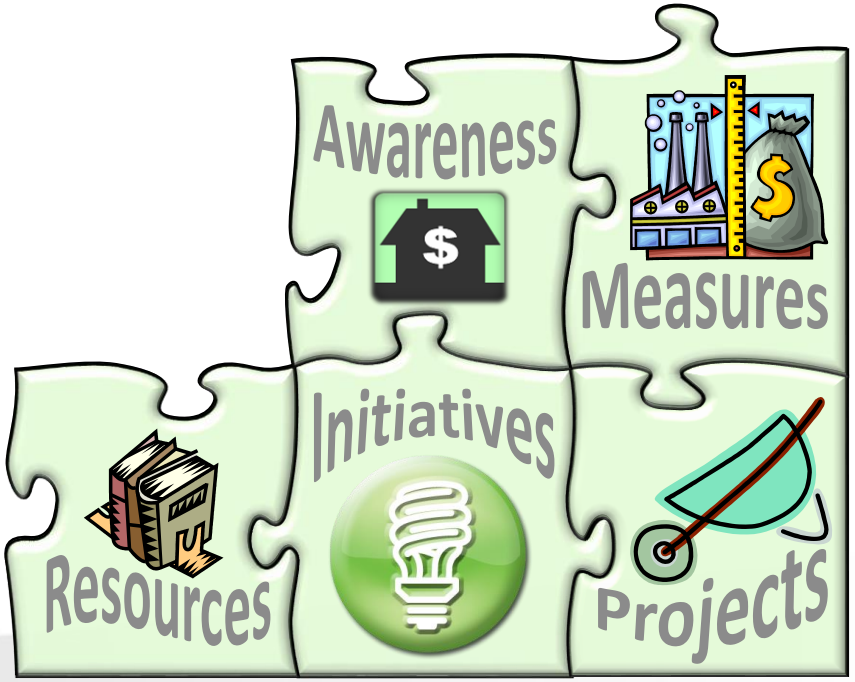


Eastman's energy management program

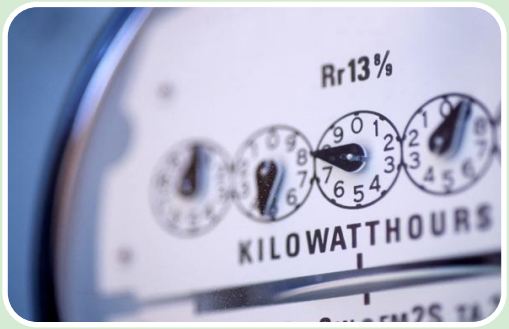
- Eastman Chemical Company started in Kingsport, TN in 1920
- This plant (now one of the largest chemical manufacturing sites in North America) began operating its first CHP system in the 1920's
- Eastman has a long history of incorporating energy efficiency in operations including site initiatives, sub-metering, training, and energy projects
- In 2010, the company set an ambitious public goal through the DOE Better Building, Better Plants program that caused a complete revamp of the worldwide energy program
- An Executive Level Steering Team was formed under the Sustainability Council and became the Design and Natural Resources Sub-council.

Principles and strategy

- Three guiding principles were developed as a reference to ensure that decisions made related to the energy program are consistent with the intended direction
- Strategy utilizes five key components:
  - Measures
  - External resources
  - Awareness
  - Initiatives
  - Projects



Guiding principles



Ensure the Accuracy of Utility Information

- Creates a basis for sound business decisions
- Required for accurate reporting and life cycle assessments

Maximize Operating Efficiency

- Reduces energy usage economically
- Typically improves the reliability of equipment

Incorporate Energy Efficiency in Capital Investments

- Improves lifetime equipment costs
- Positively impacts carbon emissions

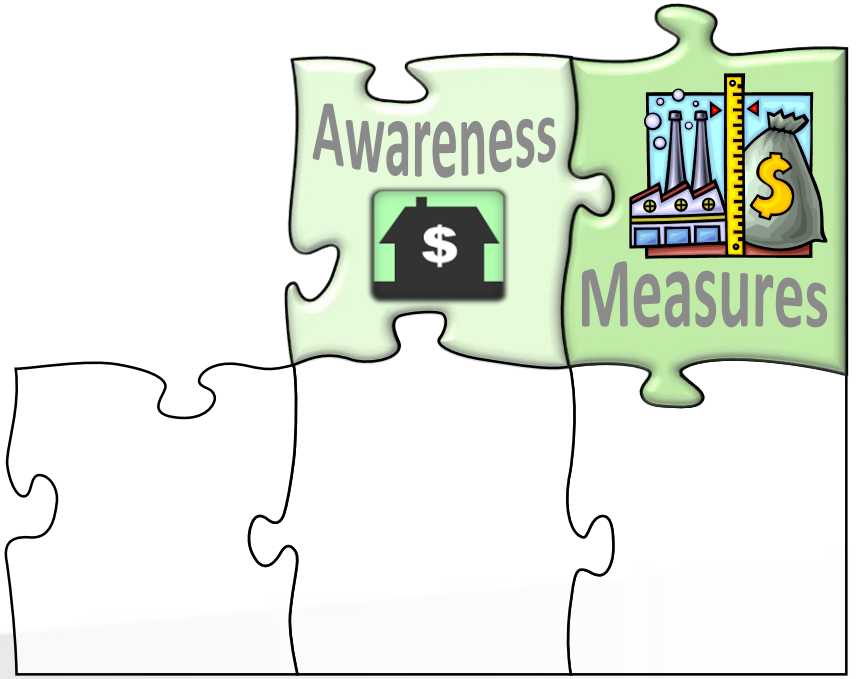
Strategy

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
Measures

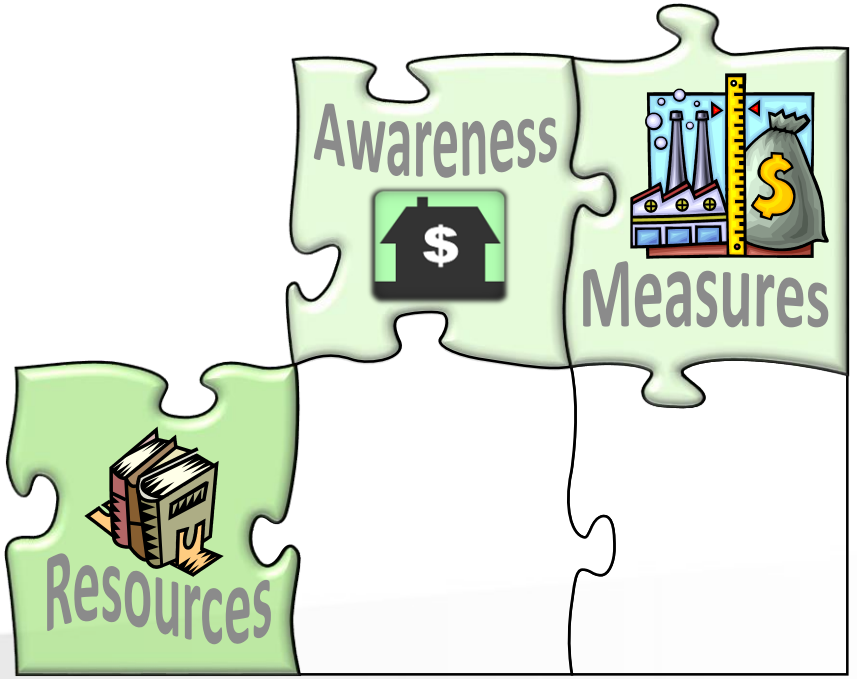
- Critical to have a well-defined, auditable measure with meaningful goals
- Eastman's existing measure (MMBtu/kkg) had to be improved in several respects to meet this criteria
  - Definition – Standardized and communicated
  - Frequency –Increased from annually to monthly
  - Automation –Reduced the opportunity for human error
  - Auditability – Reported externally in Eastman's Sustainability Report



Strategy
External Resources

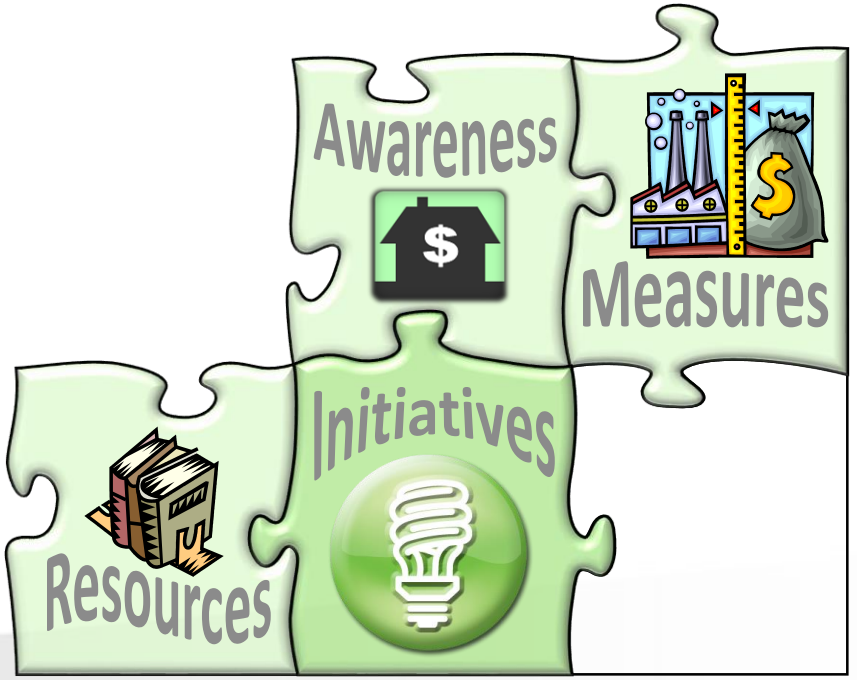
- ENERGY STAR®
  - ENERGY STAR Guidelines for Energy Management used to identify gaps in the existing program
  - Review of the existing energy program by knowledgeable, outside individuals
- DOE
  - On-site training
  - On-site assessments

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



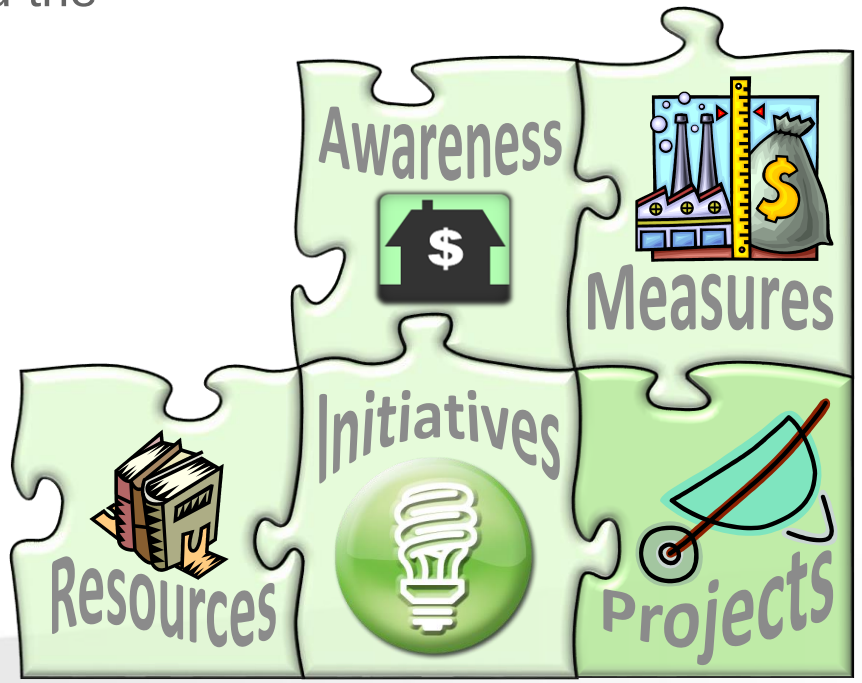
Strategy
Energy initiatives

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

- $8M is allocated specifically for energy efficiency projects
- Dedicated budget led to increased interest in the energy program
  - Manufacturing areas recognized the additional avenue for funding
  - The energy team became a welcomed partner



Manufacturing Principles

Constant priorities

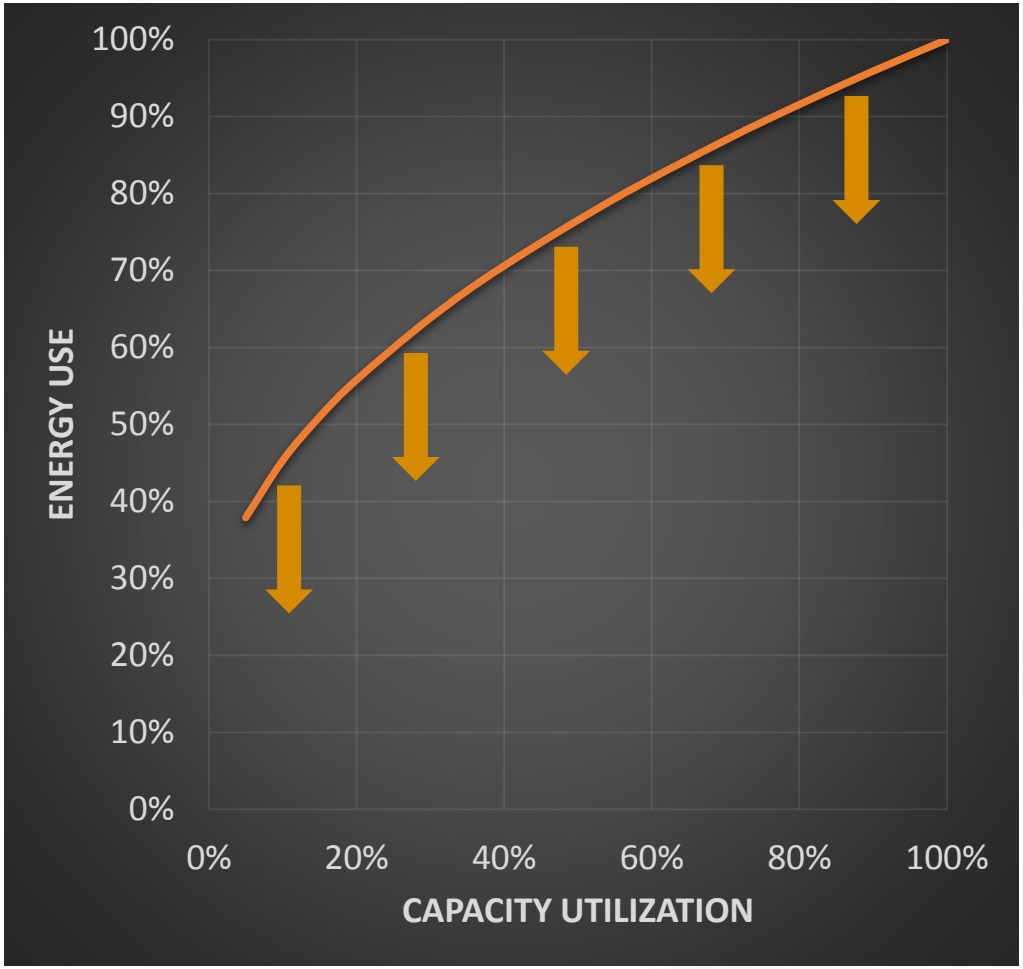
- Safety
- Environmental Compliance
- Quality
- Efficiency

Dependent on capacity utilization

- Reliability
- Inventory management
- Equipment operation modes

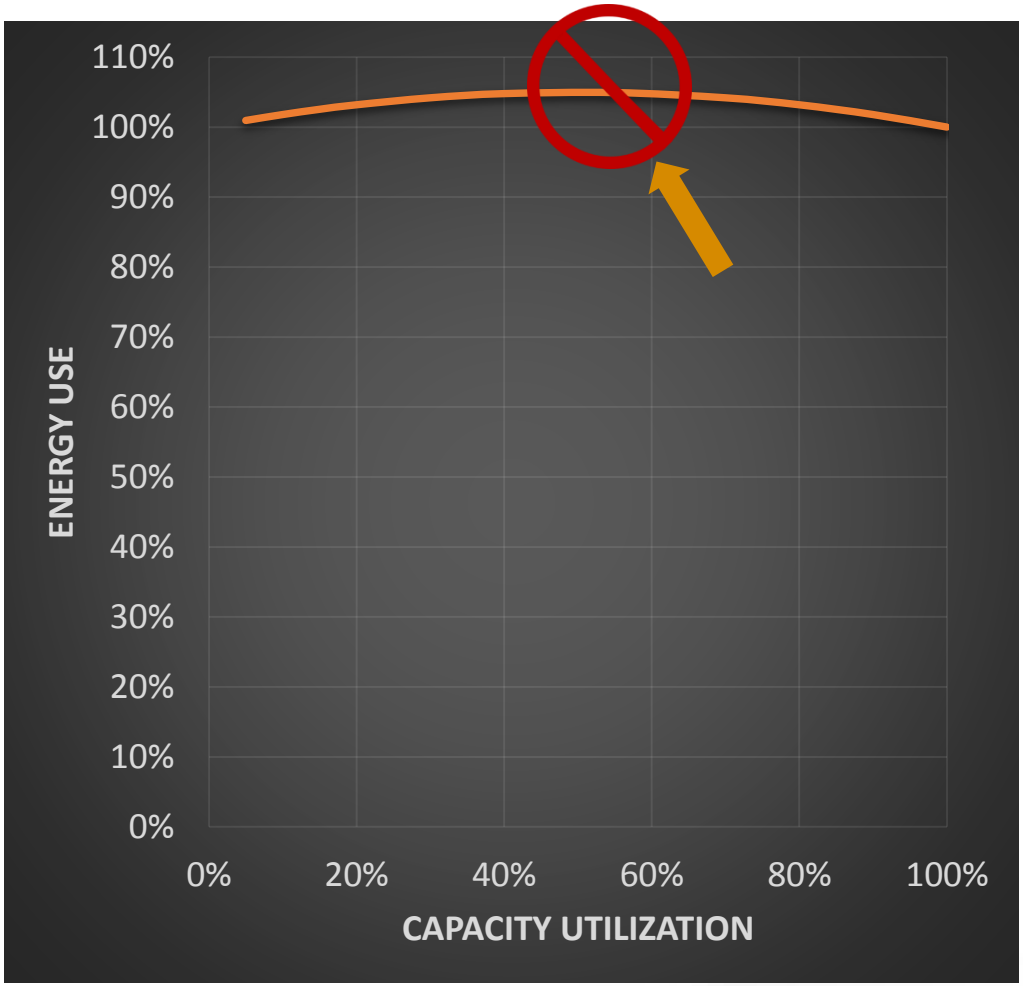
Maximize efficiency regardless of capacity utilization

- Energy use should decrease with lower capacity utilization
- Likely not a 1:1 relationship
  - Some “fixed” energy
  - Nonlinear equipment efficiencies
- Goal is to minimize energy use at every point in the curve
- Some creativity may be needed – for example:
  - Different equipment operation modes
  - More communication across divisions



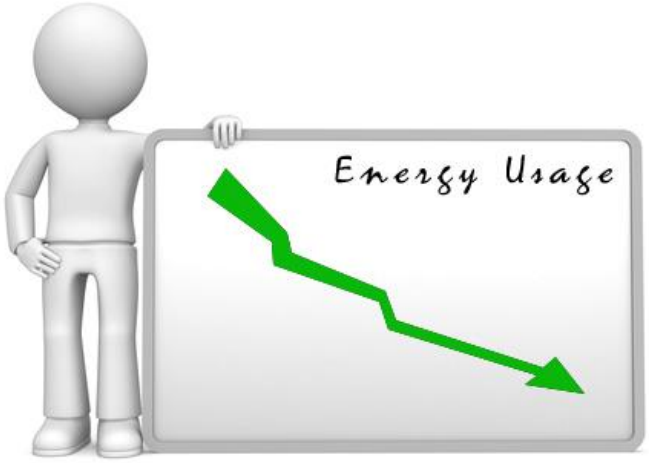
Maximize efficiency regardless of capacity utilization

- Some processes have less variable energy use than others
- A process should never use more energy at a lower capacity utilization



General ways to optimize energy at reduced production

- Shutdown unused equipment
- Preferentially run more efficient equipment
- Consider seasonal opportunities, i.e. can river water be used in the winter rather than water from cooling towers
- Review set points and reduce safety factor



Examples

Production campaigns

Reliability adjustments

Equipment optimization

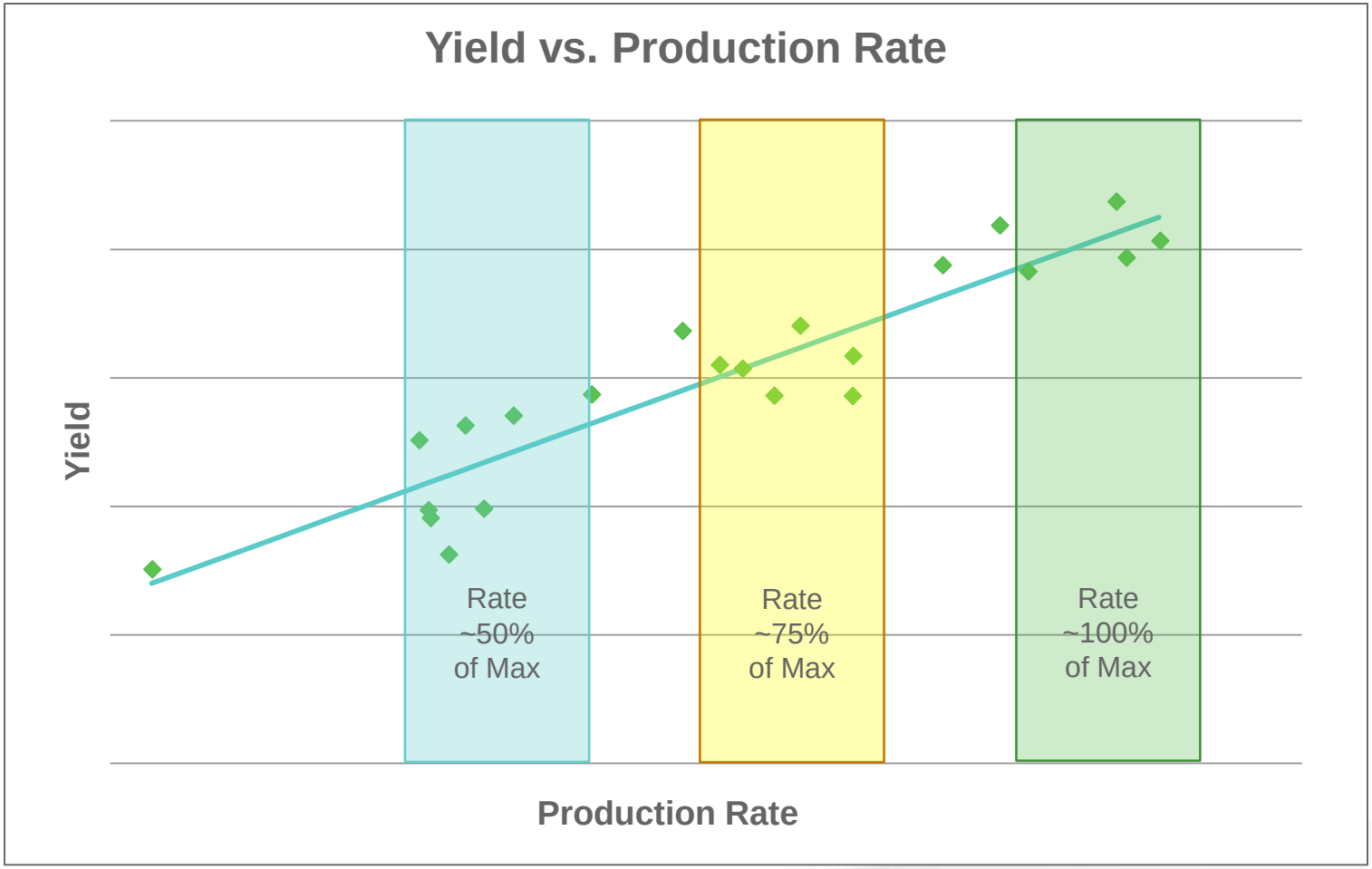
HQ campaign strategy

Project description

- Background
  - Higher production rates generate higher yields for the hydroquinone (HQ) process
  - Yield and conversion costs may be optimized by running at maximum production rates
- Problem
  - Existing operating strategy of maintaining slower rates (when not sold out) to meet demand led to inefficient operation

HQ campaign strategy

Project description



HQ campaign strategy

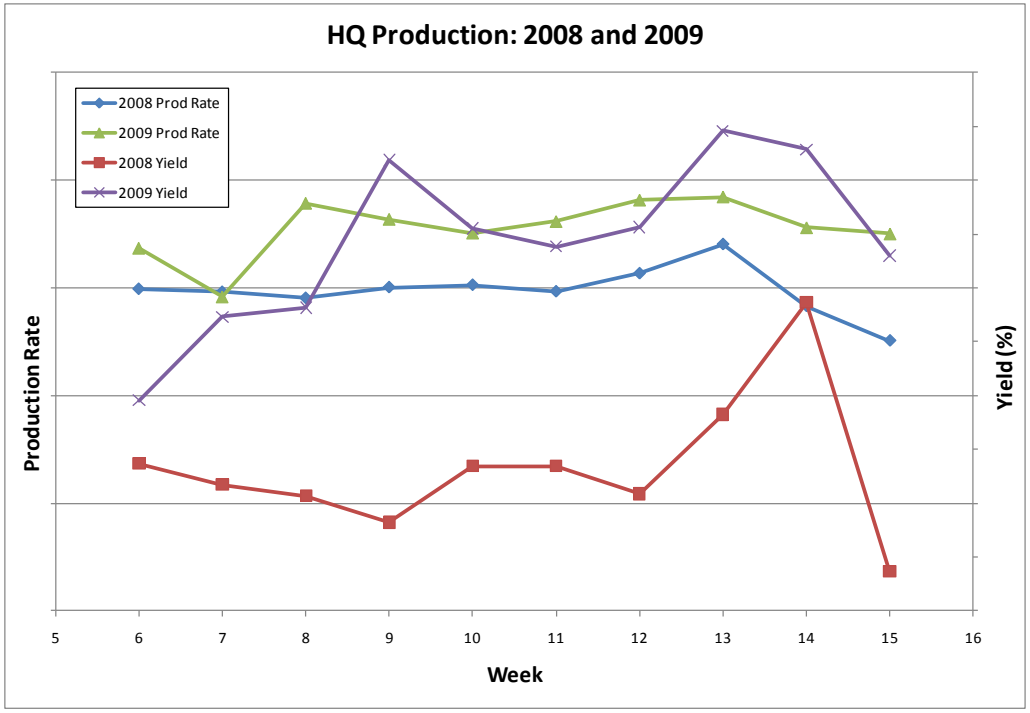
Project description

- Project Constraints
  - Minimum length of shutdown for full financial benefit: 4 weeks
  - Maximum acceptable yearend inventory: 2M kg
  - Maximum acceptable inventory at any one time: 2.5M kg
  - Latest possible shutdown to avoid winterization concerns: November
- Campaign Strategy (while the HQ plant is not sold out)
  - Maximize production rates while running and build inventory
  - Take extended shutdowns to control inventory to acceptable levels

HQ campaign strategy

Project results

- Hard savings claimed for Six Sigma were $1,015K for three year project life. (NPV of $1,740K)
- Soft savings from reducing stream usage: $1,610K
- Reduction in steam and electricity lead to a coal savings of 52,000 MMBtu/year and a reduction in emissions of 5,400 ton CO2/year



Examples

Production campaigns

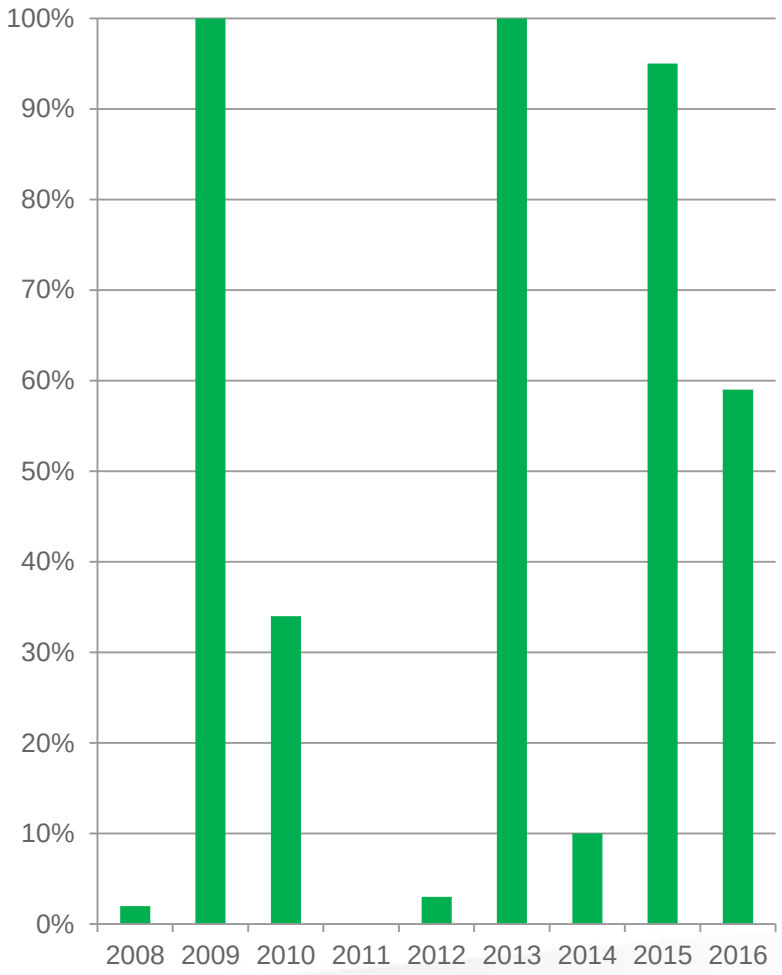
Reliability adjustments

Equipment optimization

Process steam reserve

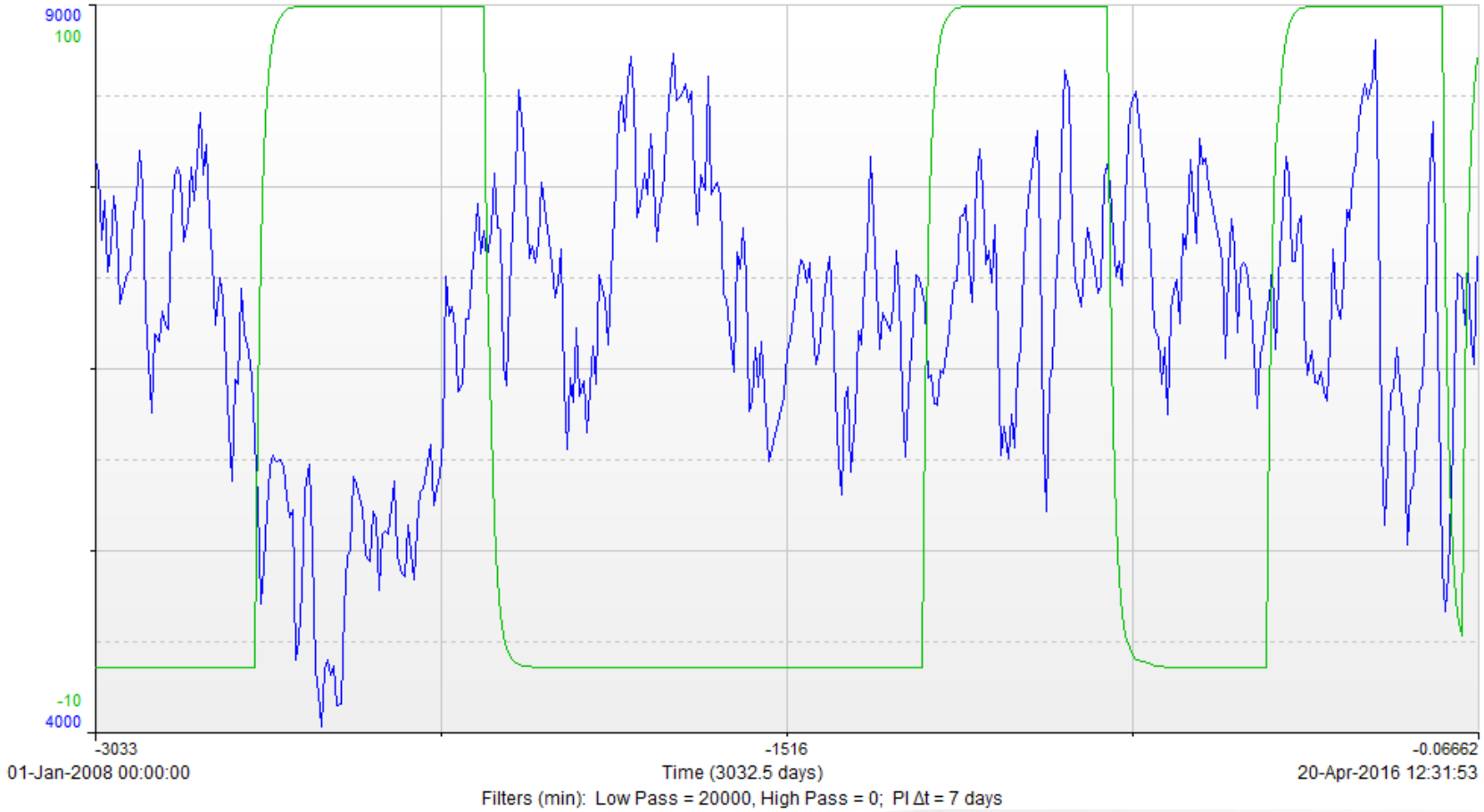
Project description

- *Steam reserve*
  - Unused boiler capacity in units already online and producing steam
  - Maintained for system reliability
- Process frequently supplies 100 kpph reserve
- At times, this allows Power Department to shut down a 600 psig boiler
  - Shifts steam load from 600 psig boilers to 1,500 psig boilers
  - Increases system efficiency
  - Reduces fuel costs



Process Production vs. Reserve

If we could have used Process for reserve 100% of the time in 2008 – 2010, 2012-2013 and 2015 , we could have reduced costs by ~ $800K.



Examples

Production campaigns

Reliability adjustments

Equipment optimization

Equipment optimization

Project description

- Background
  - Manufacturing area requires a very large flow of compressed air for manufacturing
  - Dedicated, complex system of many compressors
  - Blend of turbine and motor drives
- Problem
  - Air demand fluctuates with production
  - Difficult to define the optimum operating strategy given:
    - Constraints of the individual compressors
    - Individual compressor efficiencies
    - Impacts of compressor drives on cogeneration system efficiency and steam / electric balance

Equipment optimization

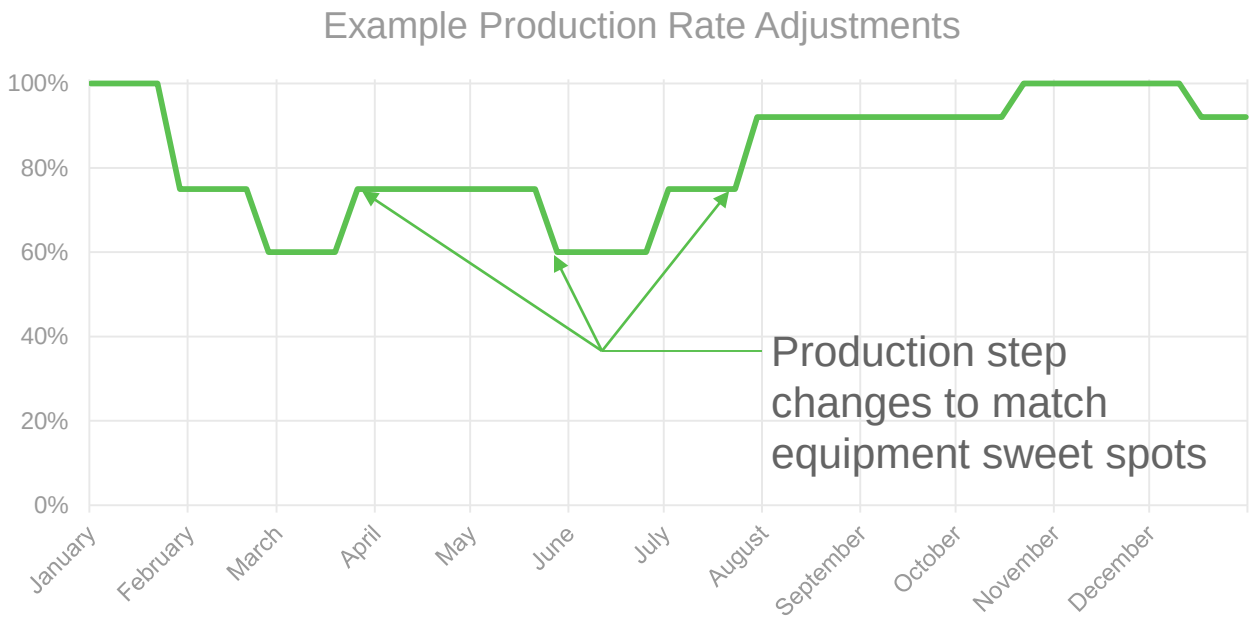
Project results

- Process data and equipment test results were combined with steam system models to develop an air control strategy
- Defined which compressors should be run under a given set of conditions
  - What is the current production rate?
  - Which compressors are available?
- Resulted in a semi-automatic system to:
  - Minimize air venting due to compressor constraints
  - Maximize system efficiency
  - Minimize purchased energy
- Optimum air flows (based on equipment combinations) were shared with production planning so that they could plan to meet customers needs in a way that optimized efficiency

Equipment optimization

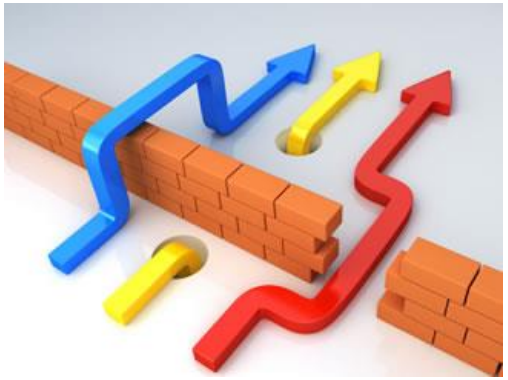
Project results

Production plans were adjusted to meet customer needs with production rates that matched equipment capabilities to improve efficiency



Dealing with barriers

- Additional coordination with other organizations may be required such as Production Planning
- Additional attention may be required by manufacturing
  - Address cultural barriers that could prevent successful implementation
  - Mitigate any risks introduced with extra startups and shutdowns



Maintain the gains

- If production rates remain high for a period of time, strategies developed to increase efficiency at partial capacity utilization may be forgotten (especially with employee turnover)
- Many strategies will force operators away from their comfort zones
- Critical to ensure any strategies are institutionalized
  - Incorporate into standard operating procedures
  - Set up automatic trigger points based on production rate
  - Develop measures to compare actual performance to ideal energy/production relationship

Summary

- Lower production may produce additional opportunities to improve efficiency
- Several general strategies may be applied across different manufacturing sectors
- Many of the solutions do not require capital
- Lock in long-term benefits by institutionalizing strategies

Questions

“Integrated Site Energy Planning”

Creating Roadmaps to Breakthrough Energy Productivity

Energy Managers’ Workshop

Industrial Energy Technology Conference
May 24th, 2016 New Orleans, Louisiana

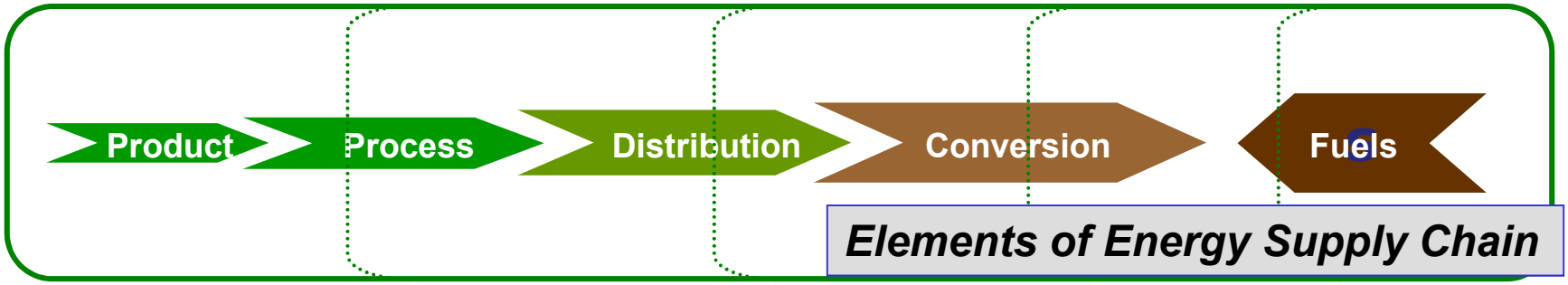
New Energy Realities

- Globalization of natural gas pricing
- Renewable power approaching grid-parity
- Friendlier regulation for on-site generation
- Ease & low cost to gather energy information
- Accelerating grid investments
- Climate change regulation
- China and India redefining energy markets
- Blackouts, weather events, water shortages..

Opportunity to Rethink Energy Planning

Integrated Site Energy Planning
From Product to Fuel

100% of Energy Value Chain

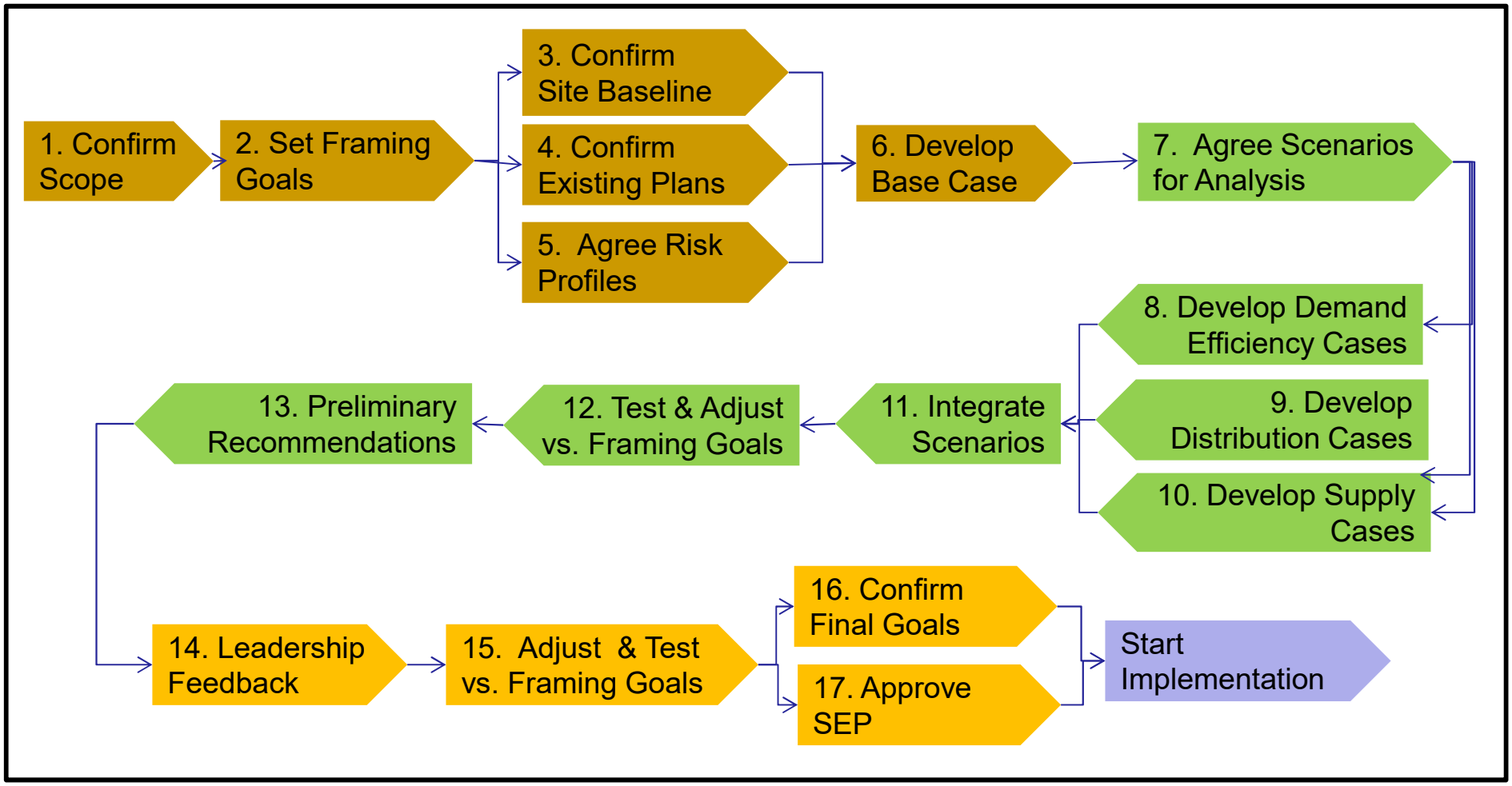


- "How much energy is really needed?"
- "How to minimize greenhouse gas emissions?"
- "Does solution pass risk adjusted hurdle rate of return?"
- "Do it meet supply reliability targets?

- Optimize total investment between efficiency, distribution, conversion, fuel for whole site/system with long-term view
- Plan and resource long-term solutions that meet acceptable returns

Optimized Long-Term Solutions

Developing Site Energy Plan
Process Overview



Supported by Relevant Benchmarking

Site View of Energy
Unique Risks & Opportunities

Costs

- High/Low energy prices
- Volatility
- Market pressures

Reliability

- Utility infrastructure
- Weather
- Internal infrastructure
- Production interruptions

Emissions

- Carbon legislation
- Carbon Taxes/Pricing

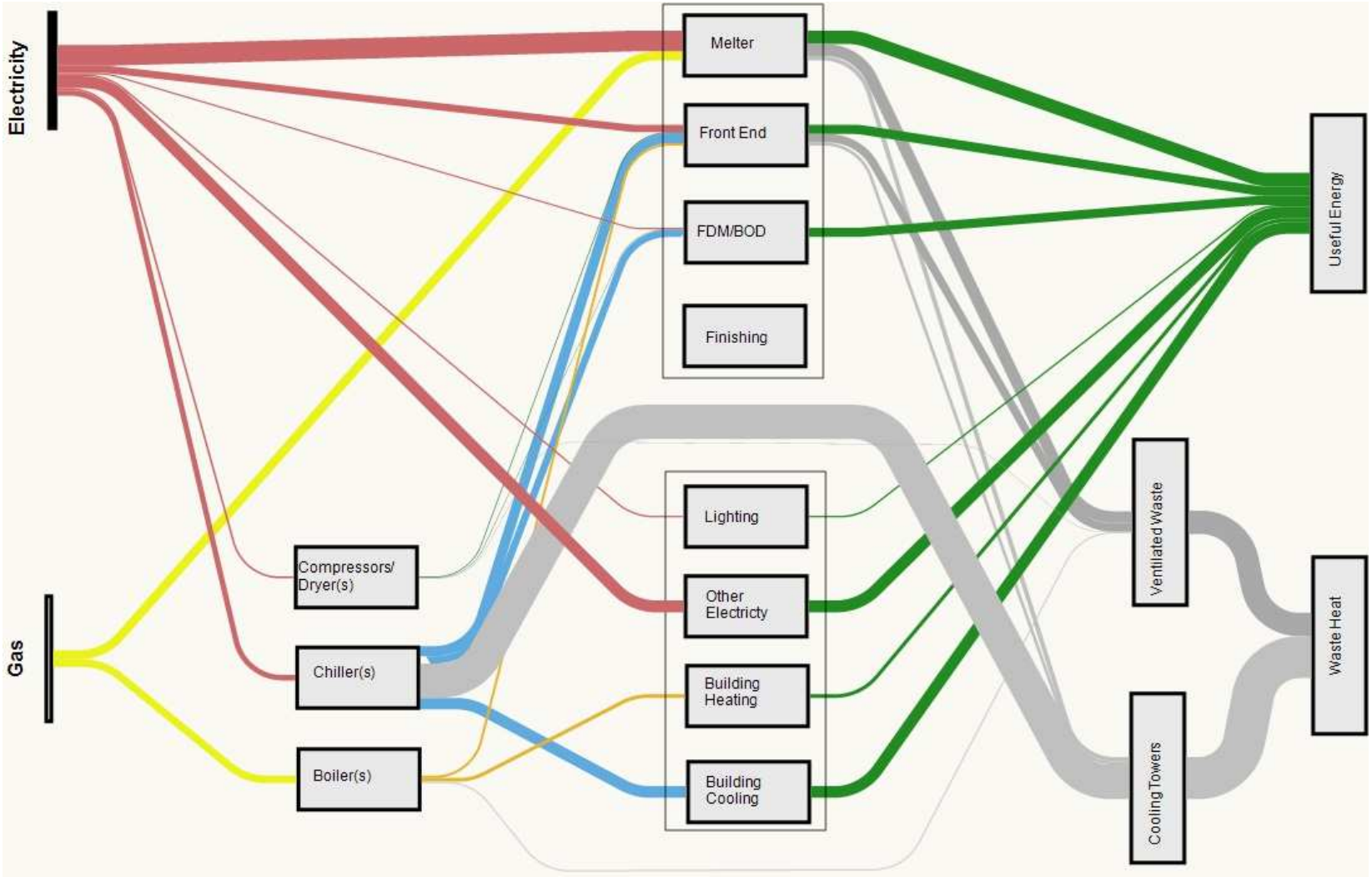
Need Site Specific Energy Road Map

Establish Site Energy Baseline

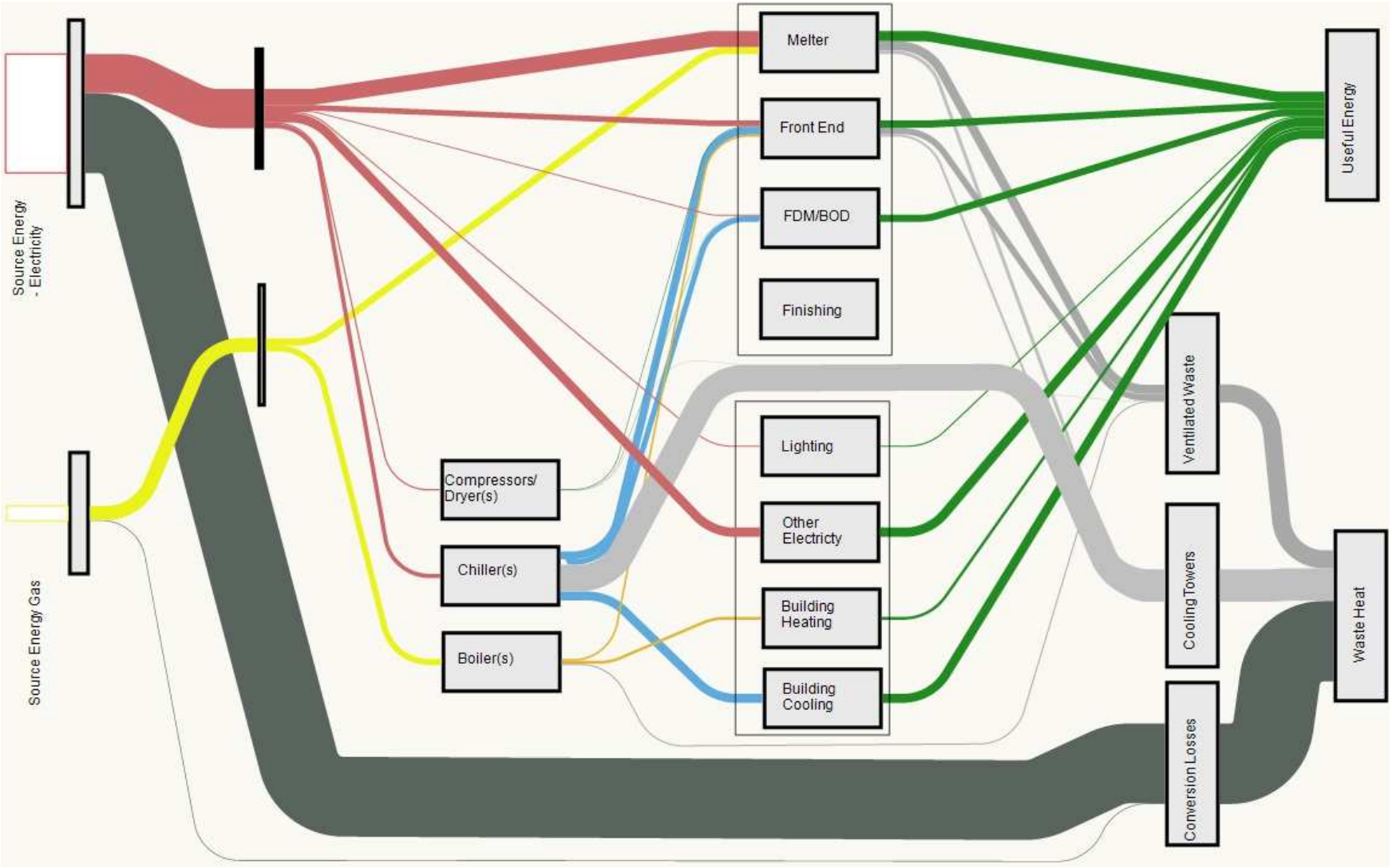
- Detailed picture of site energy flows
  - *Electricity, gas, water, heating and cooling*
  - *Major processes and equipment*
  - *Usage and cost*
  - *By season*
  - *By production loading*
- Sources of direct and indirect emissions
  - *End-uses*
  - *Fuels and utilities*
- Visually intuitive Sankey diagrams often used

Comprehensive Current Energy Picture

Sankey Diagram – Site Energy Flow
Plant 1 - Glass Production



Sankey Diagram – Source Energy Flow
Plant 1 - Glass Production



Utility Usage – Plant 1
2013 Baseline Overview

Baseline 2013	Cost	Unit cost	Unit Cost Increase	Site Energy use	Source Energy use
Item	**M$/yr**	**$/kWh**	**2006 - 2013**	**GWh/yr**	**GWh/yr**
Electricity	$xx	$xx	65%	xxx	xxxx
Natural Gas/LNG	$xx	$xx	70%	xxx	xxx
		$/m³			
Total	***$xx***			***xxx***	***xxxx***

Numerical Example to be reviewed in Workshop

End Energy Index	UoSP	Index Factor1
Production volumes	xxx,xxx,xxx	xxx,xxx,xxx
Specific Energy Index (Elec. & Gas)	xxx kWh/UoSP	xxx kWh/IF1
Grid Electricity GHG Emissions factor	768 kg/MWh	
Gas GHG Emissions factor	181 kg/MWh	
% Renewable Electricity	0%	

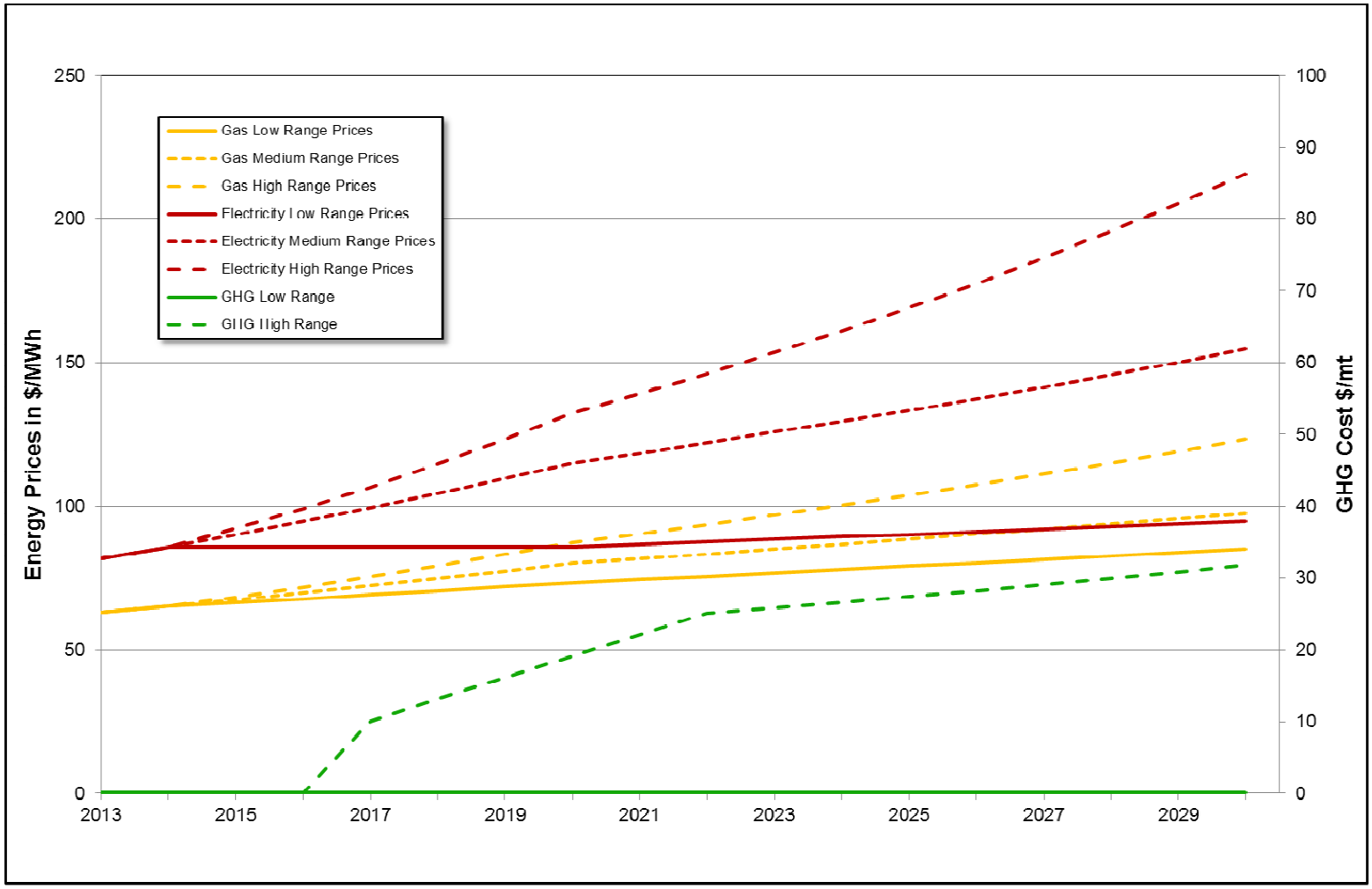
2013 Carbon Footprint YYY,000 Metric Tons CO2e

Understand and Quantify Site Risks
Plant 1 Example

- Energy Productivity
  - *Competition gaining in energy productivity*
- Energy Management
  - *Possibility of ISO 50001 being required*
- Electricity Price
  - *Uncertain national nuclear strategy*
  - *Environmental pressure on coal*
  - *Market liberalization uncertainty*
- Gas Price
  - *Fuel switching by utilities and others*
  - *Accelerating global demand*
  - *Regulation of fracking*
- Carbon Cost
  - *Uncertain national climate change regulation*
- Reliability
  - *No immediate concern – possible future risk*

Key to Evaluating Investment Returns

Example of Risk Assessment – Plant 1
Hi/Lo Energy Price Outlook 2013 - 2030



Establish Site Framing Goals

- At least 10-year goals which, ***if achieved***, would constitute a clear competitive advantage
- Framing Goals address total site, are specific and easily measured
- Balanced set of goals covering at least:
  - *Reliability / Redundancy*
  - *Energy efficiency*
  - *Environmental performance*
  - *Return on Investment*
- Different scenarios are tested for best-fit to all goals based on at least two future risk pictures
- SEP Recommendation is scenario best meeting Framing Goals taking into account the risks

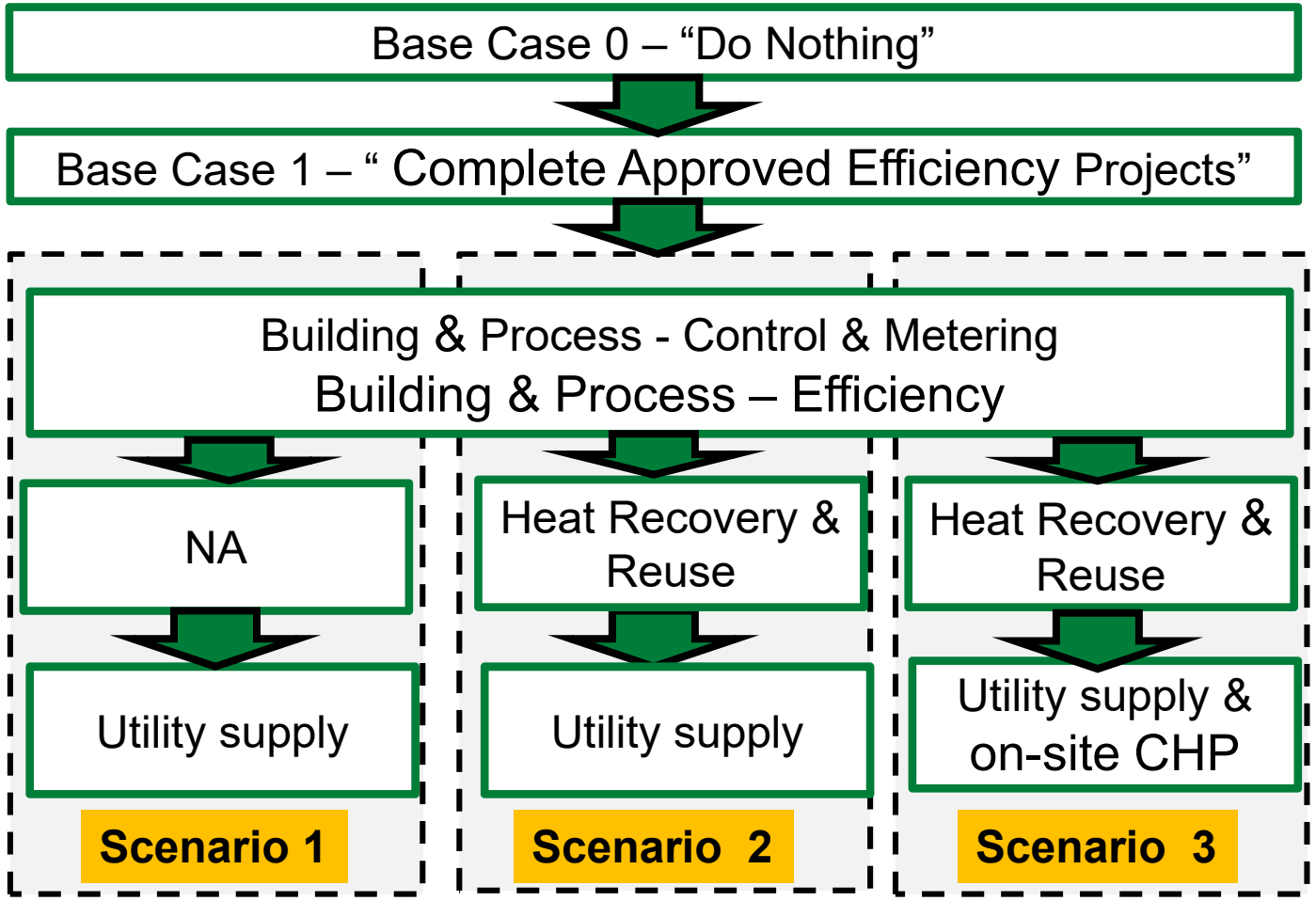
Framing Goals are Drivers

Framing Goals
Plant 1 Example

- Senior Management Challenge
  - *Discussion and alignment*
- Agreed Framing Goals
  - *At least 25 % increase in energy productivity by 2021*
  - *>25% decrease in greenhouse gas emissions*
  - *At least 10% Internal Rate of Return*
  - *No degradation in reliability*

Challenge Driven by Multiple Risks

SEP Analysis Framework
Plant 1 Example



Assess Each against Framing Goals

Plant 1 - Baseline Input Spreadsheet

Historical Data

- Utilities Usage from 2010 to 2014
- Utilities Cost from 2010 to 2014
- Annual Indexing Function 1 (IF1) from 2010 to 2014
- Annual Unit of Saleable Production (UoSP) from 2010 to 2014
- Greenhouse gas emissions indexes from 2010 to 2014

Transfer 2014 Baseline to SEP Integration Workbook

Historical Reporting

- Annual & Monthly Utilities Usage graphs with selectable period
- Annual & Monthly Utilities Costs graphs with selectable period
- Annual & Monthly Utilities Emissions graphs with selectable period
- Annual & Monthly Utilities Usage Index graphs with selectable period
- Annual & Monthly Utilities Costs Index graphs with selectable period
- Annual & Monthly Utilities Emissions graphs with selectable period
- Various energy / production comparisons

Pre-loaded from Corporate Energy Data Base

Plant 1 Risk & EEM Input Spreadsheet

Future Risks and Assumptions

- Higher and Lower Utilities Prices Outlooks from 2015 to 2031
- Higher and Lower Carbon Costs Outlooks from 2015 to 2031
- Annual Cost Inflation from 2015 to 2031
- Annual Indexing Function 1 (IF1) from 2015 to 2031
- Annual Unit of Saleable Production (UoSP) from 2015 to 2031
- Higher and Lower Discount Rate used in Cash Flow calculations
- Annual Efficiency Gain from Continuous Improvement

Transfer Risk Outlooks to SEP Integration Workbook

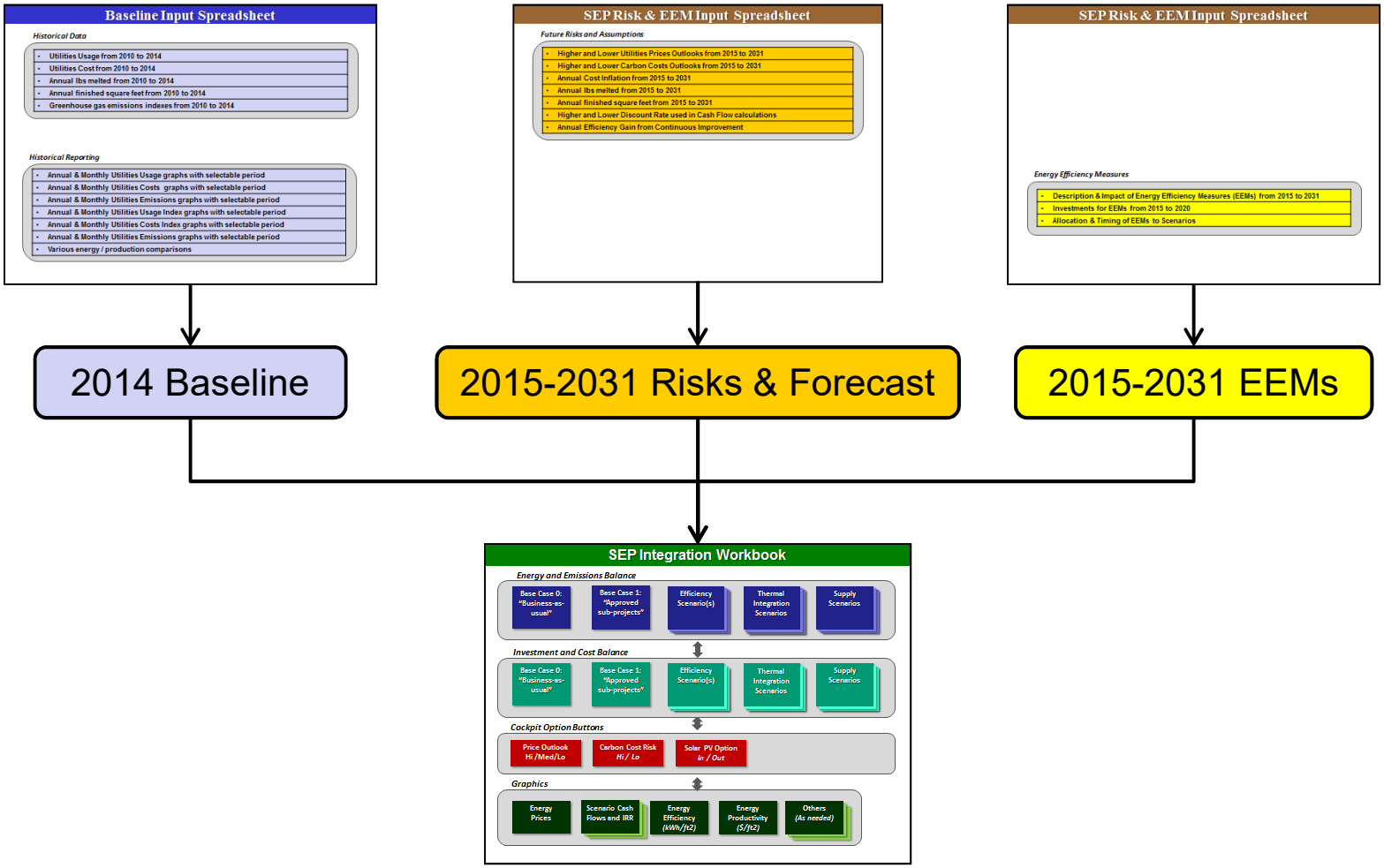
Energy Efficiency Measures

- Description & Impact of Energy Efficiency Measures (EEMs) 2015 to 2031
- Investments for EEMs from 2015 to 2025
- Allocation & Timing of EEMs to Scenarios

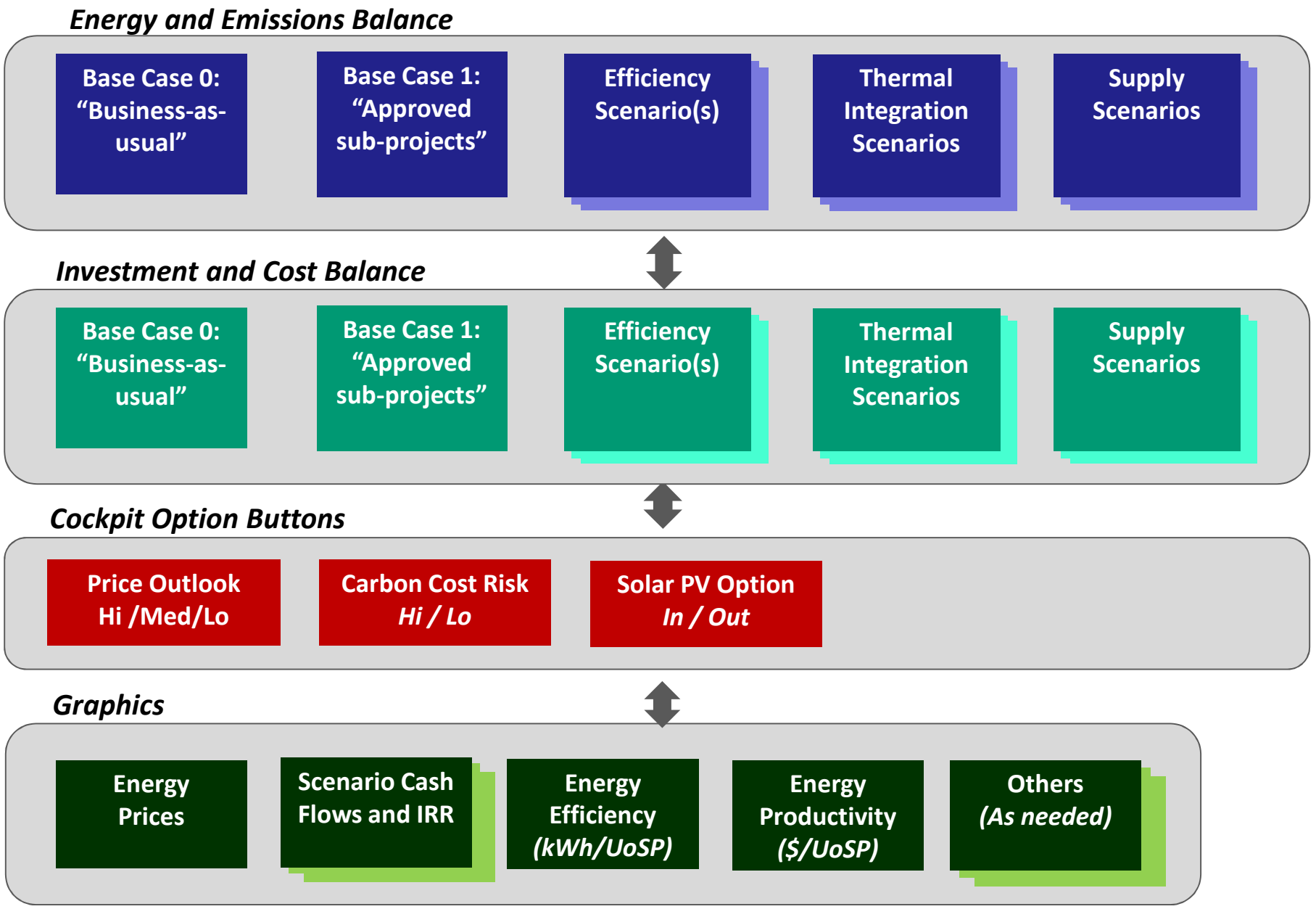
Transfer EEM details & impacts to SEP Integration Workbook

Risk Data Mostly Pre-loaded – Team Focus on EEMs

Plant 1 - SEP Data
Integration Structure



SEP Integration Workbook



Plant 1 – Scenario 1
Metering, Control & Efficiency Measures

- Metering and Control
  - *Comprehensive metering, sub-metering & integrated FMCS prerequisites for world-class energy management*
  - *SEP used industry benchmark investment levels*
    - *Metering / sub-metering*
    - *FMCS upgrades*
- Continuous Efficiency Improvement
  - *Dedicated Full-Time Site Energy Team of three*
  - *1.5% annual improvement – mid-range of benchmarks*
  - *Key sub-process rebuild energy efficiency objectives*

Benchmarks Accelerate Process

Plant 1 – Scenario 2
Efficiency + Heat Recovery & Reuse

- Major Opportunity - Process Finishing Water
  - *Recover and reuse 20 GWh*
- Other Potential Sources
  - *Compressors*
  - *Melter crown*
  - *Sidewalls*
  - *…..*
- Potential Uses
  - *Process steam*
  - *Absorption chilling*
  - *Process heating*
- Technical and Economic Estimate
  - *Recover / reuse at least 2% of total energy*
  - *No more than $10M investment from 2015 to 2019*

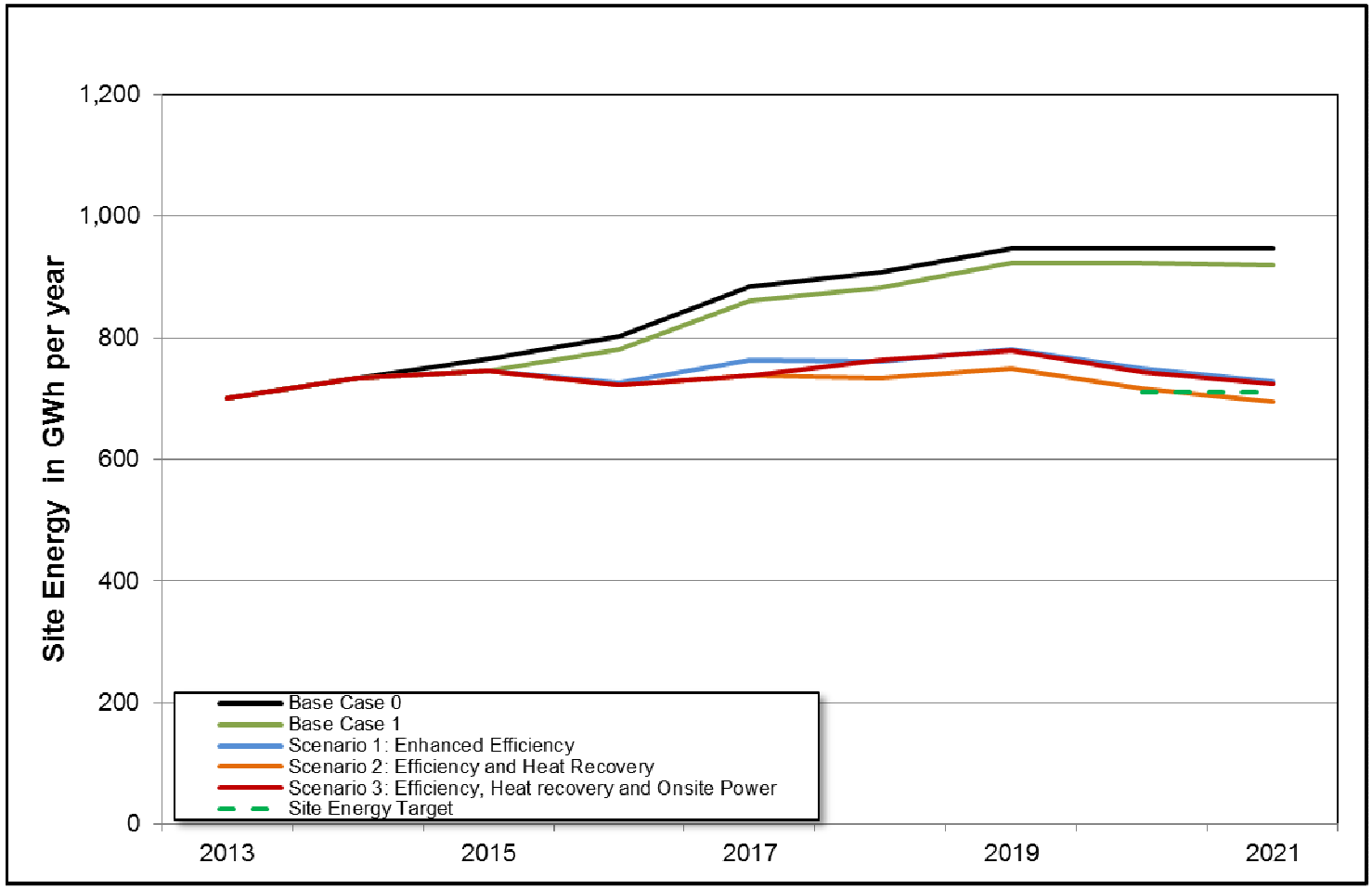
Assess Extensive Thermal Integration

Plant 1 – Scenario 3
Efficiency + HR + Alternative Supply

- On-site Combined Heat & Power
  - *Sized for base-load steam*
- Configuration
  - *Local emissions standards can be met*
  - *CHP engine 5.5 MW_{el}*
  - *Exhaust steam generator*
  - *Link all site steam networks*
- Total investments ~ $10M in 2017
- CHP Electricity pricing
  - *High = net-metered*
  - *Low = 60% net metered*

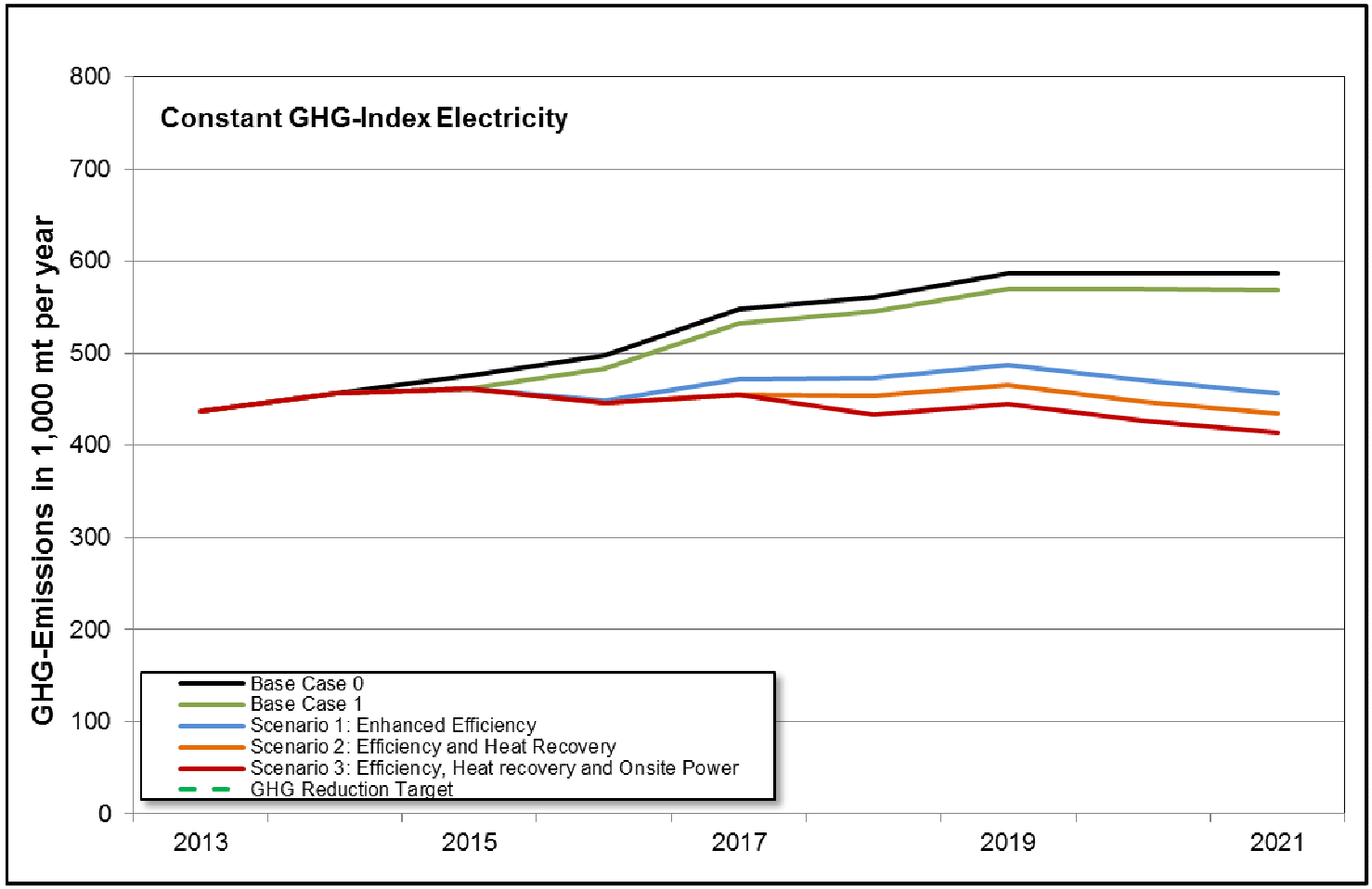
Benchmarks Accelerate Assessment

Plant I – Site Energy Use
Scenarios Impacts 2013-2021



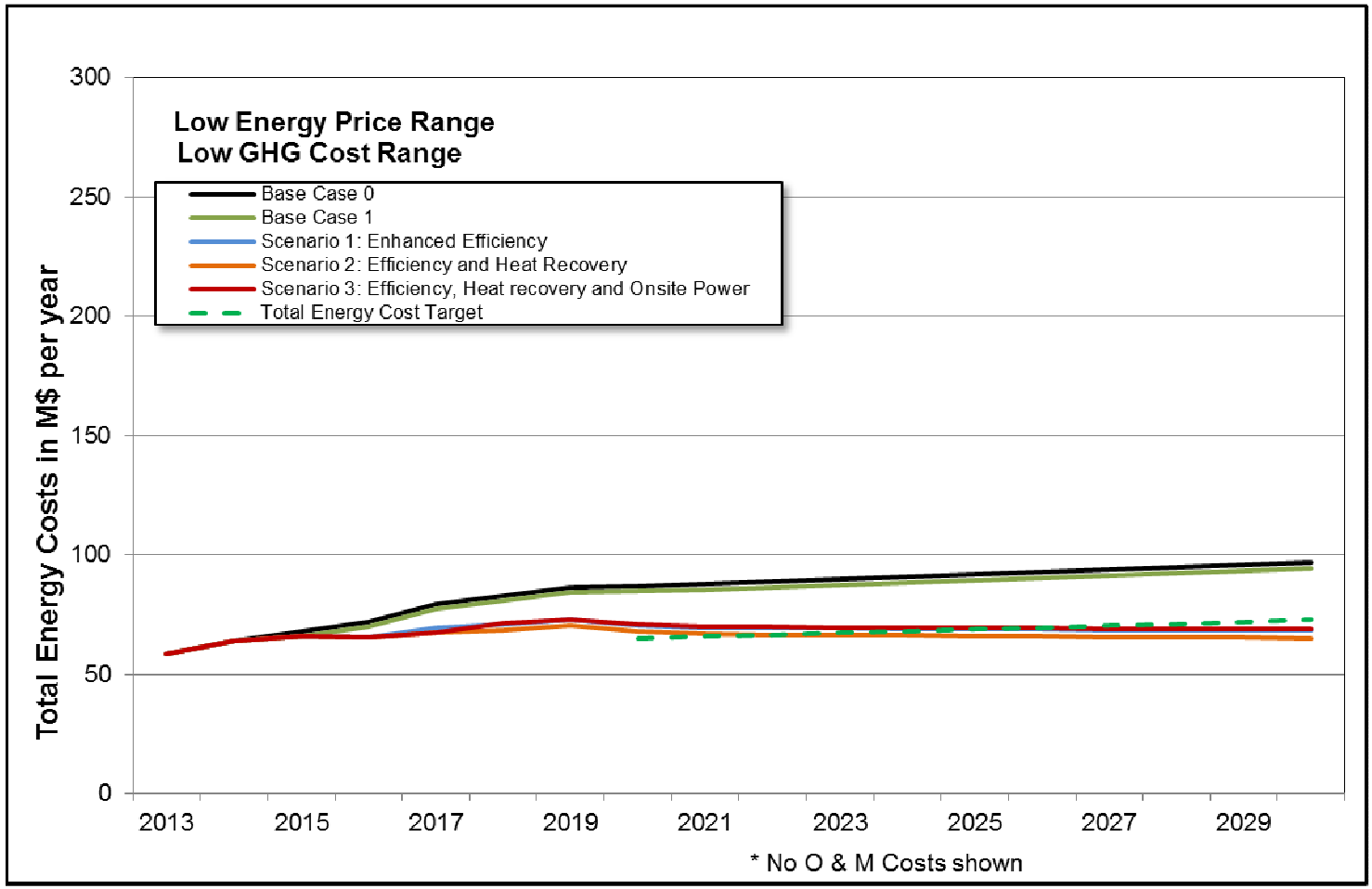
21% Energy Saving by 2020

Plant I – GHG Emissions
Scenarios Impacts 2013-2021



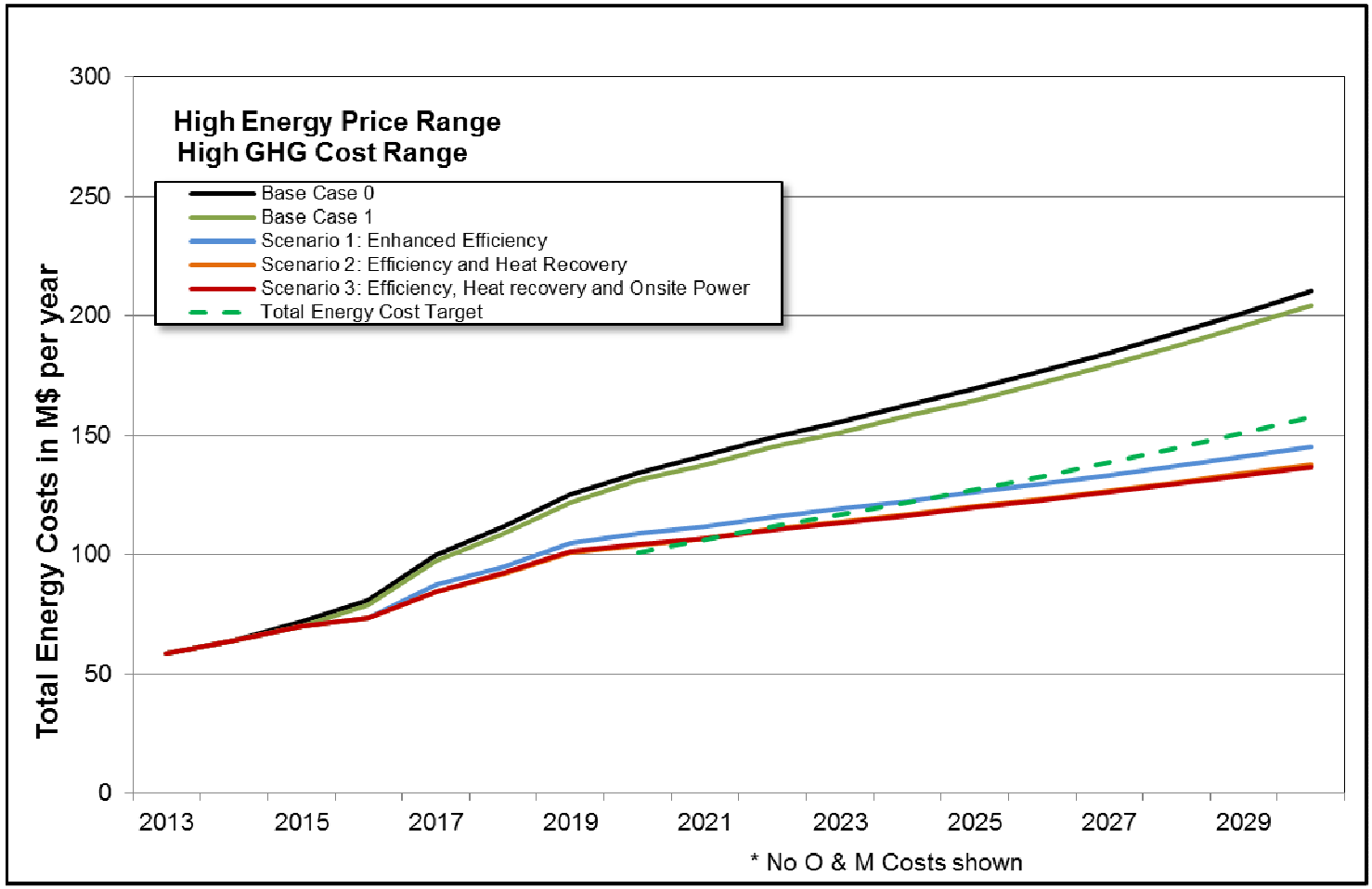
Avoid 27% Emissions by 2020

Plant 1 - Energy Cost – Low Outlook
Scenarios Impacts 2013-2021



Avoided Cost $16M in 2020

Plant 1 - Energy Cost – High Outlook
Scenarios Impacts 2013-2021



Avoided Cost $30M in 2020

Plant 1 SEP Results
Performance against Framing Goals

SEP Plant 1								
Constant GHG-Index Electricity	Low Energy Price Range							
Low GHG Cost Range	Low Interest Rate Range							
Achieved targets 2020	**Site Energy Reduction Index**	**% of Target achieved**	**Total Energy Cost Reduction**	**% of Target achieved**	**GHG Reduction Index**	**% of Target achieved**	**Internal Rate of Return (IRR)**	**% of Target achieved**
Base Case 1	X%	X%	X%	X%	X%	X%	-	-
Scenario 1: Enhanced Efficiency	X%	X%	X%	X%	X%	X%	X%	X%
Scenario 2: Efficiency and Heat Recovery	X%	X%	X%	X%	X%	X%	X%	X%
Scenario 3: Efficiency, Heat recovery and Onsite Power	X%	X%	X%	X%	X%	X%	X%	X%

Numerical Example to be reviewed in Workshop

Simple Overview of Complex Questions

Plant 1 SEP Results
Recommended Integrated Solution

SEP Plant 1	Investment ($)	NPV ($)	IRR (%)
Constant GHG-Index Electricity	***Low Energy Price Range***		
Low GHG Cost Range	***Low Interest Rate Range***		
Scenario 1: Enhanced Efficiency	XX,XXX,XXX	XX,XXX,XXX	AAA%
Scenario 2: Sc 1+Efficiency and Heat Recovery	XX,XXX,XXX	XX,XXX,XXX	BB%
Scenario 3: Sc 2 +Efficiency, Heat recovery and Onsite Power	XX,XXX,XXX	XX,XXX,XXX	*CC%*

Numerical Example to be reviewed in Workshop

- Scenario 2 recommended and approved
- 2020 cost reduction between $XXM & $YYM
- IRR of >ZZ%
- CHP is viable option if reliability issue grows

Future Template for All Major Plants

Integrated Site Energy Planning Conclusions

- Applicable to large and small sites
- Assumption-based approach manages missing and poor data
- Relatively fast to reach decision-grade plan
- Integration tools allows multiple options to be tested
- Basis for energy risk management
- Eye-opener for senior management

Multi-Year Investment Energy Road Map

Thank You

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SEEA

SOUTHEAST ENERGY EFFICIENCY ALLIANCE

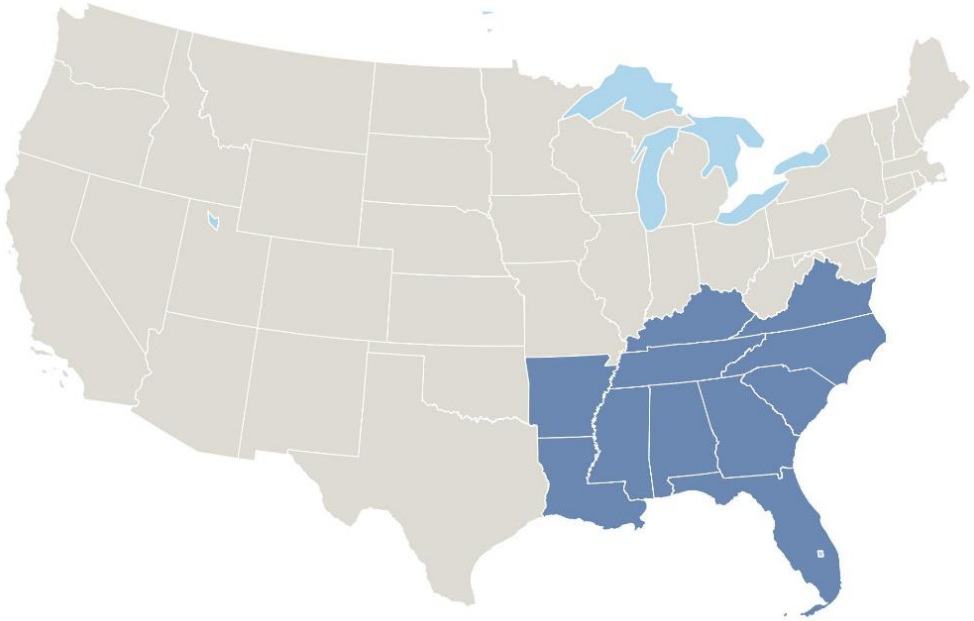
EPA's Clean Power Plan: What Southeastern Energy Managers Need to Know

Abby Fox, Policy Manager

May 24, 2016

SEEA Serves The Southeast

The **Southeast Energy Efficiency Alliance (SEEA)** promotes energy efficiency as a catalyst for economic growth, workforce development and energy security. We do this through collaborative public policy, thought leadership, outreach programs, and technical advisory activities.



Regional Energy Efficiency Organization

Eleven-state footprint

Non-profit, non-partisan

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SOUTHEAST ENERGY EFFICIENCY ALLIANCE

CLEAN POWER PLAN OVERVIEW

The Basics

- Regulates carbon dioxide emissions from existing sources within the power sector
- Numerous control strategies (including energy efficiency)
- Two forms of goals:
  - Rate-based (intensity)
  - Mass-based (carbon “budget”)
- Likely to drive greater investment in energy efficiency

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SOUTHEAST ENERGY EFFICIENCY ALLIANCE

A Two-Step Process

EPA sets stringency guidelines for states

States develop and implement compliance plans

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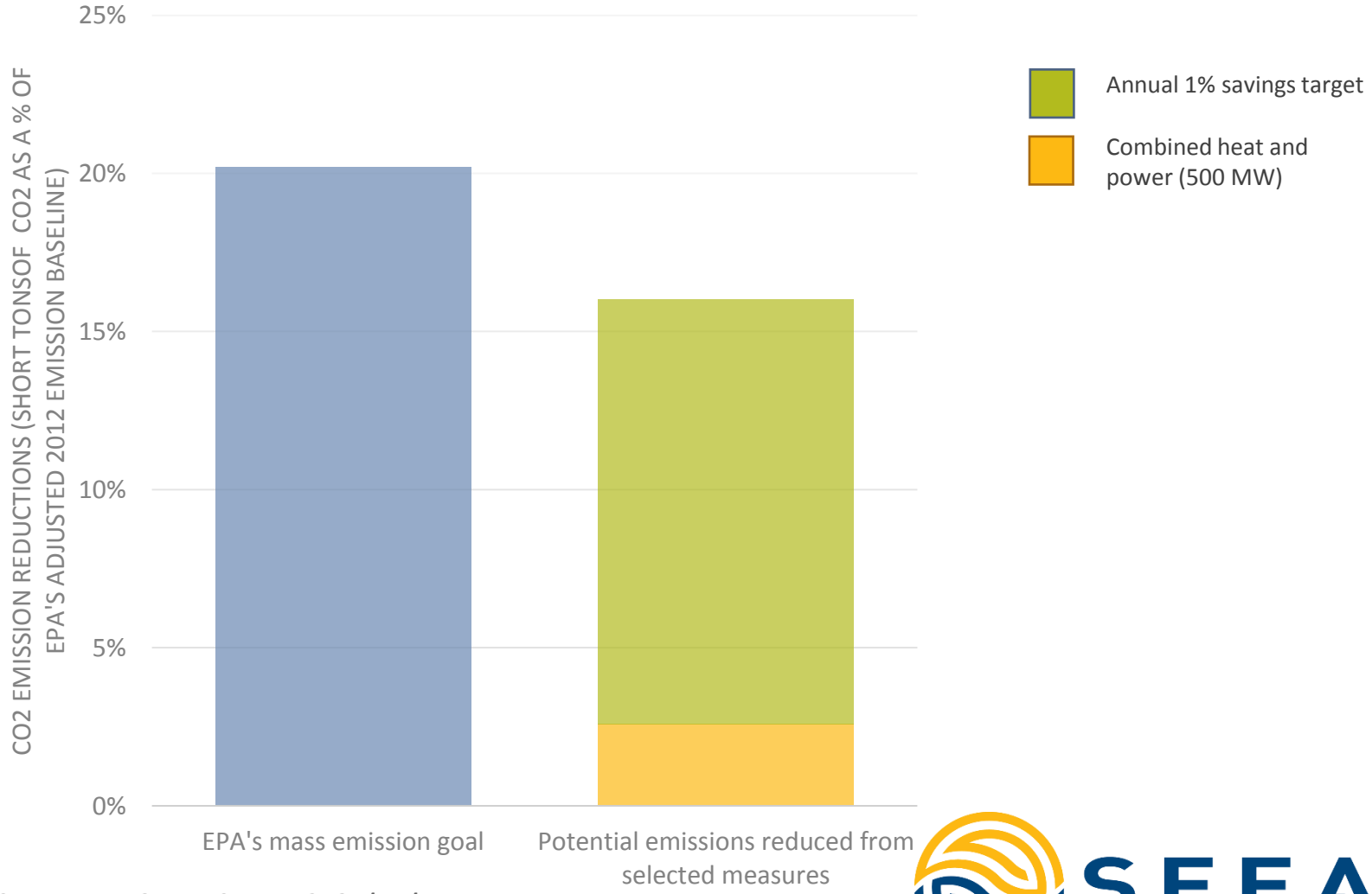
WHAT DOES THIS LOOK LIKE IN PRACTICE FOR ENERGY EFFICIENCY?

Example: Louisiana's Energy Efficiency Opportunity



Source: ACEEE SUPR 2 Calculator

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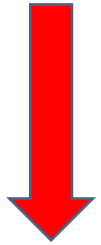
Energy Efficiency in Rate-Based Plans

- Energy efficiency generates emission rate credits (ERCs)
  - ERCs essentially "adjust" emission rates
  - 1 ERC = 1 MWh
- Energy efficiency is credited as avoided generation

Source: Synapse Energy Economics

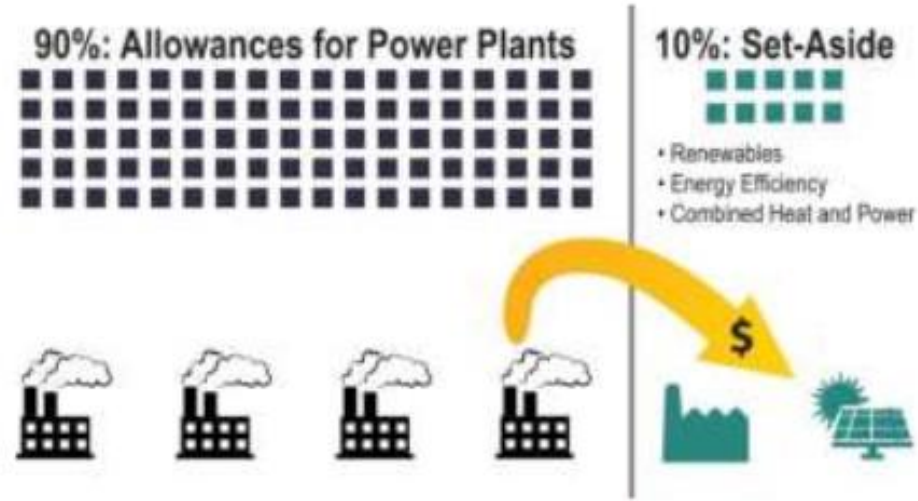
$$\text{Performance Rate} = \frac{\text{EGU Emissions (lbs of } CO_2\text{)}}{\text{EGU Generation (MWh)} + \text{Emission Rate Credits or "ERCs" (MWh)}}$$



- Emitters may purchase ERCs to achieve compliance targets

Energy Efficiency in Mass-Based Plans

- Energy efficiency “shows up” at the stack
- Tools to encourage energy efficiency:
  - Set-asides of emissions budget (“allowances”)
  - Targeted budget allocation methods
  - Investment of auction proceeds



Source: Institute for Industrial Productivity

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Key Takeaways

- EPA's Clean Power Plan has the potential to drive new, cost-effective investments in energy efficiency.
  - Energy efficiency can meet compliance obligations at least cost (and maximum benefit).
- Industrial customers may see increased revenue streams or incentive availability for energy efficiency projects.
- MAKE IT COUNT!

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SOUTHEAST ENERGY EFFICIENCY ALLIANCE

www.SEEALLIANCE.org

Superior Energy Performance®
U.S. DEPARTMENT OF ENERGY

DOE eGuide for Strategic Energy Management

Ridah Sabouni, CEM, PMP, CMVP
Senior Engineer, Energetics Incorporated
May 2016

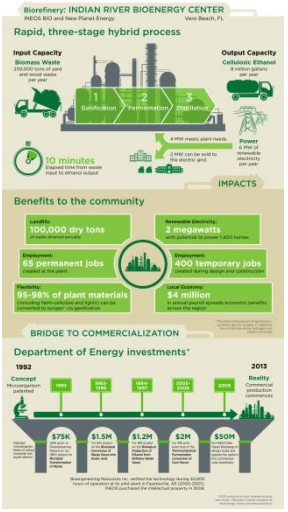
ENERGETICS
A Subsidiary of VSE Corporation

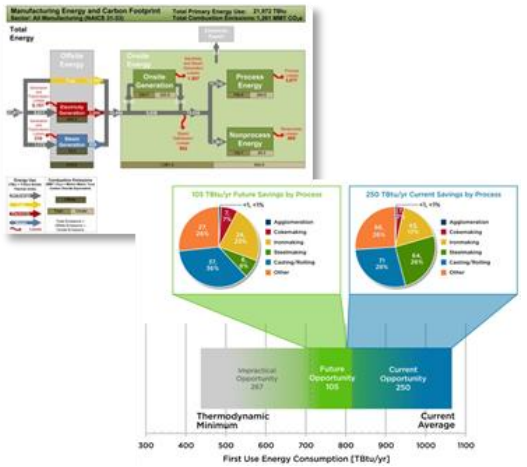
U.S. DEPARTMENT OF ENERGY

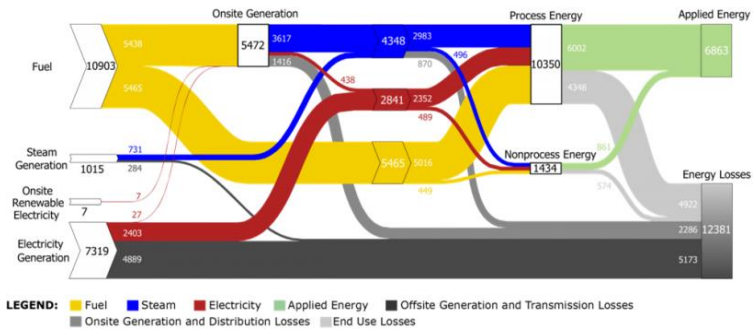
Energetics at a Glance

Providing clients with solutions that:

- Increase energy efficiency
- Diversify energy supply
- Measure impacts of new energy technologies
- Benchmark energy and carbon footprints
- Create consensus around strategic priorities
- Modernize infrastructure







120+ staff members include engineers, scientists, project managers, and communication specialists

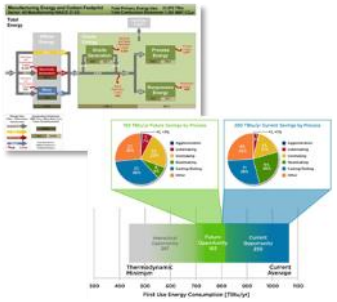
- **30+ Subject Matter Experts:**
  Advanced Manufacturing, Energy Management, Wind, Solar, Bioenergy, Battery Storage, CHP, Fuel-efficient Vehicle Technologies, Green Building Technologies, Smart Grid, Climate Change Adaptation, and Policy/Regulatory Affairs
- **Over 50% with Advanced Degrees** *(Ph.D., J.D., M.S.)*
- **55 BS/BA Engineering/Science Degrees**
- **Certifications including PMP, PE, CEM, LEED, CMVP**

Integrated delivery of technical, analytical, and communication services for over 35 years

Client Offerings

Planning & Roadmapping

Analysis & Modeling



Implementation & Deployment

NIST National Institute of Standards and Technology U.S. Department of Commerce

U.S. DEPARTMENT OF ENERGY

nyserda Energy. Innovation. Solutions.

U.S. TRADE AND DEVELOPMENT AGENCY

FEMP Federal Energy Management Program

Private Clients

SMARTGRID.GOV

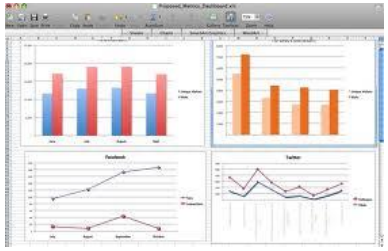
Homeland Security

CLEAN ENERGY MINISTERIAL

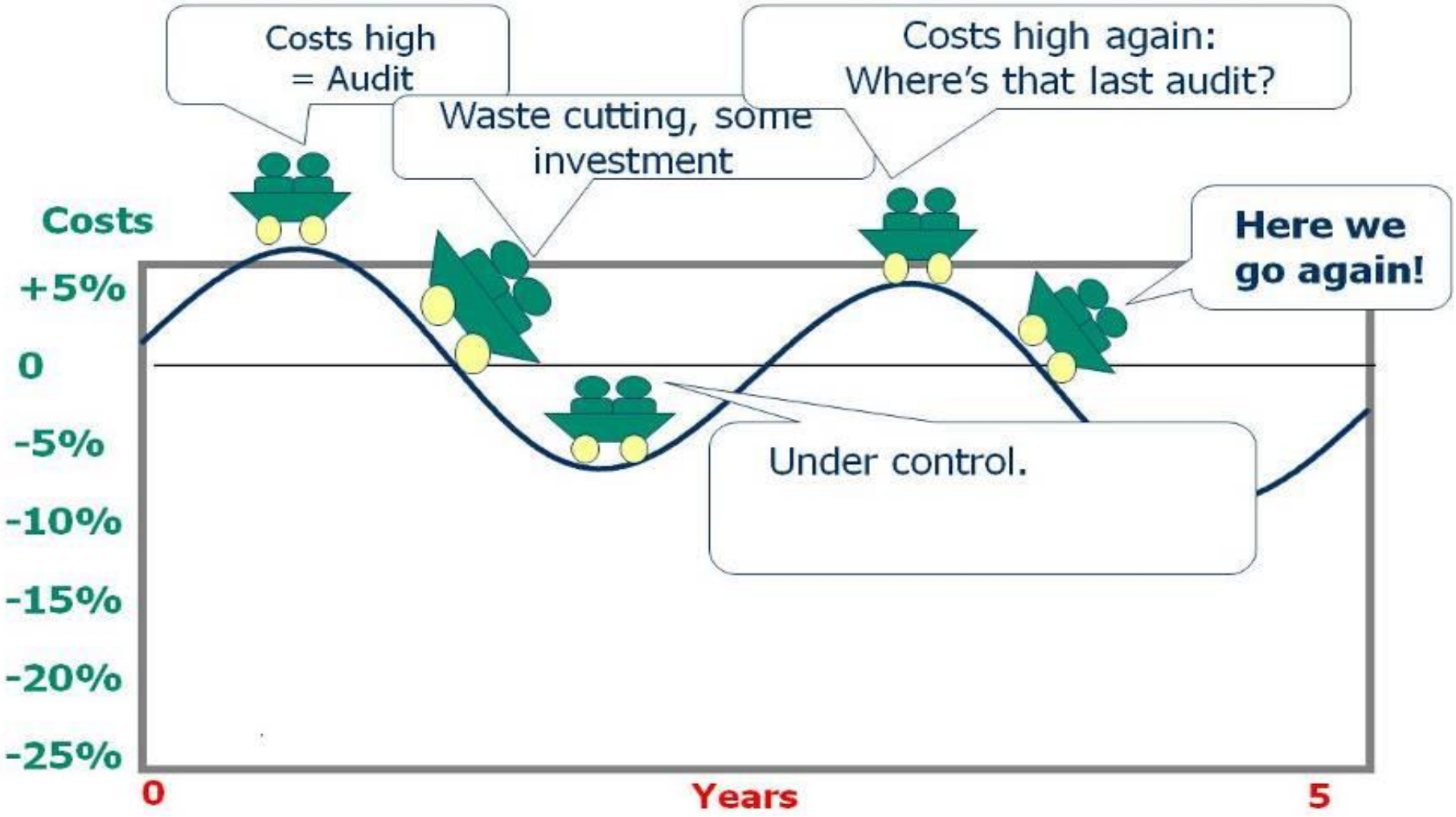
Department of Veterans Affairs

Outreach & Communications

Evaluation & Metrics

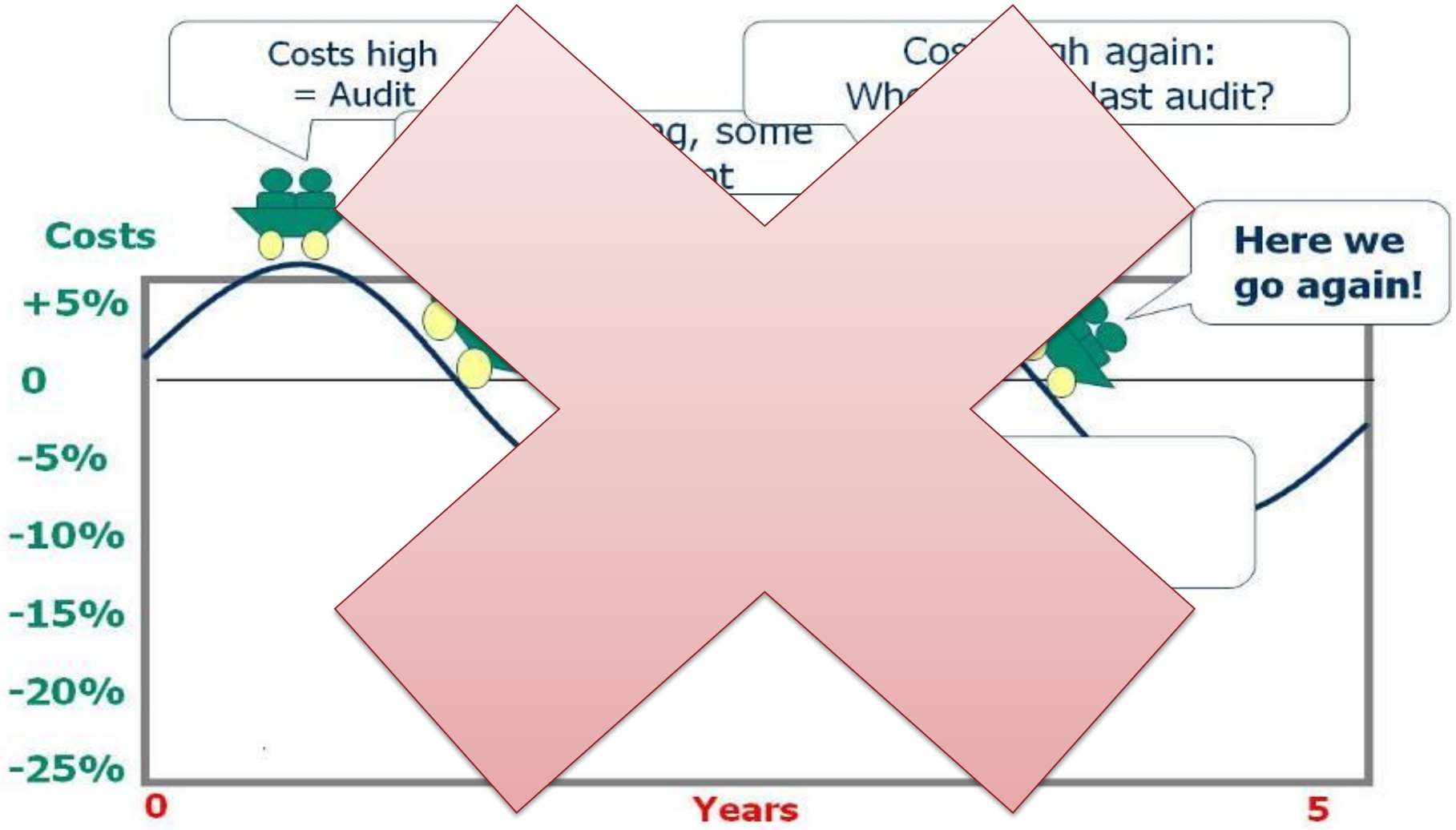


Ad hoc Approach to Energy Management



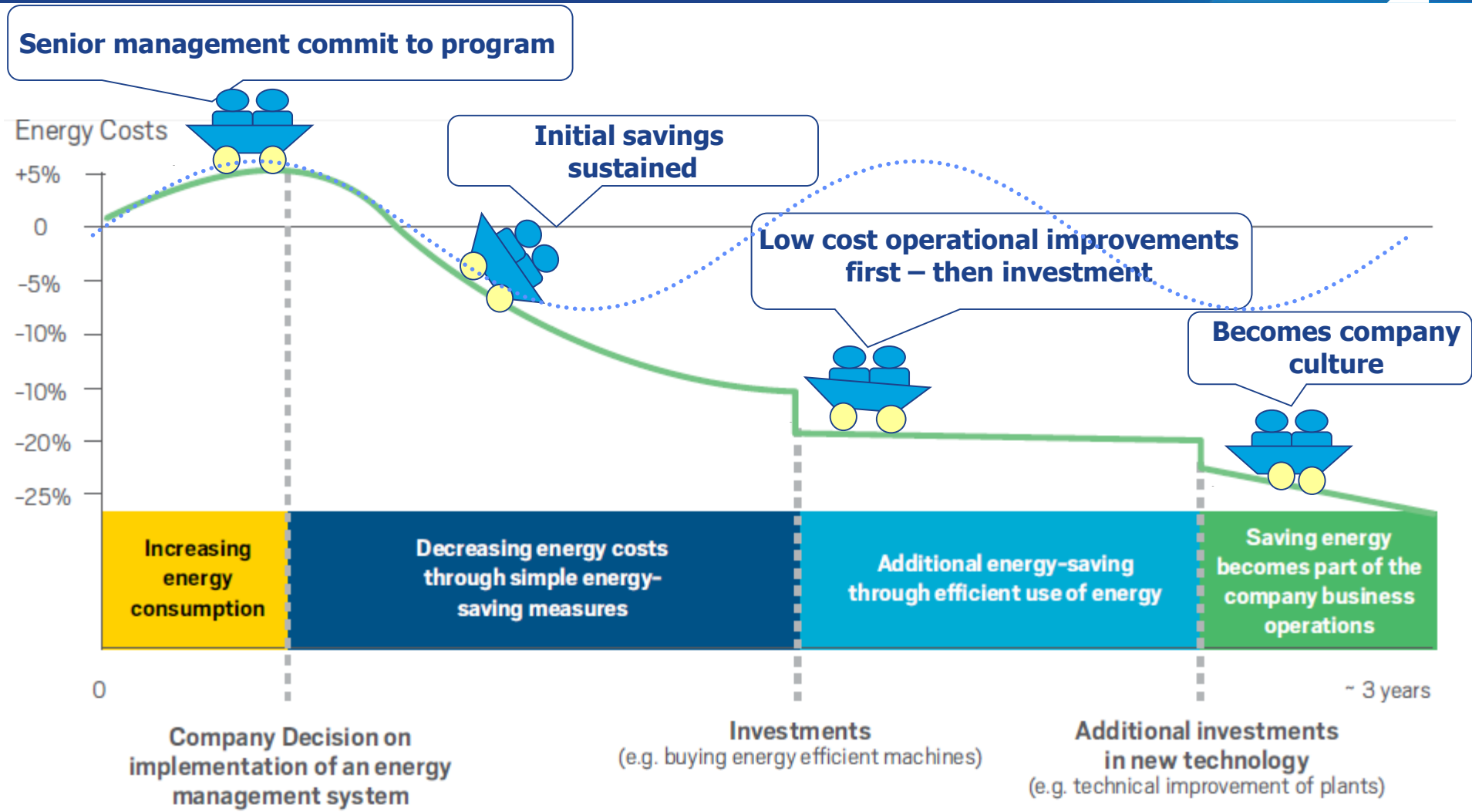
Source: UNIDO 2010

Ad hoc Approach to Energy Management



Source: UNIDO 2010

Structured Approach to Energy Management



Source: Kahlenborn et al. (2012), based on Lackner & Holanek (2007)

What is Strategic Energy Management?

- Strategic energy management (SEM) is…
  - A culture for continual improvement of energy performance and efficiency
  - A structured approach that elevates and integrates energy management into normal business practices--as has previously happened for safety & quality

What is Strategic Energy Management?

 Source: http://www.smithsonianmag.com/history/lunch-atop-a-skyscraper-photograph-the-story-behind-the-famous-shot-43931148/?no-ist

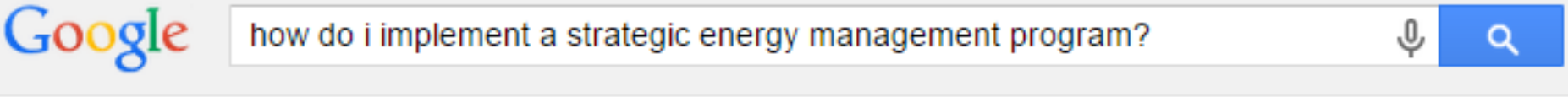
What is Strategic Energy Management?

- Strategic energy management (SEM) is…
  - A culture for continual improvement of energy performance and efficiency
  - A structured approach that elevates and integrates energy management into normal business practices--as has previously happened for safety & quality
  - Involves staff from the board room to the shop floor: Organizational change in culture
  - Positions your organization to achieve energy and cost savings through informed decision making
  - Enables the implementation of energy saving practices for facilities, processes, equipment and operations.
- Organizations of any size can benefit from some form of SEM

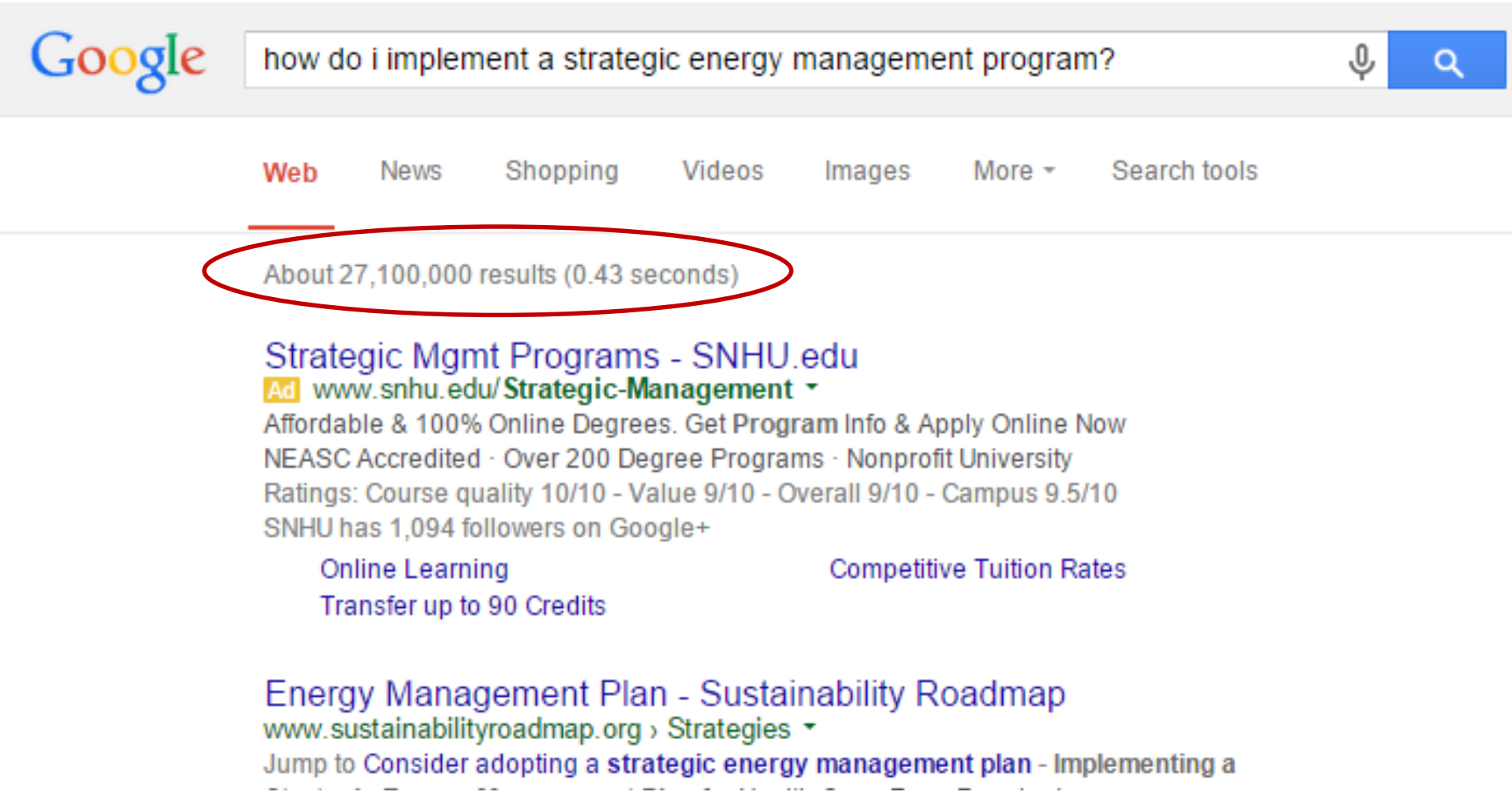
So, if you are interested in implementing SEM at your industrial facility, how should you get started??

Getting Started with SEM…

Getting Started with SEM…

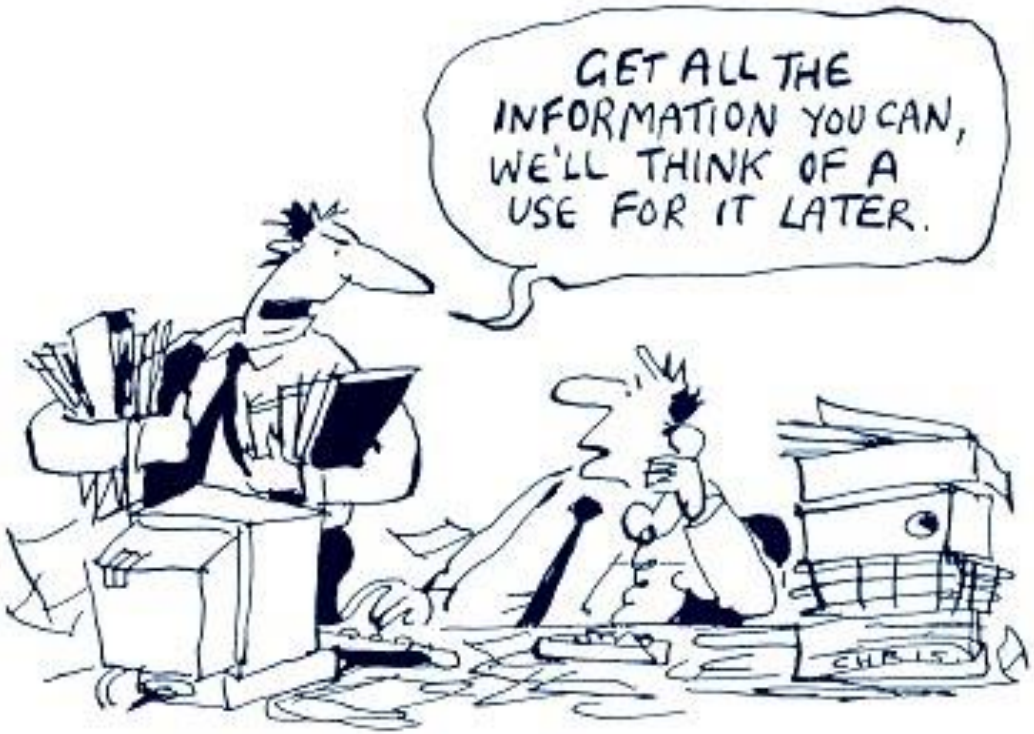


Getting Started with SEM…



Getting Started with SEM…

Getting Started with SEM…



Getting Started with SEM…

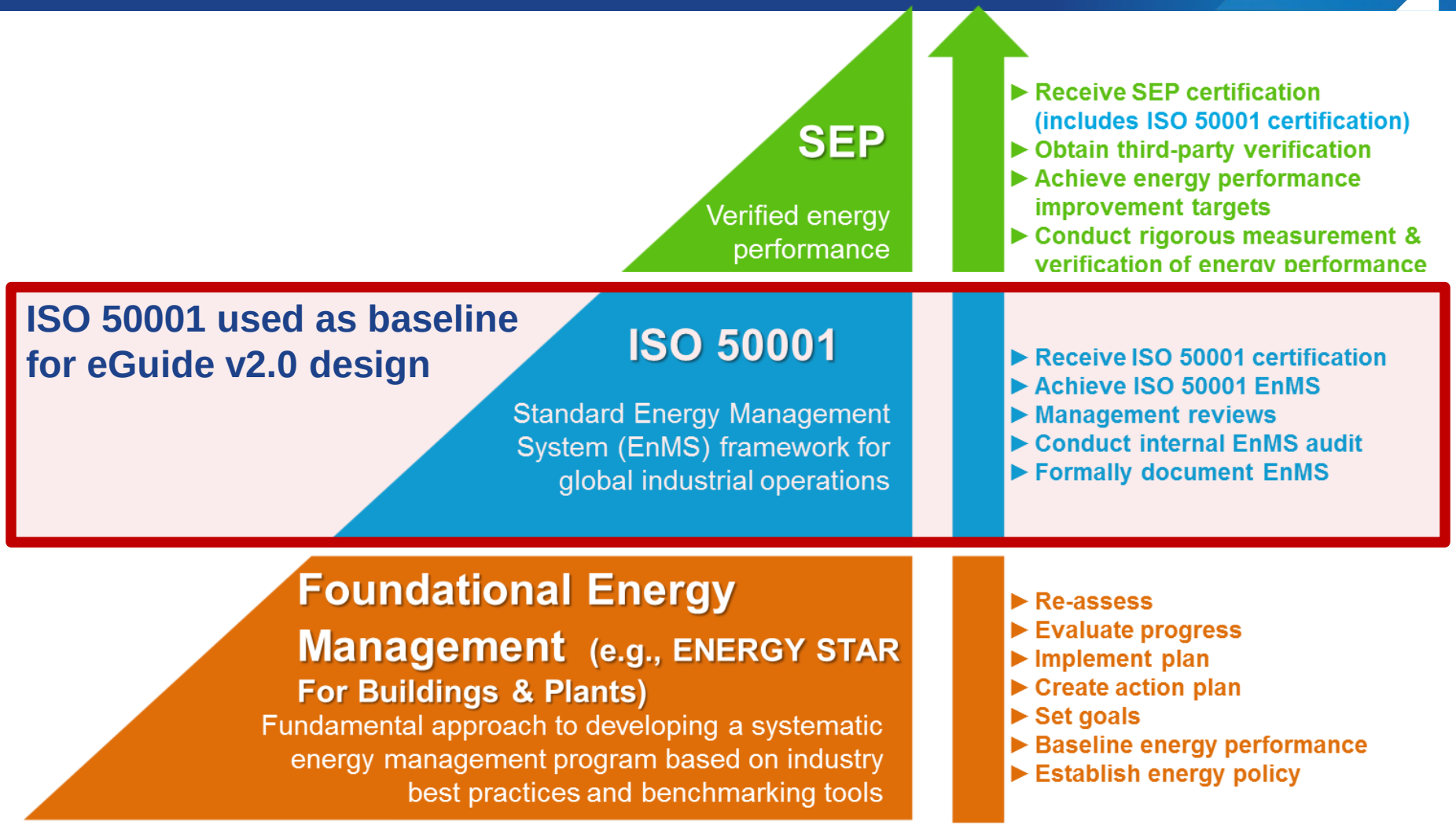
Superior Energy Performance
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY

What's the eGuide?

- The DOE eGuide to Energy Management ("eGuide") is an online resource with a step-by-step approach and tools to help organizations implement a strategic approach to energy management at their facilities
- Soft-launched in 2015, now available at: www.energy.gov/eGuide or just google "DOE eGuide"
- eGuide audience:
  - Industrial: Large manufacturing facilities and small/medium enterprises (SMEs)
  - Commercial: Small, medium, or large commercial buildings, facilities staff, schools, etc.
  - Federal & State: Public facilities with or without energy managers, DOD facilities
  - Utilities & Program Administrators (e.g., tool to help implement EPA Clean Power Plan)
  - High level decision makers in each of the above four groups

Strategic Energy Management Continuum



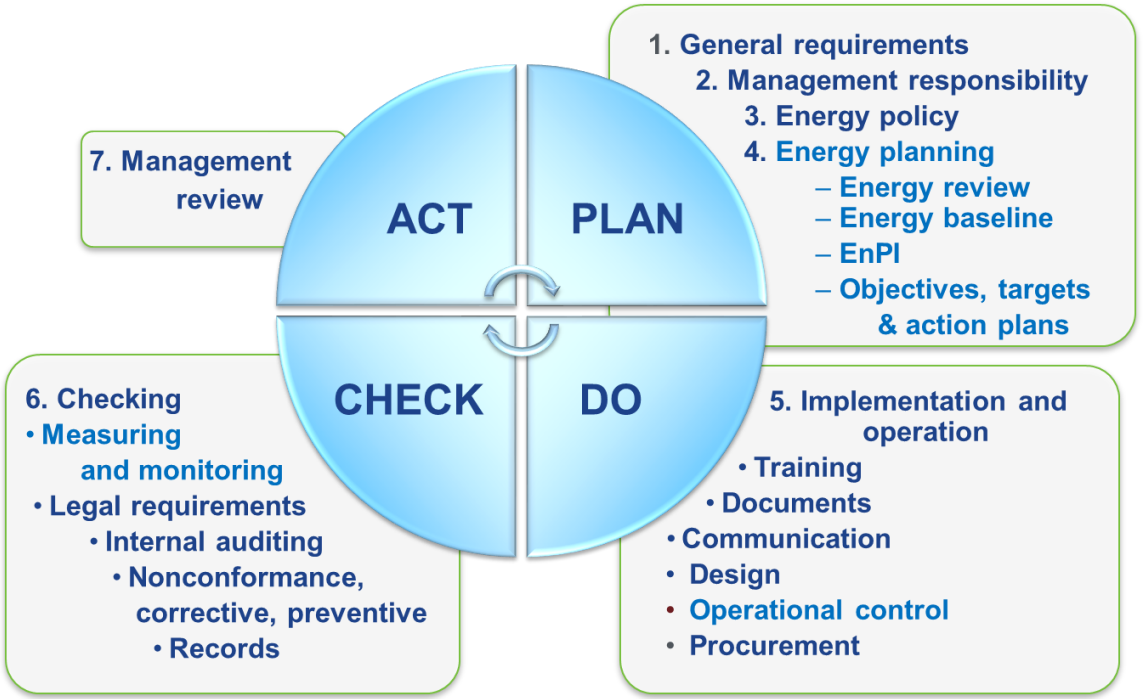
Source: U.S. DOE Advanced Manufacturing Office

ISO 50001–Energy Management Systems (EnMS)

International standard that draws from **best practices around the world**. Developed with input from 56 countries, many countries now adopting it as a national standard.

ISO 50001 specifies requirements for establishing, implementing, maintaining and improving an EnMS.

It does not prescribe specific energy performance improvement criteria.



Light blue text represents new data-driven sections in ISO 50001 that are not in ISO 9001 & ISO 14001

Superior Energy Performance® (SEP™)

SEP is a DOE certification program that verifies energy management excellence and sustained energy savings.

SEP is ISO 50001 plus:

- **Deeper, sustained savings at less cost** through robust tracking and measurement with advanced tools
- **Credible, third-party verification** by ANSI-ANAB accredited entity that market can reward supply chains, utilities, and carbon trading
- **National recognition** by U.S. DOE identifying sustainability leaders

iStock photo: 16418416

SEP Certified Facilities
and Verified Energy Performance Improvement

Improvement over 3 years unless stated otherwise

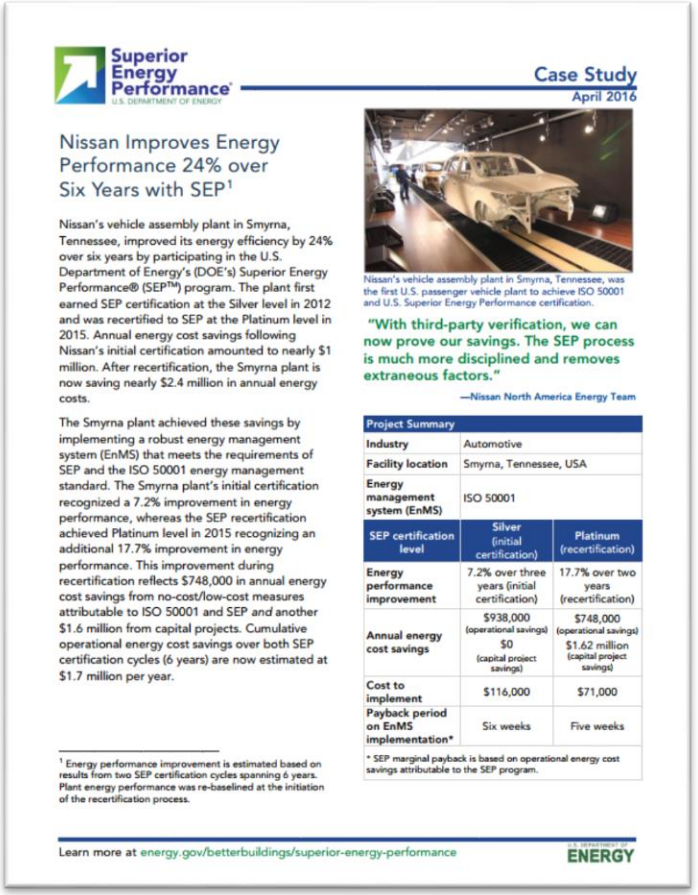
Schneider Electric	Saanichton, BC Canada	30.6%
	Smyrna, TN	23.1%
	Clovis, CA	16.7%
	Seneca, SC	15.6%
	Hopkins, SC	10.2%
	Tijuana, Mexico	10.2%
	Peru, IN	24.9% over 10 years
	Cedar Rapids, IA	8.8%
	Lexington, KY	6.9%
	Lincoln, NE	6.5%
	Rojo Gomez, Mexico	5.9%
VOLVO	Mack Trucks, Macungie, PA	41.9% over 10 years
	Dublin, VA	28.4% over 10 years
	Hagerstown, MD	20.9%
3M	Brockville, Ontario Canada	21.4% over 7 years
	Cordova, IL	5.6%
NISSAN	Smyrna, TN	17.7%
HARBEC	Ontario, NY	16.5%
Cummins	Whitakers, NC	12.6%
Coca-Cola	Dunedin, FL	12.2%
GENERAL DYNAMICS	Scranton, PA	11.9%
COOPERTIRES	Texarkana, AR	10.1%
BRIDGESTONE Your Journey, Our Passion	Wilson, NC	16.8% over 10 years
OLAM	Gilroy, CA	9.8%
MedImmune A member of the AstraZeneca Group	Gaithersburg, MD	8.5%
CURTISS WRIGHT	Cheswick, PA	7.6%
LAND O'LAKES	Carlisle, PA	5.7%

Last updated: September 1, 2015

SEP Measurement & Verification Protocol provides robust methodology to track and verify energy performance improvement.

Case Study: Nissan Improves Energy Performance 24% over Six Years with SEP

- Nissan automobile manufacturing facility implements rigorous ISO 50001 compliant energy management system



Superior Energy Performance
U.S. DEPARTMENT OF ENERGY

Case Study
April 2016

Nissan Improves Energy Performance 24% over Six Years with SEP[1]

Nissan's vehicle assembly plant in Smyrna, Tennessee, improved its energy efficiency by 24% over six years by participating in the U.S. Department of Energy's (DOE's) Superior Energy Performance® (SEP™) program. The plant first earned SEP certification at the Silver level in 2012 and was recertified to SEP at the Platinum level in 2015. Annual energy cost savings following Nissan's initial certification amounted to nearly $1 million. After recertification, the Smyrna plant is now saving nearly $2.4 million in annual energy costs.

The Smyrna plant achieved these savings by implementing a robust energy management system (EnMS) that meets the requirements of SEP and the ISO 50001 energy management standard. The Smyrna plant's initial certification recognized a 7.2% improvement in energy performance, whereas the SEP recertification achieved Platinum level in 2015 recognizing an additional 17.7% improvement in energy performance. This improvement during recertification reflects $748,000 in annual energy cost savings from no-cost/low-cost measures attributable to ISO 50001 and SEP *and* another $1.6 million from capital projects. Cumulative operational energy cost savings over both SEP certification cycles (6 years) are now estimated at $1.7 million per year.

[1] Energy performance improvement is estimated based on results from two SEP certification cycles spanning 6 years. Plant energy performance was re-baselined at the initiation of the recertification process.

Nissan's vehicle assembly plant in Smyrna, Tennessee, was the first U.S. passenger vehicle plant to achieve ISO 50001 and U.S. Superior Energy Performance certification.

"With third-party verification, we can now prove our savings. The SEP process is much more disciplined and removes extraneous factors."

—Nissan North America Energy Team

Project Summary		
Industry	Automotive	
Facility location	Smyrna, Tennessee, USA	
Energy management system (EnMS)	ISO 50001	
SEP certification level	Silver (initial certification)	Platinum (recertification)
Energy performance improvement	7.2% over three years (initial certification)	17.7% over two years (recertification)
Annual energy cost savings	$938,000 (operational savings) $0 (capital project savings)	$748,000 (operational savings) $1.62 million (capital project savings)
Cost to implement	$116,000	$71,000
Payback period on EnMS implementation*	Six weeks	Five weeks

* SEP marginal payback is based on operational energy cost savings attributable to the SEP program.

Learn more at energy.gov/betterbuildings/superior-energy-performance

U.S. DEPARTMENT OF ENERGY

Source http://www.energy.gov/sites/prod/files/2016/05/f31/Nissan%20case%20study_SEP_recertification-042916.pdf

Superior Energy Performance
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY

Case Study: Nissan Improves Energy Performance 24% over Six Years with SEP

- Nissan automobile manufacturing facility implements rigorous ISO 50001 compliant energy management system
- Energy cost savings of nearly $1M per year in initial certification cycle
  - Equivalent of 7.2% improvement in energy performance over 3 years
  - No capital project investment were needed
- Energy cost savings of nearly $2.4 million per year after recertification

Project Summary		
Industry	Automotive	
Facility location	Smyrna, Tennessee, USA	
Energy management system (EnMS)	ISO 50001	
SEP certification level	**Silver** (initial certification)	**Platinum** (recertification)
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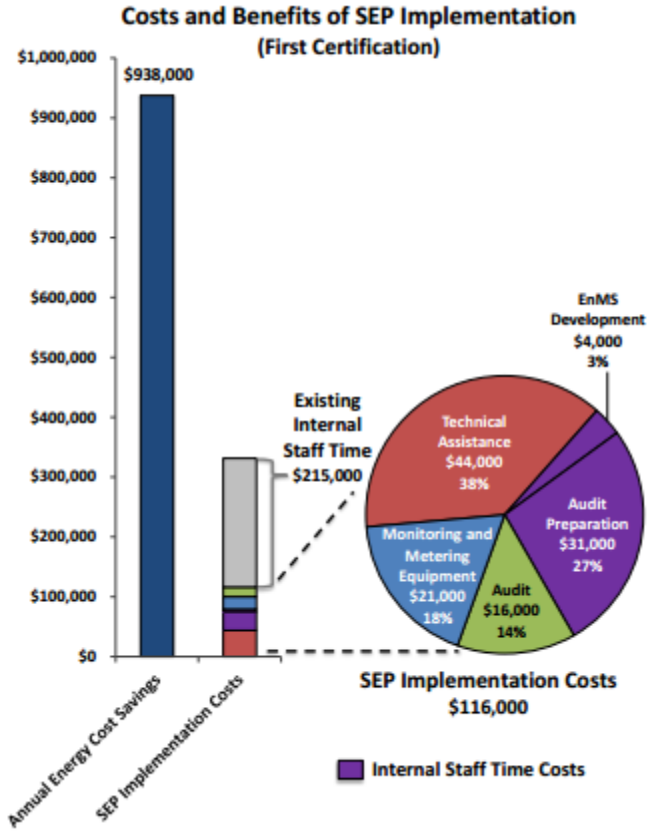
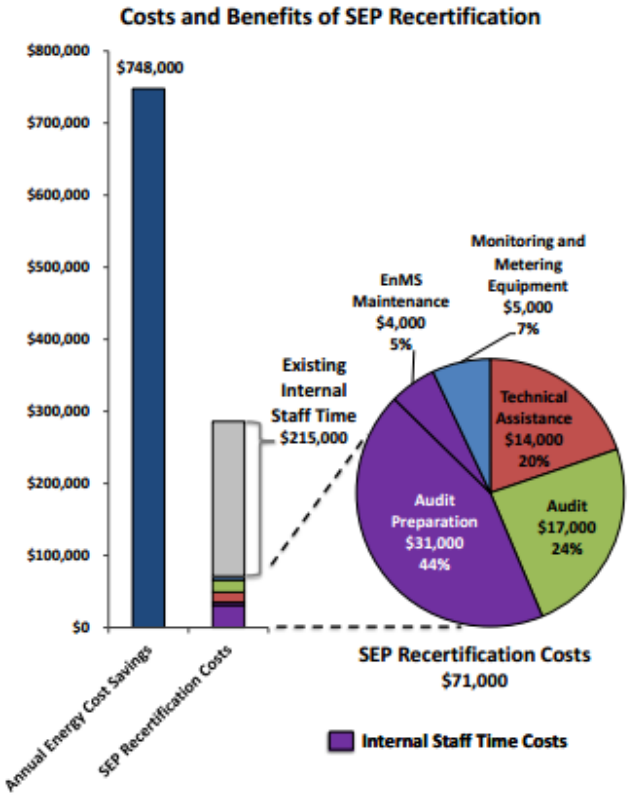
Source http://www.energy.gov/sites/prod/files/2016/05/f31/Nissan%20case%20study_SEP_recertification-042916.pdf

Case Study: Nissan Improves Energy Performance 24% over Six Years with SEP

- Implementation costs included internal staff time, external technical assistance, metering equipment, and the 3rd party audit.





Source http://www.energy.gov/sites/prod/files/2016/05/f31/Nissan%20case%20study_SEP_recertification-042916.pdf

Case Study: Harbec Plastics Improves Energy Performance by 16.5%

- Harbec plastics manufacturing facility implements rigorous ISO 50001 compliant energy management system
- Three-person energy team
- Annual energy cost savings of $52,000
  - Equivalent of 16.5% improvement in energy performance over 3 years
  - If we assume Harbec's profit margin is 5%, that's the equivalent of $1 million in extra revenue!
- No capital project investment needed
  - Costs consisted mostly of energy management system implementation (over a ~ 1 year period), training, and related labor costs
  - 2.4 year payback on those costs
- Examples of energy actions performed to save energy include:
  - Reducing unnecessary run time at CHP plant,
  - Using excess chill capacity to cool process water
  - Adding automatic sequencing so no excess CHP microturbines are operating

Superior Energy Performance
U.S. DEPARTMENT OF ENERGY

Case Study
May 2015

HARBEC—a Specialty Plastics Manufacturer—Improves Energy Performance 16.5% with SEP

HARBEC, Inc. worked with the U.S. Department of Energy (DOE) Advanced Manufacturing Office to successfully implement an energy management system (EnMS) that meets all requirements of ISO 50001[1] and Superior Energy Performance® (SEP™). HARBEC's implementation of the EnMS at its small plastics manufacturing facility in Ontario, New York, enabled a 16.5% improvement in energy performance, saving over $50,000 a year. HARBEC will recoup its investment in SEP within 2.4 years, demonstrating that even smaller manufacturing plants can cost-effectively realize significant benefits from implementing an EnMS.

Business Benefits Achieved

Implementing the EnMS saves the company's sole plant six billion Btu (6,300 GJ) each year and lowers energy costs by (US) $52,000. The $127,000 that the plant spent to implement the EnMS and obtain SEP certification will be paid back through savings in approximately 2.4 years. This SEP marginal payback is based solely on operational energy cost savings attributable to the energy management program.

Energy savings achieved at the plant were verified by an accredited third party, earning the facility certification as an SEP Partner at the Platinum level. The plant's energy resources are now proactively managed via a rigorous business system to sustain those energy savings and continue strengthening plant energy performance in the future.

[1] International Organization for Standardization Standard 50001, energy management

Working toward carbon neutrality, HARBEC, Inc.'s small-scale specialty plastics manufacturing facility in upstate New York implemented an energy management system that earned both ISO 50001 and Platinum Superior Energy Performance certification. Photo: HARBEC, Inc.

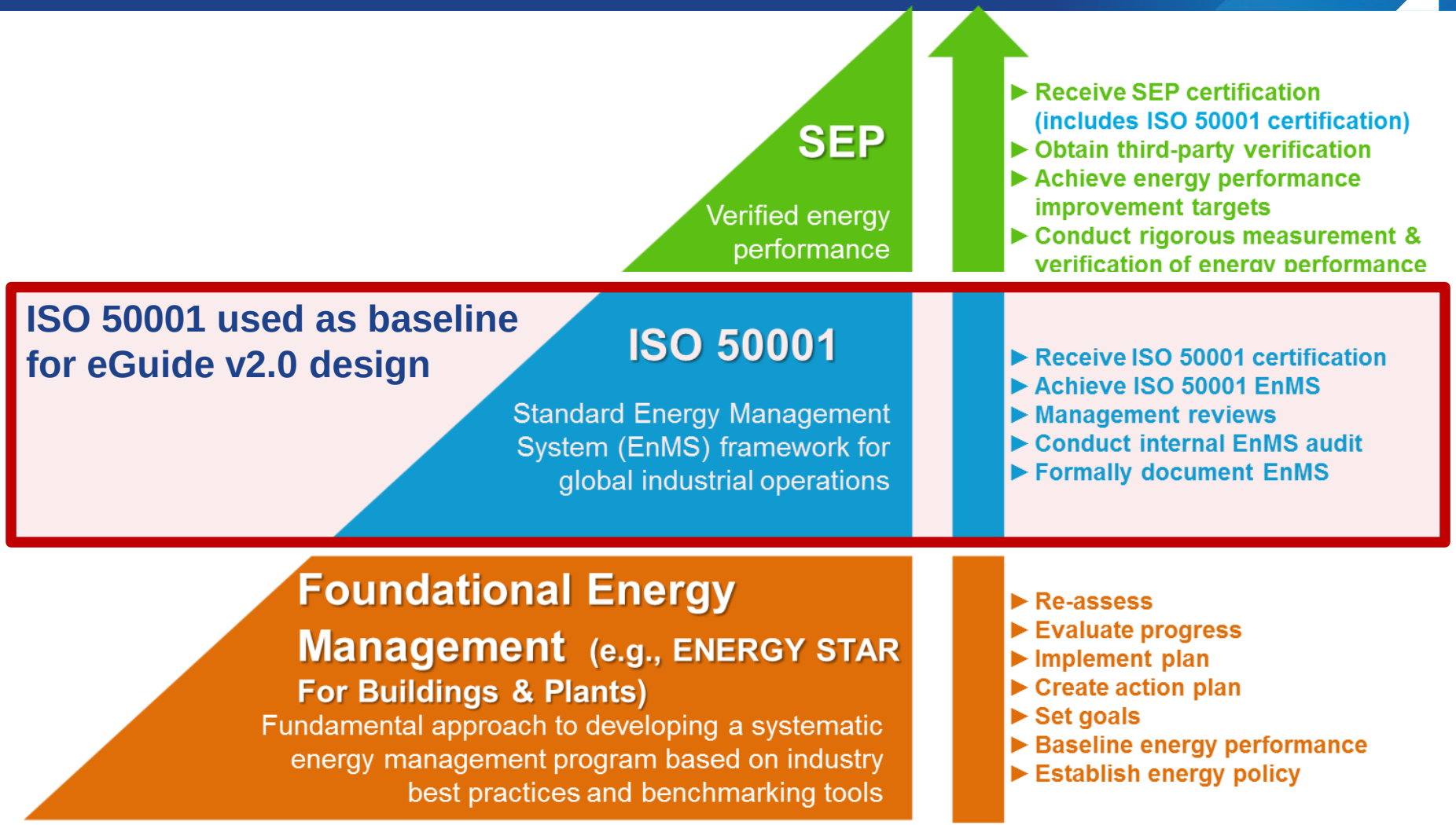
Project Summary	
Industry	Plastics
Facility location	Ontario, New York, USA
SEP certification level	Platinum
Energy management system	ISO 50001
Energy performance improvement	16.5% over 3 years
Annual energy cost savings	$52,000
Cost to implement	$127,000
Payback period	2.4 years

"The nature of SEP and ISO 50001 is that they fuel themselves. As more people see that these approaches work and save significant amounts of money, they will choose to participate."

— Bob Bechtold
President
HARBEC, Inc.

Details here:
http://energy.gov/eere/amo/downloads/harbec-inc-case-study-superior-energy-performance

Strategic Energy Management Continuum



Source: U.S. DOE Advanced Manufacturing Office

eGuide Structure: 3 Levels

3 Levels

Level 1: Foundational Energy Management	Level 2: ISO 50001 Energy Management	Level 3: SEP Energy Management

- **Level 1**: Provides a structured approach to energy management that any commercial, industrial, or government organization can implement, even organizations with little or no experience in energy management.
- **Level 2**: Provides guidance resources and examples to help organizations understand the ISO 50001 energy management standard requirements and the actions to implement the standard.
- **Level 3**: Builds upon Level 2, providing guidance on the additional requirements to achieve DOE Superior Energy Performance®

eGuide Supports Strategic Energy Management

Structured for all 3 SEM ***Levels*** *with 5* ***Core*** *Steps*

Level 1
Foundational
Energy Management

Level 2
ISO 50001 Energy
Management

Level 3
SEP Program

- Step 1 - Engage Management
- Step 2 - Plan for Energy Management
- Step 3 - Implement Energy Management
- Step 4 - Measure and Check Results
- Step 5 - Review for Continual Improvement

eGuide Structure: Substeps

Level 2:
ISO 50001 Energy Management

5 Core Steps

1	Engage Management
2	Plan for Energy Management
3	Implement Energy Management
4	Measure and Check Results
5	Review for Continual Improvement

36 Substeps

1	**Engage Management**
1.1	Learn energy management system basics
1.2	Understand and communicate benefits
1.3	Secure top management commitment
1.4	Appoint a management representative
1.5	Establish an energy team
1.6	Identify the EnMS scope and boundaries
1.7	Define the energy policy
1.8	Create organizational awareness
1.9	Ensure ongoing management responsibility
2	**Plan for Energy Management**
2.1	Identify and evaluate legal and other requirements
2.2	Identify energy sources and uses
2.3	Collect energy bills and other data
2.4	Analyze energy consumption and costs
2.5	Determine significant energy uses
2.6	Identify and prioritize energy opportunities
2.7	Determine performance metrics
2.8	Establish baseline(s)
2.9	Establish energy performance improvement objectives and targets
2.10	Select energy opportunities
2.11	Prepare action plan(s)
3	**Implement Energy Management**
3.1	Ensure proper resources are allocated
3.2	Execute the action plan(s)
3.3	Manage and control information
3.4	Address training and communication needs
3.5	Establish operational controls
3.6	Manage energy considerations in design
3.7	Incorporate energy considerations in procurement
3.8	Define specifications for purchasing energy supply
4	**Measure and Check Results**
4.1	Measure, monitor and analyze performance metrics
4.2	Respond to deviations in energy performance
4.3	Evaluate compliance with legal and other requirements
4.4	Plan and conduct internal audits
4.5	Correct and prevent nonconformities
5	**Review for Continual Improvement**
5.1	Conduct management review of performance
5.2	Recognize success and communicate results
5.3	Take action to continually improve

- The 5 core steps and 36 substeps are based on the ISO 50001 energy management standard

eGuide Structure: Substep Sections and Tasks

- Each substep is organized into four sections:

1. **Overview**: Provides an introduction to the substep
2. **How to do it**: Contains guidance on the ***specific tasks*** that you will need to complete in order to accomplish the substep. Each substep contain a fixed number of tasks.
   - For example, Level 1, Step 2.2 (Identify Energy Sources and Uses) has three associated tasks:

     ☐ 2.2.1 Identify current energy sources
     ☐ 2.2.2 Identify energy uses
     ☐ 2.2.2 Identify data needs
3. **Resources & Examples**: Provides links to resources including spreadsheets, guidance documents, templates to fill out, or weblinks to helpful websites with additional information.
4. **Next Level**: Takes you to the same substep in the next level

Overview

How to do it

Resources & Examples

Next Level

eGuide Step 1: Engage Management

Step 1: Engage Management

1.1 Learn energy management basics

1.2 Communicate the benefits

1.3 Secure top management commitment

1.4 Appoint energy management lead

1.5 Establish energy team

For ISO 50001 and SEP only

1.6 Identify Energy Management System (EnMS) scope and boundaries

eGuide Step 2: Plan for Energy Management

Step 2: Plan for Energy Management

2.2 Identify energy uses
2.3 Gather and input energy bills
2.4 Analyze energy
2.5 Determine significant energy uses
2.6 Prioritize opportunities
2.7 Determine metrics
2.8 Establish baseline
2.9 Establish performance objectives and targets
2.10 Select energy opportunities
2.11 Prepare action plans

For ISO 50001 and SEP only

2.1 Identify and evaluate legal requirements

Example of eGuide Resource: Action Plan Templates (Step 2.11)

Level 1 Step 2.11: Energy Management Action Plan Template	
Project Objective/Target:	**Planned Completion Date:**
	Actual Completion Date:
Project Description:	
Project Budget:	**Project Leader:**
Actual Cost:	**Management Review:**

Project Planning

Action Items	Responsible Position	Due Date	Required Resources/Comments

Project Results Verification (if applicable)

Description and/or Units	Pre-Project Value	Post Project Value	Net Change	Meter/Source	Responsible Party

Evaluation of Results:

Energy Management Action Plan – Page 2								
Communication/Training Plan (Departments affected by the project. Mark the first column for departments involved/affected with the project implementation. Mark the second column for departments involved/affected with sustaining the project improvements.)								
All Departments			Production			Lab		
Sales/Marketing			Maintenance			Purchasing		
Accounting			Transportation			Building/Facility Operations & Mgt		
Human Resources			Warehouse					
Customer Service			Custodial/Housekeeping					

Sustaining the project improvements

Document the details for each function necessary to sustain the energy savings achieved by the project's implementation.

Function	Tasks/Assignments for this Function
Roles	
Resources	
Communication	
Training	
Controls	
Monitoring & Measurement	

Project Follow-up Notes/Lessons Learned

eGuide Level 1, Step 2.11 Energy Management Action Plan Template
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Page 1 of 2
eGuide Level 1, Step 2.11 Energy Management Action Plan Template
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Page 2 of 2

Energy Management Action Plan Example

Objective: Reduce facility-wide energy consumption by 25% by 2020.

Target 1: By end of CY 2015, reduce electrical energy consumption in production and administrative operations by 2% from 2014 baseline.

- **Action Plan 1:** Compressed air improvements by contractor completed by end of year
- **Action Plan 2:** Upgrade lighting in Admin building to LED with occupancy sensor

Target 2: By end of CY 2015, reduce natural gas consumption in production operations by 1% from 2014 baseline.

- **Action Plan 1:** Boiler #3 upgrade in 3rd quarter

Energy Management Action Plan Example

Level 1 Step 2.11: Energy Management Action Plan Template

Project Objective/Target: Reduce electricity consumption for indoor lighting by 15% by the end of FY 2014.	**Planned Completion Date:** September 30, 2014 **Actual Completion Date:** September 19, 2014

Project Description: Replace incandescent bulbs with compact fluorescent and old fixtures and ballast with energy efficient models.

Project Budget: $1,500	**Project Leader:** G. Burdell
Actual Cost: $1,080	**Management Review:** Pending

Project Planning

Action Items	Responsible Position	Due Date	Required Resources/Comments
Measure lighting circuit amperage before project.	B. Franklin	8/26/14	
Identify and count incandescent fixtures	T. Edison	9/1/14	
Identify and count fixtures needing replacement	T. Edison	9/1/14	
Order replacement bulbs/fixtures	M. Faraday	9/5/14	
Schedule maintenance to replace bulbs	N. Tesla	9/9/14	
Schedule weekend crew to replace fixtures	N. Tesla	9/17/14	Electrical contractor: Mr. Sparky
Measure lighting circuit amperage after project	B. Franklin	9/30/14	

Project Results Verification (if applicable)

Description and/or Units	Pre-Project Value	Post Project Value	Net Change	Meter/Source	Responsible Party
Lighting circuit amps (7 circuits added together)	90.16	71.5	18.66	Amprobe ACD-16 meter	B. Franklin

Evaluation of Results: Based on amp readings, 2600 operating hours per year and 120 volt single phase power lighting
kWh: Before: 28,130 kW-hrs
After: 22,310 kW-hrs This is a 20.7% reduction, exceeding our expected reduction of 15%

Energy Management Action Plan Example

Energy Management Action Plan – Page 2

Communication/Training Plan (Departments affected by the project. Mark the first column for departments involved/affected with the project *implementation*. Mark the second column for departments involved/affected with *sustaining* the project improvements.)

All Departments			Production			Lab	X	
Sales/Marketing	X		Maintenance	X	X	Purchasing	X	X
Accounting	X		Transportation	X		Building/Facility Operations & Mgt	X	
Human Resources	X		Warehouse	X				
Customer Service	X		Custodial/Housekeeping	X				

Sustaining the project improvements

Document the details for each function necessary to sustain the energy savings achieved by the project's implementation.

Function	Tasks/Assignments for this Function
Roles	Purchasing and Maintenance
Resources	Maintenance and outside contractor are to perform the changeover. Purchasing is responsible for buying the supplies and equipment as specified.
Communication	All departments need to be advised that this project will be implemented in September 2014. Document the replacement lamp specifications for future purchases.
Training	Train Purchasing personnel on required replacement lamp specifications (needed to sustain the energy savings). Train Maintenance personnel on how to repair and maintain the new fixtures.
Controls	
Monitoring & Measurement	B. Franklin to spot check lighting circuit kW to determine that equipment is being maintained properly.

Project Follow-up Notes/Lessons Learned

There was a supply of incandescent lamps in our maintenance inventory when we implemented the project. A few of these were used as replacement lamps after the project. We have since returned these lamps and replaced the inventory with compact fluorescent replacement lamps.

Example of eGuide Resource: Energy Performance Indicator (EnPI) Tool

- EnPI is a free, excel-based energy performance tracking tool
- Tool purpose: assist organizations in calculating energy performance indicators while normalizing for variables such as weather, production, occupancy, etc.
- EnPI tool features
  - Regression analysis
  - Tracking of energy performance improvement on a non-normalized basis
  - Corporate roll-up across multiple facilities
- Inputs:
  - Monthly or weekly energy consumption data and other variables (e.g., HDD, CDD, production, etc)
- Outputs:
  - Energy savings, cost savings, CO_2-e savings

	A	B	C	D	E
1	General Energy Performance Results				
2					
3		FY1	FY2	FY3	FY4
4	Electricity (MMBTU)	15,865	14,875	10,575	8,340
5	Natural Gas (MMBTU)	463	358	172	174
6	TOTAL (MMBtu)	16,328	15,233	10,747	8,514
7	Electricity (MMBTU) Annual Savings	0	990	5,290	7,526
8	Electricity (MMBTU) Estimated Cost Savings	$ -	$ 7,740.35	$ 51,084.94	$ 55,188.35
9	Natural Gas (MMBTU) Annual Savings	0	105	292	289
10	Natural Gas (MMBTU) Estimated Cost Savings	$ -	$ 747.56	$ 1,533.33	$ 5,747.29
11	Total Production Output	149,341	122,786	64,775	43,040
12	Production Energy Intensity (MMBtu/unit production)	0.109	0.124	0.166	0.198
13	Total Improvement in Energy Intensity (%)	0.00%	-13.47%	-51.74%	-80.92%
14	Annual Improvement in Energy Intensity (%)	0.00%	-13.47%	-38.27%	-29.18%
15	Total Savings Since Baseline Year (MMBtu/Year)	0	1,095	5,582	7,815
16	New Energy Savings for Current Year (MMBtu/year)	0	1,095	4,487	2,233
17	Estimated Annual Cost Savings	$ -	$ 8,487.91	$ 52,618.27	$ 60,935.65

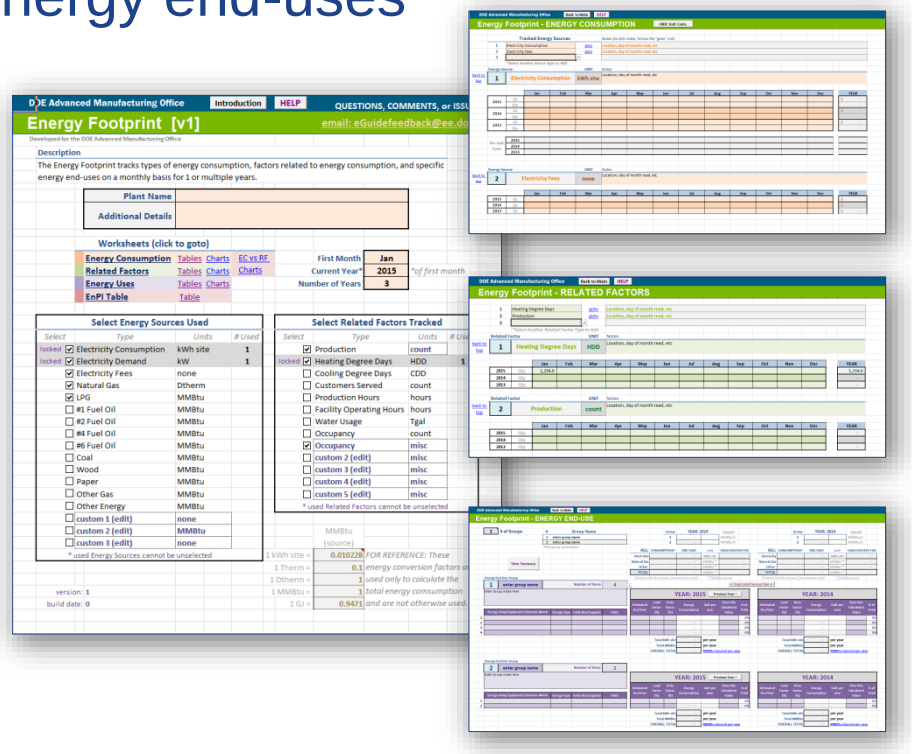
More information on the tool—including download instructions:
https://ecenter.ee.doe.gov/EM/tools/Pages/EnPI.aspx

Example of eGuide Resource: Energy Footprint Tool

Allows users to easily track multiple energy sources, consumption, related factors, and energy end-uses

Key tracking & features include:

- Energy consumption
  - Up to 20 tracked sources
- Related factors
  - Up to 20 tracked factors
- Energy end-use
  - Up to 10 end-use groups
  - Up to 30 components each
- Charts for all tracked data
- Export to the EnPI tool



More information on the tool—including download instructions:
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Superior Energy Performance U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY

eGuide Step 3: Implement Energy Management

Step 3: Implement Energy Management

3.1 Secure resources
3.2 Execute action plans
3.4 Address training and communication needs
3.5 Establish operational controls

For ISO 50001 and SEP only
3.3 Manage and control information
3.6 Manage energy considerations in design
3.7 Incorporate energy considerations in procurement
3.8 Define specs for purchasing energy supply

eGuide Step 4: Measure and Check Results

Step 4: Measure and Check Results

4.1 Measure, monitor and analyze metrics

4.2 Correct deviations in energy performance

For ISO 50001 and SEP only

4.3 Evaluate compliance with legal requirements

4.4 Plan and conduct internal audit

4.5 Correct and prevent nonconformities

eGuide Step 5: Review for Continual Improvement

Step 5: Review for Continual Improvement

5.1 Management review of performance

5.2 Recognize success and communicate results

5.3 Take action to continually improve

eGuide Built to Track your Team's Progress

- The eGuide Status Tracker is where you can track your team's progress as you work through the eGuide steps and tasks

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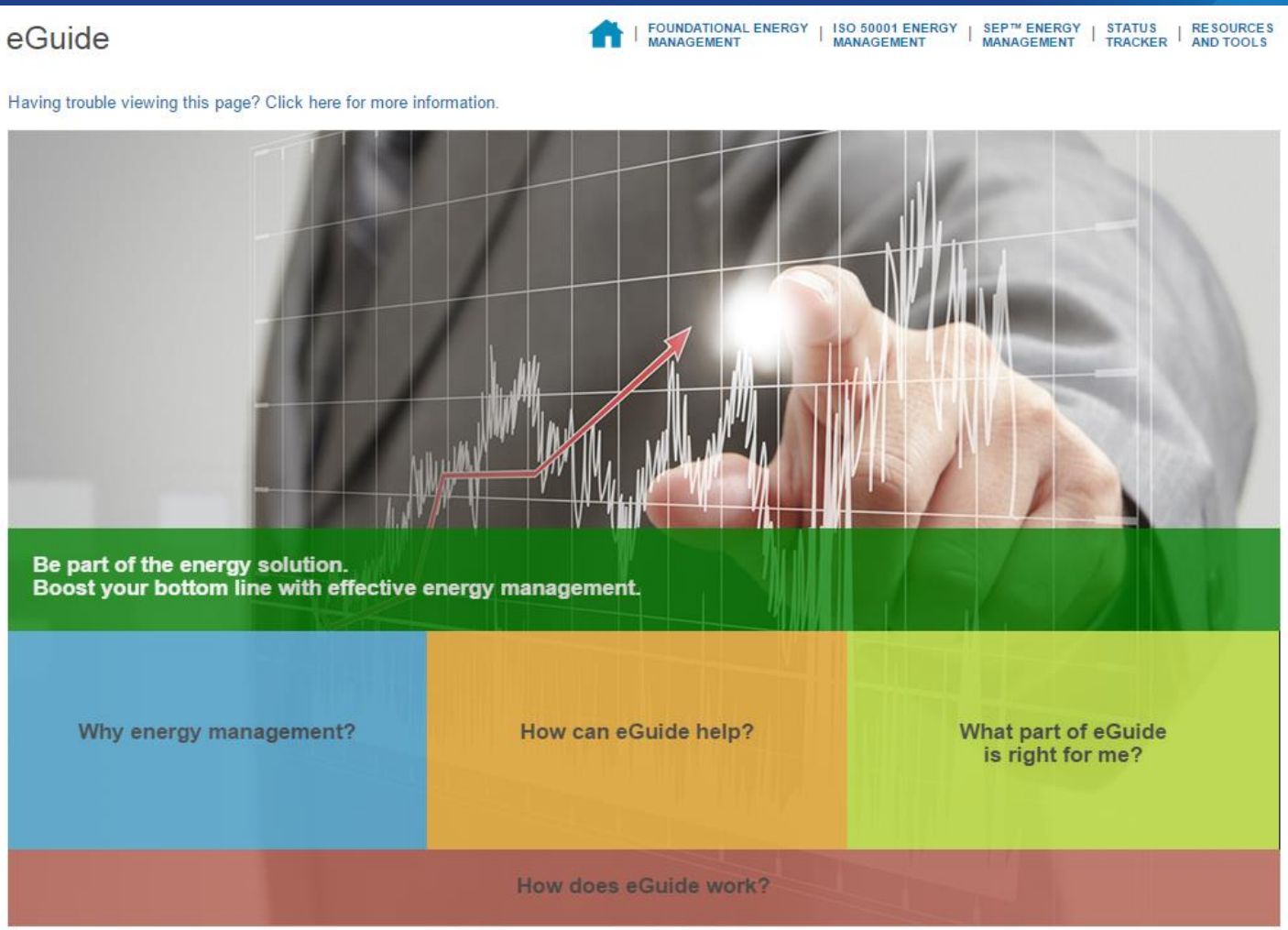
- The eGuide Status Tracker is where you can track your team's progress as you work through the eGuide steps and tasks

Take-Aways

- eGuide is a valuable tool to help industrial facilities more easily and more effectively implement a strategic energy management program, including ISO 50001 and Superior Energy Performance eGuide is designed to be a resource and source of information and tools at any stage of a SEM program's development
- eGuide resources include:
  - Templates and worksheets such as action plan templates or energy team rosters
  - Energy Footprint Tool
  - EnPI Tool
  - Helpful links with more information
- Go to www.energy.gov/eGuide and explore!
- Contact me if you if you have any eGuide feedback

eGuide Demonstration



www.energy.gov/eguide

Thank you! Any questions?

www.energy.gov/eGuide

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Better Plants
U.S. DEPARTMENT OF ENERGY

Energy Treasure Hunt Exchanges

Robert Bruce Lung, ORISE Fellow, U.S. DOE

May 23, 2016

U.S. DEPARTMENT OF ENERGY

Better Buildings, Better Plants

- Better Plants is a key component of the President's Better Buildings Initiative
- Industrial end users partner with DOE to improve energy efficiency
- Through Better Plants:
  - Organizations set long-term efficiency goals
  - DOE provides technical assistance and national recognition for their leadership
- Organizations have two opportunities to engage in Better Plants:
  1. Broader-based *Program* level
  2. Higher-level *Challenge*

Technical Assistance: In-Plant Trainings

- Teach participants how to conduct assessments, use DOE tools, and implement projects
- Open to employees from host plant, peer companies, suppliers
- ~60 INPLTs covering steam, compressed air, process heating, pumps, and fans since 2011
- ~850 participants
- Identified > 3 TBTu and $14 million in energy savings
- Pre-INPLT webinars available on program website

Process heating INPLT at an ArcelorMittal plant in Nov. 2013. Photo courtesy ArcelorMittal and ORNL.

http://energy.gov/eere/amo/better-plants/

What is INPLT Training?

- Train the Trainer Program for Industry Practitioners from Multiple Entities
- Events Range from 3 to 4 days at a **HOST PLANT Site**
- Each INPLT has Series of Class Room and Field Work Sessions
- Led by DOE Energy Experts and DOE Technical Account Manager (TAM)

Host Site

Participants

- Participating Plant Type 1 (Within the Same Company)
- Participating Plant Type 2 (Supply Chain)
- Participating Plant 3 (External Plants not within the Same Company)
- State Representatives – Utility Representatives
- Industrial Assessment Center (IAC) Participants

INPLTs give Better Plants partners the tools and motivation to accelerate and scale up the implementation and replication of energy efficiency projects

INPLT Model - The Five Major Objectives

- **I**dentifying Energy Saving Opportunities
- **N**etworking (Trainees/Utilities/State/Vendors)
- **P**roject Implementation and Replication
- **L**everaging Resources (State/Utilities/Peer Plants)
- **T**raining in a Real World Environment

Overview – Treasure Hunt Exchange

A three day training event focused on:

- Learning how to conduct treasure hunts and doing one in your plant
- Four elements DOE brings to treasure hunt exchange:
  - Profiling energy-using equipment
  - Data collection
  - Energy calculators/calculation methods
  - Relevant diagnostic equipment

Advantages of a Treasure Hunt Exchange

- A Treasure Hunt Exchange is both a training and treasure hunt
  - Does not require sophisticated technical analysis
  - Calculations are simple
  - Can be applied by employees of varying disciplines
  - At least one employee will be able to facilitate future energy treasure hunts
- Places a dollar and Btu value on ideas immediately
  - Ideas that employees have generated
- Opportunity ideas are solicited from many disciplines not just technical / engineering
- Leverages existing EPA Guidance on energy treasure hunts (https://www.energystar.gov/sites/default/files/buildings/tools/Energy_Treasure_Hunt_Guide_Jan2014.pdf)

Advantages of a Treasure Hunt Exchange

- Opportunities can be implemented rapidly
- Opportunities can be replicated across similar processes and businesses
- The Treasure Hunt process can be replicated and repeated (through this training)
- Management “buy in” can be achieved during the Treasure Hunt Exchange
- Historically more than 50% of opportunities are implemented

Learning Objectives

All Participants:

- Understand what is a treasure hunt exchange
- Understand the value/benefits of a treasure hunt exchange
- Understand how to evaluate equipment energy use (both idle and non-idle times)
- How to identify equipment and process opportunities
- Understand methods for collecting energy data and common data collection tools
- Understand how to effectively present outcomes of the treasure hunt

Learning objectives for future facilitators

- Treasure hunt facilitation
- Use of Tools to calculate opportunity value
- What to look for in a treasure hunt
- How to select processes, plants, departments for treasure hunts
- Use of diagnostic tools and techniques
- The importance of Team makeup – processes and people
- Prioritizing energy-saving opportunities
- Replication across facilities, departments, business units
- Preparation of treasure hunt outcome for management presentation

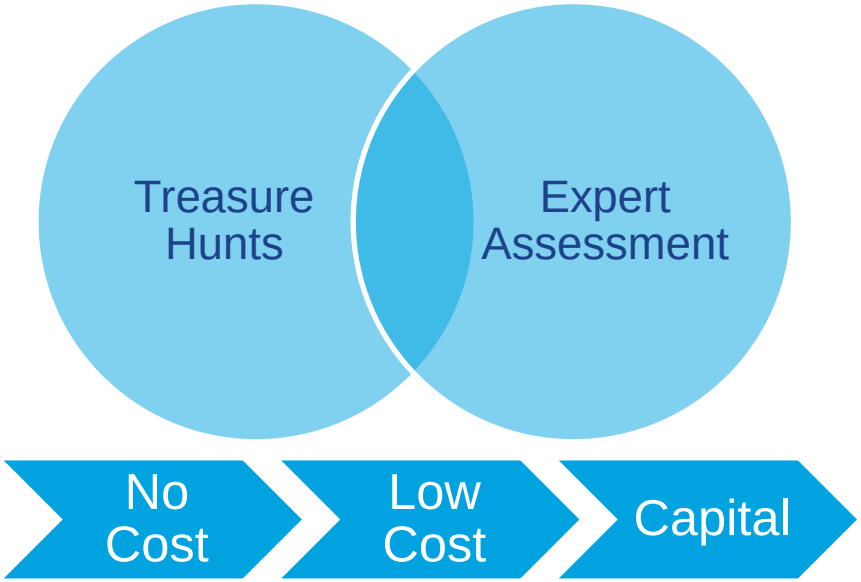
Energy Treasure Hunt Vs. Expert Assessment

Treasure Hunt

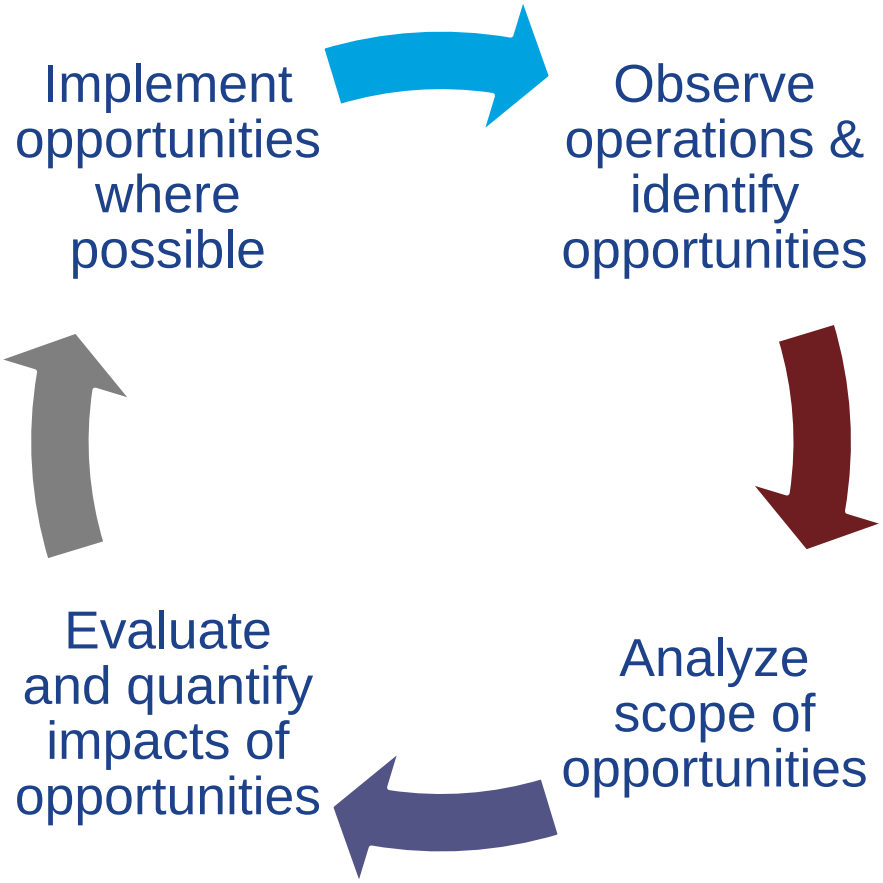
- Frequently repeatable process (repeat annually, quarterly . . .)
- Internal resources
- Focus on operational opportunities

Expert Assessment

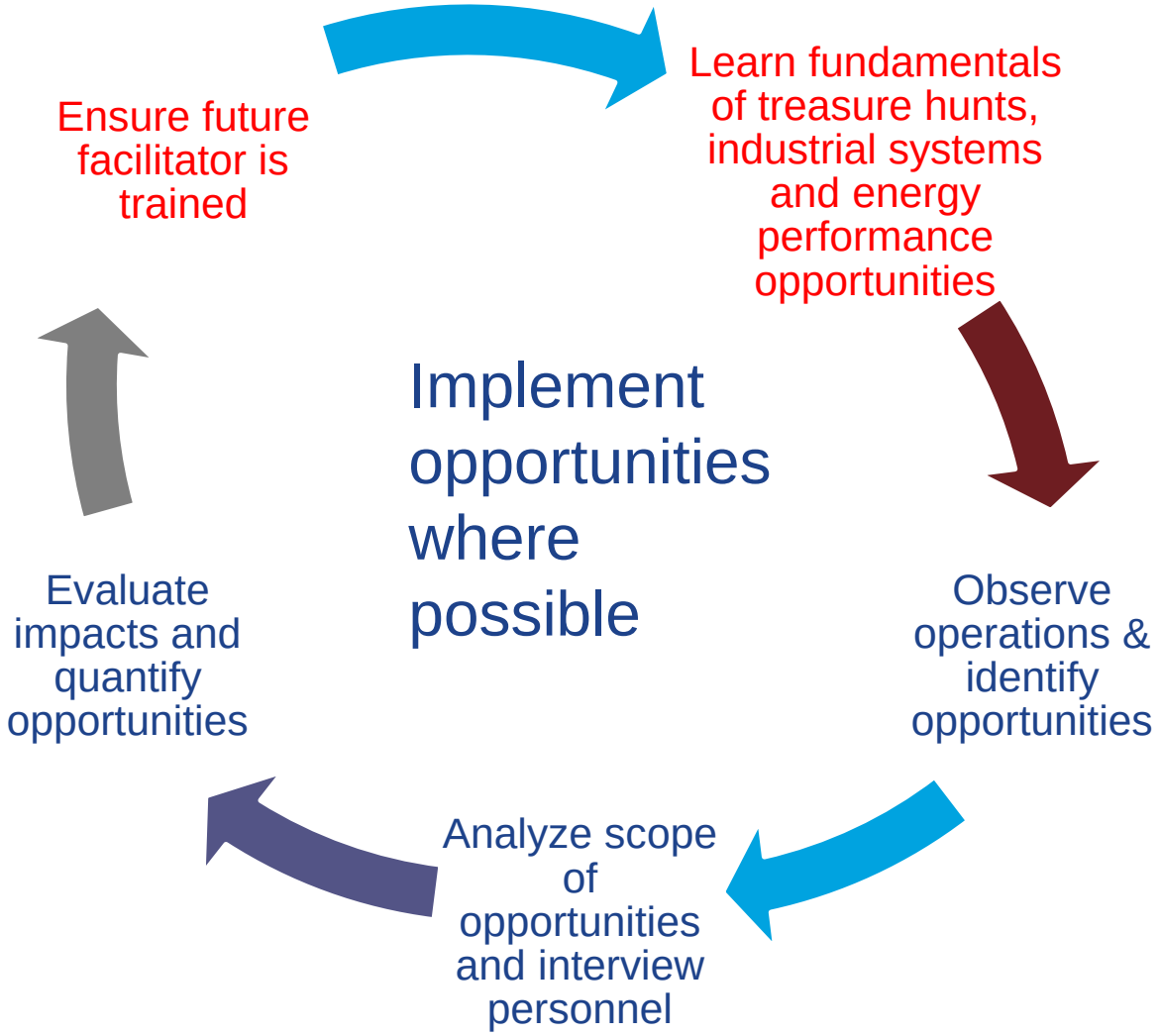
- Standalone event (assess as needed)
- External resources
- Focus on system performance and technology



Typical Treasure Hunt Process



DOE Approach to Treasure Hunt Process



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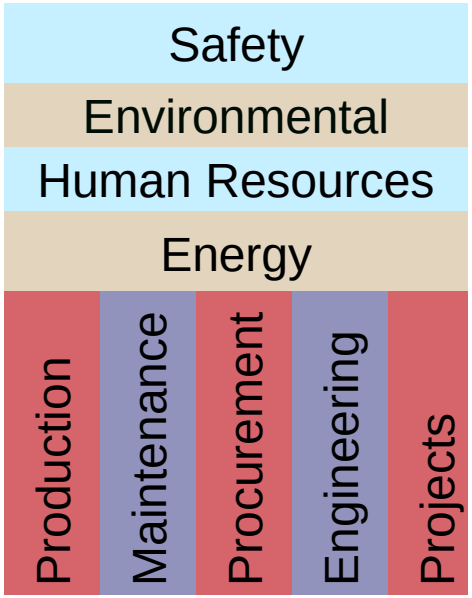
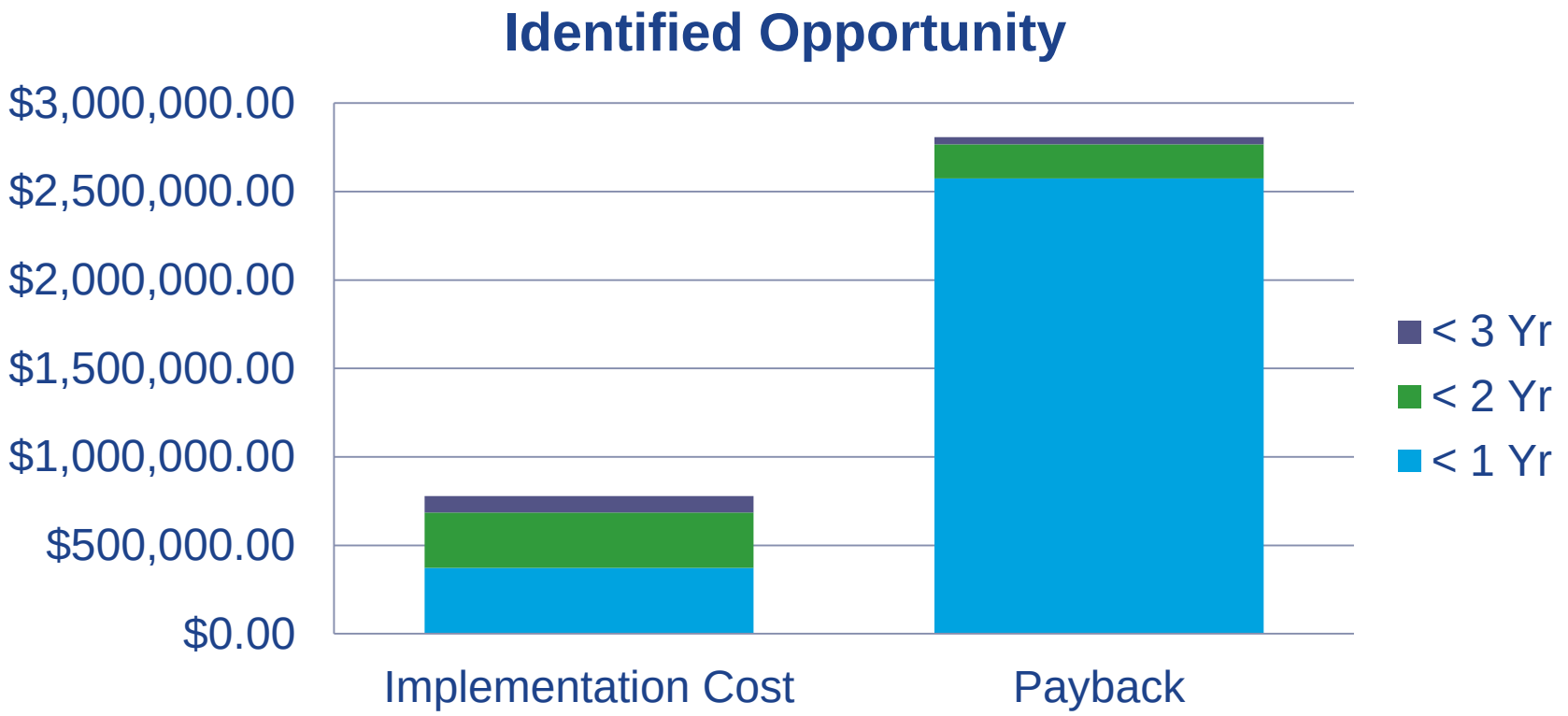
Energy Culture

- All departments have a role to play in improving energy efficiency

•*Successful energy programs are horizontal in an organization, not vertical*



90% of opportunity identified is < 1 year payback



Energy Treasure Hunt opportunities tend to be small, but economically competitive

Typical Treasure Hunt opportunities - Exhaust

- Exhaust systems frequently operate regardless of production requirements. Implement shut down procedures or automate shut down based on production processes.
  - Fume hoods
  - Scrubbers
  - Dust collectors
  - Extraction systems
  - Chip collectors

Typical Treasure Hunt opportunities – Lighting

- Lighting
  - Assess where day lighting possible and experiment by dimming or turning off lights.
  - Suggest shut down procedures or install occupancy sensors and calculate the savings.
  - Identify unnecessary lighting such as tops of ovens, warehouse shelves, and storage areas.
  - Retrofit lighting with more efficient technology
  - LED technology can save more on maintenance than energy in some applications

Typical Treasure Hunt opportunities – Steam / Comp Air

- Steam
  - General steam leaks
  - Condensate leaks
  - Boiler efficiency
  - Building heat with poor control – If areas are excessively warm experiment with reducing steam heat.

Compressed air leaks!

- Compressed Air
  - Operate at the lowest practical discharge pressure
  - Replace pneumatic energy with electrical energy where practical
  - Evaluate high efficiency nozzles
  - Eliminate inappropriate end use applications
  - Optimize control strategy
  - Perform a leak survey
  - Install solenoid valves on open blowing

Typical Treasure Hunt opportunities – Process Heating

- Process Heating
  - Combustion tuning
  - Combustion efficiency – burner upgrades, recuperators
  - Poor furnace insulation
  - Furnace shut downs / non-production management
    - Temperature setpoints
    - Recirculation fans / blowers
    - Minimize ramp up time
    - Excessive soak time

Typical Treasure Hunt opportunities – Facilities

- Cooling Towers
  - Match tower capacity with process requirements
    - Less active cooling may be needed during night, colder seasons, and non production
  - Check for throttled pumps / opportunities for VFD

- HVAC / Makeup Air / Comfort Cooling
  - Use programmable thermostats to optimize cooling schedule
    - Particularly in non 24/7 areas such as offices, warehouses, partial production areas
  - Challenge temperature set points
  - Less makeup air may be needed during non production, if possible, shut down a few units

Typical Treasure Hunt opportunities – Process Equipment

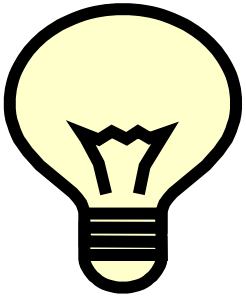
- Process Equipment
  - Ensure auxiliary energy is minimized during non production
    - Shut down lubrication pumps, valve off compressed air, consoles, lighting panels
  - Production cells should have a shut down procedure during idle time
  - Optimize throughput
    - parts washers,
    - cooling tables / fans
    - die heaters

  - If the process is not a bottleneck in plant production, consider batch processing and avoid constant idle time waiting for product

The Basic Mission

At the end of each day the teams brief each other on what they are pursuing

Assemble with your teams



Facility walk through for each team to generate ideas

Assess idea feasibility, gather data, quantify

The 4 Fundamentals: Energy Profiling

- Mechanism to point out significant energy users
- Usually snapshots of plant processes
- Can include:
  - Equipment specifications
  - Checklists
  - Block diagrams
  - Energy mapping, e.g. pie charts, Sankey diagrams, DOE footprint tool
- DOE facilitator will spend extra time with team leaders to develop these tools

The 4 Fundamentals: Data Collection

- DOE facilitator will train attendees on information to collect:
  - Name plate data
  - Utility bills
  - Operating parameters
  - Background information
- Team leads to understand data collection protocols
  - Must quantify a “before” and “after” state for the equipment
  - What data to collect
  - When to collect data
  - How to leverage technology, e.g. dashboard systems to input data
- Data must be entered in common tool, e.g. spreadsheet

The 4 Fundamentals: Data Calculation

- Each opportunity is documented and quantified using a standard tool, e.g. Excel spreadsheet

- Tool must be have certain functionalities:
  - Standardized algorithms to generate ROIs
  - Utility rates/rebates embedded
  - Conversions to energy units, e.g. kWh to MMBtu

- Teams need to calculate energy savings for each opportunity

The 4 Fundamentals: Diagnostic Equipment

- Field measurements are essential to determine energy savings
- DOE will lend diagnostic tools on Treasure Hunt Exchanges
- Facilitator or TAM will train team leads on
  - What are relevant diagnostic tools
  - How to use diagnostic tools and understand their output

The 4 Fundamentals: Diagnostic Equipment

HOBO U12 Data Logger + 600 AMP Split Core Current Transformer

HOBO H22 Energy Logger – Multi Channel Multi Transducer Data Logger

HOBO U12-014 Logger – 0 to 1800 degree thermocouple

Testo 540 Light Meter

Kill-A-Watt 120VAC outlet energy meter

Dickson Pressure Logger

Fluke 345 – Clamp Meter (Power Factor / Energy Logging)

UE Ultrasonic Leak Detector

Questions / Comments

Thank You!