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Organizing for Success, Creating a Sustainable Energy Management Program

IETC June 2, 2015

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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”

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Creating a Sustainable Energy Management Program Outline

- Organize for Success
- Develop a Long Term View
- Execute Technical Energy Audits
- Be Project Focused, Not Program Focused
- Explore New Energy Technologies
- Train your employees
- Monitor Progress and Provide Feedback

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Creating a Sustainable Energy Management Program Organize for Success

- Develop Convincing Supporting Arguments
  - Necessary to Stay Competitive
  - A Controllable Cost
  - Compliments Other Efforts
  - Economic Justification
- Obtain and Communicate Top Management Support
- Put a Working Energy Organization in Place
- Establish Active Site Energy Team(s)
- Don’t Compete with Existing Programs, Use Them
- Focus the Energy Program on the Plant’s Needs, Not Corporate’s
- Implement Projects via the Plant Energy team(s)
- Set effective, and achievable, goals

- Be prepared to address misconceptions:
  - Questionable value
  - Just another initiative
  - A distraction from priorities
- Don’t be destined to repeat history:
  - Learn from the past
  - Effective aspects of other programs?
  - “Not my responsibility”
- “Pursue the biggest bang for your buck”

Goal Setting

- Set the tone for improvement throughout the organization
- Measure the success of the energy management program
- Help the energy team to identify progress and setbacks at the facility level
- Foster ownership of energy management, create a sense of purpose, motivate staff
- Create schedules for upgrade activities and identify milestones

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Creating a Sustainable Energy Management Program
Develop a Long Term View

- Contents
  - Address Major Utilities
  - Create Energy Balances
  - Forecast Cost Variability
  - Identify Incremental Energy Costs
  - Reliability Focus
- Site Specific for all Key Sites
- Coordinate with Capital Plan
- Periodically Revisited/Revised

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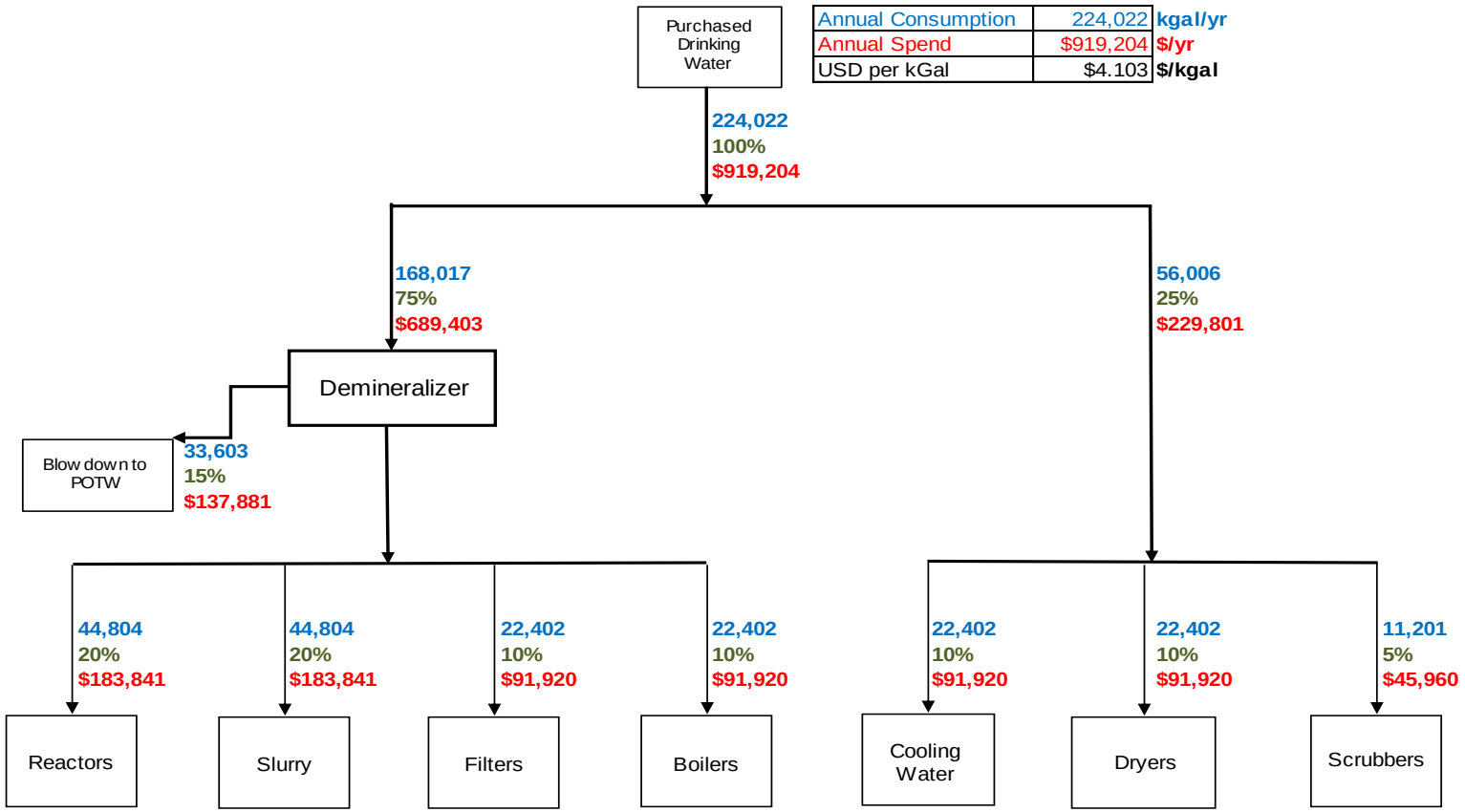
2013 Water Balance - Site ABC



NOTES: Purchased water inputs are actual, all others are non-metered estimates.
GPY = Gallons Per Year (calculated from estimated percentage)
% = percentage of total influent
$ = Annual spend (calculated from estimated percentage)
k = 1,000

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Plant X Energy Price Estimate							
Incremental Price Forecasts		2014	2015	2016	2017	2018	2019
Natural Gas	$/MBTU	5.88	5.75	6.50	6.81	7.69	8.02
Steam	$/klb	12.04	11.77	13.31	13.94	15.75	16.42
Electricity	$/MWh	78.03	51.01	78.85	79.05	79.25	79.47
Nitrogen	$/kSCF	2.13	2.215	2.304	2.396	2.492	2.591
Water	$/kgal	1.90	1.976	2.055	2.137	2.223	2.312
Effluent	$/kgal	4.70	4.888	5.084	*5.287*	*5.498*	*5.718*
Rules-of-Thumb		2014	2015	2016	2017	2018	2019
$/Hp-Yr	$/Yr	489	320	494	495	497	498
$/klb/Yr - Steam	$/Yr	101,162	98,891	111,794	117,128	132,267	137,945
$/kSCF/Yr - Nitrogen	$/Yr	17,892	18,608	19,352	20,126	20,931	21,768
$/kgal/Yr - Water	$/Yr	15,960	16,598	17,262	17,953	18,671	19,418
$/kgal/Yr - Effluent	$/Yr	39,480	41,059	42,702	44,410	46,186	48,033

Revised 8/12/11

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Creating a Sustainable Energy Management Program
Execute Technical Energy Audits

- Technical energy audits should address all aspects of supply, conversion, and consumption to identify improvement opportunities within a given economical return
- Cornerstone of an energy management program
- A project is not a project unless it is quantified
- Consider a focused audit, i.e. steam, process, water, etc.
- All projects are assigned a priority and implementation plan
- Charge the site energy team with implementation

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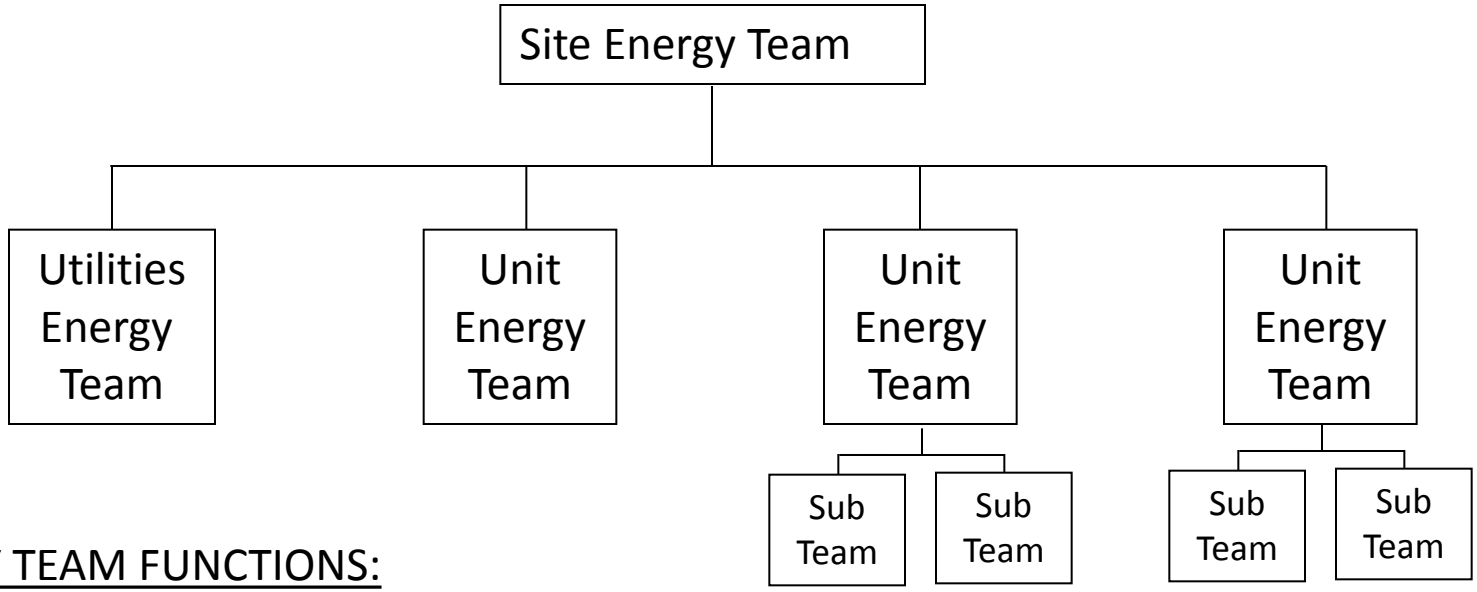

ENERGY TEAM FUNCTIONS:

- Manages Project Implementation
- Consists of Site Employees: Operations, Maintenance, Engineering, Utilities, etc.
- Use of Sub-Teams
- Membership Rotation
- Idea Generation: Utility Strategies, Audits, Brainstorming
- Project Tracking
- Progress Tracking

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Creating a Sustainable Energy Management Program
Be Project Focused, Not Program Focused

- Structure all activities as projects
- For each project
  - Develop definitive scope
  - Determine installation costs and annual savings
  - Assign a “primary person responsible”
- Energy Teams
  - Meet on an as needed basis
  - Discuss progress/bottlenecks
  - Do not use as a problem solving session

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Item	Recommendation ACTIVE ITEMS	Ann Sav (k$)	Impl Cost (k$)	SPB	Comp Date	PPR	Comments
2-23 QW	Reduce air comp disch. press 5 psi: reduces input energy by 1%	1.8	0		Q205	CED	will reduce by 6/30/2005 and quantify savings of not running the Sullair
1-20 QW	Reduce air comp disch. press 10 psi: reduces input energy by 1%	3.5	0		Q205	TEC	will reduce by 6/30/2005
2-15 QW	Fix door on Chem-Strip room to eliminate need for pressurization blower (3 HP),	1.0	0.1		Q405	CED	complete by 3/30/2005
1-46 QW	Deaerator vent controls.				Q205	CLB	develop measurement by 6/30/2005
1-42	Consistent use of turbine	14.2	0.0	Immed.	Q305	CLB	trial by 3/30/2005
1-35	Reduce sphere cooling water	3.8	0.0	Immed.	Q305	CLB	define flow basis before change by 6/30/05
1-11QW	Reduce steam venting needs.				Q405	RG	to be investigated
1-47	O2 inhibitor vs deaerating.				Q405	CLB	investigate new o2 control system by 6/30/05 - get Clark info fromk Freeport
1-1	Optimize T1401 steam usage	68.7	7.6	0.1	Q305	DRR	trays removed on column - update by 6/30/05
1-18	Optimize N2 pads on tanks.				Q205	DRR	Develop cost savings by 6/30/05
1-33	E1103 elimination.				Q405	DRR	to be investigated
1-4	Steam trap survey	15.0	0.0	0.2	Q205	EZJ	investigate replacement cost
2-3	Steam trap survey	10.0	0.0	0.2	Q205	EZJ	investigate replacement cost

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Creating a Sustainable Energy Management Program
Explore New Energy Technologies

- Define your site's technology needs
- Apply new technologies selectively
- Don't forget the older, non-competitive technologies
- Be alert to developing technologies
- Consider only proven technologies
- Get help from an expert in the field
- Environmental benefits also justify new technology
- New technology may also provide maintenance benefits

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Creating a Sustainable Energy Management Program
Train Your Employees

- Recognize that energy management is:
  - 80% people and 20% technology
  - 20% of the people control 80% of the energy
  - Must try to influence 100% of the people
- Sponsor on-site energy training
  - Workshops
  - Seminars
  - Multi-site technology exchanges
- Be selective on outside technical training

Communications:

- Have facility leadership communicate the importance of energy management to associates
- Develop targeted information for key audiences about our energy management program
- Build support at all levels of your facility for energy management initiatives and goals
- Use in-house publications and gatherings for communication

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Creating a Sustainable Energy Management Program
Monitor Progress and Provide Feedback

- Monitor progress
  - The rule of 2 M's, "if you can't measure it, you can't manage it"
  - Establish effective EnPI's
  - Normalize production to energy ratios
- Provide feedback
  - To energy teams and individual units quarterly at a minimum
  - Top management via annual reviews at a minimum
  - Track accrued savings from base year
- Develop performance indexes for specific utilities
  - Steam = BTU fuel/pound steam
  - Compressed air = 4 SCFM/Hp
  - Refrigeration = 0.70 kW/Ton

ISO-50001 definition - EnPI :
“energy performance indicator EnPI….quantitative value or measure of energy performance, as defined by the organization …..a quantitative measure of energy consumption ….a quantitative measure of energy consumption relative to a desired output “

The purpose of an EnPI is:
“…..to provide the organization (user) with useful quantitative information regarding the performance of its energy use and consumption …..to enable an organization to compare current performance to a previously established bench mark of the same EnPI …..to enable an organization to specify a target for future energy performance that is relevant to the activities of the organization”

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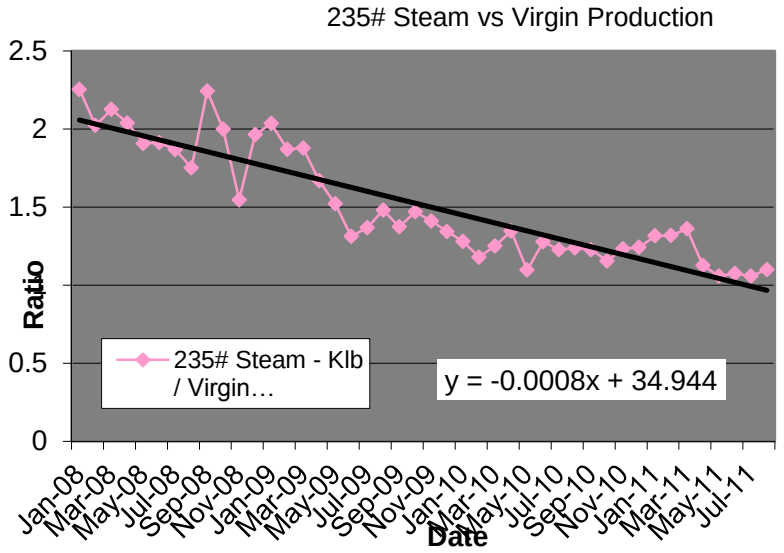

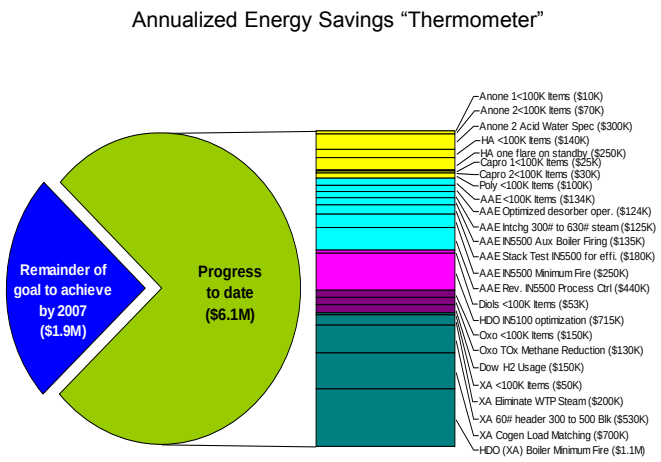

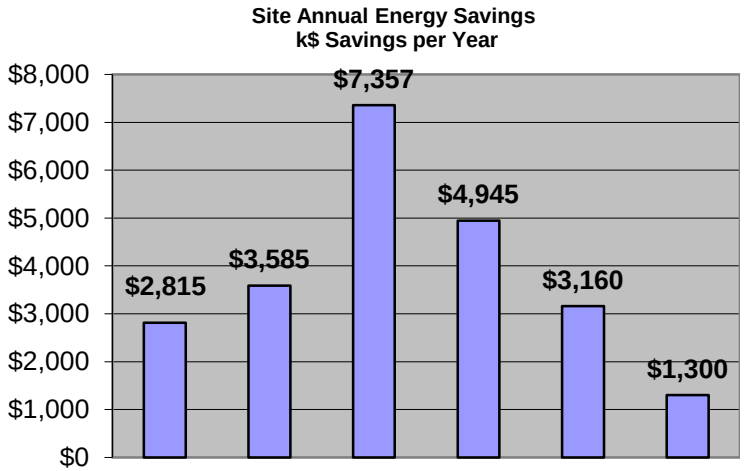

Energy spend ($ mill.)	Energy spend (%)	KPI trend - RC data - (Project target: 1.5% p.a.) Primary Energy	KPI trend - PO projects (Energy Savings/Energy Consumed)	External Power Reliability Study	Internal URC	OPEX	Site Development Plan (incl. BU objectives)	Site Infrastructure	Site Energy Concept	Review MSS services	Energy & BU/Site objectives?	Energy Survey or TPO w/ Energy Team	Energy Survey Team Initiated	Boiler MACT audit / regulatory requirements	Compressed Air Audit / Assessment / Study	Steam Trap Maintenance	Insulation Survey & Implementation	Recent Best Rates Analysis	Utility Invoice Audit	Relevant Energy Project Pipeline	Potential Energy Projects (monthly)	Energy Awareness Program	Boiler MACT Items	2015 OpEx targets	2014 Energy Objectives	Energy Survey or TPO w/ Energy Team	Energy Initiation	Compressed Air Audit / Assessment / Study	Comments
Spend		KPI		RELIABILITY		OPEX						OPEX Plan		Reg.	BEST PRACTICES					OUTLOOK									OTHER
66.7	18.4%	1.5% (2002)	3.9% (2003)	2007	2012	2015	2012	2013	2014	2012	no	2013	2002	2015	2010	2011	2010	N/A	2014	yes	yes	TBD	2015			N/A	TBD	TBD	major energy infrastructure revisions underway
59.5	16.4%	1.2% (2002)	3.9% (2004)	2007	2010	2015	2012	2013	2014	2012	yes	2013	2005	2015	2010	2012	2010	N/A	2014	yes	yes	TBD	2015			2014	TBD	TBD	major energy infrastructure revisions underway
51.5	14.2%	0.8% (2007)	0.4% (2009)	N/A	N/A	2013	2013	N/A	N/A	2014	yes	2007	2007	N/A	2007	N/A	N/A	N/A	N/A	no	yes	TBD	N/A			N/A	Q4 2014	TBD	highly engaged in energy conservation topics/mindset
17.3	4.8%	0.9% (2002)	0.6% (2009)	N/A	2014	2012	2014	2014	2014	2014	yes	2009	no	2014	2010	?	no	2014	2014	no	yes	TBD	2014			N/A	2015	TBD	major infrastructure upgrades underway/under consideration
16.1	4.4%	0.9% (2002)	0.6% (2009)	2007	2009	2013	2014	2014	2014	2014	no	2005	2005	2014	N/A	2014	2005	N/A	2014	no	yes	TBD	2014			2016	2016	2016	plant with high energy efficiency (Solomon Benchmarking): site focus on max prod. rates
15.4	4.3%	2.8% (2002)	0.1% (2010)	N/A	N/A	2011	2012	TBD	2010	2013	yes	2012	2012	N/A	2010	2010	2010	N/A	2012	yes	yes	TBD	N/A			TBD	TBD	2014	limited use of PO / OPEx database
12.6	3.5%	2.3% (2000)	1.9% (2010)	N/A	2014	2013	2013	2013	2013	2014	no	2011	2012	2014	2011	2014	2014	N/A	2014	no	yes	TBD	2014			N/A	2014	N/A	siginificant energy activities covered with "MCI tomorrow"
11.8	3.2%	0.1% (2001)	1.3% (2007)	N/A	N/A	2012	2015	2014	N/A	Q1 2014	no	2007	2007	N/A	2008	2014	2008	2014	2013	no	yes	TBD	N/A			TBD	Q1 2014	N/A	
7.9	2.2%	0.2% (2011)	1.8% (2013)	2012	2012	2011	TBD	2014	2013	2013	yes	2011	2011	2014	no	2014	2013	N/A	2014	no	yes	2014	2014			N/A	2014	2015	Investment reluctant site, but long Cognis history in energy conservation
7.6	2.1%	0.6% (2007)	0.0%	N/A	N/A	TBD	2015	2013	N/A	2014	no	2007	no	N/A	2007	?	?	2014	2014	no	yes	TBD	N/A			TBD	TBD	N/A	team would be beneficial, site interested?

Monitoring and Verification of flows

- Collect energy use information and document data over time
- Determine the starting point from which to measure progress
- Compare the energy performance of your facilities to each other, and competitors, and prioritize which facilities to focus on for improvements
- Understand your energy use patterns and trends
- Evaluate the operating performance of facility systems and equipment to determine improvement potential

Energy Benchmarking

- Track energy consumption, “reduce energy intensity by 25% in 10 years”
- Identify underperforming plants
- Set priorities
- Monitor progress
- Verify improvements, repair and correct significant deviation in energy consumption

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Creating a Sustainable Energy Management Program Summary

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Any Questions?

Thank you for you attention!

For more information please contact:
Tom Theising, C.E.M., C.D.S.M.
970-709-6389
tom.theising@yahoo.com

Advancing each generation.

ALCOA

Managing Energy for a large Industrial Company

IETC June 2015

Managing a large industrial energy program is like a single plant only more of them right?

- *Not really!*
- *Different businesses with different needs and energy use*
- *Different countries and cultures*
- *Different management focus*
- *Different levels of skill and knowledge*

Innovation leader in lightweight metals, products and solutions

- Founded in 1888; 200+ locations in 30 countries
- Revenue 2014: $23.9 billion (+ 4%)
- Leader in delivering value-add products made from a range of lightweight metals and flat-rolled aluminum
- Inventors of the original aluminum process
- Member of the Dow Jones Sustainability Index for 12 consecutive years

Number of Employees (2014)	
U.S.	26,000
Europe	17,000
Other Americas	9,000
Pacific	7,000
	59,000

Downstream - EPS

- Alcoa Fastening Systems and Rings
- Alcoa Power & Propulsion
- Alcoa Wheel & Transportation Products
- Alcoa Building & Construction Systems
- Alcoa Forgings & Extrusions

Midstream - GRP

- Alcoa Global Packaging
- Aero, Transportation and Industrial
- China and Consumer Electronics

Upstream - GPP

- Alcoa Mining
- Alcoa Refining
- Alcoa Smelting
- Alcoa Casting
- Alcoa Global Energy Assets

GPP: Combined Alumina and Primary Metals segments, GRP: Global Rolled Products, EPS: Engineered Products and Solutions
Source: 4Q 2013 earnings announcement

Managing a Large Industrial Energy Program

The basic Elements

- Sponsorship
- Accountability
- Tools and Resources
- Communications
- Culture differences
- Execution
- Tracking
- Managing change
- Recognition

Energy Efficiency Program

- Top level commitment –Sponsorship
- Goal setting
- Reporting
- Recognition

- Energy assessments
- Energy Kaizens
- Technical assistance
- Project financing
- Standard practices
- Energy projects

- Share results
- Training
- Global & regional meetings
- Workshops
- Case studies

- Plant Energy SPAs
- Other internal groups
- Regional energy organizations
- External corporations
- Agencies (DOE, ABRACE, ETC.)
- Corporate Energy Team

Sponsorship

Has the CEO sponsored the program? – is it real sponsorship?

Has it trickled down to businesses and locations?

Have goals been set and communicated?

Example of Goals

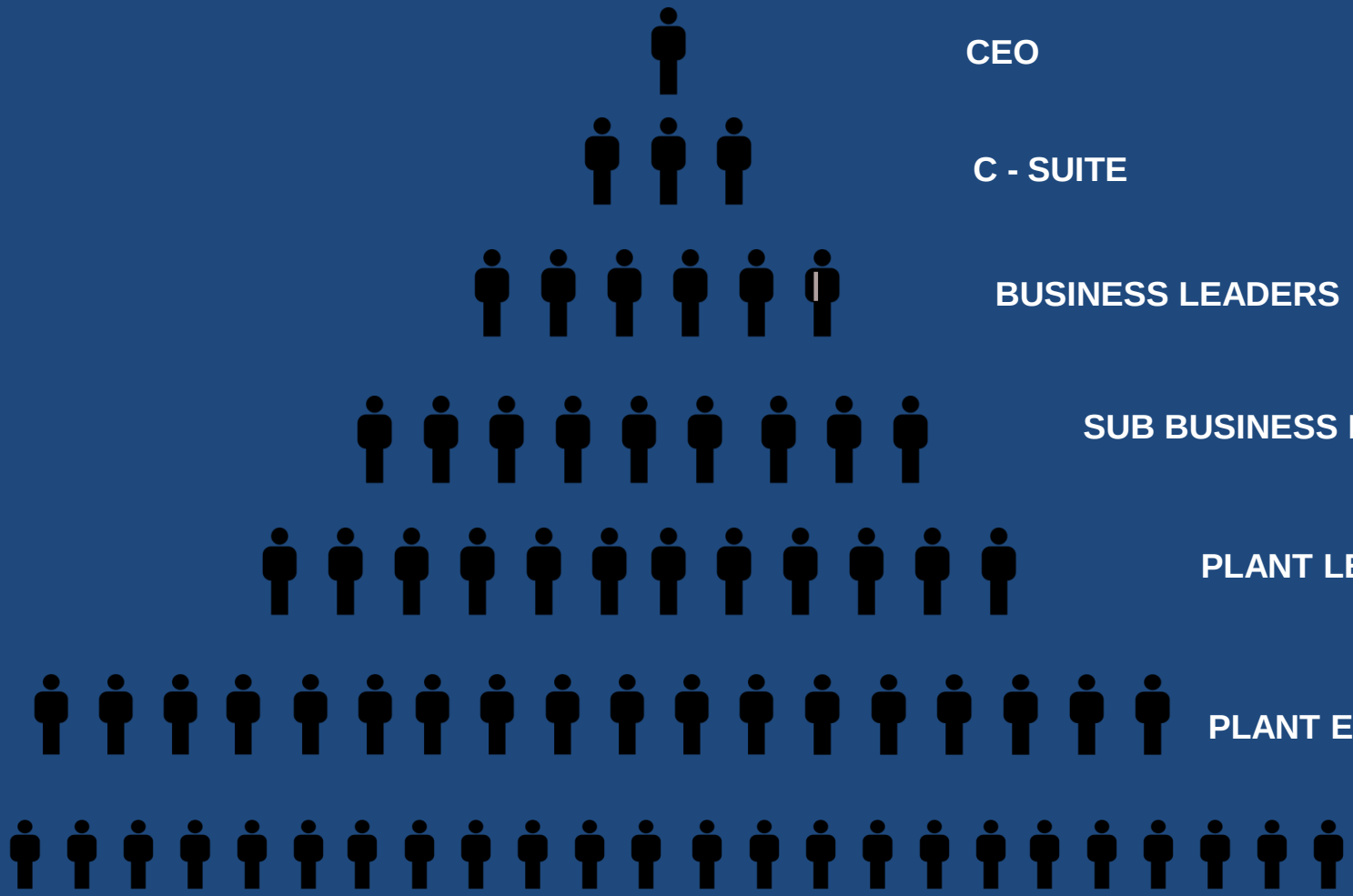
ENERGY

MATERIAL ASPECT

We are committed to reducing the energy requirements for all of our operations and have set the following long-term strategic targets:

- From a 2005 baseline, a 10% reduction in the energy intensity of Global Primary Products (GPP) by 2020; 15% by 2030; and
- A 20% reduction in the energy intensity of all other businesses—Global Rolled Products (GRP) and Engineered Products and Solutions (EPS)—by 2020 from their baselines of 2005 and 2010, respectively; 30% by 2030.

Is the message really trickling down?



Top Level Commitment

MANAGEMENT

- Dedicated energy team and energy efficiency staff.
- Each business sets annual energy reduction goals.
- Businesses and business units designate energy champions (SPAs).
- Each business establishes an energy cost reduction goal and strategy.
- Executive compensation linked to an energy reduction goal.

Got Sponsorship – Now What?

Show the value of energy efficiency

Measure in $ not energy units

Sell it!

Get some results!

- Understand company cost reduction efforts
- Show businesses what is achievable
- Find a willing candidate
- Execute the assessment phase
- Then share with others

Estimated Potential by location

$000

	Compressed Air	Pumping	Fans and cooling	lighting and misc	HVAC	Energy management	Total
Site 1	$151	$63	$31	$377	$75	$298	**$995**
Site 2	$50	$21	$10	$93	$11	$45	**$230**
Site 3	$72	$30	$15	$135	$34	$138	**$424**
Site 4	$223	$93	$47	$558	$59	$234	**$1,213**
Site 5	$71	$30	$15	$178	$32	$127	**$451**
Site 6	$6	$2	$1	$14	$1	$6	**$31**
Site 7	$202	$84	$42	$378	$81	$325	**$1,112**
Site 8	$86	$36	$18	$160	$31	$122	**$452**
Site 9	$96	$40	$20	$240	$43	$172	**$612**
Site 10	$69	$83	$21	$124	$38	$151	**$486**
Site 11	$62	$26	$13	$155	$17	$69	**$342**
Site 12	$156	$65	$33	$390	$58	$233	**$935**
Site 13	$35	$15	$7	$88	$17	$70	**$232**
Site 14	$3	$1	$1	$6	$1	$3	**$14**
Site 15	$391	$163	$82	$979	$98	$391	**$2,104**
Site 16	$17	$7	$4	$44	$6	$25	**$103**
Site 17	$37	$28	$23	$131	$46	$183	**$449**
Site 18	$4	$2	$1	$11	$2	$8	**$28**
Site 19	$248	$103	$52	$621	$77	$309	**$1,411**
Site 20	$64	$27	$13	$161	$27	$109	**$402**
	$2,044	**$918**	**$448**	**$4,842**	**$755**	**$3,019**	**$12,025**

Capital is required for some execution

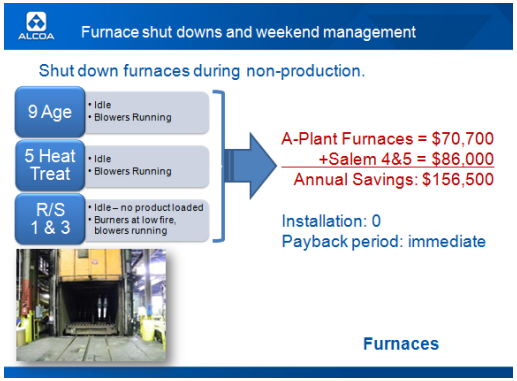
Get Engagement

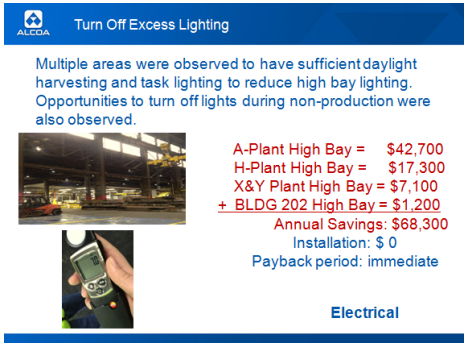
- Sponsorship is top down
- Engagement is bottom up
  - Face time with plant people
  - Bring credible (and humble) resources
  - Use plant resources

Tools for assessing opportunities

Energy Assessments

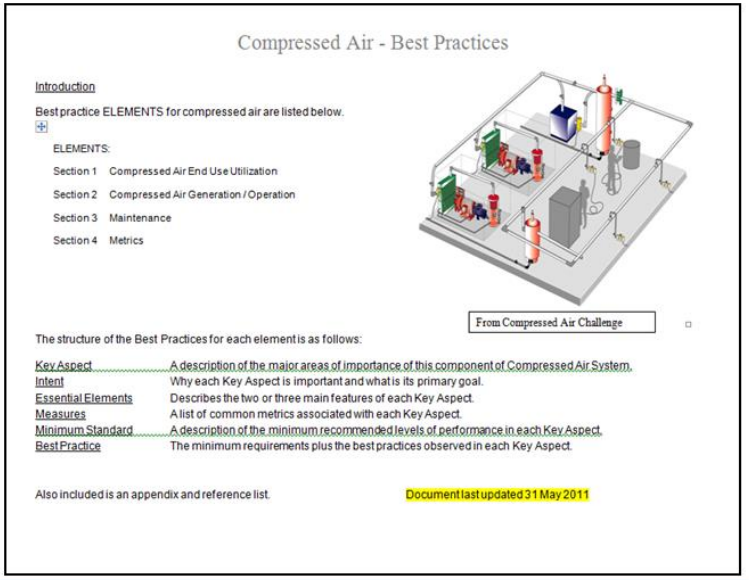
Energy Kaizens





Tools for assessing opportunities

Standard Practices



Compressed Air - Best Practices

Introduction

Best practice ELEMENTS for compressed air are listed below.

ELEMENTS:

Section 1 Compressed Air End Use Utilization

Section 2 Compressed Air Generation / Operation

Section 3 Maintenance

Section 4 Metrics

From Compressed Air Challenge

The structure of the Best Practices for each element is as follows:

Key Aspect	A description of the major areas of importance of this component of Compressed Air System.
Intent	Why each Key Aspect is important and what is its primary goal.
Essential Elements	Describes the two or three main features of each Key Aspect.
Measures	A list of common metrics associated with each Key Aspect.
Minimum Standard	A description of the minimum recommended levels of performance in each Key Aspect.
Best Practice	The minimum requirements plus the best practices observed in each Key Aspect.

Also included is an appendix and reference list.

Document last updated 31 May 2011

DOE and agency Assistance

Use Agency and governmental assistance

Share the Results

- **Only after values are verified**
- **Only if the plant agrees to share**
- **Send results to any “friends” that will be interested**
- **Watch it blossom**

Make friends with communications group

Torrance Energy Kaizen Finds 6.4% Savings

Close

Front row from left: Spencer Lee, Greg Harrell, Dave Lawton, Steve Zhang, Michael Howard, Paul King. Back row from left: Walt Brockway, Adam Vucelich, Mike Urbanovit, Sharon Wang, Tom Lightfoot, Ellen Dempsey, Kenny Cochran and Curtis Lea.

A recently completed energy Kaizen at Alcoa Fastening Systems (AFS) in Torrance, California (USA) found 6.4% in savings that could be implemented quickly. The estimated savings add up to approximately $125,000 per year, with very little capital expenditure for implementation.

In addition to Torrance employees, representatives from six Alcoa locations in the California cities of Fullerton, Newbury Park-Republic, Newbury Park-Van Petty, Simi Valley Distribution and City of Industry, as well as Tucson (Arizona, USA) took part in the Kaizen. Involving multiple locations brought new ideas to Torrance and also sent the team members back to their own facilities with blueprints for savings.

Participants divided themselves into two teams to find savings in Torrance's North and South buildings and focused on several energy resources:

Kaizen Series Takes Aim at Energy Reduction

It's all about the energy.

In June, representatives of Massena AFE, Massena West Primary, Massena East, Warrick Power Plant, Warrick Rolling Mill and the Quebec smelters were joined at the NYPA Visitor's Center at Hawkins Point by representatives of the Alcoa Global Energy Group, U.S. Department of Energy and outside companies to discuss ways to reduce electricity, natural gas, steam and compressed air usage. The event, an Alcoa Energy Workshop, included an energy reduction kaizen in AFE, which played host to the workshop.

"This is one of four regional energy workshops," said Alcoa Global Energy Efficiency Manager Walter Brockway . "We held an event in Brazil in January, we have another event planned in Europe, and we're hoping to do an additional session on the U.S. west coast."

Brockway said the events were focused on low-cost and no-cost energy reduction solutions that could be implemented quickly and easily.

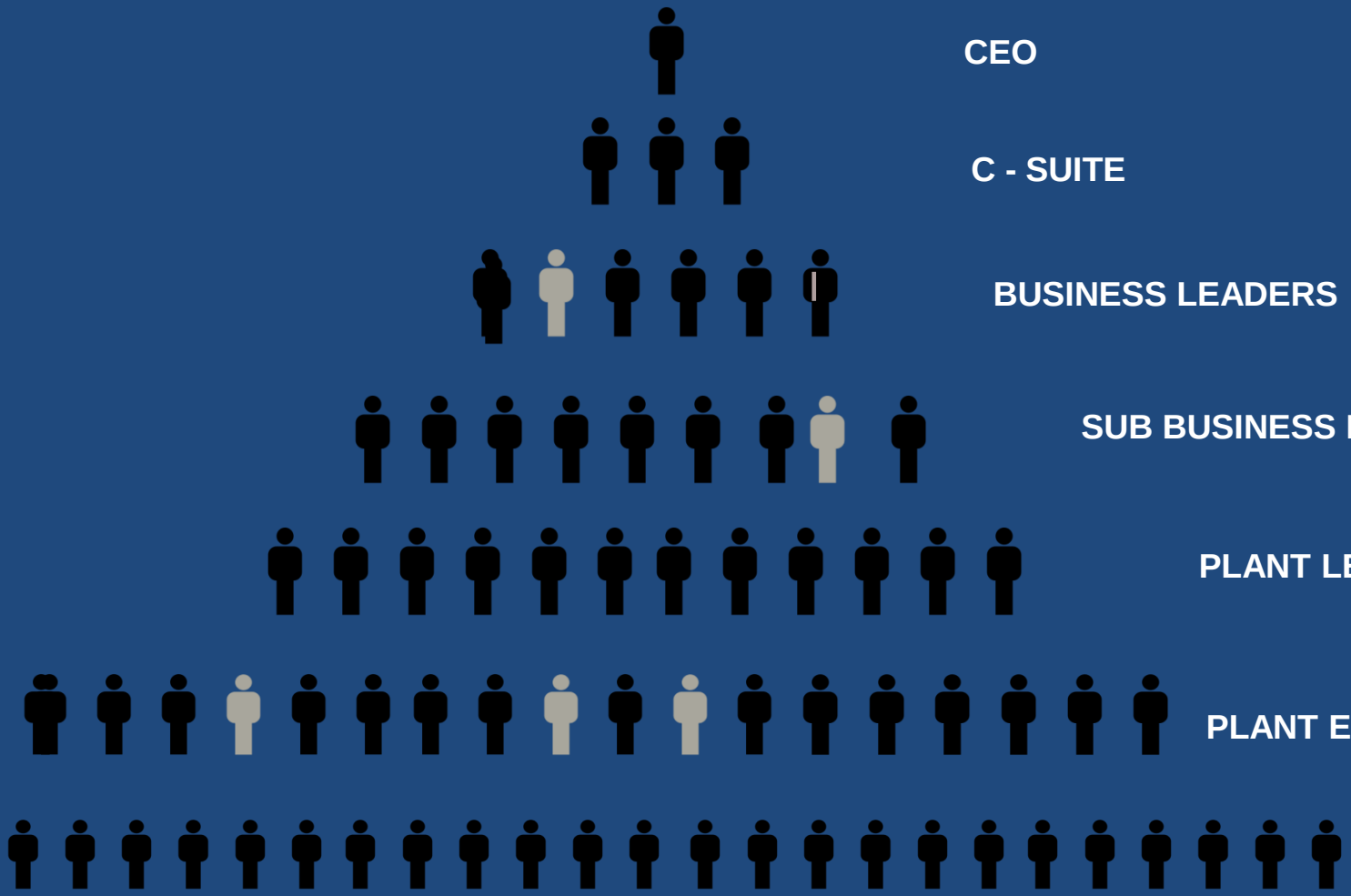
"We have folks sharing what they've been doing at their lo-

Continued on Page 2

What about country and culture differences?

- Culture will be driven by the “home” country
- Some will embrace help
- Others will shun help
- Find a way to leverage each

Changes Happen All the time

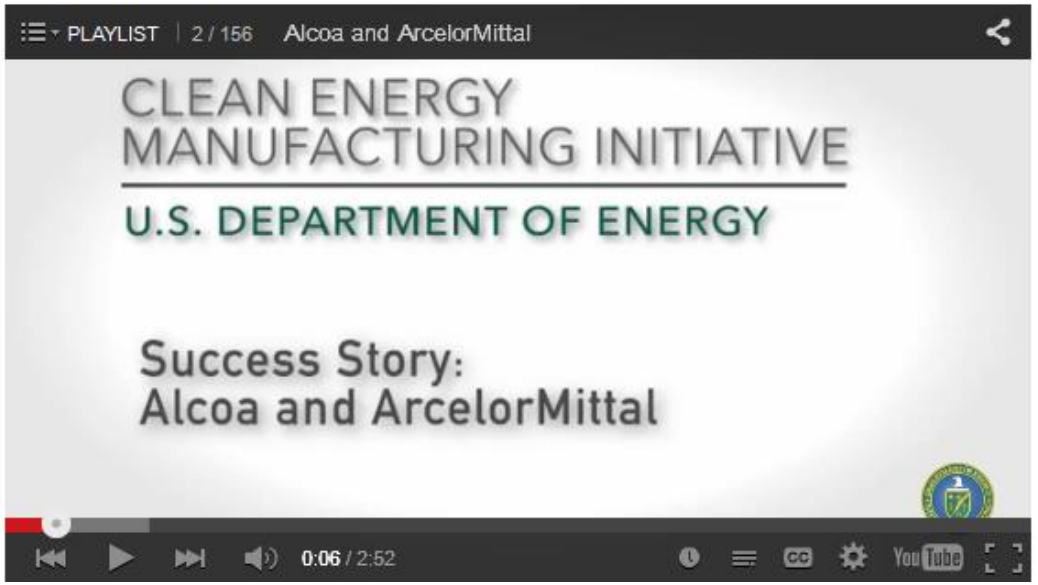


Recognition is Important

For the employees ….

Recognition is Important

For management ….



Advancing each generation.

What it takes to sustain an Energy Program

Fred Schoeneborn, CEM
FCS Consulting Services, Inc.

June 2, 2015

IETC 2015 --- Energy Managers Workshop

Three Areas need to be sustained --

Managerial

Technical

Organizational

Managerial --

Commitment – You are not alone

Policy – Your Dance Card

Goals – The vision and target of the program

Funding – Energy projects need a level playing field

Reviews – The validation of your work

Recognition – Give credit away

To survive

An Energy Program needs Senior Management Support and Commitment

How does Senior Management perceive the Energy Program?

Non-Core part of the Business

No Real Value

Not Worth Funding

An Ego-Trip for Sponsor

A flavor-of-the-month Program

FCS CONSULTING SERVICES, INC.

What matters to Senior Management?

Presents Visionary Appeal – Leader Image

Environmental Stewardship – Corporate Citizen

Senior Peer Contacts – in same/other industries

Politics – high-level access to organizations

Government Relations – extends to other work

Sustainability – $ generation – cost avoidance

Exposure of other company efforts

FCS CONSULTING SERVICES, INC.

Technical --

Design Guidelines – The beacon needs to be lit

Commissioning – Trust is Great Control is Better

Assessments – Self-Assessments – Treasure Hunts

Projects – The glue of the energy program = $$

Project Tracking -- Accountability

Best Practices – No company has a monopoly on great ideas

FCS CONSULTING SERVICES, INC.

Respect the knowledge at the plant -

Site Energy Leader – your vehicle for action

Site energy teams need to be there for each shift

WHO Owns energy consumption at the Plant?

Get a seat at the weekly meeting table for energy

Show what other plants have done – Case studies

Celebrate great projects – implemented at the plant

Organizational --

Network – Ability for Best Practices and Replication

Tracking – Show the value of the plant's work

Reporting – Show what you and the PLANTS have done

Communication – Your BEST FRIENDS

Training – Provide TOOLS for learning

Awareness – The people-side of the program

Continue to get the message out - with

Direct Reporting – Status meetings

Use a senior manager (champion) as Air-Cover

Elevator Speech – positive, easy to understand, no ego and reference a company site / person

Use your contacts in other areas – Public Relations, Gov. Relations, EHS, Sustainability and Plant Managers

Board - Member companies

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Vehicles for continuing the Message

Company Newsletter

Shareholder meetings / information

Third party awards – the ones you can't BUY

Annual Reports

Company events

Posters - contests

Employee awareness programs

FCS CONSULTING SERVICES, INC.

Sell, Sell and Sell --

Lead with Benefits not Features

Energy projects financial returns are certain

Speak the language of the company – Production unit equivalent

Let OTHERS (not you) accept awards

Form a BU energy council that has the CEO's ear

Use peer companies to show that you are in good company

You Can't Over-Communicate --

Communicate – Publish or Perish

Create and distribute a "One Year Later" one-page report

Conduct Summit meetings of the Energy Management network

Brand your Program

Get BUs to agree and set energy efficiency reduction attainment Goals

Continue to get the message out --

Use today's Headlines regarding energy cost and security

Always refer to existing procedures that are being enhanced with the NEW ideas. This is not the First Time your company has approached Energy Efficiency

Transparency – create a company website where status of all projects is shown

Show progress in G Y R scorecards and Thermometer graphs --- Eye Candy

FCS CONSULTING SERVICES, INC.

Energy Management Career Traps --

Tell all that it is YOUR program

Do not expand the program to other areas

Look only In-House for wisdom

Don’t bring others along into the program

Let your EGO guide your decision-making

Cut out your management from the program

SELL Your Accomplishments, But Sell with FACTS

THANK YOU

EASTMAN

ENERGY STAR AWARD 2015
PARTNER OF THE YEAR
Sustained Excellence

Better Plants CHALLENGE
U.S. DEPARTMENT OF ENERGY

Leveraging Energy Management to Address Water Conservation

Sharon L. Nolen, PE, CEM
Eastman Chemical Company
Manager, Worldwide Energy Program

Agenda

- Background of Eastman Chemical Company
- Increased awareness of water issues
- Water conservation and energy management synergies
- Developing a water conservation strategy

EASTMAN

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
- 2014 revenue of $9.5 billion

2015 World's Most Ethical Company® by the Ethisphere® Institute

2015 ENERGY STAR® Partner of the Year Sustained Excellence
following 2012, 2013, and 2014 ENERGY STAR Partner of the Year

#7 in Bloomberg Businessweek Top 50

2013 Secretary of Defense Employer Support Freedom Award

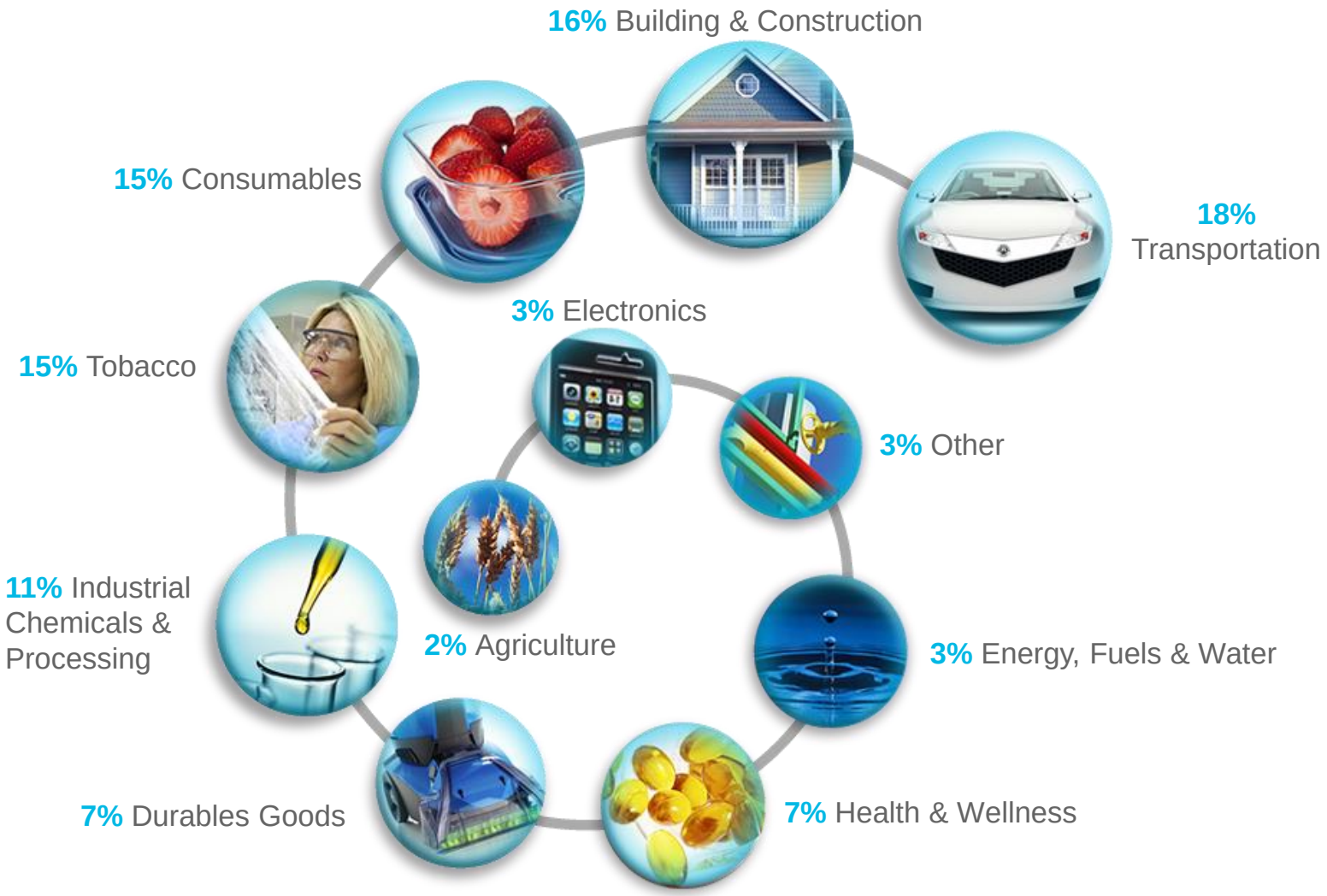
2013 Responsible Care® Company of the Year – large category

Our manufacturing locations

Anniston, AL
Antwerp, Belgium
Canoga Park, CA
Chestertown, MD
Chicago, IL
Columbia, SC
Dresden, Germany
Fengxian, China
Fieldale, VA
Franklin, VA
Ghent, Belgium
Hefei, China
Indianapolis, IN
Itupeva, Brazil
Jefferson, PA
Jurong Island, Singapore
Kashima, Japan
★ **Kingsport, TN**
Kohtla-Järve, Estonia
Kuantan, Malaysia
Lemoyne, AL
Leuna, Germany
Linden, NJ
Longview, TX
Martinsville, VA
Middelburg, The Netherlands
Monongahela, PA
Nanjing, China
Newport, Wales
Nienburg, Germany
Oulu, Finland
Pace, Florida
Santo Toribio, Mexico
São Paulo Mauá, Brazil
Sauget, IL
Sete, France
Shenzhen, China
Springfield, MA
St Gabriel, Louisiana
Sun Prairie, WI
Suzhou, China
Texas City, TX
Trenton, MI
Ulsan, Korea
Uruapan, Mexico
Watertown, NY
Workington, UK
Wuhan, China
Yixing City, China
Zibo, China

Diversified product lines & technologies

2014 sales revenue by market*



*Does not include revenue from Taminco or Commonwealth Laminating and Coating

Background of Eastman Chemical Company

Increased awareness of water issues

Water conservation and energy management synergies

Developing a water conservation strategy

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

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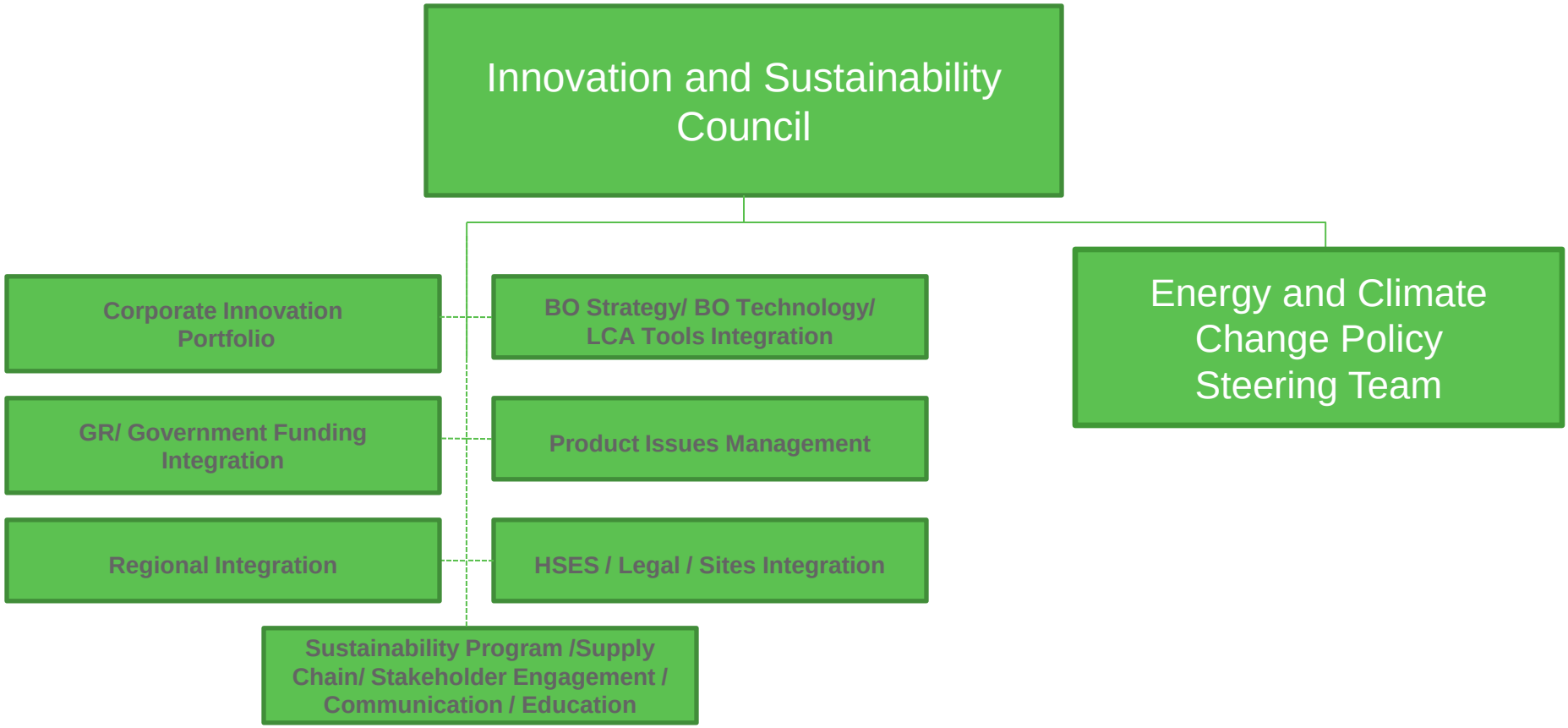
Innovation & Sustainability Council Formed (2010)



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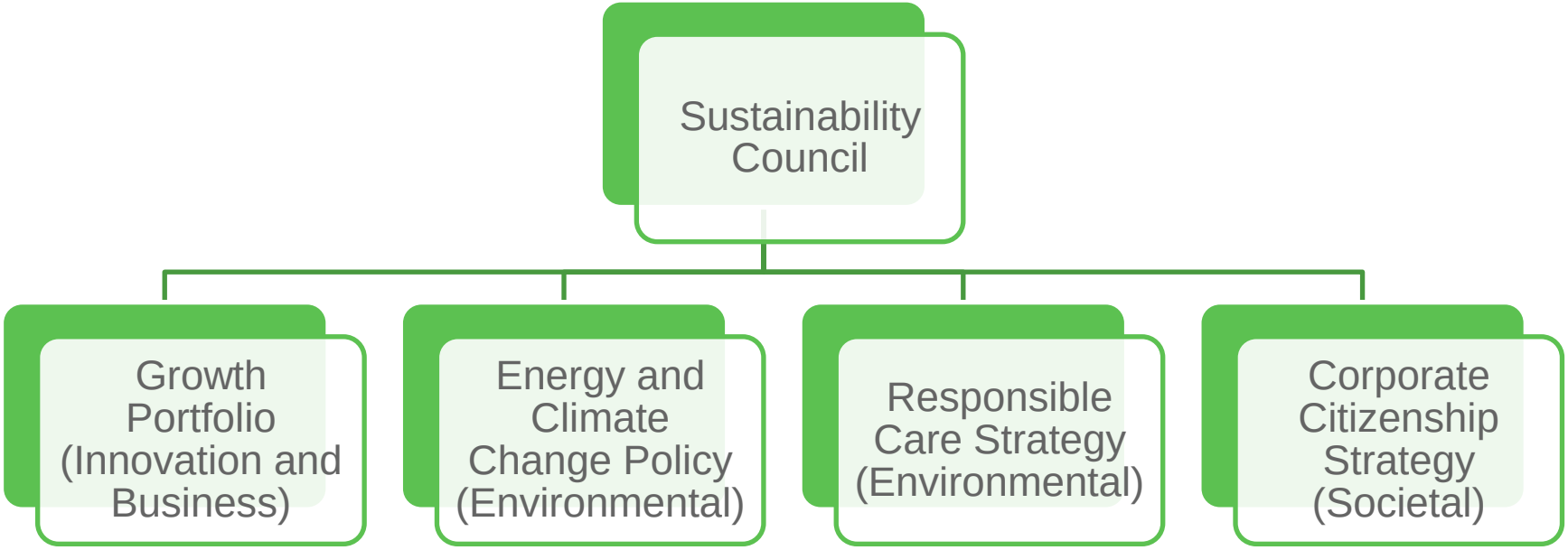
Evolution of Sustainability Council (2012)



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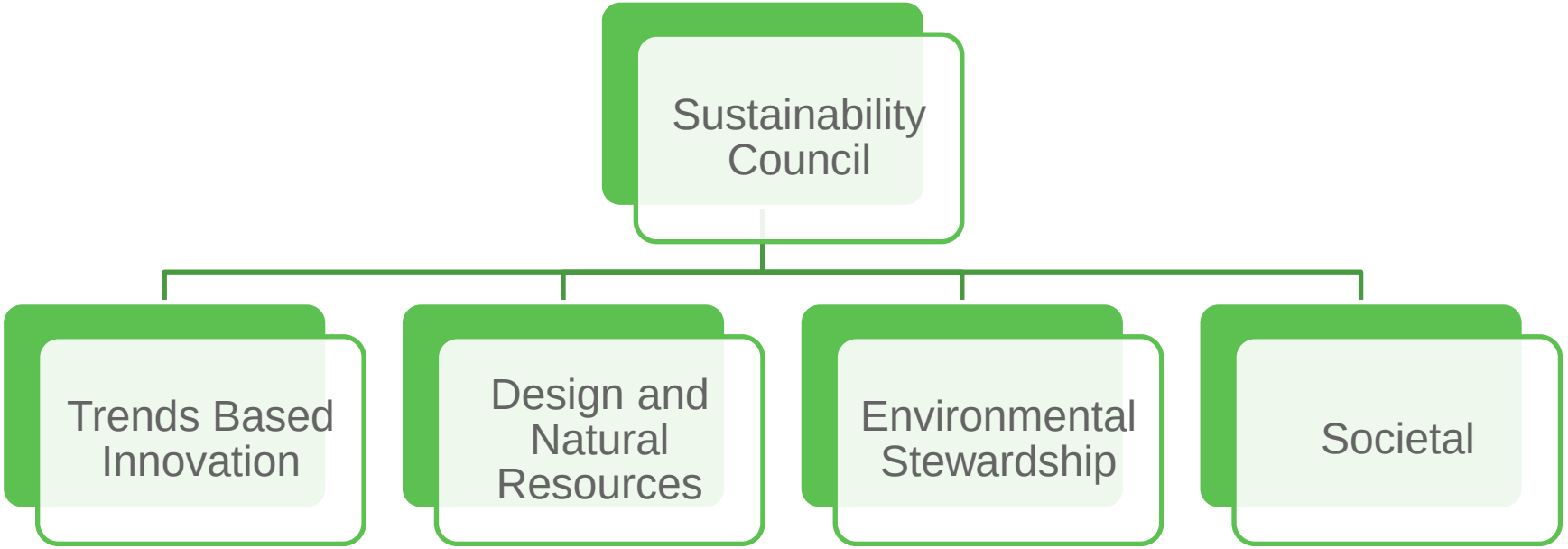
Sustainability Council (2014)



Name change reflects increased attention to considerations early in the design process and a broader consideration for natural resources

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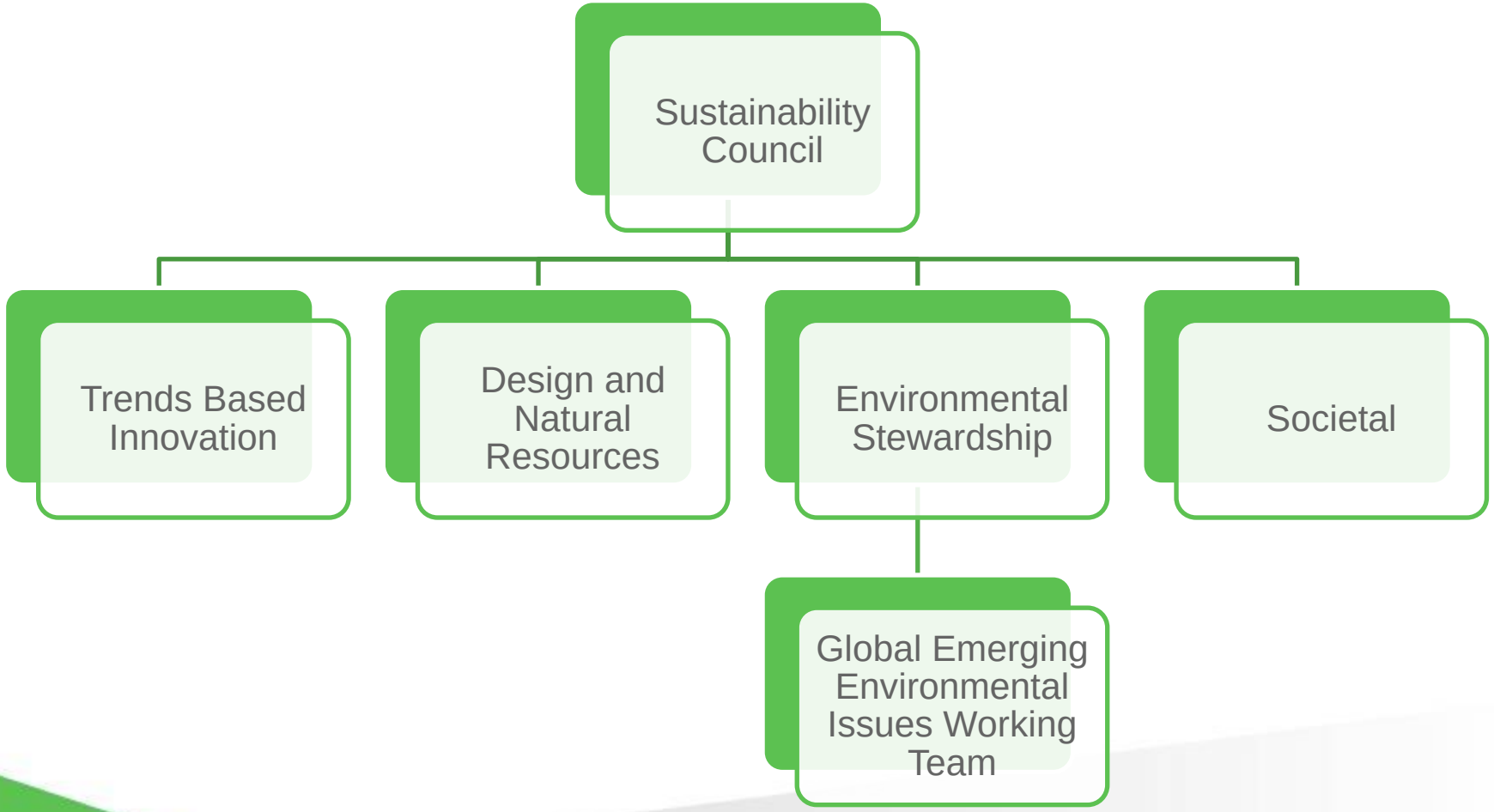
Drivers to address water issues

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

Sustainability Council (2015)



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Global Emerging Environmental Issues Working Team

The old emerging issue process created regulations…
The new process creates political and market pressures…threats and opportunities.

- Members represent organizations engaged in the “Emerging Environmental Issues Process” and bring with them knowledge and contacts from their relationships with the business and other organizations
- Team develops multi-functional, global positions and strategies that mitigate the threats and seize the opportunities
- Team captures the insights, defines roles and responsibilities, maintains communications and executes the strategies

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Background of Eastman Chemical Company

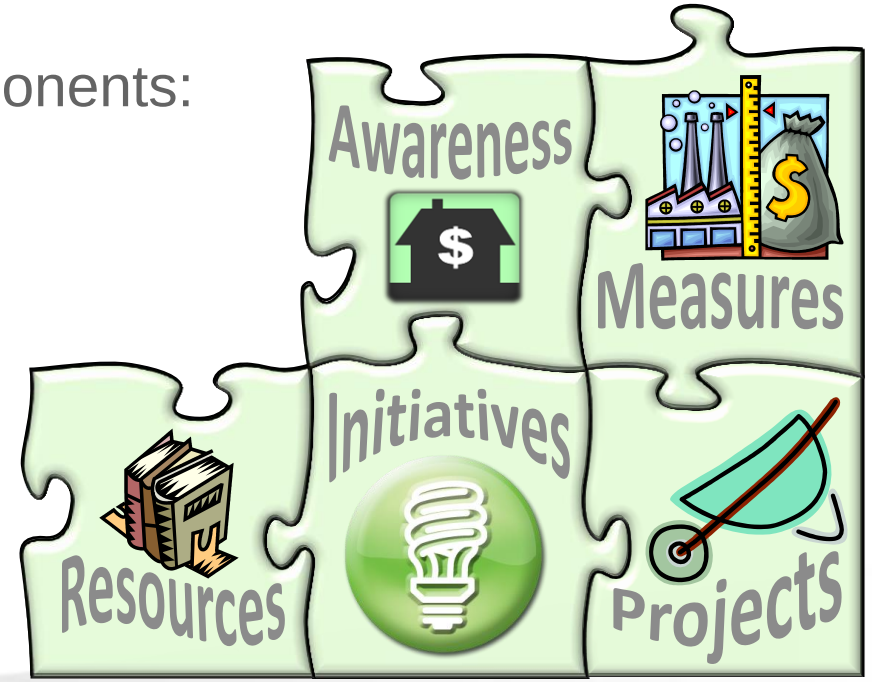
Increased awareness of water issues

Water conservation and energy management synergies

Developing a water conservation strategy

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



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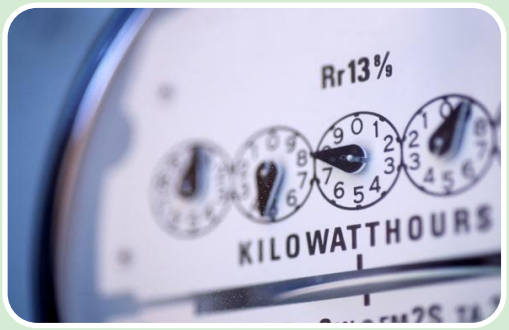
Guiding principles



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

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Principles

Ensure the accuracy of utility information

- Site management at the largest site proactively decided to add meters in strategic locations
- Energy surveys check the accuracy of allocated costs and correct placement of meters
- Modelling efforts have been able to predict energy use on a product level

Manufacturing managers are more than willing to make good energy decisions – they just need the right information to enable them to do so

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Principles

Maximize operating efficiency

- Rotating equipment is tested to ensure that each piece of equipment is operating at the best efficiency point on the operational curve
- Equipment includes turbines, pumps, chillers, and compressors
- Equipment that is not performing as designed is scheduled for maintenance to restore optimum performance

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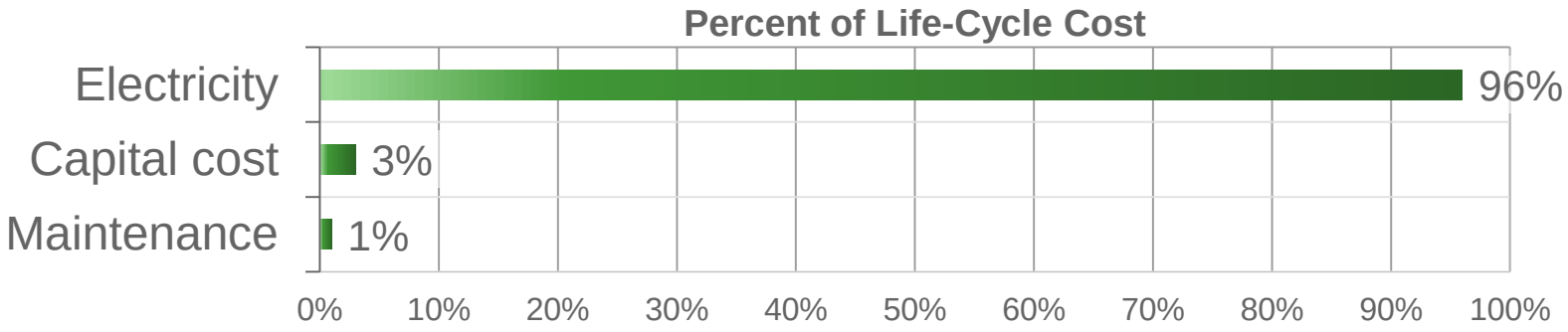
Principles

Incorporate energy efficiency in capital investments

- Most opportunities for energy efficient equipment and processes occur during the design stage versus retrofits
- According to external publications, the total life-cycle cost makeup of an electric motor is:



- Energy efficiency considerations can have a large effect on the total ownership costs related to machine drives

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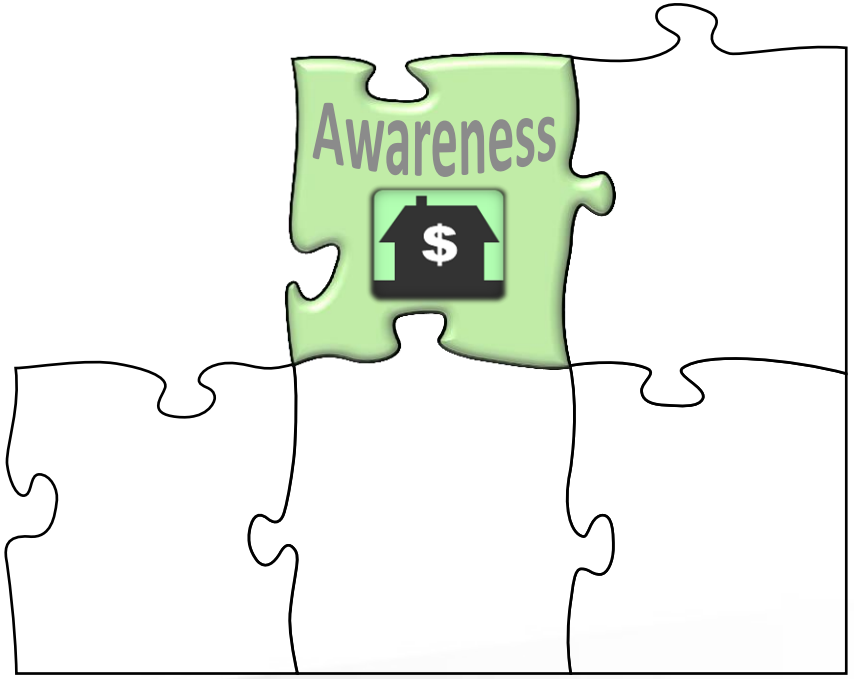
Strategy

Employee awareness

- Energy program was originally only project-focused
- ENERGY STAR® helped expand the program to include employee engagement and awareness
  - Posters, brochures, children's activity books, and displays are available for ENERGY STAR partners
  - ENERGY STAR is a well-recognized and positively perceived brand
- Energy fairs
  - Held first fair in 2011 after visiting another company's fair
  - Used ENERGY STAR resources
  - Local utilities and retail stores manned booths showcasing energy efficiency products



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Strategy

Employee awareness

- Green Teams
  - Geared toward sharing information with employees that have personal interests in preserving the environment
  - ENERGY STAR provides a Green Team Checklist with the needed framework
  - Monthly newsletters with ideas and events
- ENERGY STAR® Battle of the Buildings
  - Goal is to reduce energy use intensity by 20% in one year
  - Two Eastman buildings exceeded this target (3 entered)
  - Both buildings finished in the top 10 in 2013 (of 3,200)
  - Reaching the goal involved building automation systems, EnerLogic window film, and occupant involvement
- ENERGY STAR Portfolio Manager
  - Enables office employees to benchmark building energy use
  - Obtained first ENERGY STAR Certified Building in 2013 after decreasing energy usage in a building by 57%
  - Internal competition between similar buildings increases enthusiasm

EASTMAN

Strategy - Water

- Some may have to be convinced that it really is an issue
  - Water is plentiful and cheap in some parts of the world
- Some of the same methods of communication can be used, i.e. Green Team Newsletters
- Employees can be asked to relate issues at home to issues at work
- The same employees who are interested in conserving energy will likely be interested in saving water

EASTMAN

Global Water Supply/Demand

- Water supply is recirculated through the atmosphere, but no “new” water is being created
- Only 3% of the earth’s total water supply is fresh water, versus salt water, and the majority of fresh water is inaccessible
  - 1% in surface water, such as rivers, lakes, and streams
  - 29% in underground aquifers, which are being over-pumped beyond their recharge capability in many regions
  - 70% in frozen glaciers
- 15-35% of agricultural water withdrawals are in excess of sustainable limits
- Water production lost due to leakage, theft, and inadequate billing practices is typically 40-50% in developing countries, and may be 10-30% in developed nations
- Industrial withdrawals are expected to rise by 55% by 2025
- Despite efforts by global governments, nearly 1.1 billion people still lack access to water supply service and 2.6 billion people lack access to sanitation, mostly in Asia and Africa
- About 5 million people die every year from water-related illness
- By 2050, untreated wastewater could contaminate one-third of global annual renewable freshwater supplies
- The world’s population has tripled in the 20th century – but global water use has grown six-fold
- Another 40-50% in population growth is expected within 50 years, along with increasing urbanization and industrialization, with the fastest growth taking place in water-short areas, including the American Southwest, China, and India
- In 1995, over 400 million people lived in countries experiencing water stress or water scarcity
- By 2025, that number is expected to rise to 4 billion – over half the world’s population
- 50% of global population growth is expected to take place in water-stressed countries
- China’s demand for water is expected to increase 400% by 2030
- China’s population is 21% of the world and is increasing 1%/yr, yet China only has 7% of the world’s water. 400 of China’s 660 main cities face water shortages one-third of rural residents drink unsafe water
- By 2020, India’s demand for water is expected to exceed all current sources of supply
- 70% of irrigation and 80% of domestic water use comes from groundwater, which is rapidly being depleted. 15% of aquifers are in critical condition this is expected to grow to 60% in 25 years

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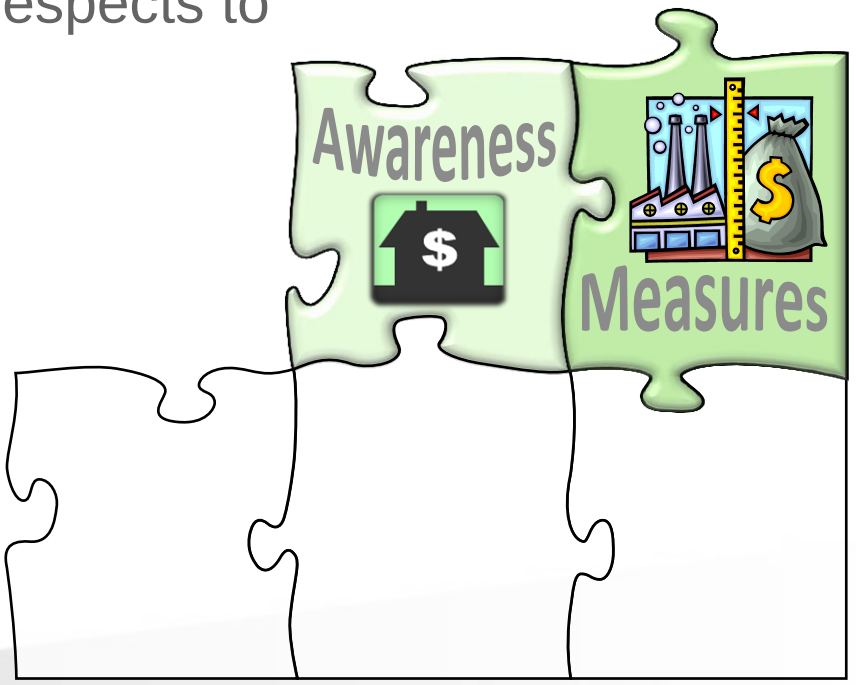
Strategy

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



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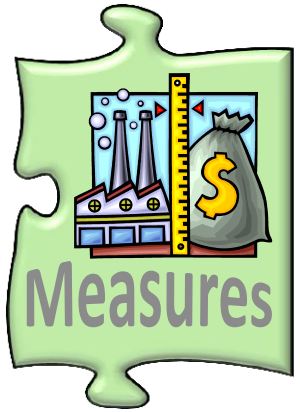
Strategy - Water



- Measures may be more important for individual sites rather than the entire company
- Measures could be based on amount withdrawn, consumed, or intensity or limited to specific sites
- Quantitative examples:
  - Reduce water consumption by at least 30% at global sites that are located where the renewable freshwater supply is either scarce or stressed as determined by the United Nations analysis of river basins globally. For all other sites, we will hold water consumption flat on an absolute basis through the year 2015, offsetting any increased demand from production volume growth through conservation, reuse and recycle practices.
- Qualitative examples:
  - The goal is focused on water conservation planning and reductions efforts in regions of the world where water resources are limited or excessively extracted (water stressed and hyper stressed).
  - Specific goals developed for sites that are in water stressed areas or have identified potential water savings potential.

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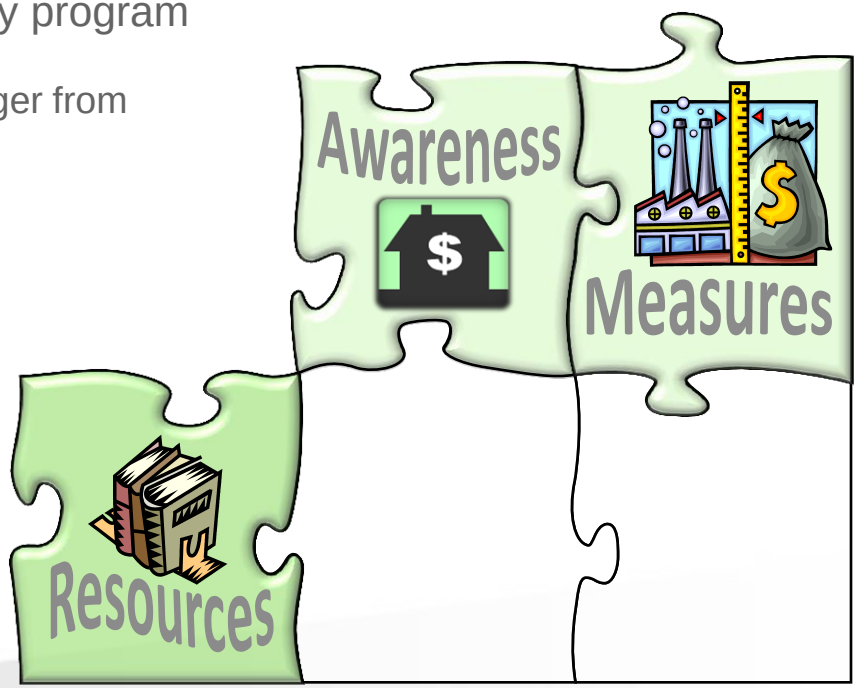
Strategy

External resources

- ENERGY STAR®
  - ENERGY STAR Guidelines for Energy Management used to identify gaps in the existing program
  - ENERGY STAR Partners have the opportunity to benchmark with other companies and share best practices
  - Partner meetings, website, and webinars provide insight
  - Review of the existing corporate energy program by knowledgeable, outside individuals
    - An assigned mentor (an energy manager from another company)
    - Technical Advisor
- DOE
  - On-site training
  - On-site assessments of utility systems

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



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Strategy - Water

Understanding Water Issues

IETC 2015 June 2 - 5 New Orleans

ENERGY STAR AWARD 2015
PARTNER OF THE YEAR
Sustained Excellence

Better Plants CHALLENGE
U.S. DEPARTMENT OF ENERGY

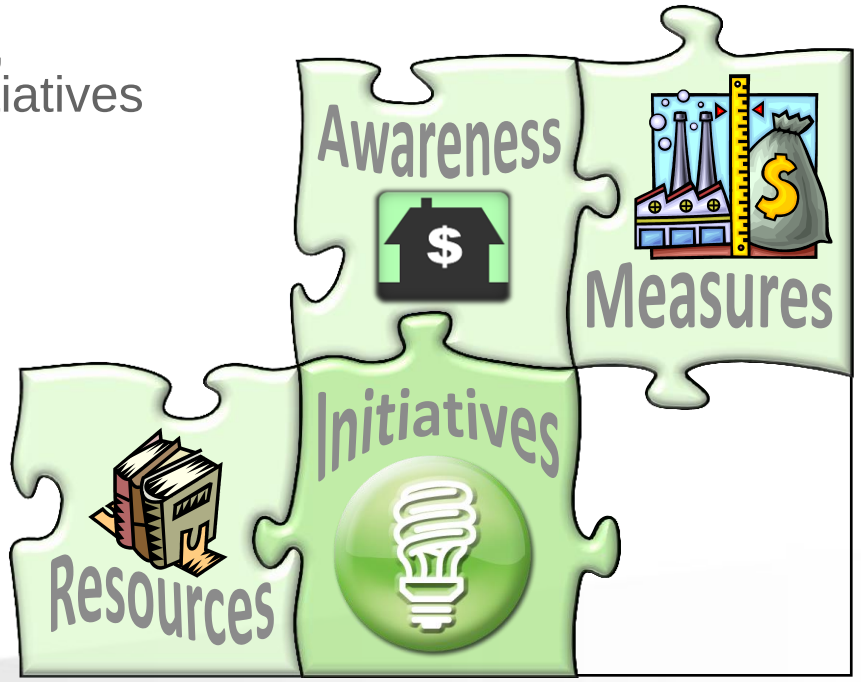
WATEREUSE

- Participate in industrial networking opportunities (conferences, work groups)
- Increase engagement on water issues in ENERGY STAR and DOE Better Buildings, Better Plants networks
- Understand customer requirements and inquiries

Strategy

Energy initiatives

- Sharing of best practices
  - One manufacturing area took a different approach to steam leak repair that led to a 98% reduction in leaks over ten years
  - Their approach has been recognized internally as a best practice and incorporated into the program
- Potential identified for a centralized, standardized approach for other 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



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Strategy- Water

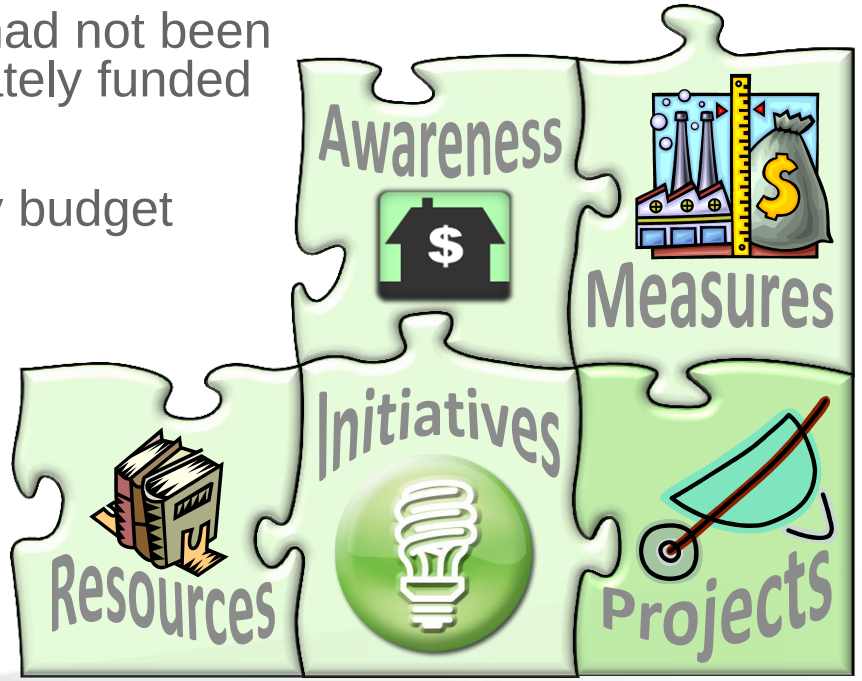
- Centralized utility organization can drive improvements
  - Focus on condensate return improvements. This increases energy efficiency and reduces water use.
  - Encourage use of appropriate water source. Don’t use municipal water if the quality of filtered water is sufficient. This saves money and water.

EASTMAN

Strategy

Energy efficiency projects

- In 2010, no capital money was allocated specifically for energy efficiency projects
- Many good energy projects simply fell below the approval level when competing with other projects
- When shown a list of projects that had not been funded, the Steering Team immediately funded $4.2M of energy projects
- Within two years, the capital energy budget grew to $8M/year
- Led to increased interest in the energy program
  - Manufacturing areas recognized the additional avenue for funding
  - The energy team became a welcomed partner



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Strategy

Energy efficiency projects

- Database of potential projects is continually updated
- Best projects are identified
- Typical projects
  - Upgrades to more energy-efficient equipment
  - Heat recovery opportunities
- Project ideas are usually process-specific, but there is some potential to find common opportunity across the company

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Strategy

Example Projects

- Running a line from a source of high pressure natural gas to eliminate a compressor used on low pressure natural gas
- Installing O2 meters to allow tighter control of excess air in a combustion process
- Replacement of old equipment with newer more efficient equipment (i.e. boilers, pumps)
- Installing additional piping to allow condensate return
- Fine tuning temperatures of heat exchangers using refrigeration and steam to meet but not exceed requirements
- Installing variable frequency drives to eliminate control valves

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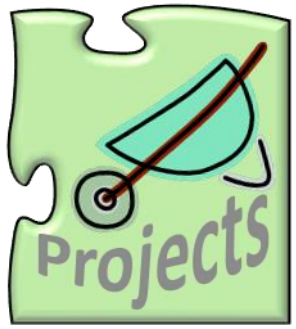
Strategy - Water



- Add water conservation to the energy surveys
  - Check meter accuracy and location
  - Capture project ideas in the energy project database for future consideration
- Consider water conservation in design
- Look for opportunities for water reuse (much like heat integration)

Challenge: Energy projects often have good returns, water projects almost never do

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Background of Eastman Chemical Company
Increased awareness of water issues
Water conservation and energy management synergies
Developing a water conservation strategy

Objective

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

Strategy - Properly Identify and Manage Water Risks and Opportunities

- Develop preliminary identification of water-stressed sites using commercially available tools - Aqueduct and Global Water Tool (complete)
- Follow up conversations with all sites beginning with those identified as water-stressed
  - Identify the appropriate contact
  - Review results and confirm status
  - Identify issues and any current mitigating actions
  - Determine water costs and any known escalations
- Develop prioritized list of action items/projects. This will be an evergreen document, continually updated as more information is available
- Conduct water assessment of new sites within two years of acquisition
- Develop schedule for re-evaluation of all sites every five years (or sooner if there is a triggering event such as a drought or expansion)
- Water risks and opportunities will be addressed by the appropriate functional organization

EASTMAN

Roles and Responsibilities – Global Environmental Affairs (GEA)

- Regulatory advocacy and liaison with government affairs on legislative issues
- Initial gathering of data on site withdrawal and consumption
- Assessment of regulatory and availability (quantity and quality) risks
- Communication of risks to appropriate contacts
- Respond to customer inquiries as they occur, i.e. waterborne wastes and site water withdrawals and discharges.
- Maintain water measures for internal use and external reporting
- Maintain knowledge and responsibility for water risk tools, i.e. Aqueduct and Global Water Tool

EASTMAN

Roles and Responsibilities - Energy Program

- Use Green Teams and other avenues to increase awareness of water issues
- Promote involvement of Engineering and Manufacturing Site Resources
- Evaluate water reuse opportunities and confirm use of the appropriate source/quality (i.e. not using city water when filtered water will do)
- Evaluate infrastructure issues, i.e. adequate sewers
- Maintain list of water conservation projects by site prioritized by risk and return
- Maintain expertise on water evaluation tools (cost and utilization), i.e. Nalco monetization software

Additional Roles and Responsibilities

- to be defined by Global Emerging Environmental Issues Working Team

- Establish goals (i.e. withdrawal, consumption, reduction of municipal water)
- Develop the “Eastman water story” for consistent internal and external messaging by Sustainability, Corporate Communications, Marketing Communications, etc.
- Support consistent legislative and regulatory advocacy efforts by GEA and Global Public Affairs and Policy
- Engage Technology through their knowledge of emerging technologies and the LCA Team
    - Incorporate water information into life cycle analyses
    - Respond to customers re. product water information
- Work through Global Product Stewardship and Regulatory Affairs to engage the businesses
    - Leverage work to enhance current business position (promoting current products that promote water sustainability)
    - Identify portfolio opportunities based on the macro trend
- Interface with Sustainability and Corporate Social Responsibility

EASTMAN

Path Forward

- Continue evaluation of water stressed sites
- Initiate defined roles and responsibilities for GEA and Energy Program
- Coordinate with existing programs, i.e. Drainage Analysis Team and Infrastructure Sustainability Effort
- Expand as determined by Global Emerging Environmental Issues Working Team

EASTMAN

Summary

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

EASTMAN

Questions?

EASTMAN

SIMPLE PAYBACK: Tricks and Traps

INDUSTRIAL ENERGY TECHNOLOGY CONFERENCE

Energy Managers Workshop

June 2015

Christopher Russell

Visiting Fellow : American Council for an Energy Efficient Economy : crussell@aceee.org

Principal : Energy Pathfinder Management Consulting : info@energypathfinder.com

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Purpose for Today

- Business margins
- Payback addiction
- Coping with a payback habit

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MANUFACTURING EXAMPLE

INCOME STATEMENT ('000)		
Revenue	$100,000	100%
Cost of goods sold	63,000	
Gross profit	**37,000**	**37%**
Operating expense	29,300	
EBIT*	**7,700**	**7.7%**
Other income	150	
Total income	7,850	
Interest expense	960	
Pre-tax profit	$6,890	
Income tax @17.5%	1,208	
NOPAT**	**$5,682**	**5.6%**

GROSS MARGIN: product & commodity market performance

OPERATING MARGIN: core business activity performance

NET MARGIN: performance of capital invested in the business

* Earnings before interest & taxes
**Net operating profit after tax

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Business Margins: Performance Indicators

GROSS MARGIN:
external opportunities

- Leveraging the difference between input commodity & product market prices

OPERATING MARGIN:
internal opportunities

- Operating performance

NET MARGIN:
return to shareholders

- Equity performance (free cash flow)

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Free Cash Flow: Where does it go?

1. Working capital.
   Inputs for current plant & equipment

2. Capital investment.
   1. Add production capacity
   2. **Make existing capacity more efficient**

3. Outside investment.
   Mutual funds, deposits

4. Debt reduction, stock buy-back….

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CAPEX PROJECT
Simple Payback?

$1,300,000 cost
(after utility rebate)

$380,000 1st-year savings

Escalate energy prices 1.5%/yr

SPB =

COST/ ANNUAL SAVINGS

SPB = 3.4 YEARS

HURDLE = 2 YRS OR LESS.

OUTCOME: REJECT.

Reject the energy project…

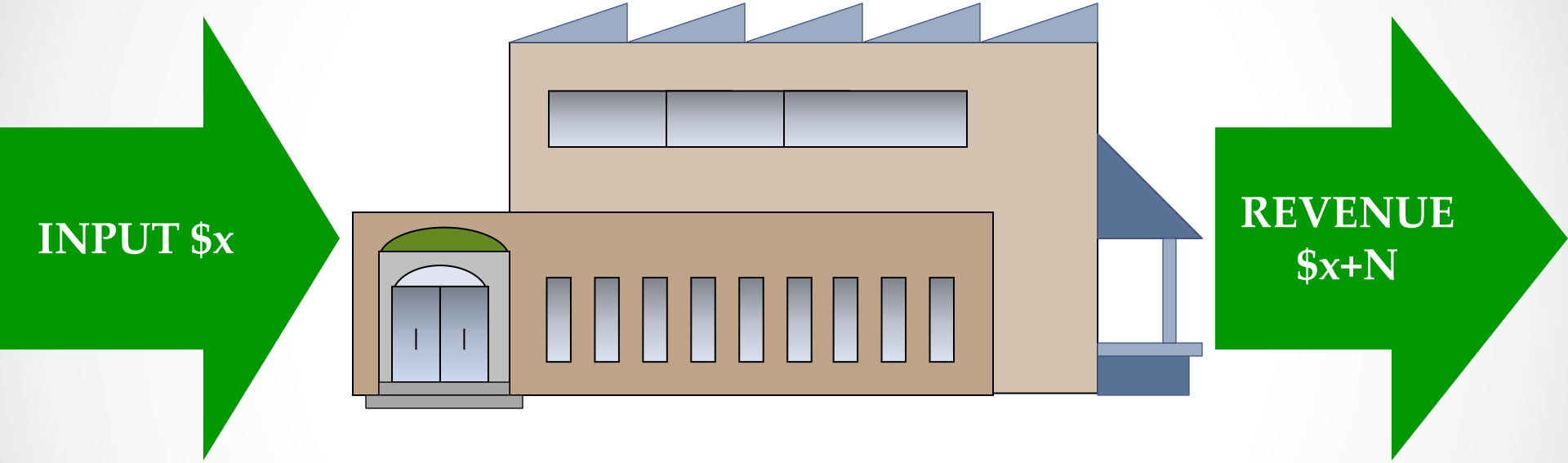
NOW WHAT will you do?

Earnings have to go SOMEWHERE.

How do you choose?

By what criteria do you choose?

Any Profitable Business is a "MONEY-MAKING MACHINE"



Operate 24/7

…as long as you cover variable costs

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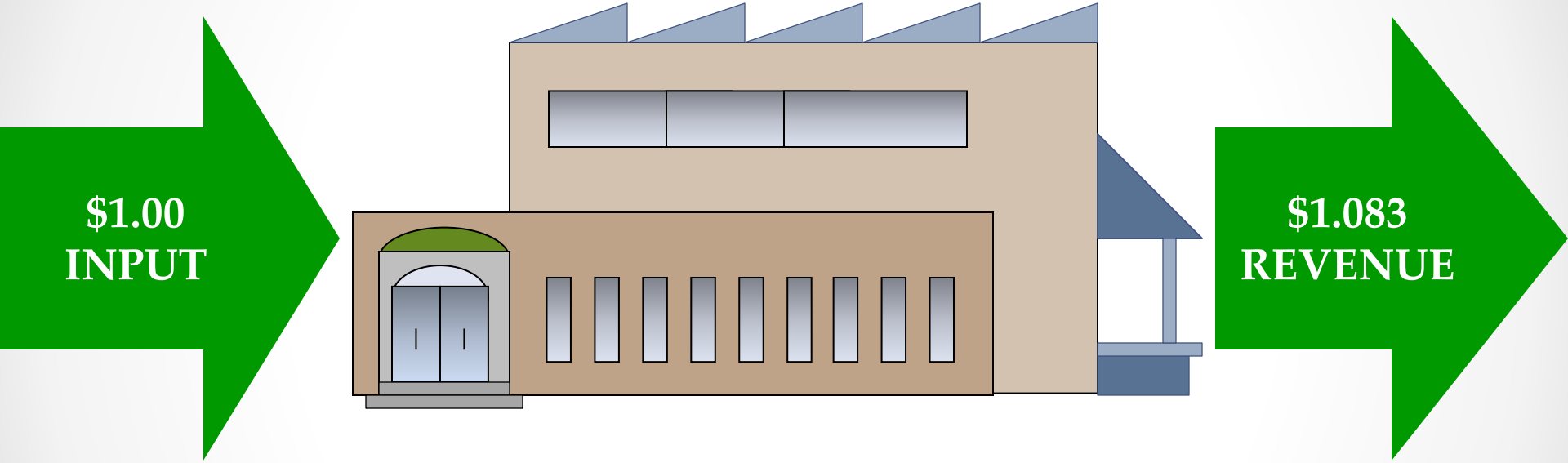
EX: 7.7% operating margin

$100,000 in revenue resulting from
$92,300 expense input yields $7,700 operating income



$$\frac{\$7,700}{\$92,300} = 8.3\% \text{ rate of return on each \$1 of inputs}$$

Based on 2014 financial results

INCOME STATEMENT	RATE	2014	MARGIN
REVENUES		$100,000,000	100%
Cost of Goods Sold		63,000,000	
GROSS PROFIT		$37,000,000	37%
Operating Expenses:			
Wages, Maintenance, Utilities		24,000,000	
Depreciation		800,000	
Selling & Administrative Expenses		4,500,000	
TOTAL OPERATING EXPENSES		$29,300,000	
EARNINGS BEFORE INT & TAX (EBIT)		$7,700,000	7.7%
Other Income		150,000	
TOTAL INCOME		$7,850,000	
Interest Expense		960,000	
PRE-TAX PROFIT		6,890,000	
Provision for Income Tax	17.53%	1,208,000	
NET OPER PROFIT AFTER TAX (NOPAT)		$5,682,000	6%

BALANCE SHEET				2014
ASSETS			LIABILITIES AND EQUITY	
Cash	$850,000		Accts Payable	$1,100,000
Securities	100,000		Notes Payable	212,000
Accts Receivable	1,500,000		Accrued Expenses Payable	440,000
Inventories	4,000,000		Accrued Taxes Payable	50,000
Total Current Assets	$6,450,000		Total Current Liabilities	$1,802,000
Plant & Equipment	58,000,000	4%	Long-Term Debt	$24,000,000
Other Assets	18,000,000		Total Liabilities	$25,802,000
Total Fixed Assets	$76,000,000			
Total Assets	$82,450,000		Stockholders' Equity:	
			Preferred Stock	8,500,000
			Common Stock	42,000,000
			Paid-in Capital	5,000,000
			Retained Earnings	1,148,000
			Total Stockholders' Equity	$56,648,000
			Total Liabilities and Equity	$82,450,000

Pre-Tax Return on Equity (ROE)

CONSOLIDATED FINANCIALS	
INCOME STATEMENT ($000)	
REVENUE	$100,000
COST GDS SOLD	63,000
OPERATING EXP.	29,300
EBIT	$7,700
BALANCE SHEET ($000)	
FIXED ASSETS	$76,000
LIABILITIES	25,802
EQUITY	$56,648

Dupont Identity

$$\textit{OPERATING MARGIN} \times \textit{ASSET TURNOVER} \times \textit{FINANCIAL LEVERAGE} = ROE_{PRE\text{-}TAX}$$

$$\frac{\text{EBIT}}{\text{REVENUE}} \times \frac{\text{REVENUE}}{\text{ASSETS}} \times \frac{\text{ASSETS}}{\text{EQUITY}}$$

$$\frac{\$7{,}700}{\$100{,}000} \times \frac{\$100{,}000}{\$76{,}000} \times \frac{\$76{,}000}{\$56{,}648}$$

$$8\% \times 1.32 \times 1.34 = 13.6\%$$

PRE-TAX ROE

Post-Tax Return on Equity

OPERATING MARGIN		ASSET TURNOVER		FINANCIAL LEVERAGE		TAX BURDEN		INTEREST BURDEN	= ROE POST TAX
EBIT / REVENUE	X	REVENUE / ASSETS	X	ASSETS / EQUITY	X	NOPAT* / PRE-TAX PROFIT	X	PRE-TAX PROFIT / EBIT	
$74,600 / $100,000	X	$100,000 / $76,000	X	$76,000 / $56,648	X	$5,682 / $6,890	X	$6,890 / $7,700	
0.077	X	1.316	X	1.342	X	82.47%	X	89.48%	= 10.0%

Post-tax ROE

CONSOLIDATED FINANCIALS	
INCOME STATEMENT ($000)	
REVENUE	$100,000
COST OF GOOD SOLD	63,000
OPERATING EXPENSES	29,300
EBIT	$7,700
INTEREST	$960
PRE-TAX PROFIT	$6,890
NOPAT*	$5,682
BALANCE SHEET ($000)	
FIXED ASSETS	$76,000
LIABILITIES	25,802
EQUITY	$56,648

*NOPAT = Net Operating Profit After Tax

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CAPEX PROJECT

…rejected per 2-YR payback criterion

PROBLEM:

All other investment alternatives measured by **RATE OF RETURN**.

Note for this project:

- 29% IRR pre-tax
- 13% IRR after tax
- 25-yr economic life

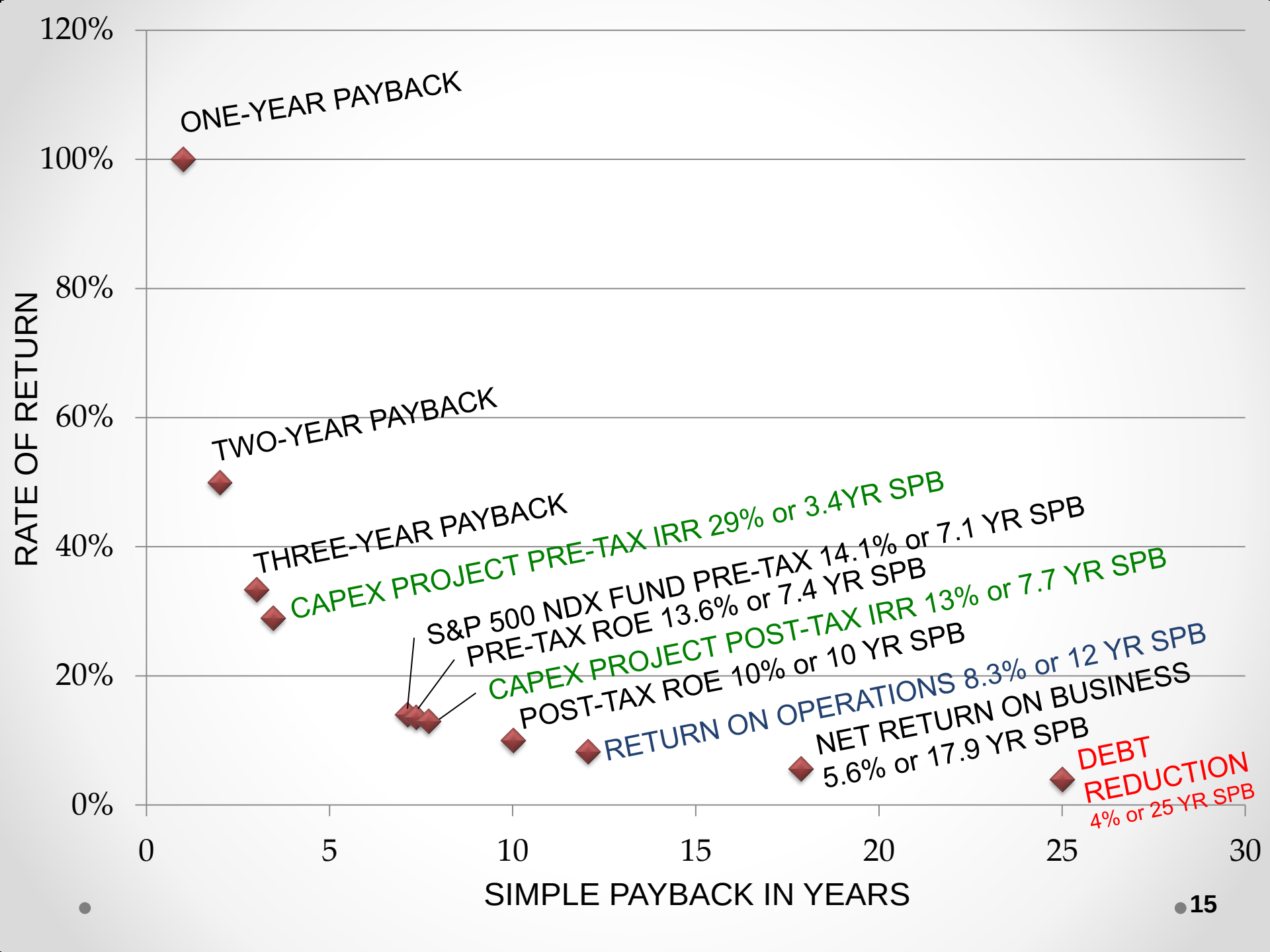
Payback or Rate of Return?

Apples to apples…

$$\frac{1}{\text{PAYBACK YEARS}} = \text{PERCENT RATE OF RETURN}$$

…and:

$$\frac{1}{\text{PCT. RATE OF RETURN}} = \text{PAYBACK YEARS}$$


120%
100%
80%
60%
40%
20%
0%
RATE OF RETURN
0
5
10
15
20
25
30
SIMPLE PAYBACK IN YEARS
ONE-YEAR PAYBACK
TWO-YEAR PAYBACK
THREE-YEAR PAYBACK
CAPEX PROJECT PRE-TAX IRR 29% or 3.4YR SPB
S&P 500 NDX FUND PRE-TAX 14.1% or 7.1 YR SPB
PRE-TAX ROE 13.6% or 7.4 YR SPB
CAPEX PROJECT POST-TAX IRR 13% or 7.7 YR SPB
POST-TAX ROE 10% or 10 YR SPB
RETURN ON OPERATIONS 8.3% or 12 YR SPB
NET RETURN ON BUSINESS
5.6% or 17.9 YR SPB
DEBT
REDUCTION
4% or 25 YR SPB

Payback = CAPITAL VELOCITY

…or the TIME REQUIRED to:

STATUS QUO: Benchmark for current business returns

17.9 yrs Double value of existing assets, post tax & finance
10.0 yrs Double existing equity investments, post tax
12.0 yrs Replenish expenditure on inputs

DEFENSE: Reduce capital "drain" from debt

25.0 yrs Double the value of lent/borrowed capital

PROACTIVE: Return on new investment

7.1 yrs Double the value of EXTERNAL investment (S&P 500 NDX)
3.4 yrs Double the value of incremental CAPEX (our example)

ORDINAL RANKING OF OPTIONS	PERCENT RATE OF RETURN	SIMPLE PAYBACK (YRS)
CAPEX PROJECT pre-tax	29.0%	3.4
S&P 500 FUND pre-tax avg yield$_{10yrs}$	14.1%	7.1
RETURN ON EQUITY pre-tax	13.6%	7.4
CAPEX PROJECT post-tax	13.0%	7.7
RETURN ON EQUITY post-tax	10.0%	10.0
RETURN ON OPERATIONS	8.3%	12.0
NET BUSINESS RETURNS post tax & finance	5.6%	17.9
RETURN ON DEBT REDUCTION	4.0%	25.0

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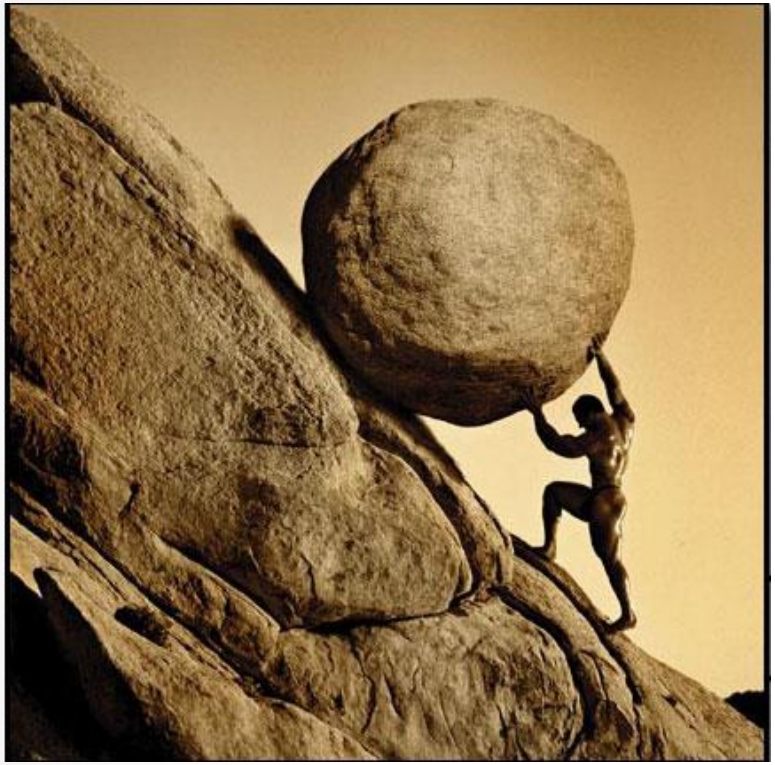
U.S. INDUSTRY FINANCIAL MARGINS
Sampled in January 2015

INDUSTRY	*n*	*OPERATIONS*		*NET*	
		MGN	SPB-YRS	MGN	SPB-YRS
Chemicals, specialty	103	14.4%	6.9	10.0%	10.0
Electronics, consumer & office	28	7.1%	14.0	3.6%	28.1
Food processing	96	11.9%	8.4	6.9%	14.6
Pharmaceuticals	151	24.6%	4.1	16.0%	6.3
Tobacco	20	40.6%	2.5	22.4%	4.5
Green & renewable energy	26	18.5%	5.4	0.4%	277.8
Utility, general	21	16.0%	6.3	8.7%	11.5
Hospitals & healthcare facilities	56	13.4%	7.5	4.5%	22.2
Insurance, life	25	14.1%	7.1	8.2%	12.2

SOURCE:
http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/margin.html



SIMPLE PAYBACK

If we MUST use it…

KNOW HOW TO COMPARE INVESTMENT RESULTS.

THANK YOU!

Questions?

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Better Plants

U.S. DEPARTMENT OF ENERGY

DOE BETTER PLANTS PROGRAM: NEW WAYS OF FINDING ENERGY SAVINGS AND DELIVERING VALUE TO INDUSTRY

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

May 12, 2015

U.S. DEPARTMENT OF ENERGY

Better Buildings, Better Plants

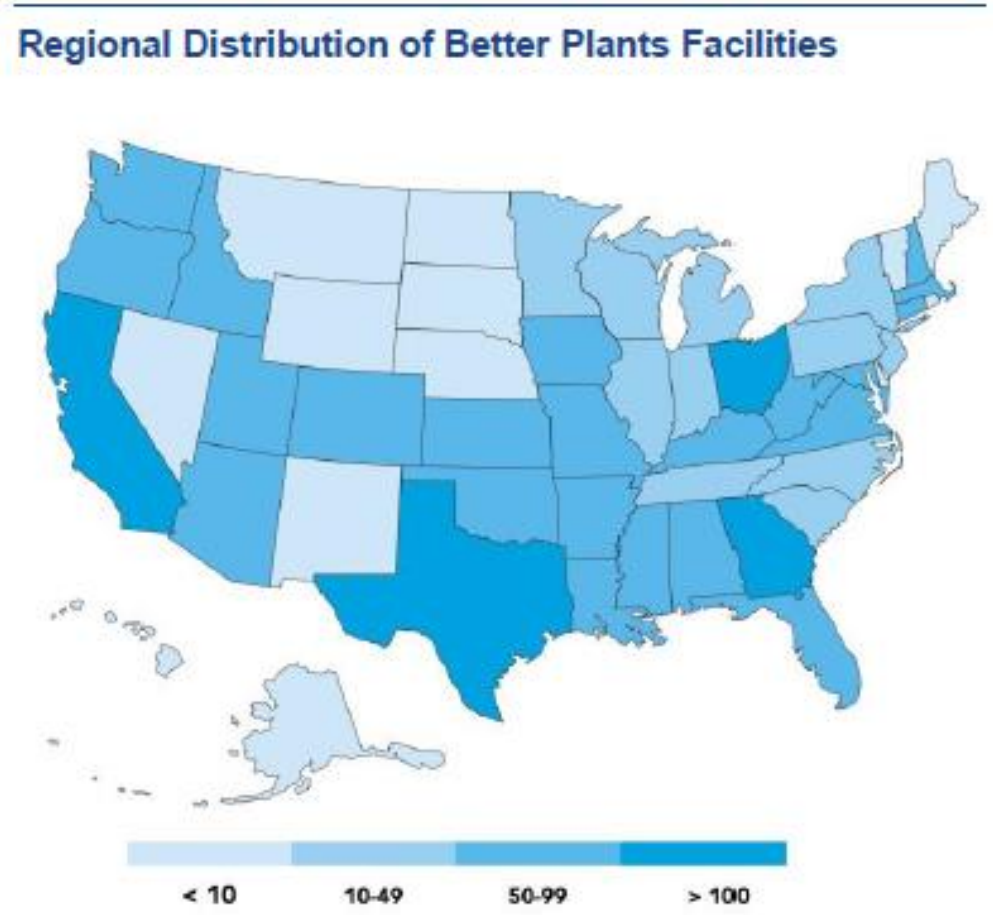
- Better Plants is a key component of the President's Better Buildings Initiative, which seeks to improve the energy efficiency of commercial and industrial buildings by 20% by 2020.
- Through Better Plants:
  - Industrial organizations commit to efficiency goals
  - Receive technical assistance and national recognition for their achievements
- Manufacturers have two opportunities to engage in Better Plants:
  1. Broader-based *Program* level
  2. Higher-level *Challenge*

Better Plants Overview

Better Plants partners at a glance:

- 158 companies and over 2,300 facilities
- 13 members of the Fortune 100
- Approximately 11% of the U.S. manufacturing energy footprint

- ***Seventeen new Program Partners since October 2014; eight new Challenge Partners***



http://eere.energy.gov/betterplants

Partners Achieve Strong Energy Savings!

Average energy intensity improvement rate of 2.4% per year; cumulative savings ~320 Tbtus and $1.7 billion

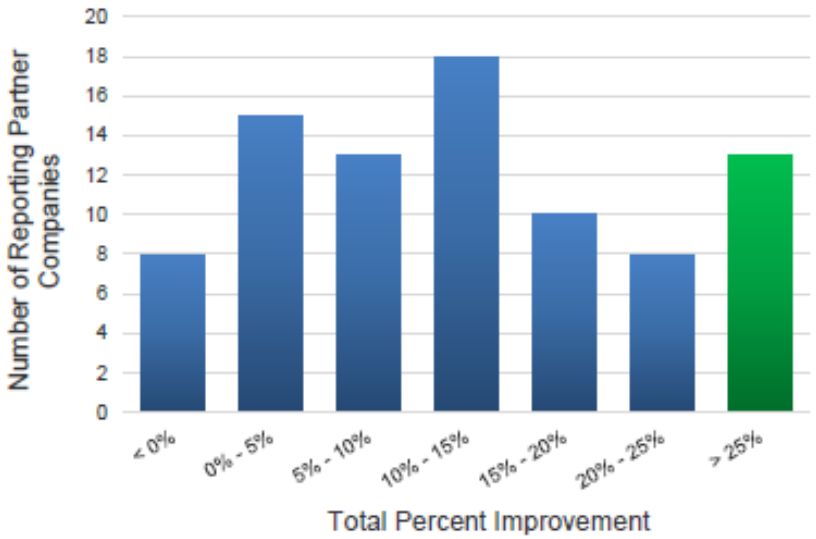
Estimated Cumulative Avoided CO_2 Emissions are Equivalent to Annual Emissions from:

4.9 coal-fired power plants

1.7 million U.S. homes' energy use

3.9 million passenger vehicles

2013 Total Energy Intensity Improvement



Partnership Benefits

- National recognition
- In-Plant Trainings
- Networking opportunities
- Access to an expert Technical Account Manager
- Priority access to other DOE energy efficiency resources

Better Buildings Challenge

Launched December 2011

Goals:

- Make commercial, industrial buildings, multifamily housing 20%+ more efficient in 10 years
- Save more than $80B+ for US organizations
- Create American jobs; improve energy security
- Mitigate impacts of climate change

(Official White House Photo by Lawrence Jackson)

How:

- ✓ Leadership
- ✓ Results
- ✓ Transparency
- ✓ Best Practice Models
- ✓ Recognition
- ✓ Catalyzing Action

Now 250 Partners

Commercial, Industrial, Public, Private

Represent:

3.5+ Billion Square Feet

$2 Billion Private Financing

600+ Manufacturing plants

http://www4.eere.energy.gov/challenge/

Better Plants Challenge Partners

Access to In-Plant Trainings

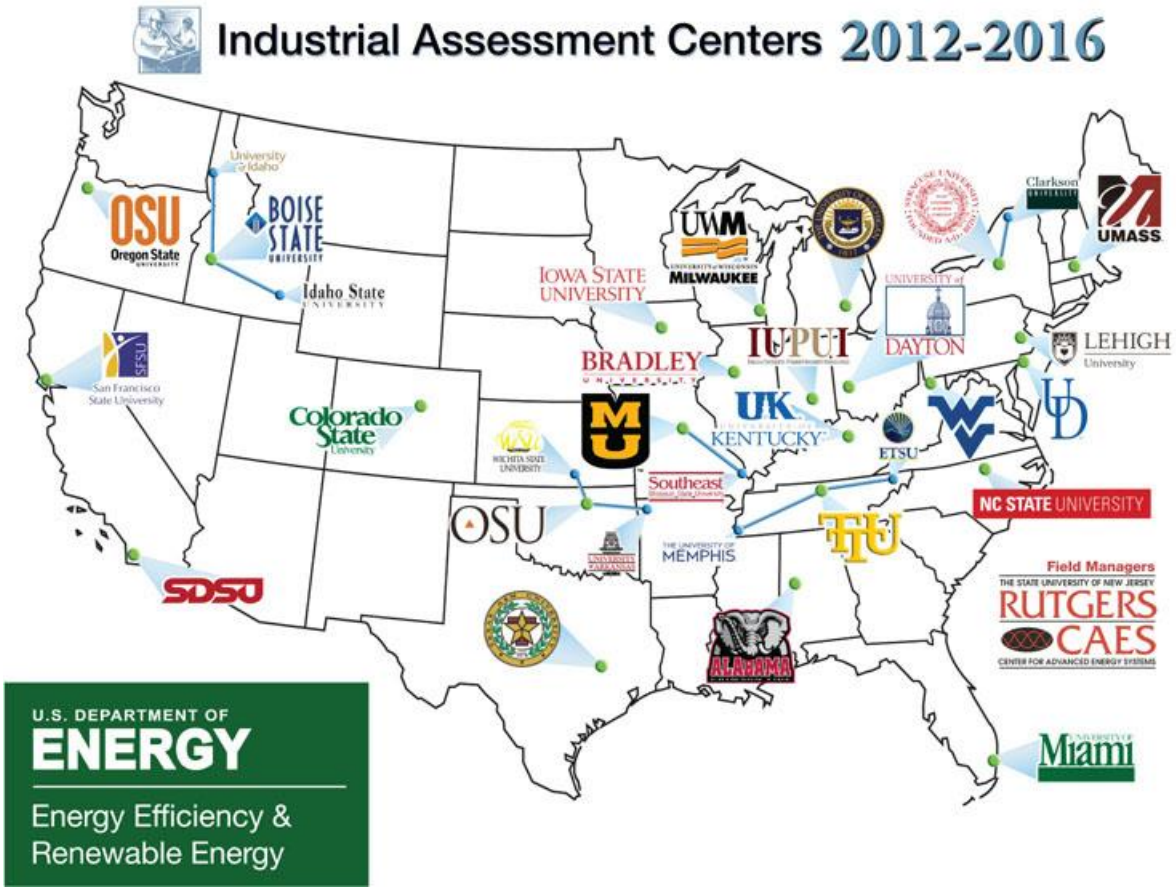
- INPLTs teach participants how to conduct assessments, use DOE tools, and implement projects
- Employees from host plant, peer companies, suppliers, and others
- Over 40 INPLTs covering steam, compressed air, process heating, pumps, and fans since 2011
- Over 750 participants
- Identified > 2.5 TBTu 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/

Access to Industrial Assessment Centers (IAC)

- Qualifying Better Plants Partners receive free energy audits from DOE's IACs.
- IACs are university-based centers, led by professors and staffed by engineering students.
- Typical audit uncovers savings equal to about 8% of plant-wide energy consumption



CHP Deployment

CHP Technical Assistance Partnerships provide

- Market Opportunity Analysis
- Education and Outreach
- Technical Assistance

Better Plants Partners receive free CHP screenings

SEP™ & ISO 50001

- SEP is a plant-level certification program that requires conformance with ISO 50001 and 3rd party validation of energy savings
- 28 plants have been certified so far. Nine improved energy performance by an average of 10% and saved over $500,000 per year

Superior Energy Performance
U.S. DEPARTMENT OF ENERGY

ISO International Organization for Standardization

ISO 50001 is a foundational tool that any organization can use to manage energy

ISO 50001

Components in place:
- Top Management
- Energy Team
- Policy
- Planning
- Baseline
- Performance Metrics

Superior Energy Performance

ISO 50001

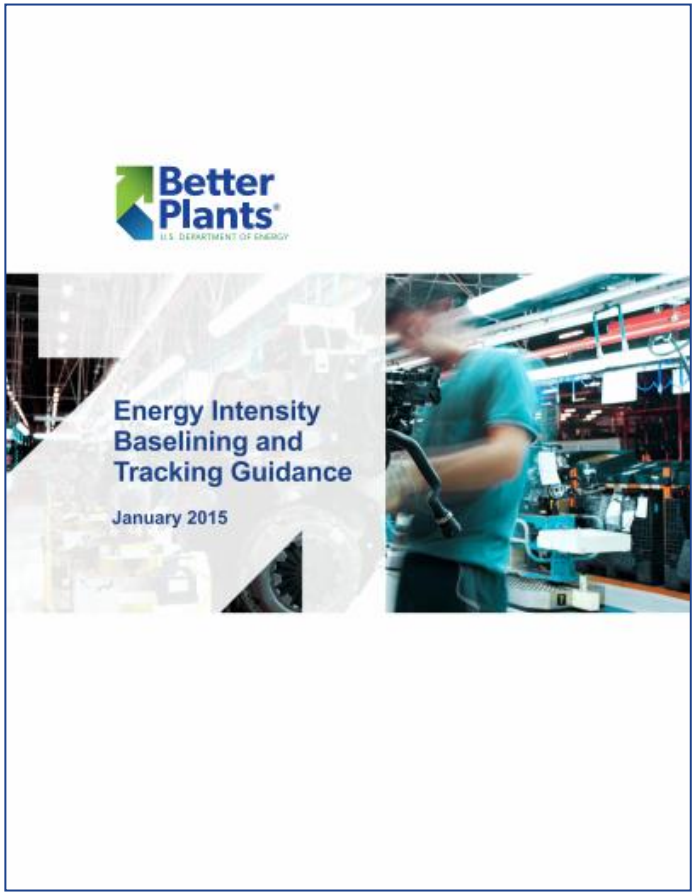
Single facility ISO 50001 conformance with verified energy performance improvement

Superior Energy Performance® Certified Plants

HARBEC Technical Innovation with Environmental Responsibility	*Ontario, NY*	16.5%
CCP COMPOSITES	*Houston, TX* Recertification	13.0%
Cummins	*Whitakers, NC*	12.6%
GENERAL DYNAMICS	*Scranton, PA*	12.6%
Coca-Cola	*Dunedin, FL*	12.2%
Allsteel®	*Muscatine, IA*	10.2%
COOPERTIRES	*Texarkana, AR*	10.1%
BRIDGESTONE	*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%
NISSAN	*Smyrna, TN*	7.2%
LAND O'LAKES	*Carlisle, PA*	5.7%

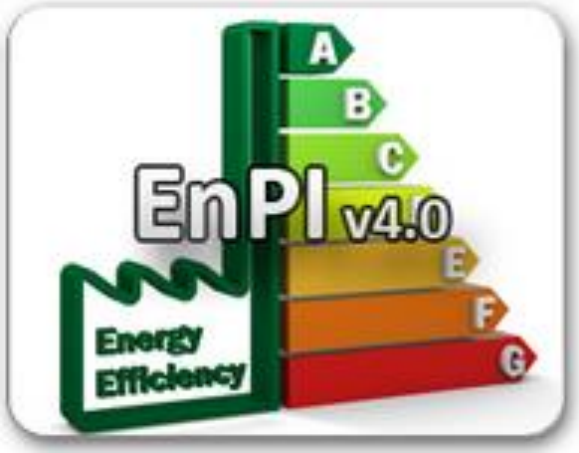
TAM Support/Improved Resources for Data Analysis

- Guidance on energy baselines and data tracking/reporting
- Data protocols remain same, but better details and more examples
- Guidance aligned with DOE's EnPI 4.0 tool, updated recently to include GHG and cost savings calculations
- Focused webinars on updated guidance will be available to Better Plants Partners this year

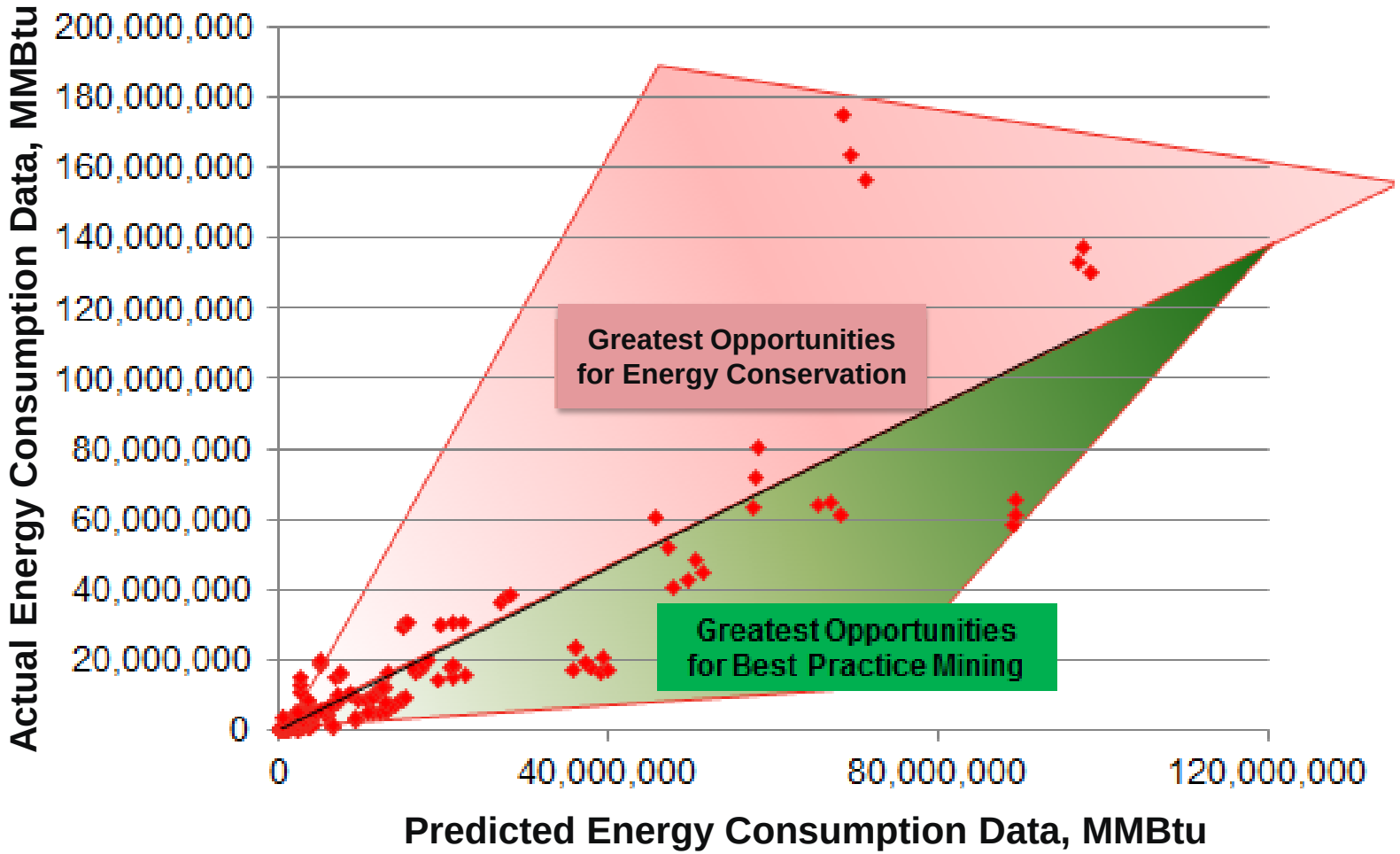


Benefits of Regression Analysis

- Accurate, “apples-to-apples” comparisons, holding for critical variables related to:
  - Weather
  - Production
- Validate energy savings
- Facilitates energy manager’s efforts to report EE impacts
- Improves comparative analyses for benchmarking
- Helps strategic planning



Benefits of Regression Analysis – Example



Source: Cummins

New for 2015

- Expanded Value to Partners:
  - Supply Chain Pilot
  - Water Savings Pilot
  - New In Plant Trainings in 2015
    - Strategic Energy Management
    - Water/Energy (concept)
    - Smart Manufacturing (concept)
  - Water/Wastewater Agencies

Supply Chain Pilot

- Existing Partners are enrolling key suppliers into Better Plants
- Performance data to be collected later in the year
- New pilot participants coming on board in 2015

Supply Chain Pilot Partner	Better Plants Suppliers
legrand Engaged 9 suppliers	Chapco, COILPLUS, COMPLETE Design & Packaging, DureX, SSS Stanley Spring and Stamping Corporation, LYNAM, Magnetic Metals, Rowley Spring & Stamping Corp
United Technologies Engaged 7 suppliers	SELMET, INC., GKN AEROSPACE, MB AEROSPACE, HITCHINER MANUFACTURING CO., INC., RTI International Metals, Inc., WEBER METALS, INC.

Supply Chain Pilot

- Cohort companies receive:
  - Access to DOE resources, INPLT trainings and technical assistance
  - Priority/free access to IAC audits
  - Opportunity to network and learn from peers
  - Individual assistance from Technical Account Managers

- Expected partner benefits:
  - Leaner supply chain
  - Lower supply chain risk
  - Positive publicity/PR

- Preliminary results expected in 2016

Water Pilot

- Pilot partners set water efficiency goals and implement actions
- Cross-sector effort with representation from commercial, public and multifamily housing sectors
- Water saving solutions will be shared with the market

Water Pilot Partners and Savings Goals

Company	Water Intensity Reduction Goal	Baseline Year
Cummins	40% by 2020	2010
Ford	30% by 2015	2009
General Motors	20% by 2020	2010
HARBEC	Water Neutral by 2015	2013
Nissan	2% by 2016	2013
Saint-Gobain	6% by 2016	2012
United Technologies	40% by 2015*	2006

* United Technologies has set an absolute water intensity reduction target.

Water Pilot

The opportunities in industry are significant:

Industry	Process	Cooling	Landscape	Consumptive	Boiler	Domestic	Misc.	Savings Opp.
Meat processing	58%	33%	1%	-	-	8%	-	27%
Dairy	23%	71%	3%	-	-	3%	-	27%
Beverages	45%	5%	-	46%	-	3%	1%	15%
Textiles	90%	5%	-	-	-	-	5%	39%
Paper & pulp	88%	4%	-	-	4%	-	4%	33%
Fabricated metals	67%	15%	-	-	-	1%	17%	35%
High tech*	70%	20%	-	-	-	5%	5%	38%
Petroleum refining	6%	57%	-	-	34%	-	3%	74%

Table courtesy of Prakash Rao, LBNL, “Energy Savings from Industrial Water Reductions”

Water Pilot

Initial results are promising:

Partner Company	Original Goal	Actual Achievement
Nissan	2% by 2016 (2013 baseline)	16.1%
Ford	30% by 2015 (2010 baseline)	37%
Saint-Gobain	6% by 2016 (2012 baseline)	13.1%
GM	20% by 2020 (2010 baseline)	11.7%

Lessons Learned and Future Approach

- Data is more variable than with energy data
  - Partners got value from the BP data review process
- Industry generally less aware of water consumption compared with energy
- Pilot partners had existing water management programs
- Companies setting water savings targets as part of sustainability strategies
- Expand the pilot to BP Challenge level partners

Water/Wastewater Treatment Sector

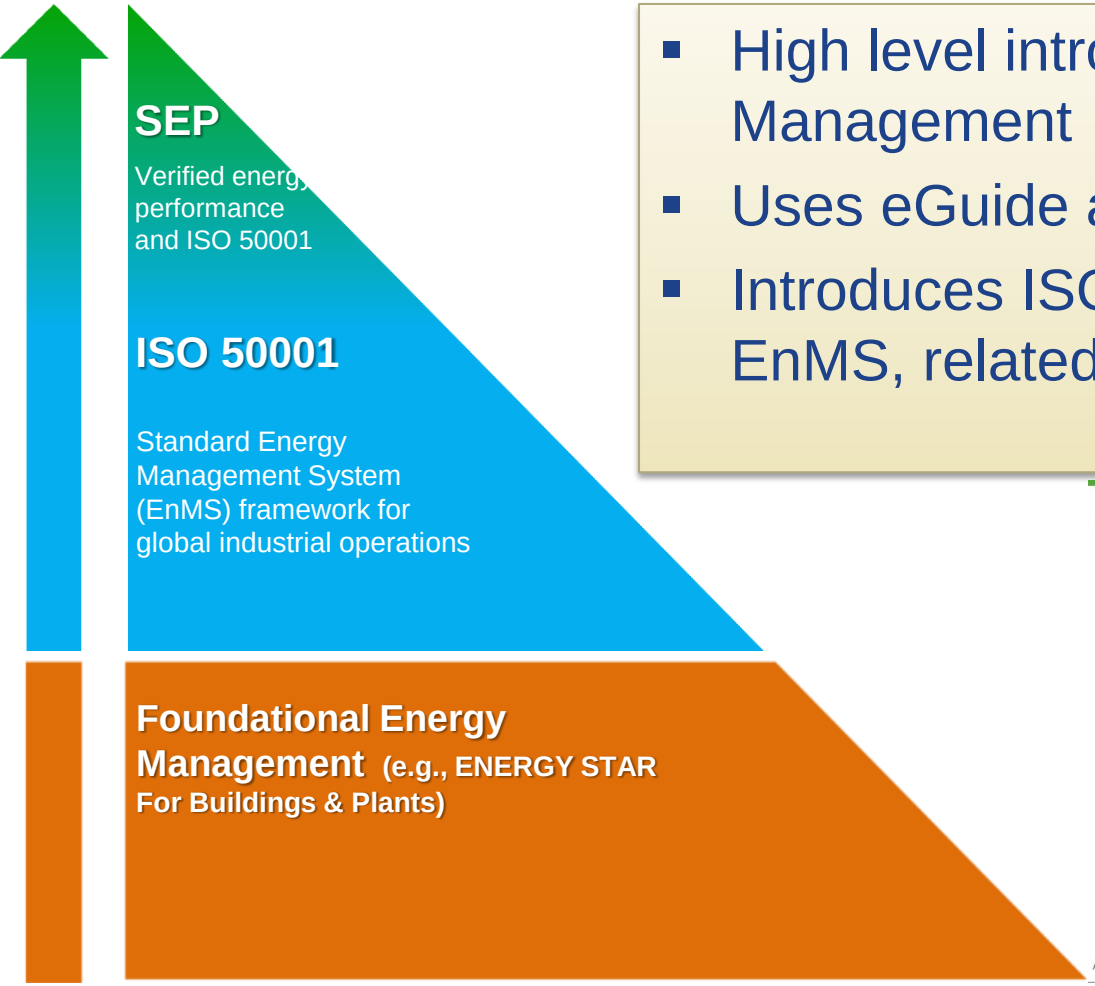
- Better Plants recently expanded to water and wastewater treatment agencies
- Ten organizations have joined, 3 at Challenge level
- DOE will work with this sector to understand key challenges, refine metrics, and share solutions

Water/Wastewater Treatment Sector

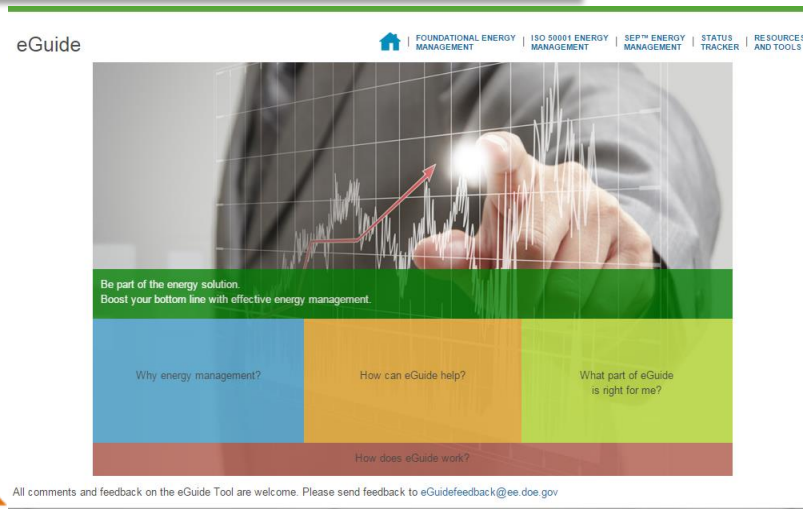
- Opportunities in this sector are significant:
  - Energy costs ~25% to 40% of total operating costs
  - Environmental mandates increase energy intensity
  - Mitigate increases to ratepayers

	Water Supply	Wastewater
# facilities in U.S.	**51,000**	**15,000**
Electricity consumption (billion KWh/year)	**39**	**30**

New INPLT Training: Strategic Energy Management



- High level introduction to Energy Management
- Uses eGuide as a learning tool
- Introduces ISO 50001-based EnMS, related tools and SEP



https://ecenter.ee.doe.gov/EM/SPM/Pages/SEM_home.aspx

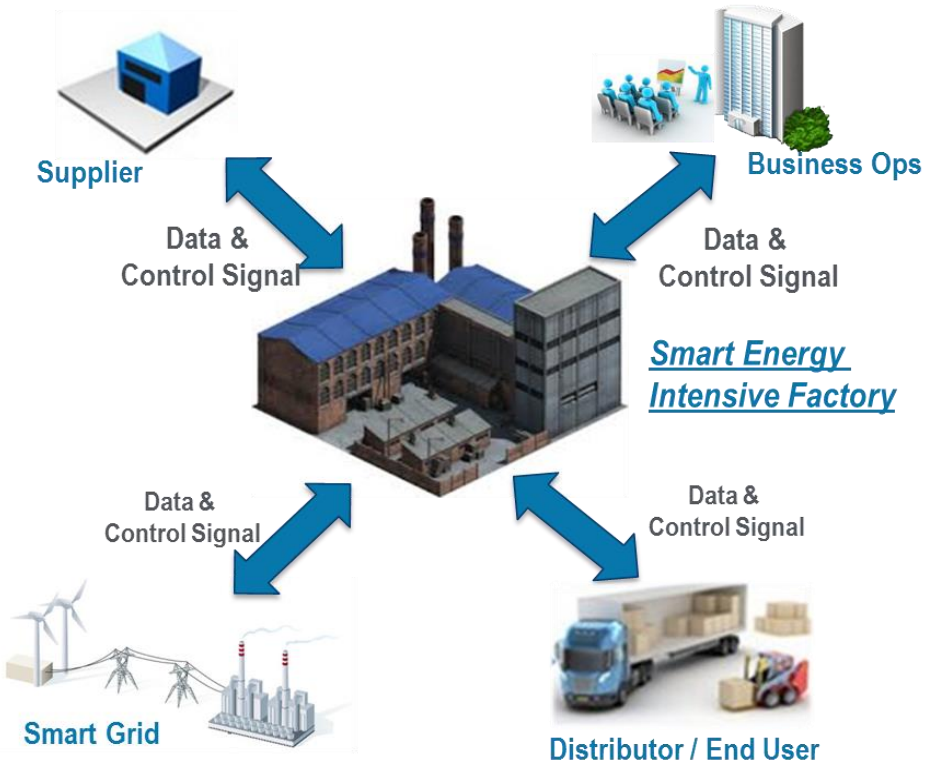
Concept for New In-Plant Trainings: Water and Energy

- **Water and Energy Closely Linked**
  - Energy is needed to extract, treat and convey water
  - Energy is needed to treat wastewater
  - Water is needed in manufacturing

- **Energy Efficiency can Save Water and Energy**
  - Improving industrial system energy efficiency
  - Energy management training
  - Energy efficiency in design considerations
  - Metering improvements and energy monitoring

Concept for New In-Plant Trainings: Smart Manufacturing

- Leveraging convergence between intelligence in operational technologies and ICT
- Potential for $15 Billion in energy savings by 2035
- Energy intensity average reduction potential of ~20%
- Improved decision-making
- Potential to reduce WIP and scrapped parts



Examples from Industry: Nissan

Through the Better Buildings, Better Plants Challenge, Nissan North America has committed to improving energy efficiency at its 3 U.S. plants by 25% by 2020.

NISSAN

- **Efficiency efforts have yielded more than $11.5 million per year in cost savings.**
- **Supplier energy summits to share energy efficiency success stories, methods for reducing energy use, and publicly available resources.**
- **In Smyrna, TN, $200 million investment in a new paint plant that will improve energy efficiency by 30% compared to the plant it is replacing.**

Nissan Americas Headquarters, Franklin, TN

Showcase Project: Nissan

Workers polish the roof of a new Nissan vehicle

NEW PAINT PLANT

Showcase Project: Nissan

LOCATION
Smyrna, TN

PROJECT SIZE
250,000 Square Feet Footprint

FINANCIAL OVERVIEW
Project Cost: $200 Million

Annual Energy Use (Source EUI)

Baseline (2010)	7.9 MMBTU/Vehicle
Expected (2013)	5.5 MMBTU/Vehicle
Actual	COMING SOON

Expected Energy Savings: **30%**

Annual Energy Cost

Baseline (2010)	100%
Expected (2013)	70%
Actual	COMING SOON

Expected Savings: **30%**

Examples from Industry: UTC

- Showcase event kicked off program partnership
- Participated in In-Plant Trainings
- Participating in water initiative
- SOP requires DOE energy software and e-Guide program guidance

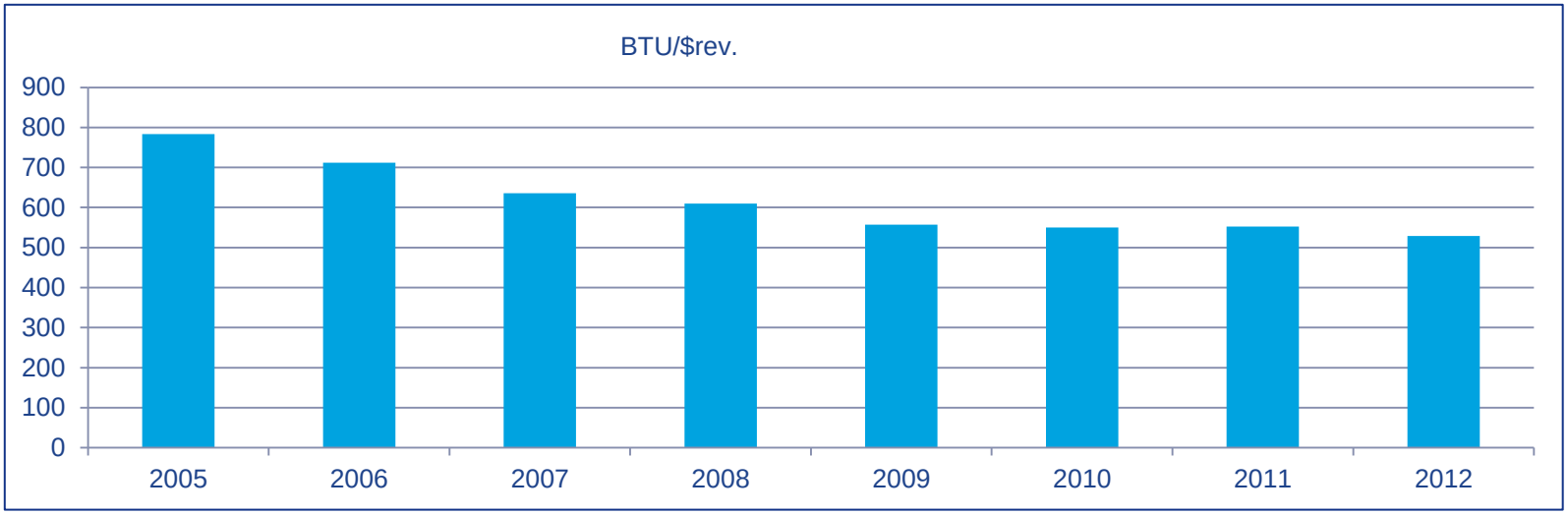
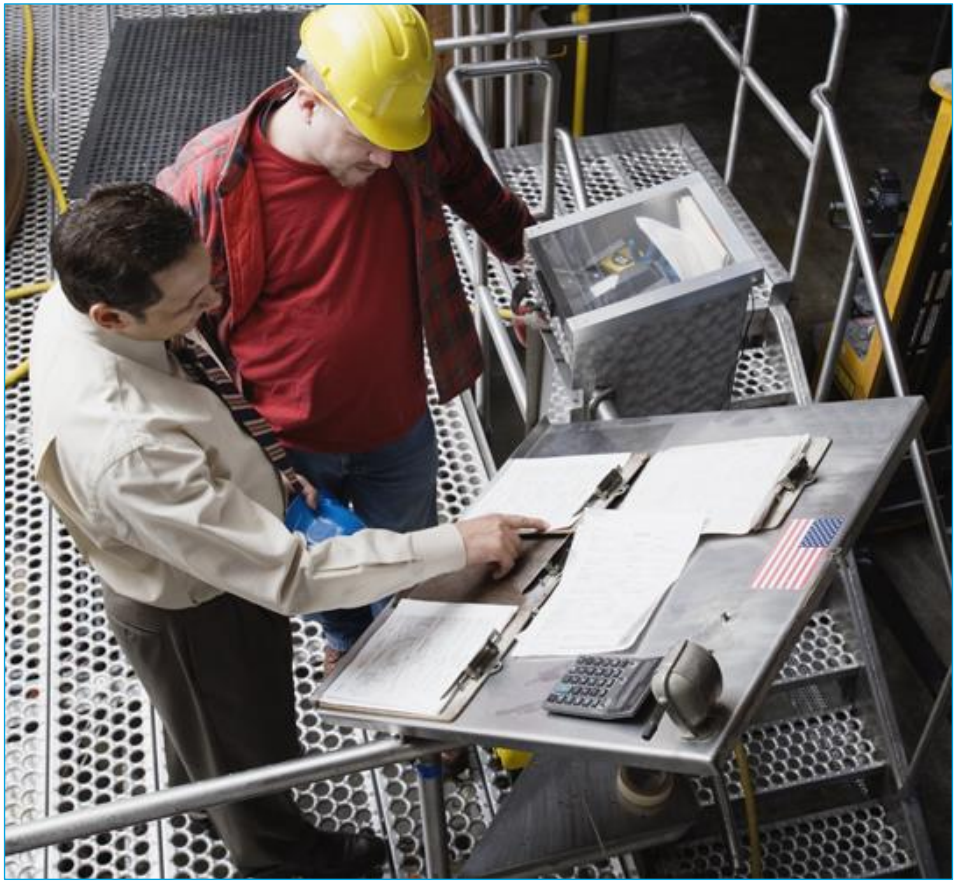


Table courtesy of UTC

Examples from Industry: Legrand



- **Aligns with corporate energy and carbon emissions reduction goals**
- **Reveals other operational efficiency opportunities**
- **Sharpens understanding of supplier and customer energy challenges**
- **Sets positive example for our employees and other businesses**

Examples from Industry: Alcoa

DOE Partnership Brings Significant Energy Savings

Goal Setting

- **Better Building Better Plants Challenge energy efficiency goal of 25% provides a target**
  - Achieved a 13% reduction to date.

Access to technical expertise

- DOE provides valuable support:
  - Plant INPLT training/assessments
  - Energy management training
  - Tools and analysis for reporting
  - DOE laboratories

Recognition

- Better Plants Challenge Partner
- Customized web page
- White House event

Examples from Industry: Volvo Trucks

Through the Better Buildings, Better Plants Volvo Trucks met 10-year reduction goal in five years

- **Technical assistance enabled:**
  - Establishing a Corporate Energy Management Model
- **Results**
  - Identified previously unknown EE projects
  - Energy cost savings ~$2 million
  - Payback periods of four to six months
- **AMO-Sponsored Activities**
  - Guidance – In-Plant trainings
  - Participated in U.S. Council for Energy Efficient Manufacturing (U.S. CEEM)
  - Dublin, VA and Macungie, PA plants achieved Superior Energy Performance certification

For more Information

Questions, Comments, Accusations?

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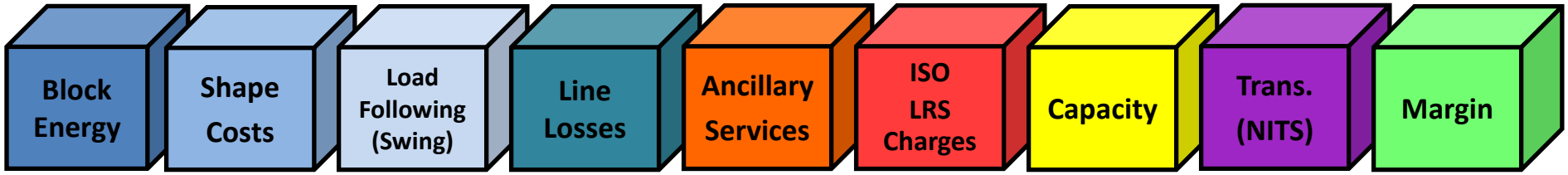
BetterPlants@ee.doe.gov

Better Buildings, Better Plants:
http://eere.energy.gov/betterplants

Better Buildings Challenge:
http://www4.eere.energy.gov/challenge/

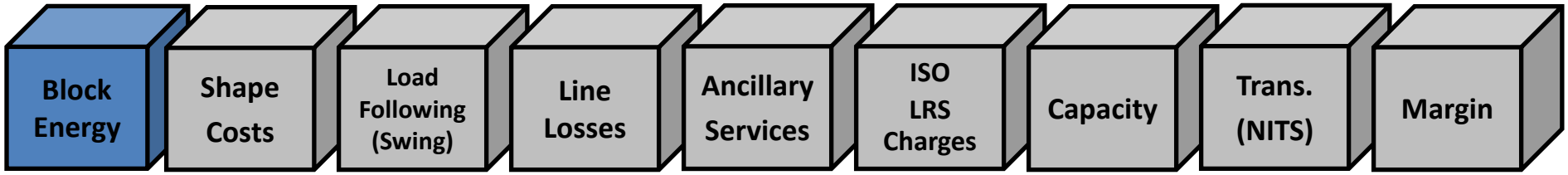
Components of a Retail Electricity Price

Building Blocks of any Retail Product



- **Block Energy** - energy that is the same quantity and price for a period of time (same hours for multiple months).
- **Shape Costs** - cost of the difference from forecasted hourly shape of the energy compared to the block energy.
- **Load Following (or Swing)** - cost associated with forecast error. Actual energy used and actual prices will vary from forecasted quantities and prices.
- **Line Losses** – cost of the lost energy consumed by the wires and transformers in the electrical grid.
- **Ancillary Services (A/S)** - charges associated with the four market-cleared charges used to maintain grid reliability.
- **ISO (ERCOT) Load Ratio Share (LRS) Charges** – charges from the ISO (ERCOT) used to maintain the grid and allow the ISO to remain revenue neutral.
- **Capacity** – Secondary revenue stream for generators for their availability to generate electricity; a charge allocated to suppliers based on an end-user's peak demand.
- **Transmission (NITS)** – a regulated charge to customers to reimburse utilities for transmission system upgrades.
- **Margin** – includes gross margin, all costs to serve, and operating costs of the supplier and third party.

Block Energy



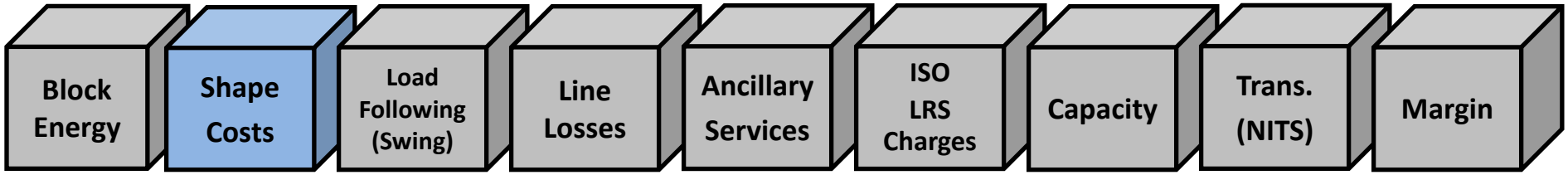
Block Energy

- These costs are the vast majority of energy costs and the majority of the overall cost of a retail price
- Blocks come in different increments like day of week / time of day groupings like: on peak (5[1]x16[2]), weekend (2x16), and nights (7x8)
- When building up a retail price, a supplier will calculate the total value of all the appropriate blocks that fill in the basic square shape of the expected load (customer's usage)
- Blocks have very little risk premiums and are the most liquid product traded in electricity

[1] the first number is the number of days per week, 5 being Mon. –Fri., 2 being Sat & Sun., 7 being all week.

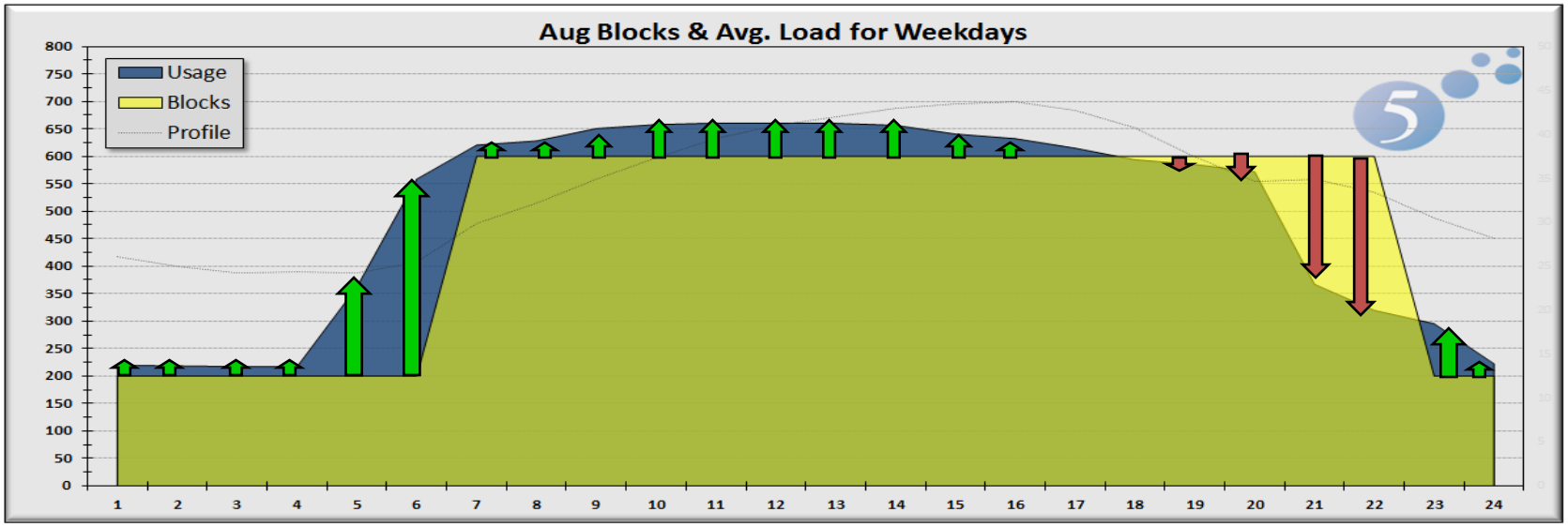
[2] the second number is the number of hours per day, 16 being the hours 6 am to 10 pm; 8 being 10 pm to 6 am.

Shape Costs

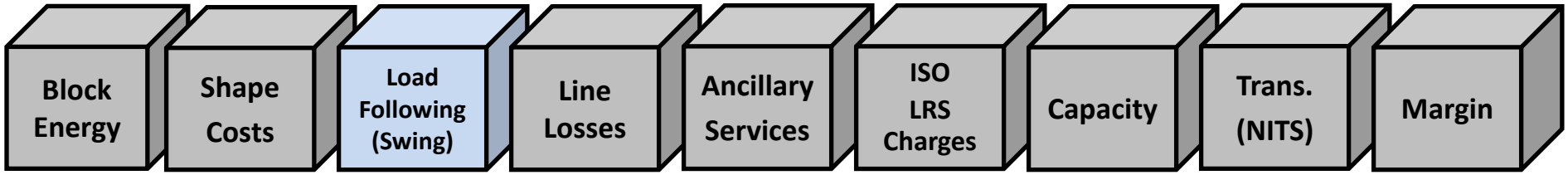


Shape Costs

- The additional cost of purchasing more power when the load is expected to be more than the block, and receiving credits for the selling of power when the block is more than the expected load.
- Green arrows are additional purchases, red arrows are credits for hours sold back into the market.

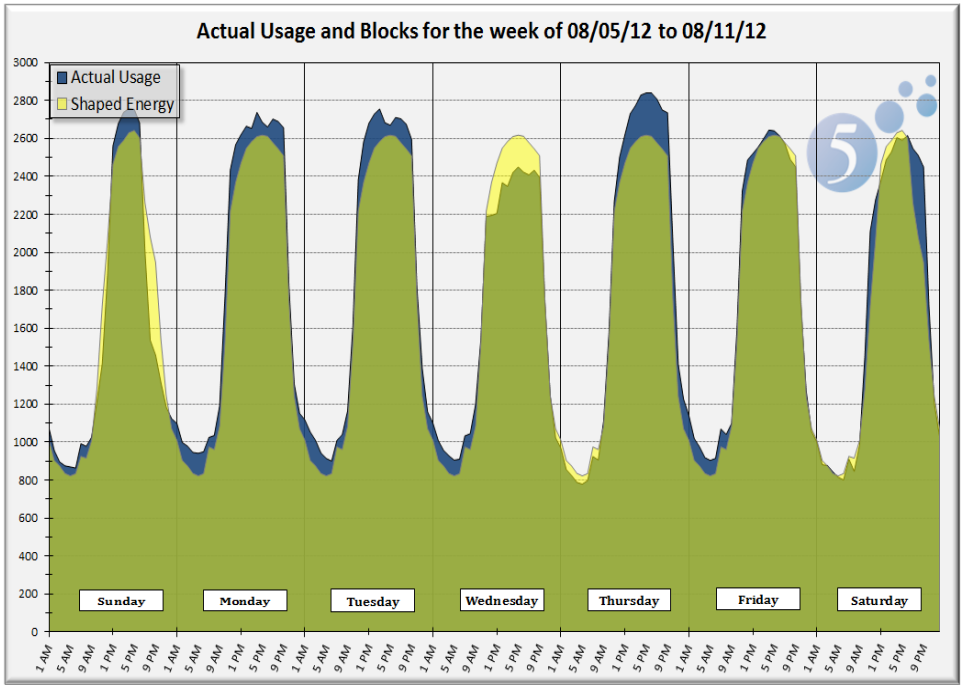


Load Following (or Swing)

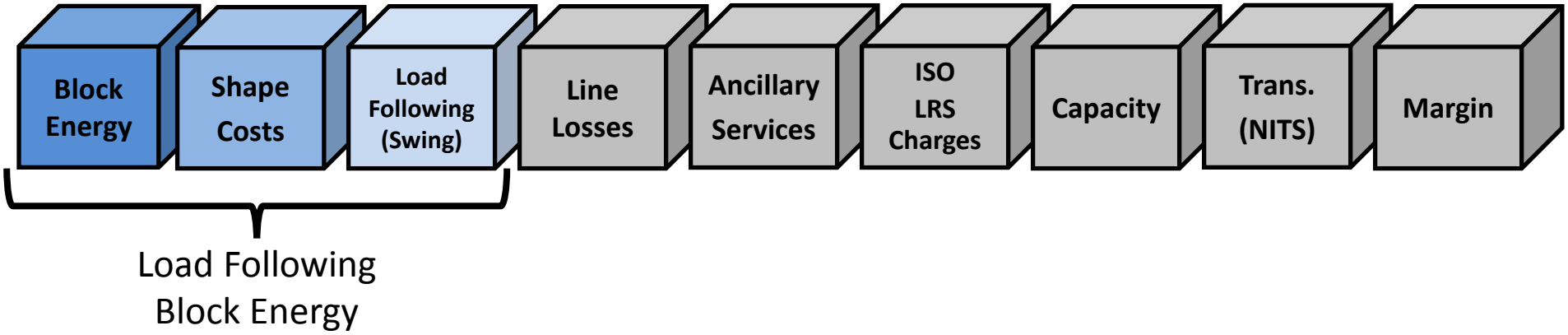


Load Following Premium / Swing

- Load Following Premium (LFP) is a risk premium associated with two facts:
  - The actual load will never be exactly the same shape as the forecasted shape used for pricing.
  - Actual real time index price at the time of settlement will also not be the exact same as forecasted prices.
- You can think of the LFP as the total additional cost of each hour's load forecast error multiplied by the error in hourly price forecasted used in shape pricing.
- During hot summer days when real time prices are typically high and customers used more power than normal, load following costs can actualized much higher due to the high cost of additional power that needs to be purchased.



Load Following Block Energy

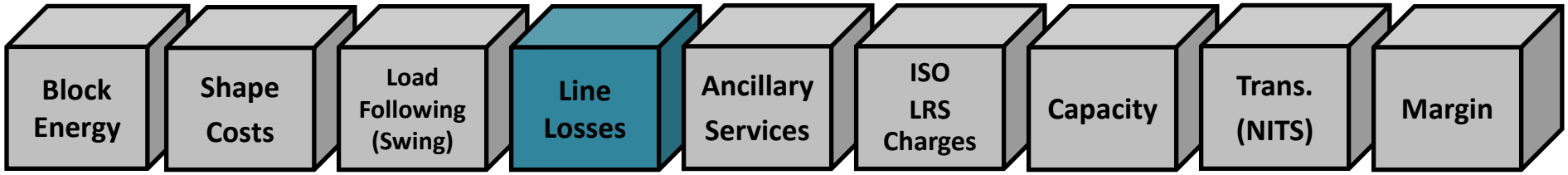


Load Following Blocks

These three blocks together make up what we commonly refer to a load following blocks, load following block energy or weighted average energy price.

- For any product other than traditional Block & Index these three components are grouped together.
- When finding a fixed price for energy, you use all of the quantities for the 3 components(Block, Shape & LFP) for each of the time periods (Peak, Off Peak, hourly) for each of the forward months in the quotes time frame in a weighted average calculation.

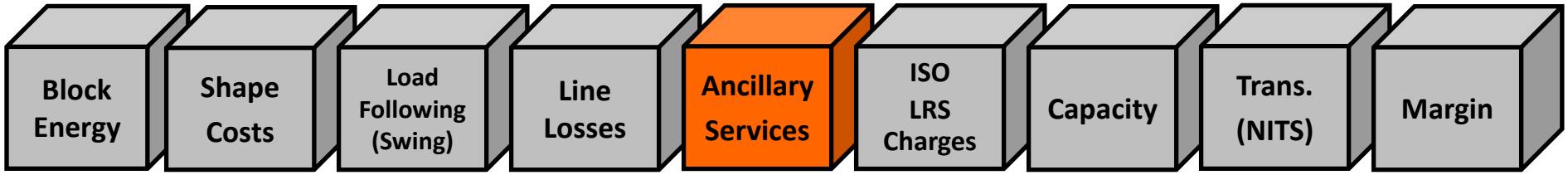
Trans. & Distribution Line Losses



Transmission and Distribution Line Losses

- Line losses are the costs associated with the fact that suppliers must purchase additional energy to cover the physical loss of electrons as they travel through the transmission and distribution system.
- These transmission and distribution losses are derived from a very complex formula updated annually by ERCOT or other ISOs and usually published on webpages like: http://www.ercot.com/mktinfo/data_agg/index
- Transmission losses are usually around 2.5% of total energy, and distribution losses range from an additional 2% to 14% based on the utility and where the customer is on the distribution system.
- Since customer's meters record electricity after the losses have occurred, the price has to be inflated to recoup the costs of these losses.
- The formulas that derive the actual settled percentages are typically updated annually.

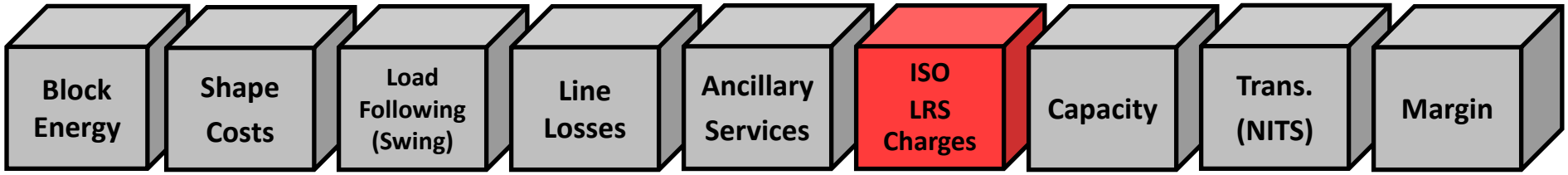
Ancillary Services



Ancillary Services (A/S)

- Ancillary Services are the four market-cleared services provide by generators needed to maintain a safe and balanced grid.
- The four main services (in ERCOT) are:
  - Regulation Up (Reg. Up)
  - Regulation Down (Reg. Dn)
  - Responsive Reserve Service (RRS)
  - Non-Spin Responsive Service (NSRS)
- You can think of these services as the “second string” players of the energy market. You have to pay for them to stand on the sidelines and be ready to play on very short notice.
- The required quantity is known the day before delivery, and the ISO’s procurement methodology is usually updated annually.

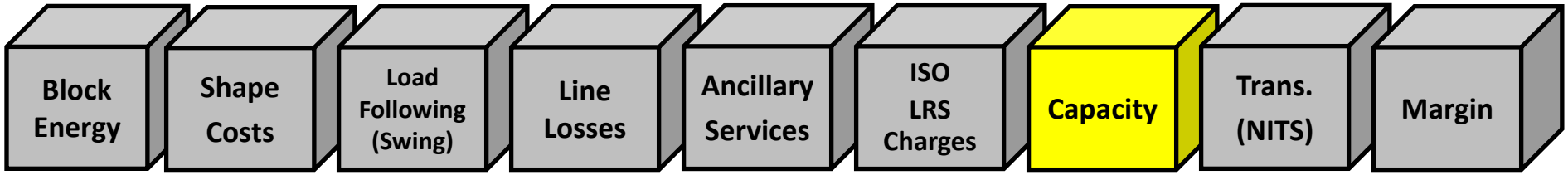
ISO LRS Charges



ISO Load Ratio Share (LRS) Charges

- These costs represent all the additional services provided by the ISO and generators required to maintain grid stability.
- These charges are uplifted to all Load Serving Entities (LSE) equally in a $/MWh per MW of load served.
- Since these future charges are unknown, they must be priced with a risk premium to account for the variability of the unknown.
- Some examples are:
  - ERCOT Admin Charge
  - Black Start Service
  - Revenue Neutrality Adjustment

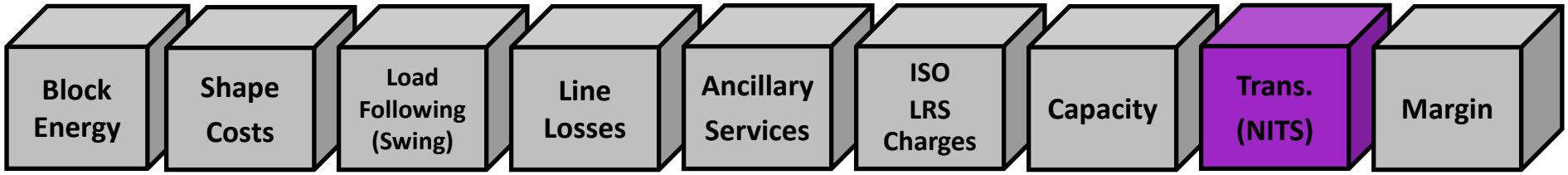
Capacity Charges



Capacity Charges

- Capacity charges are market specific: PJM, NYISO & MISO are capacity markets, Texas & California are not.
- Charges are calculated based on peak demand (a capacity tag) multiplied by the clearing price of capacity for a time frame specific to that market:
  - PJM – annual capacity auction from June through May, cleared in $/MW Day.
  - NYISO – bi-annual auction for May–Oct and Nov–Apr, and spot auctions for monthly prices; all cleared in $/kW Month.
  - MISO – annual capacity auction from June through May, cleared in $/MW Day.
  - ISO-NE – annual capacity auction from June through May, cleared in $/MW Day.
- To convert to kWh based rate, the supplier must forecast annual capacity cost and divide by forecasted annual kWh to get a $/kWh. Supplier then wears customer's volumetric risk.

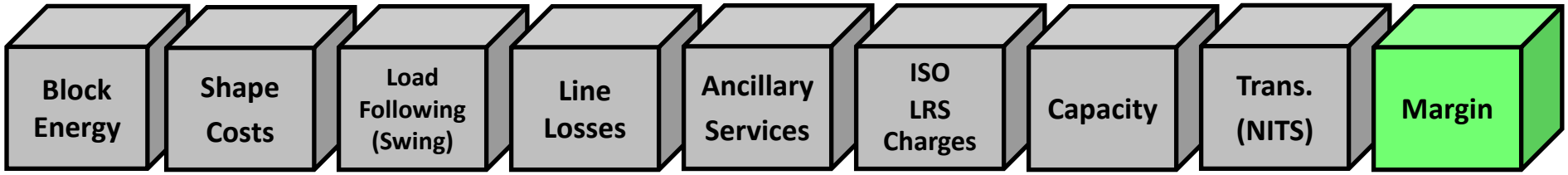
Transmission Charges



Transmission (NITS) Charges

- Transmission Charges are also known as Network Integration Transmission Service.
- Applicable to the majority of PJM states except Ohio (Texas & Ohio law require including transmission charges in the standard tariff based utility charges).
- Charges are calculated based on peak demand (a trans tag) multiplied by the regulated and approved rate. Rates are often quoted in $/MW Year.
- Rate are only known for upcoming year, very little forward price signals.
- To convert to kWh based rate, the supplier must forecast annual transmission cost and divide by forecasted annual kWh to get a $/kWh. Supplier then wears customer's volumetric risk.

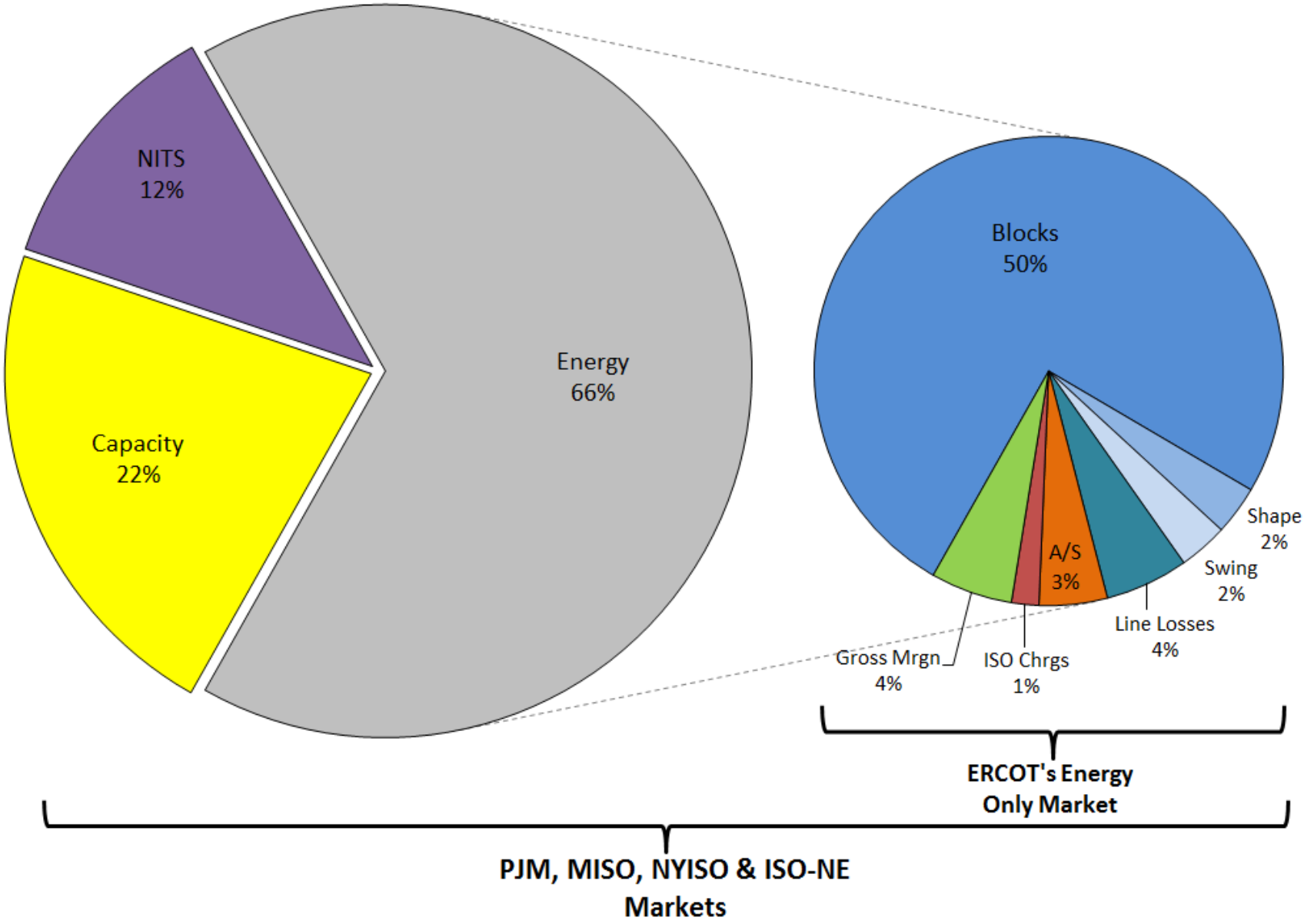
Margin & Miscellaneous Costs



Gross Margin & Misc.

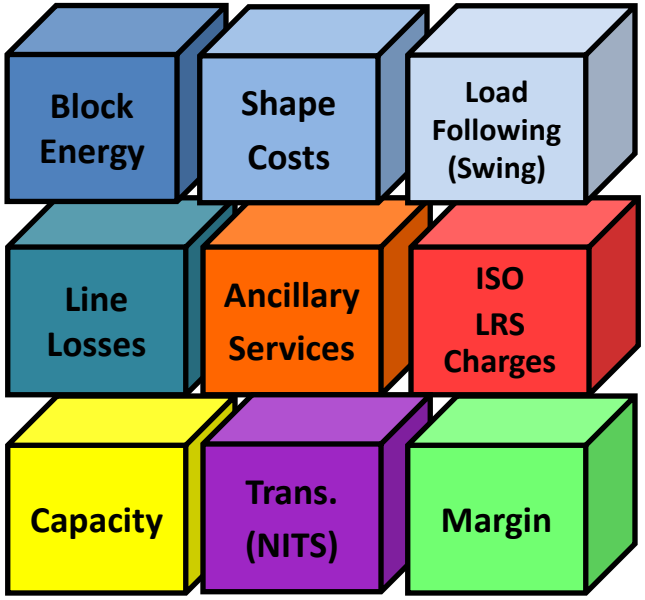
- Gross margin usually includes all costs require to serve the customer other than energy related items. These are things like:
  - Billing costs
  - O&M
  - Commissions to both internal and external sales forces
- Miscellaneous items might include:
  - PUCT required Renewable Energy Credits (aka Renewable Portfolio Standards)

Components as Percentage of Whole



Fixed Price

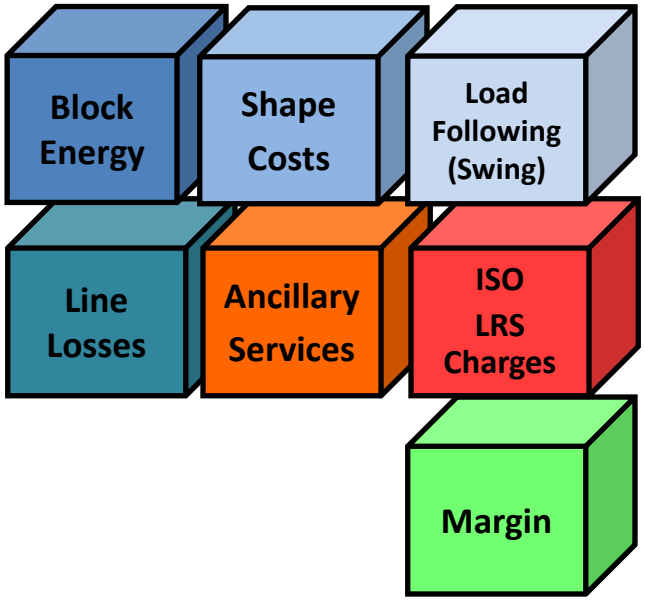
Fixed Components



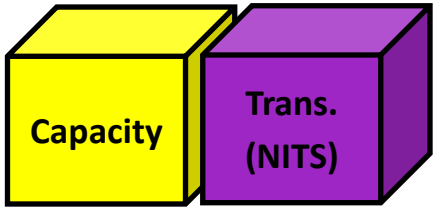
Floated Components

Fixed Price with Cap. & Trans. PT

Fixed Components

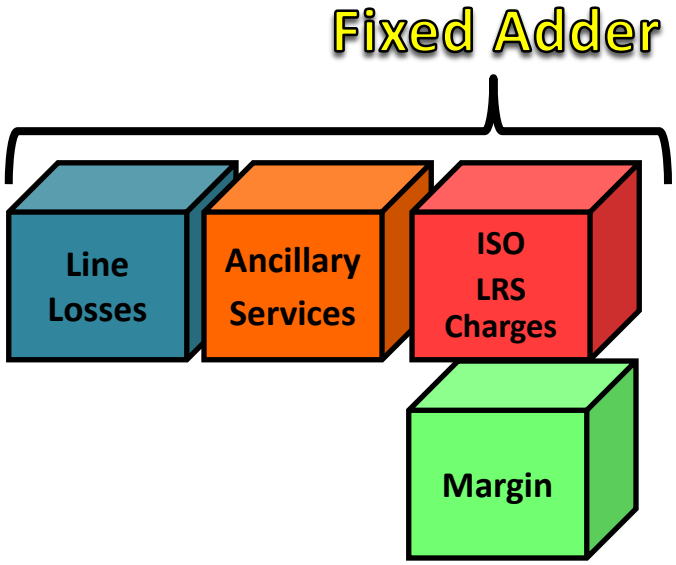


Floated Components



Index with Fixed Adder

Fixed Components



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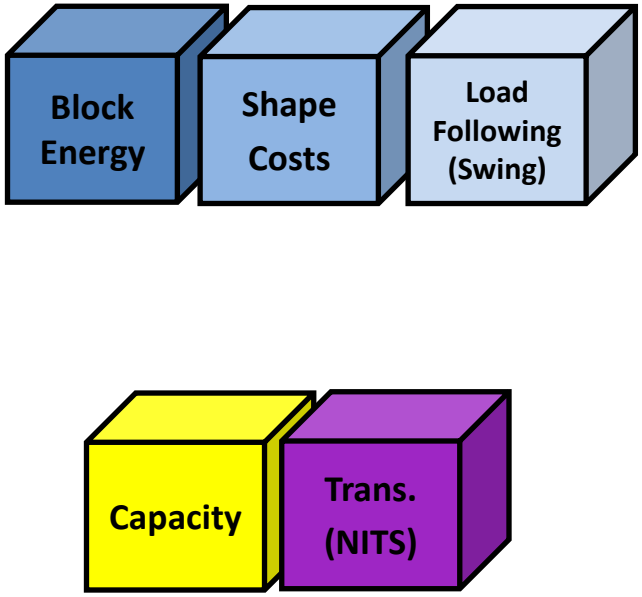
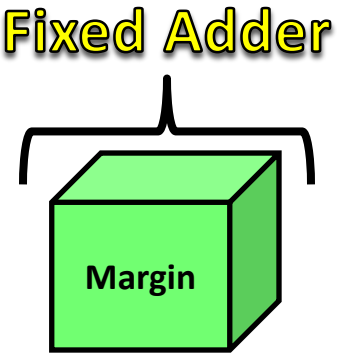


Index with Full Pass Through

Fixed Components



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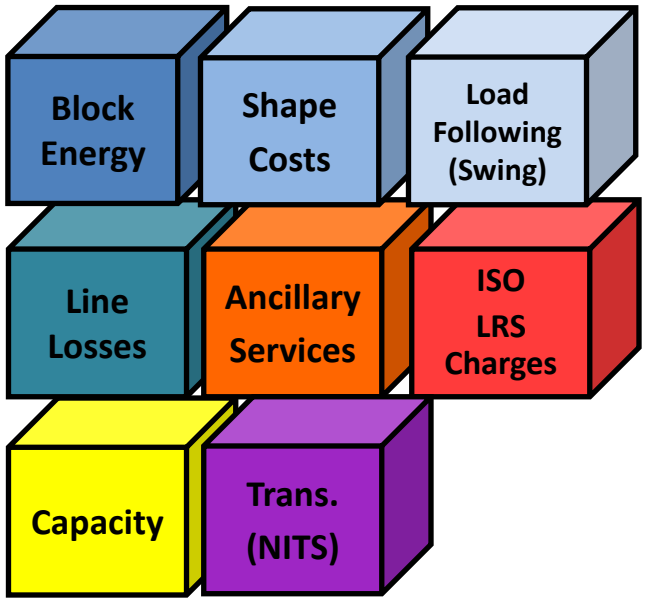
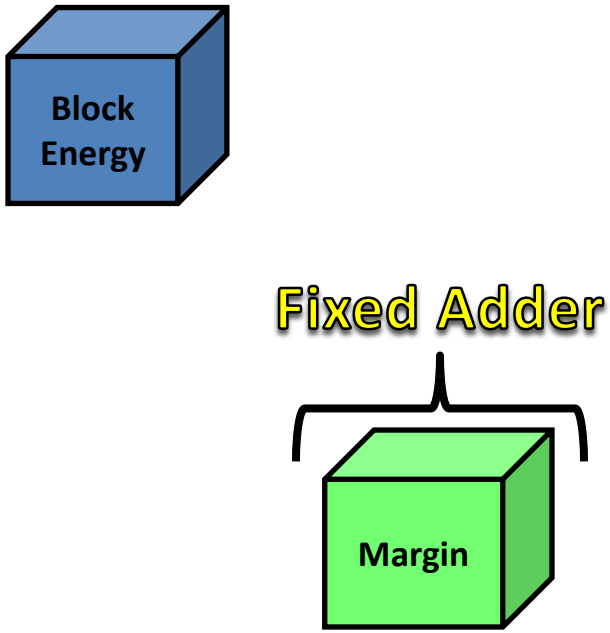


Block & Index with Full Pass Through

Fixed Components



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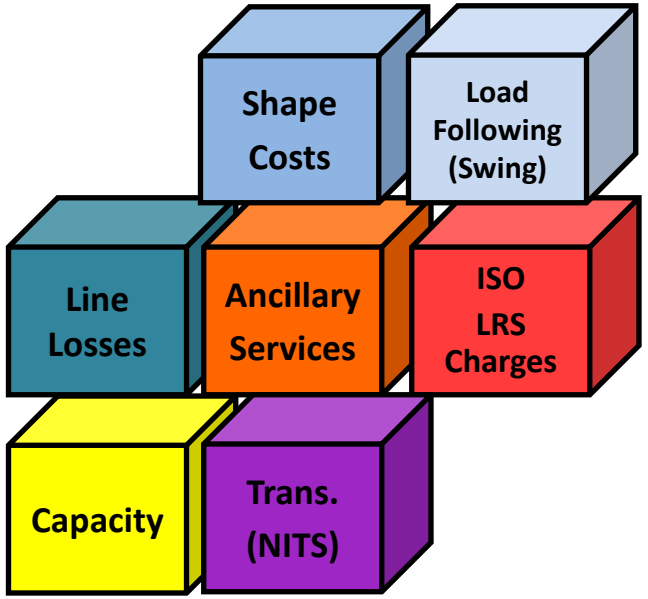
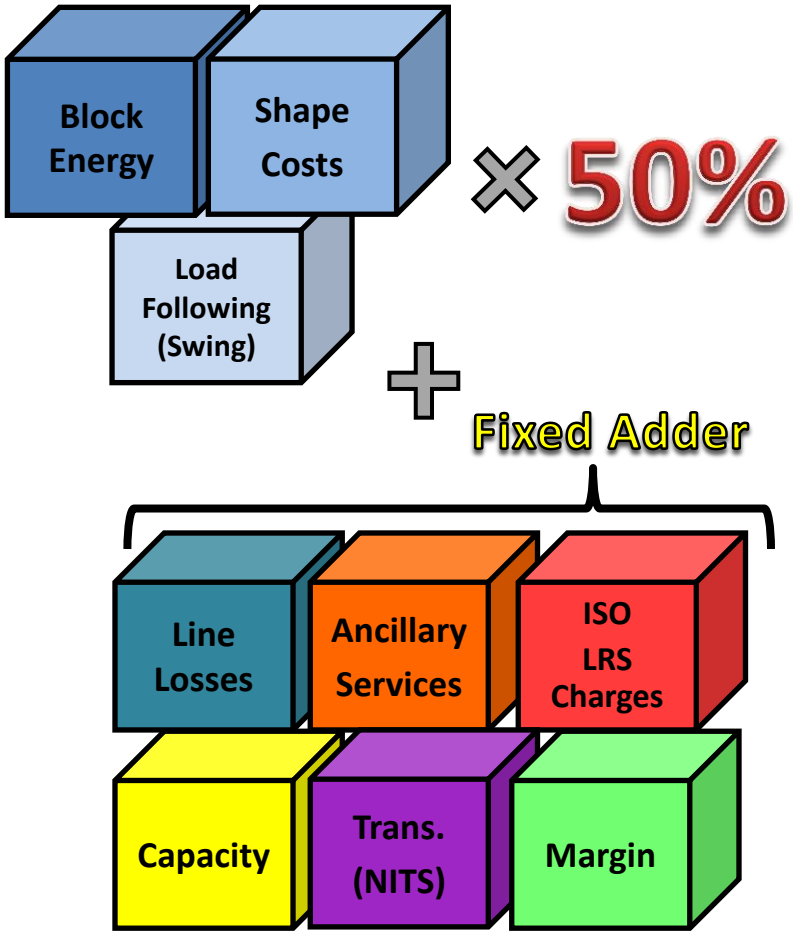
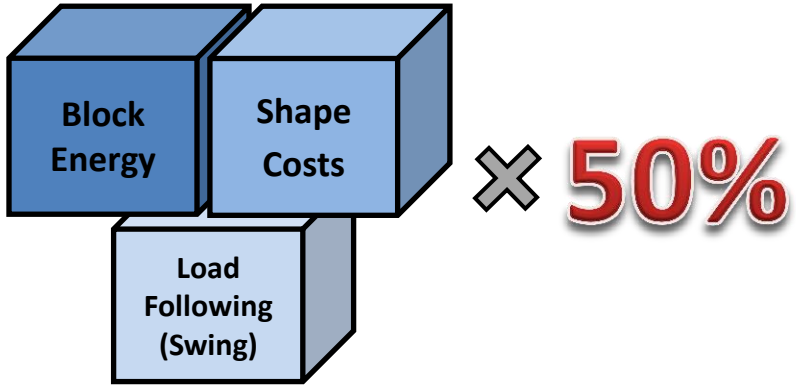


Percentage Fixed & Index (aka LFB)

Fixed Components



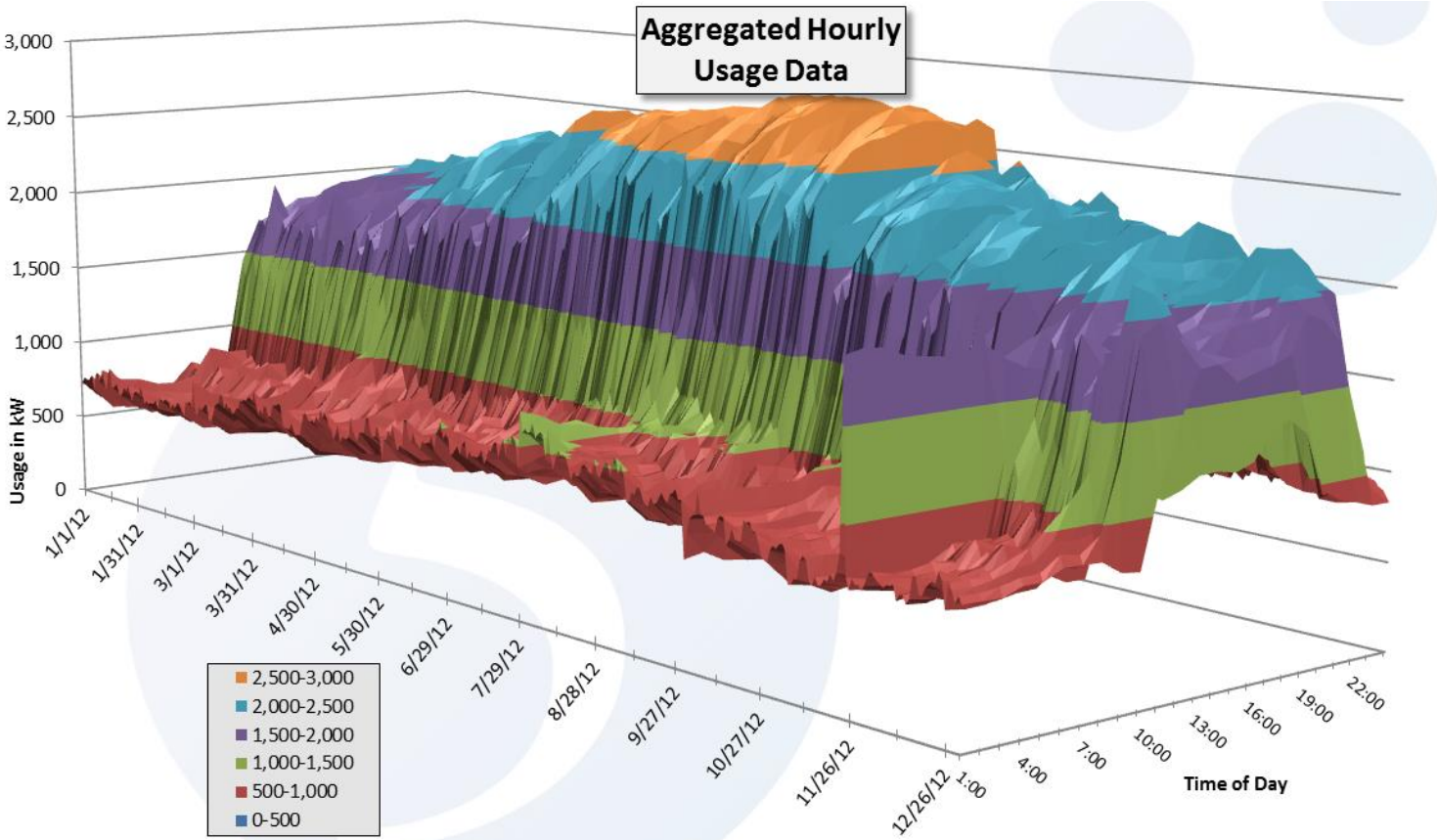
Floated Components



So we understand products and risk premiums, now what?

Hourly Data Analysis

Utilize Interval Data Recorders (IDR) or Automated Meter Reading Systems (AMR/smart meters) to analysis a customer's actual usage.

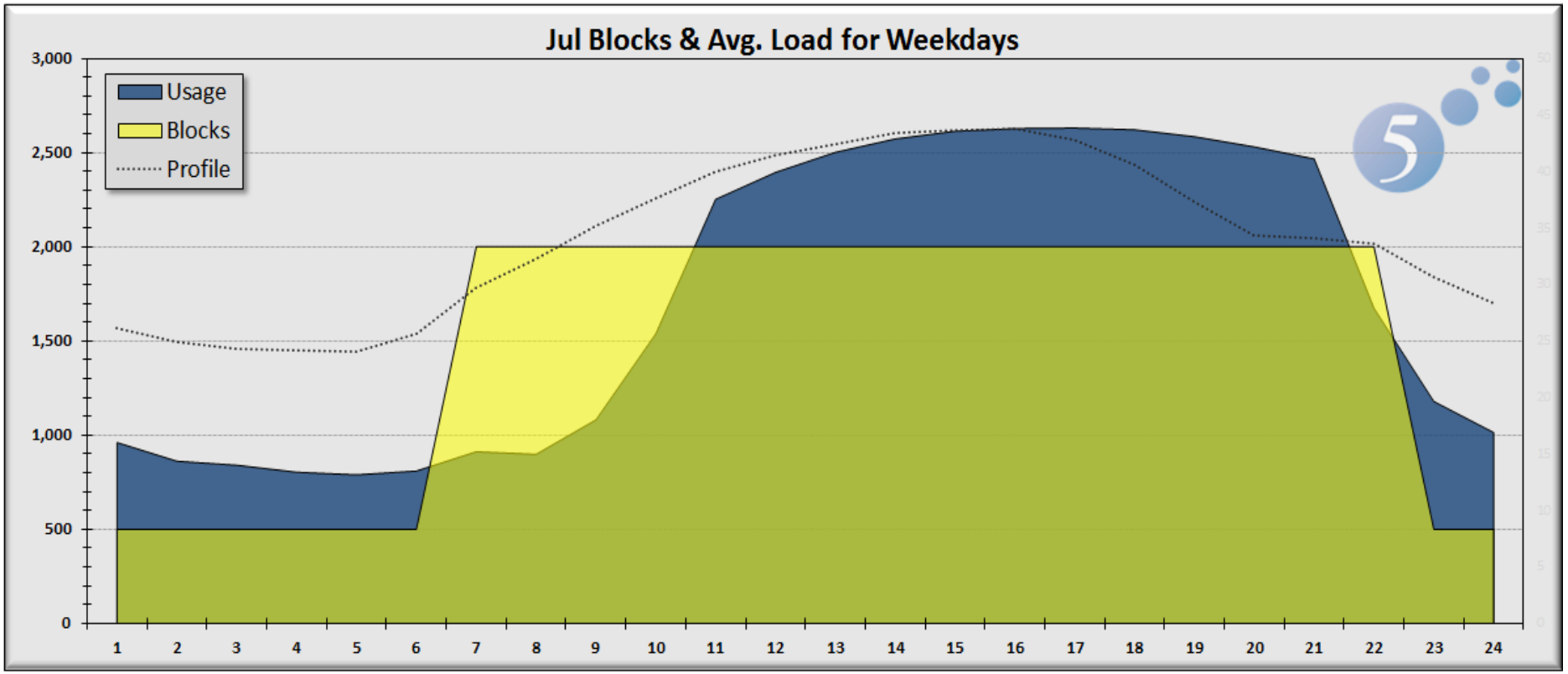


A North Texas shopping mall.

Notice the usage oddity?

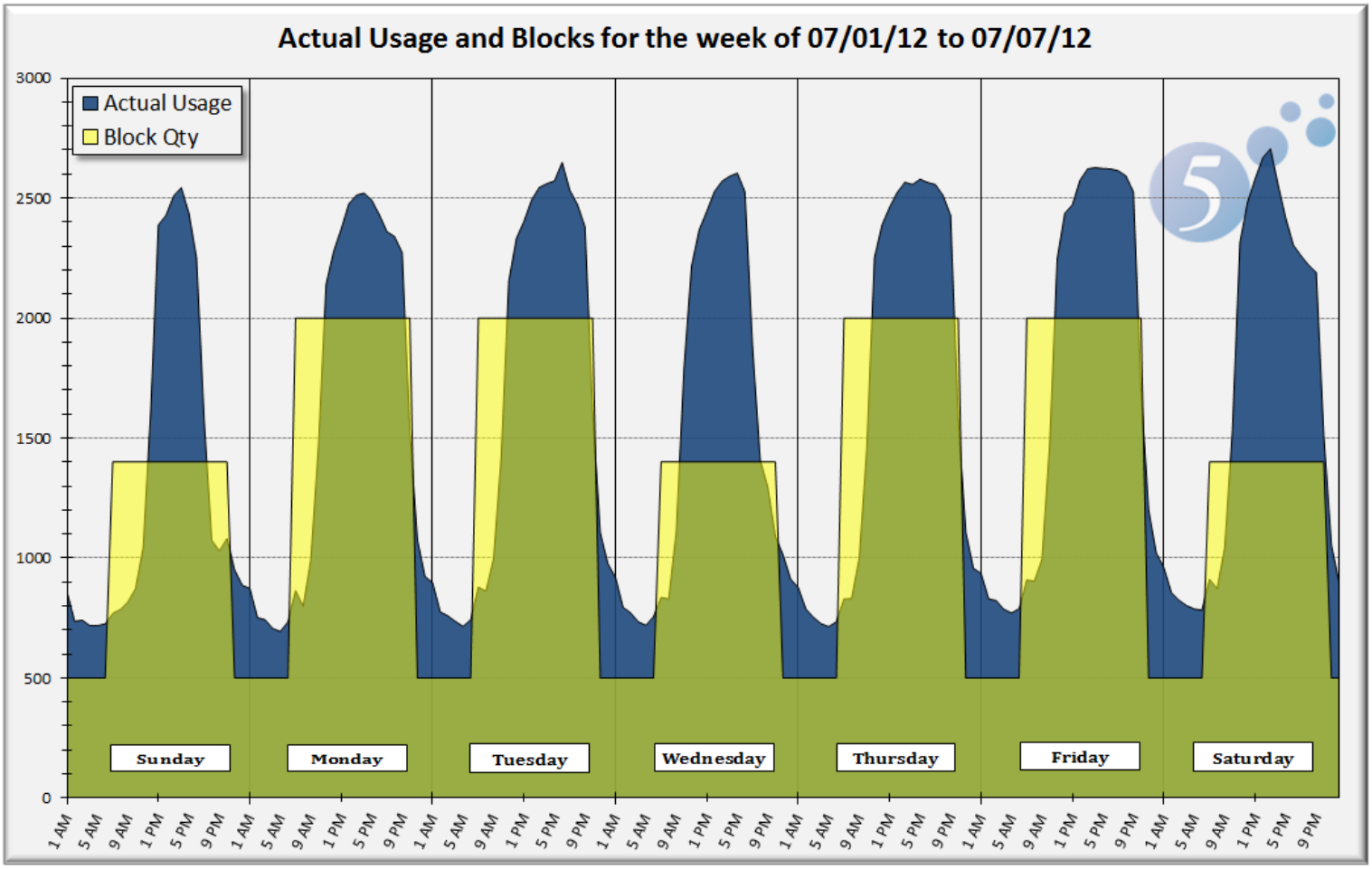
Hourly Data Analysis

Look at the average hourly usage values per month to find proper risk-adjusted amount of block energy to recommend.



Hourly Data Analysis

After finding optimal block quantities based on monthly averages, we check the actual usage to look at potential cost of Load Following Premium and if the client's volumetric volatility is worth self-insuring.



Questions?