Upgrade Your Sports Lighting Without Breaking the Bank

Presented by

- Tim Imhoff
- Bob DeCouto
- Danny Sheldon
- Jason Frucht
- Lewis Gilbert

musco Lighting
We Make It Happen.

Objectives for Today:

- Identify existing issues with old lighting systems, how these issues create safety concerns and performance limitations of new technologies
- Identify examples of technological advances that decrease electric use and decrease or eliminate maintenance
- Identify funding options to upgrade infrastructure without increasing budget requirements

The Goal of Sports Lighting

To provide an artificial lighted environment where the players can play the game safely, the spectators can watch the game safely and to maintain the integrity of the lighting design over the long term.

Sports Lighting Issues and Concerns

Light Levels Uniformities

Standards

Electrical System Structural

Maintenance

Light Pollution

Glare Sky Glow Spill Light

Cost of Ownership

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Cost of Ownership

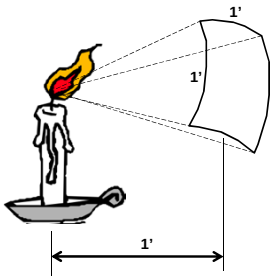
How About Lighting Standards?

What are the lighting standards?

Basic Design Criteria

Quantity - Amount of light on the field (footcandles)

What is a foot-candle?



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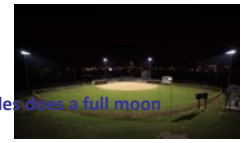
What can the human eye adapt to?

How many footcandles does the sun produce?

10,000 FC

Most facilities are illuminated between 30 and 75 foot-candles



Yet, the eye adapts

How many footcandles does a full moon produce?

.02 FC

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Basic Design Criteria

Quantity – What factors can effect the quantity of light levels?

- Age of the system
- Hours of usage
- Starting point of initial design

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Basic Design Criteria

Quality – Smoothness of Light (Uniformities)

Countryside Soccer Complex
Clearwater, FL

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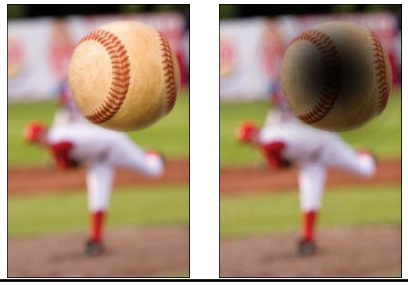
Basic Design Criteria

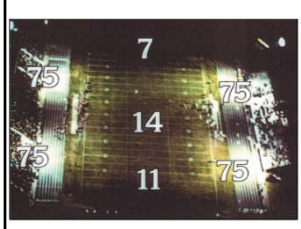
Quality – Why is Smoothness Important?

Allows players to track the ball and play safely



Basic Design Criteria

Quality – What factors can effect smoothness?



Uniformities can be effected by lamp outages or fixture alignment

Quantity of Light

Illuminating ENGINEERING SOCIETY

"Maintained Average Illuminance is the average illuminance below which the light level is not supposed to fall throughout system life" IESNA – RP-6-01 page 5

How do you <u>maintain</u> light levels?

Depreciating Light Technology

1. **Initial Light Levels (extra light when first energized)**
2. **Maintained Light Levels (eventual light levels as lights dim)**
3. **Group Re-Lamp after lights dim to Maintained Light Levels**

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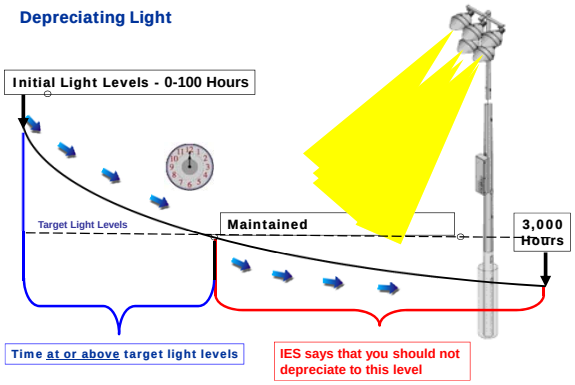
Depreciating Light



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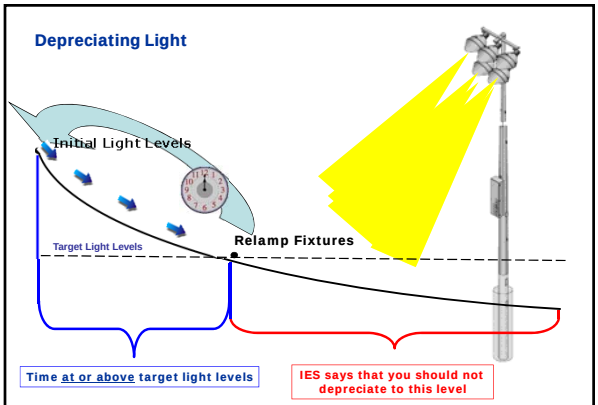
Depreciating Light



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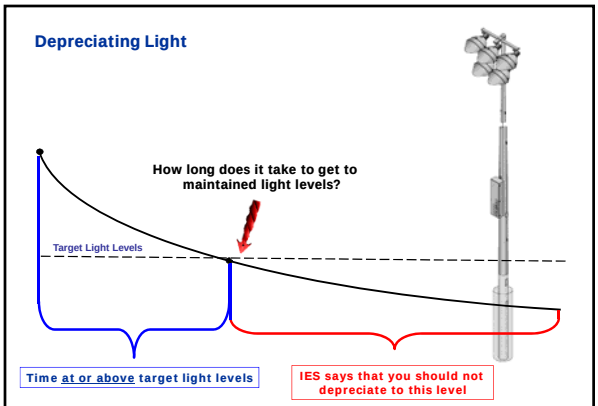
Depreciating Light



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Maintained Light Levels

Until January 2010 the Industry Relied on:

- **Lamp Cut Sheets**
- **Field Testing**

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All 1500w Metal Halide Lamp Cut Sheets tell you the following:

The "rated" life of a 1500w metal halide lamp is 3000 hours

Metal Halide Lamps will lose 20% of their lumen output after burning for 40% of the lamps rated life

Which means … In an air conditioned, perfect environment, this lamp will lose 15-20% of its light ***when operated for 1,200 hours***

Is the rated life for a Sports lighting application different?

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Factors that effect Lamp life

Operating Position - "Rated life" for universal lamps operated horizontally is 75% of the published rating

Operating Cycles – Most metal Halide lamps are rated for 10 hour stop/start cycles

Operating temperatures - Extremely high operating temperatures will reduce lamp life

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Maintained Light Levels

Until January 2010 the Industry Relied on:

- Lamp Cut Sheets
- **Field Testing**

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Maintained Light Levels

January 2010, I.E.S. Published – Penn State Report

Leukos Vol 6 No 3 January 2010 Pages 183-201

Light Loss Factors for Sports Lighting

KW Houser, PhD, PE, MP Royer, and RG Mistrick, PhD, PE

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Maintained Light Levels

Background

- **Started with 37 Fields (31 Ultimately Qualified)**
- **Four Different manufacturers**
- **Five Different Cities**

Additional Criteria

- **Initial Design calculations**
- **Documentation of the LLF used in the designs**
- **1500w Lamps**
- **Verifiable hours of usage**

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Conclusion – Recommendations

Initial / Maintained Systems

Maintenance Factor	Maintained Target	Initial Light Levels	Group Re-Lamping Hours
0.80	**30fc**	**37.5**	**750**
0.75	**30fc**	**40.0**	**1200**
0.69	**30fc**	**43.5**	**2100**
0.65	**30fc**	**46.2**	**3000**

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Sports Lighting Issues and Concerns

Light Levels

Uniformities

IES Standards

Electrical System

Structural

Maintenance

Light Pollution

Glare

Sky Glow

Spill Light

Cost of Ownership

Wood Poles

Electrical

Steel in the ground?

Checked the water inside your direct buried steel pole lately?

Integral Ballast

Remote Ballast

Every System Requires Maintenance

History of Warranties

1975-1990 – 5 year warranty (2 year lamp, 5 year on other components … parts only)

1991 – 1999 - 7 Year warranty (2 year lamp, 7 year on other components … parts only)

2000 – 2005 – 10 Year Warranty (Comprehensive parts and labor warranty includes lamp outages and re-lamp)

2005 - Today – 25 year Warranty (Comprehensive parts and labor warranty includes lamp outages, re-lamps and guaranteed light levels)

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Most systems installed prior to 2001 have expired warranties

Cost of maintenance?

Keeping lamps burning

Costs associated with maintaining minimum standards

Group Re-Lamping

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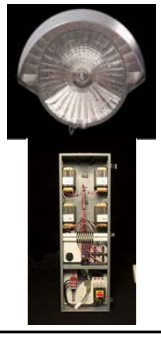
If fewer fixtures are being used, there should be a visible difference between old technology and new technology to produce beam overlap

Old Technology **New Technology**



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Factors that effect Spill & Glare

Pole Mounting Heights

Taller poles create a more downward angle of aiming for the fixtures. This can reduce the off light spill to the adjoining properties.

Reflector Design

Optic design can control light and limit the amount of off site spill & glare

Arc Tube Orientation

The position of the arc tube within the fixture can effect the amount of glare produced by the fixture

Mounting Heights

Improper mounting heights can increase spill and glare on adjacent properties

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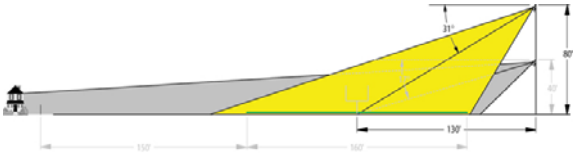
Mounting Heights

Improper mounting heights can increase spill and glare on adjacent properties



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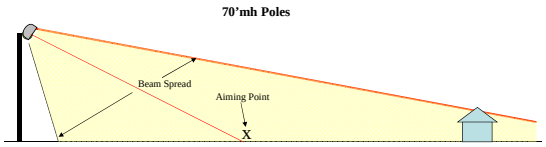
Factors that effect Spill & Glare

Pole Mounting Heights



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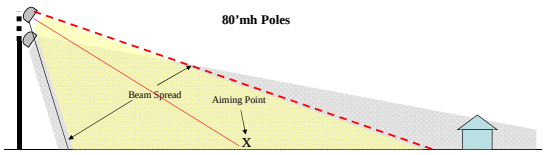
Factors that effect Spill & Glare

Pole Mounting Heights



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Factors that effect Spill & Glare

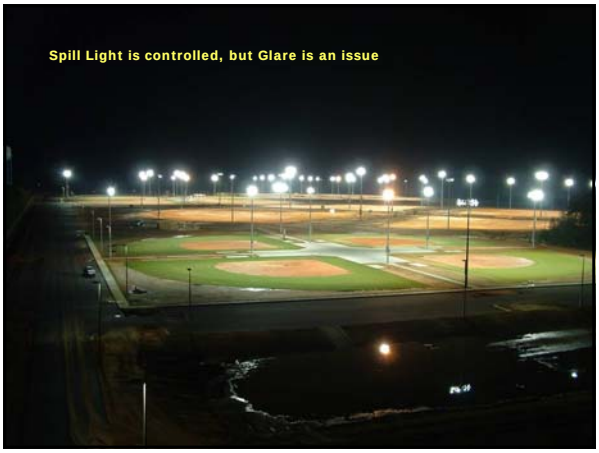
Reflector Design

Reflector Design

Evaluating Glare Control


Glare


Spill and glare


Spill Light is controlled, but Glare is an issue

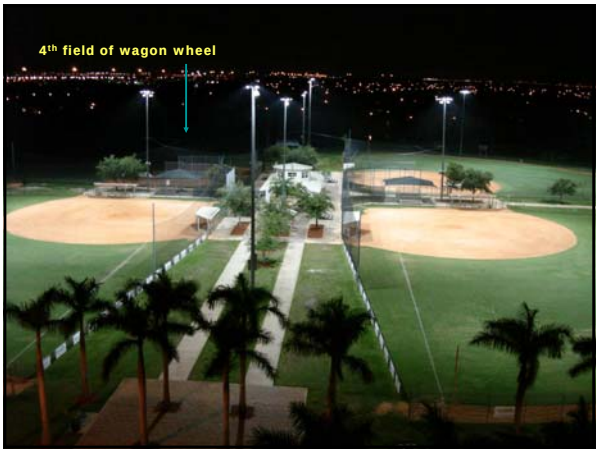

Skyglow


Before


Before
After


Before


After


4th field of wagon wheel

Sports Lighting Issues and Concerns

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Spill Light

Cost of Ownership

Evaluating Long Term Costs

Operating Costs

IESNA – PAGE 83

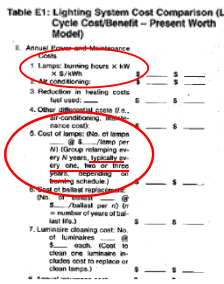

Table E1: Lighting System Cost Comparison (Life Cycle Cost/Benefit – Present Worth Model)

II. Annual Power and Maintenance Costs

1. Lamps: burning hours × kW × $/kWh $ ____ $ ____

2. Air conditioning: $ ____ $ ____

3. Reduction in heating costs (add if used): ____ $ ____ $ ____

4. Other differential costs (i.e., air-conditioning, maintenance cost): $ ____ $ ____

5. Cost of lamps: (No. of lamps ____ @ $ ____/lamp per N) (Group relamping every N years, typically every one, two or three years, depending on burning schedule.) $ ____ $ ____

6. Cost of ballast replacement: (No. of ballasts ____ @ $ ____/ballast per n) (n = number of years of ballast life.) $ ____ $ ____

7. Luminaire cleaning cost: No. of luminaires ____ @ $ ____ each. (Cost to clean one luminaire includes cost to replace or clean lamps.) $ ____ $ ____

25-year Life Cycle Costs

Eddie C. Moore Park – Clearwater, FL

	Prior Technology	Light·Structure GREEN.	Your Savings
Hours	850 Annual	850 Annual	
Luminaires	430	228	
Average kW	696.6	355.68	
Energy	**$1,632,223**	**$833,404**	**$798,819**
Group Relamp	$1,451,250	$0	$1,451,250
Lamp Maintenance	$90,000	$0	$90,000
Controls – Energy	$0	$0	$0
Controls – Labor	$0	$0	$0
25-Yr Life Cycle Cost	**$3,173,473**	**$833,404**	**$2,340,069**

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$.116 kWh, Re-lamping every 750 hours according to Penn State Report

Objectives

- Identify existing issues with old lighting systems, safety concerns and performance limitations
- Identify examples of technological advances that decrease electric use and decrease maintenance
- Identify funding options to upgrade infrastructure without increasing your budget

What's Next for Sports Lighting?

Electronic Ballasts?

LED?

Other enhancements?

LED

Bay Bridge LED Video

Wadi Abdoun Bridge

Bridge Architectural Lighting

Wadi Abdoun Bridge

Musco is LM-80 certified (LM-80 was developed by IES for the Dept of Energy. There Are only 21 certified labs in the US and 30 worldwide)

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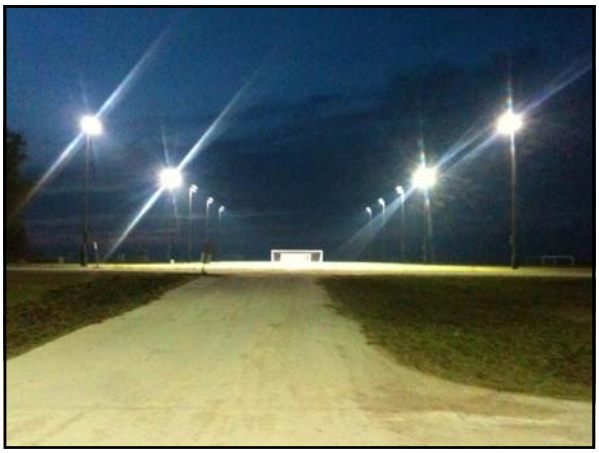
LED

Sports Lighting?



LED Sports Lighting Gone Bad
Arizona

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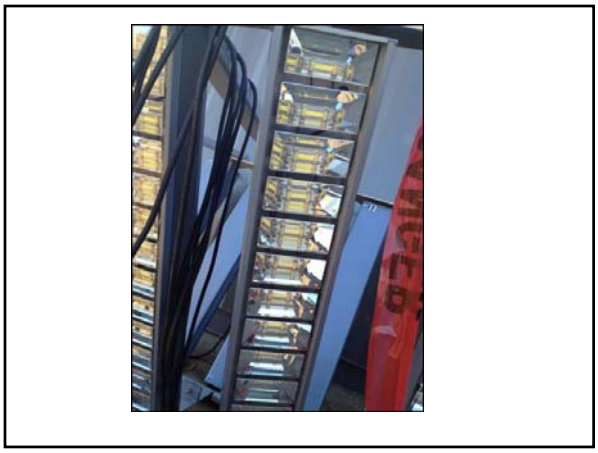

	LED Field	MH Field
Infield Avg.	16 fc	36 fc
Outfield Avg.	6.3 fc	21 fc
Infield Max:Min	3:01	1.6
Outfield Max:Min	9.4:1	5.2
kW Used	12.3*	42.8**

Electronic Ballasts

Benefits of Electronic Ballasts

Introduced to the market in 1981 for Fluorescent systems

Benefits

- **Enhanced Lumen maintenance (differing numbers depending on cut sheets, up to 30%)**
- **Higher efficiency (10-30% more means reduced fixture counts)**
- **Reduction in noise**
- **Enhanced controllability (dimming)**
- **Improved lamp life (up to double)**
- **Re-strike time 5 minutes**
- **Does not need a capacitor or ignitor**

Consider

Consider:

Benefits decrease with the rising lamp wattage.
(Previous numbers were for low wattage applications)

Higher costs

Electronic Ballasts must be kept 40-45% cooler than magnetic ballasts.

Musco can put up to 6 ballasts in our ECE.
Some manufacturers can only put 2

Electronic Ballast must be operated at low frequency (Sport Lighting (magnetic ballasts) operates using high frequency)

Limitations of Technology

Both Electronic Ballast and LED are tremendously effected by heat

Limitation of technology related to high wattage applications

Costs – Technology can work but is it a value?

LED – Challenge of throwing light great distances

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Evaluating New Technology
Separating Fact from Fiction

- **Ask for independent testing reports validating the manufacturers ability to maintain light levels.**

- **Testing should be conducted by 3rd Party with no affiliation with manufacturer**

- **Ask for specifics on re-lamp schedules and be sure they match the independent reports**

What are the Options in sports lighting??

We basically have 2 options!

Timed Power Adjustments - A Recognized Alternative

Illuminating Engineer Society
Lighting Control Strategies page # 27-3

agement). Lumen depreciation control strategy calls for reducing the initial illumination of a new system to the designed minimum level. As lumen depreciation occurs, more power is applied to the lamps in order to maintain constant output. Thus, full power is applied only near the end of the lumen maintenance period, significantly reducing energy use over the life of the lamp (Figure 27-3).[2]

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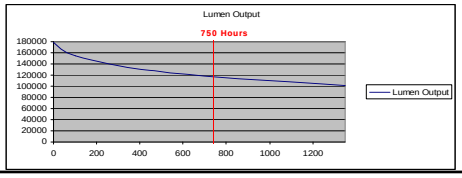
Mosher report

Depreciation curve at .8 maintenance factor



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SO! ! !
Now that we have:
Identified the needs and
Identified the wants ! ! !

How do we pay for the upgrades???

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Budget???

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Performance Contracting

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What is Performance Contracting?

Essentially, Performance Contracting is the acquisition of comprehensive energy improvements (lighting, HVAC equipment, controls, etc.) and services provided by qualified ESCOs where the energy and maintenance savings achieved by the installed energy project cover all project cost of equipment and installation, including financing, over a specified contract term.

What is an ESCO?

An ESCO, or Energy Service Company, develops and installs projects designed to modernize infrastructure and improve the energy efficiency and reduce maintenance and operating costs for facilities.

- National Association of Energy Services Companies

Why Performance Contracting?

Energy and Maintenance Savings Performance Contracting enables Cities, Counties and School Boards to use future Energy and Maintenance Savings to pay for up-front costs of energy-saving projects, eliminating the need to dip into capital reserves or add to existing budgets.

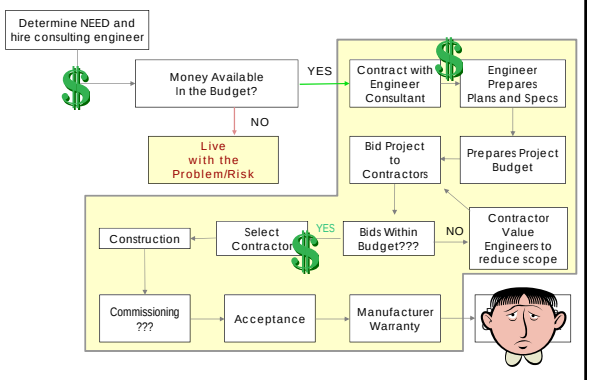
Emerging issues being faced by Local and State Governments

- Global Oil Prices and corresponding rise in Electric/Utility Rates
- Natural Gas Shortages
- Pricing Uncertainties
- Safety and Environmental Issues
- Lack of Modernization Options for Local Government
- Aging Public Facilities – Shrinking Budgets
- Limited Revenue and State Budget Crisis

Traditional option of Retrofitting & Modernizing

- "Plan – Spec - Bid"
- This method is very "First-Cost" Sensitive; Limited "Life Cycle" or Long Term Ownership Considerations
- There is an Immediate Financial Commitment Required
- The Process is Focused on Budgets and Design Specifications – Not on Operational Results and Benefits.
- Uncertain Final Costs – Change Orders

Traditional Repair and Replace Method

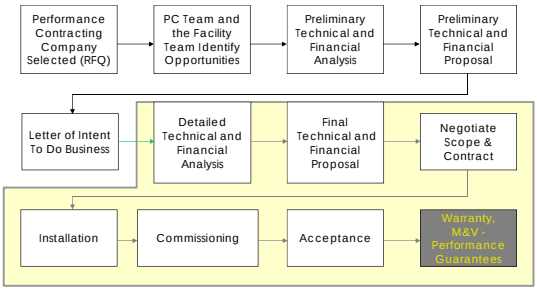


The ESCOs Role…

ESCOs serve as developers for a wide range of tasks and assume the technical and performance risk associated with projects. Typically, they:

- Develop, design, and install energy efficiency projects.
- Commission and maintain the performance of equipment/systems installed.
- Measure, monitor, and verify the project's energy and related cost avoidance (savings).
- Assume project risks that the project will save the amount of energy guaranteed.

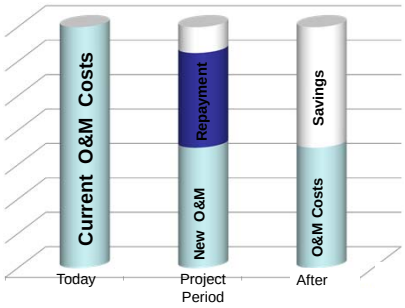
Performance Contracting Option



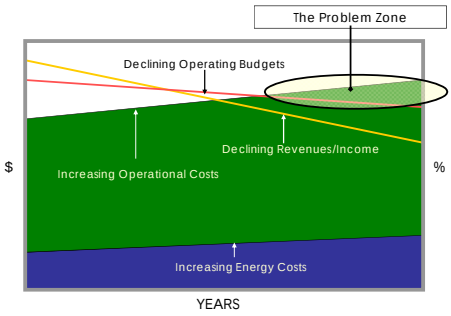
Practical Benefits of Performance Contracting

- No Up-front Funding
- Allows Replacement of Outdated Equipment - Modernization
- Helps Define, Acquire O&M Services
- Solutions to Problems
- Guaranteed Performance
- Eliminates Technical and Financial Risks
- Uses Future Energy/ Operational Cost Avoidance Now
- Capital Avoidance on planned projects

How does Energy Performance Contracting Work?



Why over 40 States Currently Have PC Legislation



What Does it Take to Address the "Problem Zone"?

A fresh source of funding dollars –

A *Financial and Contractual Solution* to impact building infrastructure, modernization and comfort.

- Solution is self-funded by energy and/or operational cost savings.
- Uses future stream of cost savings to fund immediate facility needs.

Who Needs an “ESCO” Solution?

- **Any Municipality or Organization Looking For:**
  - Cost Reductions – Energy, Operations, Maintenance
  - Energy Use Reduction
  - Project Financing
  - Upgrades/Modernization of Aging Systems and Existing Buildings
  - Environmentally Friendly Solutions

ESCO vs. “Do-it-Yourself”

- ESCO Expertise Benefits Customers with:
  - Professional Survey, Analysis, Design and Technology Applications
  - Professional Project Management, Installation, O&M Development, and M&V
  - Prepares for Energy Procurement, Secures Utility Rebates, Meet State Legislation
- Using ESCO Means Minimal or NO Costs until Energy Cost Avoidance Accrue
- ESCO provides a Total Solution
- ESCO provides Long-Term Sustainability of Project Results

Resources

- *National Association of Energy Services Companies* (NAESCO) – www.naesco.org
- *Energy Services Coalition (ESC)* – www.energyservicescoalition.org
- *Federal Energy Management Program (FEMP)* - www.ornl.gov/sci/femp
- *Rebuild America* - www.rebuild.org
- Local Utility
- Local State Energy Office

❖ *C:\FRPA 2012\FRPA TRANE Presentation.pptx*

One Last Question

Does this equation make sense to you???

50 % Energy Savings

-100 % Maintenance Costs

=25 Year Parts & Labor Warranty

We can show you how to Make it Happen!