Energy Project Financial Analysis: What Have We Been Missing?

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ABSTRACT

According to the Department of Energy, energy efficiency projects are the most attractive investments in industry with internal rate of returns above 20% and investment risk rivaling the safest opportunities available anywhere. Given this attractive combination, why are energy projects so difficult to sell to management? Part of the problem rests with a structural component where most projects enter from the facilities side and have to be sold to management bottom-up. In addition, the project champion often has minimal financial skills, limited budget authority, and/or not part of the decision making framework. A more fundamental issue rests in how payback analysis is frequently run as the only decision tool, presented to management, and competes with a broad range of other company capital investment projects, many that get funded despite their inferior performance. How do we change this current business dynamic to motivate greater energy project investment, which is just sound business?

Introduction

The purpose of this paper is to demonstrate a more comprehensive and robust method for systematically analyzing and ranking energy projects and funding them using sound investment strategies. We'll begin by citing three specific case examples, each with greater complexity and required analysis. The first case is an emerging technology in lighting which show cases full life-cycle cost analysis[1], a tool required by the federal government for project analysis and supported by the Department of Energy's eQUEST/DOE2 software package[2]. The second case is a standard furnace upgrade delivering significant operational financial benefits that outweigh straight energy savings by a factor of 4 to 1. This second example is modeled using the Transformation Planner, a manufacturing performance benchmarking tool measuring sensitivity and benefits from improving manufacturing metrics[3]. The third case is a solution combining improvements in process cooling eliminating the need for cooling towers, and deploying smaller point-of-use chilled water systems. The application described is for a plastics injection manufacturer and the accrued benefits are a full spectrum: Operational improvements that include water conservation. In each case, we'll attempt to point out some of the obvious weaknesses with limiting project analysis to current practices. Our goal is to demonstrate a

[1]Authors Disclaimer: The cases represent technologies available today. While the authors have made efforts to validate the claims of the manufacturers and believe the analyses based on project performances are reasonable, readers are cautioned to evaluate each with thorough due diligence.
[2]The Department of Energy Website where eQUEST and DOE2 can be downloaded for free: **http://www.doe2.com/**
[3]Church, G 2005: "Value and Energy Stream Mapping (VeSM™) Linking Manufacturing Improvements to Energy Efficiency", Proceedings of the 2005 World Energy Conference, Lilburn, GA: Association of Energy Engineers.

rationale based on a decision tree that invests time and resources when implementation risk is high and the potential for missing additional project benefits, especially non-energy, is greatest.

Case 1 HID Lighting Retrofit – Life-Cycle Cost Analysis

While there are many applications, for the purpose of this paper, Life-Cycle Costing (LCC) is a set of analyses to establish the total cost of ownership for a capital purchase[4]. LCC calculates all the elements that contribute to costs associated with operating and maintaining a system or equipment over its given life-span. The results of an LCC analysis can be used to assist management in the decision-making process where there is a choice of options. Since the results of LCC are measured over time, and the longer the window the greater the potential error, LLC is most valuable as a comparative tool when long term assumptions apply to all the options and with approximately the same impacts. Of note, up-front costs for purchases often represent a small portion of total cost of ownership – consider your last automobile purchase assumptions.

In most environments, the responsibility for purchase and later costs to operate and maintain equipment are managed by different functional areas. Benefits and costs often accrue in different areas. As a result there is often little or no incentive to apply the principles of LCC beyond simple payback analysis without strong management policy. The LCC benefits are many and include a) measuring performance against cost, b) total cost to own and operate, c) comparison of dissimilar projects from different types and locations, and d) ability to model changes in costs over time. LCC establishes a common platform to compare and measure project variances.

Our first case study is an emerging technology in High Intensity Discharge (HID) lighting termed by the manufacturer, the SmartPOD Luminaire, and can be researched at **www.HIDLabs.com**[5]. There are a number of interesting features concerning this new approach including lighter electronic ballasts capable of operating at a wide range of voltages, with matrix connectivity, running at lower temperatures, and much higher frequencies. This last attribute reportedly allows for rapid start, dimmable ballasts, and nearly no loss over time in lumen output[6]. According to the literature for upgrades, the options include high-bays, hot, cold, and dirty air quality operating environments, zoning areas with reduced lighting for energy savings and demand reduction, and outdoor lighting using earlier generations of HID[7], among others.

For this case study, a simple high-bay manufacturing area making lead batteries operating in a dirty air quality environment was chosen to demonstrate life-cycle costing. Three options are observed: 1) Base case operating HID Magnetic Ballasts with a single 400W lamp; 2) Electronic T8 54W 6 Lamps/Fixture Fluorescent; 3) Electronic T5 32W 6 Lamps/Fixture Fluorescent; and 4) HID Labs Pulse Start Electronic Ballast with a single 320W Ceramic Metal Halide Lamp. To compare these, each lighting system is normalized to an estimated output of 10,000,000 lumens. The following table compares the basic system performances:

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[4] Capehart, Barney L., Wayne C. Turner, and William J. Kennedy, Chapter 4 in the *Guide to Energy Management*, Fourth Edition, Fairmont Press, Lilburn, GA, 2003.

[5] **www.HIDLabs.com**

[6] DiLouie, Craig, 2004: "Dimming HID Lamps", Lighting Controls Association **www.aboutlightingcontrols.org/education/papers/hiddimming.shtml**

[7] Thuman, Albert and D. Paul Mehta, Chapter 4 in *Handbook of Energy Engineering*, Fifth Edition, Fairmont Press, Lilburn, GA, 2001.

Table 1: Basic Lighting Fixture, Lamp, Lumen Comparison and Operations Comparison[8, 9]

Systems Normalized to 10,000,000 Lumens Output	Base Case - Magnetic HID 400w Probe Start	Electronic T-8 (6 lamp) Fluorescent	Electronic T-5 (6 lamp) Fluorescent	Electronic HID 320W Ceramic Metal Halide
System Performance				
Initial Lumens Per Lamp	36,000	3100	5000	37,500
Lamp Lumen Depreciation	0.65	0.90	0.94	0.88
Mean Lumens Per Fixture after Depreciation	23,400	16,800	28,200	33,000
Color Rendering Index	68	82	82	90
Number of Required Fixtures	430	600	351	303
Total Estimated System Lumens	10,062,000	10,800,000	9,898,200	9,999,000
Estimated cost per fixture	-	$280	$295	$433
Total System Expense with No Installation Costs		$168,000	$103,545	$131,199
System Energy Costs				
Number of Fixtures	430	600	351	303
Energy Consumption Per Lamp	468W	224W	351W	340W
Annual Fixture Energy Cost (5616 hours at $0.12 kWh)	$315	$151	$237	$229
Annual Energy Cost (5616 hours at $0.12 kWh)	$135,620	$90,575	$83,028	$69,427
System Operating Costs				
Expected Life-cycle per lamp	2	2.7	2.7	3.5
Relamping Costs per lamp @ $75	$16,125	$16,660	$9,750	$6,493
Annual Cleaning Costs: $3/sgl lamp & $9/6 lamp fixture	$1,290	$5,400	$3,159	$909
Total Energy and Operations Costs	$153,035	$112,635	$95,937	$76,829
Full Annual Savings to Baseline	$0	$40,400	$57,098	$76,206
Simple Payback No Rebates or Tax Incentives		4.2	1.8	1.7
*** No calculations made for differences in installation costs, rebates, demand response, tax incentives, or GHG reduction.**				

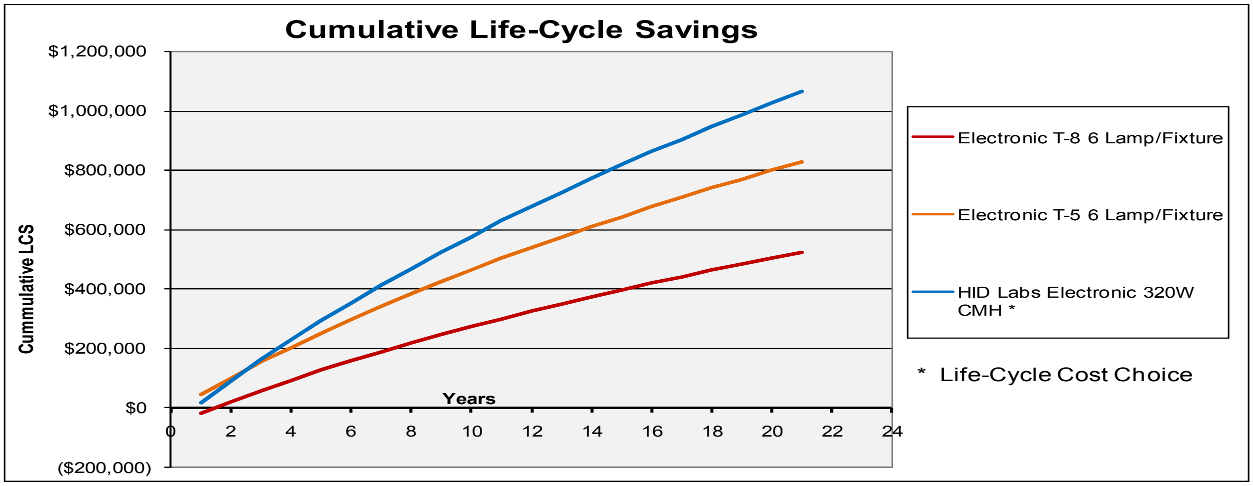
The T-5 system upgrade may seem the most reasonable approach if a simple screening approach was used in the proposed Tier I Decision Tree because first cost investment is smallest and conserving cash and reducing liabilities on the balance sheet might prevail. Against this reasoning could be federal tax advantages and rebates including demand response incentives – will shorten the payback by about 50% in California – with greater benefits tilted towards the single HID lamp systems. Still, the T-5 solution is an excellent choice but is it the best if each system meets the required technical specifications? What does Life-Cycle costing in our proposed Tier II analysis show over a longer "lifetime" window?

A fuller analysis from the DOE2 Software package is included in Appendix A (pg10). In the figure below, the T-5 project slightly out performs the HID 320W project in the first two years but there is a cross-over in year three; the slopes of the lines (savings increase) are much different, and the net savings in present value over 20 years are $541,287, $779,699, and $1,045,932 for the T-8, T-5, and Electronic HID implementations respectively. If the decision still isn't clear at this point, the next step in our tiered approach would be to run a sensitivity analysis in Tier III and model changes in the electric rate commodity, time of use tariffs, and demand response charges. We could include predictions of better lumen output using electronic ballasts over time, which could be as much as 50% over magnetic legacy systems.

[8] Davis, Gregory, "Beyond the Obvious", Hid Laboratories Inc., White Paper, 2009, email requests to www.HIDLabs.com

[9] BC Hydro. 2006. High-Intensity Discharge Lamps. www.bchydro.com/powersmart/technology_tips/buying_guides/lighting/hid_lamps html

Figure 1: LCC Chart from DOE2 Analysis showing Increasing Financial Gap over Time



The proceeding example demonstrates the advantages of looking beyond first costs and even energy savings alone. This is particularly important when operations will be negatively impacted with ongoing maintenance, upgrades, and replacement costs. Adding greater system operating flexibility will also provide opportunities for additional savings by reducing load and energy usage with time of use cost reduction advantages. These changes will generate greater dividends over time due to the expected increasing costs over time in electric prices – the cost curves for these commodities are probably not going to be gentle linear slopes. LCC, therefore, is an important analytical tool that provides input to model these potential commodity and resource cost differences over time even without taking into account discount rates.

Case 2 Furnace Upgrade -- Energy plus Operational Savings

The second case is an aluminum smelting furnace upgrade. The original furnace was built with modifications during installation that changed the incidence angles of the burners towards the melting pile and shortened the loading distance thereby increasing loading cycle times. Project changes have both energy savings and operational benefits but the latter were not calculated in the initial engineering analysis. Improvements in the manufacturing systems included decreased charging time from 5 to 2 hours, decreased melt times, improved quality, and an increase from 4 to 5 "drops" per day increasing melt capacities by 40,000 lbs/day or an increase of approximately 20%. The upgrade included installing new efficient burners, adding several feet back to the loading area, re-installing trim controls that had been decommissioned, and re-insulating the melting container. Engineering data described the following retrofit costs, energy savings, and simple payback ranges included in Tables 2 and 3 showing potential annual energy savings for the upper case estimate was $35,327/month.

Due to non-energy savings from this measure, a broader analysis was proposed to review the other financial benefits that would come from this project. We applied a financial benchmarking tool comparing improved performance in manufacturing operations created by the National Institute of Standards and Technology and the U.S. Commerce Department, and managed by the Michigan Manufacturing Extension Partnership, called Transformation

Planner[10]. A current state set of performance data is input into the model after interviewing production personnel, operators, and company management. Table 4 below represents a conservative estimate of gains in operations based on improving performance in the six performance areas previously described boosting total project savings by an additional $133,088/month above the original estimate.

Table 2: Engineering Data Showing Energy Savings Scenarios

Units	Baseline	Heat Recovery		Control Optimization		Annual Savings	
		Lower (15%)	Upper (30%)	Lower (10%)	Upper (20%)	Lower Estimate	Upper Estimate
MMBTU/yr	113016	96063	79111	86457	63289	26559	49727
Therms/yr	1130157	960633	791110	864570	632888	265587	497269
$/Therm	0.85	0.85	0.85	0.85	0.85	0.85	0.85
$/yr	$963,458	$818,939	$674,421	$737,045	$539,537	$226,413	$423,922
lbs/Month	44,489,496	44,489,496	44,489,496	44,489,496	44,489,496	0	0

Table 3: Basic Furnace Project Economics

Economics	Lower Savings Estimate	Upper Savings Estimate
Annual Cost Savings	$226,412.67	$423,921.59
Gross Project Cost	$620,000.00	$620,000.00
Simple Payback (yrs)	2.7	1.5
Expected Rebate Incentive	$132,793.43	$200,000.00
Net Project Cost	$487,206.57	$420,000.00
Simple Payback with Rebate (yrs)	2.2	1.0

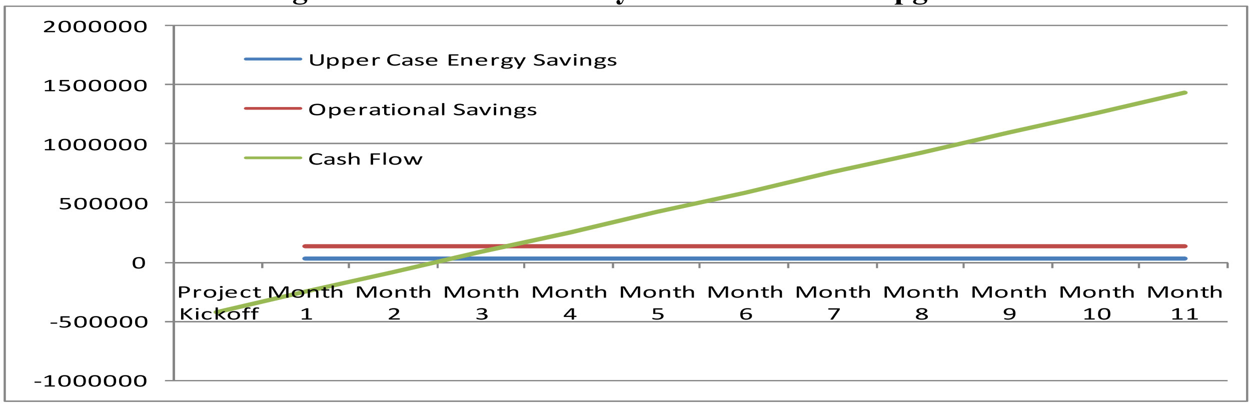
Table 4: Operational Improvements Modeled

Operational Improvements from 1 additional drop/day or 40,000 or ~ 20% increase	Modeled Improvement	Annual Benefits from Transformation Planner
On-time delivery improvement 5%	84% to 89%	$70,808
Inventory turns increase 5X	40.9 to 45.9	$76,240
Machine Run Hours 1.5% (conservative)	85.48% to 87%	$1,333,171
Days Receivables reduced by 2 days	19 to 17 days	53,178
Schedule Bumping drop 0.5%	2% to 1.5%	63,656
Profit and Loss Benefit (improves operating margin 0.8%)	1.5% to 2.3%	1,597,053

Figure 4 is a cash flow analysis comparing energy, operational, and combined savings. In stark contrast, the project achieves positive cash flow from the upper energy savings estimate alone in 12 months but when savings from improving manufacturing performance are included it becomes 2.5 months. This example shows what additional information would come from analyzing non-energy related benefits in our proposed Tier III analysis. Management decisions would derive out of quantifying benefits against other capital intensive projects based on a standard such as Internal Rate of Return and possibly include an implementation risk component.

[10] http://www.mmtc.org/

Figure 4: Cash Flow Analysis from Furnace Upgrade



Case 3: Process Cooling Closed-Loop System -- Energy, Operations & Other Resources

The third case deals with intelligent process cooling utilizing closed-loop systems, point of use chillers, and ambient air managed with efficient motors and fans. Traditional design constraints allow only incremental improvements around more efficient heat transfer and motors though any costs continue unchecked: water and energy usage, chemical treatment and maintenance. The system built by Frigel Systems, **www.frigel.com** called Ecodry[11], eliminates the traditional cooling tower with a closed-circuit fluid cooler. The water returning from the process is pumped into heat exchangers and cooled with ambient air flow. This process is designed to provide clean water at the right temperature to process machines year round. The result based on the manufacturer's claims is a modular, flexible, pre-engineered system with benefits in energy and water savings, which can achieve 95 – 98 % without chemical treatment.

This case is a plastics manufacturer operating 22 injection molding machines with annual revenues of $243,000,000. Support equipment: 150 ton cooling tower with 1 chiller rated at 60 tons. The energy saving from Ecodry originated from a decentralized system saving on energy from pumping, operating at proper chilled water temperatures (50 to 80°F), and supporting processes cooling temperature control versus managing suboptimal temperatures from a central location with distributed thermal losses. The ability to automatically provide ambient cooling utilizing in lieu of chiller for cooling molds when dry bulb is below 71F was an additional savings factor. Table shows the potential energy savings with a project cost of $497,600.

But what about the improvements obtained from cycle time improvements utilizing smaller point-of-use chiller systems with 20% reduction in mold cooling times, reduced mold changeovers, and improved product quality? To measure the financial benefits from operations we again used the financial benchmarking tool, Transformation Planner. Restating, the process is two steps. First, input the current manufacturing performance. Second, model the expected or desired changes in percentages or dollars. The model recalculates benefits in annual cash flow and balance sheet. Calculating the improved state, we held the improvements in operational performance to 5% although productivity improvements from cycle times based on customer

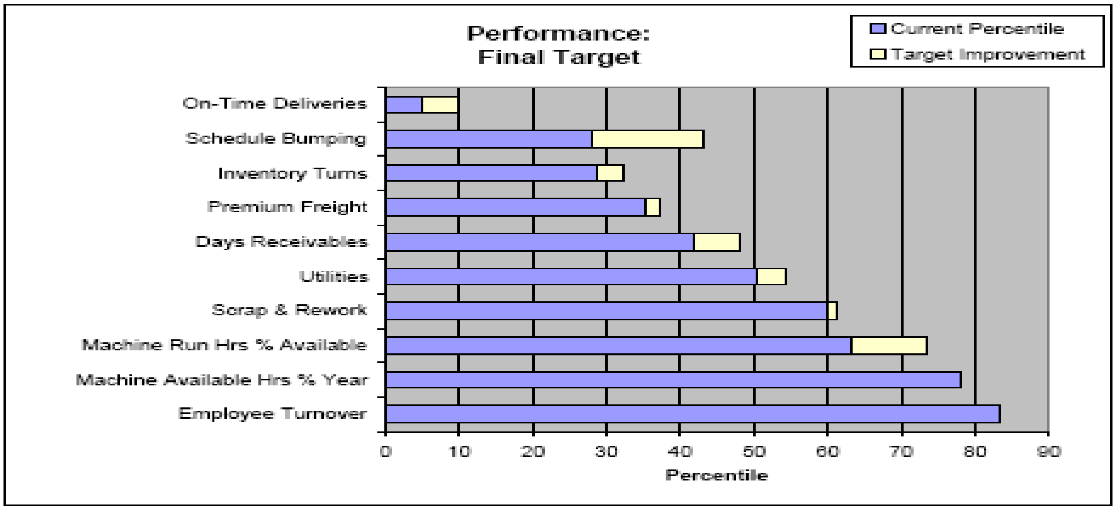
[11] **http://www.frigel.com/na/news_ecodry.html**

interviews achieved 20% and reduction in scrap and rework by better control over mold temperatures would be reduced by 10% or more over the current state[12,13]. Table 6 shows the input/outputs from modeling with manufacturing changes held to 5% in relative improvement or absolute dollars with the target improvements ranging from 2-15 percentiles from this project.

Table 5: Chiller Current to Future State Upgrade Economics

Current	UF	kW	kW hrs/year	$/Year	Upgrade	UF	kW	kW hrs/year	$/Year	Savings
TCU Pumps	85%	122	734,400	$ 51,408	TCU/RC Pumps	85%	96	577,575	$ 40,430	21%
Chiller Pumps	100%	44	385,440	$ 26,981	Chiller Pumps	-	0	0	$ -	100%
Compressor	100%	74	648,122	$ 45,369	RC Compressor	100%	20	121,626	$ 8,514	81%
Tower Pumps	100%	116	1,016,160	$ 71,131	Ecodry Pumps	100%	15	90,000	$ 6,300	91%
Tower Fan	100%	15	134,583	$ 9,421	Ecodry Fans	100%	6	38,226	$ 2,676	72%

Figure 5: Current Manufacturing Performance in Blue with Expected Changes in Yellow



Finally, annual water savings were 1,847,814 gallons (Existing tower 1,981,076 minus upgrade at 137,262). Annual dollar savings from water equals $1,201 at $0.00065/gallon. Water treatment pre-Ecodry equals $15,000 annually and is reduced to $1200 annually following installation. Total project savings from water is $15,001 but this raises a question about this resource: what are the embedded electric costs with moving and treating all this water for the customer and utility? Today, utility rebates follow specific utilities with rare opportunities for cross-over savings and multiple rebates and we hope this situation. We expect future financial modeling will need measurement capabilities far more extensive than what are currently using. Our tired analysis anticipates these new variables with planned functionality to include them.

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[12] A discussion about the relationship between calculating changes in manufacturing performance and energy savings can be found at; La Palme, Glen, et al: 2007, "Generating and Calculating Energy Intensity Savings from Manufacturing Productivity Improvements", 2007 ACEEE Summer Study of Energy Efficiency in Industry, American Council for an Energy Efficient Economy, Washington, DC, **http://aceee.org/**

[13] United States Environmental Protection Agency, *Lean and Energy Toolkit*, Revised October 2007, EPA-100-K-07-003, **www.epa.gov/lean**

Figure 6: Energy and Operations Savings from Process Cooling Closed Loop System

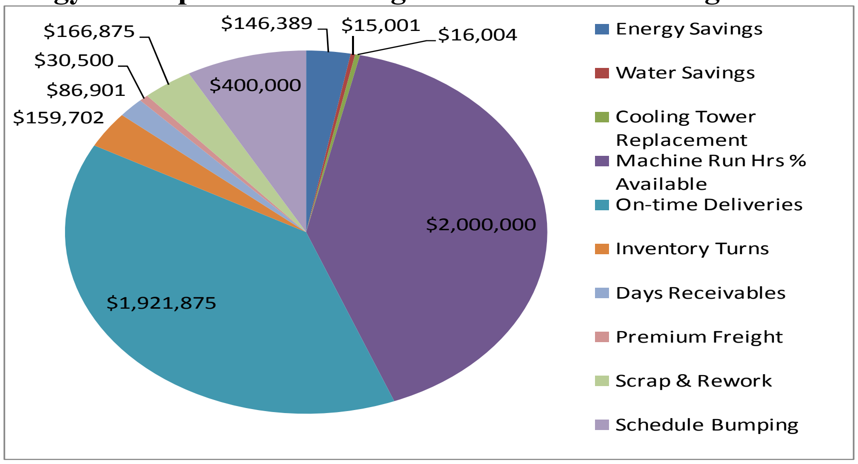


Table 6: Improvements in Cash Flow, Profit and Loss from Process Cooling Energy Project

Income Statement	Initial Evaluation	%	Target Objectives	%	Opportunity
Annual Revenue	$243,750,000		$243,750,000		
Cost of Goods Sold	$166,874,000		$161,962,758		
Operating Margin	$76,875,000	31.50%	$81,787,242	33.60%	$4,912,242 Annual Benefit
Balance Sheet					
Average Inventory	20,468,750.00		$19,404,070		
Receivables	33,125,000.00		$31,386,986		$2,802,694 One-Time Benefit

Proposed Decision Tree Flow

Given the greater effort and skills required to analyze projects with multiple benefits is there a standardized process flow that can be followed as a tiered approach where time and resources are incrementally invested when project costs and risk are highest? The following was designed by the author's for a global GHG reduction program with world-wide manufacturing operations.

Discussion about Decision Tree

We propose a four tiered financial and resource analysis approach that is modular with each new layer added to the previous one but with the ability for rapid implementation of additional customer desired elements. An example would be adding carbon adders, energy price escalators, and inflation to the initial financial model using best estimates of changes. The result of this change would be a "simple payback" financial estimate for projects with a time based element incorporating future changes in costs and calculating an expected Internal Rate of Return. While not a full Lifecycle Cost Analysis (LCA), it would be a close approximation for screening purposes and the functional elements would be incorporated into the next phase and so on.

Data Collection and Site Assessment Methodology Considerations for the Decision Tree

Work begins with benchmarking facility energy usage within the various categories of building types, i.e., office, manufacturing, warehouse, etc. The next activity incorporates investment grade audits on selected sites to assess the energy and demand consumption and usage pattern on a system and device level. Projects involving energy efficiency and onsite generation (both conventional and renewable) will be evaluated. Low Cost / No cost savings measures are looked for at this stage and include maintenance and behavioral changes. Potential energy efficiency and demand savings will be established in accordance with the methods contained in DOE's IPMVP (International Performance Measurement and Verification Protocol). Savings estimation tools considered for this effort will include government supported energy simulation models such as eQUEST and California's DEER and equipment manufacturer performance curves. When applicable, onsite generation technologies will be assessed using manufacturer performance curves and government sponsored simulation models (such as NREL's PV Watts). GHG emissions reductions will be evaluated using the seasonal generation mix for the utility service territory where the site is located. Feasible energy projects will be ranked based on economic viability. When requested, monetary benefits of GHG emissions reductions, renewable energy credits and avoided energy costs will be computed. Project engineering and equipment costs will be developed using published data and actual budgetary quotes.

Tier I: Initial Financial Screening Analysis

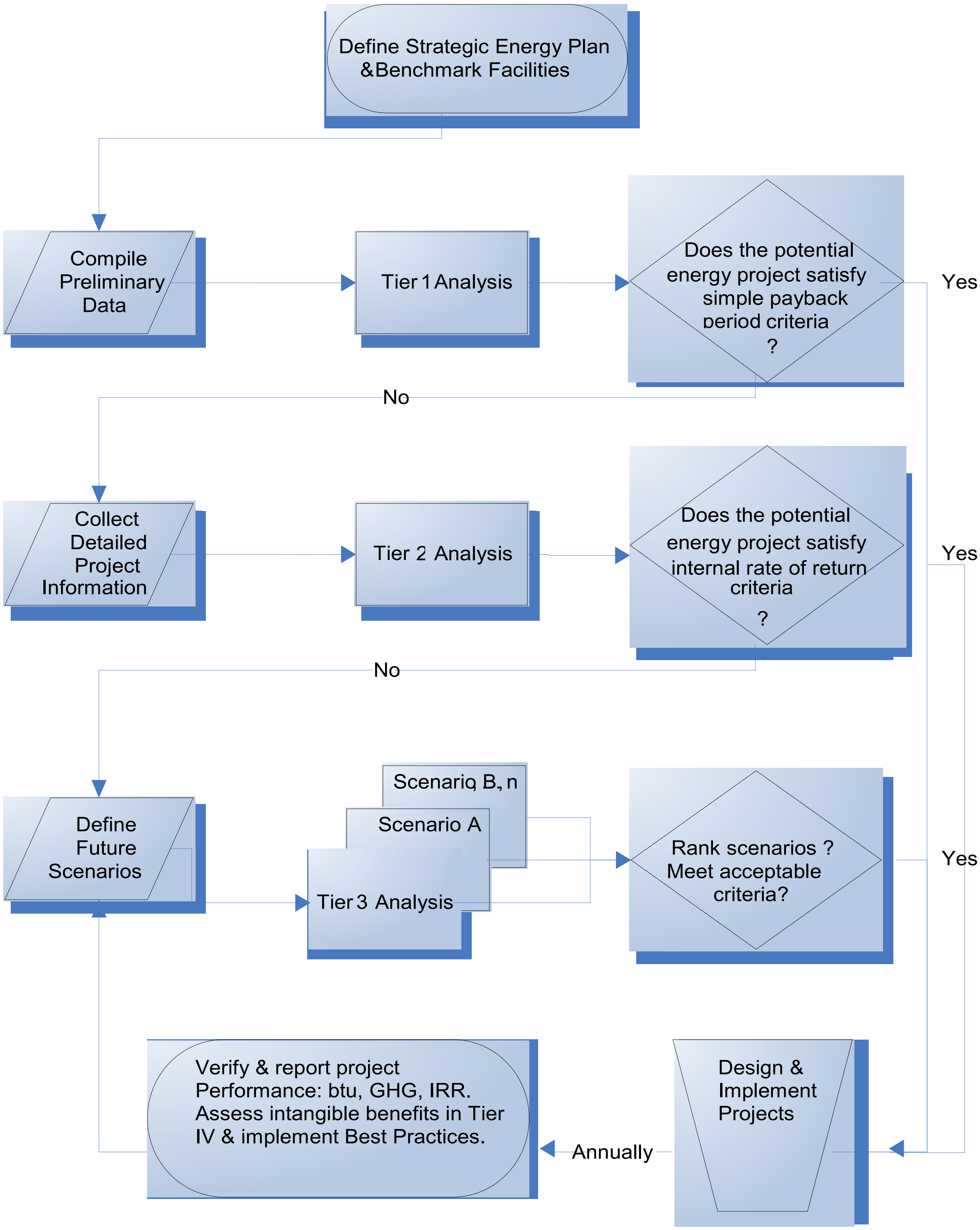
The initial screening tool will provide a simple method to analyze a group of select project opportunities for a given site and rank them according to potential energy savings and GHG reduction. Some projects will have low financial risk with quick payback, i.e. high bay lighting replacing first generation fluorescents proceeding directly to scoping and implementation.

- Inputs: Initial capital investment, energy costs and energy and other resource savings with an option to add carbon adder calculations for qualifying projects
- Outputs: Simple payback, estimated energy savings, GHG reduction, and Internal Rate of Return (IRR) to normalize different types of projects from different regions

Tier II Life Cycle Cost (LCC) Analysis

Projects not eliminated in Tier I, with energy savings and GHG reductions upsides, but with financial risk, will undergo detailed Life Cycle Cost (LCC) Analysis. LCC makes sense for a number of reasons. First, it is the approved standard for conducting projects in federal buildings. Other benefits include the ability to compare competing projects at the same site and/or compare multiple options for the same project; it provides an excellent platform for running sensitivity analysis (in Tier III), and, most importantly, it uses a time value of money approach for variable costs such as energy or inflation. In this Tier, each project will be evaluated using fixed inputs. Incorporating a GHG escalator, regional energy prices and changes in inflation will be a simple process.

Figure 7: Energy Project Analysis Decision Tree



- Inputs: Initial capital investment, useful life, interest rate, building lease agreement, regional energy prices, Greenhouse Gas credits, resources price and value escalation factors , annual operation and maintenance costs, rate of inflation, utility and/or government incentives, equipment overhaul or replacement costs.
- Outputs: Net present value (NPV) for projects (including do-nothing case), NPV levelized energy cost ($/kWh), Internal Rate of Return, energy costs and savings, and O&M for each year.

Tier III Sensitivity Analysis

A more detailed analysis will be possible with the LCC model developed and tested in Tier II. Model outputs can be tested for sensitivity to changes in energy prices; GHG credits, carbon allowances, rebates, against other competing projects, and incorporate operational benefits. Resource Sensitivity Analysis (RSA) will include energy, water, GHG market prices or penalties if adopted, and operational improvements including energy intensity reductions.

- Inputs: Include escalators for all resources and direct savings from operational improvements as in the second and third case studies
- Outputs: Include modeling options for low, mid, high case analysis with updated Cash Flow and IRR outputs. Compare competing projects using same criteria.

Tier IV Intangible Benefits

It is recognized that corporations are benefiting from long-term strategies to reduce energy costs and in increased profitability, market share, customer perception, employee retention, and goodwill. Benefits will increase as GHG reduction is added to their risk management strategies. The same skill set and processes to reduce energy costs translates to good carbon management. Fortunately, the literature is full of case studies and examples can be used for selecting choices.

- Inputs: Some possibilities are satisfaction and retention surveys, and carbon footprints
- Outputs: Trend analysis, customer loyalty, “green” awareness, employee retention

Conclusion

From the project examples, a case was made to extend measuring project benefits beyond energy savings to help compare and select energy projects. Life-Cycle Costing showed how projects perform over longer time windows. The third case added water savings to energy and operations expanding our data acquisition and analysis needs beyond traditional methods. Future carbon reduction strategies will offer many options beyond demand side management broadening our needs even more. Describing the full benefits of projects to management is a sound way to motivate greater investment in energy savings projects. Finally, creating an internal roadmap – in our example a tiered approach – to measure and track energy savings projects with a continuous improvement feedback loop – may prove to be a prudent method to guide and support decision making, and to reconcile the many competing interests in our organizations.

Addendum A -- LCC Output from DOE2 (updated 16 June 2008).

Life-Cycle Costs Summary

Lighting Selection Analysis

Case	Description	One-Time Costs 1st year $	One-Time Costs LCC PV $	Electric 1st year $	Electric LCC PV $	Total Utility 1st year $	Total Utility Undisc LCC PV $	Total Utility LCC PV $	Maintenance 1st year $	Maintenance LCC PV $	Total Undisc LCC PV $	Total LCC PV $	Investment Related PV $	Operations Related PV $
	Life-Cycle COSTS													
Base	Magnetic HID 400W Pulse Start	$150,000	$389,899	$135,620	$1,837,752	$135,620	$2,458,130	$1,837,752	$1,290	$19,192	$2,956,430	$2,246,843	$150,000	$2,096,843
Alt 1	Electronic T-8 6 Lamp/Fixture	$168,000	$415,859	$90,575	$1,227,358	$90,575	$1,641,684	$1,227,358	$5,400	$80,338	$2,250,884	$1,723,556	$168,000	$1,555,556
Alt 2	Electronic T-5 6 Lamp/Fixture	$103,545	$248,600	$83,028	$1,125,091	$83,028	$1,504,893	$1,125,091	$3,159	$46,998	$1,866,618	$1,420,689	$103,545	$1,317,144
Alt 3	HID Labs Electronic 320W CMH *	$131,199	$227,798	$69,427	$940,787	$69,427	$1,258,374	$940,787	$909	$13,524	$1,537,613	$1,182,109	$131,199	$1,050,910
	** alternative with least life-cycle cost*													
	Life-Cycle SAVINGS (negative entries indicate increased costs)													
Alt 1	Electronic T-8 6 Lamp/Fixture	($18,000)	($25,959)	$45,045	$610,393	$45,045	$816,447	$610,393	($4,110)	($61,146)	$705,547	$523,287	$18,000	$541,287
Alt 2	Electronic T-5 6 Lamp/Fixture	$46,455	$141,299	$52,592	$712,661	$52,592	$953,237	$712,661	($1,869)	($27,806)	$1,089,812	$826,154	($46,455)	$779,699
Alt 3	HID Labs Electronic 320W CMH *	$18,801	$162,101	$66,193	$896,964	$66,193	$1,199,757	$896,964	$381	$5,668	$1,418,818	$1,064,733	($18,801)	$1,045,932
	** alternative with least life-cycle cost*													

Analysis Assumptions:

DOE/FEMP Fiscal Year	2008	
Real Discount Rate for this Analysis	3.0%	
Study Period (years covered by the LCC analysis)	20	
# of Years before Project Occupancy or Opration	0	
DOE Fuel Price Escalation Region	4	*(West)*
Analysis Sector	2	*(Commercial)*