Simple Payback:
THE WRONG TOOL FOR ENERGY PROJECT ANALYSIS?

Council of Industrial Boiler Owners

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OUTLINE

- **"If the only tool you have is a hammer…"**
- **Investment: What questions *should* we ask?**
- **A better way for energy project analysis?**
  - **Save-or-buy criterion**
  - **Economic penalty for doing nothing**
  - **Break-even (the most you SHOULD invest)**
  - **Budget for additional analysis, design, etc.**
- **If you MUST use payback, then….**

ABOUT SAIC-Benham

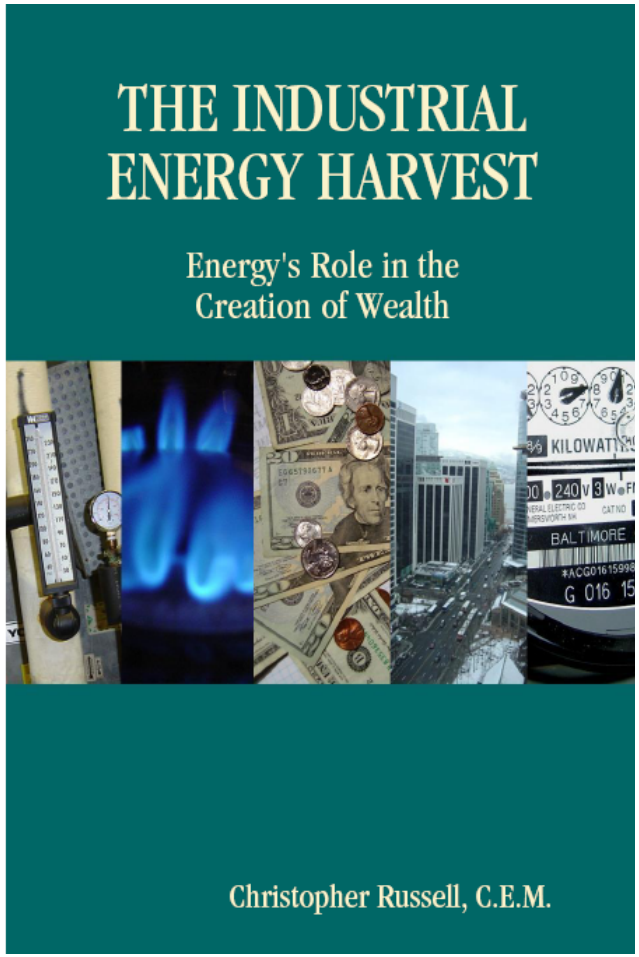
SAIC
From Science to Solutions

- Founded 1969
- $8.3 billion revenue in FY 2007
- Fortune 500® company – #298
- More than 44,000 personnel worldwide

BENHAM

- Project services
- Architecture
- Engineering
- Environmental
- Systems & Controls
- DesignBuild
- Facility management

All figures current as of April 2007.



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WHAT'S THE PAYBACK?

Spend Today:	Return 1yr out:	Return 2yrs out:	Return 3yrs out:	Return 4yrs out:
-$100	**$50.00**	**$50.00**	**$50.00**	**$50.00**

PROBLEMS WITH PAYBACK

- **Payback criteria rarely change, if ever** (e.g. “two years or less”)
  - Interest rates and our profitability measures change daily.
  - “Cost of money” is cost to *waste* as well as cost to borrow

- **Payback calculations remain fixed in our minds.**
  Boiler replacement example:
  - In 2002 with gas @ $2.50/MMBtu: 4-year payback
  - In 2008 with gas @ $7.50/MMBtu: 1.3-year payback

- **So why do we rely on payback?**
  - Our operating goals, budgets, bonuses, and rewards are fixed in an annual (time) format.
  - Simple payback seems to fit naturally in our calendar-driven world

WHAT'S WRONG WITH PAYBACK?

- Simple payback is a risk assessment tool
- It is NOT a profitability metric
- It does NOT reflect cost of money (interest rates)

- If a 12-month payback is better than 24 months…
- Then a 6-month payback is better than 12 months…
- So a zero-month payback must be best!
- Why? Because there's no wait to get the money back!

If getting the money back is a concern, then there's no reason to make the investment.

Simple Payback: *Wrong Tool for Evaluating Energy Improvements*

- Payback poses a two-step question in reaching one conclusion:
  - **How long until I get my money back?**

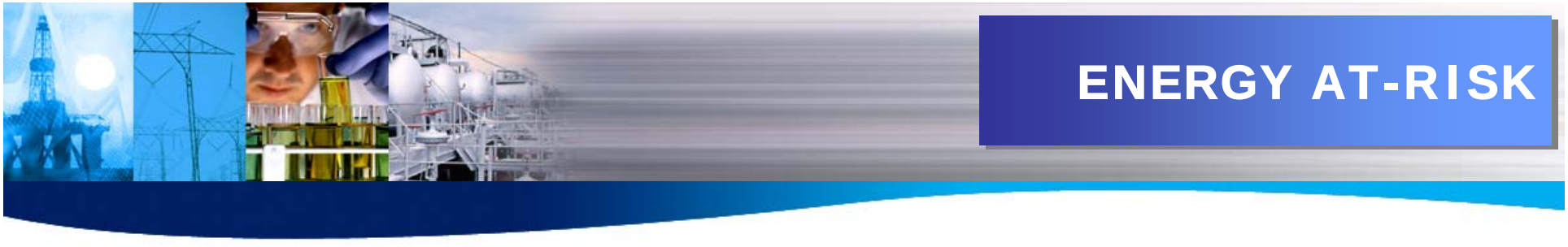
    And depending on my risk aversion…
  - **Is this an investment I should make?**
- **Investment questions are reduced to a Y/N decision**
- Energy management becomes a stop-and-go experience, stalling with each project rejection…
- …while interest rates, energy prices, and budget-to-actual performance change constantly.

Decide Which Questions to Answer …THEN Pick the Tool to Answer Them

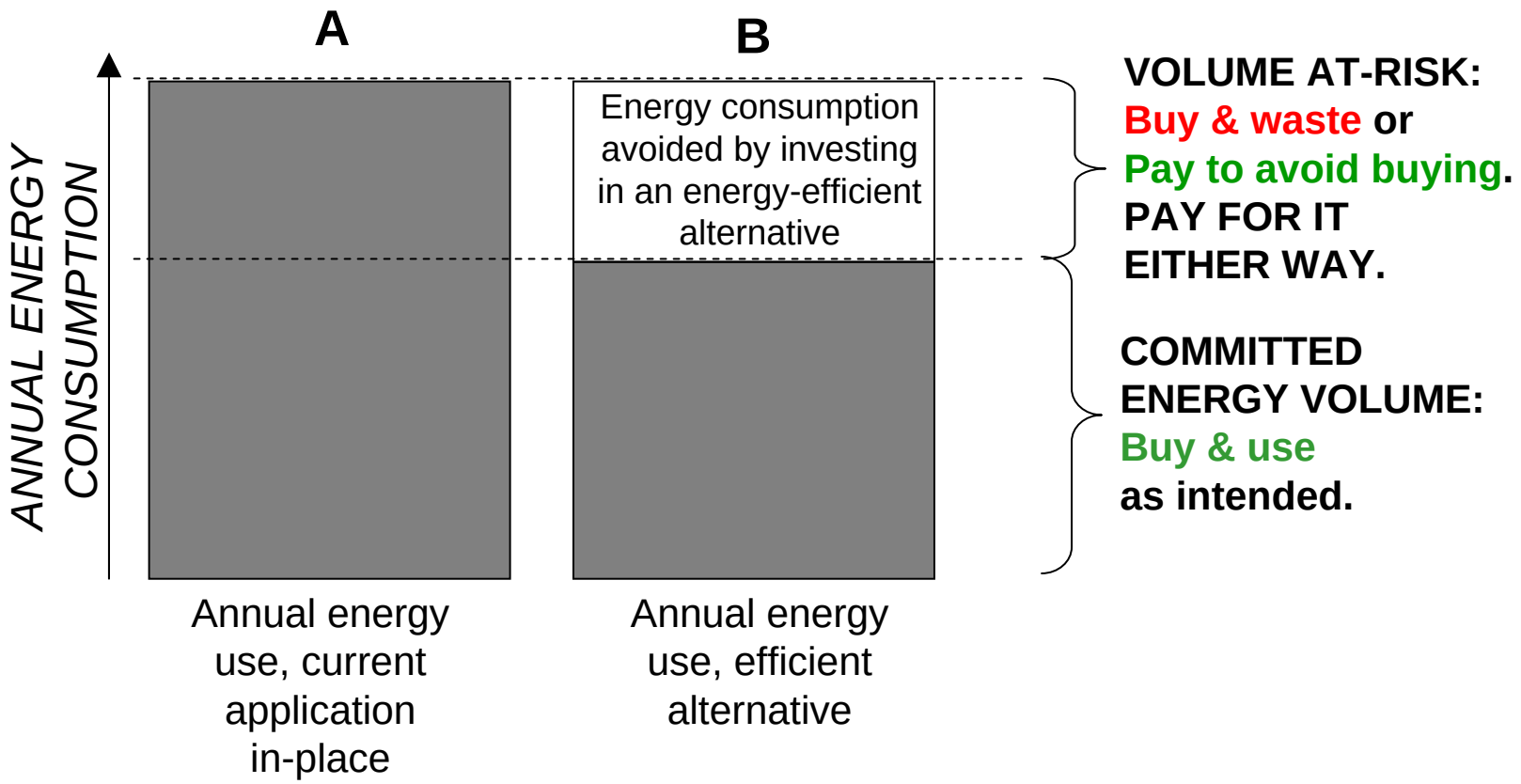
- What is the cost of buying a therm or kWh vs. the cost to avoid buying it?
- What's the most you should be willing to pay for an energy improvement?
- What's the economic penalty for DOING NOTHING?
- What's your budget for supporting design and analysis work?

If You Use PAYBACK, You Use A 1950s Financial Analysis Tool!

Is there a better way?



ENERGY AT-RISK



VOLUME AT-RISK:
Buy & waste or
Pay to avoid buying.
PAY FOR IT EITHER WAY.

COMMITTED ENERGY VOLUME:
Buy & use as intended.

SAVE or BUY?

- Continue to **BUY** energy at-risk from the market?
  - Remain exposed to constant price volatility
- **SAVE** energy by reducing the volume at-risk?
  - Do projects when cost to save a unit of energy is less than the price to buy it
  - Annualized cost stays fixed over the economic life of the project

EXAMPLE: BOILER REPLACEMENT
Reference Data

Current price per therm:	$1.611
Economic life of new boiler (n):	25 yrs
Discount rate/cost of capital (i):	8%
Capital recovery factor (CRF):	.0937 = [i(1+i)^n]/[((1+i)^n)-1]

	OLD	NEW	SAVINGS
Therms consumed/year:	390,780	298,998	91,782
Annual fuel cost:	$629,547	$481,686	$147,861

Construction cost:	$239,305
Engineering fees:	$ 29,900
Total installed cost (TIC):	$269,205

ANNUALIZED PROJECT COST

$$\text{ANNUALIZED PROJECT COST} = \left(\text{UP-FRONT PROJECT COST}\right) \times \left(\text{CAPITAL RECOVERY FACTOR}\right)$$

$$\text{CAPITAL RECOVERY FACTOR (CRF)} = \frac{i(1+i)^n}{[(1+i)^n]-1}$$

Where:
i = cost of capital or discount rate on future cash flows
n = economic life (years) of remedy (energy improvement project)

WHY?

- **Operating budgets are ANNUAL**
- **Energy savings are accounted ANNUALLY**
- **Compare ANNUAL cost to ANNUAL benefit**
- **Compare 3-yr project to 10-year or 5-year projects….**

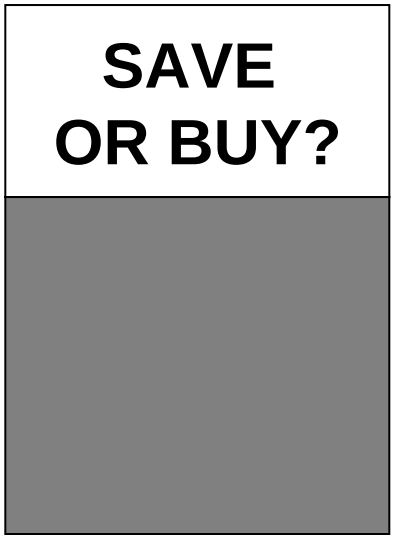
BOILER EXAMPLE:
"Operationalizing" a Capital Cost

ANNUALIZED PROJECT COST = (UP-FRONT PROJECT COST) x (CAPITAL RECOVERY FACTOR)

$25,225 = ($269,205) x (.0937)

ANNUALIZED PROJECT COST PER ANNUAL THERM SAVINGS = $\frac{\$25,225}{91,782}$ = $0.2748

YOUR CHOICE!



ENERGY AT-RISK

You will pay for it either way

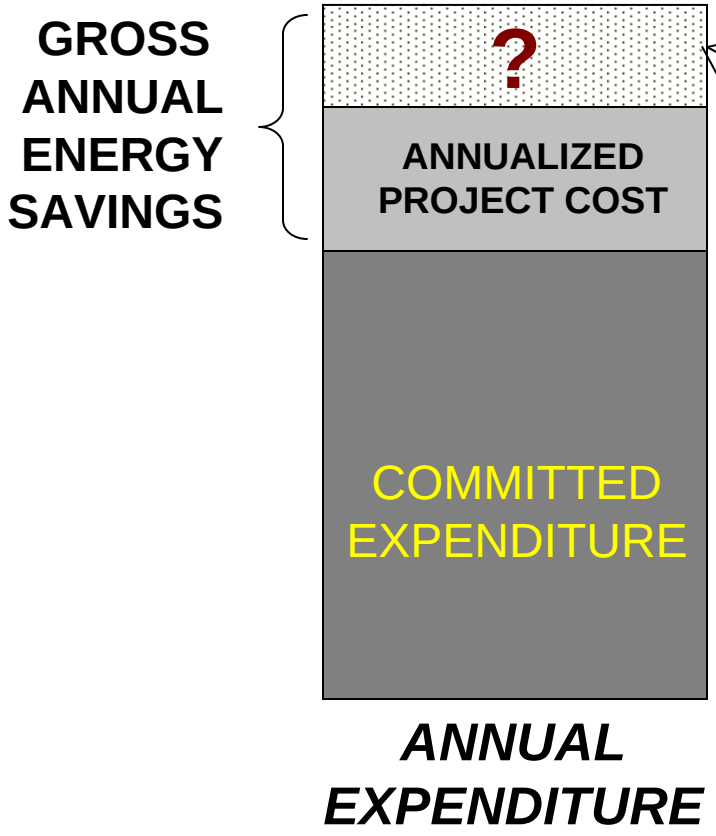
SAVE @ $0.2748 or BUY @ $1.611?

COST-BENEFIT RATIO

$$\frac{\text{COST TO SAVE A THERM}}{\text{PRICE TO BUY A THERM}} = \frac{\$0.2748}{\$1.611} = 0.17$$

This project allows the investor to pay $0.17 to avoid buying $1.00's worth of energy

INTERPRETING ANNUALIZED COST ANALYSIS



Annualized net savings

Annualized penalty for ***DOING NOTHING***

Theoretical maximum annualized budget for additional design, analysis, or reconfiguration

ECONOMIC PENALTY FOR DOING NOTHING

(Price per unit to buy energy − Annualized cost to avoid purchasing a unit of energy) X Volume of avoidable energy purchases = Annualized Penalty for *Doing Nothing*

USING THE BOILER REPLACEMENT EXAMPLE:

($1.611 per therm − $0.2748 per therm) X 91,782 therms = $122,639

$122,639 = annual premium paid over the
25-year economic life of the proposed improvement

- Assumes energy prices and cost of money stay constant
- Penalty for doing *nothing* goes up:
  as <u>energy prices rise</u> and as <u>interest rates fall</u>

BREAK-EVEN POINT

ANNUALIZED PROJECT COST = TOTAL VALUE OF ANNUAL ENERGY SAVINGS

What's the MOST that should be paid for the project, given certain investment criteria?

BREAK-EVEN ANALYSIS

ANNUAL VALUE OF AVOIDED ENERGY PURCHASES = PRICE PER UNIT OF ENERGY times ANNUAL NUMBER OF UNITS AVOIDED = MAXIMUM TO PAY FOR AN ENERGY EFFICIENCY INVESTMENT (Break-Even Cost)

$$\text{ANNUAL VALUE OF AVOIDED ENERGY PURCHASES} = \frac{\{\text{PRICE PER UNIT OF ENERGY} \times \text{ANNUAL NUMBER OF UNITS AVOIDED}\}}{\text{CRF}}$$

Use CRF to account for economic life of investment and the time-value of money.

BREAK-EVEN ANALYSIS

Capitalizing an Operational Cost

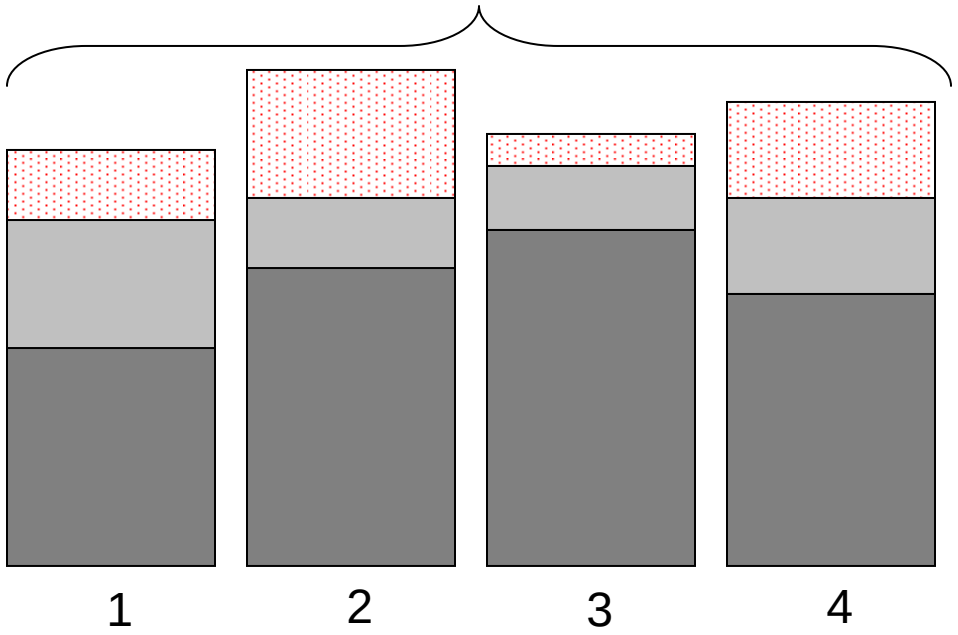
MAXIMUM TO PAY FOR AN ENERGY EFFICIENCY INVESTMENT (Break-Even Cost) = $\dfrac{\{\text{PRICE PER UNIT OF ENERGY} \times \text{ANNUAL NUMBER OF UNITS AVOIDED}\}}{\text{CRF}}$

$1,578,383 = $\dfrac{\{\$1.611 \times 91{,}782\}}{.0937}$

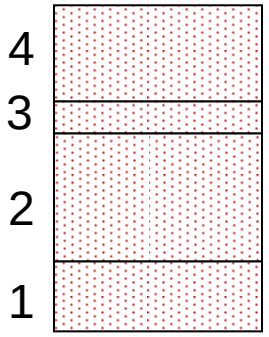
Actual cost is only $269,205... definitely worth it.

Toward a Portfolio

ANNUALIZED ENERGY EXPENDITURES
FOR PORTFOLIO OF APPLICATIONS



SUM OF ANNUALIZED
NET SAVINGS



___% Cash Flow?

___% Design Work?

___% Analysis?

___% Reconfiguration?

= ANNUALIZED NET SAVINGS

= ANNUALIZED PROJECT COST

= COMMITTED EXPENDITURE

PAYBACK vs. SAVE-OR-BUY ANALYSIS

FEATURE	PAYBACK	SAVE-OR-BUY ANALYSIS
Account for cash flows over the life of the improvement?	NO	YES
Incorporate the time-value of money?	NO	YES
Provide basis for break-even cost evaluation?	SORT OF	YES
Compare value of projects with different economic lives?	NO	YES
Permit real-time evaluation of the cost of waste?	NO	YES
Measure the penalty for NOT taking action?	NO	YES

Organizing Capital Budgets

NEW INITIATIVES:

- Option to invest in new commitments
- Alternative to investing is to keep the money
- Investment is a Yes/No choice
- Example: new product line, new plant addition
- **Simple payback** is the appropriate criterion

COMMITTED EXPENDITURES

- Make change to existing commitments
- More expensive vs. less expensive commitment
- Example: energy efficiency improvement
- **Save-or-buy** is the right criterion.

CAPITAL BUDGET IMPLICATIONS

If your capital budget comingles

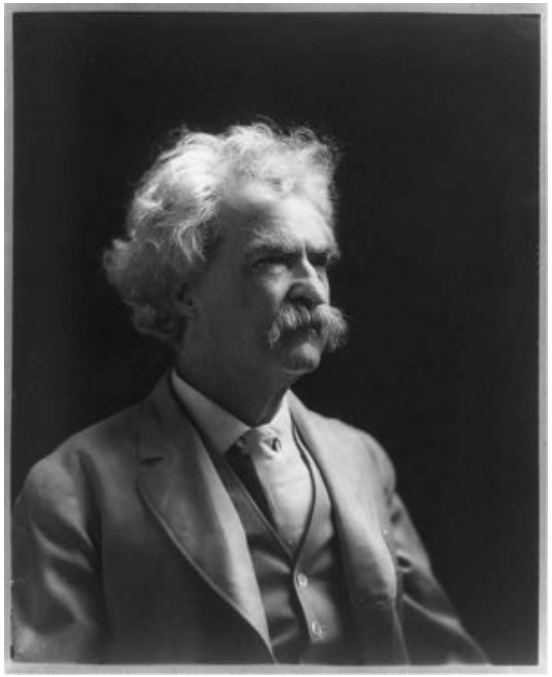
New Initiatives with

Committed Expenditures:

…then add the capitalized cost of forfeited energy savings to the capital cost of the new initiatives that you accept.

Payback on your new initiative should be enough to pay for that project PLUS the value of the energy waste that you decide to live with.

MARK TWAIN (1835-1910)



"Education consists mainly of what we have unlearned."

THANK YOU!

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