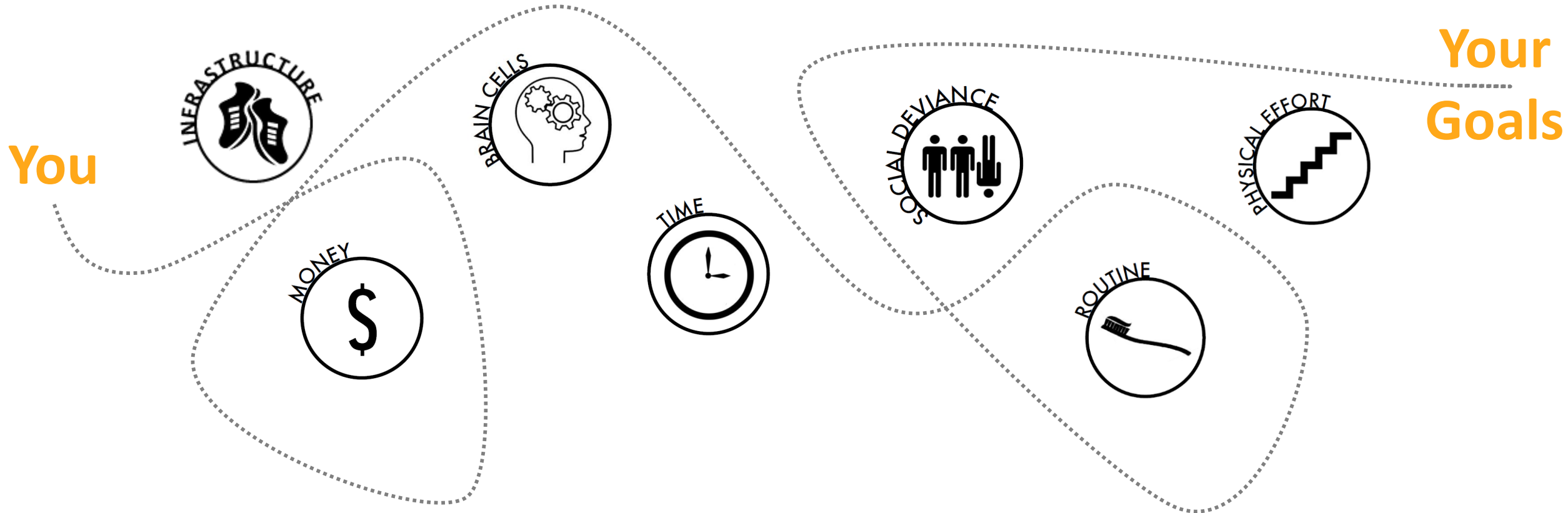


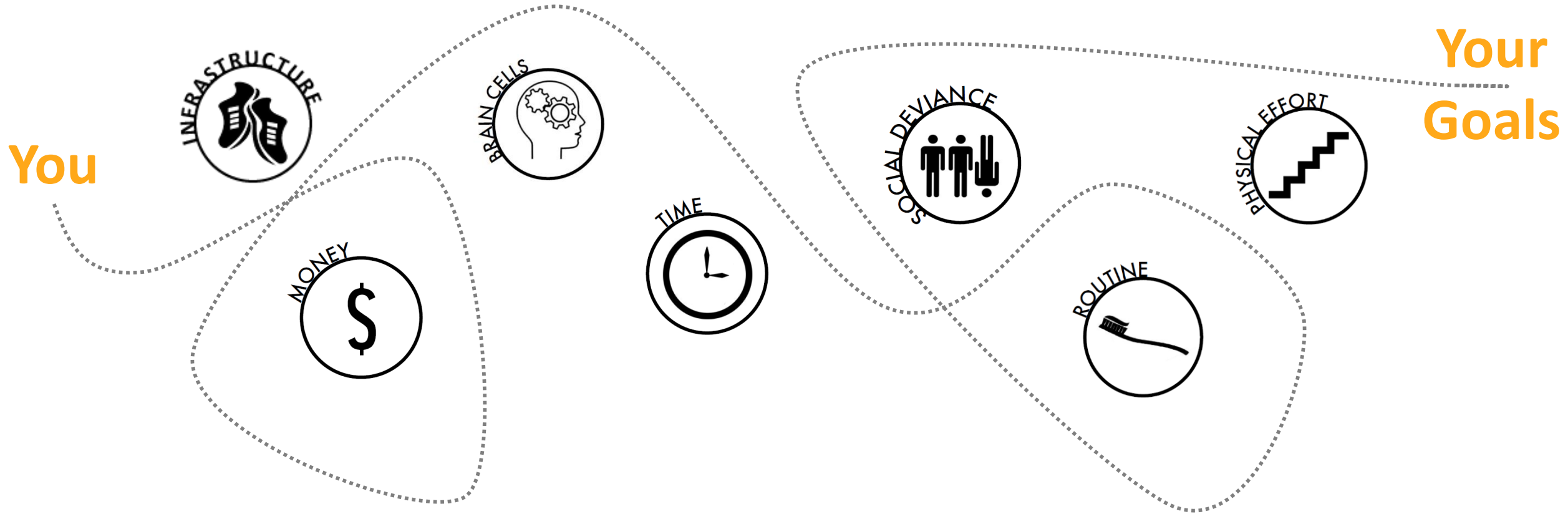


Squeezing More Out of Your Existing Buildings:  
Moving Beyond the Low-Hanging Fruit  
February 23, 2017

# Your Goals



# Your Institution's Goals



# Squeezing More Out of Your Existing Buildings

## Agenda

- » Technology
- » Finance
- » Process
- » Getting Buy-in

# Avoiding Paralysis

## Existing Buildings

» Slated for demolition in  
next 10 years

Band Aids

» Slated for major renovation  
in next 10 years

Deep Energy Retrofits

» Everything else

# Your Institution's Goals

You

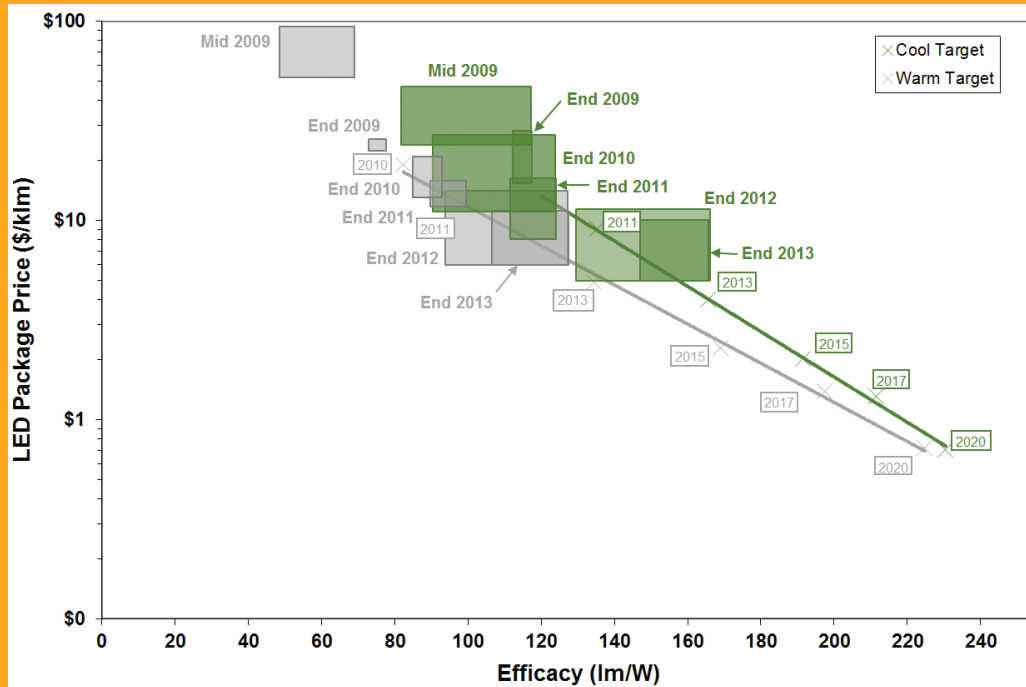


## Technology and Tactics

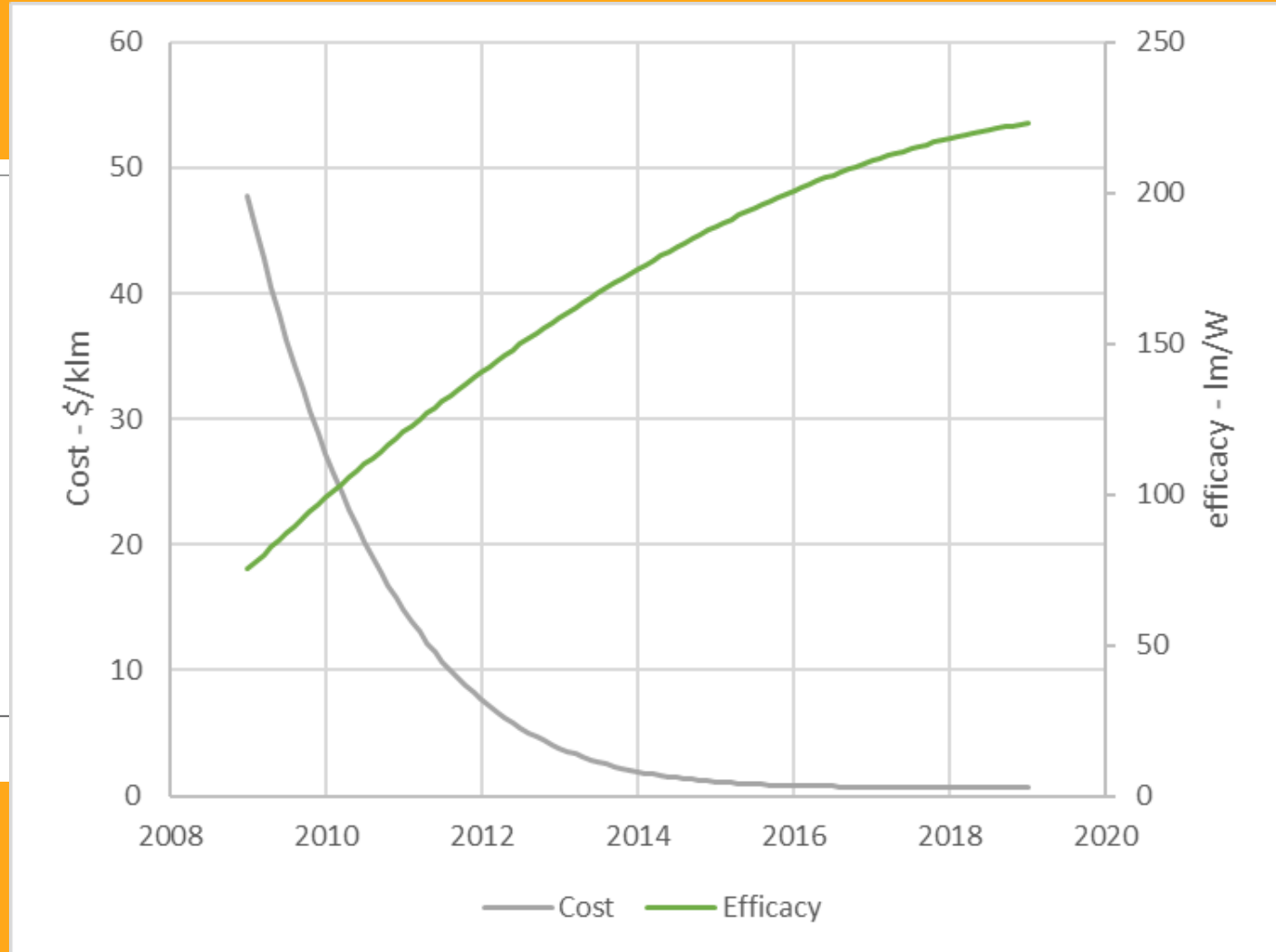
Your  
Goals

# Energy Efficiency 2.0: Technology & Tactics

## LED Lighting



From DOE Quadrennial Technology Review, September 2015  
Attributed to Navigant Consulting



# Technology & Tactics - Controls

- » Advanced sequences of operation
  - ✓ ASHRAE Guideline 36 – High Performance Sequences of Operation for HVAC
  - ✓ Chiller plant optimization based on modeling of part load performance of all components
- » Integrated lighting/HVAC control
  - ✓ CSI – Division 25 – Integrated Automation
  - ✓ Smart room controls



# Technology & Tactics – Heating and Cooling

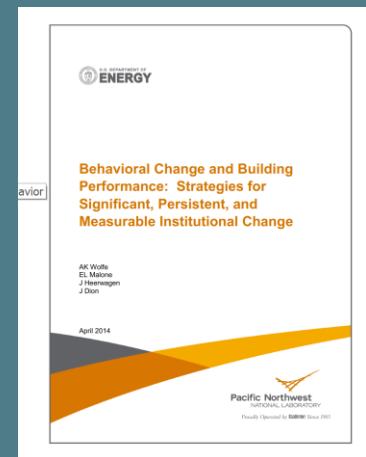
- » Ground source heat pumps
- » Low temperature heating systems
- » Higher temperature cooling systems
- » Heat recovery chillers
- » Variable Refrigerant Flow (VRF)

# Technology & Tactics – Advanced HVAC Design

- » Separate ventilation and conditioning air
- » Recycle/re-use ventilation air
- » Optimize air distribution (labs) – focus on ventilation effectiveness
- » Wherever possible, integrate building envelope improvements

# Technology & Tactics – Behavior and Education

- » Systematic approach\*
- » Build relationships with building occupants
- » Leverage building system improvements
- » Communicate, communicate, communicate



\*"Behavioral Change and Building Performance: Strategies for Significant, Persistent, and Measurable Institutional Change" Pacific Northwest National Laboratory, April 2014

# Your Institution's Goals

**Your  
Goals**

**You**



**Finance**

# Finance – Changing the Mindset

» “Low hanging fruit”

What about the rest of the fruit?

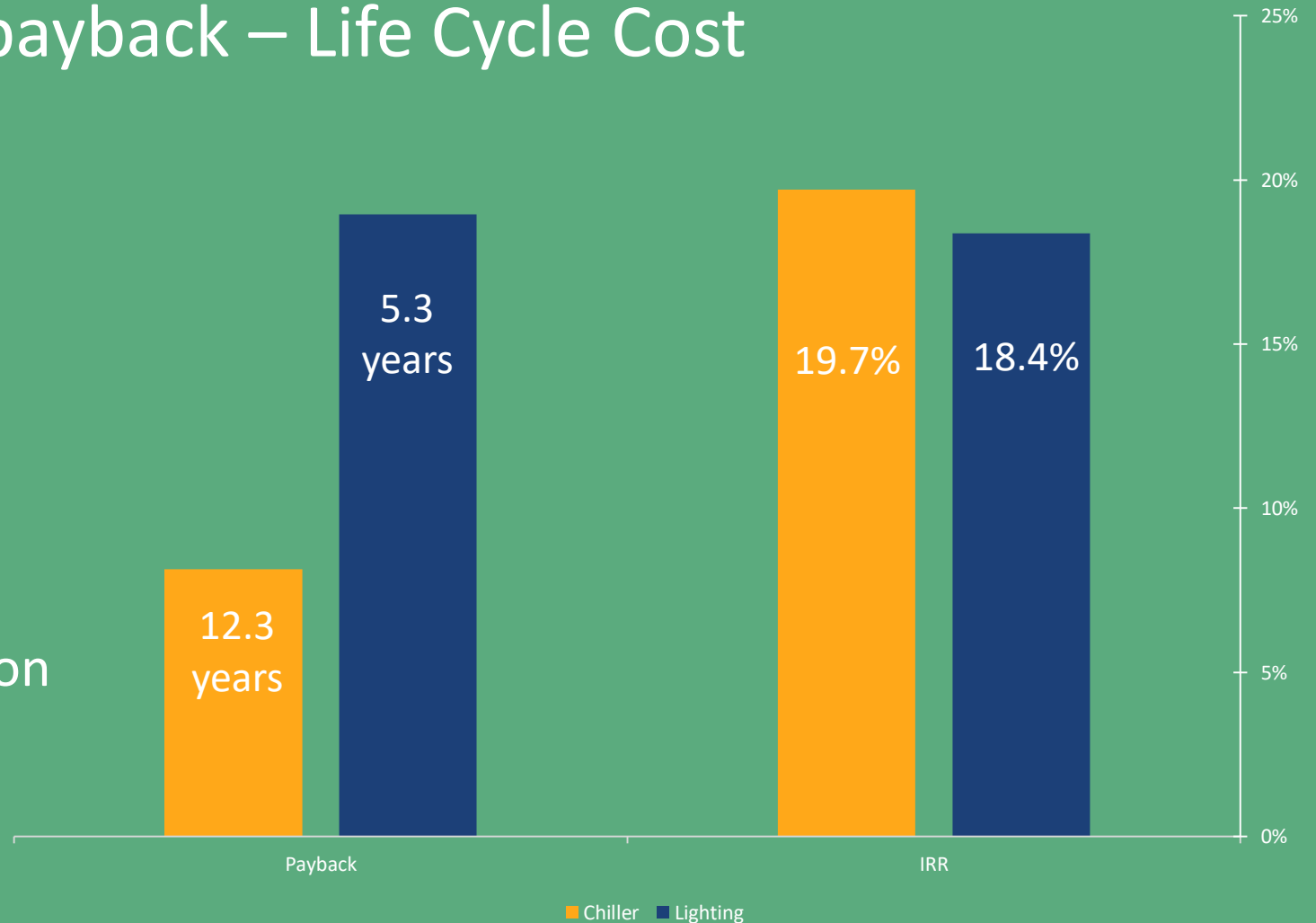
» “No brainers”

If we’re just going to do “no brainers”, what do we need all these smart people for?

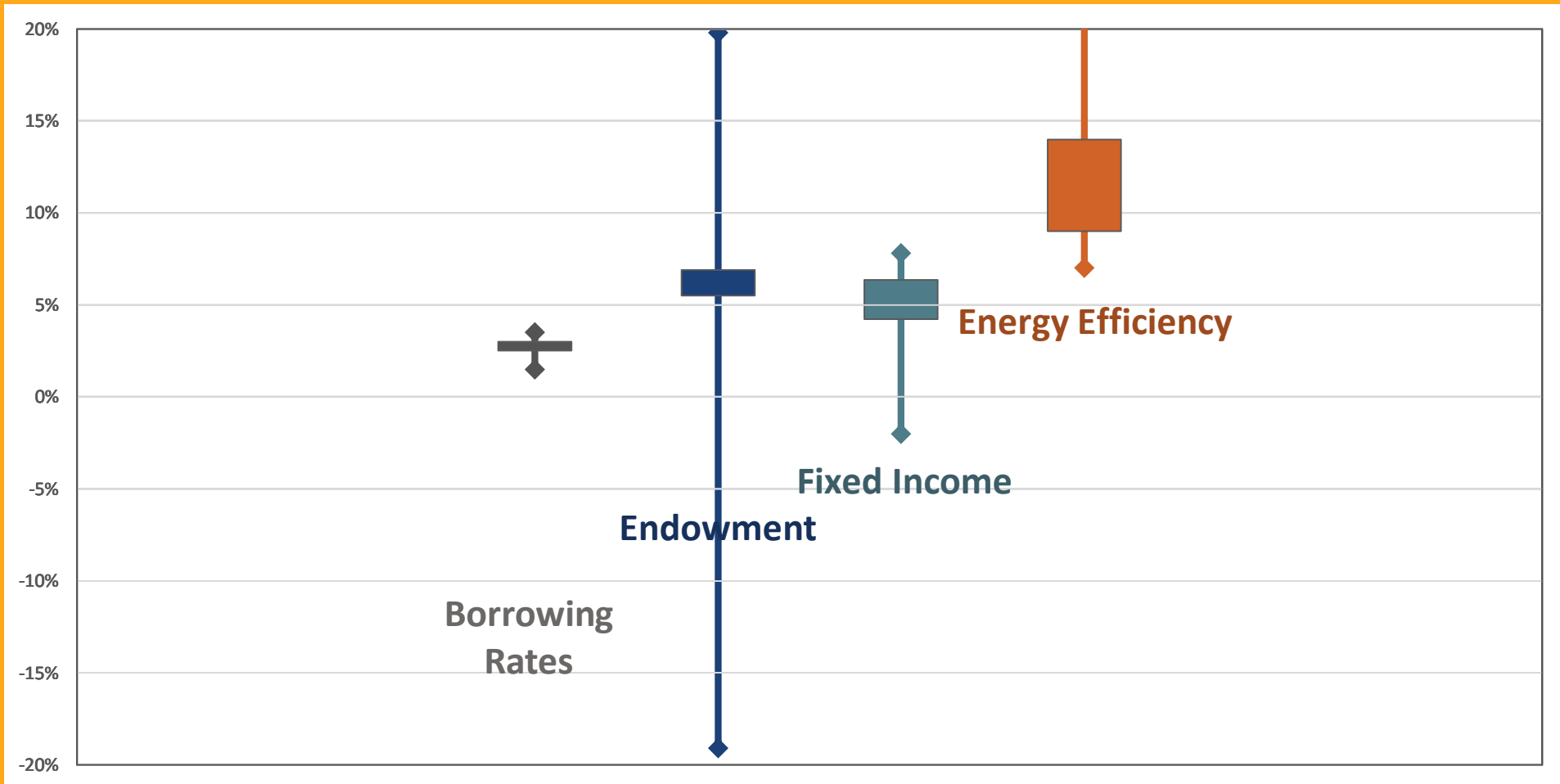
# Finance – Investing In Your Campus

## Looking beyond simple payback – Life Cycle Cost

- » Capital cost
- » Energy cost
- » Maintenance cost
- » Replacement cost
- » Intangible costs
  - ✓ Comfort
  - ✓ Headaches/distraction
  - ✓ Appearance
  - ✓ Productivity



# Finance – Investing in Your Facilities





# Finance – Investing In Your Campus





# Finance – Investing In Your Campus

**“\$1 in stewardship avoids  
\$3 in future capital renewal investment”\***

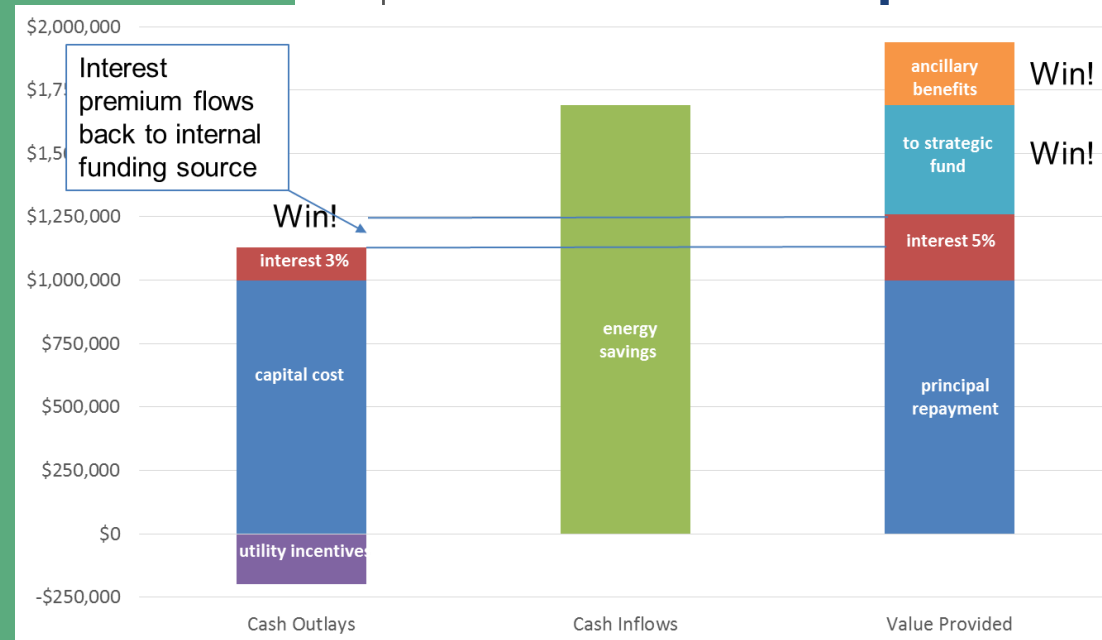
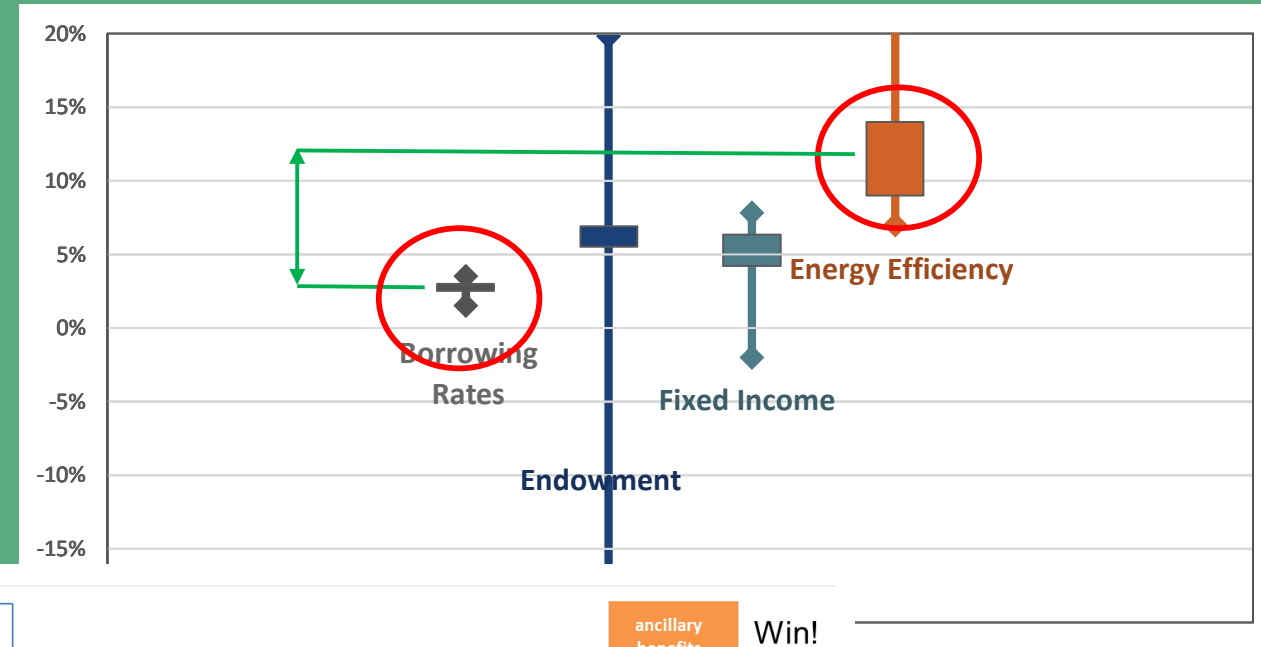
\*Sightlines, “State of Facilities in Higher Education – 2015 Benchmarks, Best Practices & Trends”

# Finance – Options

- » Debt
- » Lease
- » Performance Contract
- » Self fund
- » Energy Service Agreement
- » Endowment Finance
- » Carbon Fee
- » Crowd Sourcing

# Finance – Debt

- » Least expensive outside source
- » Maximum control



# Finance – Leasing

## Capital Lease

- » On balance sheet
- » Capital expense
- » Fixed payment schedule
- » Can be tax exempt
- » Nominal buyout price

## Operating Lease

- » Can be off balance sheet  
(at least theoretically)
- » Operating expense
- » Fixed payment schedule
- » Not tax exempt
- » “fair market” buyout  
option

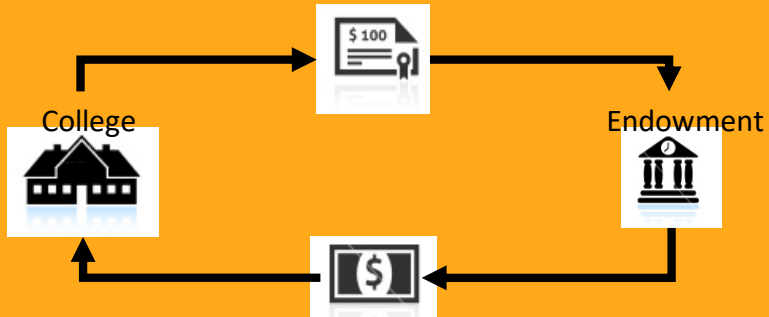
# Finance – Performance Contracting

- » ESCO arranges financing (typically a capital lease) and provides a savings guarantee\*
- » Less flexible than other options
- » More common among state universities
- » Expensive
  - ✓ ESCO Risk premium
  - ✓ M&V cost
  - ✓ Higher finance rates than direct debt

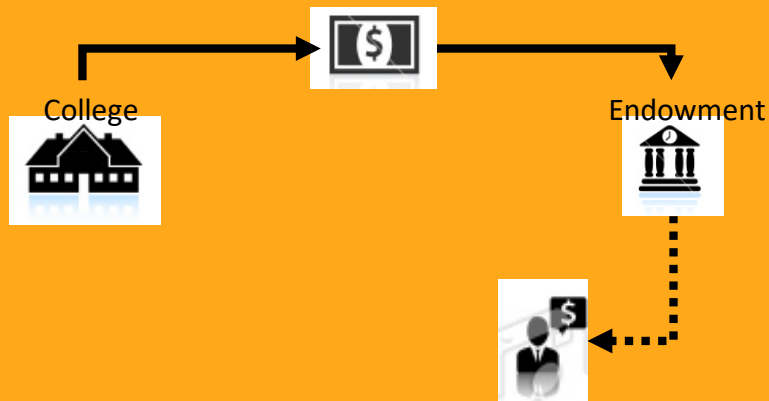
# Finance – Energy Service Agreement

- » Provider finances
- » Pay for delivered savings only\*
- » Off balance sheet
- » Fair market buyout

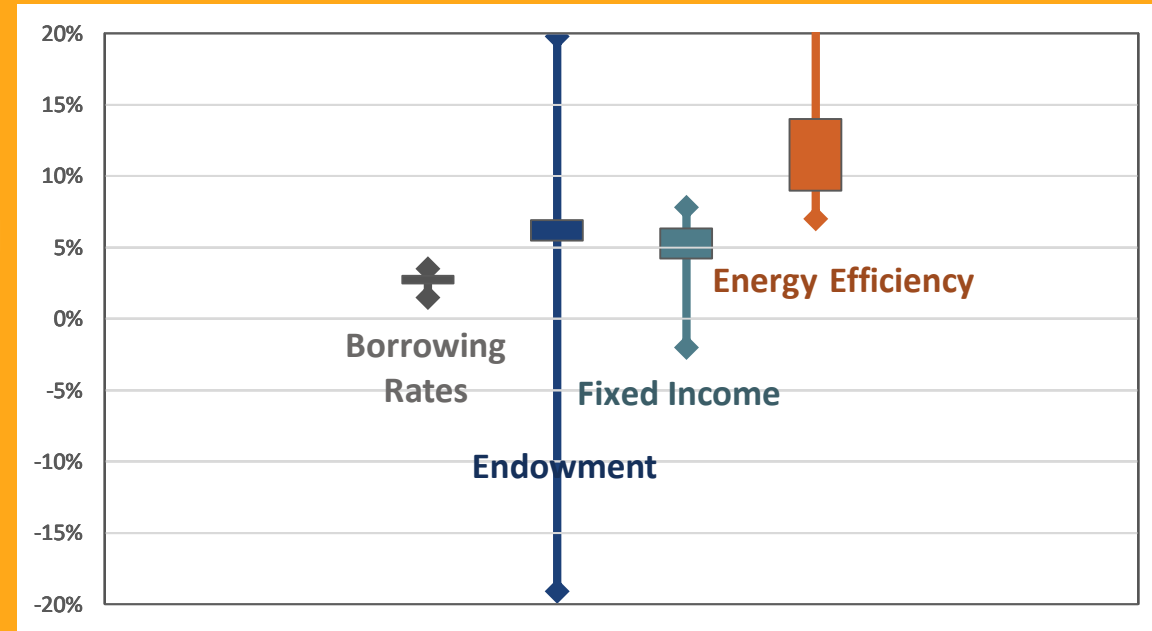
# Finance – Endowment Financing



- 1** College issues a Fixed Income security.  
Endowment invests in security.



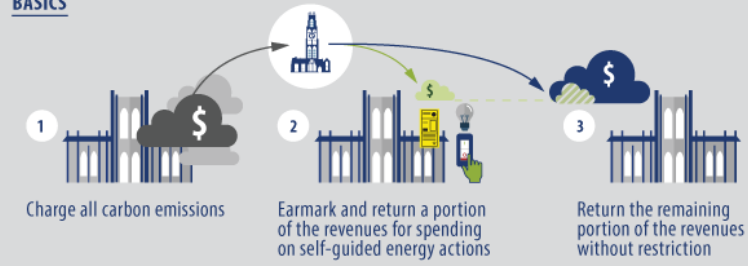
- 2** Endowment receives regular interest and principal payments from College.  
Endowment can hold security until maturity OR sell it to a third party.



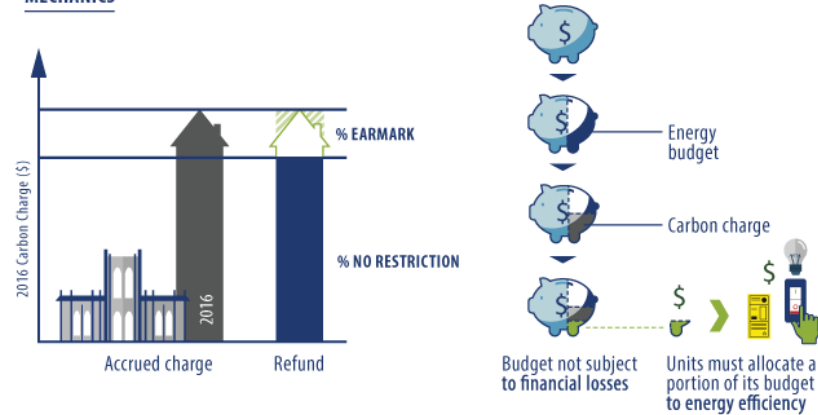
# Finance – Carbon Fee

## 3. Energy Efficiency Earmark SET ASIDE FUNDS FOR ENERGY ACTIONS

### BASICS




### MECHANICS



### BUDGET IMPACT



Requires participating units to invest a portion of their budget to reduce energy consumption and emissions



Scheme can be revenue neutral at university level if units achieve energy cost savings equal to expenditures



# Finance – Crowd Sourcing & Donor-Investors

## » Sources:

- ✓ friends of the university
- ✓ investors looking for green investments

## » Significant legwork required to secure source of funds

## » Mid-range cost

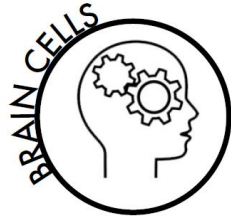


# Finance – Self Funding

- » Most commonly used option
- » Simplest and least expensive option
- » Energy  $\approx$  2% of annual operating budget
  - ✓ Robust EE program can be funded at  $\approx$  0.5% / year
- » Sources
  - ✓ Reserve Accounts
  - ✓ Capital Budgets
  - ✓ Operating Budgets

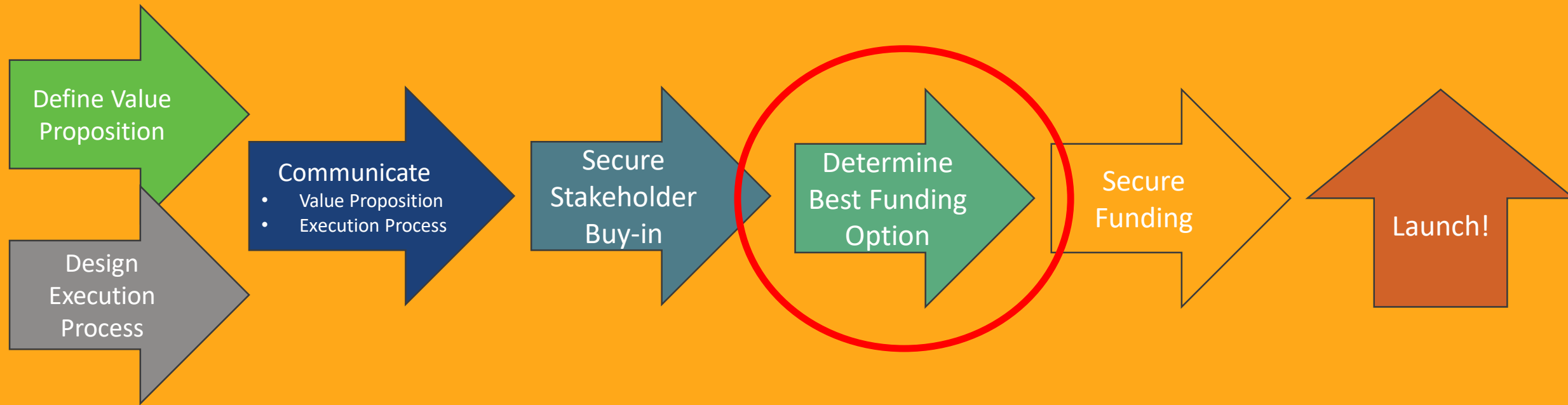
# Your Institution's Goals

You  
Process



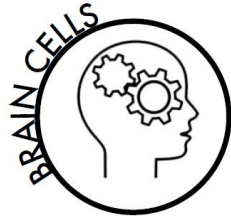
Your  
Goals

# Process Overview



# Your Institution's Goals

You



- » Define Decision-Making Process
- » Define Project Approval Criteria
- » Identify what additional expertise you need

# Your Institution's Goals

You



Your  
Goals

- » Schedule early activities
- » Define program timeframe
- » Identify key scheduling issues

# Your Institution's Goals

- » Partnerships / structure of the work
- » Communication
- You** » Engagement with stakeholders
- » Finances
- » Accountability



Your  
Goals

# Your Institution's Goals

You

- » Staff time required
- » Disruptions to campus routine



Your  
Goals



# Your Institution's Goals

Your  
Goals

You

- » Performance Monitoring
- » Ongoing optimization



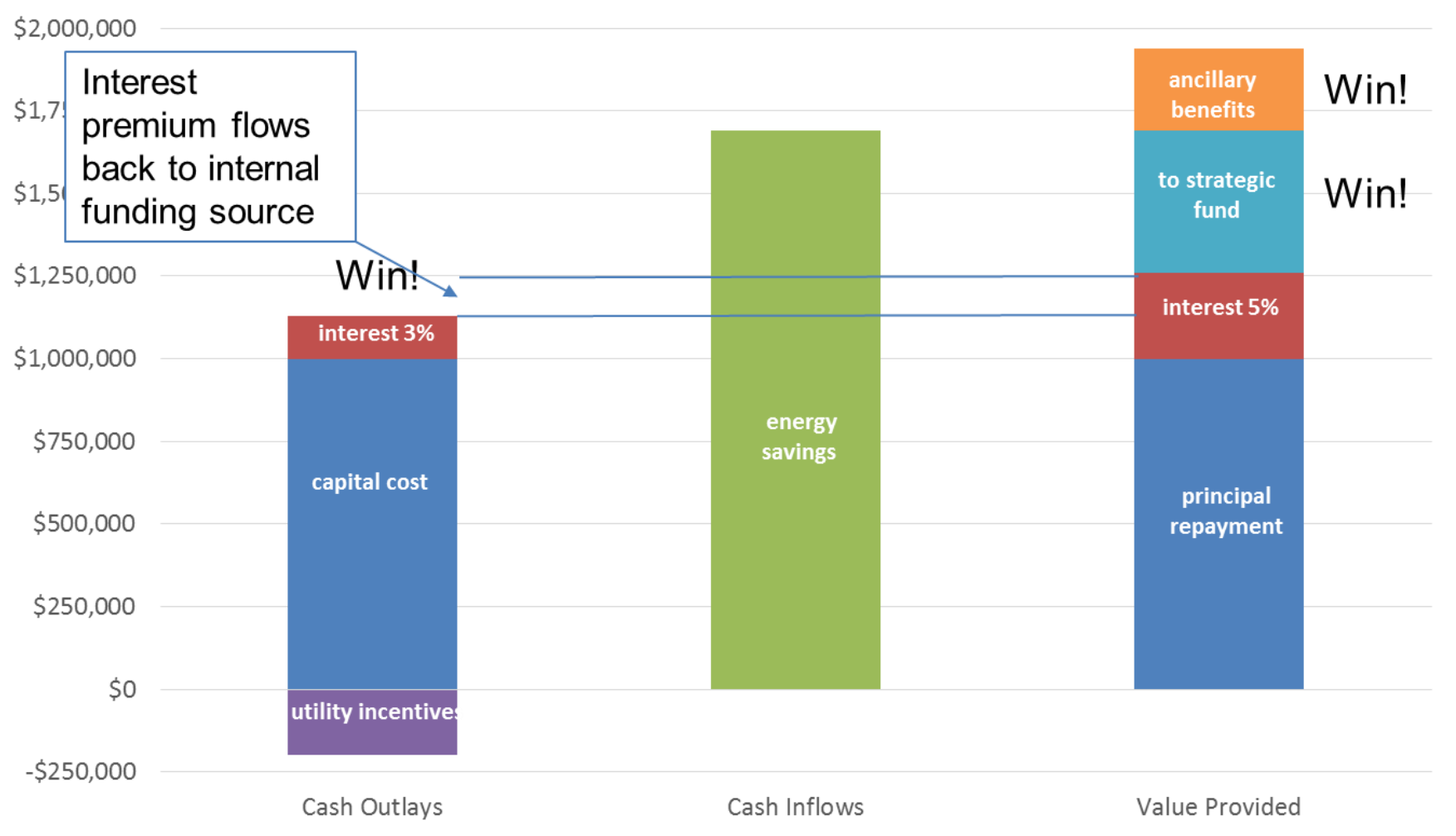
# Your Institution's Goals

» Getting other people to go along  
**You** with you



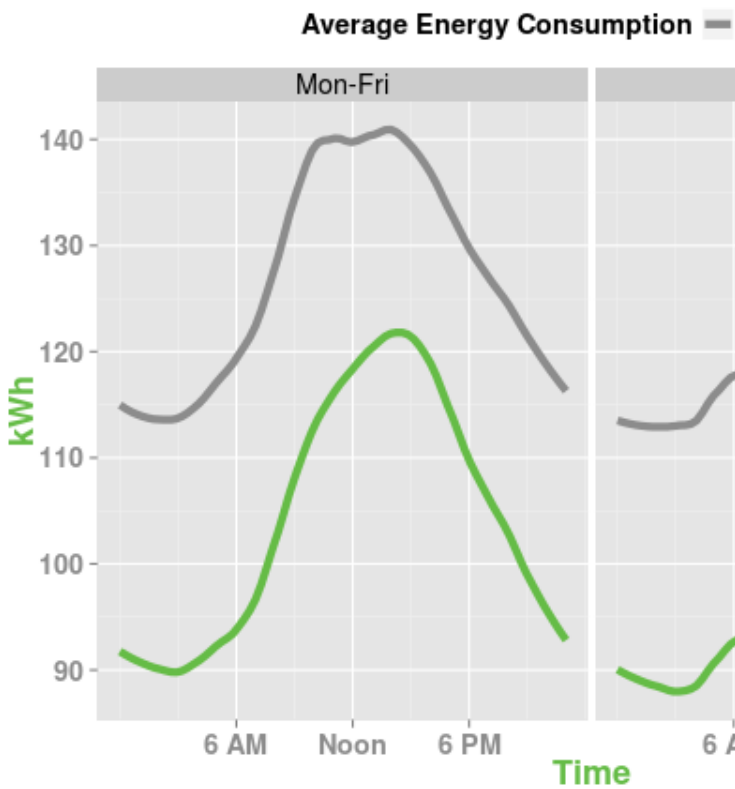
**Your  
Goals**















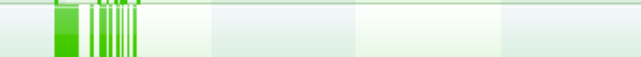

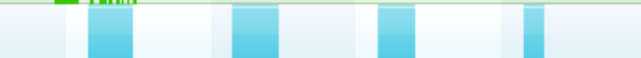



# Getting Buy-in



# Getting Buy-in – Accountability

Daily Load Profile  
Pre/Post-work



Targets					
					 (2)
					 309B Lab
					 AHU-1
					 201B Lab
					 (10)
t	Wed 1st	Thu 2nd	Fri 3rd	Sat 4th	
					 Building-Wide
					 AHU-1
					 AHU-1
					 AHU-2
t	Wed 1st	Thu 2nd	Fri 3rd	Sat 4th	
					 AHU
t	Wed 1st	Thu 2nd	Fri 3rd	Sat 4th	

# Getting Buy-in

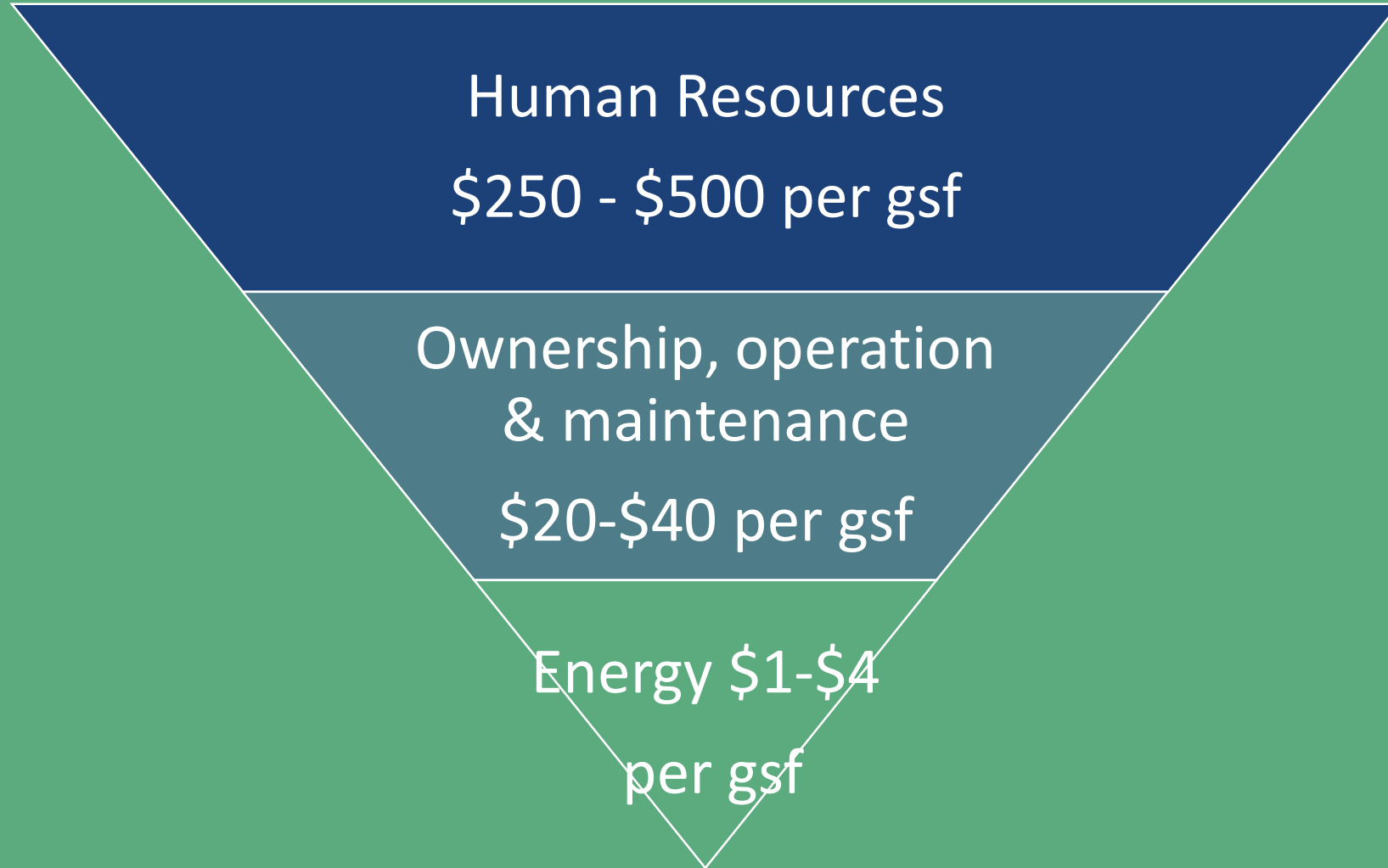


Energy \$1-\$4  
per gsf

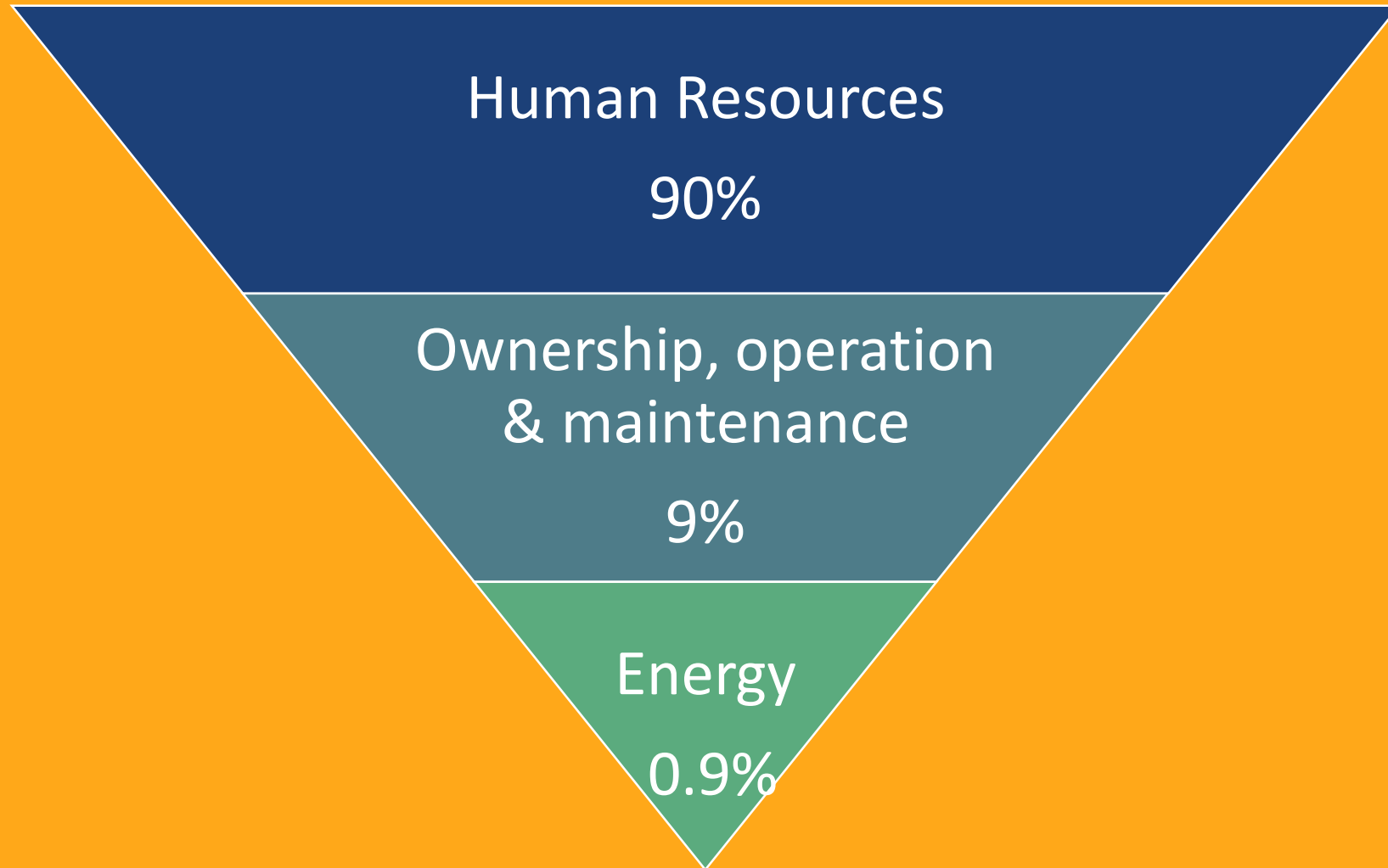
# Getting Buy-in



# Getting Buy-in



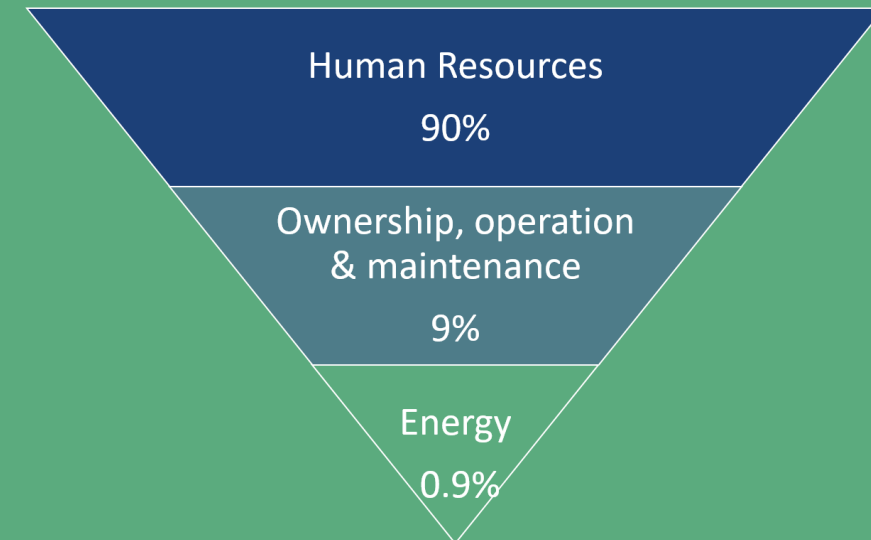
# Getting Buy-in





# Getting Buy-in

- » Doubling the ventilation rate increased worker performance by 8%\*
- » Studies have also shown that temperature and lighting affect productivity



\* “Economic, Environmental and Health Implications of Enhanced Ventilation in Office Buildings”  
MacNaughton, Pegues, Satish, Santanam, Spengler and Allen, International Journal of Environmental Research and Public Health, November 2015.  
<http://www.mdpi.com/1660-4601/12/11/14709/html>

# Getting Buy-in – Alignment with Mission

- » *“We are teaching through the force of institutional example.”* – Paul Zingg, President Emeritus of California State University at Chico
- » “Our students spend 5% of their time in the classroom and 95% of their time on the campus. *We are teaching with what we do on campus.*”  
Jonathan Lash, President of Hampshire College

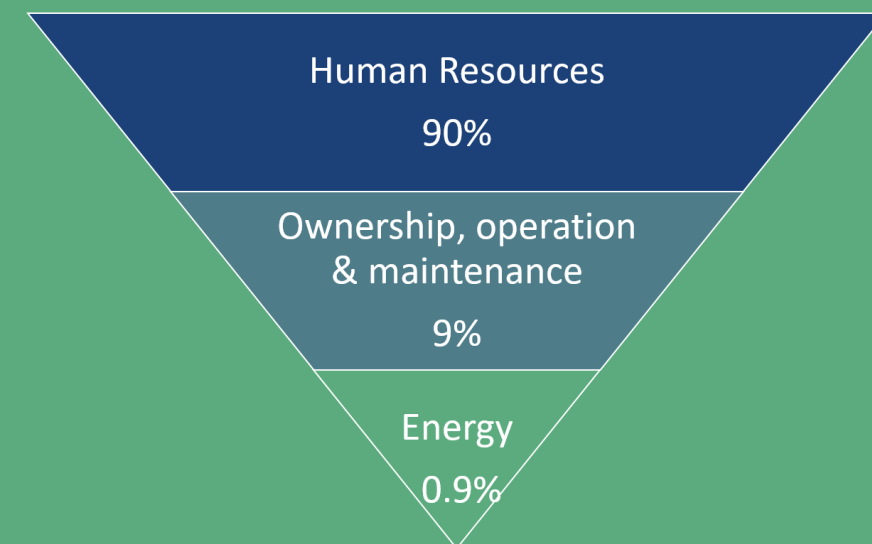
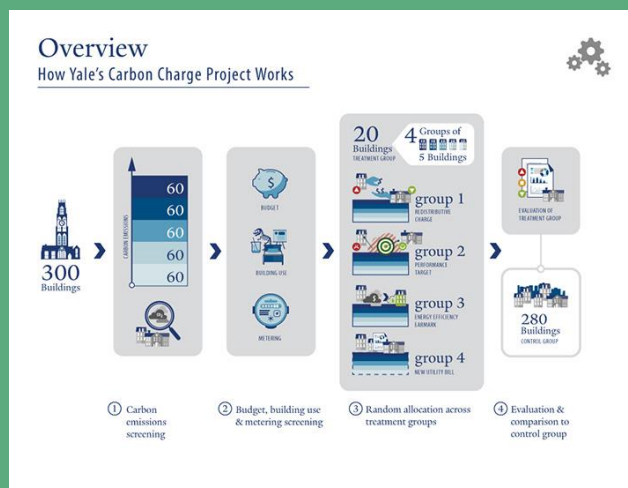
# Getting Buy-in



“We will *invest*, not *divest*.”

Williams College President Adam Falk, announcing intent to invest up to \$50 million in climate change mitigation efforts.

# Getting Buy-in – Do your homework



# Questions?

GREENER  | Thank You!