



# Veolia Boston Cambridge DES and LEED

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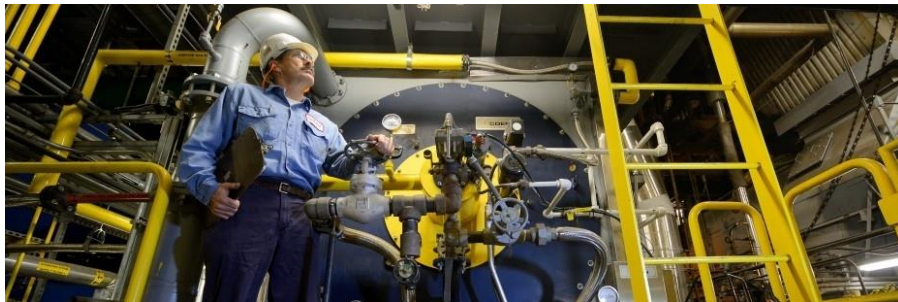
# Veolia Boston – Cambridge System is Internationally Recognized as No. 1



- Veolia's Boston-Cambridge network was selected as the 2015 'System of the Year' from a pool of 350 district energy systems in 26 countries.
- Recognizes Veolia's sustainable investment in Combined Heat and Power (CHP) at its Kendall Station facility
- Reducing greenhouse gas emissions by 475,000 tons
- Improving the environment by removing our heat discharge from the Charles River ecosystem.



# Reliable and Resilient Energy Infrastructure



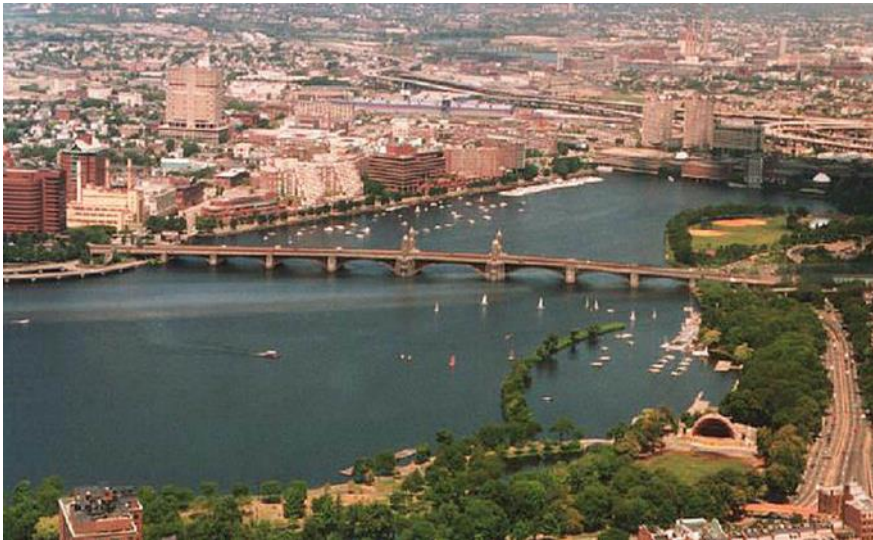
## ◦ Secure Energy Source

- *District Energy/CHP keep going when the grid goes down*
- *Dual fuel (No. 2 oil & NG) capable at all locations- can switch mid-operation*
- *2.5 Million gallons of fuel oil storage onsite*
- *Redundant to utility grids*
- *Ability to “black start”*
- *Multiple sources of feed water*

## ◦ Back up generation

- *Kendall Co-gen*
- *Back up boiler plant at Kendall*
- *Agreement to purchase steam from MIT*
- *Agreement to purchase steam from Veolia operated CHP plant in Cambridge*

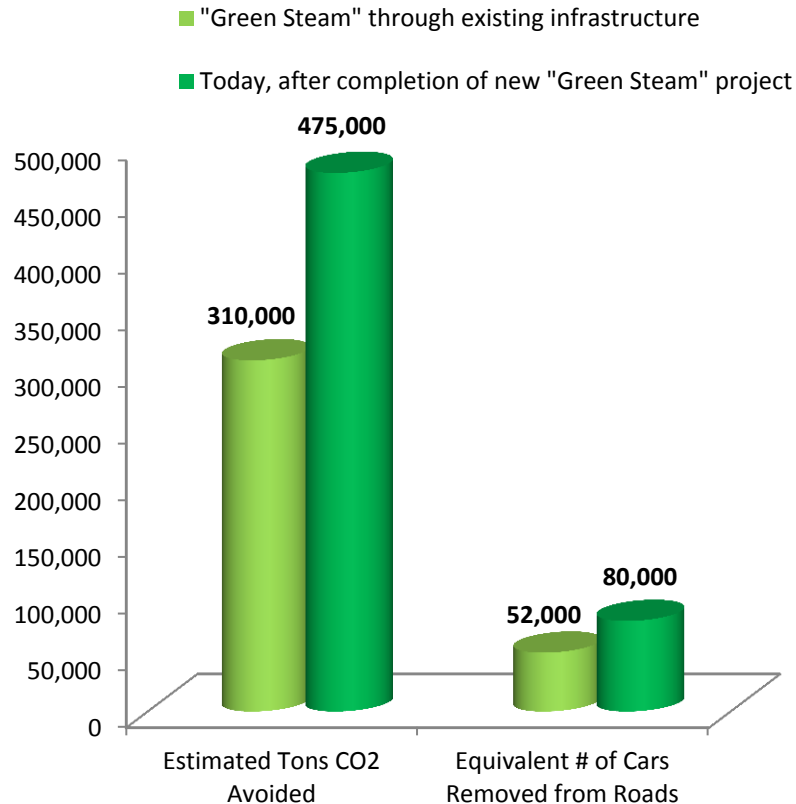
# Boston Green Steam Project



## Boston Green Steam long Term Investment - \$112M:

- Kendall Acquisition: \$50 million
- Reconfiguration: \$35 million
- Charles River Transmission Pipe: \$27 million
- Cambridge wide condensate system improvements
- Job Creation:
  - *\$21 million in labor costs*
  - *147,500 man hours – welders, pipe fitters, insulators*

# Reducing Boston's Carbon Footprint



- Boston carbon reductions of 475,000 tons/year, equivalent to:
  - *Removing more than 80,000 cars from the streets; 600 football fields of solar PV*
- Produces 75% of Boston's district heating requirements
- Eliminates waste heat from the Charles River ecosystem



## Boston-Cambridge Service Territory

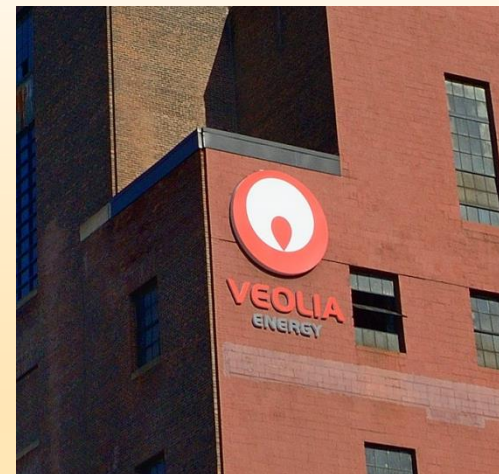


# Boston/Cambridge District Energy and Cogeneration (CHP)

District energy meets the critical energy requirements of **250 customers** in the central business district of Boston, the biotechnology corridor of Cambridge, and the Longwood Medical Area

## Major Customers Served

- 70% of high-rise office buildings in Boston – 90,000 workers
- All large healthcare facilities in Boston – 1,740 hospital beds
- Hotels in Boston
- Universities in Boston
- Biotechnology leaders in Cambridge
- Pharmaceutical leaders in Cambridge
- 20 million sq ft of new and renewals - last 3 years



# The Kendall Timeline

- **2005**
  - **Veolia (Dalkia) acquires the Cambridge District Energy System**
- **2006**
  - **Veolia purchases Tri-gen North America (including Boston system)**
- **2007**
  - **Veolia (Dalkia) commissions two new 200 psig Naturag Gas fired boilers for Cambridge system (replacing oil fired boilers)**
- **2010**
  - **Commitment made to remove heat from Charles River Eco-system**
- **2013**
  - **Construction of the 7,000 ft “Green Steam Pipe” between Cambridge and Boston**
- **2014**
  - **Veolia acquires Kendall Station with partner I-Squared**
  - **Invest in reliability, plant/system longevity and control upgrades to GE7FA gas turbine**
  - **Conversion to dual fuel (natural gas, ultra low sulfur diesel fuel)**



# The Kendall Timeline

- **2015**

- **Veolia buys out Dalkia**
- **Upgrade water treatment system with additional capacity**
- **Implement plant 'black-start' capability – ISO New England**
- **Plant capable of restoring steam service during blackout**

- **2016**

- **New Back Pressure Steam Turbine/ (BPST) and Air Cooled Condenser (ACC) eliminates water withdrawals and heat discharge to the river**
- **Replaces 1950's Westinghouse turbine**

# LEED V4 applicability

- LEED BD+C
- Points available under the Energy and Atmospheric Credit



# LEED BD+C

- What is it?
- How does Veolia
- Boston impact an application for LEED NC?







Energy Efficiency Optimization

# Why Energy Matters for LEED?

○ 18 out of 110 points

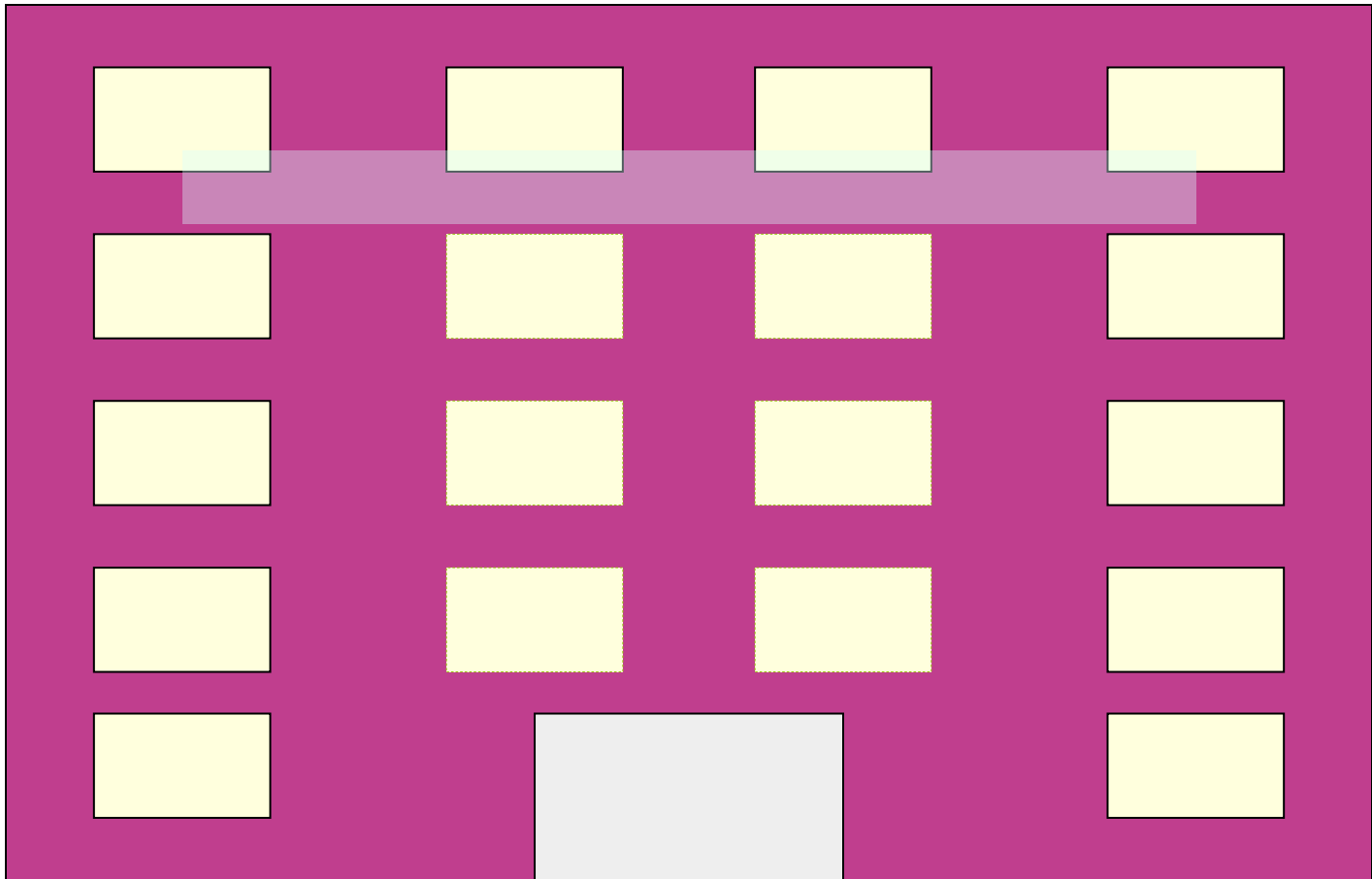


# Goals & Application – Energy

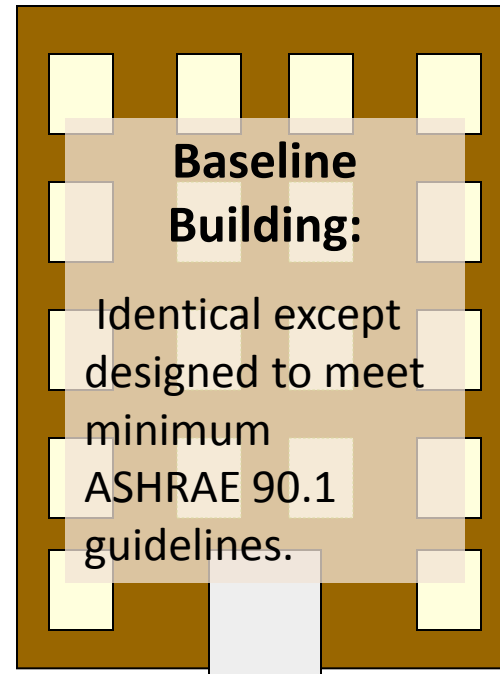
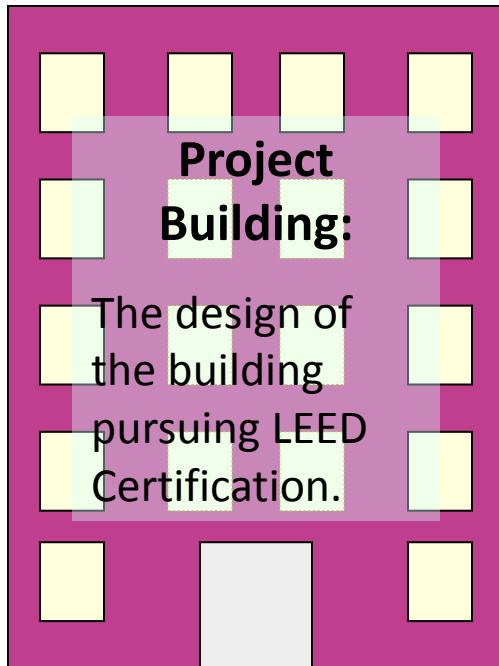
- Optimize Energy Performance:
  - **Goal:** *Demonstrate energy performance greater than required by the pre-requisite.*
  - *For energy modeling, this is referred to as Option 1, Path 2 – Aggregate Building/DES Scenario.*



# ASHRAE 90.1

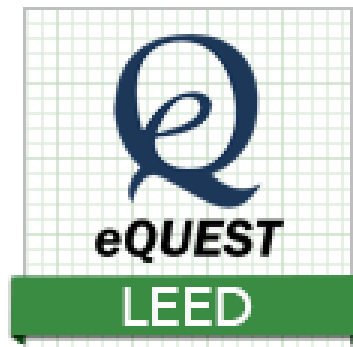


# Appendix G



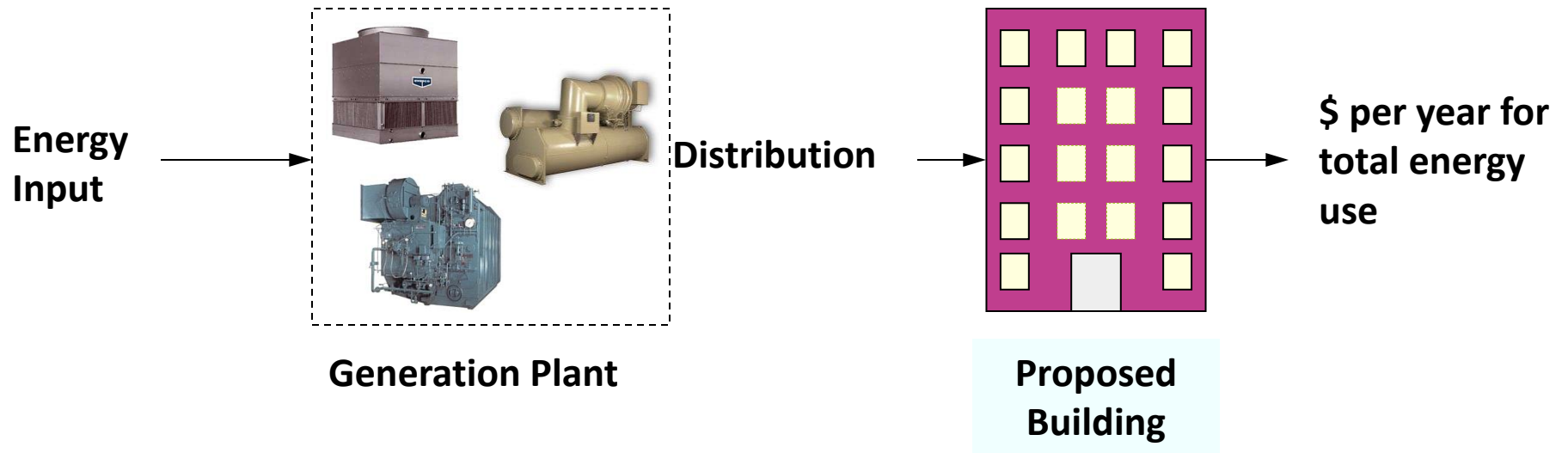
## ENERGY USE IN DOLLARS

# Modeling Software Options

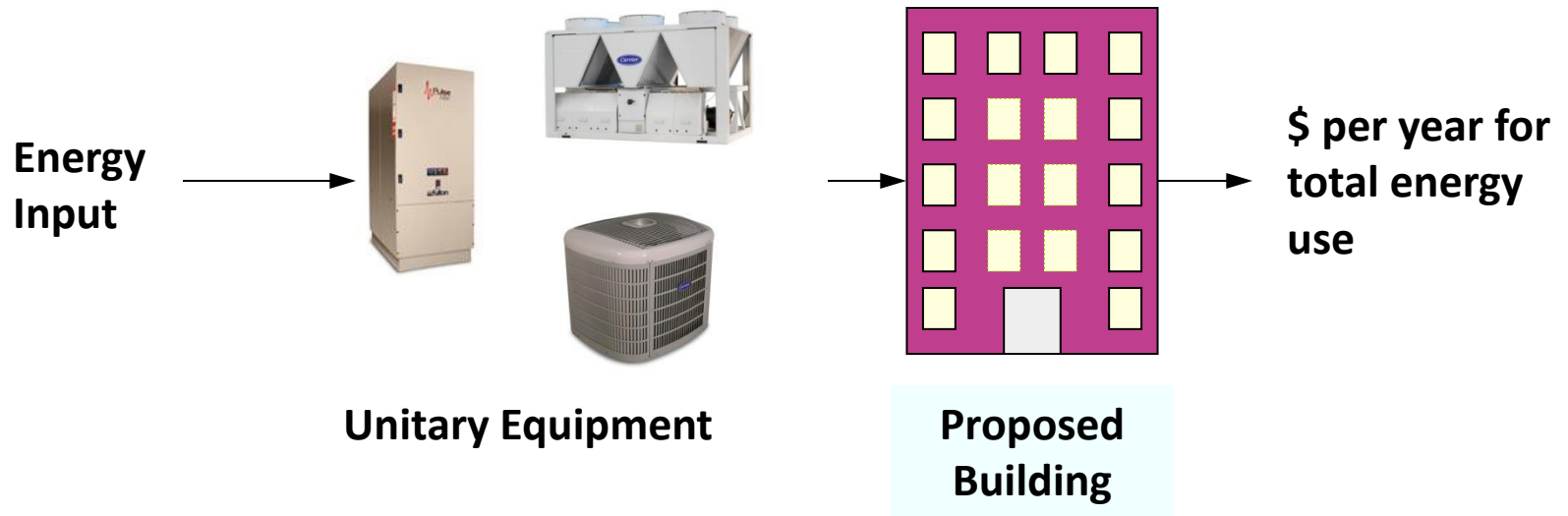




# District Energy Analysis

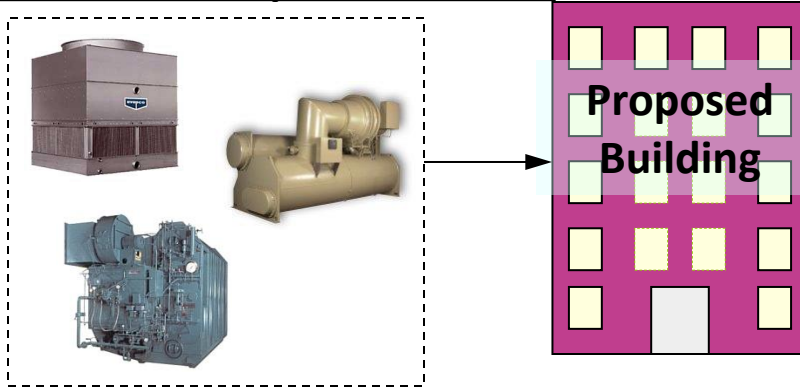


# Code Minimum Comparison



# Option 1 Path 2 Model

## Virtual DES-equivalent Plant

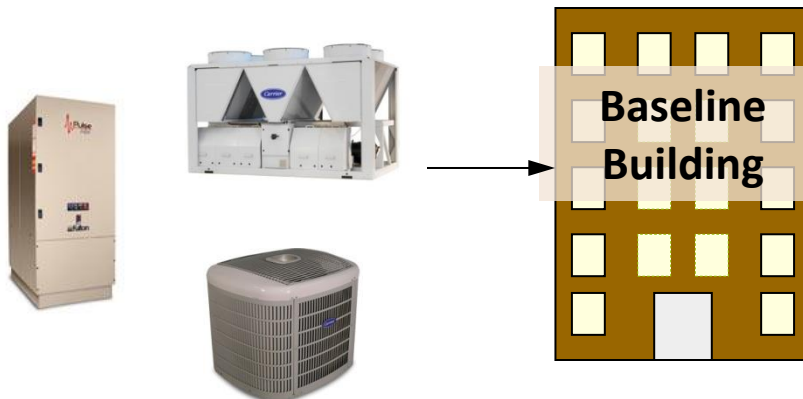


\$ per year  
for total  
energy use

$$100 * \left( 1 - \frac{\text{Proposed Building \$}}{\text{Baseline Building \$}} \right) = \text{Percentage Improvement}$$

LEED Version 2009	
% Improvement	Points Earned
12%	1
16%	3
20%	5
24%	7
28%	9
32%	11
36%	13
40%	15
44%	17
48%	19

## On-Site Equipment per ASHRAE 90.1 - 2004

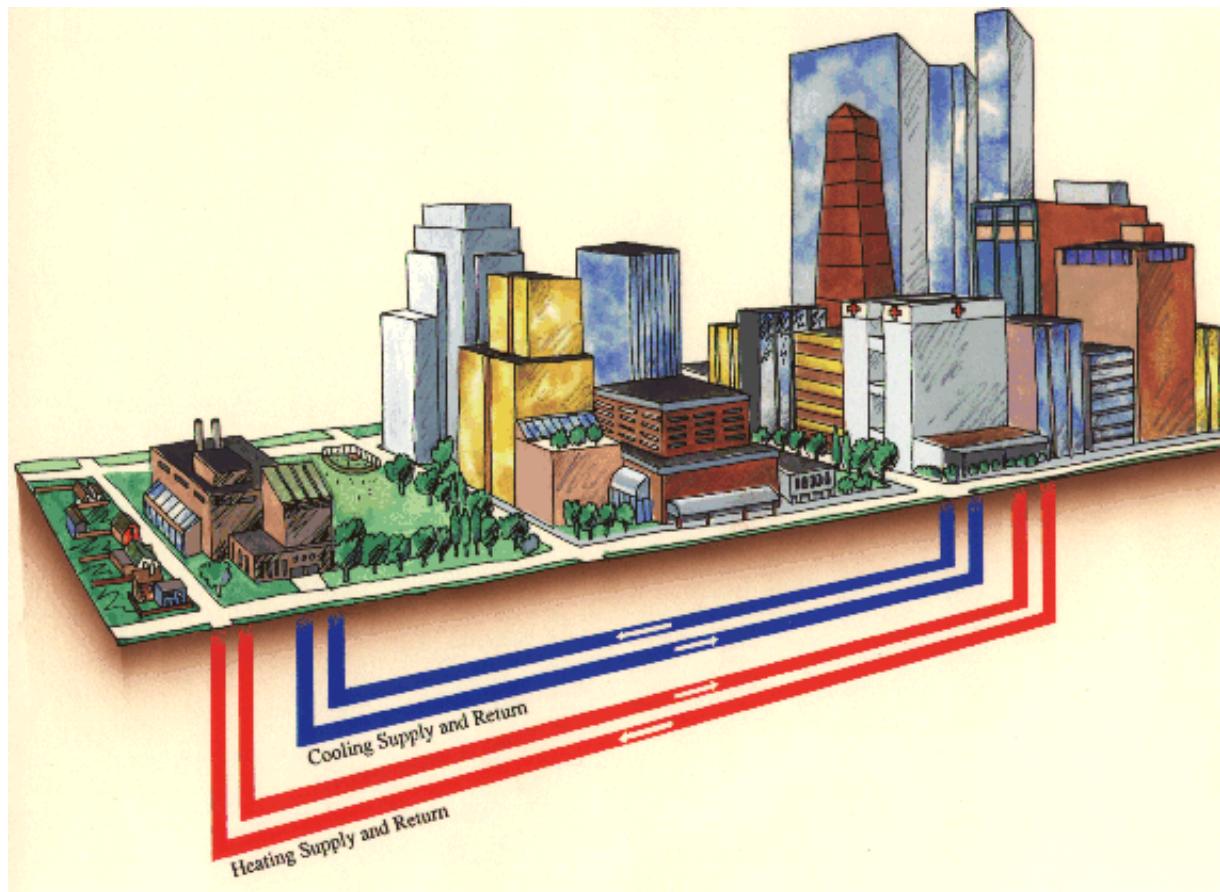


\$ per year  
for total  
energy use

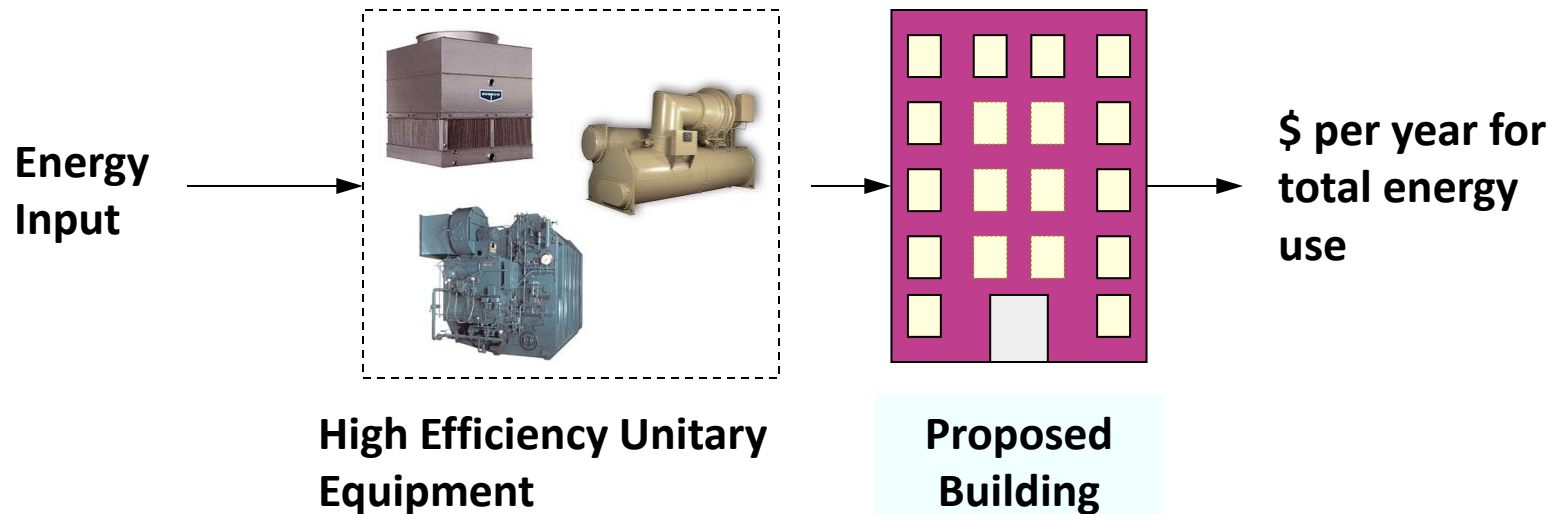
LEED Version 2.2	
% Improvement	Points Earned
10.5%	1
14%	2
17.5%	3
21%	4
24.5%	5
28%	6
31.5%	7
35%	8
38.5%	9
42%	10

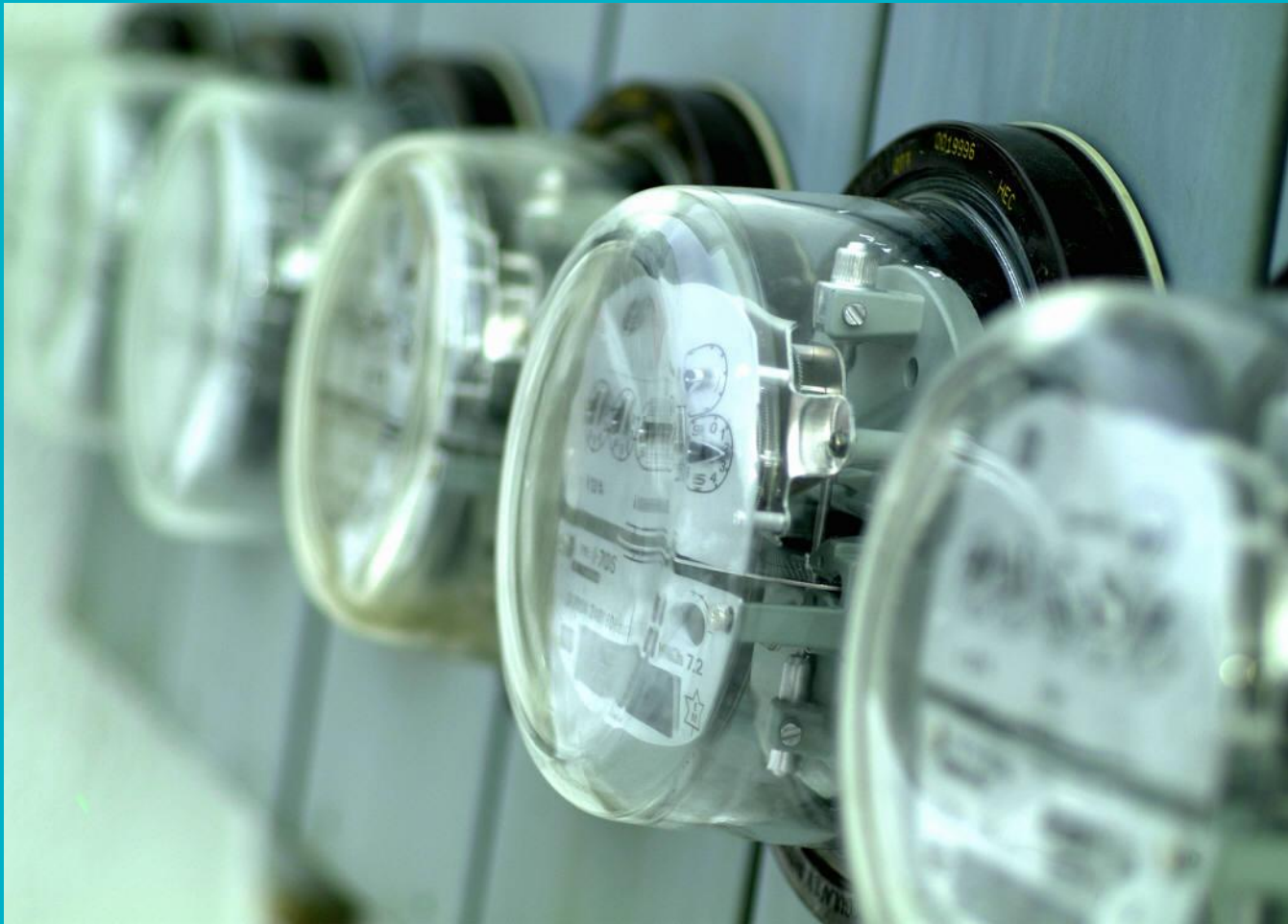


# District Energy - Challenges



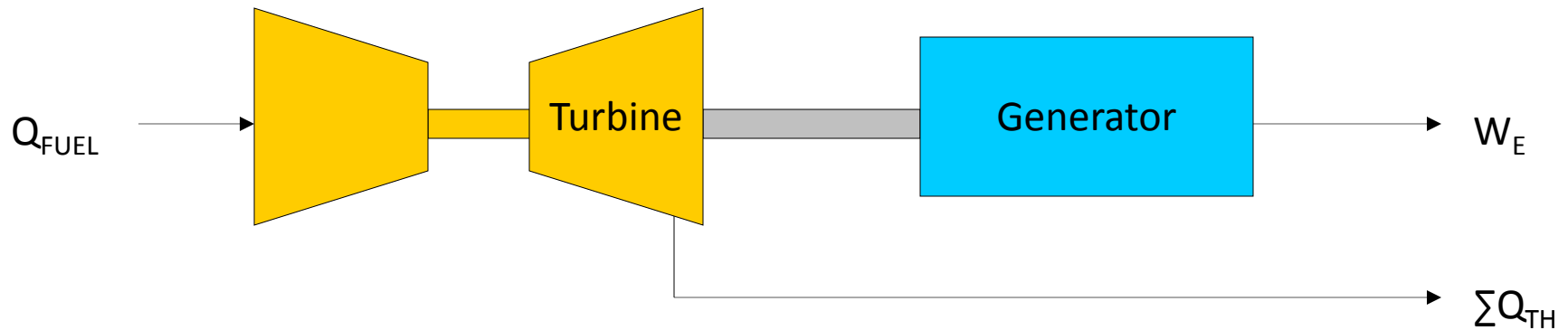
# Real Comparison





## Combined Heat and Power (CHP) in DES

# Option 2 for CHP



$Q_{\text{FUEL}}$  – Sum of all fuel used by the CHP.

$W_E$  – Net useful Electrical Power, produced by the CHP.

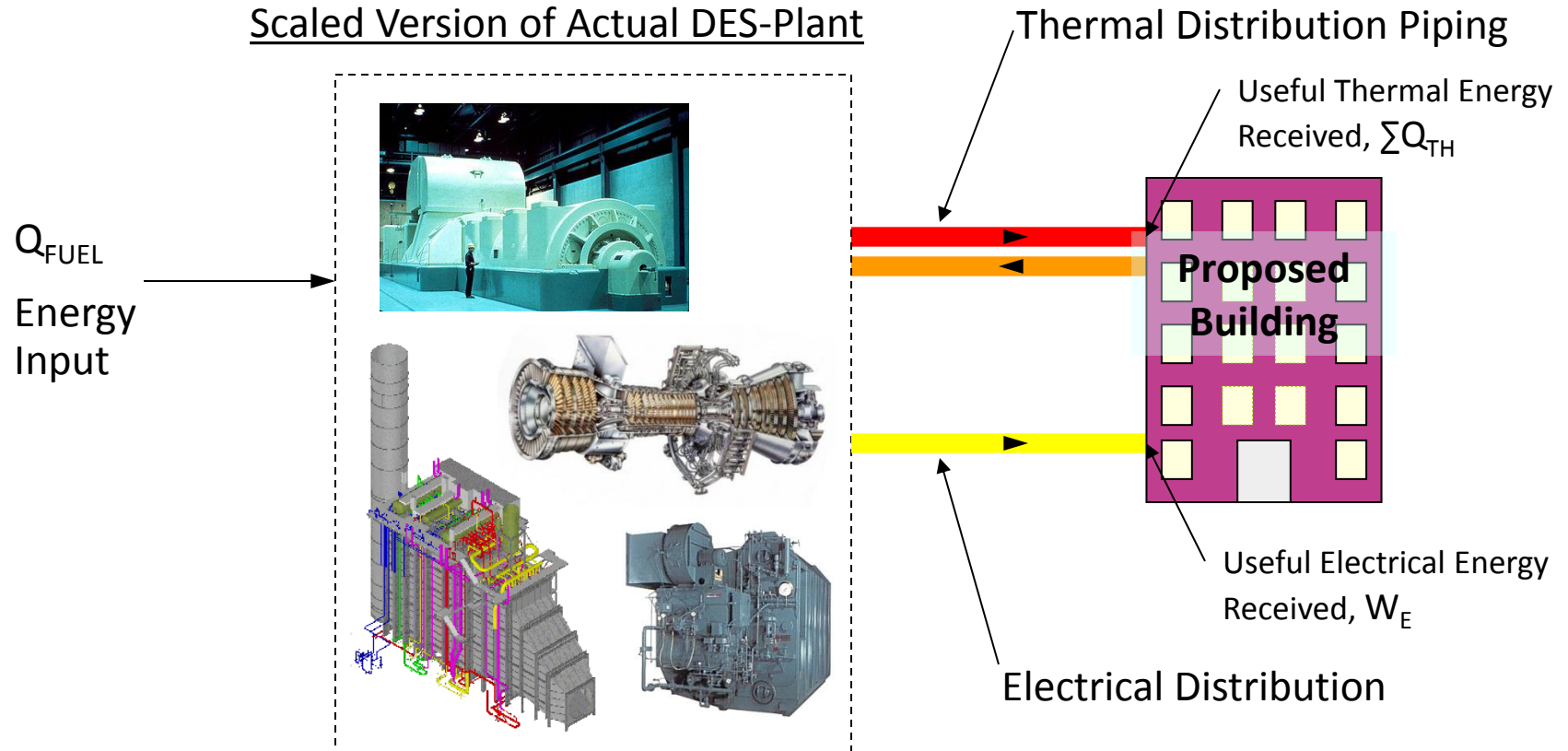
$\Sigma Q_{\text{TH}}$  – Net useful Thermal Output, produced by the CHP.

Reference: <http://www.epa.gov/chp/basic/methods.html>



# Free Electricity

Scaled Version of Actual DES-Plant



# The Economists – October 15<sup>th</sup>, 2013

- Traditional power plants that use coal, gas or nuclear energy typically only convert a third of the energy they produce into electricity. The rest is wasted as heat. A combined district utility can convert 40% of that energy into electricity and 40% to heat buildings, wasting just one-fifth at the generation stage, though another 7% is on average is wasted in distributing the heat around a city.

# How Does VB Compare?

- Typical Electric Production = 33% efficiency
- Electrical = 33%
- Steam = 25%
- CHP = 58%



# Veolia Boston's Numbers

- For every 1 BTU of Steam Required, the Plant Uses 5.33 BTU's of Natural Gas





# Veolia Boston's Numbers

- For every 1 MMBTU of Steam Required, the Building receives credit for 0.53 MWh of Free Electricity.



# Real Comparison

Annual cost of energy in \$



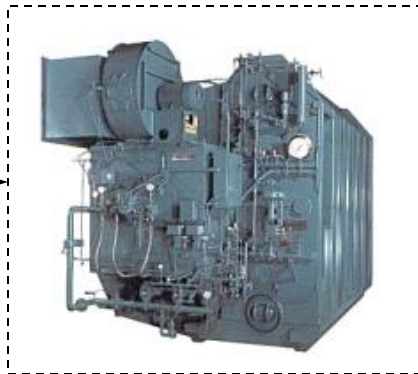
# Our Variables

- Natural Gas Costs:  
\$11.00/decatherm
- Electrical Cost =  
\$0.15/KWh
- Blg. Boiler Eff. =  
95%

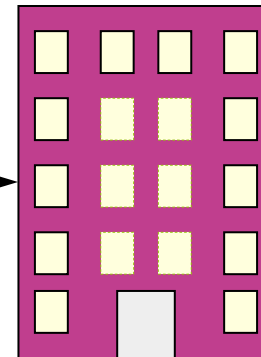


# Modeling Methodologies

Energy Input =  
5,330 MMBTU



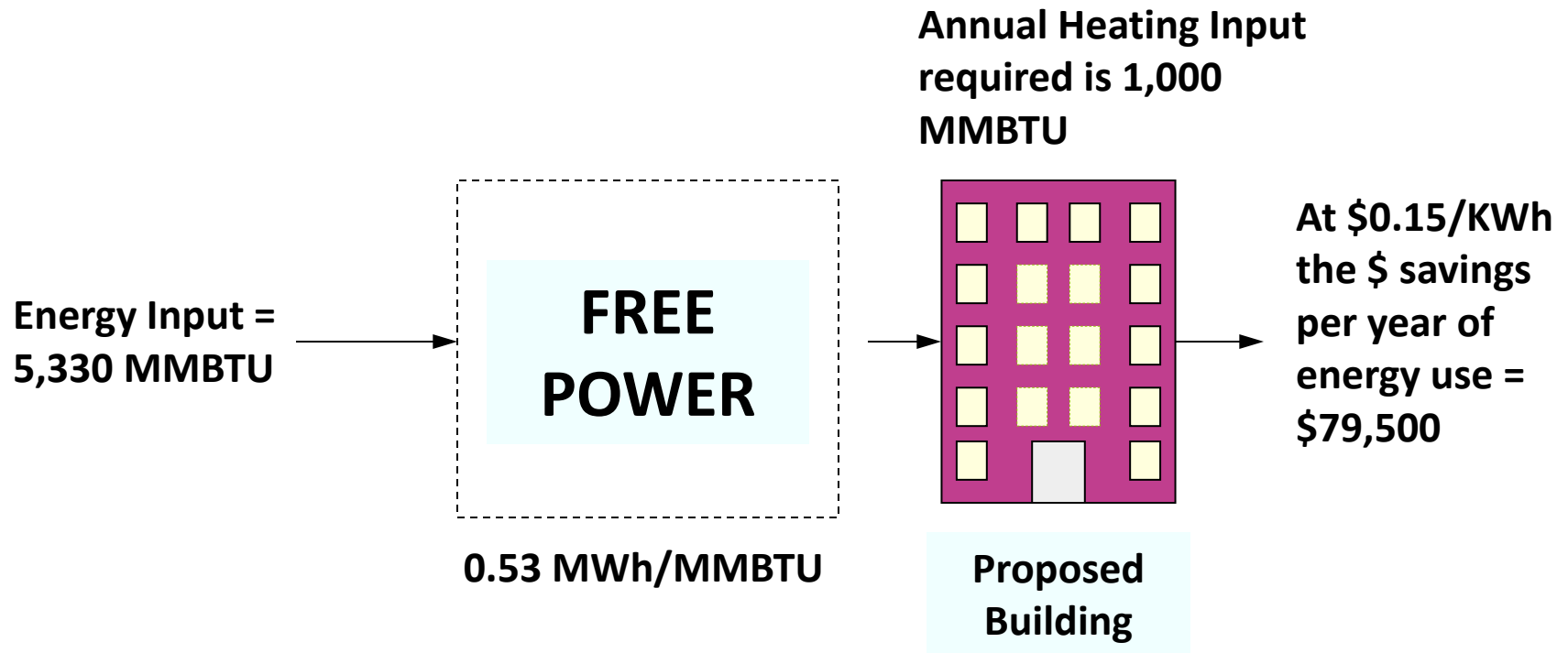
Annual Heating Input  
required is 1,000  
MMBTU



Proposed  
Building

At  
\$11.00/MMBTU  
the \$ per year  
for total energy  
use = \$58,630

# Modeling Methodologies





# How Does VB Compare?

- VB Cost of Heat =  
(\$20.87)/MMBTU
- 95% Efficient  
Building boiler  
Cost of Heat =  
\$11.58/MMBTU



# Summary

- Since the electric power produced through VB's processes is double the efficiency of traditional power production, the benefits of VB's CHP are recognized and credited thru LEED.

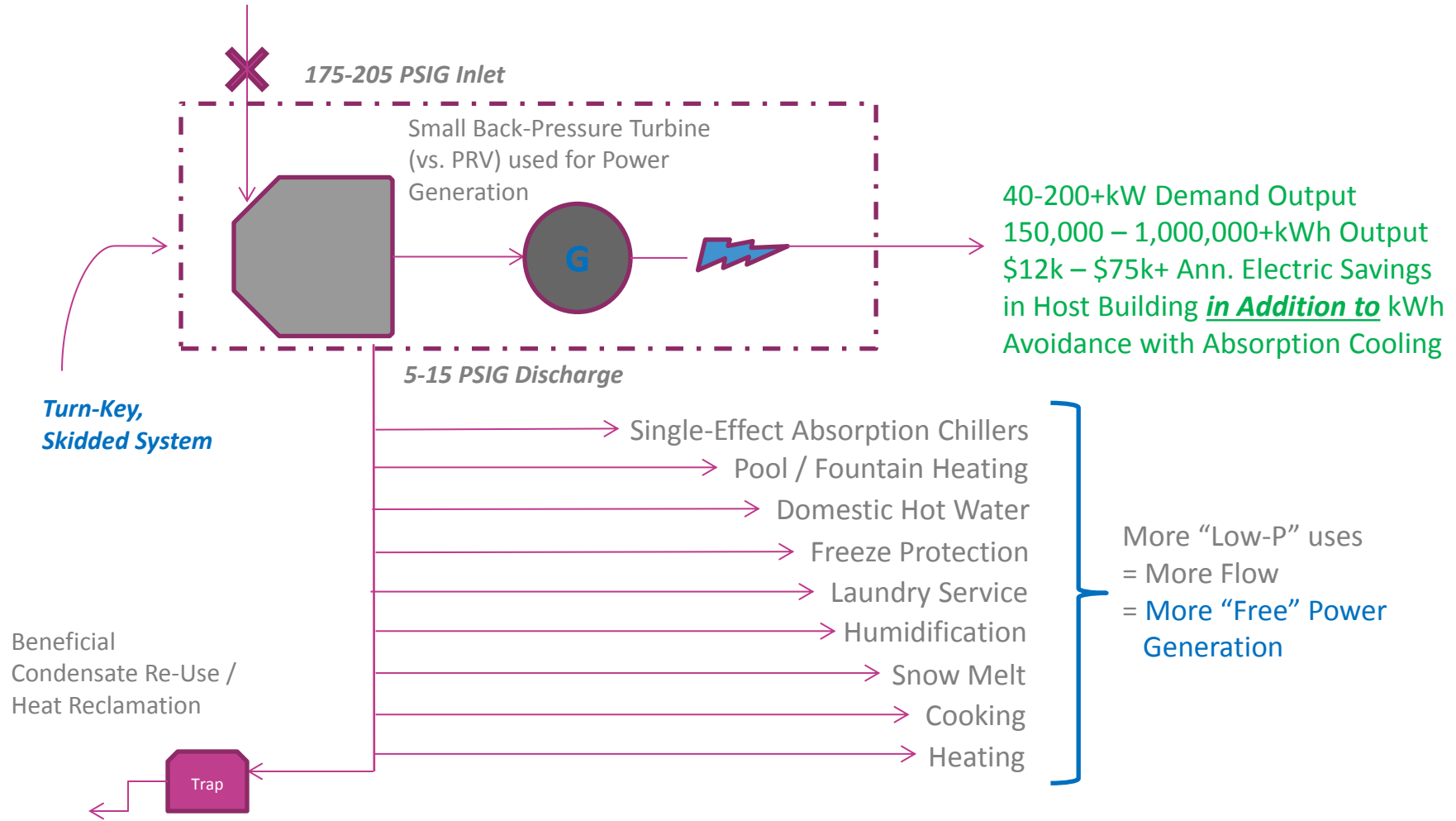
# Summary

- For every 1 MMBTU of steam received, the building can credit 533 KWh of FREE Electricity!



# Options for Platinum

High-T Sterilization  
Double-Effect Absorption Chillers  
Turbine-Driven Chillers



- Quarterly Column in *District Energy Magazine*
- [tim.griffin@rmf.com](mailto:tim.griffin@rmf.com)
- 919.941.9876



**Closing**



# Veolia and LEED

- In 2015 RMF Engineering conducted a LEED analysis of Veolia's Boston-Cambridge system
- Benefits of Veolia's CHP are recognized and credited thru LEED.
- For every 1 MMBTU of steam received, the building can credit 534 KWh of FREE Electricity!
- A project can obtain 10 – 12 more LEED points through DES than self performance with gas boilers.

DEPARTMENTS | LEED + DISTRICT ENERGY

## Connecting to District Energy: A no-brainer

Tim Griffin, PE, LEED AP, IDEA USGBC Liaison

**Editor's Note:** "LEED + District Energy" is a quarterly column providing information about the U.S. Green Building Council's LEED rating system and how it applies to buildings served by district energy systems.

**WHAT'S THE CUSTOMER'S PERCEPTION?**

This spring I had the opportunity to work with Veolia's Vincent Martin, Rod Fraser and other team members to analyze their Boston and Cambridge system from a LEED (Leadership in Energy and Environmental Design) certification standpoint. The question to be answered was, What would be the impact on a potential building customer's LEED application of tying into Veolia's district steam system? This is a complex question in which many variables come into play. In the case of Veolia's Boston and Cambridge system, the main issue is energy efficiency. How many more or fewer points will a customer be awarded in a LEED application by connecting to Veolia's district steam compared to installing energy-efficient in-building boilers? LEED is a point-based system, and points are valuable.

For a CHP system like Veolia's, the key energy efficiency variables in determining achievable LEED points include the building customer's natural gas and electricity rates. As is the economic case for all CHP systems, the higher the price of electricity relative to the price of natural gas, the greater the economic value of the CHP system. Boston has historically high electricity rates but not as high natural gas rates. This certainly helps in the analysis. Another key variable is the percentage of the total steam produced from CHP. Large district energy systems often produce some of their steam as a waste product from a CHP process but generate the balance of the steam from traditional boilers. The greater the percentage of waste steam, the greater the potential for customers to earn LEED points. In Boston and Cambridge, the majority of the steam produced is a waste product of the CHP process.

The final variable is the percentage of a potential building customer's total energy consumption that will be used for heating the building and for domestic hot water. The higher the percentage of energy needed for heating, the more points that can be earned in LEED. In New England, winter is long and cold; we all remember stories of mountains of snow in Boston earlier this year. Again, this helps in Boston district energy customers' LEED analysis.

**CHP - AN IDEAL SITUATION**

In all cases above, the variables that impact a potential building customer's LEED application all favor tying into Veolia's Boston and Cambridge system. In fact, when you include the overall energy efficiency of the system, the case is even clearer. I developed a "points calculator" for Veolia's system to determine - based on actual utility rates for natural gas and

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# Questions



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