Veolia
Boston Cambridge DES and LEED

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RMF Engineering
Reliability. Efficiency. Integrity.

VEOLIA

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

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

- 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

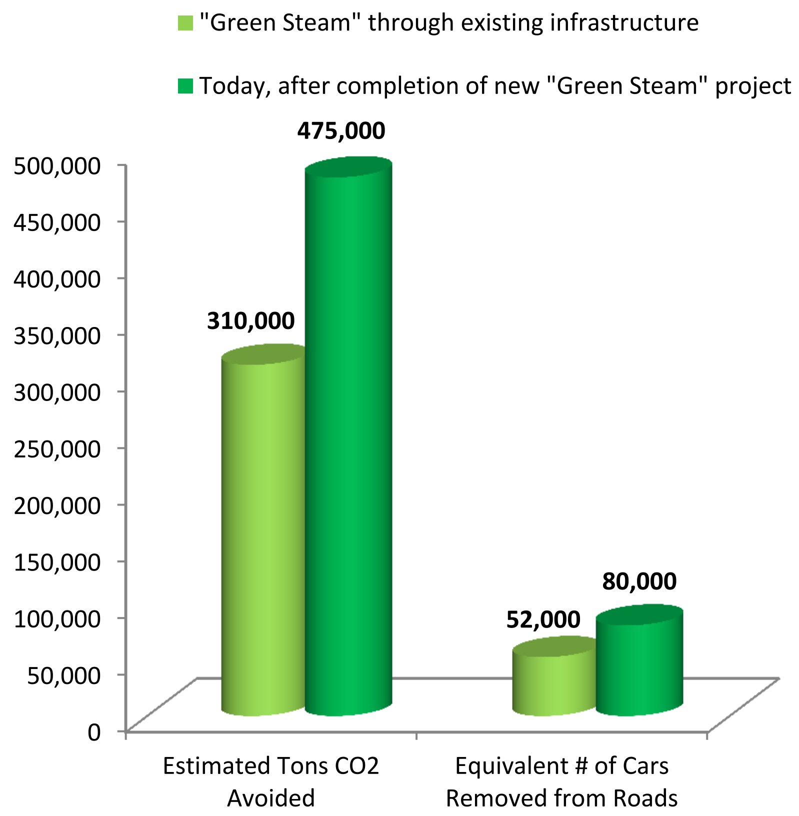
- Secure Energy Source
  - *District Energy/CHP keep going when the grid goes down*
  - *Dual fuel (No. 2 oil & NG) capable at all locations- can switch mid-operation*
  - *2.5 Million gallons of fuel oil storage onsite*
  - *Redundant to utility grids*
  - *Ability to “black start”*
  - *Multiple sources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

VEOLIA

LEED BD+C

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

Energy Efficiency Optimization

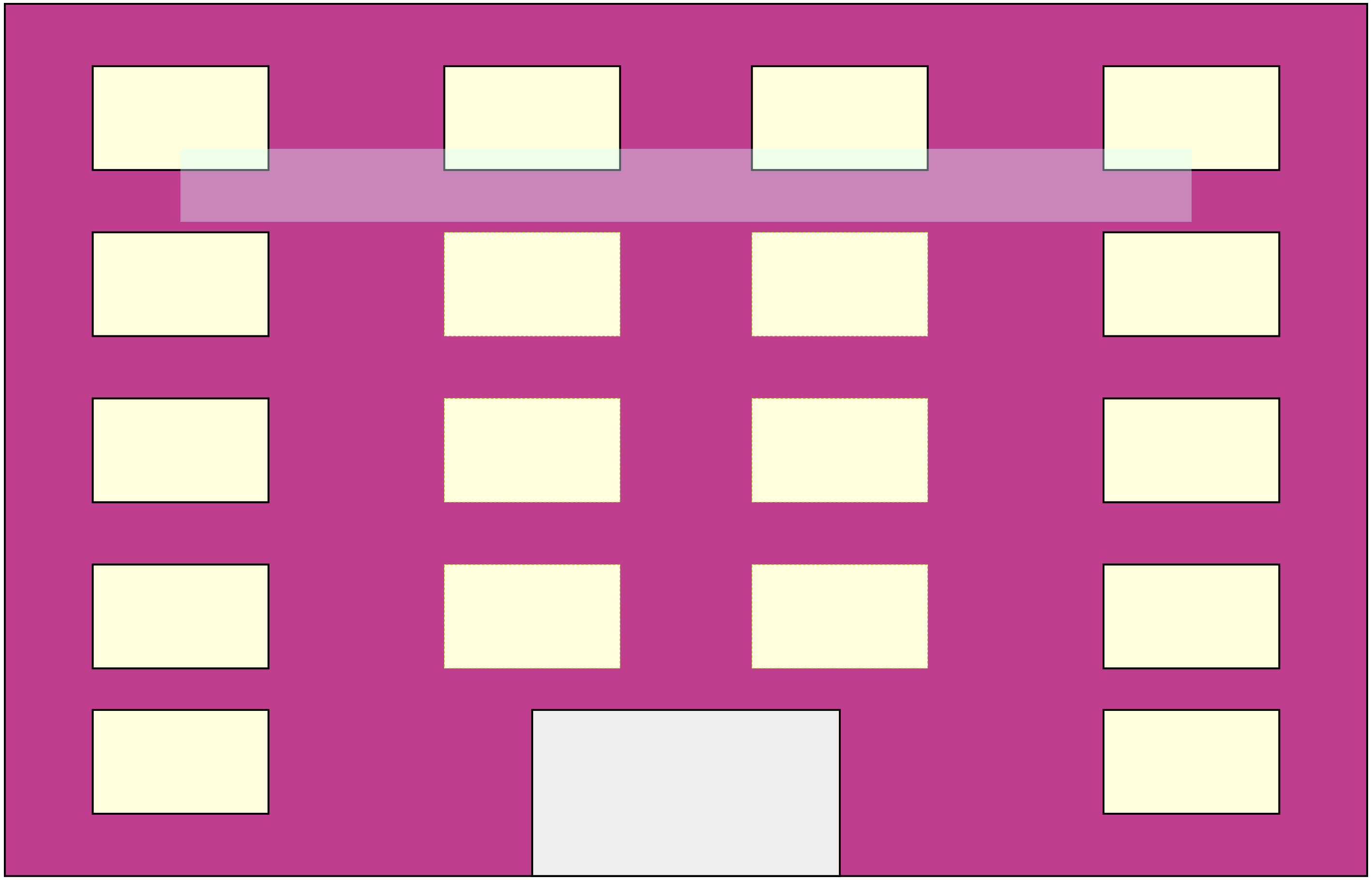
Why Energy Matters for LEED?

- 18 out of 110 points

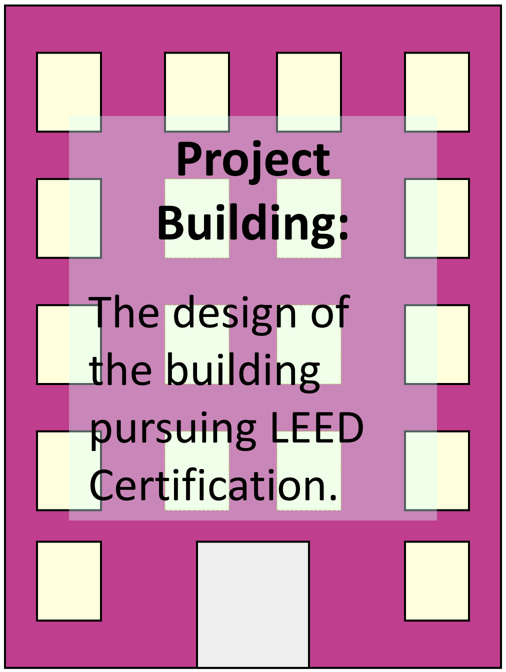
Goals & Application – Energy

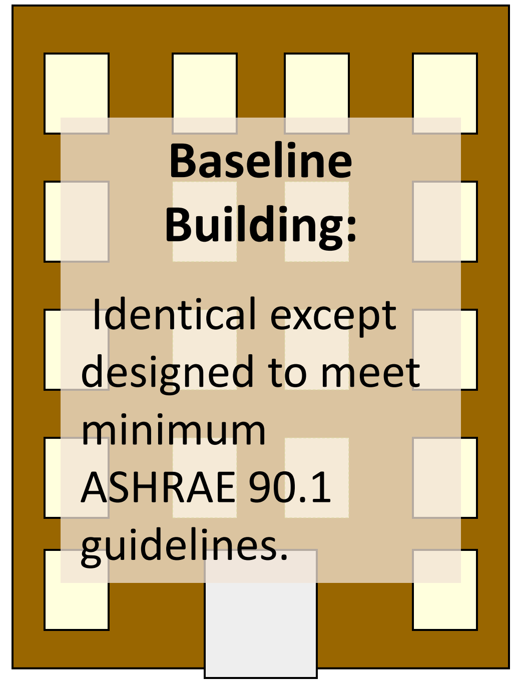
- Optimize Energy Performance:
  - ***Goal**: Demonstrate energy performance greater than required by the pre-requisite.*
  - *For energy modeling, this is referred to as Option 1, Path 2 – Aggregate Building/DES Scenario.*

ASHRAE 90.1



Appendix G





ENERGY USE IN DOLLARS

Modeling Software Options

T 700

eQUEST

LEED

Carrier

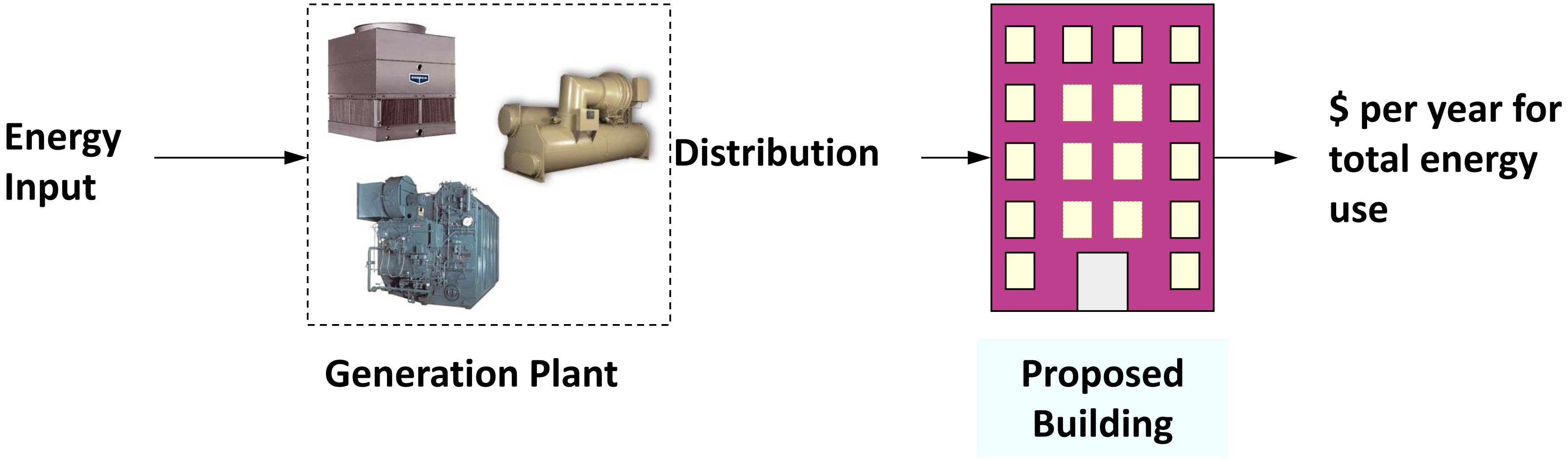
HAP

EnergyPlus

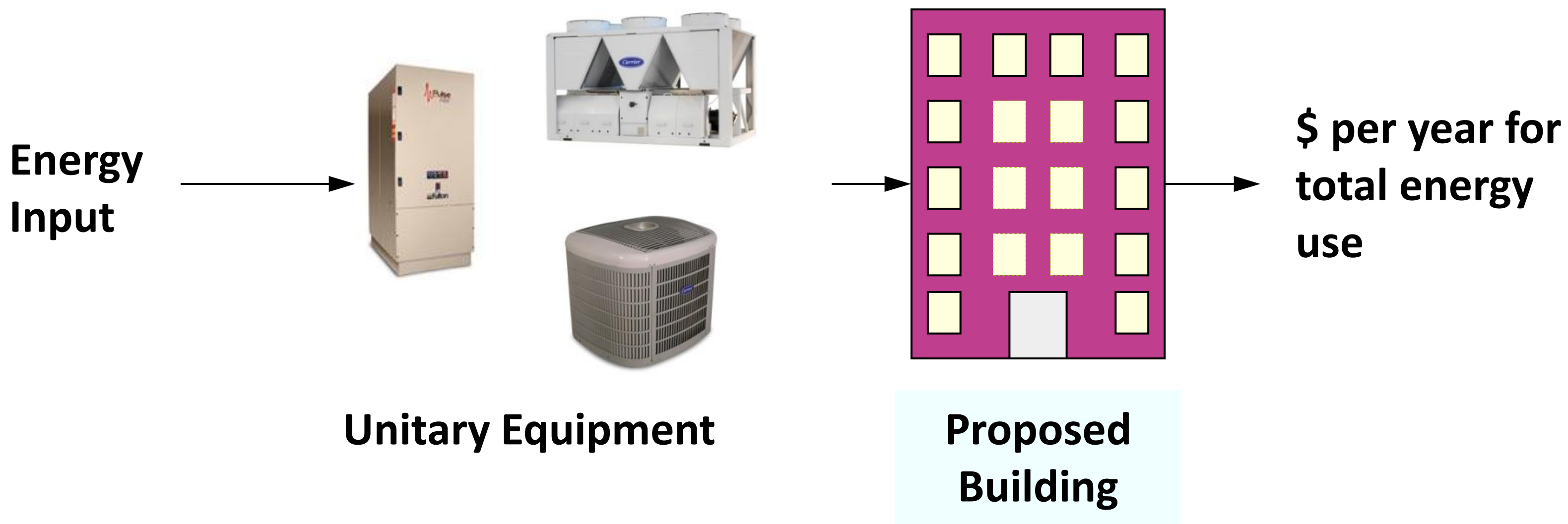
Bentley

ies

District Energy Analysis



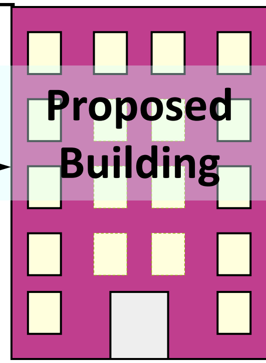
Code Minimum Comparison



Option 1 Path 2 Model

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

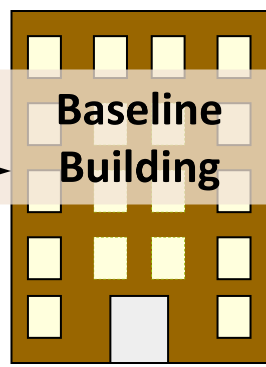
Virtual DES-equivalent Plant



$ per year for total energy use

$$100 * \left(1 - \frac{\text{ProposedBuilding\$}}{\text{BaselineBuilding\$}}\right) = \text{Percentage Improvement}$$

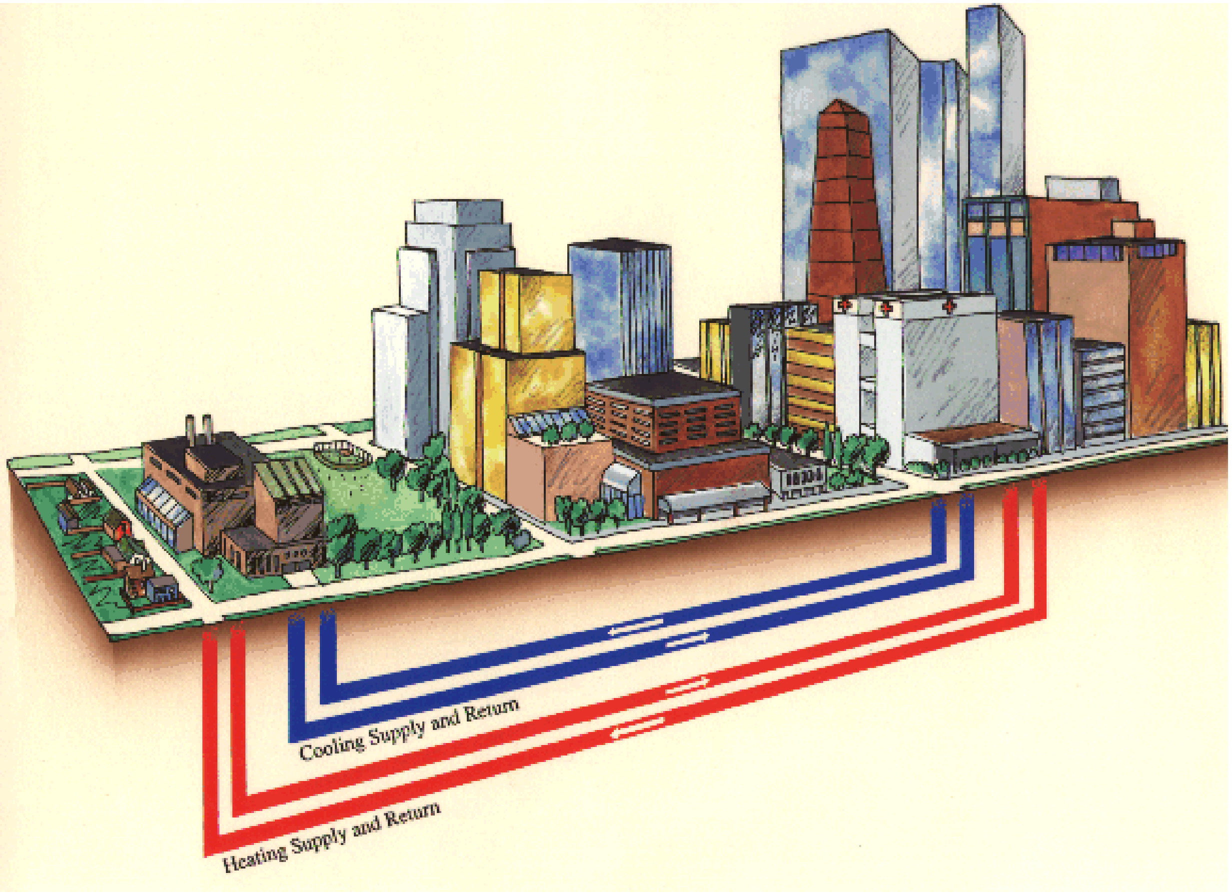
On-Site Equipment per ASHRAE 90.1 - 2004



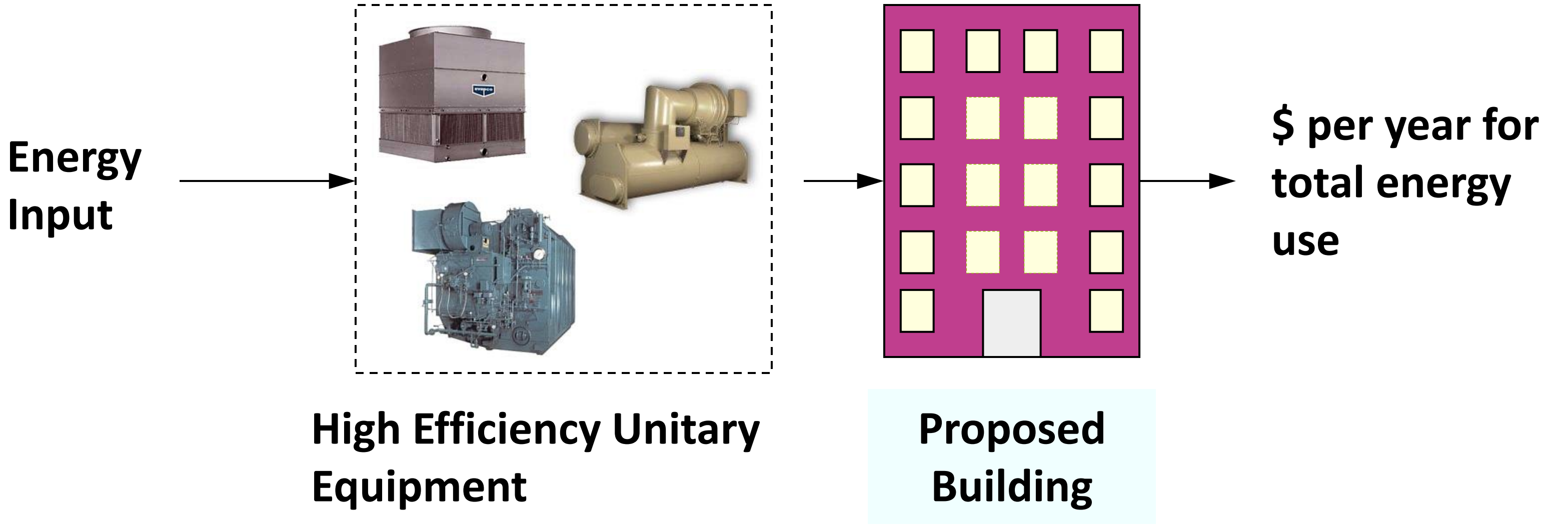
$ per year for total energy use

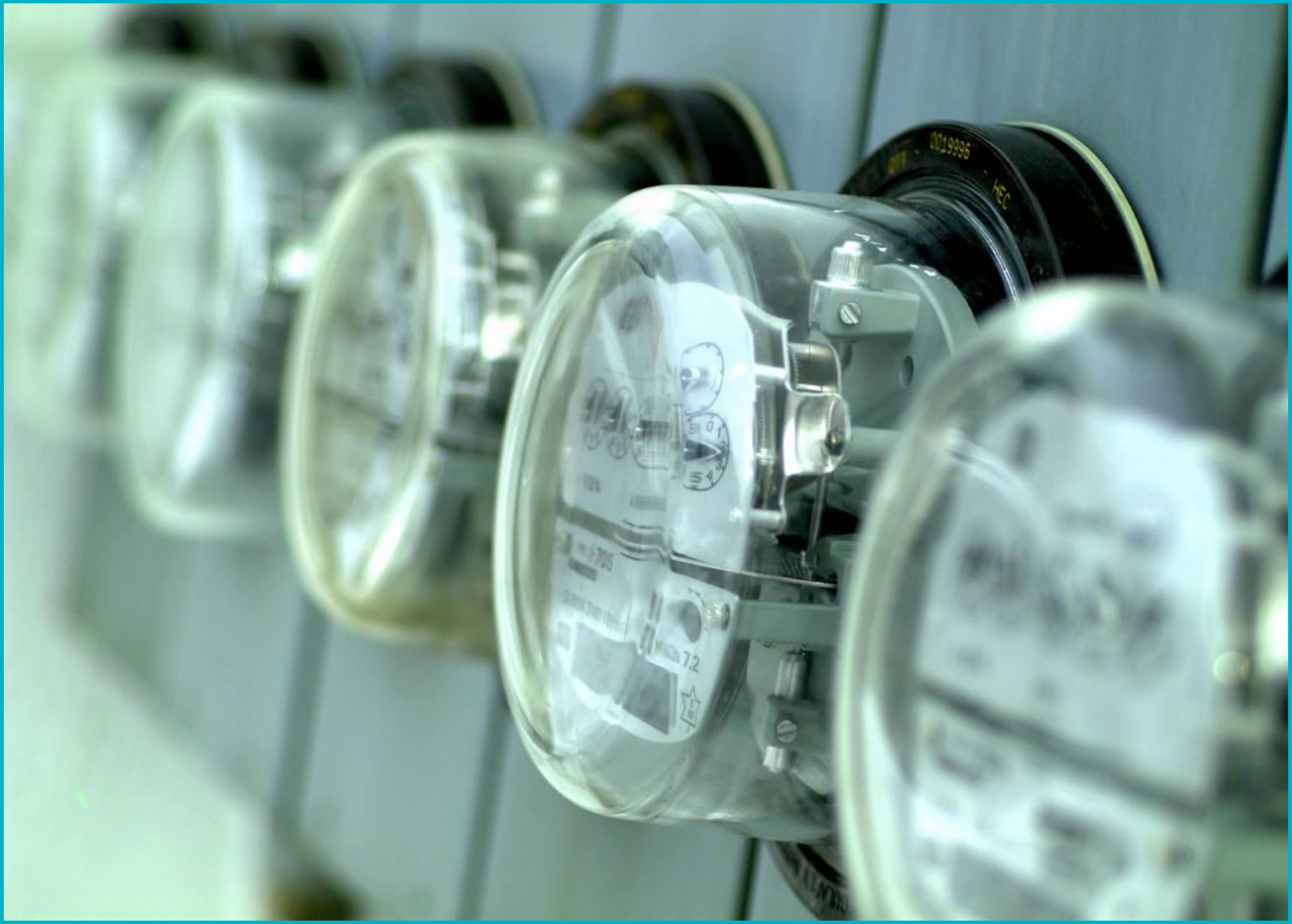
LEED Version 2.2	
% Improvement	Points Earned
10.5%	1
14%	2
17.5%	3
21%	4
24.5%	5
28%	6
31.5%	7
35%	8
38.5%	9
42%	10

District Energy - Challenges



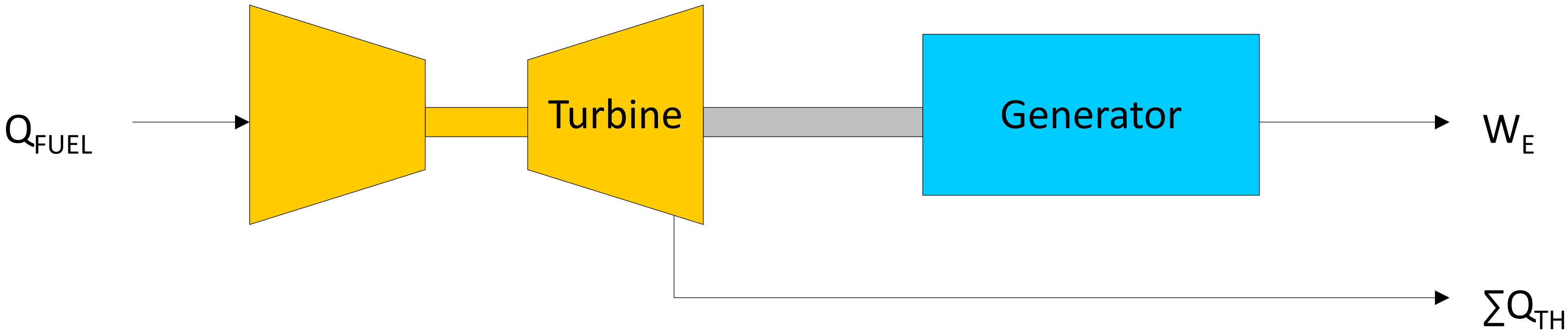
Real Comparison





Combined Heat and Power (CHP) in DES

Option 2 for CHP



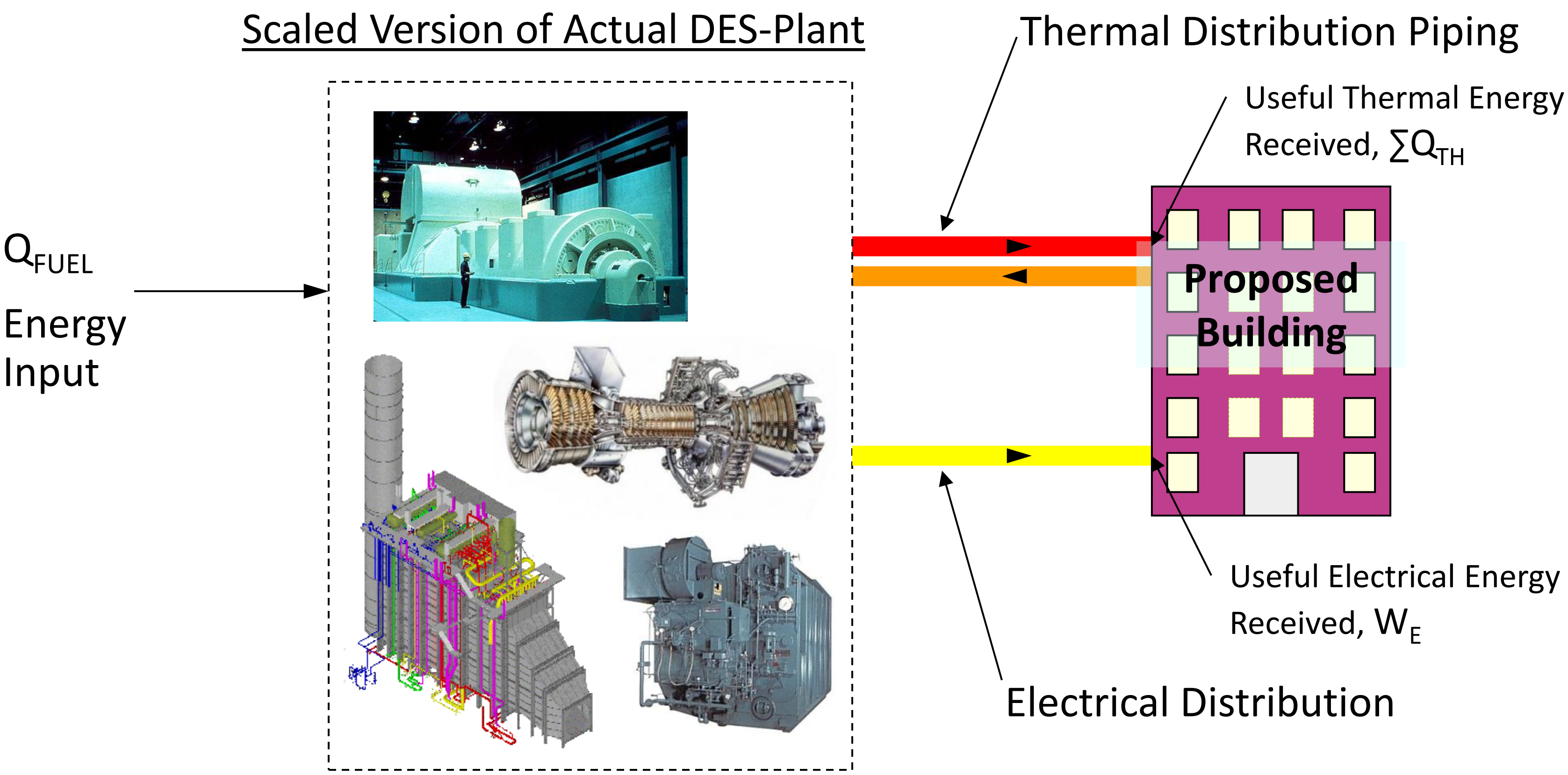
Q_{FUEL} – Sum of all fuel used by the CHP.

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

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

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

Free Electricity



The Economists – October 15th, 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%

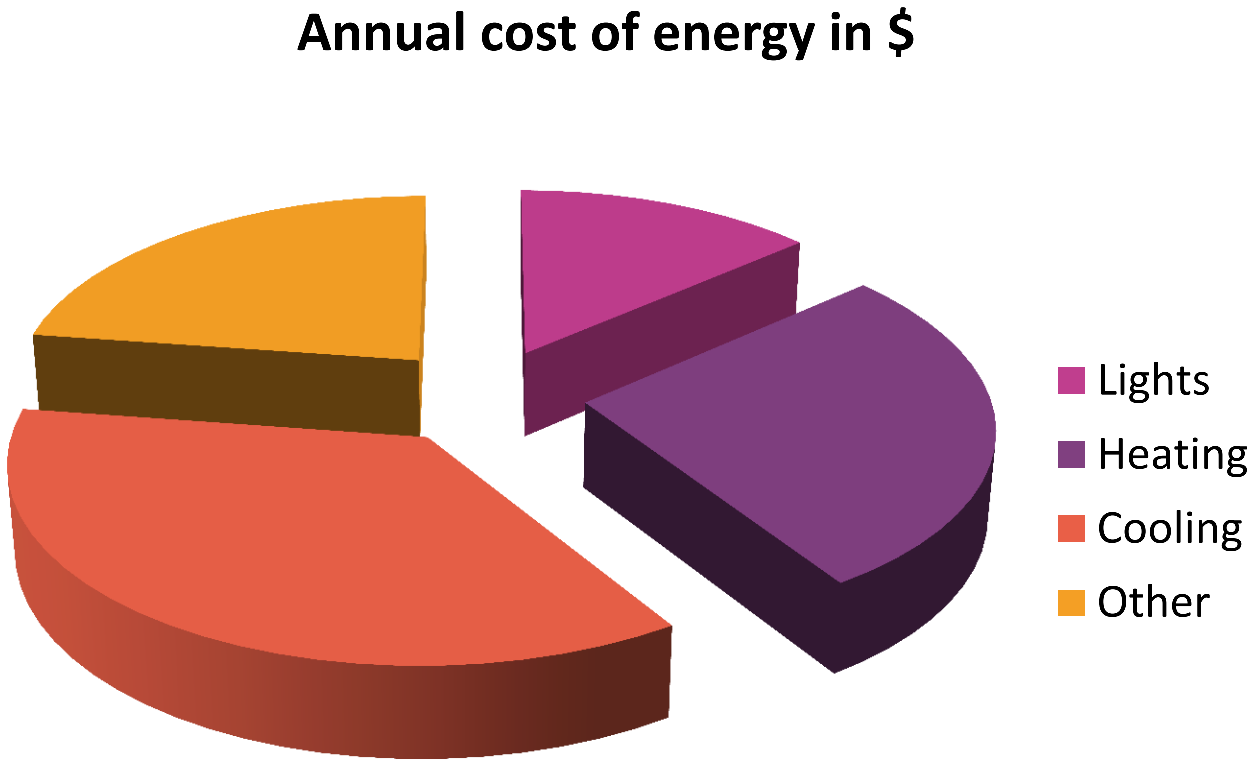
Veolia Boston's Numbers

- 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



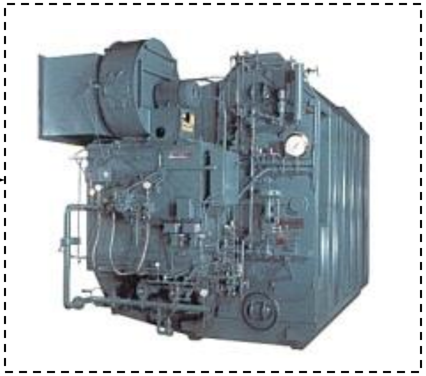
Our Variables

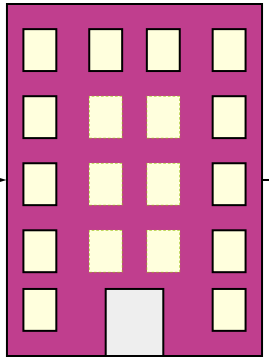
- Natural Gas Costs: $11.00/decatherm
- Electrical Cost = $0.15/KWh
- Blg. Boiler Eff. = 95%

Modeling Methodologies

Annual Heating Input required is 1,000 MMBTU

Energy Input = 5,330 MMBTU





Proposed Building

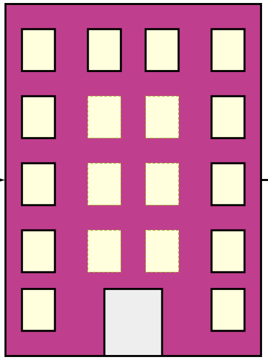
At $11.00/MMBTU the $ per year for total energy use = $58,630

Modeling Methodologies

Annual Heating Input required is 1,000 MMBTU

Energy Input = 5,330 MMBTU

FREE POWER



At $0.15/KWh the $ savings per year of energy use = $79,500

0.53 MWh/MMBTU

Proposed Building

How Does VB Compare?

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

Summary

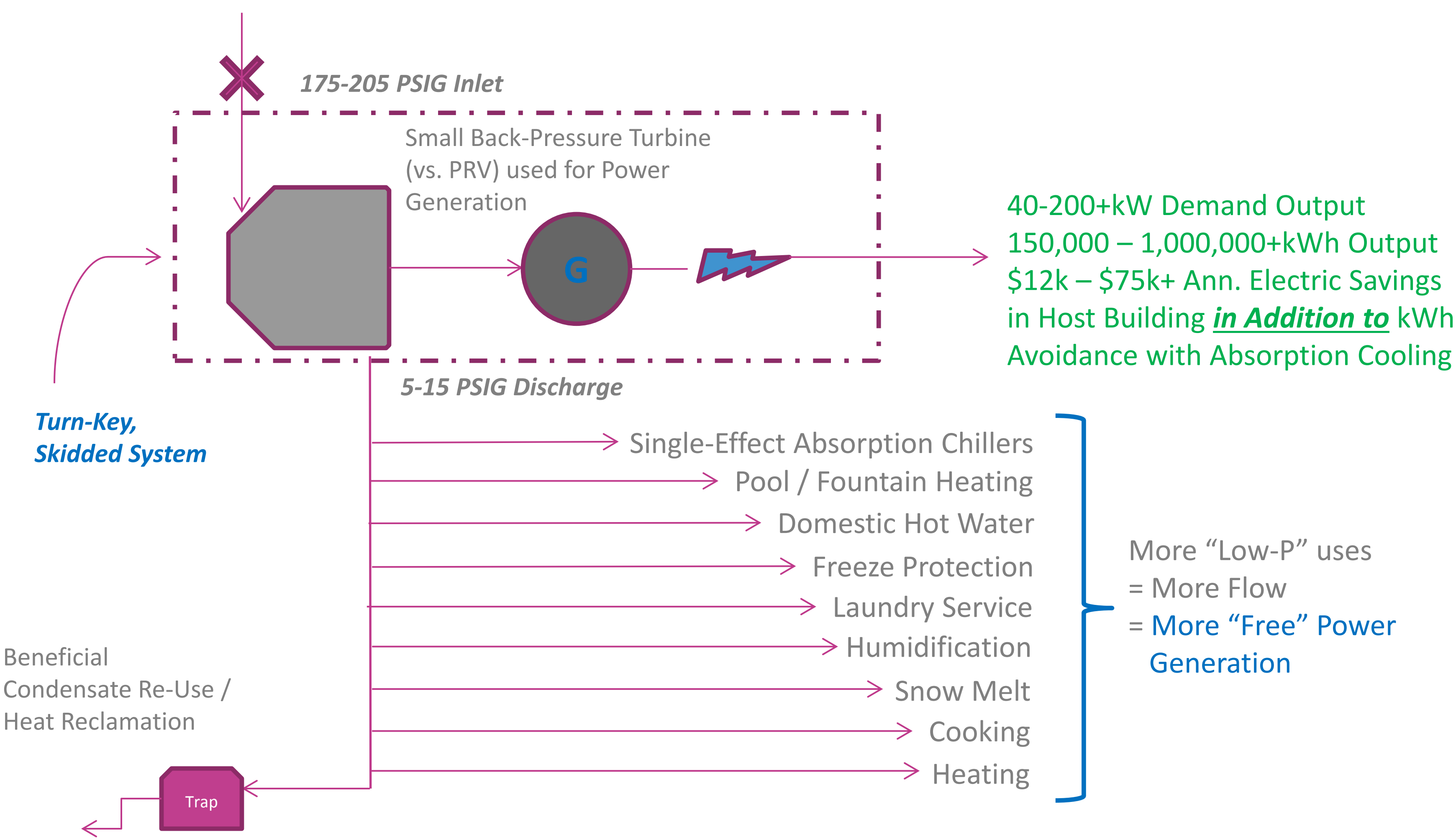
- Since the electric power produced through VB's processes is double the efficiency of traditional power production, the benefits of VB's CHP are recognized and credited thru LEED.

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*
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RMF Engineering
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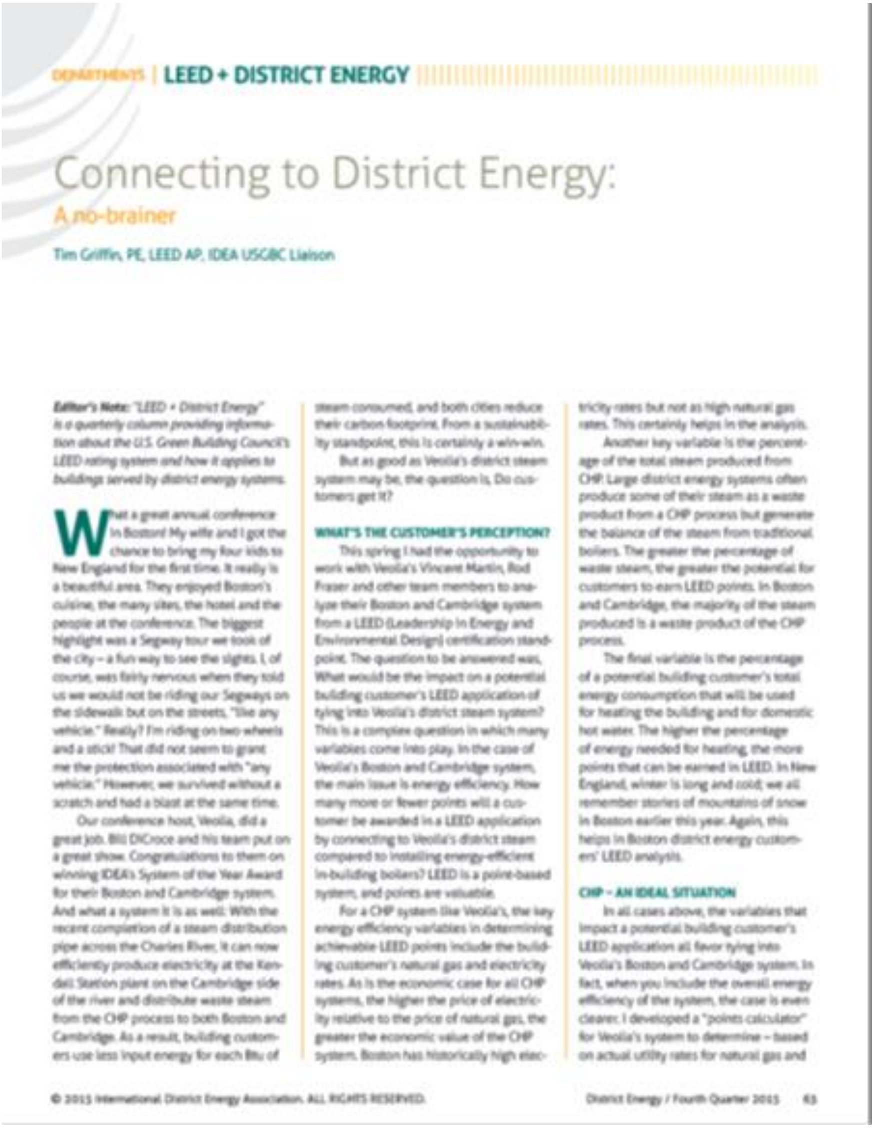
Closing

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

Questions

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Resourcing the world VEOLIA