BELMONT HIGH SCHOOL
SUSTAINABILITY 1.0

PERKINS+WILL AKF i:p Nitsch Engineering WARNER LARSON LANDSCAPE ARCHITECTS BALA

DEC 07, 2017

1. How Do We Define and Measure Sustainability?

TRIPLE BOTTOM LINE

MSBA / 3rd PARTY RATING SYSTEMS

RESPONSIBLE RESOURCE USE

MATERIAL HEALTH

SITE DESIGN

RESILIENCY

2. How Do We Make Decisions?

3. How are Schools Achieving Deep Green?

Case Study 1

Case Study 2

Case Study 3

How Do We Define and Measure Sustainability?

EXPANDING OUR DEFINITION

Educational Community

Cultivating a shared sense of community

Improves conservation awareness

Potential for curriculum integration

Environmental Stewardship

Responsible Resource Use (water + energy)

CO2 Emissions

Material Health

Site Ecology

Resiliency

Flexibility and Reliability

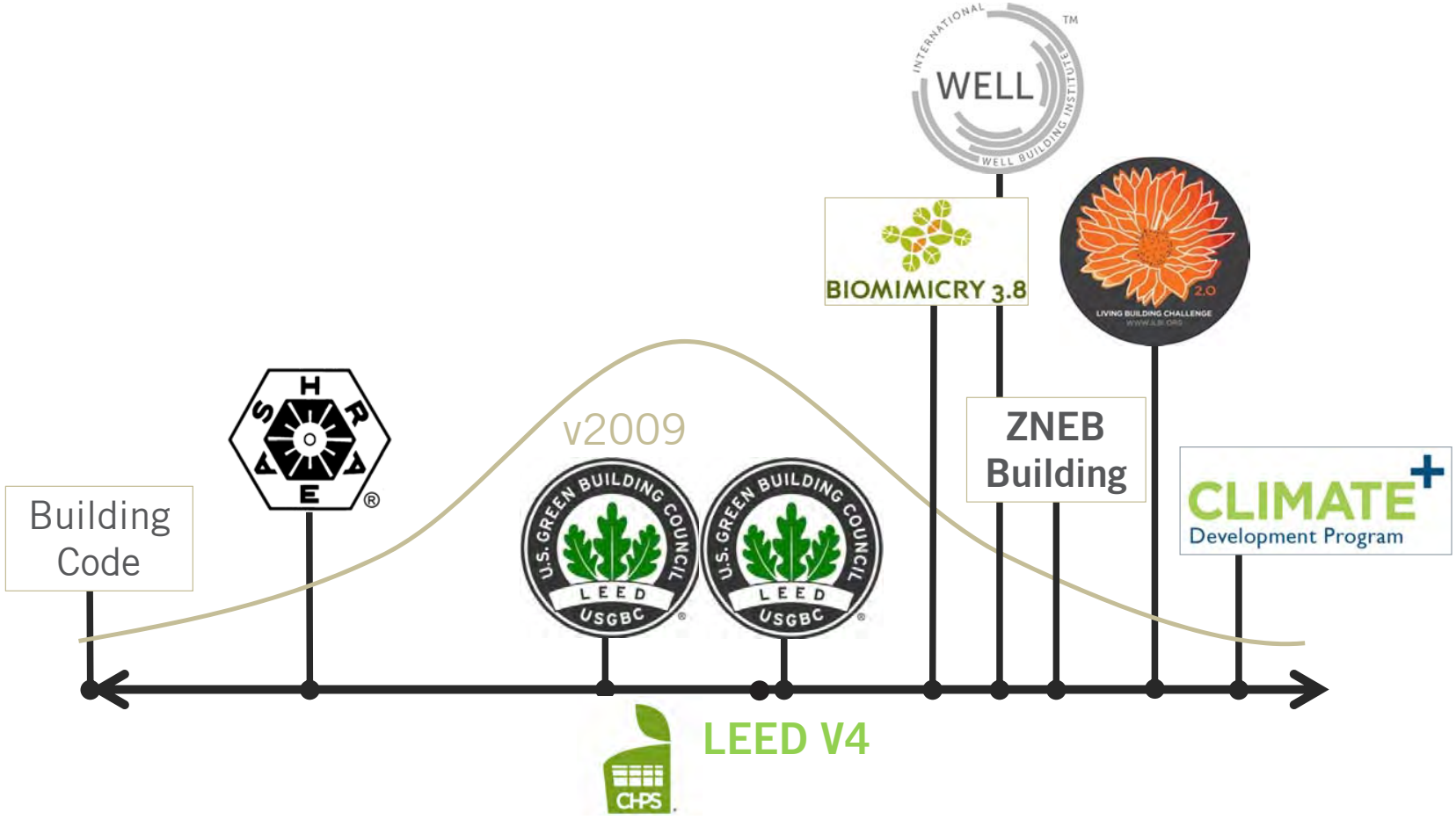
Resiliency
Layout and Load Adaptability

Ease of Maintenance

Proven technology vs innovation?

3rd Party Rating Systems

3RD PARTY CERTIFICATION



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LEED-S v4

Minimum Requirement

Certified Level (40 points)

10% energy savings

(3 OEP points)

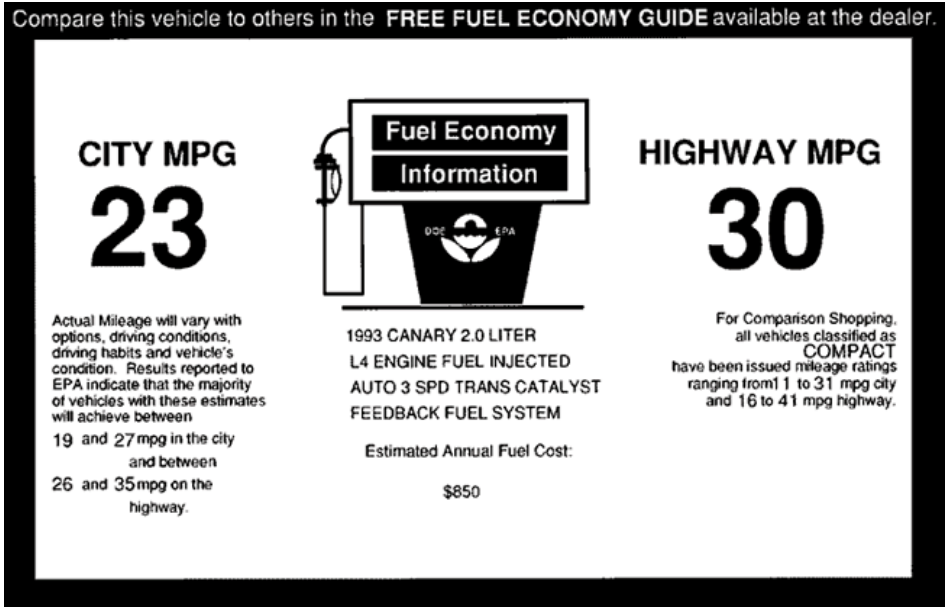
Additional 2% Reimbursement

20% energy savings from MA base energy code

(8 OEP points)

Responsible Resource Use

RESPONSIBLE RESOURCE USE



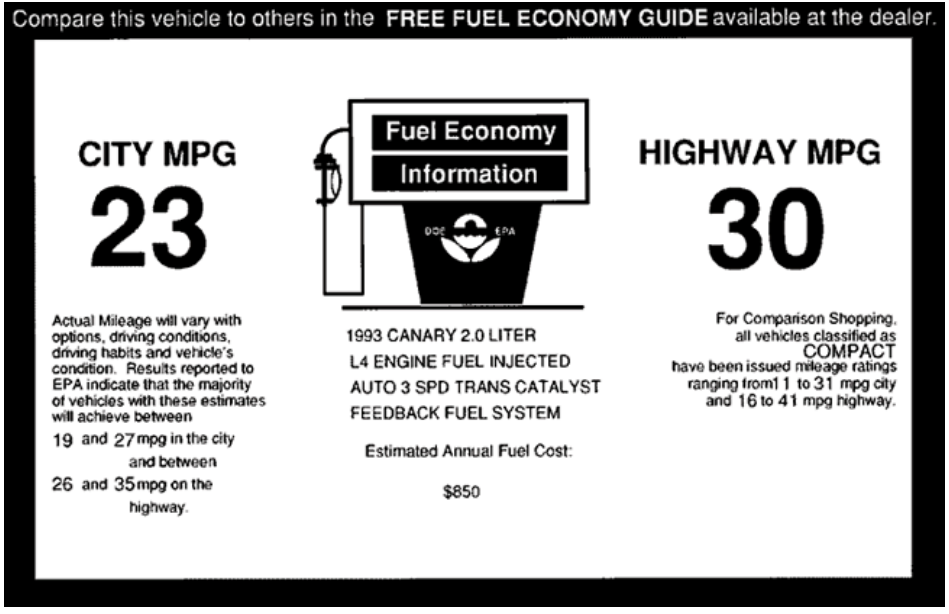
EUI (Energy Use Intensity)

kBTU / square foot of building area p/year

Building equivalent of “miles per/gallon”

Measurement informs life cycle costing

RESPONSIBLE RESOURCE USE



WUI (Water Use Intensity)

Gallons / square foot of building area p/year

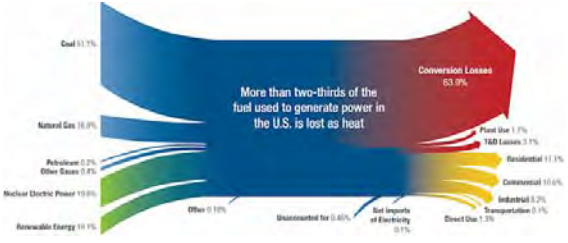
Includes site use

Requires campus wide strategy

RESPONSIBLE RESOURCE USE

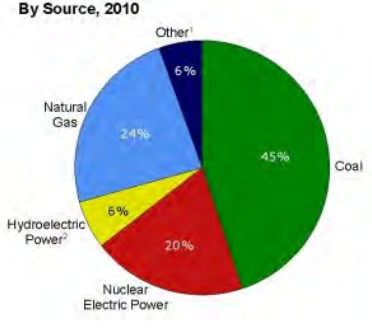
Energy at the Site:

Energy at the Source:



Energy by Cost:

Energy Emissions:



NREL Definitions: Accounting For Energy

RESPONSIBLE RESOURCE USE

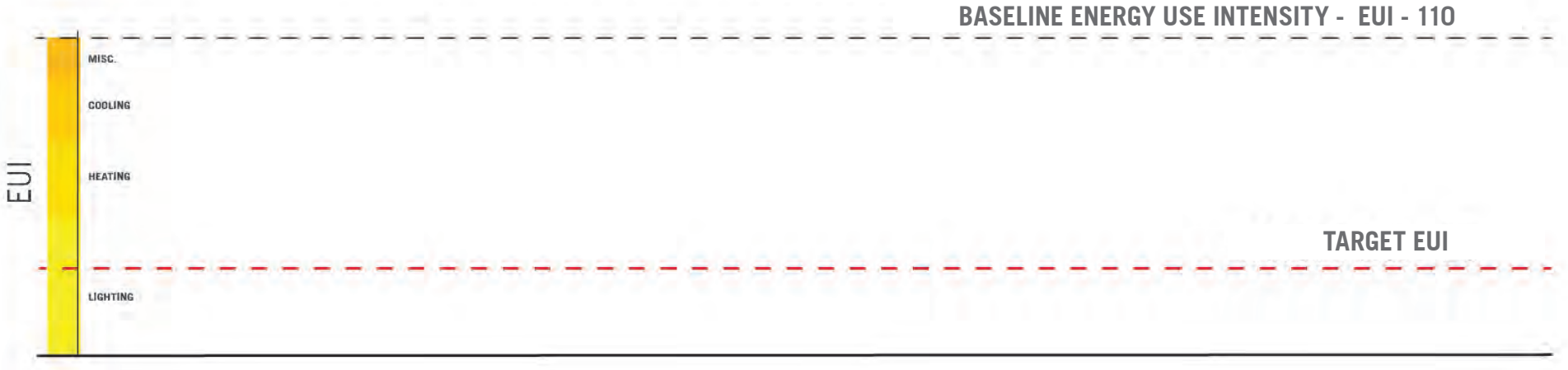
NZEB:A	**Renewable energy harvested within the building footprint**
NZEB:B	Renewable energy harvested within the building footprint and on the site
NZEB:C	Renewable energy harvested within the building footprint, on site or by renewable sources imported to the site
NZEB:D	Renewable energy harvested within building footprint and/or on site and supplemented by purchased renewable energy certificates

Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options, NREL, June 2010

How Do We Define a Net Zero Energy Project

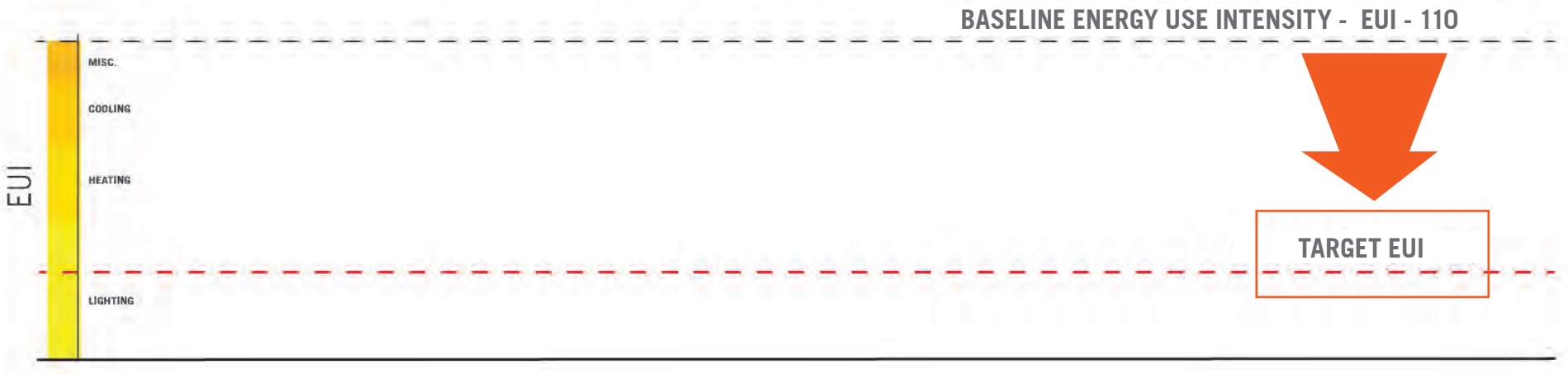
RESPONSIBLE RESOURCE USE

Business as Usual



RESPONSIBLE RESOURCE USE

Defining an Energy Budget

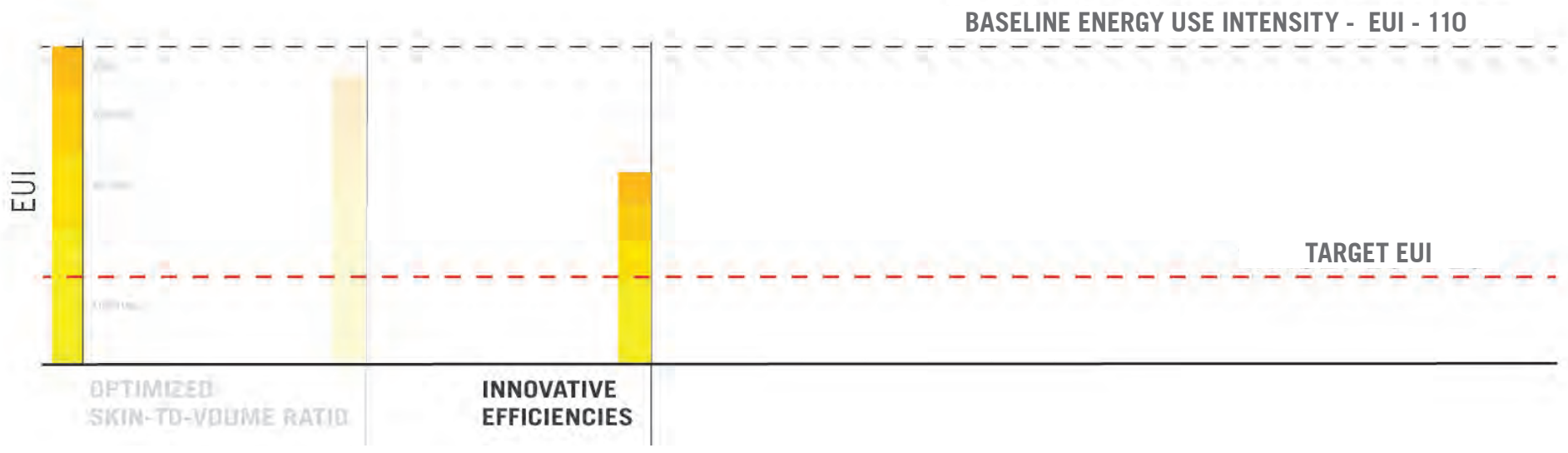


RESPONSIBLE RESOURCE USE

What if we find the ideal orientation for building performance?

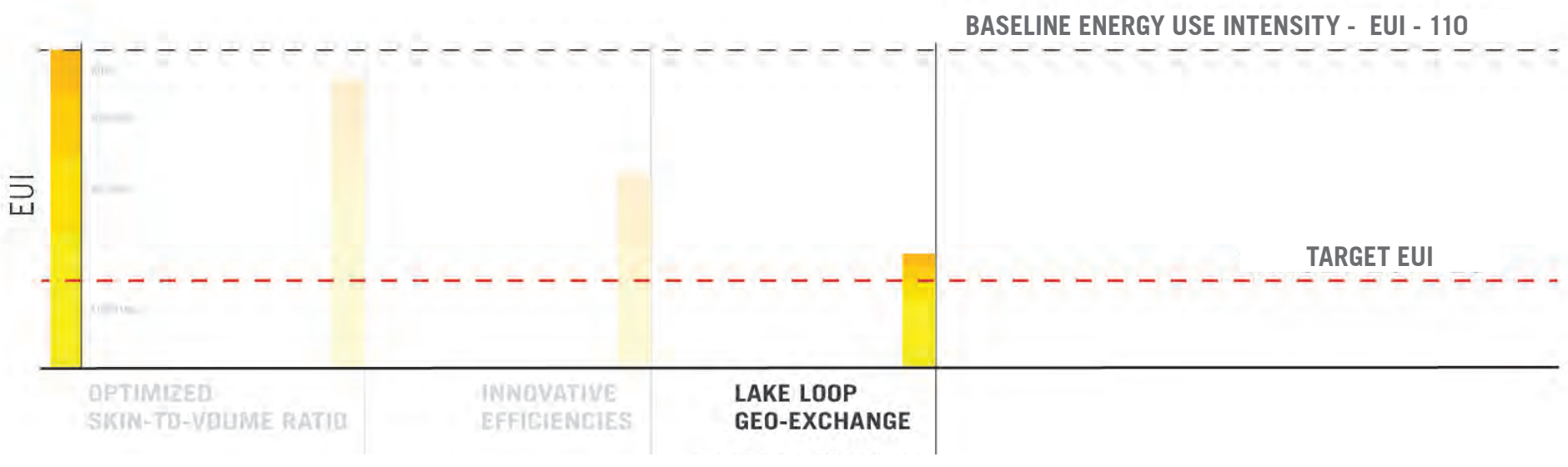
RESPONSIBLE RESOURCE USE

What if we specify the most efficient systems?



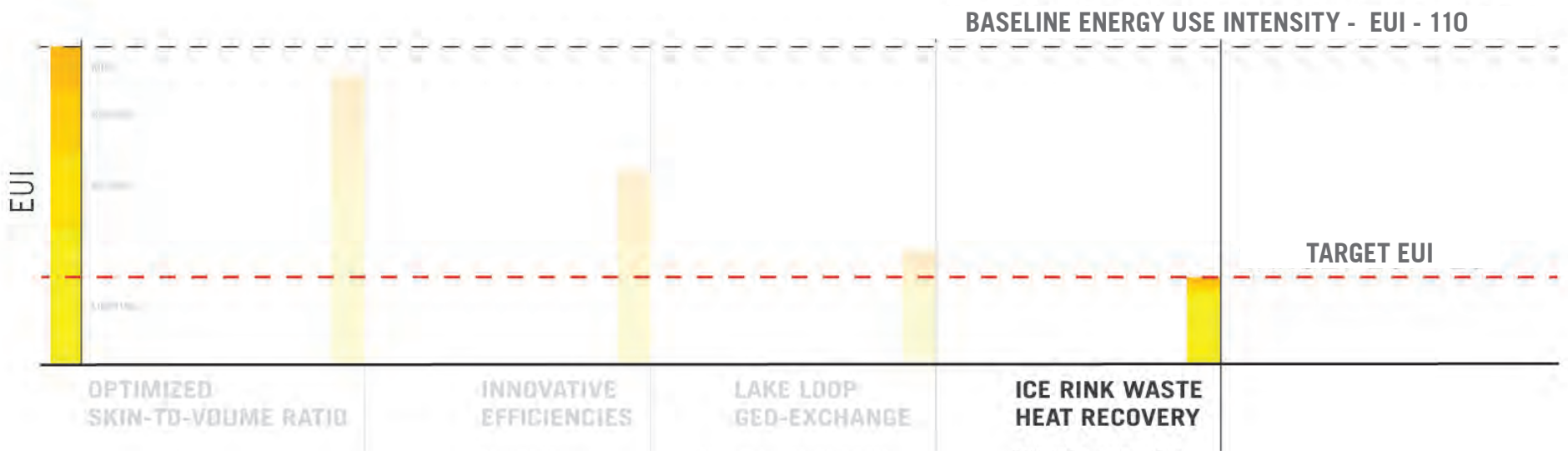
RESPONSIBLE RESOURCE USE

What if we explore innovative ways to use the site?



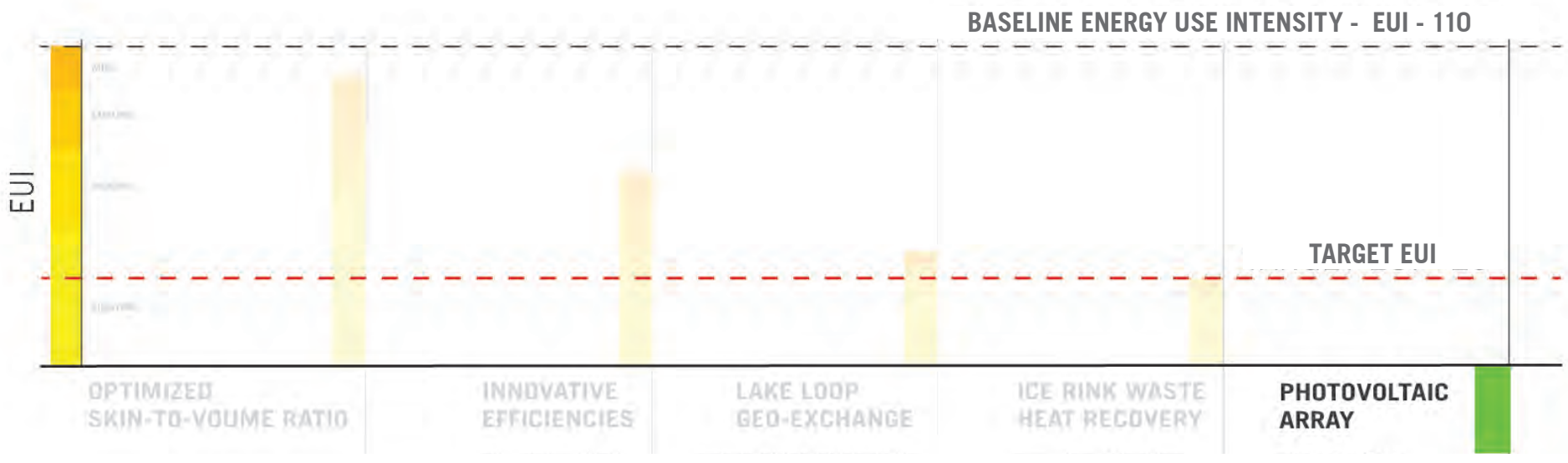
RESPONSIBLE RESOURCE USE

What if we take a campus approach to energy?



RESPONSIBLE RESOURCE USE

What if we invest in on-site energy generation?

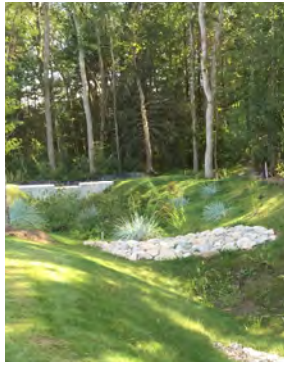


Site Design

SITE DESIGN

What if the site design utilizes green infrastructure?

Bioretention



Stormwater Planters

Permeable Paving

Rainwater Harvesting

Green Roofs

SITE DESIGN

June Jorden School of Equity, San Francisco

What if the site performs as an educational *and* habitat rich envronment?

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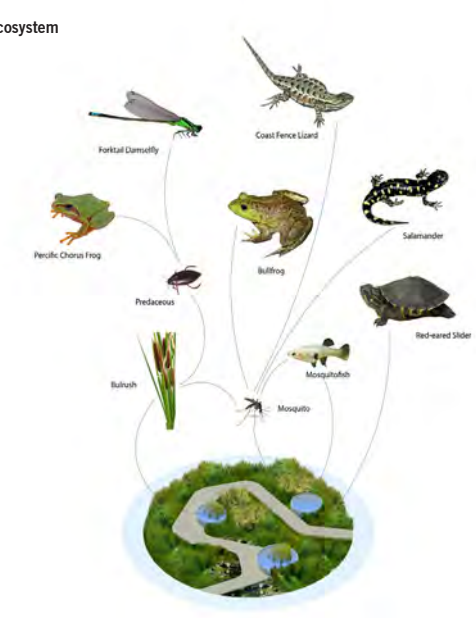
SITE DESIGN

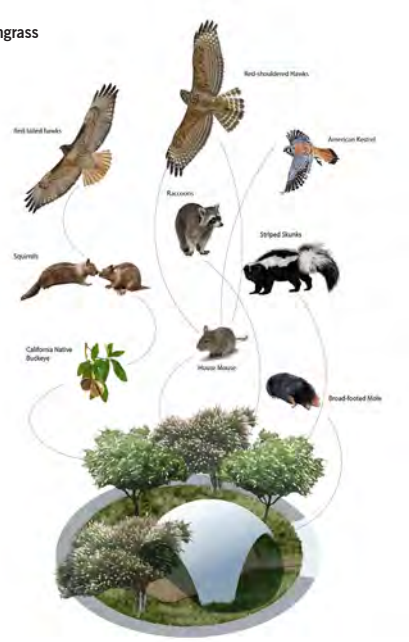
June Jorden School of Equity, San Francisco

What if the site performs as an educational *and* habitat rich envronment?

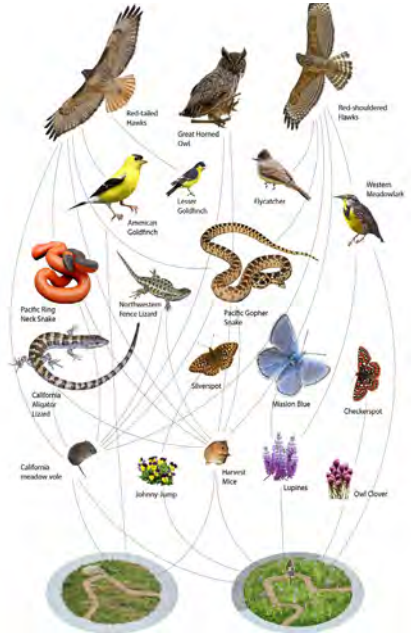
Pond/Bioswale Ecosystem



Native Buckeye And Bunchgrass Meadow Ecosystem



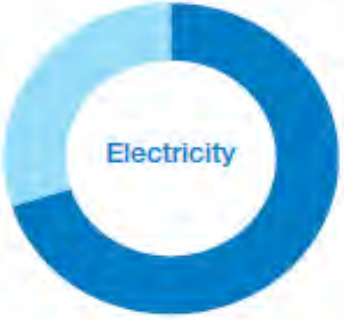
Grassland Ecosystem



Material Health

MATERIAL HEALTH

Percent of Total U.S. Electricity Used By Buildings



Close to 70 percent of electricity consumption

Percent of Total U.S. Potable Water Used By Buildings

14 percent of potable water consumption

We know the impacts of buildings on our resources and the environment

MATERIAL HEALTH

We know the impacts of buildings on our resources and the environment

...but what is the impact of the built environment on our health?

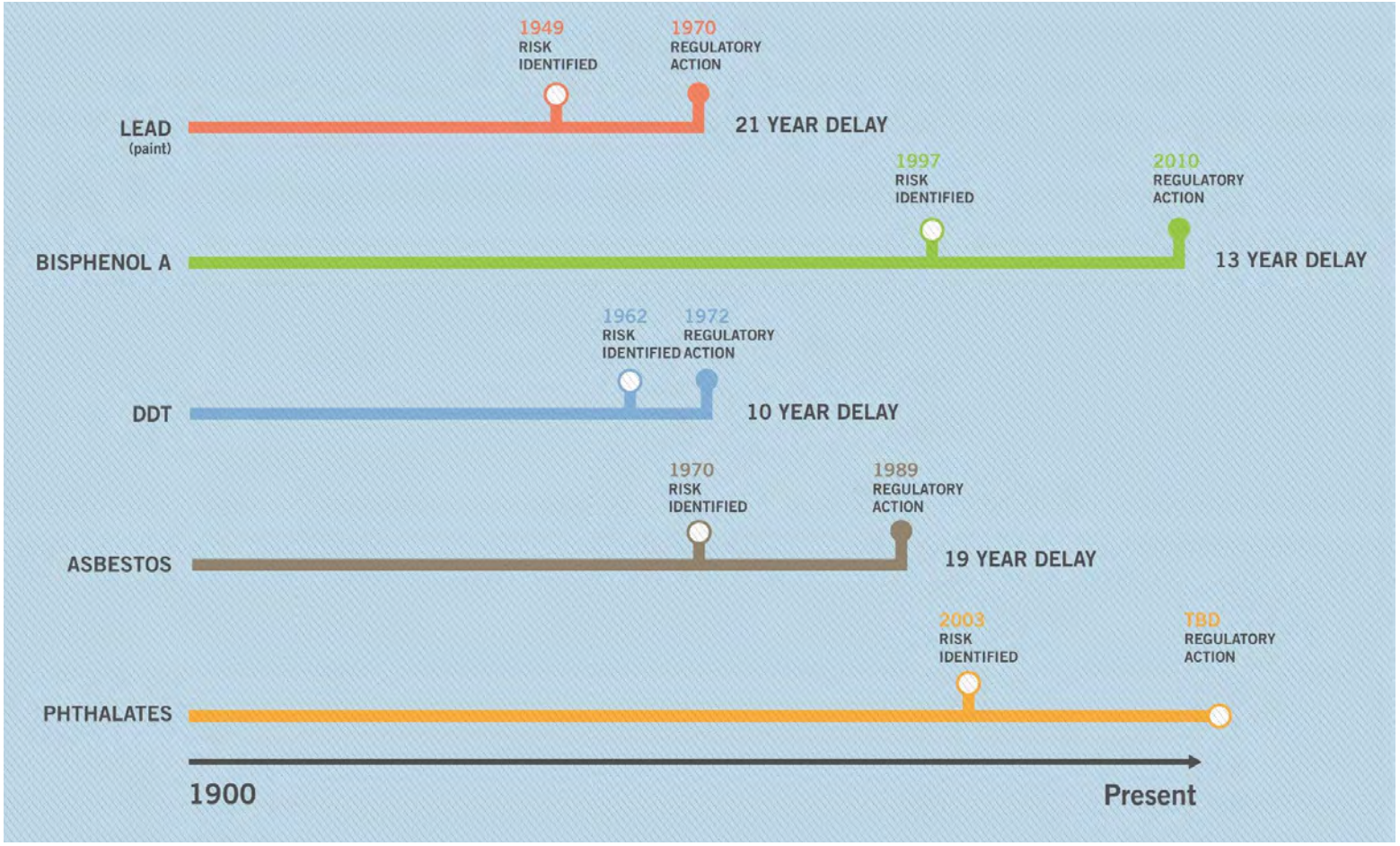
MATERIAL HEALTH

US CHEMICALS POLICY

Toxic Substances Control Act (TSCA)

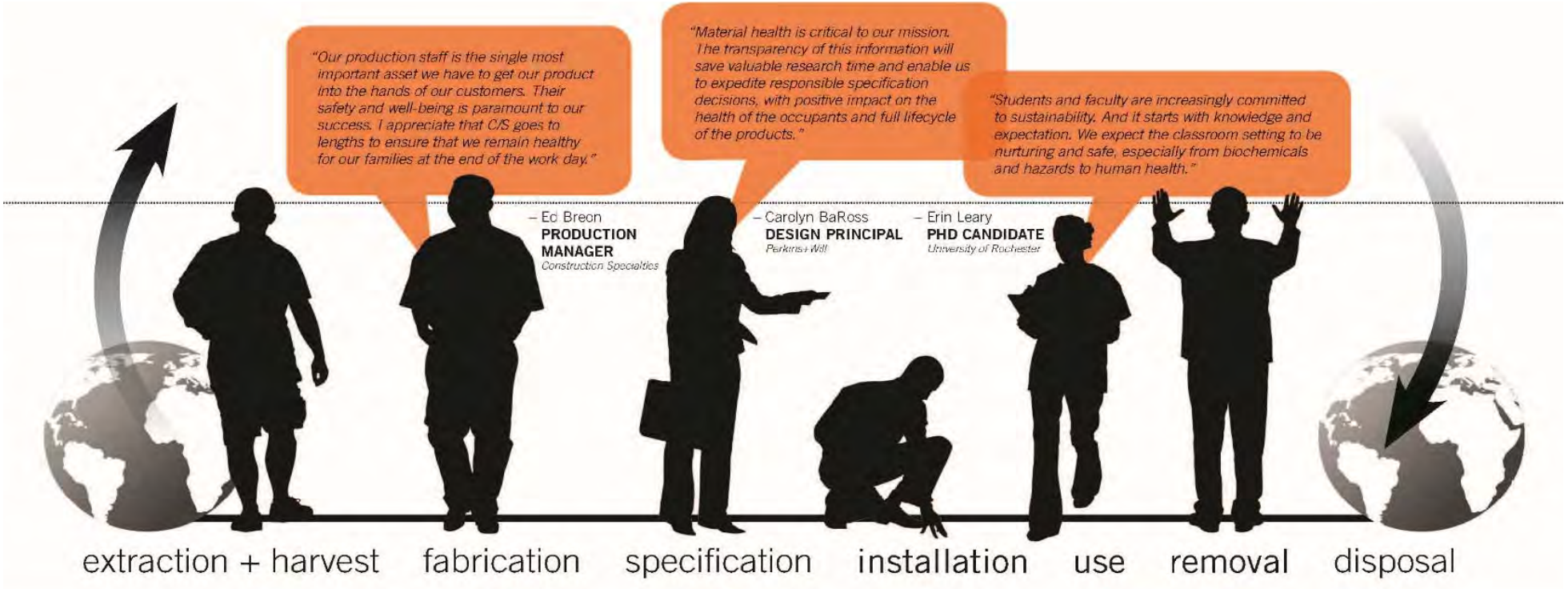
- 84,000 chemicals registered in the United States
- 62,000 were grandfathered in when the law was enacted
- About 700 are introduced per year
- 650 are monitored through the EPA Toxic Release Inventory (TRI)
- Only 200 have been tested for threats to human health and safety
- Of these 200, 5 were partially regulated
- Only 1 chemical has been banned: PCBs

MATERIAL HEALTH



MATERIAL HEALTH

What if we choose materials that consider a wider Belmont HS community?



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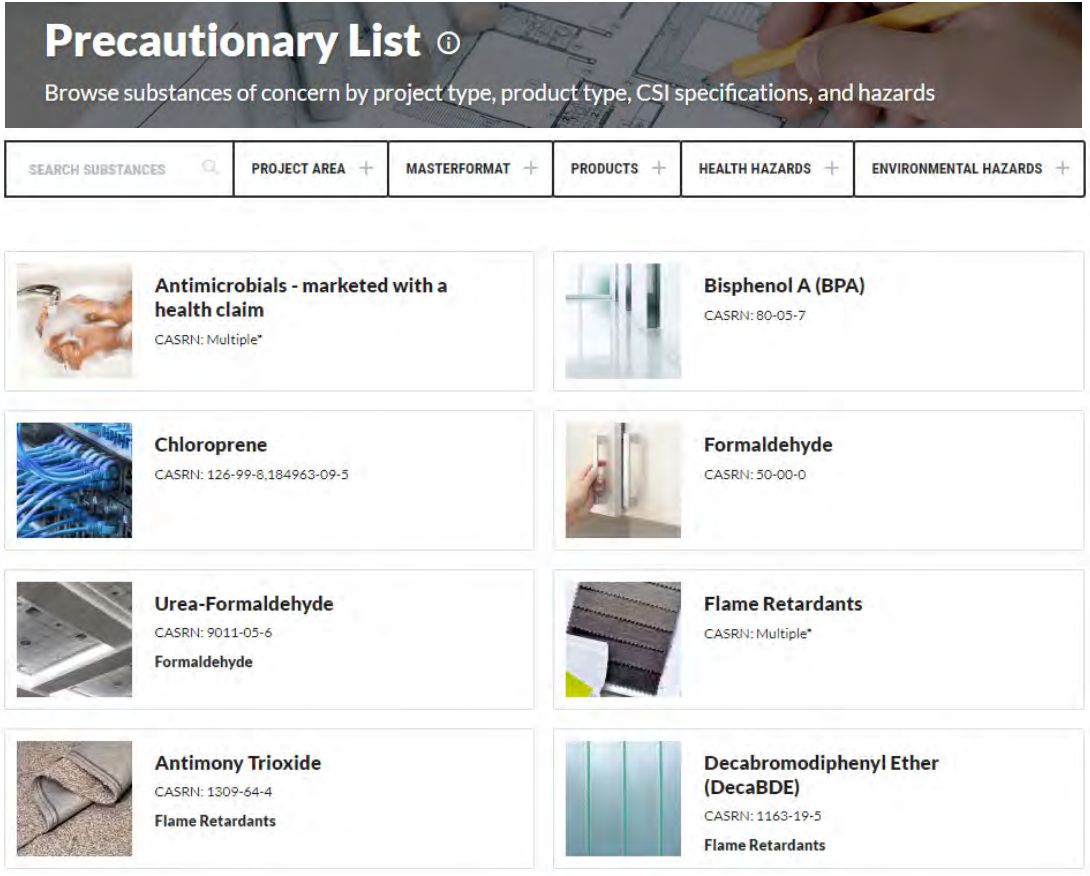
MATERIAL HEALTH



context

Perkins + Will Precautionary List
transparency.perkinswill.com

Green Science Policy Institute
greensciencepolicy.org
saferinsulation.org

6 Classes of Harmful Chemicals
SixClasses.org

Cradle to Cradle Products Innovation Institute
c2ccertified.org

Level / furniture certification program (BIFMA)
levelcertified.org

UL Lens

Fabric certification program (ACT)
contracttextiles.org

Resiliency

RESILIENCY

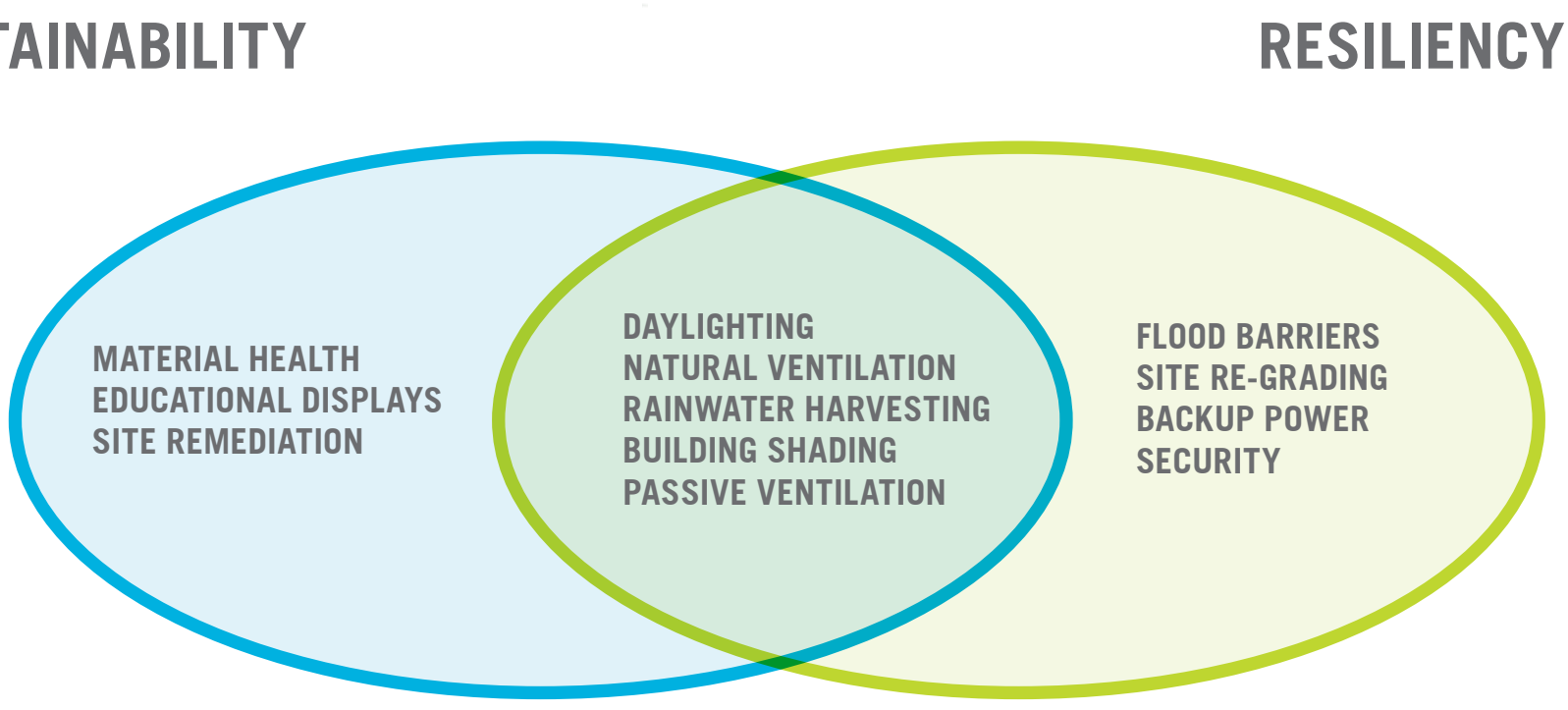
Strengthen facility resistance to weather events and resource depletion

Improve safety and stability during security incidents

Maintain continuity of school business and community activities during chronic and acute events

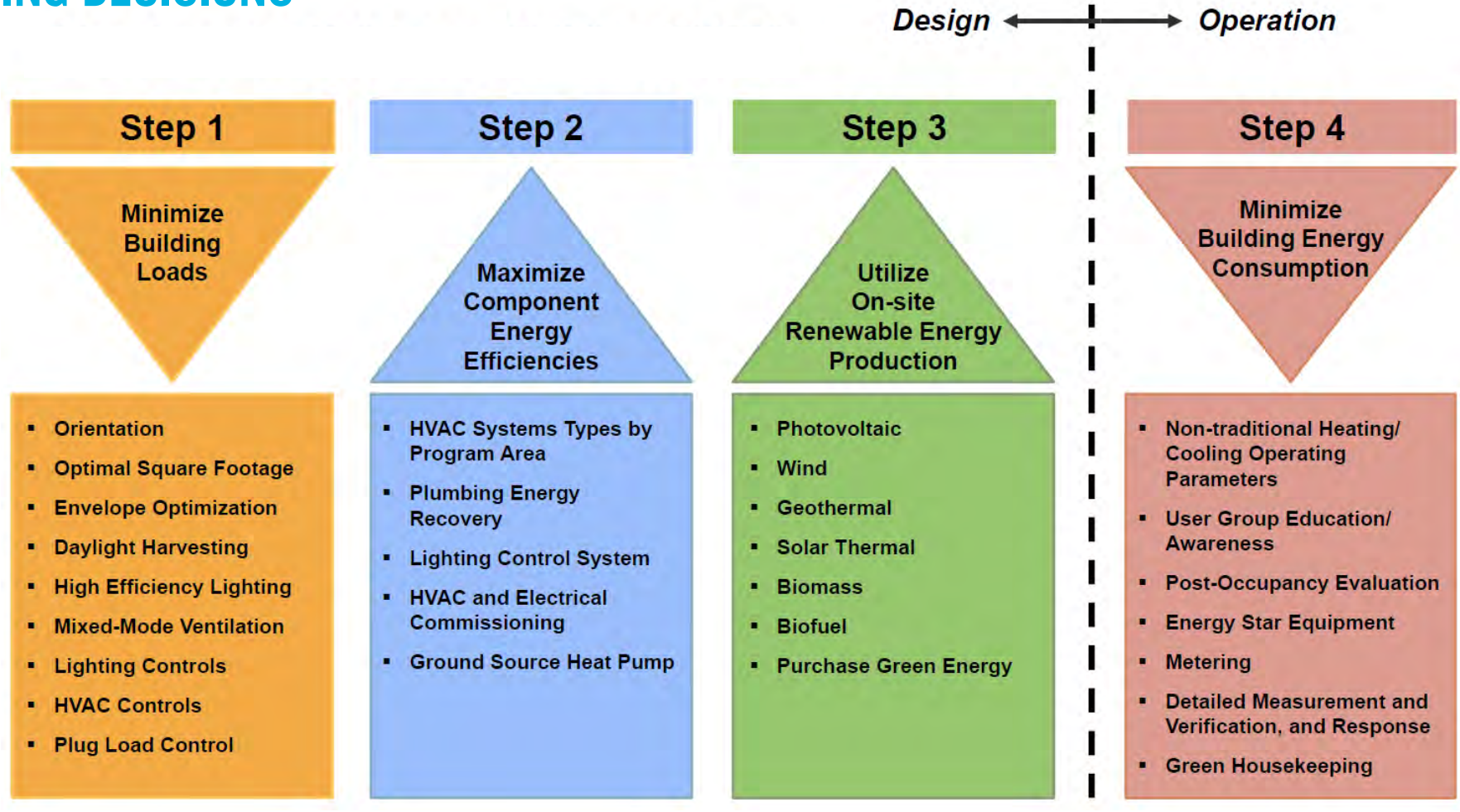
Manage risk premiums associated with operations, insurance and financing

RESILIENCY

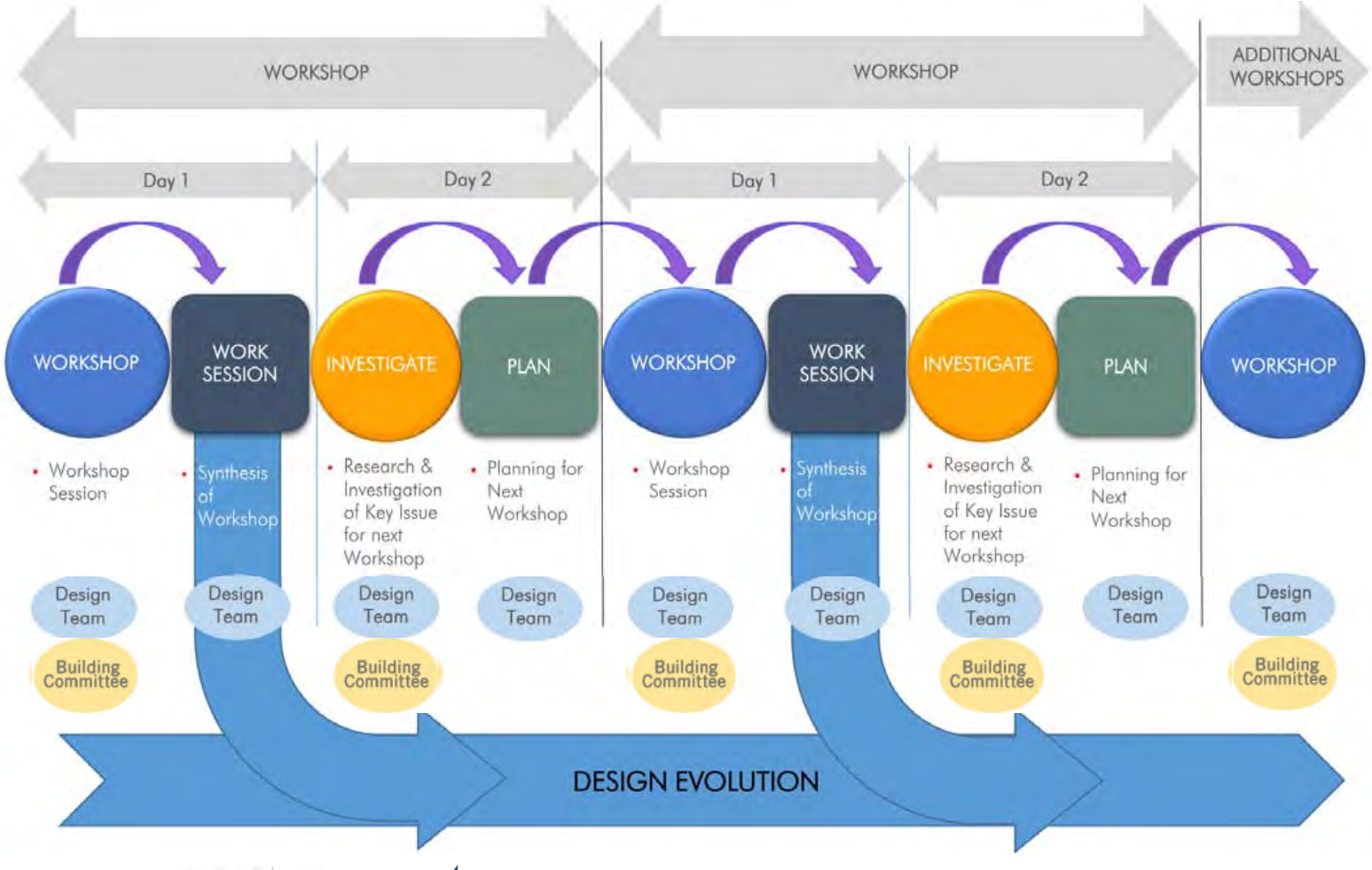

SUSTAINABILITY
RESILIENCY
MATERIAL HEALTH
EDUCATIONAL DISPLAYS
SITE REMEDIATION
DAYLIGHTING
NATURAL VENTILATION
RAINWATER HARVESTING
BUILDING SHADING
PASSIVE VENTILATION
FLOOD BARRIERS
SITE RE-GRADING
BACKUP POWER
SECURITY

How Do We Make Decisions?

MAKING DECISIONS



MAKING DECISIONS



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MAKING DECISIONS

BELMONT HIGH SCHOOL ENERGY REDUCTION STRATEGIES

Strategy Description	*upfront cost*	*% of project budget*	*annual $ savings*	*payback (years)*	*kBtu/SF/yr savings*	*cost-effectiveness*	*comments*
PROPOSED STRATEGIES							
Ground Source Heat Pump	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
High Performance 2-Pipe Fan Coil	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Partial Cooling	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Improved Wall & Roof Insulation	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	*As-built averages: R-29 walls and R-49 roof; compared with industry standard R-19 wall and R-? Roof*
Improved Glazing	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	*0.22 U-Factor, 0.44 SC*
External Shading	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	*brise-soliel provides heat gain mitigation and improves user comfort without compromising daylight and views*
Temperature Set Points (82° F / 68° F)	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	*0.22 U-Factor, 0.44 SC*
Point of Use Hot Water	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Plug Load Control	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	*School policy to provide "smart power strips" for offices and classrooms*
Solar Hot Water System	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Expanding Day Lighting Sensor Controls	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Exterior Lighting Controls	$0.00	0.00%	$0.00	#DIV/0!	0.00	*#DIV/0!*	
Comprehensive Accepted Building Strategies	**$ -**	**0.00%**	**$ -**	**#DIV/0!**			*Strategies are dependent on one another and may provide different results for different project types, locations, and strategy combinations*

Payback Tracking

Case Studies

CASE STUDY- KATHLEEN GRIMM SCHOOL

Net Zero Energy Primary School

Kathleen Grimm School for Leadership and Sustainability (Staten Island, NY)

ABOUT THIS PROJECT

Pre-K – 5th Grade Net Zero Energy School

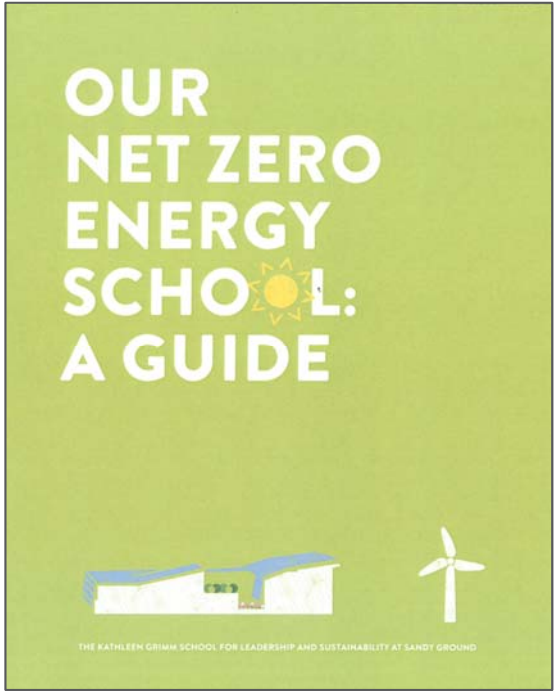
66,000 SF, 2-Stories, 440 Students

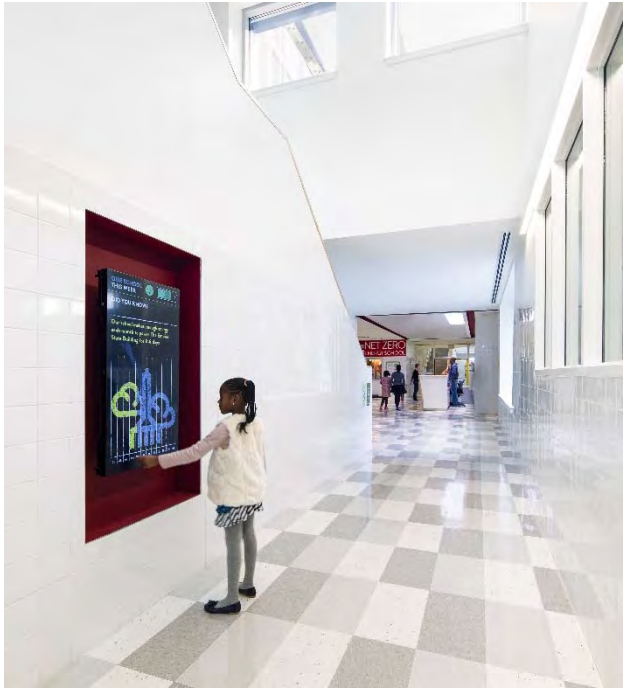
- Integrated Metering and Dashboard System
- User & Occupant Engagement
- Geothermal Heating & Cooling System
- Daylight Harvesting
- Low-Flow Plumbing Fixtures
- Solar Thermal Hot Water
- Student Vegetable Garden/Greenhouse

Image Credit: Stark Video, Inc.

Kathleen Grimm School: Energy at Play

Kathleen Grimm School: Education & Feedback





Kathleen Grimm School: Teaching Tool

- Four themed teaching nodes
  (Sun, Wind, Earth & Water)
- Real-time access to energy performance through school network

CASE STUDY- MARTIN LUTHER KING, JR SCHOOL

Supporting Community Carbon Neutral Initiative

Martin Luther King, Jr. School (Cambridge, MA)

ABOUT THIS PROJECT

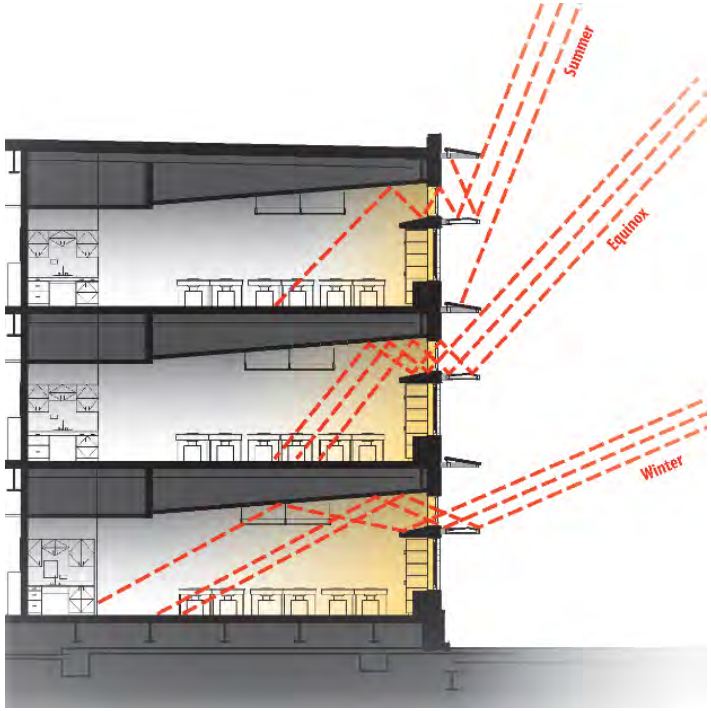
Pre-K – 8th Grade Community School

NZE Goal in support of Cambridge Carbon Neutral Initiative

170,000 SF, 4-Stories, 700 Students

- Hybrid Geothermal Heating & Cooling
- LED Lighting w/ Daylight Harvesting
- Storm Water Harvesting
- Student Garden

MLK, Jr. School: Optimizing Daylight



MLK, Jr. School: Connect to Nature

CASE STUDY- PRINCETON, FRICK CHEMESTRY LAB

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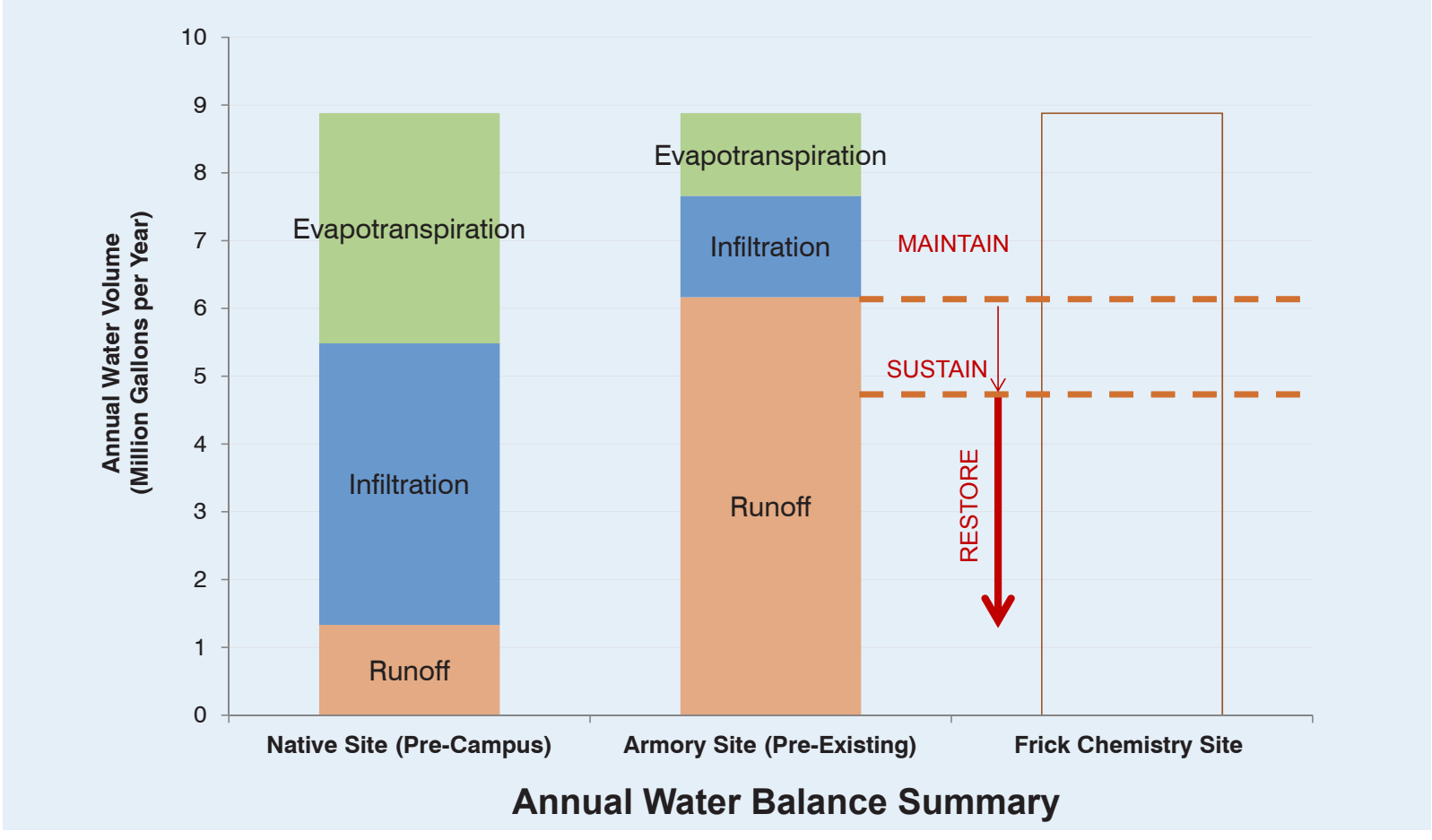
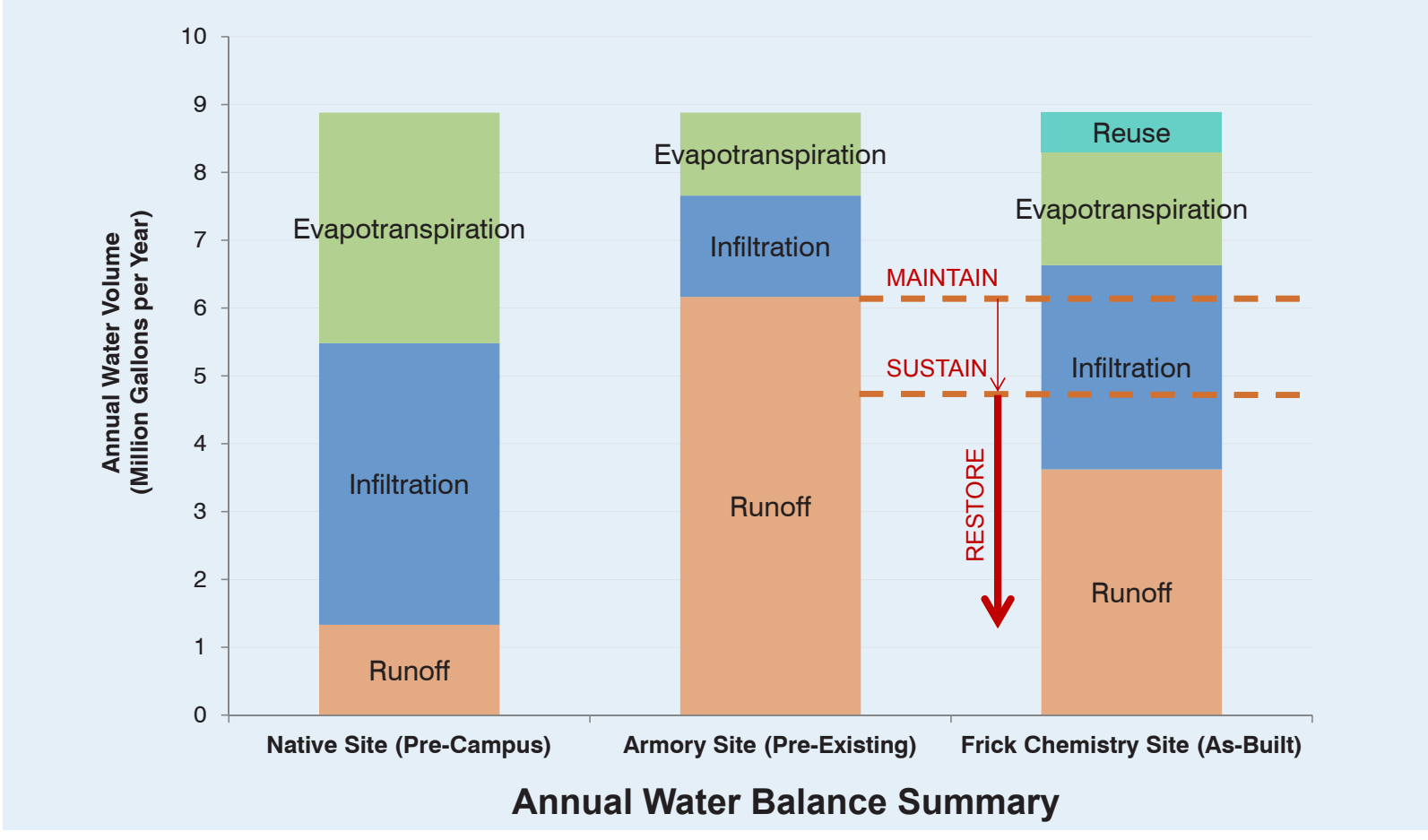


CASE STUDY- PRINCETON, FRICK CHEMESTRY LAB



CASE STUDY- PRINCETON, FRICK CHEMESTRY LAB

Nitsch Engineering

RainUSE®: Rainfall ReUSE Simulation v2.0
New Project

Project Information:

Location: Boston, Massachusetts
Client: Confidential
Project Number: 1234
Date: 03/08/2011
Notes: Cistern used for seasonal irrigation and year-round toilet flushing

Inputs and Assumptions:

Rain Gauge: BOSTON LOGAN INT'L
Rain Years: 1982 - 2011
Avg Annual Precip (in): 40.34
Area (AC): 0.732
Runoff Coeff.: 0.95
Abstraction: 0.02

Demand (gal/day)

Jan	617	Jul	3,404
Feb	617	Aug	3,404
Mar	617	Sep	617
Apr	617	Oct	617
May	617	Nov	617
Jun	3,404	Dec	617

Total Annual Demand: 481,609 gallons

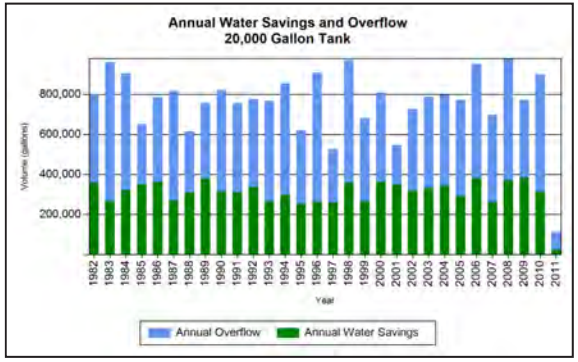
Greywater (gal/day)

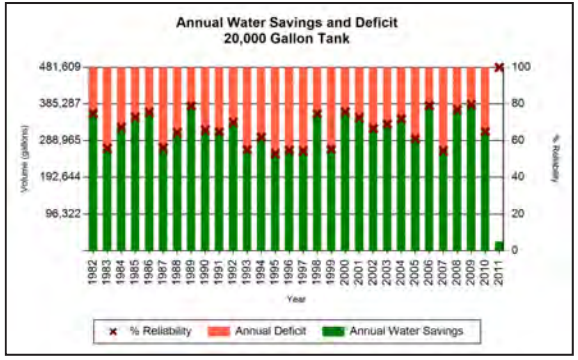
Jan	0	Jul	0
Feb	0	Aug	0
Mar	0	Sep	0
Apr	0	Oct	0
May	0	Nov	0
Jun	0	Dec	0

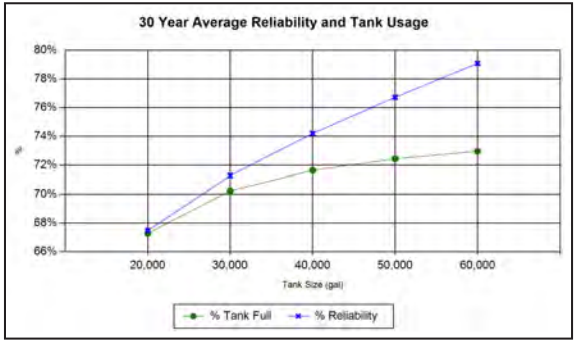
Total Annual Greywater: 0 gallons

Outputs:

Tank Size (gal)	Average Annual Water Savings (gal)	Average Annual Overflow (gal)	Average Annual Deficit (gal)	Average Annual % Reliability	Average Annual % Tank Full
20,000	309,788	451,946	156,713	67%	67%
30,000	328,140	433,594	138,361	71%	70%
40,000	342,170	419,564	124,331	74%	72%
50,000	354,324	407,410	112,177	77%	72%
60,000	365,692	396,043	100,810	79%	73%







Software-Based Service

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CASE STUDY- PRINCETON, FRICK CHEMESTRY LAB

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