

Induction units



variable air volume



variable air volume



variable air volume with radiant floor



**optimization
in
lighting design**

Strategy with a goal of maximizing the reduction of energy consumption

- Orientation and building forms
- Efficient Hardware ie) fixtures, control devices
- Behavioral operation ie) switches/dimmer, BMS

Internal Power Consumption / Heat Gains

Architect to Confirm

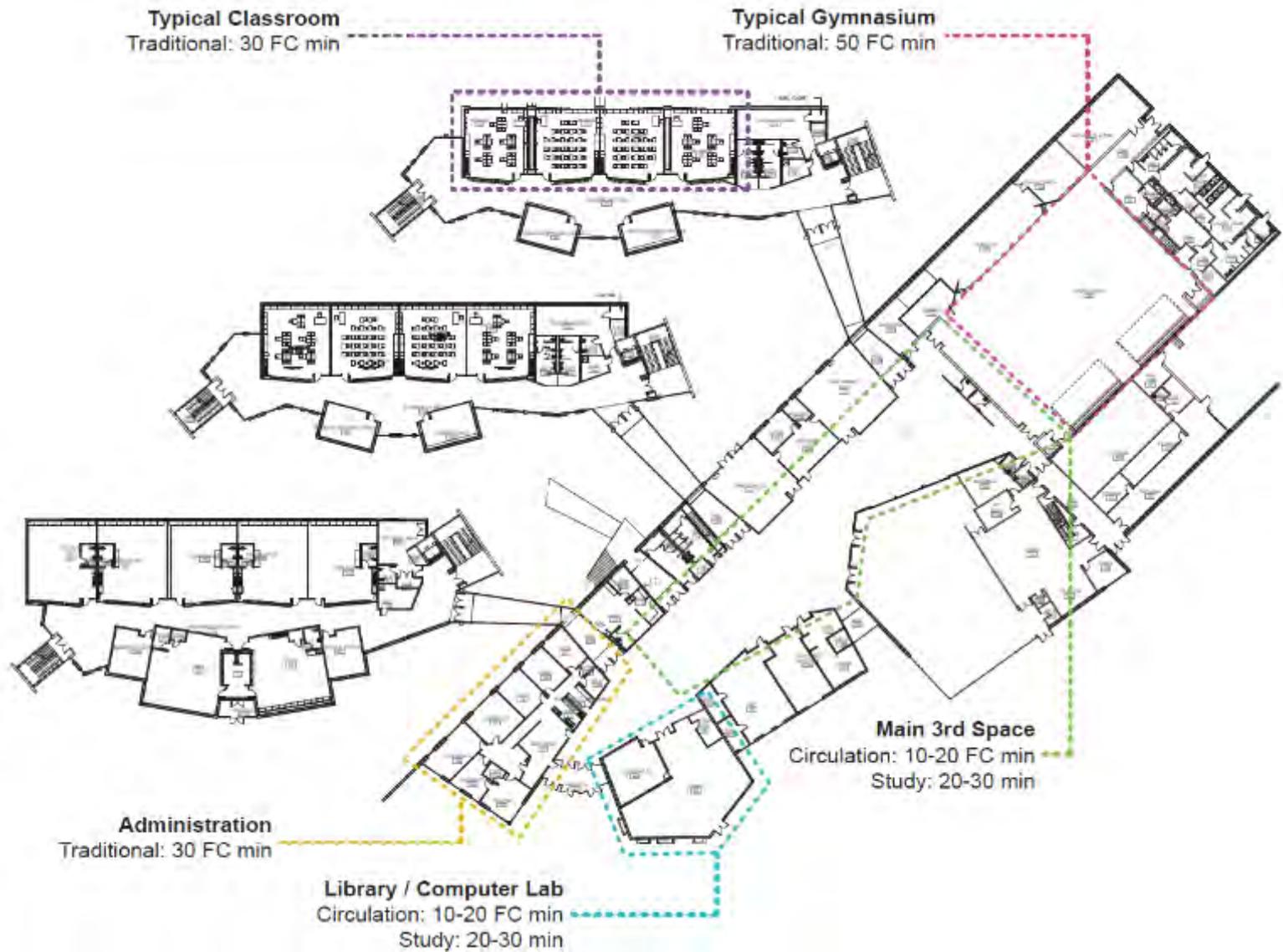
Internal Gains

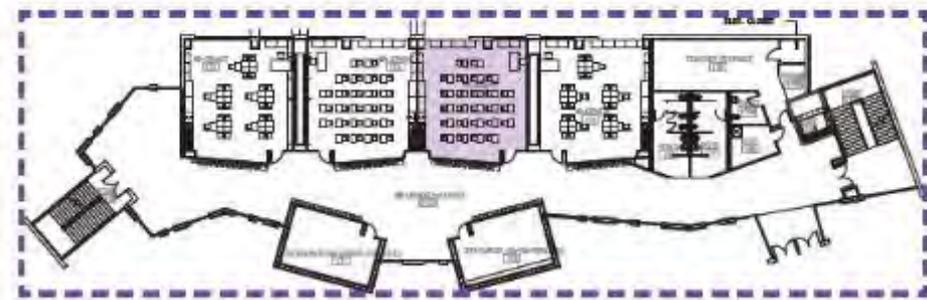
Space Use	Baseline		Proposed		Occupant Loads Modelled Occupancy Density [SF/Person]	Heat Gain/ Person	
	Lighting Power Density [W/SF]	Equipment Power Density [W/SF]	Lighting Power Density [W/SF]	Equipment Power Density [W/SF]		Sensible [Btu/h per Person]	Latent [Btu/h per Person]
Active storage	0.80	0.20	0.80	0.20	-	-	-
Classroom/ Lecture/ Training	1.40	1.00	1.00	1.00	27	225	105
Conference/ Meeting/ Multipurpose	1.30	1.00	1.30	1.00	20	250	200
Corridor/ Transition	0.60	0.20	0.60	0.20	-	-	-
Dining area	0.90	0.50	0.90	0.50	14.3	250	200
Dressing/ Locker/ Fitting room	0.60	0.50	0.70	0.50	25	250	200
Electrical/ Mechanical	1.60	0.20	1.50	0.20	-	-	-
Elevators - Equipment	-	-	-	-	-	-	-
Food preparation	1.20	1.50	1.20	1.50	14.9	275	275
Gymnasium/ Exercise center - Exercise area	1.40	0.50	1.50	0.50	33.33	710	1090
Library - Reading area	1.20	1.50	1.20	1.50	40	250	200
Lobby	1.30	0.50	1.30	0.50	6.67	250	200
Lounge/ Recreation	1.20	1.00	1.20	1.00	40	250	200
Office - Enclosed	1.10	1.50	1.00	1.50	6.75	250	200
Office - Open plan	1.10	1.50	1.00	1.50	6.75	250	200
Restrooms	0.90	0.00	0.50	0.00	-	-	-
Stairs - Active	0.60	0.00	0.60	0.00	-	-	-
Void/Plenum	-	-	-	-	-	-	-

Possible Space
for Improvement



REVIEW OF SPECIFIC SPACE TYPES





Typical Classroom



9 am

summer solstice | clear

equinox | mid-season

winter solstice | overcast

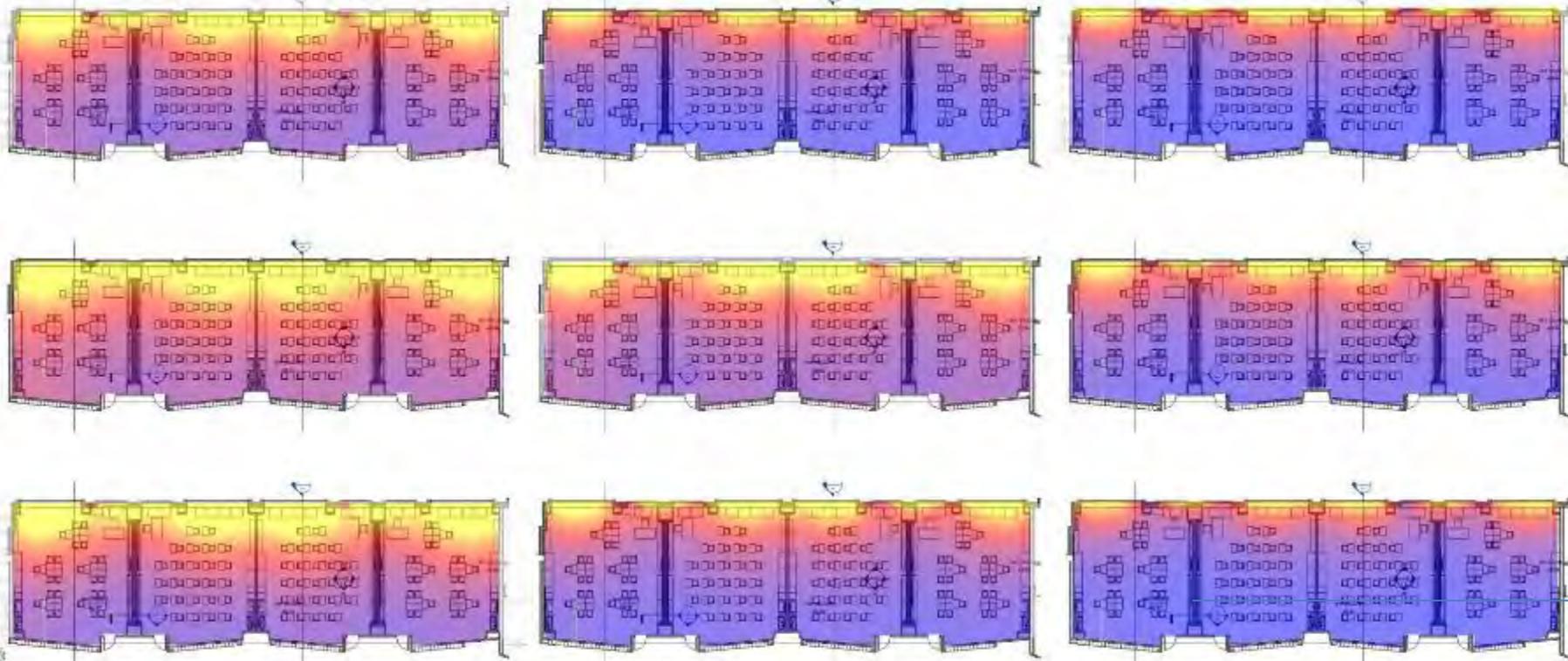
12 pm

3 pm

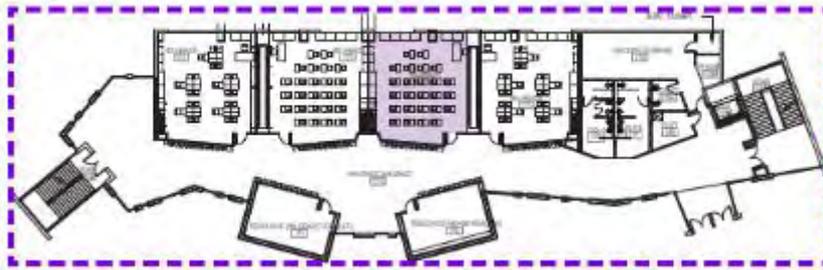


daylit | > 35fc (SED)

grade4 clsrms | glazing study



Typical Classroom



Lighting Zones

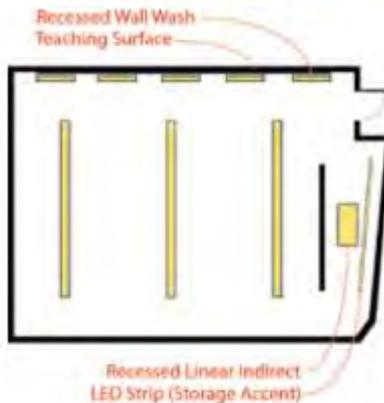
Zone 1: General Ambient - Suspended Direct/Indirect, Recessed Linear Indirect

Zone 2: Teaching Surface Accent - Recessed Wall Wash

Zone 3: Storage Accent - LED Strip

Key Considerations:

1. Projector Placement
2. Extruded Aluminum vs. Steel (Cost)
3. Total Length of Fixtures Required (Cost)



Zone 1 Option:
Suspended Direct/Indirect



Zone 1 Option:
Recessed Indirect 2x2 or 2x4



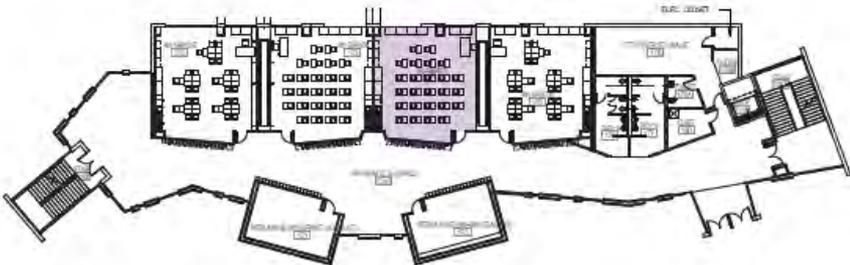
Zone 2 Option: Recessed Wall Wash



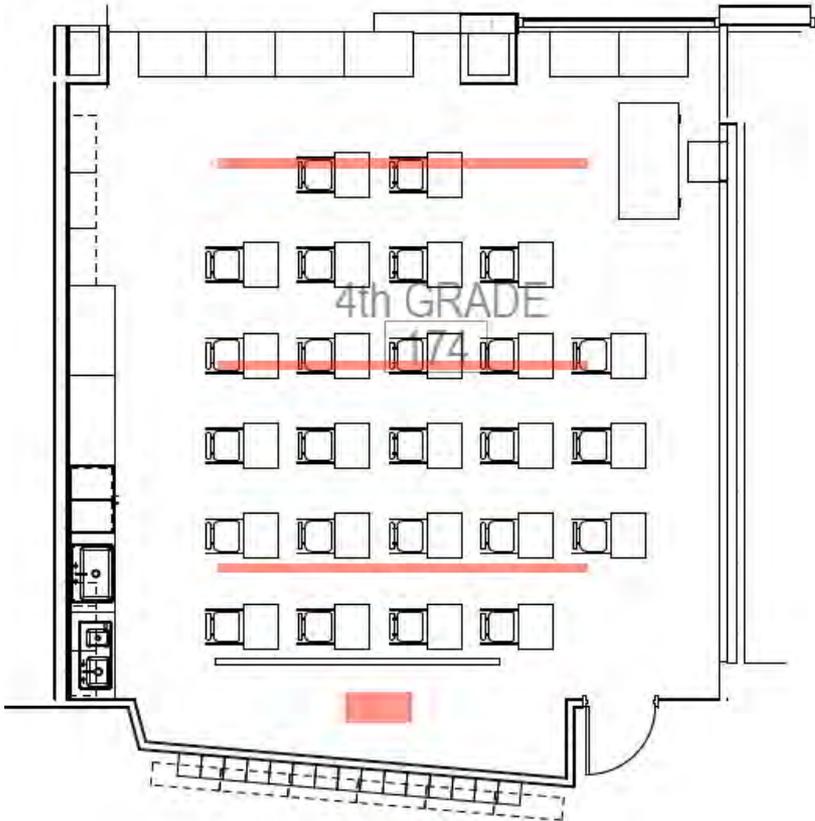
Zone 3 Option: LED Strip

Typical Classroom Option 1

Suspended Direct/Indirect Fluorescent

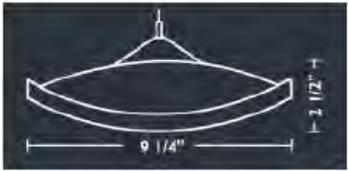
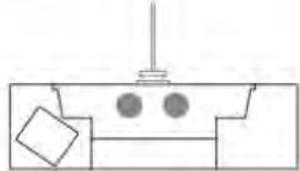


Recommended Illuminance: 30-40 FC
 Allowable LPD: 1.4 w/ft²



Illuminance Calculation Summary

2 Lamp
 Ave: 35.50 FC (From ambient zone only)
 LPD: 1.11 w/ft² (Including All Zones)

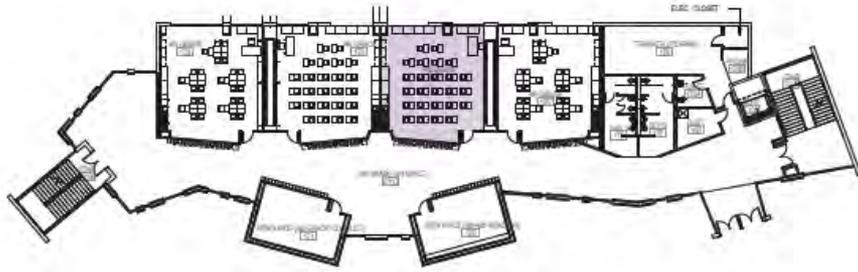


Rectangular Profile Option

Curved Profile Option

Typical Classroom Option 2

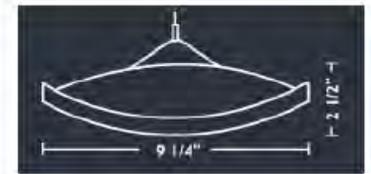
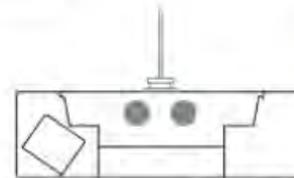
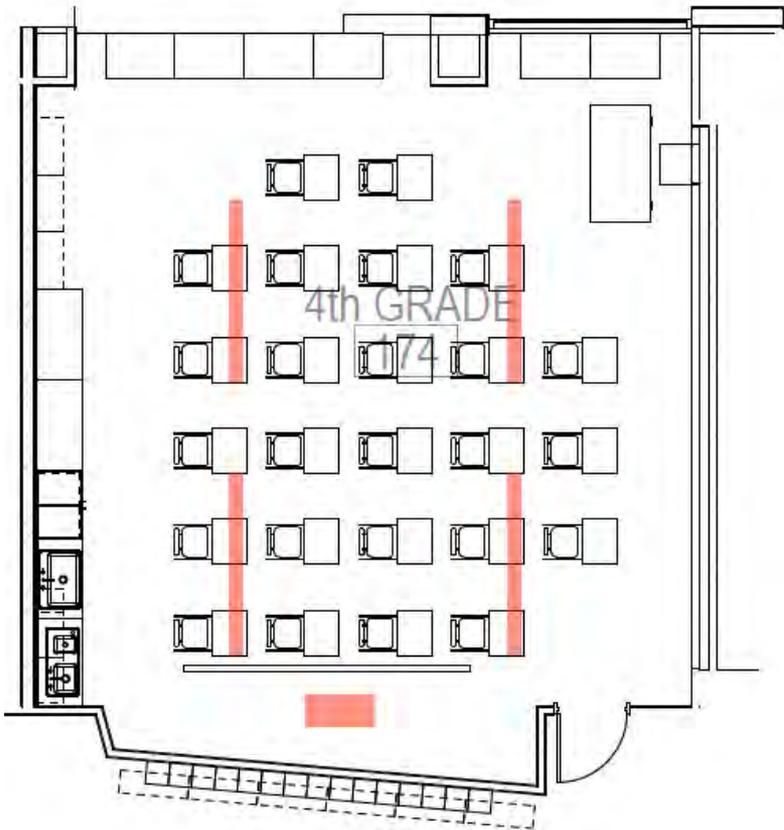
Suspended Direct/Indirect Fluorescent



Recommended Illuminance: 30-40 FC
 Allowable LPD: 1.4 w/ft²

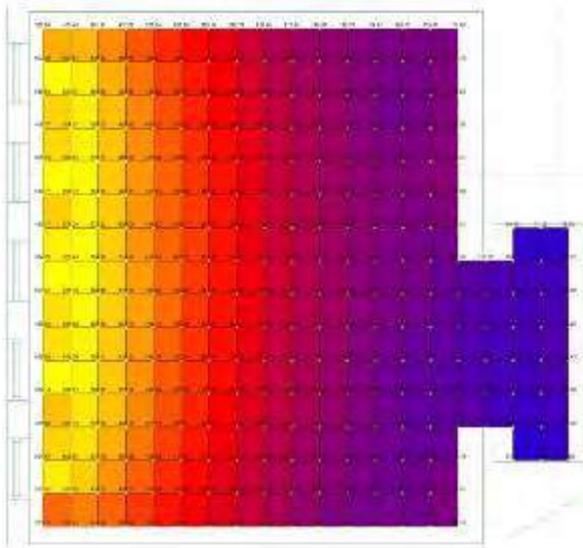
Illuminance Calculation Summary

3 Lamp
 Ave: 32.65 FC (From ambient zone only)
 LPD: 1.11 w/ft² (Including all zones)



Fixture Type:
 Linear Lighting Simplicity SP27

Fixture Type: Axis LT



+



=



issue with maximization



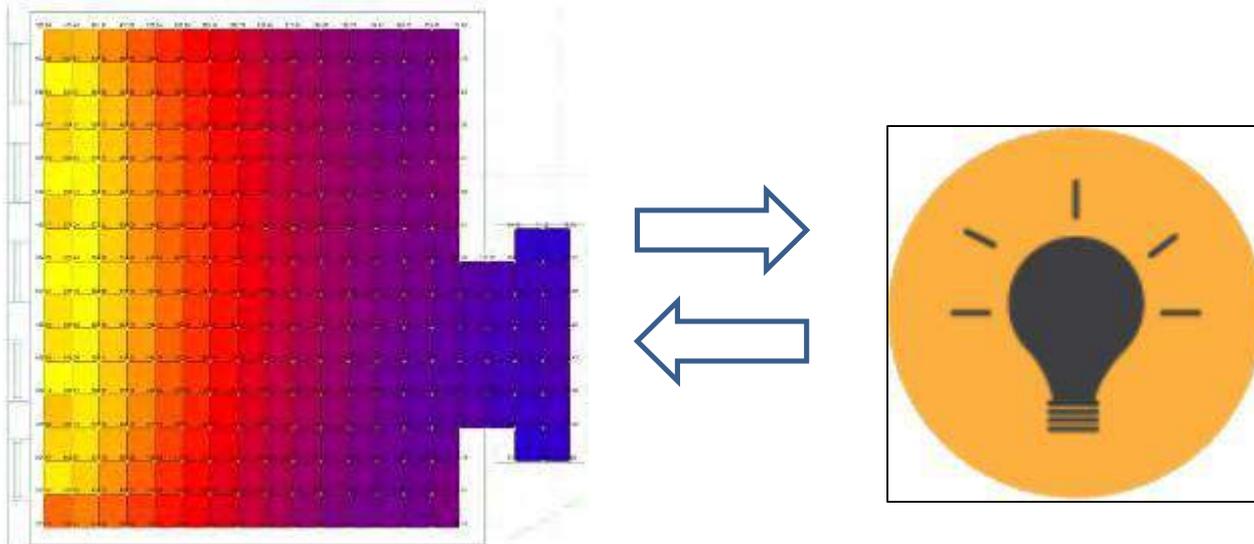
issue with maximization

- Contrast Glare

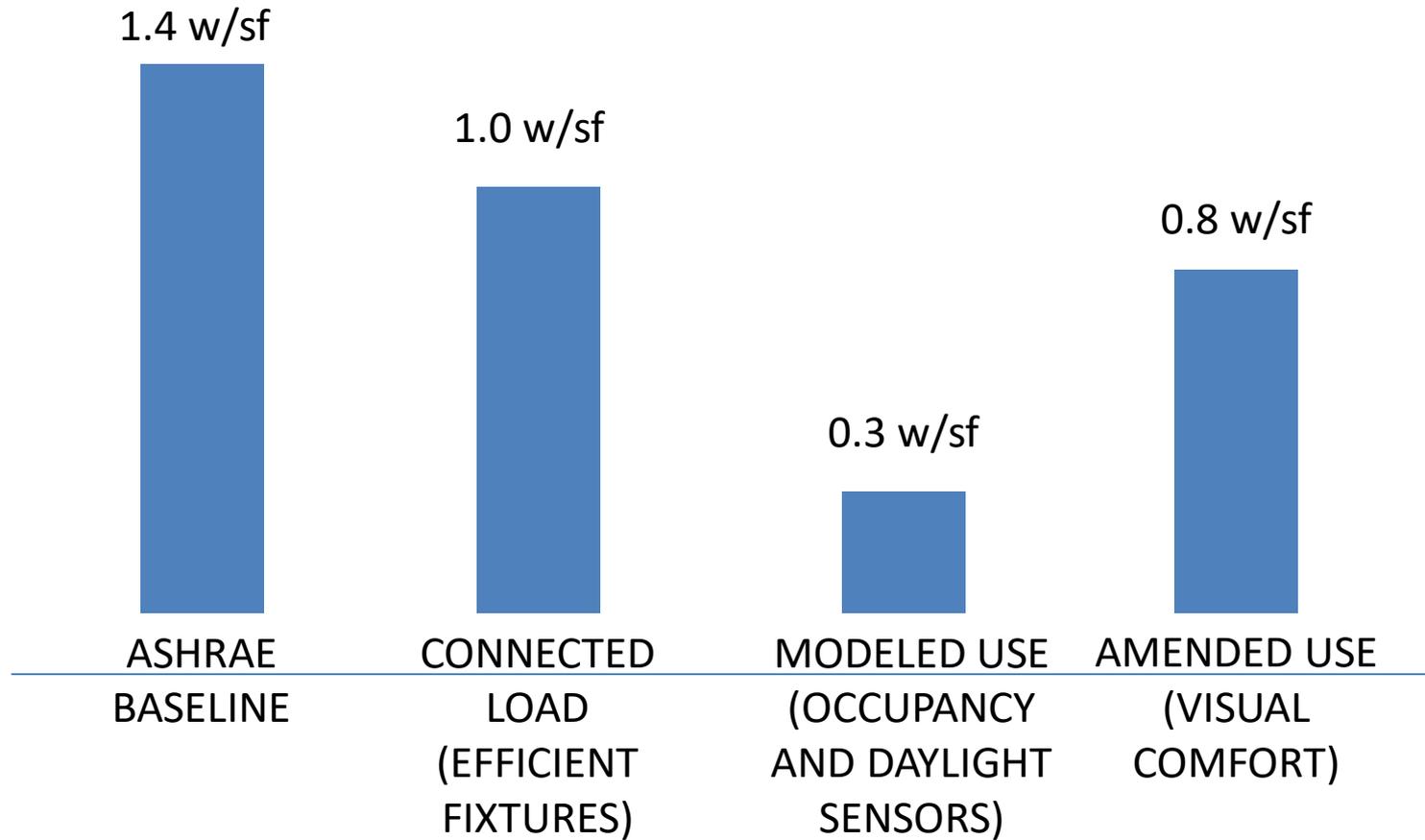
- Dissatisfaction from end-users (teachers/staff) =
CONTRAST GLARE
- Higher electrical usage than modelled/intended

qualitative strategy – optimization

- What was done at MacArthur?
 - Modify dimming strategy
 - Set min footcandle at low end, cap max LPD at high end
- Incorporate/compile modeling
 - replicate actual situations

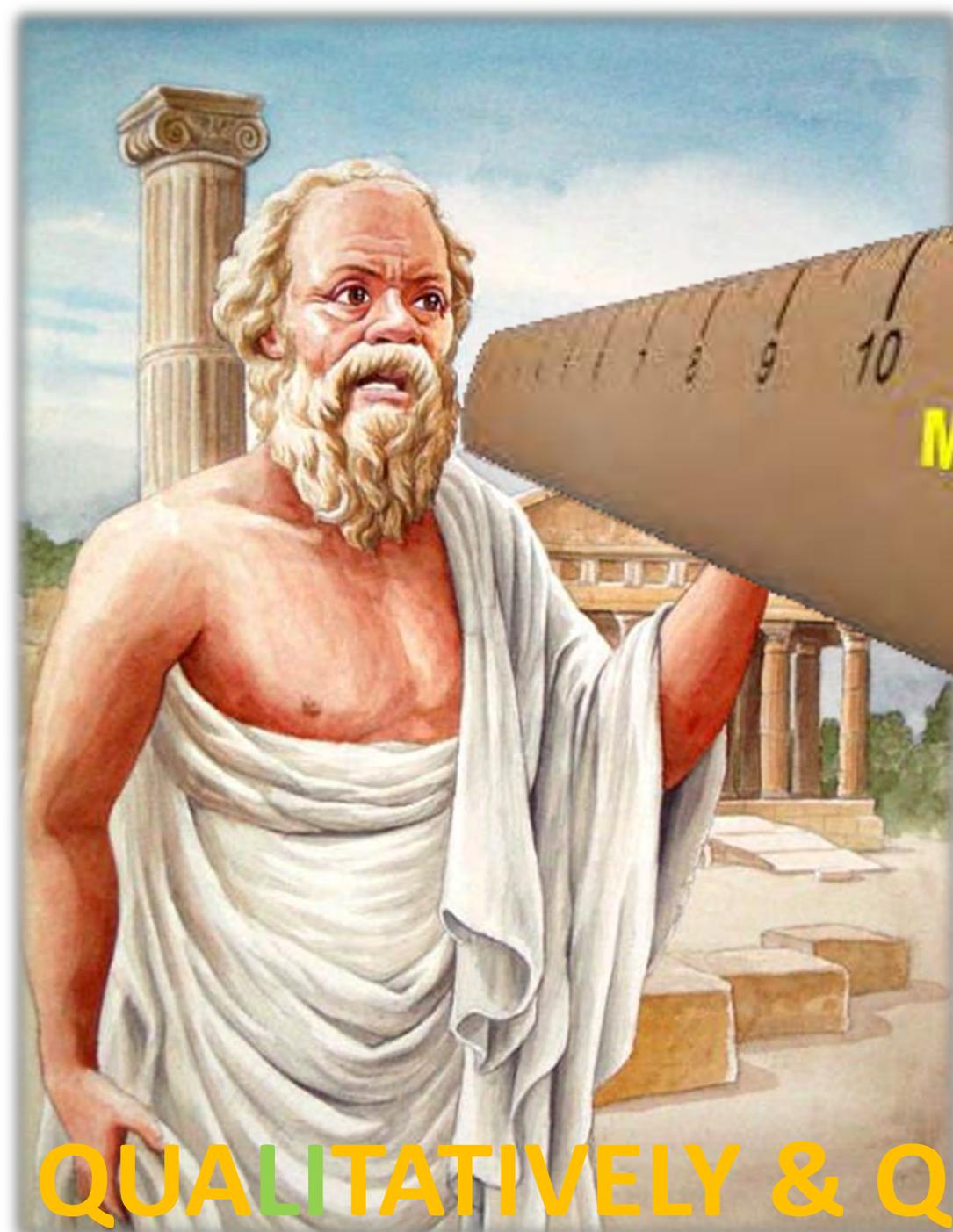


quantitative result - maximization to optimization



TYPICAL CLASSROOM LIGHTING LOADS

**tracking high
performance design**

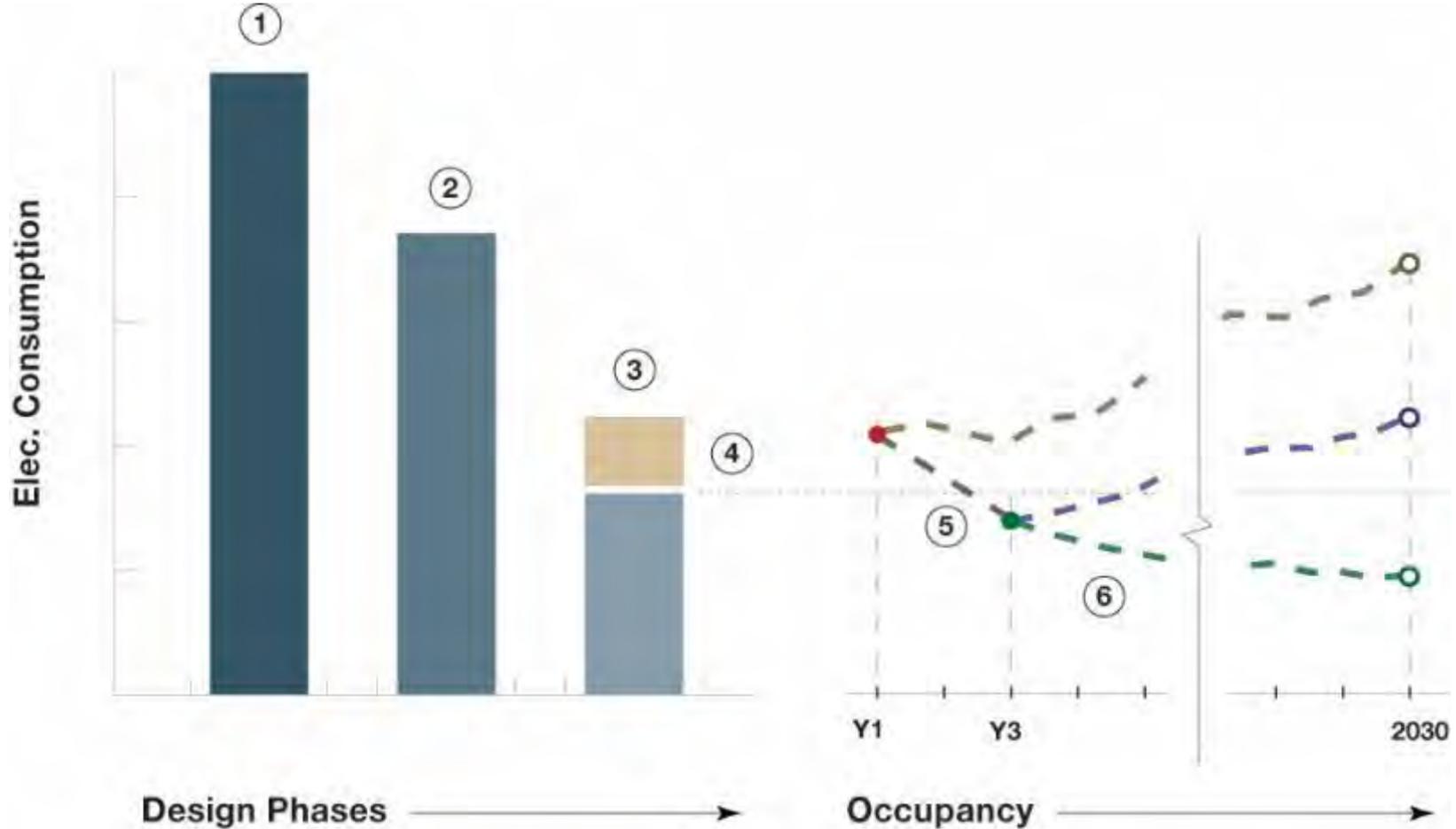


TO
MEASURE
IS TO
KNOW

QUALITATIVELY & QUANTITATIVELY

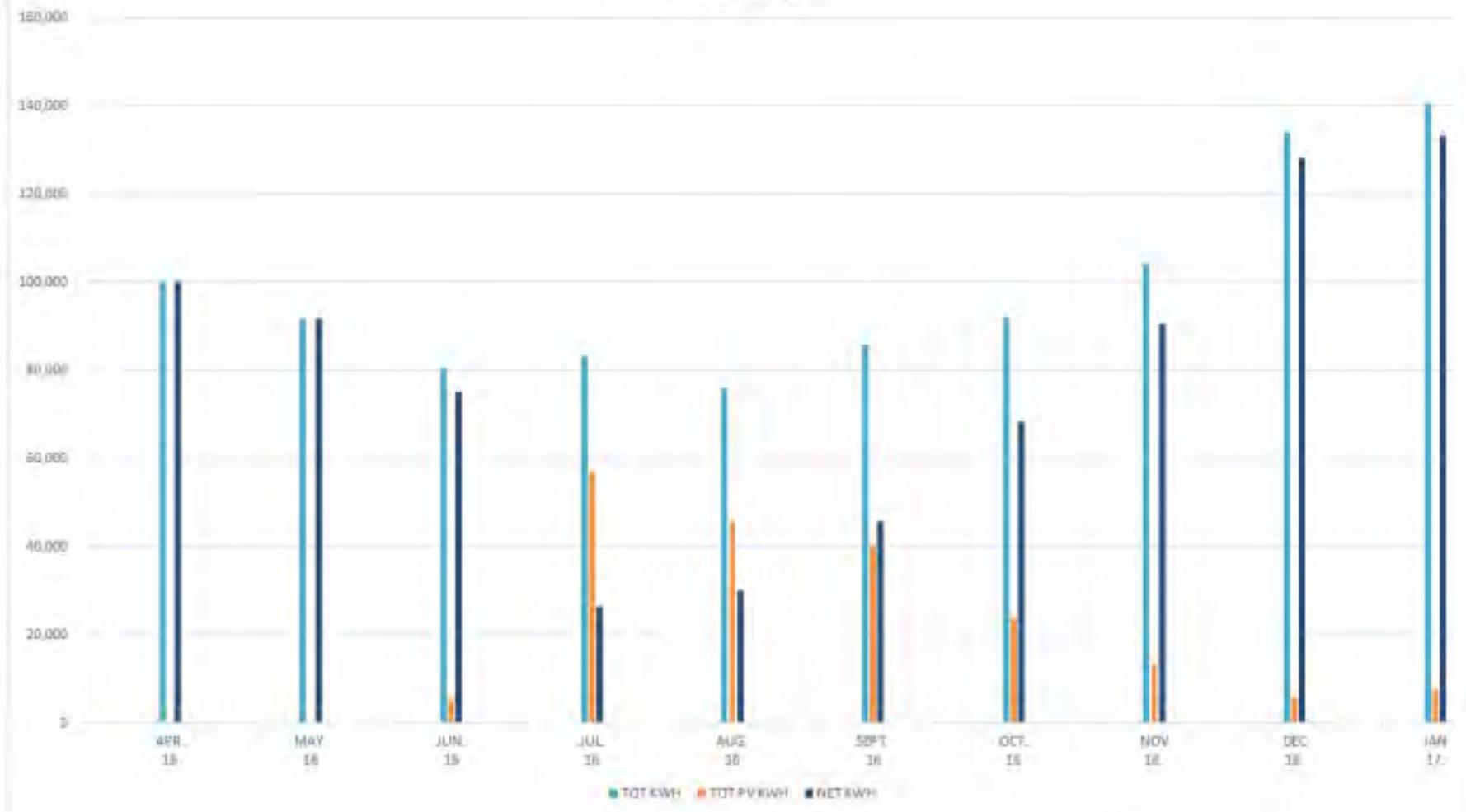
QUANTITATIVELY

energy reduction path



QUANTITATIVELY

Energy Usage



visioning



board of education



staff



students



community

- we will **respect** the energy of the site

- we will **heal** our relationship with the river

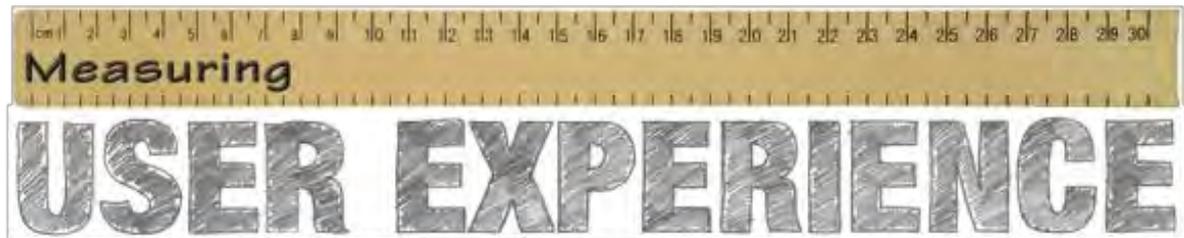
- we will **create** a net zero fossil fuel building

- we will **teach**

- we will create a **safe** and welcoming place for students and the **community**

**TELL US WHAT
YOU THINK**

, we want



QUALITATIVELY

22, 21, 19, 16, 12...

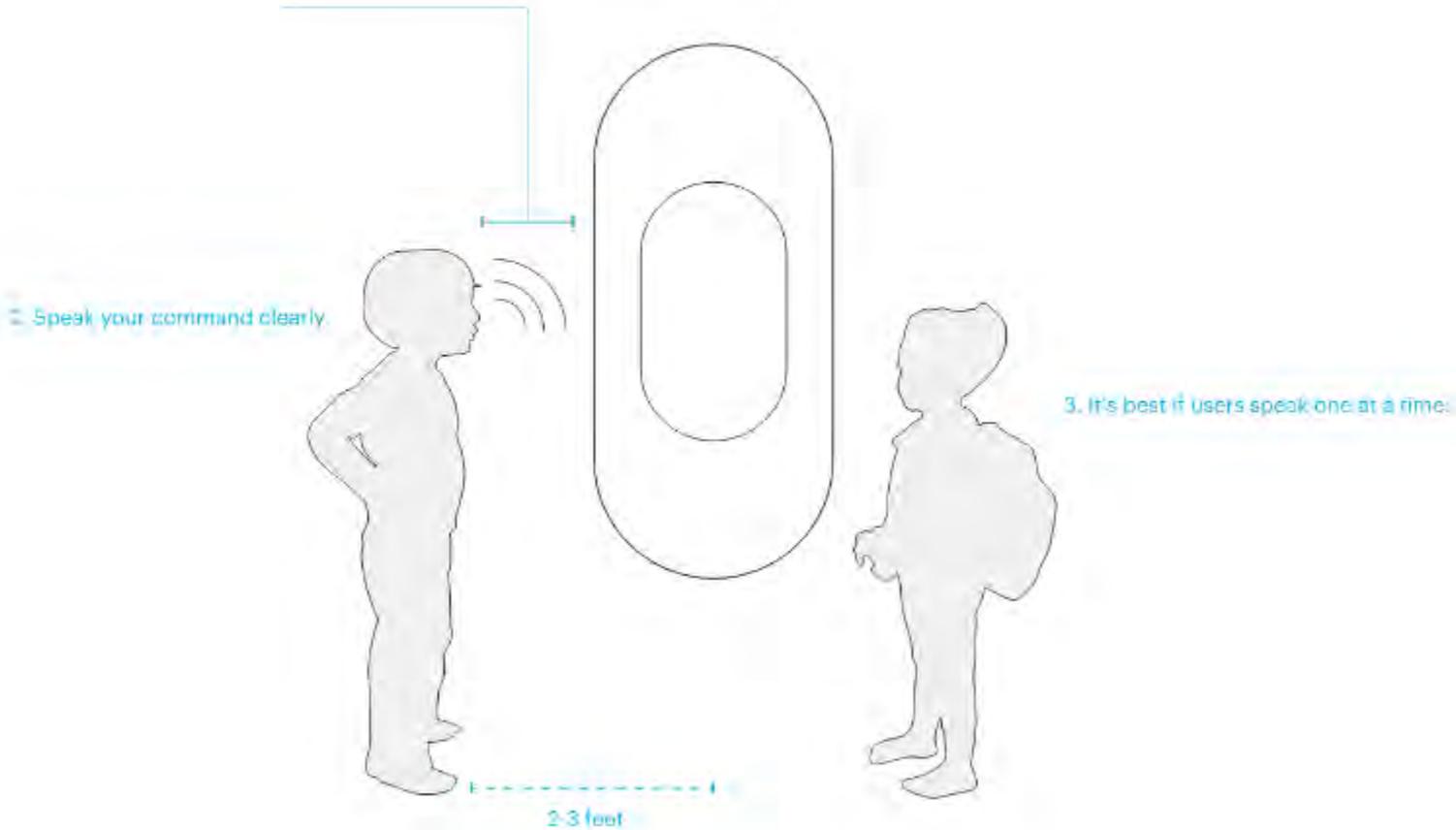
?

QUALITATIVELY

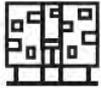
story of Arthur



Using Arthur



Arthur Current Modes



Report Mode

Report on the school's current energy status.



Compare Mode

Compare energy usage of a type over time.



Weather

Report the weather for today or tomorrow.



Arthur Current Modes



Passive Mode

Cycles through updates on energy, weather, date, time and messages.

Energy mode card featuring a grid icon at the top, a smiley face, and four vertical bar charts below. Each bar chart has a small icon above it: a snowflake, a bar chart, a heart, and a water drop. Below each bar chart is a small circular icon with a downward arrow.

Weather mode card featuring a snowflake icon at the top, a smiley face, and a circular arrow icon with '+20%' next to it. Below is the text: "we're using more cooling this month than last month".

Date mode card featuring a calendar icon at the top, a smiley face, and the text "this week" above a week view. The week view shows days m, t, w, t, f with dates 25, 26, 27, 28, 29. A small dot is positioned below the date 29.

Messages mode card featuring a speech bubble icon at the top, a smiley face, and the text: "Far far away, behind the word mountains, far from the countries Vokali." Below is the text: "mon at 12:10".

Time mode card featuring a clock icon at the top, a smiley face, and a large analog clock face. Below the clock is the time "03:15:23".

The Monthly Energy Report Page **generates a report** for MacArthur Elementary's **energy usage** over the past month. We envision this page living on the MacArthur Elementary website as **a source of updating information** for teachers, students and parents.

 = indicates a user's interaction.

arthur

Energy Report

Energy Wall Feed

User can select between the Energy Report or the Telling Wall Feed.

MacArthur Elementary Energy Report

Published 10.01.16

September 2016

B+

The color and grade of the Report is dictated by Arthur's average mood for the month.

This September we're using a **lot less** energy than we usually do. We're using less cooling, gas, electricity and water! Let's keep up the great work!

cooling



Energy Overview

We posted to the Telling Wall:

42
photos

24
messages

4
announcements



Award winners Tom, Sarah and John



Elliot Harris from Pre-K



A book club session in the school library



These sample photos from the Telling Wall can be selected by the school admin from the photos taken that month.

cooling



Q&A

