



# Building Operator Certification – Level I



*A Partnership of the  
NYC Department of Education  
Division of School Facilities,  
International Union of Operating  
Engineers, and the  
City University of New York*



Class 3

# Dimensions of Sustainability: Measuring Performance

## Objectives

- Understand the process of setting baselines, types of data & instruments used in this process, including data-loggers.
- Understand basic energy units and Portfolio Manager, and be able to log into a Portfolio Manager account.
- Be able to set-up and calculate a resource usage case for building water use

# Agenda

- Creating Baselines of Building Conditions
  - Data Loggers & Demonstration
  - Practical Project – Review Session
- Energy Basics & Energy Units
  - Portfolio Manager & Demonstration
- Water Efficiency in Schools
  - Exercise: Water usage calculation

# Common Conditions in Buildings

- Temperature is too high in Summer
- Temperature is too low in Winter
- Ventilation rate is too low – window ventilation only
- Ventilation rate is too low – fans are broken
- Lighting is too high or low
- Humidity is too high / leak in roof
- Presence of moisture, water damage
- Outdoor pollutants or vehicle exhaust
- Animal and other biological allergens

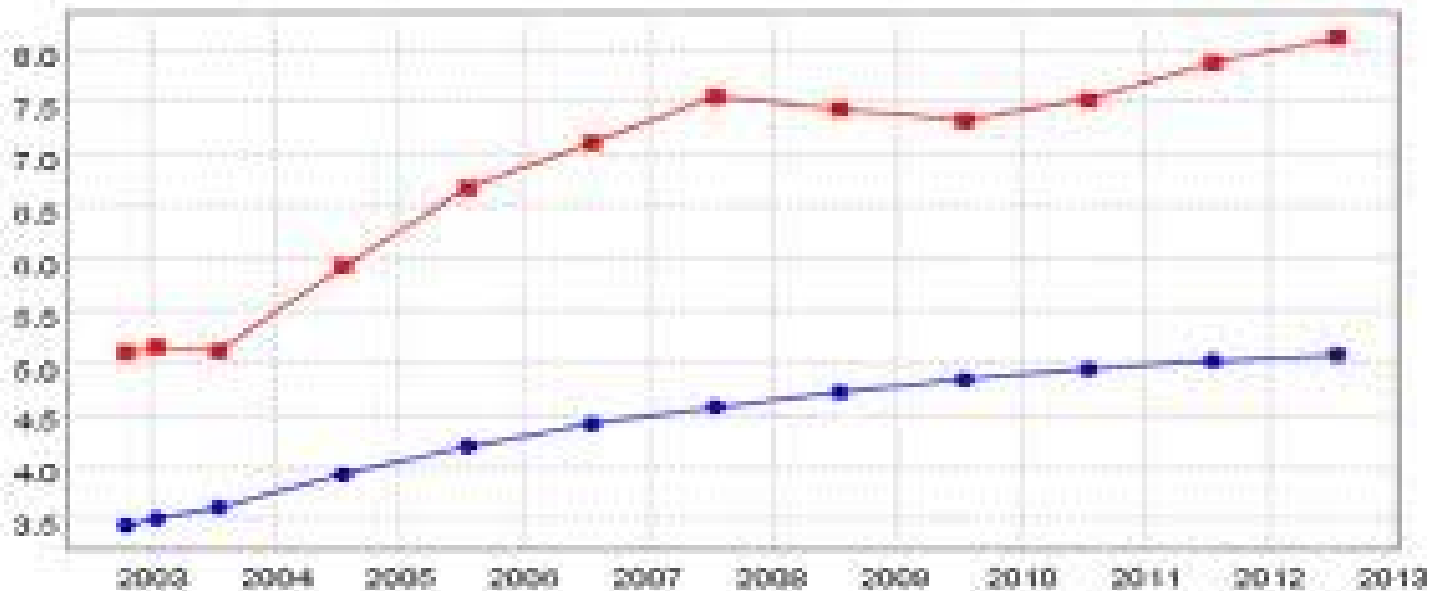
# Setting Baselines of Building Conditions

What do we mean by a “baseline”?

Current conditions, measurements, operations

To be used for comparison to future operations

The reference year for comparison



# What is involved in setting baselines?

## Measurement

- More than just single point in time
- Establish a record (documentation)

## How can we measure?

- Hand-held instrument readings - logged
- Data-loggers
- Occupant surveys

# What data, for IEQ baseline?

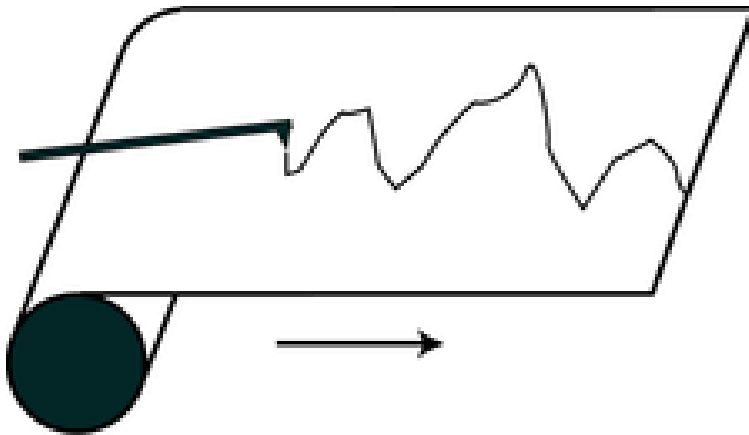
- Temperatures
- CO2 levels
- Ventilation Rate

# What data, for Energy baseline?

- Daily energy use – gallons of oil / day
- Monthly energy use – kW-hrs / month
- Annual energy use – Therms of natural gas / year

# Data-loggers

- Circular Chart Recorders
- Strip Chart





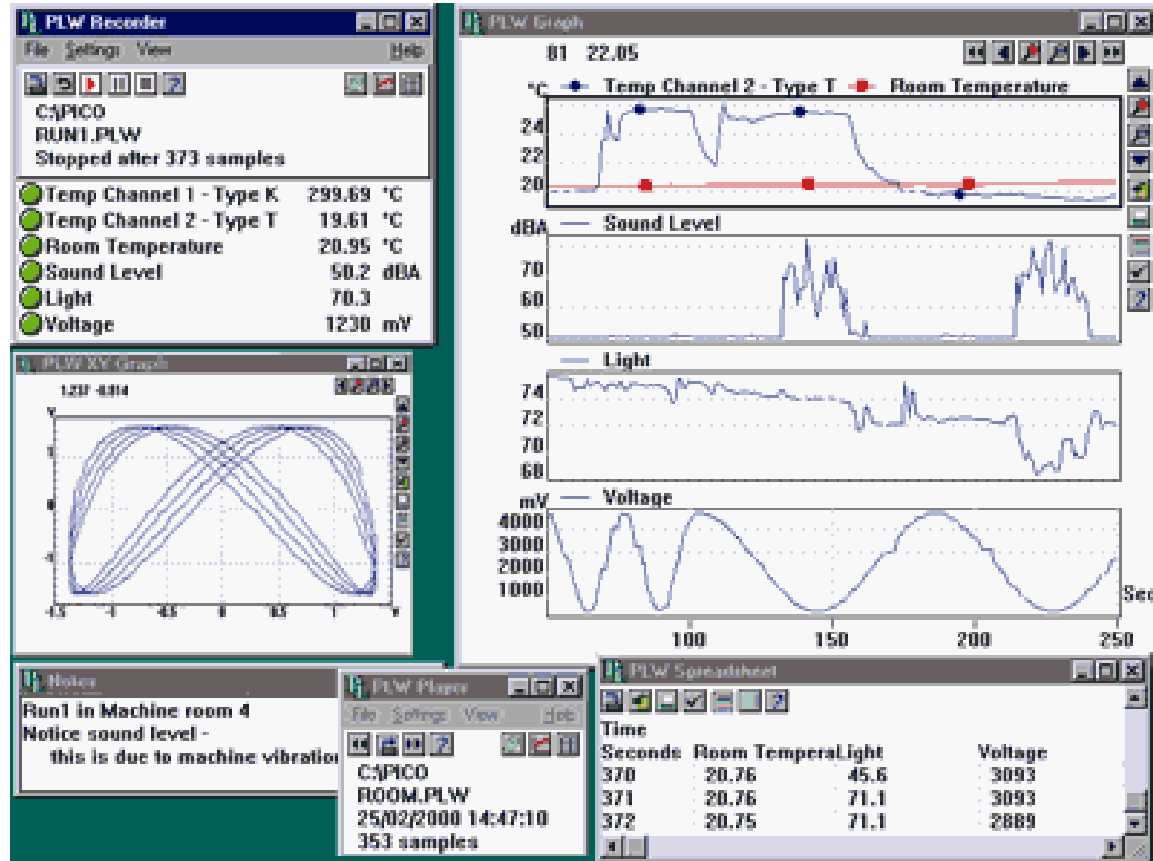
# What are data-loggers and how do they work?

- Chip-based device with a sensor or sensors
- Continuously collect data over extended periods of time
- Small, unobtrusive, no wiring



# Data-logger Output

- Export data directly into spreadsheets
- Graphical formatting of large datasets
- Mark time and synchronize multiple loggers



# How can we use data-loggers?

**Video:** A demonstration of Data-logger

<http://www.onsetcomp.com/evaluating-hot-water-heating-system-efficiency-with-data-loggers>

## Summary of Data-logger uses

- Collect temperature records for same times in different parts of building to show distribution balance
- Record on-hours of lighting and hours occupied
- Identify equipment cycling (motors on/off)

# Practical Project – Part 1A

## Site Plan Sketch & Conditions Mapping

- Sketch a site of your school on 11x17 paper
- Review YELLOW handout in your binders for what to include on the sketch
- Review the Example Sketch
- Review progress of your sketch with your buddy
- Your **School Site Sketch** and the **Survey Form** are due on **Class 5**, same day as your **1<sup>st</sup> test**.

# Project Folders

When you complete each part of your project, you will use the Project Folder to:

- Hand in your projects
- Track the status of your projects
- See the parts which have to be completed

**Project Status Sheet** – The way for us to communicate with you. This will show you the part of your project which need some work. Please review this very closely.

## Guidelines:

- Hand in your original, keep a copy
- Do not write on the Project Status Sheet

# Break

Stretch your legs for 10 minutes.

No smoking on this floor; designated smoking area for the building is 25 feet outside the front door on the first floor.



# Energy Basics

- **What are energy units?**
- **What is an energy index?**
- **What is total energy usage of a building?**
- **How do we sum the total energy usage of a building?**
- **What do we mean by a “benchmark”?**

# Energy Basics

- **What are energy units?**

Each type of energy is measured in units.

- Fuel Oil                      Gallons
- Electricity                    kW-hours
- Natural Gas                  Therms

- **How do we sum the total energy usage of a building?**

- Convert to a common unit: Btu



# Exercise

**A building uses the following amounts of energy:**

Fuel Oil #6	10,000 gallons / month
Electricity	300,000 kw-hr / month

**How many BTU's does it use?**

Fuel Oil #6 – 10,000 gal x 150,000 Btu/gal	= 1,500,000 Btu
Electricity – 300,000 kwh x 3413 Btu / kW-hr	= 1,023,900 Btu
total	= 2,523,900 Btu

# Energy Basics

## What is an energy index?

A ratio of numbers which is an indication of a energy efficiency.

School Sq Ft	Electric Cost /Yr Examples	Electric Cost /Yr Index \$ / Sq Ft
100,000 Sq Ft	\$100,000	\$1.00 / Sq Ft / yr
100,000 Sq Ft	\$150,000	\$1.50 / Sq Ft / yr

Joe has an Electric Cost Index of \$1.00 /sq ft/ yr

Frank has an Electric Cost Index of \$1.50 /sq ft/ yr

# Energy Utilization Index (EUI)



**Mileage - MPG**

**Energy Rating**



**Total Energy / SF / Year**

**Energy Rating**

# Energy Star Portfolio Manager



- National database tool
  - US Environmental Protection Agency (EPA) and US Department of Energy (DOE)
- Free and Web-based
- Enter your energy usage and your facility data
- Computes a ranking against a national sample of similar buildings.

# Comparison of EUI Values for various facility types

<b>TYPE OF BUILDING</b>	<b>Energy Utilization Index (EUI) AVERAGE BTU / Sq Ft / Yr</b>
▪ Retail Stores	75,000
▪ Office / Professional	90,000
▪ Religious Worship	44,000
▪ Restaurant	258,000
▪ School	80,000

# EUI - comparing buildings

Exercise – Compare the EUI of 2 schools

> School #1

Energy Usage: 8,000 Million Btu / sq ft / yr

Square Feet: 100,000 SF

> School #2 –

Energy Usage: 14,000 Million Btu / sq ft / yr

Square Feet: 200,000 SF

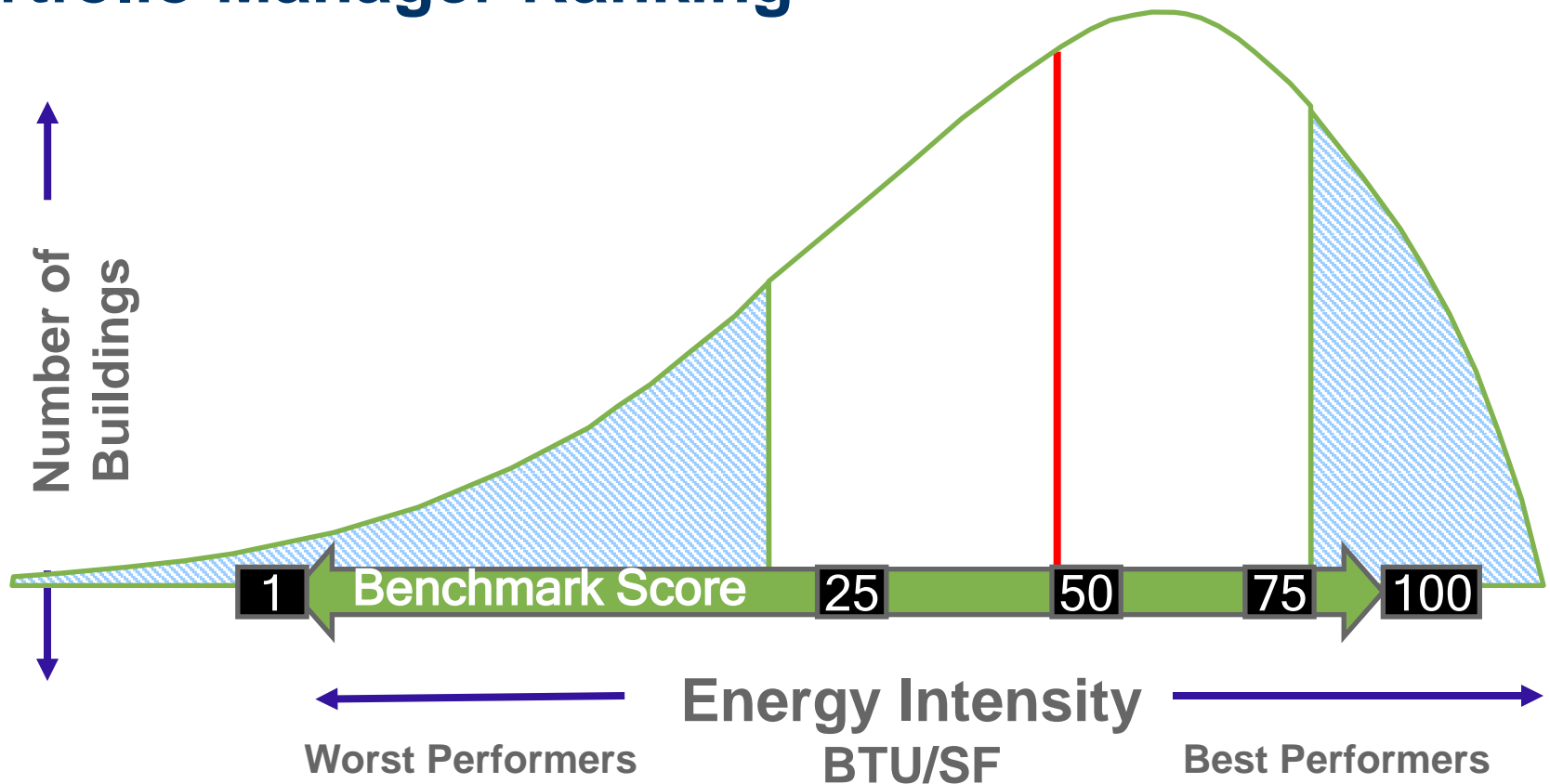
Which one has better energy performance?

# Setting Building Baselines and Benchmarks

## What do we mean by a “benchmark”?

- A measure used for reference and comparison
- Comparison against others
- Comparison against self across time

# Portfolio Manager Ranking



- Ranks based on percentile of similar buildings
- Highest Energy Star score is 100
- 75 means performance is better than 75% of sample of similar buildings. **Energy Star Rated = 75%**



# Energy Star Portfolio Manager Demonstration of Account Login

- Intro/walk-thru of Portfolio Manager (PM)
- How it works, how to use & find data.
- Get your school established in your PM account.
- Learn basic reporting/graphing functions.



# Portfolio Manager Log-in Information

## 1. These are YOUR accounts

Account Username is permanent - associated with school.

## 2. Log in to PM

Open Internet Explorer and type in Portfolio Manager website:

<http://www.energystar.gov/benchmark>

- > Username: benchmark\_M101 ( \_your school ID#)
- > Password: saveenergyM101 ( your school ID#)



# Portfolio Manager Log-in - Step by Step

When you log in, the **M** is always Upper Case.

See: Custodian Name     [Access My Portfolio](#) Click on This

See the table: **Facility Name**

1023467 7 Digit Number Click on This

See the table: **Space Use**

School Click on This     See the Attributes of School

See the table: **Energy Meters**

Click on each Meter

Go Back: Top Left     1023467 7 Digit Number Click on This



# Break

Stretch your legs for 10 minutes.

No smoking on this floor; designated smoking area for the building is 25 feet outside the front door on the first floor.

# Water Efficiency



# Measuring Water Use

**Meters** measure in cubic feet (CF) or  
hundred cubic feet (HCF or CCF)

**Utility bills** are in 100 cubic feet (HCF or CCF)

**1 CF = 7.48 gallons**

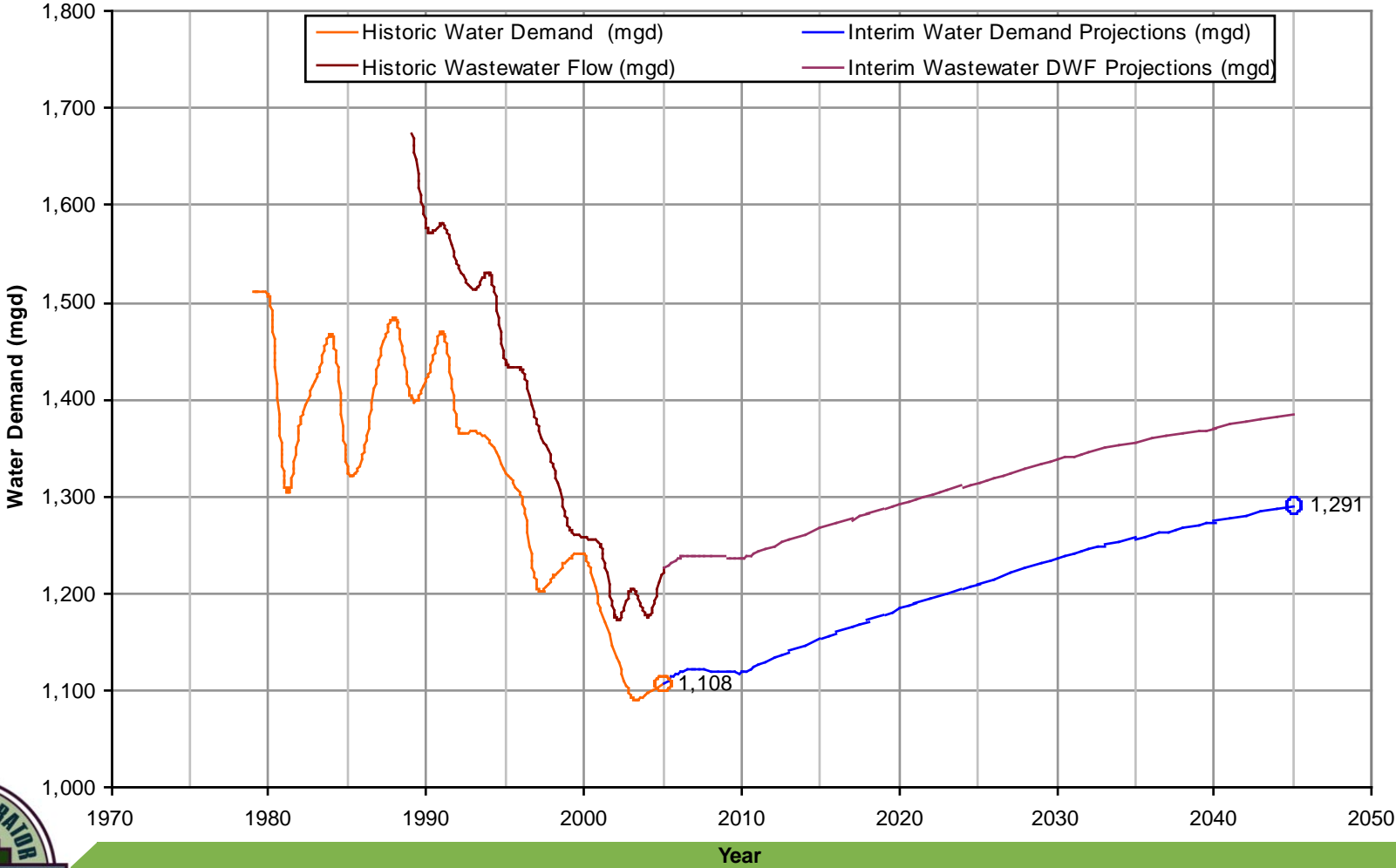
**1 HCF = 748 gallons**

Convert the usage to an index, such as;  
**cubic feet / day / person**

# Reductions of Water Use in NYC

*Significant change is possible!*

Figure 1 2006 DEP Interim In-City Water Demand



# Evolution of Water Use Standards

1970's and before: No standard, toilets at 5-7 gpf

1980's: Informal standard of 3.5 gpf

1990's: some state and local governments pass local requirements for 1.6 gpf, based on European and Japanese models

EPACT 1992 makes 1.6 gpf standard national

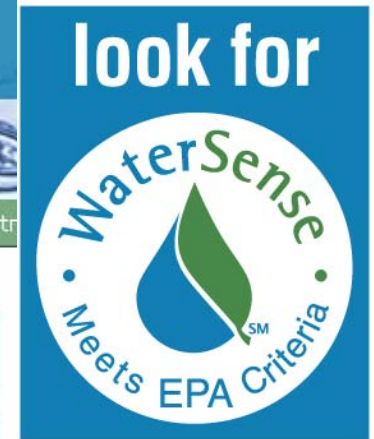
EPA WaterSense Label - fixtures that are 20% more efficient = 1.28 gpf

**GPF** = Gallons per Flush





# Water Efficiency

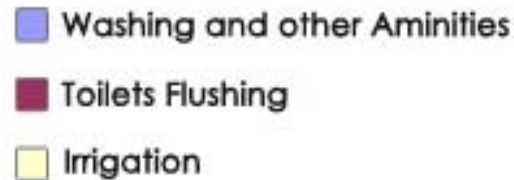
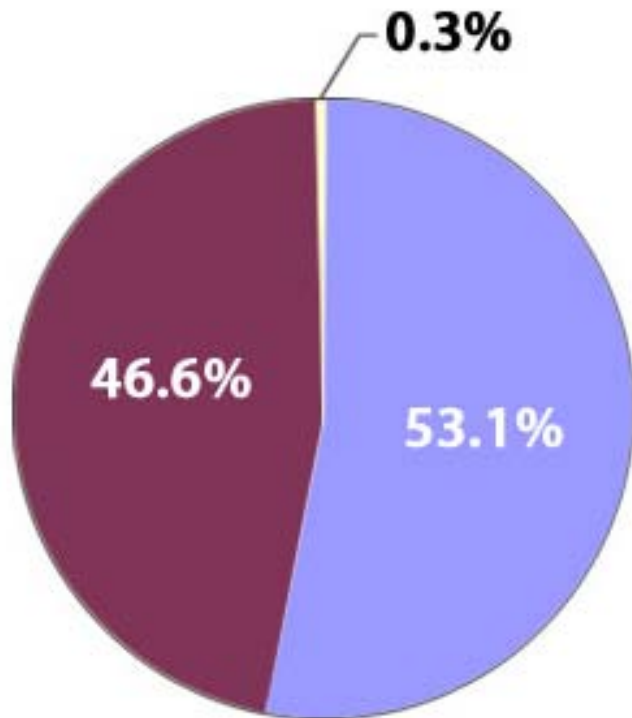


**EPA WaterSense Label** - makes it easy to find and select water efficient product with a label backed by independent testing and certification.

20% more water efficient than average



# How is Water Used in Schools?



Inventory and estimate all uses

- Toilets and hand-washing
- Kitchens
- Cleaning
- Equipment
- Landscape (irrigation)

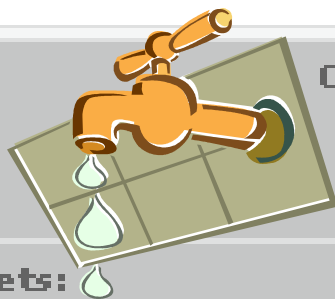
Best targets are where usage is greatest

Source: Ten Percent Challenge <http://tenpercent.sec.org.sg/school.html>

# Major Sources of Water Savings

- **Toilets:** Reduce 1.6 gpf to 1.28 gpf (25%)
- **Urinals:** Reduce 1.0 gpf to 0.5 gpf (50%)
- **Lavatory faucets** with auto shut-off controls.
- **Showerheads** – low flow with pause control.
- **HVAC Equipment (Boilers):** 10% to 40%
- **Cooling tower:** 15% to 55%
- **Leaks!**

# Leaks and Their Costs



Costs:

Per Day

Per Year

Water Charge

Sewer Charge

Total

Water Charge

Sewer Charge

Total

Faucets:

Slow Drip	36 Gallons	\$0.14	\$0.23	\$0.37	\$51.82	\$82.40	\$134.22
Steady Drip	180 Gallons	\$0.17	\$1.13	\$1.84	\$259.11	\$411.99	\$671.10
One Quarter Open	684 Gallons	\$2.70	\$4.29	\$6.99	\$984.62	\$1,565.55	\$2,550.17
One Half Open	1,620 Gallons	\$6.39	\$10.16	\$16.55	\$2,332.00	\$3,707.88	\$6,039.88
Full Open	3,600 Gallons	\$14.20	\$22.57	\$36.77	\$5,182.22	\$8,239.73	\$13,421.95

Toilets:

***What about the leaks that you CAN'T SEE?***

Seeping	30 Gallons	\$0.12	\$0.19	\$0.31	\$43.19	\$68.66	\$111.85
Leaking	250 Gallons	\$0.99	\$1.57	\$2.55	\$359.88	\$572.20	\$932.08
Constantly Running	6,000 Gallons	\$23.66	\$37.62	\$61.29	\$8,637.03	\$13,732.88	\$22,369.91

# Monitor Equipment

## Boilers

- How much blow-down?
- Buried return lines? Use Infra-red to detect under-floor pooling
- Install water meter on make-up water (City Water)
- Test by shutting off automatic water feed and monitoring the water level of the boiler

## Cooling Towers, Outside Irrigation

# Going further with water... the next generation

- Storm-water & Gray-water capture
- Capture in a tank or cistern
- Re-use for flushing and irrigation
- Simple to install for outside irrigation
- For use with indoor plumbing – dedicated piping
- For new construction only – not for retro-fit

# Exercise – Water Usage Calculation

## Objective

- Practice an approach to manage water use in your school

## Activity

- Work in groups of 4 using the exercise sheet provided
- Make sure you complete all calculations on Page 1 & 2
- Debriefed as a whole group at end of activity

## Time

- 35 minutes for whole exercise



# Class Reading Assignments

IUOE, Indoor Air Quality Solutions: Chapter 10

*Recommended:* FEMP Chapters 5 and 6

*Reminder:* Bring your project work into next weeks class for group discussion

... one more message





# Week 4 – We are starting on time

Week Number 4 - We are starting on time

Benefits to get here on time:

- Review key points of the previous class
- Review key points of the reading
- These are key points of the exam
- We start late = We end late