WaterSense®

Water Use and Opportunities in the Commercial and Institutional Sector

Stephanie Tanner
Water Smart Innovations
October 2012

Presentation Overview

- Introduction to WaterSense
- CI Water Use
- WaterSense CI Efforts
- Progress to Date
- Challenges Ahead

What is WaterSense?

- Voluntary partnership and labeling program launched by U.S. EPA in 2006 designed to reduce municipal water use across the country
- Simple way for consumers to identify products that use 20% less water and perform well
- WaterSense aims to increase the adoption of water-efficient products and services by consumers and organizations
- A label with integrity - third-party certified, not only for efficiency, but for performance too

WaterSense Product Evaluation Factors

WaterSense uses the following factors in determining which products to label

Products must:

- Offer equivalent or superior performance
- Be about 20 percent more water-efficient than conventional models
- Realize water savings on a national level
- Provide measurable results
- Achieve water efficiency through several technology options
- Be effectively differentiated by the WaterSense label
- Be independently certified

WaterSense Labeled Products

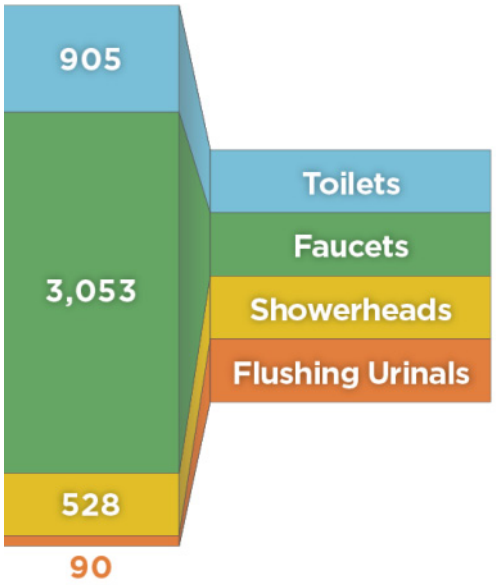
look for WaterSense Meets EPA Criteria

Flushing Urinals

Lavatory Faucets

Irrigation Controllers

2011
4,576
TOTAL LABELED MODELS



New Homes

Tank-Type Toilets

Showerheads

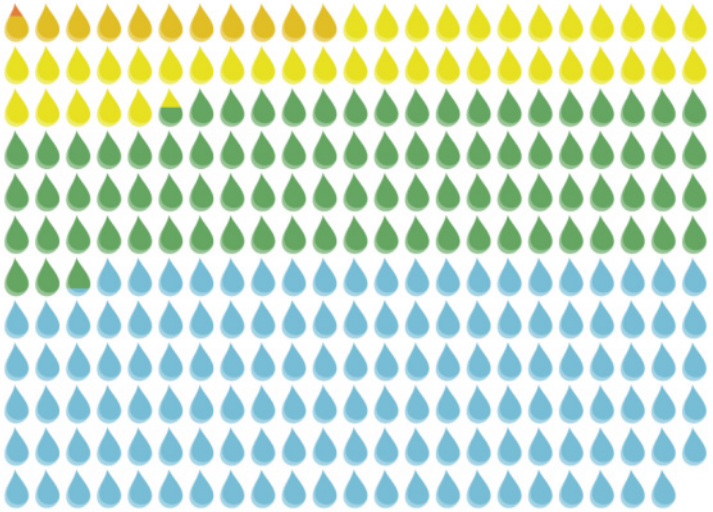
ENERGY STAR

Water factors are also included in many ENERGY STAR qualified products

Savings add up!
2006-2011 Results

look for WaterSense Meets EPA Criteria

287 billion **gallons of water** saved since 2006!

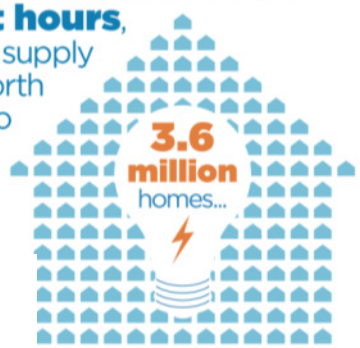


143 billion gallons saved in 2011

That's enough water to supply all the homes in **Georgia** or **Arizona** **for a year!**

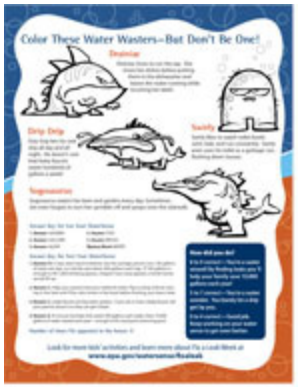
WaterSense has helped **reduce** the amount of **energy needed** to heat, pump, and treat water by

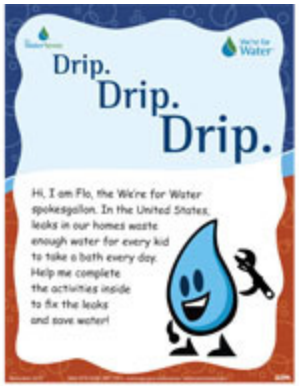
38.4 billion **kilowatt hours**, enough to supply a year's worth of power to more than

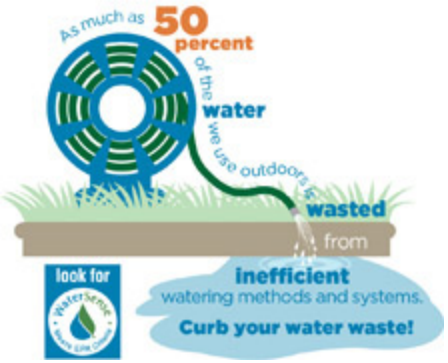


...and **saving consumers** **$4.7 billion** in water and energy bills

More than 2,600 WaterSense partners
EPA tools to help them



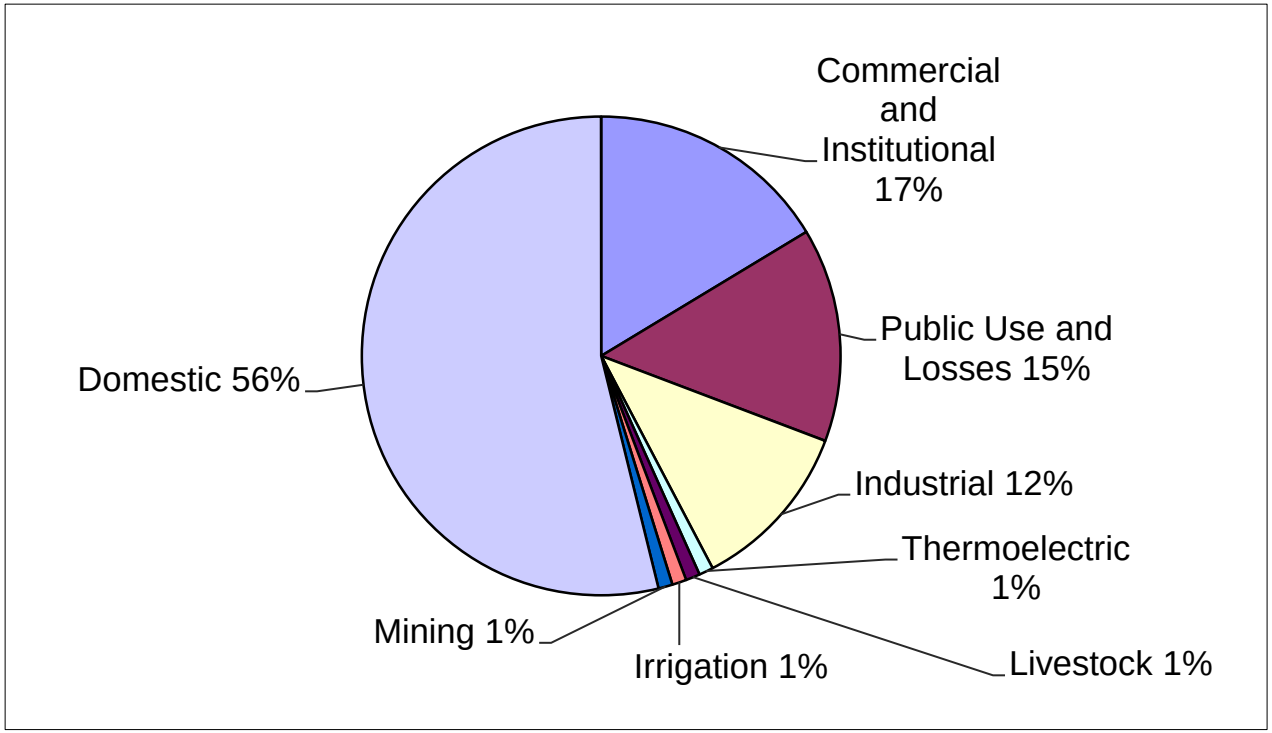




WATER USE IN THE CI SECTOR

Water Use by the C&I Sector

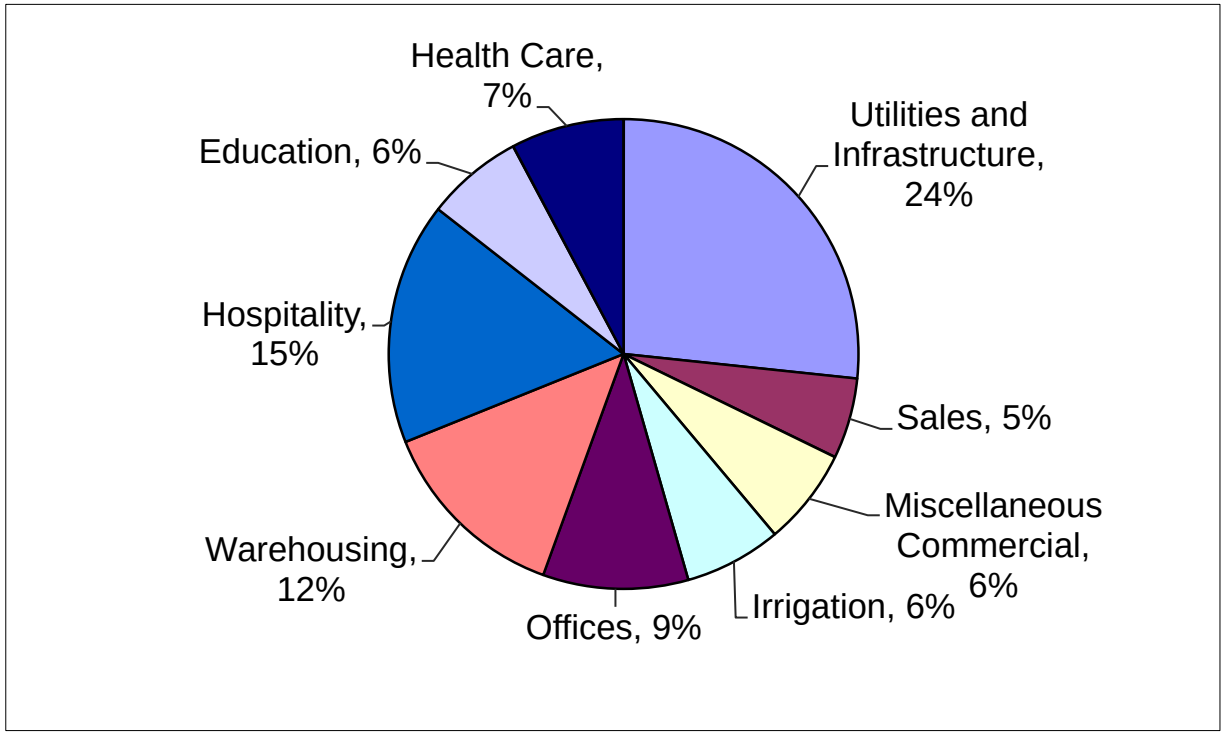
- The C&I sector accounts for approximately 17% of the US public water supply withdrawals



*Source: Modified from *USGS Estimated Use of Water in the United States in 1995*

Water Use by C&I Subsectors

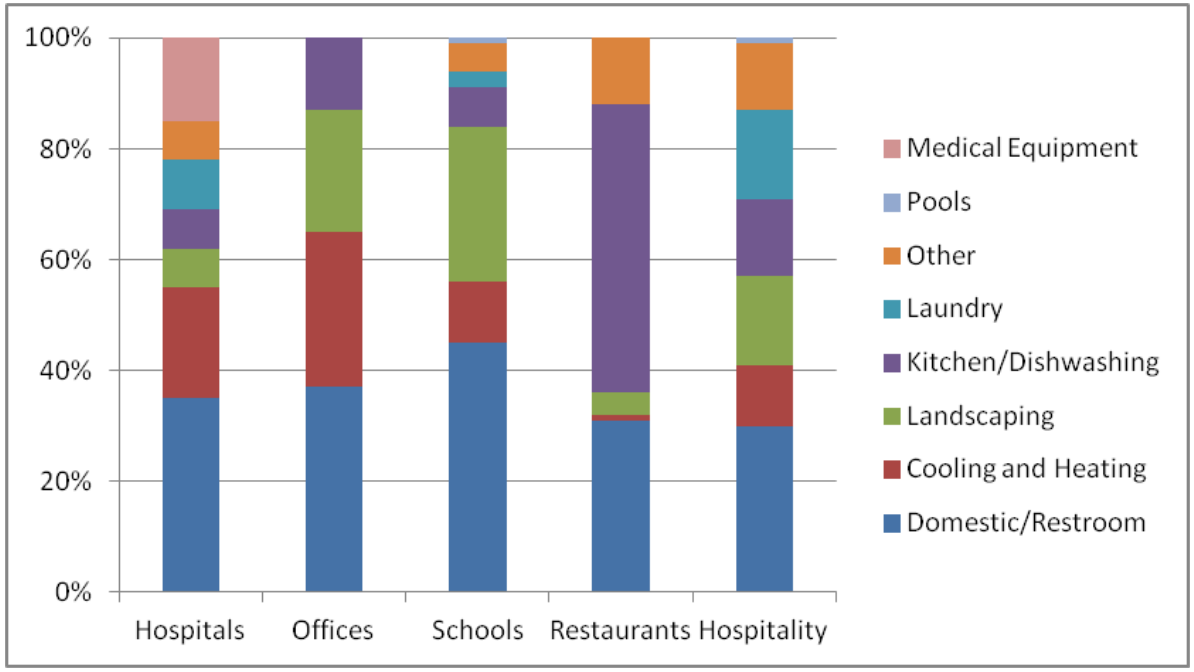
- Utilities and infrastructure, hospitality, and warehousing are the largest C&I subsector water users



*Source: AWWA Research Foundation's *Commercial and Institutional End Uses of Water*

Water Use Within C&I Subsectors

- Domestic/restroom, cooling and heating, and landscaping are typically largest uses of water across C&I subsectors



*Created from New Mexico Office of the State Engineer's *Water Conservation Guide for Commercial, Institutional, and Industrial Water Users;* AWWA Research Foundation's *Commercial and Institutional End Uses of Water; East Bay* Municipal Utility District's *WaterSmart Guidebook: A Water Use Efficiency Plan Review Guide for New Businesses;* AWWA's *Helping Businesses Manage Water Use, A Guide for Water Utilities.*

Limitations of Existing C&I Water Use Data

- Though we have data on C&I water use, it is not adequate for benchmarking
  - Non uniform classification of C&I subsectors
  - Not discrete enough to support normalization and direct comparison of facilities with similar operating characteristics
    - May not separate out indoor and outdoor water use
    - Specific facility sizes unknown
  - Do not have access to recent data (latest source of quality data on C&I subsector water use is from 2003)
  - Data is based upon a small sample size

WATERSENSE CI EFFORTS

2009 WaterSense CI Meeting

- In 2009 EPA released a white paper *Water Efficiency in the Commercial and Institutional Sector: Considerations for a WaterSense Program*
  - Summarized current state of water use knowledge in the CI sector
  - Outlined the possibility and options for expanding WaterSense to commercial and institutional sectors

- Held two stakeholder meetings and accepted written comments

2009 WaterSense CI Meeting

- Primary stakeholder recommendations on C&I options and opportunities included:
  - Target specific subsectors based on water consumption and stakeholder interest
  - Remain focused on product labeling and align product specifications with a subsector based approach
  - Support development of building certification and labeling program (or work to improve existing programs)
  - Issue best management practices for water uses applicable to multiple sectors
  - Label certification programs for professionals in the C&I sector including water auditors, facility managers, plumbers
  - Create a national repository for C&I water use and benchmarking data
  - Create an awards program to recognize early adopters

Since 2009

- Since 2009 WaterSense has been working to address several of the recommendations, including:
  - Developing specifications for products used in the C&I sector
  - Compiling comprehensive water-efficiency best management practices
  - Working with ENERGY STAR to support tracking of C&I water use and develop benchmarks
  - Working with ENERGY STAR to initiate an awards/challenge program for C&I buildings that save the most water

Water use efficiency – reducing water footprint requires action in every part of an organization

look for WaterSense Meets EPA Criteria

Set goals, prioritize actions, and provide resources to measure, manage and track water use

Corporate-level

Facility-level

Assess operations and implement efficiency measures

Products/Supply Chain

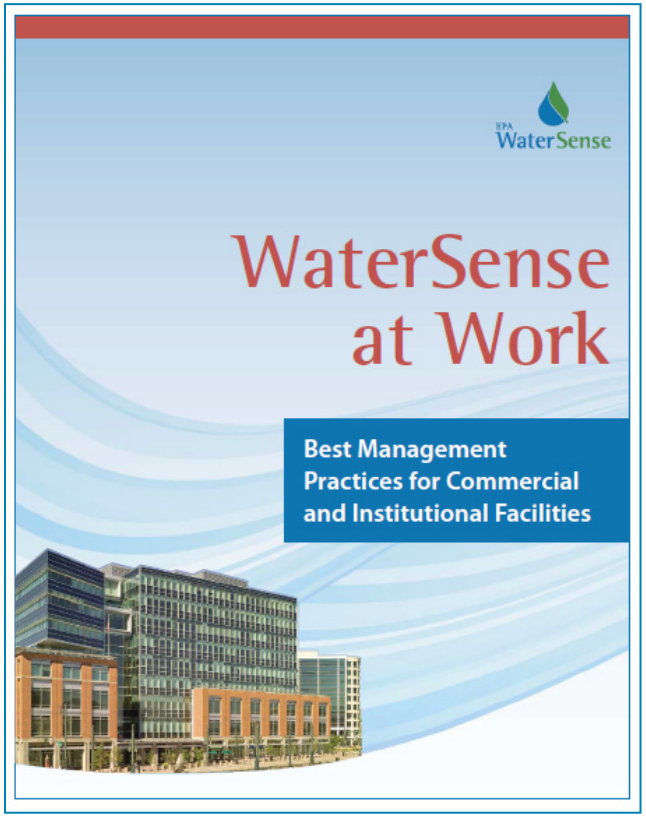
When purchasing, consider product choices – explicit and embedded water use

Staff

Build awareness & promote behavior change to use water efficiently – internal and customer messaging

Water Efficiency Best Management Practices

Coming November 2012



- Water management planning
- Water use monitoring and education
- Sanitary fixtures and equipment
- Commercial kitchen equipment
- Outdoor water use
- Mechanical systems
- Laboratory and medical equipment
- Onsite alternative sources of water

http://www.epa.gov/watersense/commercial

Water Efficiency Best Management Practices

- BMPs designed to help C&I facility owners and managers understand and better manage their water use
- Each of 36 BMPs provide:
  - An overview of the technology
  - Operation, maintenance, and user education tips
  - Retrofit and replacement options
  - Information to help facilities calculate savings and payback
- 7 case studies outline success stories in major BMP areas

6.3 Cooling Towers

EPA WaterSense

Overview

Cooling towers are used in a variety of commercial and institutional applications to remove excess heat. They serve facilities of all sizes, such as office buildings, schools, supermarkets, and large facilities, such as hospitals, office complexes, and university campuses. Cooling towers dissipate heat from recirculating water that is used to cool chillers, air conditioning equipment, or other process equipment. By design, they use significant amounts of water.

Cooling towers often represent the largest use of water in industrial and commercial applications, comprising 20 to 50 percent or more of a facility's total water use. However, facilities can save significant amounts of water by optimizing the operation and maintenance of cooling tower systems.[4]

Cooling towers

Cooling towers work by circulating a stream of water through systems that generate heat as they function. To cool the system, heat is transferred from the system to the water stream. This warm water is then pumped to the top of the cooling tower, where it is sprayed or dripped through internal fill (i.e., a labyrinth-like packing with a large surface area). Fans pull or push air through the tower in a counterflow, crossflow, or parallel flow to the falling water. As some of the water is evaporated, the heat is removed.[5] The remaining cooled water is recirculated back through the systems to repeat the process.

The thermal efficiency and longevity of the cooling tower and its associated water loops depend upon the proper management of water recirculated through the tower. Water leaves a cooling tower system in four ways: evaporation, blowdown or bleed-off, drift, and leaks or overflows.

Evaporation

Evaporation is the primary function of the tower and is the method that transfers heat from the cooling tower system to the environment. The quantity of evaporation is not typically targeted for water-efficiency efforts, because it controls the cooling process (although improving the energy efficiency of the systems that use the cooling water will reduce the evaporative load on the tower). The rate of evaporation from a cooling tower is typically equal to approximately 1 percent of the rate of

[4] North Carolina Department of Environment and Natural Resources, et al. May 2009. *Water Efficiency Manual for Commercial, Industrial and Institutional Facilities*. Page 39. savewatersmc.org/fourhome.php.
[5] Ibid.

6-8 *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities*

Collaboration with ENERGY STAR

- WaterSense is working with ENERGY STAR to improve Portfolio Manager's water use data tracking
  - Portfolio Manager could serve as a national platform for building energy and water use tracking and management

- WaterSense is working with ENERGY STAR to align the building water use data collected between ENERGY STAR and EIA to support future benchmarking opportunities
  - EIA water consumption survey will provide the data against which building water use reported in Portfolio Manager can be benchmarked

Collaboration with ENERGY STAR

- WaterSense working with ENERGY STAR on cross promotion of programs
  - Example: WaterSense will label PRSVs, ENERGY STAR will promote them to commercial kitchen managers

- ENERGY STAR added water as a factor for recognition in its National Building Competition Battle of the Buildings
  - First time ENERGY STAR highlighted and encouraged facilities to track energy AND water use
  - Tracks energy and water use in Portfolio Manager from January 1 – December 31, 2012
  - Winners announced April 2013

BENCHMARKING AND CHALLENGES

C&I Water Use & Benchmarking

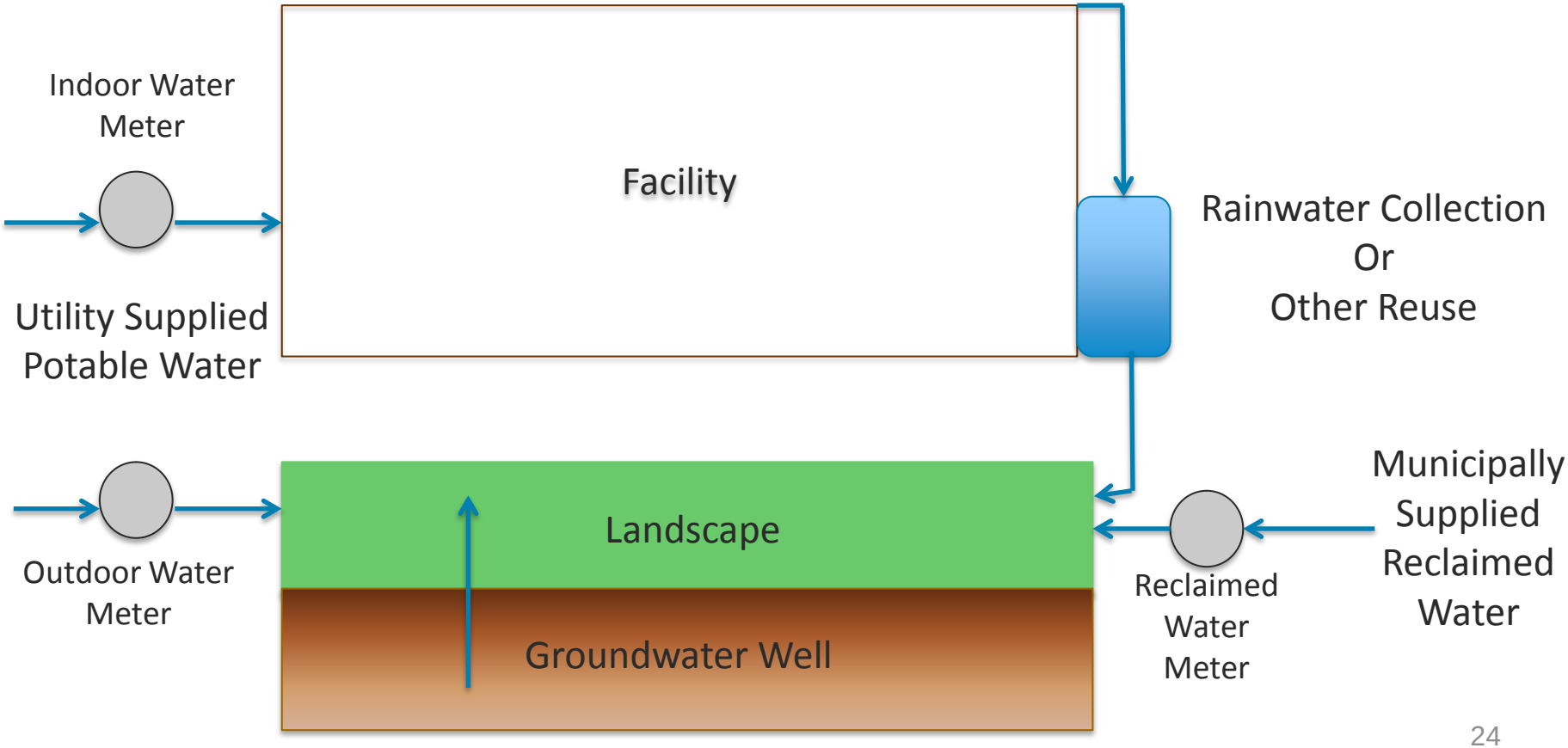
- Water use data is not as mature as energy use data and groups are still evaluating ways to accurately track and benchmark building water use

- In 2007 the Energy Information Administration (EIA) began collecting building water use information as part of its commercial building energy consumption survey (CBECS), which is conducted every 5 years

- ENERGY STAR now tracks commercial building water use information through Portfolio Manager

Challenges for Benchmarking Water Use

- Tracking sources not just metered supplies/end uses



Challenges for Benchmarking Water Use

- For accurate benchmarking, need to be able to compare a facility to facilities with similar water use features/building operating characteristics
  - Gross tonnage of the cooling tower
  - Separate out outdoor water use
  - Operation of a commercial kitchen
  - Operation of an on-premise laundry
  - Operation of a pool or spa

Challenges for Benchmarking Water Use

- Accurately tracking water costs (water bills are confusing!)
  - Utilities typically meter incoming water use and charge for the corresponding amount of wastewater discharged
    - Sometimes not all water is not sent to the sewer (i.e., irrigation water or cooling tower evaporation) and utilities may offer a credit
  - Water bills usually include other charges besides water and wastewater (fire, storm water, etc)
  - There may be more than one water meter to account for
- An accurate understanding of water and wastewater costs is necessary to support cost effectiveness analysis from water reduction opportunities

CBECS

Commercial Building Energy Consumption Survey

- EIA conducts the Commercial Building Energy Consumption Survey every 5 years
- In 2007 they began collecting building water use data
  - 56% of all responding sampled buildings were able to report water consumption or expenditures or both
  - Reporting success varied by building type, with inpatient healthcare buildings reporting at the highest rate, 69%
- The 2012 survey will incorporate improvements based on lessons learned from 2007
  - Data collection will begin in early 2013, with results published in 2014

Commercial Building Energy Consumption Survey

- Data collected from 2007 survey:
  - Total volume of domestic water used (consumption) in 2007
  - Cost of water (expenditures)
  - Whether the volume was metered or estimated
  - How much of the water was used outside the building
  - If the building used central chillers, what volume of water was used for cooling towers
  - Whether the sewer flow was metered
  - Whether the facility had sterilizers or autoclaves
  - Whether the building had a landscape irrigation system
  - The number of commercial ice makers present
  - Heard of WaterSense

Commercial Building Energy Consumption Survey

- Changes in 2012 survey
  - Clarifies that total water use should be for all sources combined and not just related to domestic water use (metered)
  - Identifies whether sewer flow is separately metered
  - Clarifies that outdoor water use is for a landscape irrigation system
    - Asks if this water use was metered separately
  - Clarifies reporting of cooling tower water use
  - Does not ask the respondent to provide water expenditure data, only asks for a copy of the water bill

Commercial Building Energy Consumption Survey

- WaterSense is working with ENERGY STAR and EIA to align CBECS and Portfolio Manager to support future benchmarking opportunities
  - Track water use by source rather than metered supplies
  - Collect similar building operational characteristics to facilitate categorization of like facilities

EPA ENERGY STAR®

Background and Strategy

Cindy Jacobs

U.S. Environmental Protection Agency

2012

EPA

Learn more at **energystar.gov**

Introduction to ENERGY STAR

- A voluntary, energy efficiency program administered by the US EPA
- ENERGY STAR for products, homes, buildings & industrial plants
- 80% of Americans recognize the ENERGY STAR

20 years of partnership, promise, and progress

Opportunities in Buildings

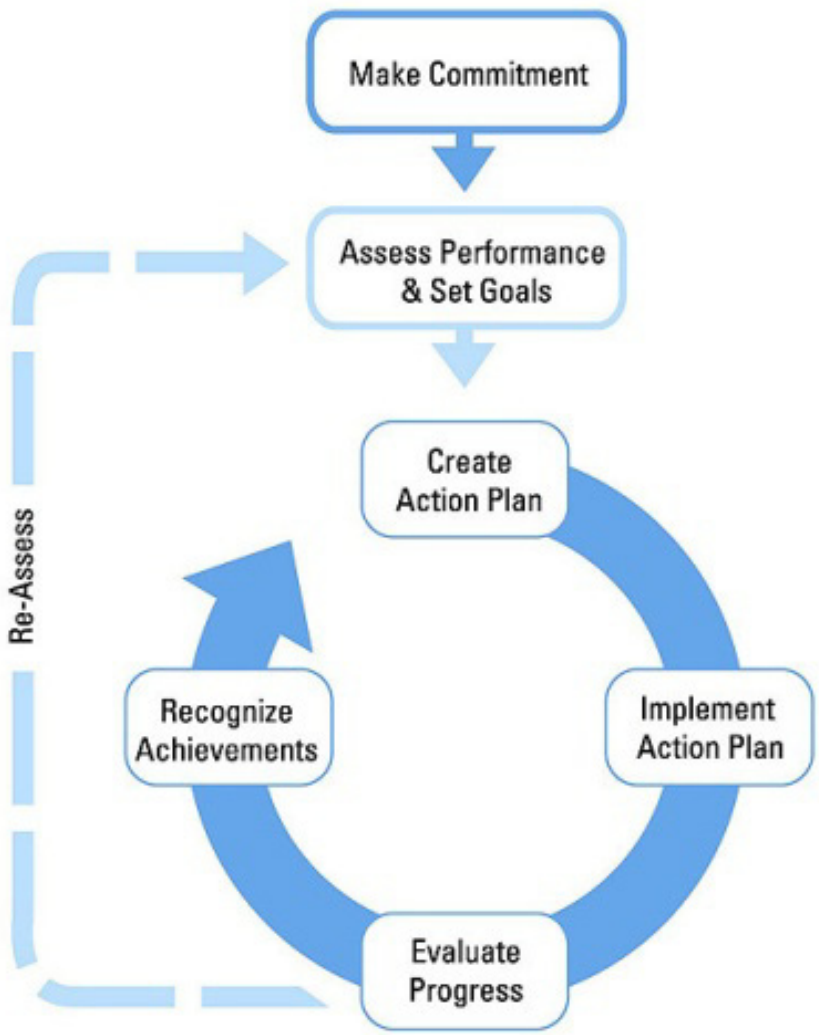
- Commercial buildings in the US are responsible for nearly **20 percent** of both the nation's energy use and greenhouse gas emissions.
- **30 percent** of energy consumed in commercial buildings is wasted.
- Reductions of **10 percent** in energy use can be possible with little or no cost.

ENERGY STAR Commercial Buildings Program

- Offers a strategic approach to energy management
- Enables building owners, managers, and tenants to save money & protect the environment
- Provides organizations with measurable information on energy savings and greenhouse gas emissions reductions from commercial buildings
- ENERGY STAR on a building = Superior Energy Performance

Strategic Approach to Energy Management

- Assess Energy Performance
- Set Goals
- Implement Projects
- Document Savings
- Recognize Achievements
- Earn recognition



ENERGY STAR® Portfolio Manager™

CELEBRATING 20 YEARS OF ENERGY STAR

- Management Tool – Helps business and organizations by offering a platform to:
  - Assess whole building energy and water consumption
  - Track changes in energy, water, greenhouse gas emissions, and cost over time
  - Track green power purchase
  - Share/report data with others
  - Create custom reports
  - Apply for ENERGY STAR certification

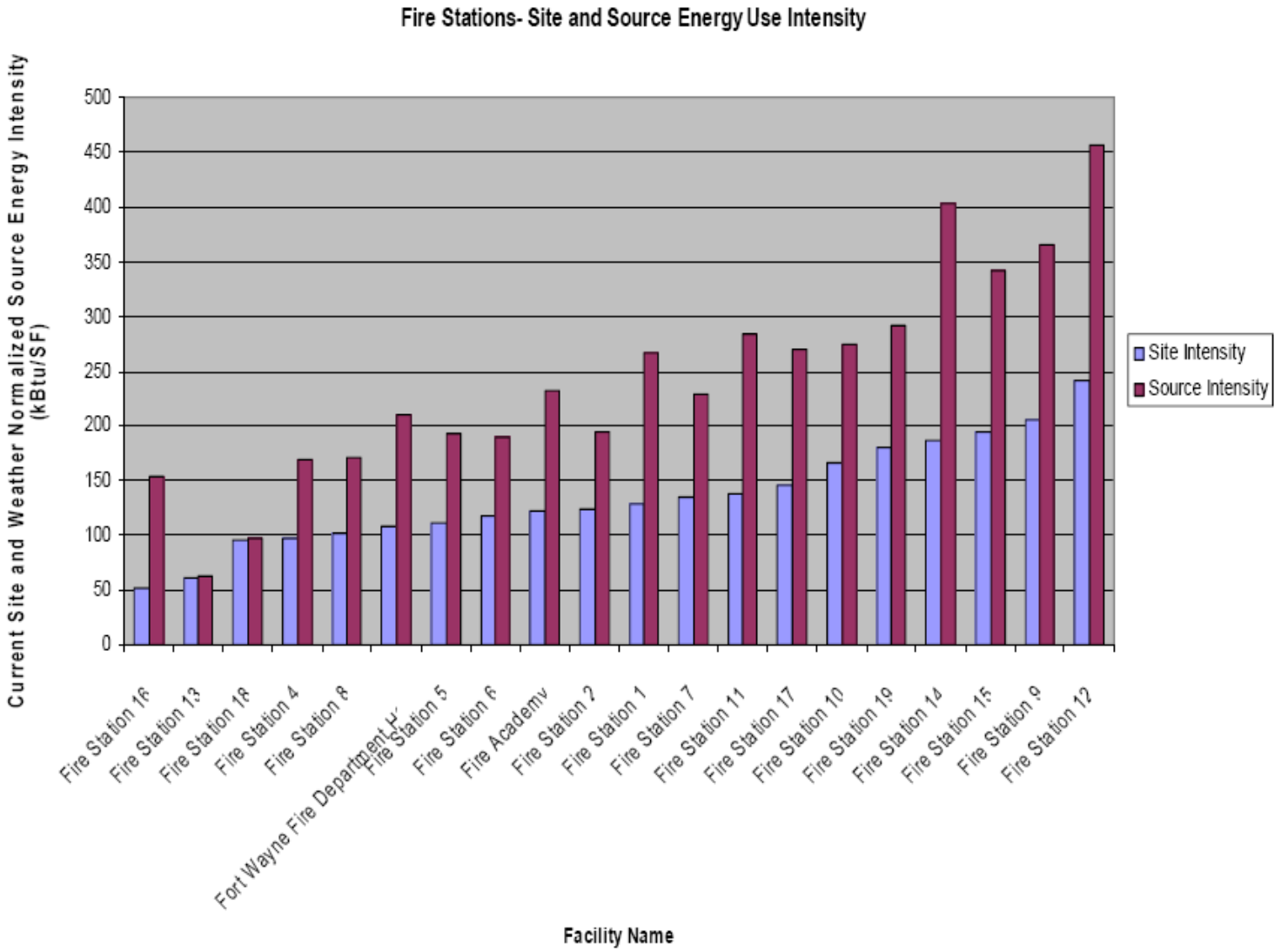
- Metrics Calculator – Provides key performance metrics to integrate into a strategic management plan
  - Energy consumption (source, site, weather normalized)
  - Water consumption (indoor, outdoor)
  - Greenhouse gas emissions (indirect, direct, total, avoided)
  - ENERGY STAR 1-to-100 score (available for 15 building types)

→ ***Accessible in a free, online platform: www.energystar.gov/benchmark***

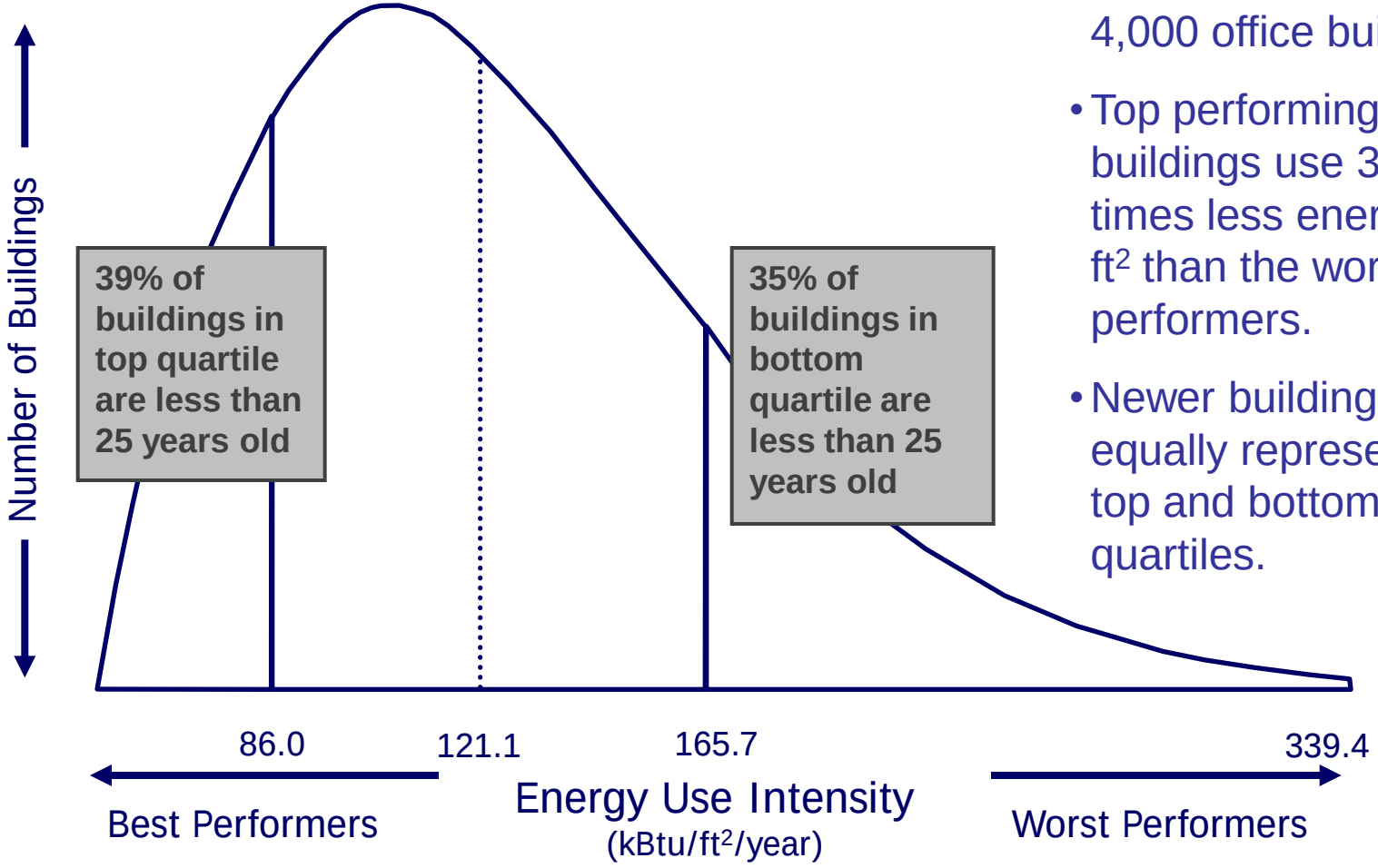
Why Use Portfolio Manager? Understand Comparative Performance

- ALL buildings can be benchmarked
- Benchmarking through Portfolio Manager enables you to:
  - Compare one building against a national sample of similar buildings
  - Compare all of your buildings of a similar type to each other
  - Set priorities and targets for the use of limited staff time and/or investment capital

Fort Wayne - 20 Similar Buildings with Different Energy Use



New Doesn't Always Equal Efficient



- Based on survey of 4,000 office buildings.
- Top performing buildings use 3 to 4 times less energy per ft^2 than the worst performers.
- Newer buildings are equally represented in top and bottom quartiles.

Factors that contribute to energy consumption: Age

Figure 22: Scatter Plot of Multifamily Building EUI Versus Age

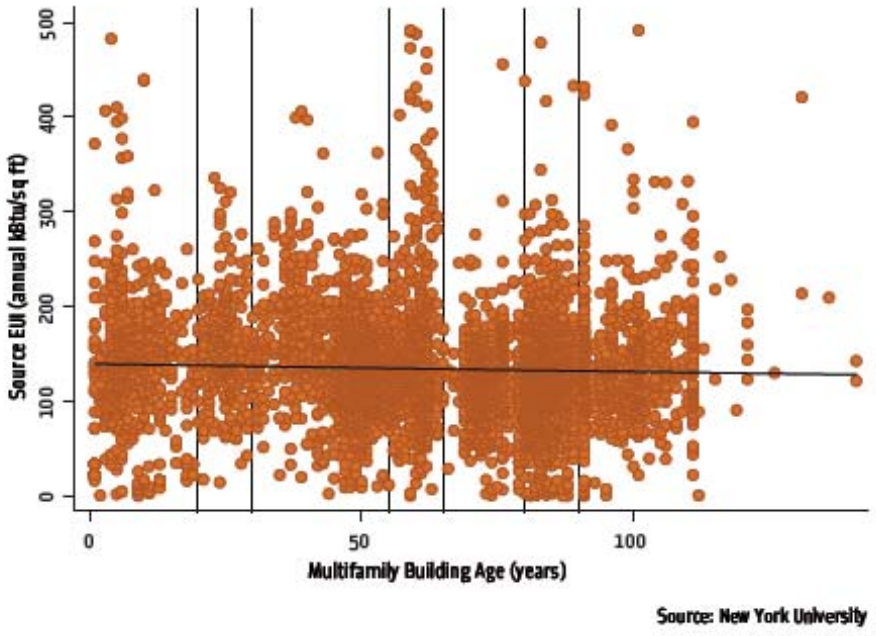
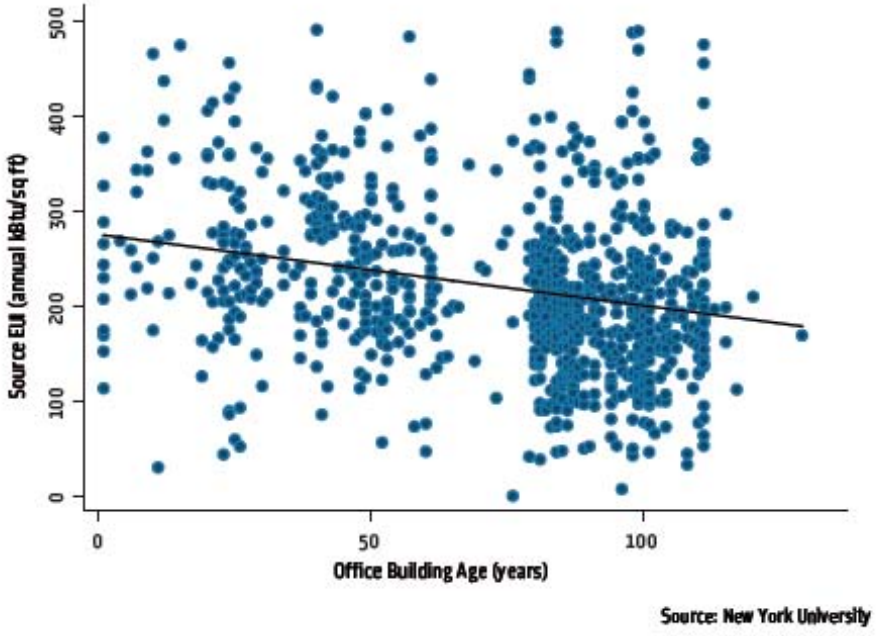
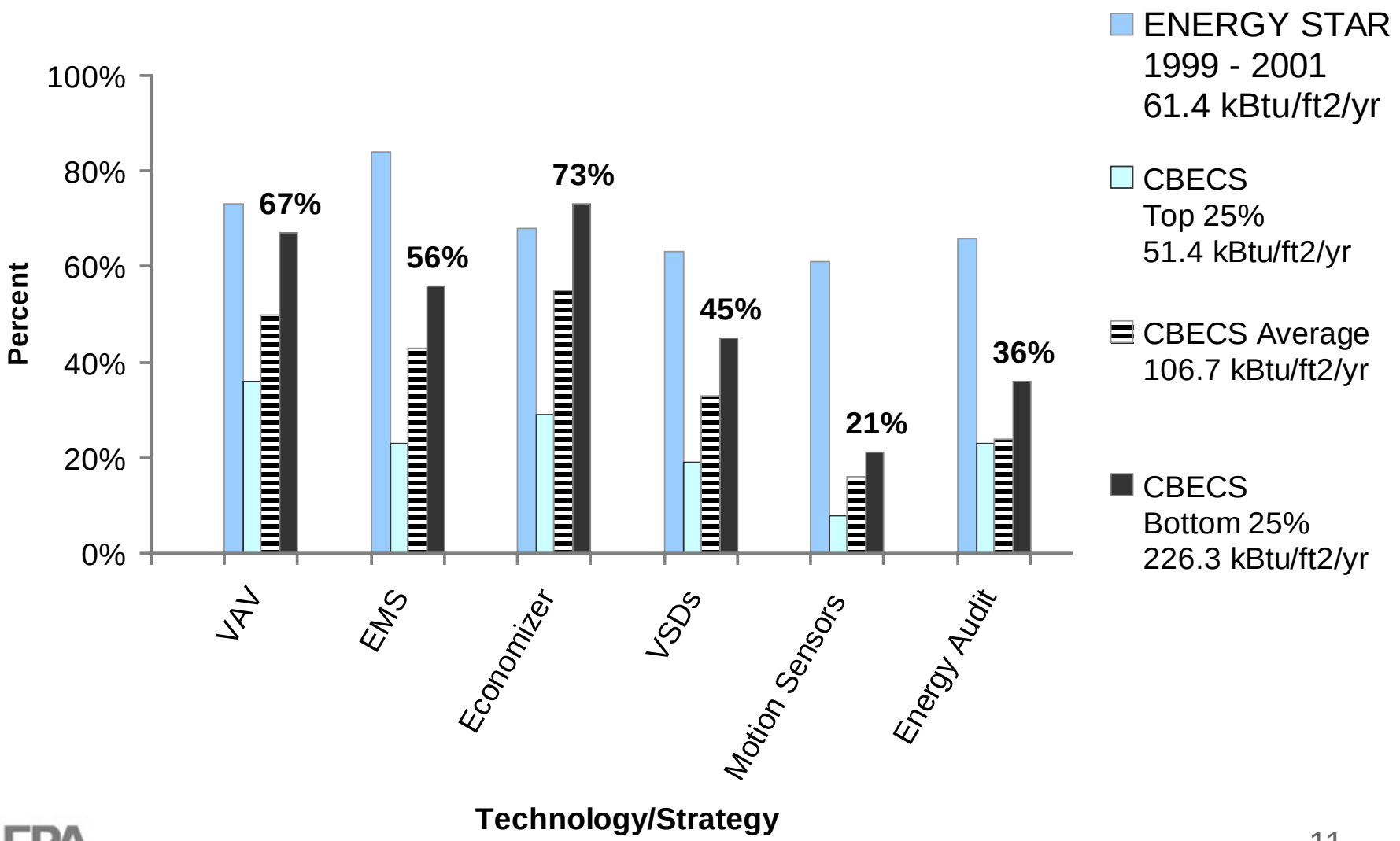


Figure 23: Scatter Plot of Office Building EUI Versus Age



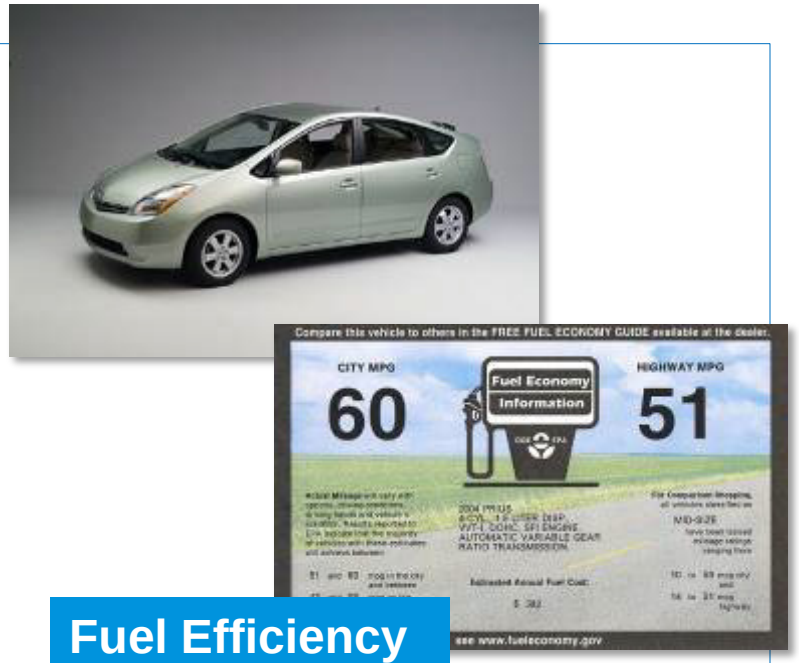
Source: NYC presentation at GreenGov Symposium

Presence of Technology Does Not Save Energy



Note: CBECS = U.S. Department of Energy's Commercial Building Energy Consumption Survey

ENERGY STAR Score Put Performance Into Context



Fuel Efficiency

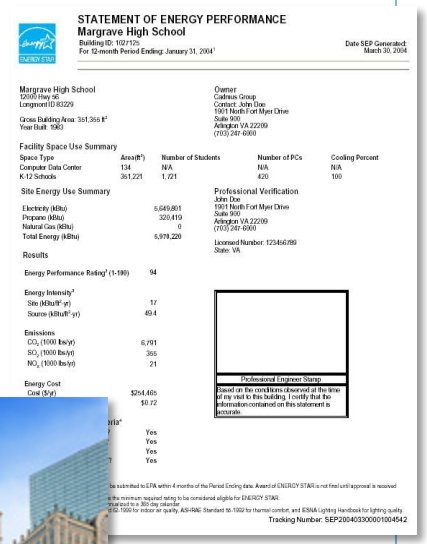
MPG

Is 60 MPG high or low for an automobile?

Is 80 kBtu/SF/YR high or low for a building?

Statement of Energy Performance

ENERGY STAR Score


STATEMENT OF ENERGY PERFORMANCE
Margrave High School
Building ID: 102712s
For 12-month Period Ending: January 31, 2004[1]
Date SEP Generated: March 30, 2004
Margrave High School
12005 Hwy 98
Longwood ID 83229
Gross Building Area: 361,366 ft²
Year Built: 1963
Owner
Cadmus Group
Contact: John Doe
1901 North Fort Myer Drive
Suite 900
Arlington VA 22209
(703) 247-6000
Facility Space Use Summary
Space Type | Area(ft²) | Number of Students | Number of PCs | Cooling Percent
Computer Data Center | 134 | N/A | N/A | N/A
K-12 Schools | 361,221 | 1,721 | 420 | 100
Site Energy Use Summary
Electricity (kWh) 5,649,801
Propane (kBtu) 320,419
Natural Gas (kBtu) 0
Total Energy (kBtu) 5,979,220
Professional Verification
John Doe
1901 North Fort Myer Drive
Suite 900
Arlington VA 22209
(703) 247-6000
License Number: 123456789
State: VA
Results
Energy Performance Rating[1] (1-100) 94
Energy Intensity[2]
Site (kBtu/ft²·yr) 17
Source (kBtu/ft²·yr) 49.4
Emissions
CO_2 (1000 lbs/yr) 6,701
SO_2 (1000 lbs/yr) 365
NO_x (1000 lbs/yr) 21
Energy Cost
Cost ($/yr) $254,465
$0.72
Professional Engineer Stamp
Based on the conditions observed at the time of my visit to this building, I certify that the information contained on this statement is accurate.
Yes
Yes
Yes
Yes
Tracking Number: SEP20040330000100454

ENERGY STAR Score

- 1-to-100 scale identifies how a building is performing relative to similar buildings nationwide
- Scoring models derived from a statistically representative sample of the national building population
- Accounts for climate and business activity specific to each building type – size, number of employees, weekly operating hours
- Score based on *actual* billed energy consumption *not* estimates or simulations

Eligible to Receive an ENERGY STAR Score

Bank/Financial Institutions

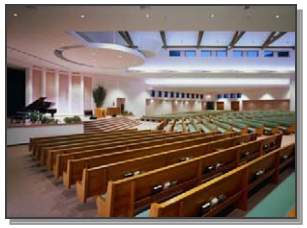
Courthouses

Data Centers

Dormitories

Hospitals

Hotels



Houses of Worship

K-12 Schools

Medical Offices

Office Buildings

Retail Stores

Senior Care Communities

Supermarkets

Warehouses

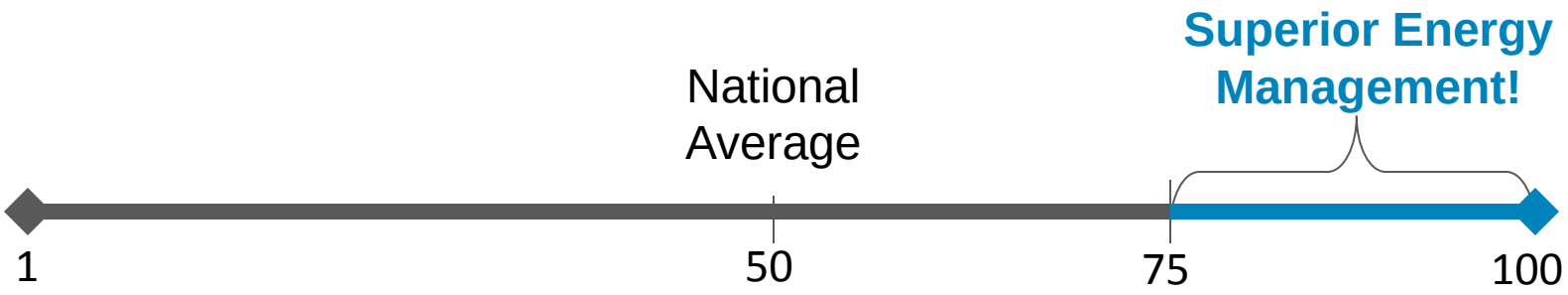
Wastewater Treatment Plants*

*Wastewater Treatment Plants are not eligible for ENERGY STAR certification.

Earn the ENERGY STAR

- Recognition for superior energy performers – score 75 or above – provided the they meets industry standards for indoor environmental quality

1 to 100 Energy Performance Scale



Apply for the ENERGY STAR

Energy Performance Score 75 to 100

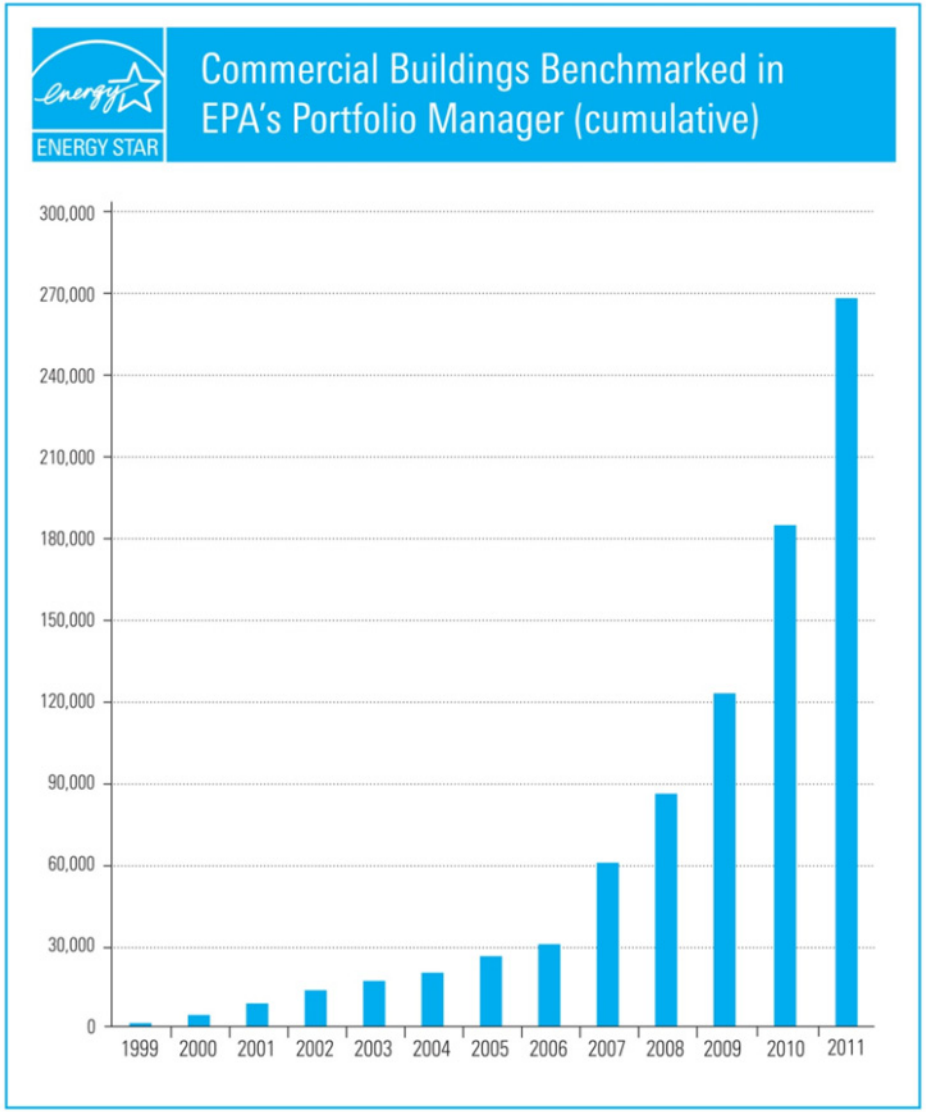
Obtain Professional Verification

Submit SEP & Application

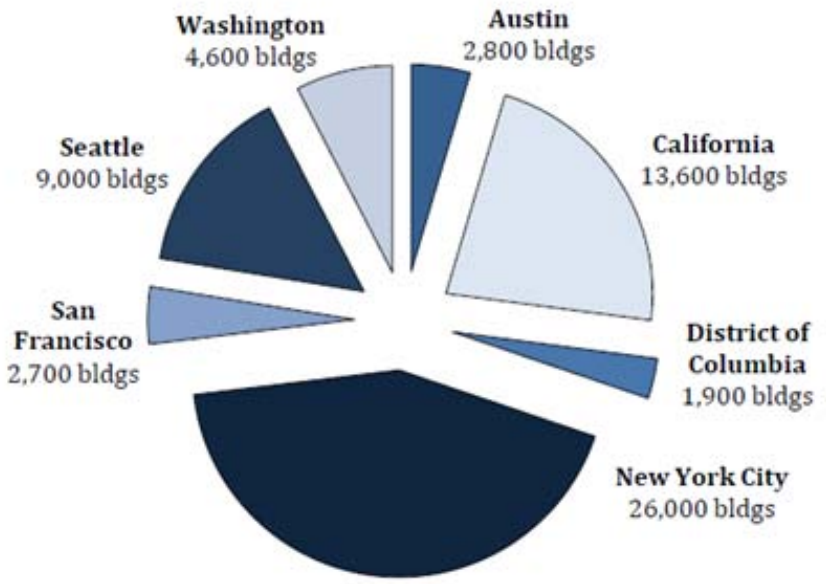
Certified Building Label

Create and Submit Building Profile

Tremendous Growth in Benchmarking in Portfolio Manager



Mandatory Benchmarking and Disclosure Policies Moving into Implementation



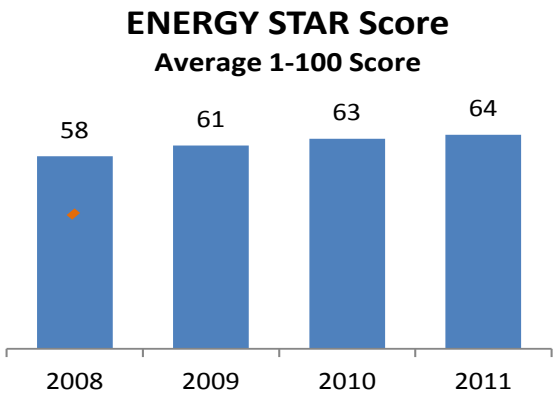
Policy Impact Projection on Number of Buildings by Jurisdiction. Graphic credit: Institute for Market Transformation

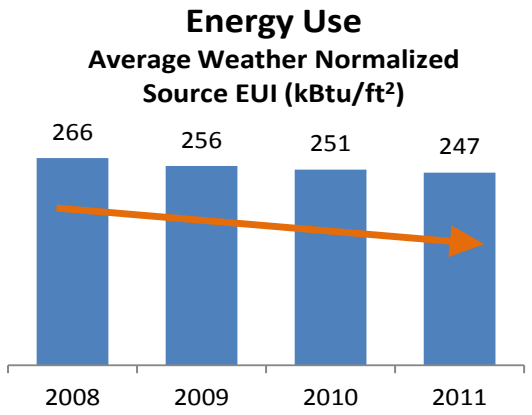
Philadelphia recently adopted policy

- **Eight U.S. jurisdictions have enacted policies**
  - Affect 60,000+ buildings, ~4 billion SF
  - All policies began phasing in 2011- 2012
  - NYC, DC, and Philadelphia include water
- **Continued interest from states and cities**
  - Driven by interest in existing buildings
  - Market transparency attractive to both parties
  - Policymakers want the data
  - More in pipeline: CT and VT have introduced legislation

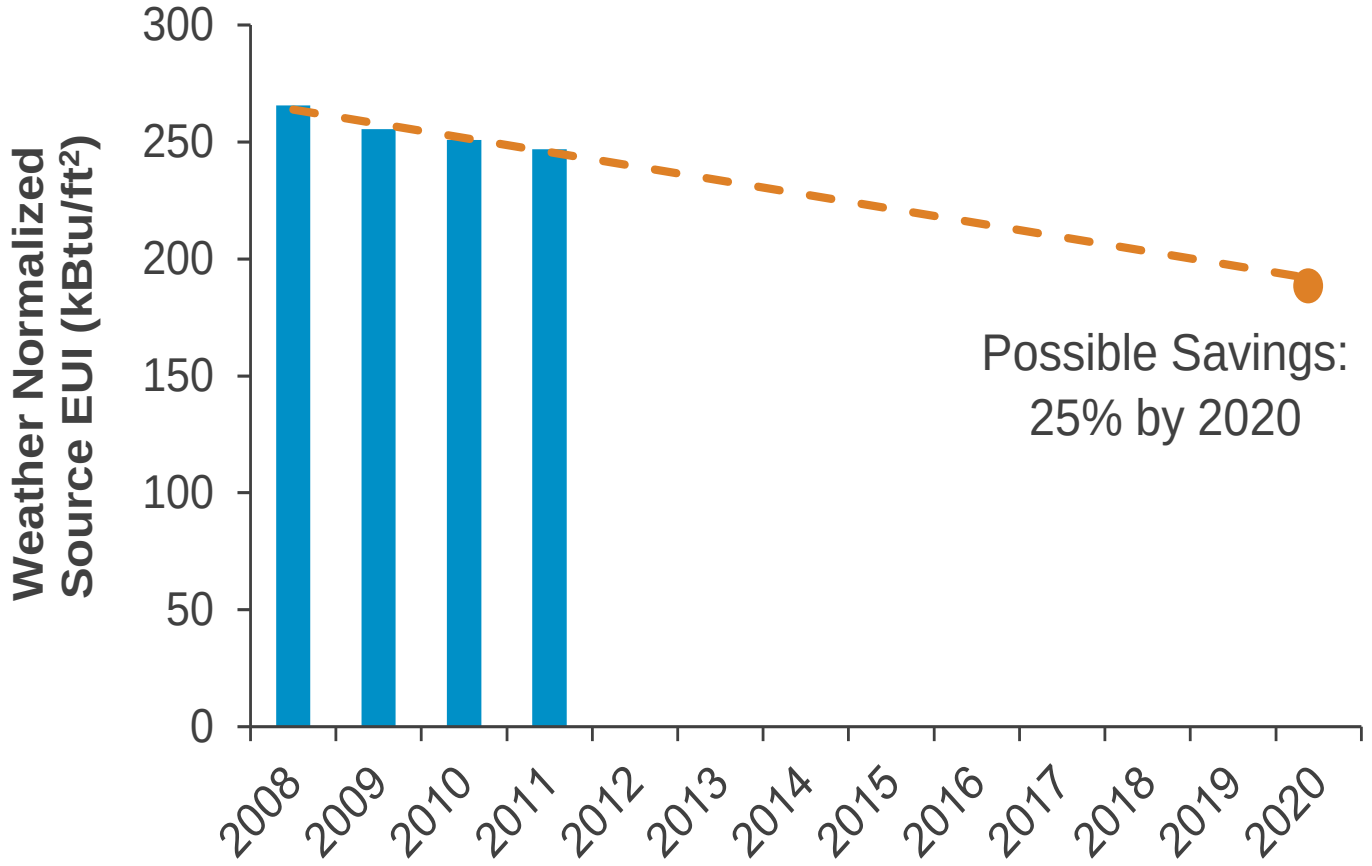
Evidence of the Power of Information

- EPA analyzed data for buildings that benchmarked in Portfolio Manager for 4 consecutive years: 2008-11 (3 full years of data)
- Dataset of 36,000 buildings, including all major building types, range of sizes and locations
- Results
  - Total energy reduction of 7%
  - Average of 2.4% per year





Small Savings Add Up!



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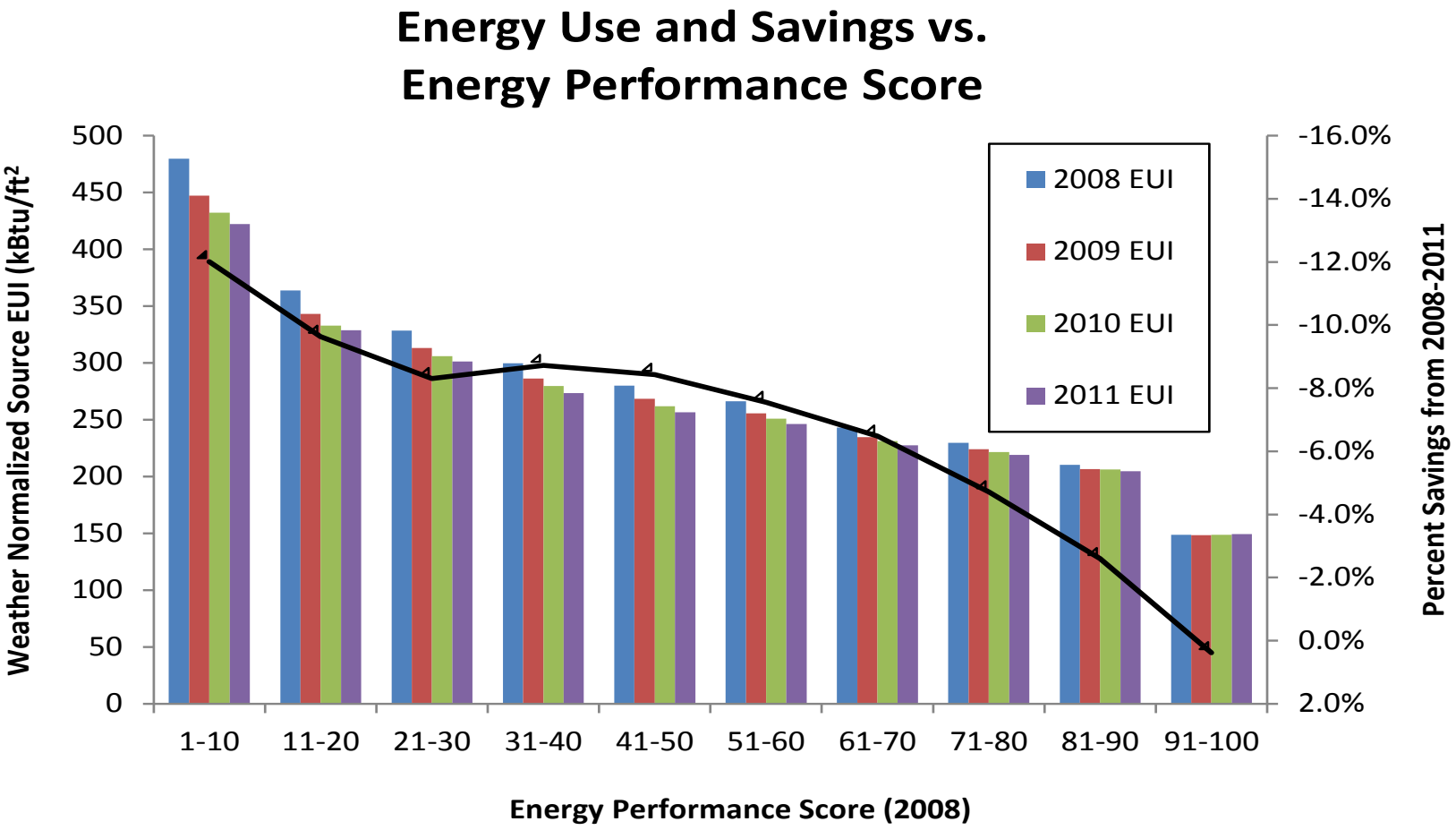
The Least Efficient Buildings Improved the Most

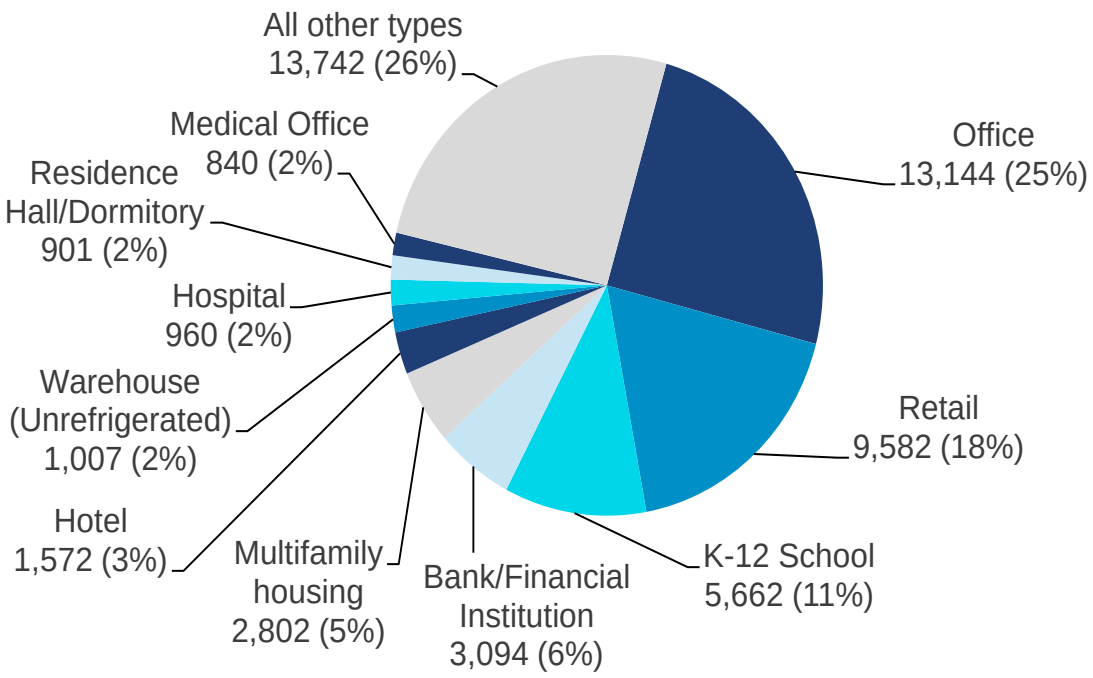


Least Efficient

Most Efficient

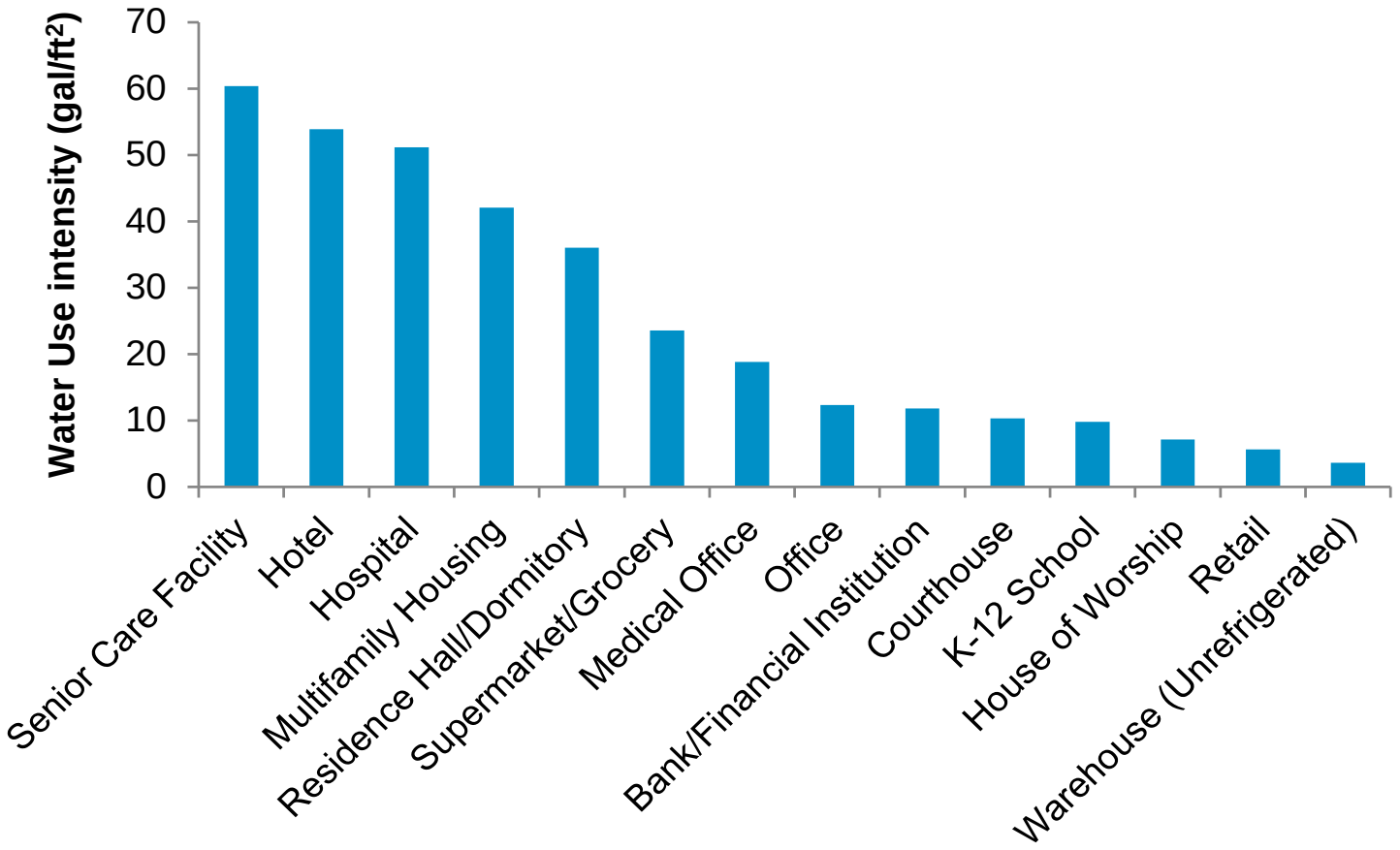
21

Water Use Tracking in Portfolio Manager

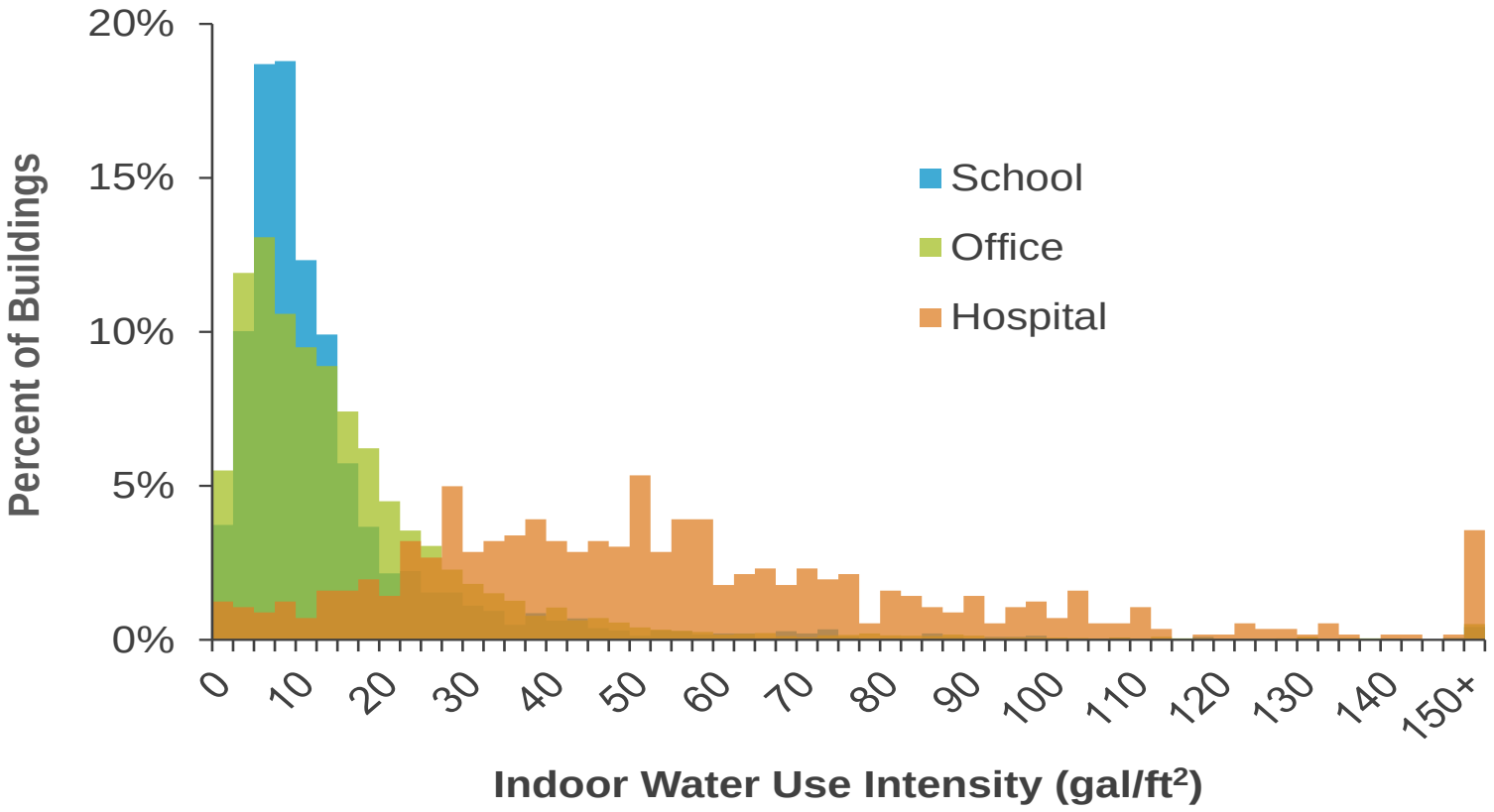


- 53,000 buildings tracking water (20% of total)
- 6.2 billion square feet of space

Median Water Use Intensity Observed (Indoor only)



Range of Water Use Intensity (Indoor only)



ENERGY STAR® Portfolio Manager™

- Major upgrade underway, to be rolled out in spring 2013
  - New interface, streamlined functionality, and improved usability
  - All users can continue to benchmark during upgrade -- all data will be transferred
  - Status updated regularly on **energystar.gov/PMUpgrade**
  - Periodic webinars to keep stakeholders informed; thousands have already attended

Changes to Water Tracking as part of Portfolio Manager Upgrade

Current meter tracking

- Indoor water
- Outdoor water
- Combined indoor/outdoor
- Wastewater/sewer
- Other

New meter tracking

- Municipally supplied potable water
- Municipally supplied reclaimed water
- Alternative water generated on-site
- Can specify “Indoor”, “Outdoor”, or “All” for each category

Thank You!

- **For more information:**
  - Visit www.energystar.gov/buildings
  - Email jacobs.cindy@epa.gov

BENCHMARKING AND CHALLENGES

C&I Water Use & Benchmarking

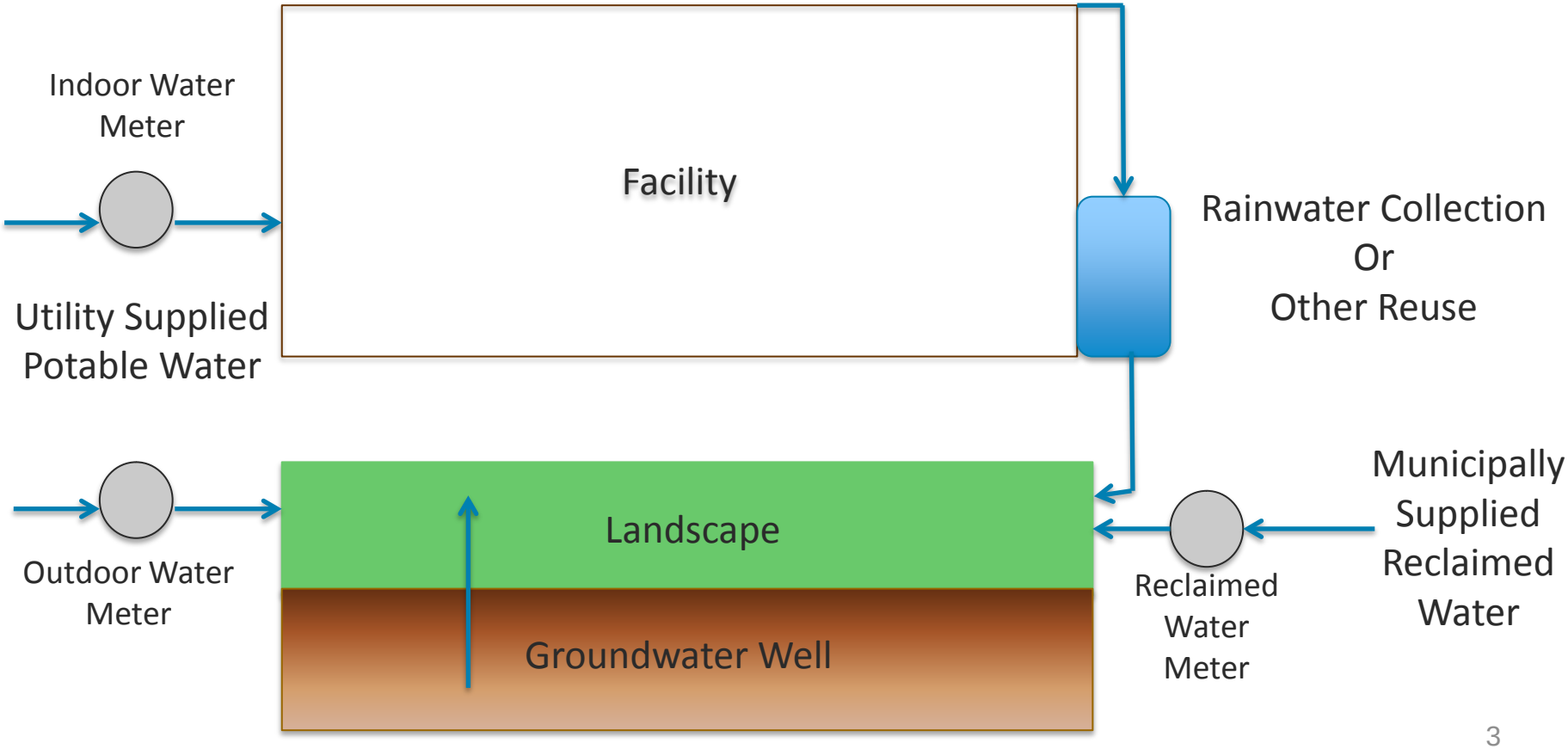
- Water use data is not as mature as energy use data and groups are still evaluating ways to accurately track and benchmark building water use

- In 2007 the Energy Information Administration (EIA) began collecting building water use information as part of its commercial building energy consumption survey (CBECS), which is conducted every 5 years

- ENERGY STAR now tracks commercial building water use information through Portfolio Manager

Challenges for Benchmarking Water Use

- Tracking sources not just metered supplies/end uses



Challenges for Benchmarking Water Use

- For accurate benchmarking, need to be able to compare a facility to facilities with similar water use features/building operating characteristics
  - Gross tonnage of the cooling tower
  - Separate out outdoor water use
  - Operation of a commercial kitchen
  - Operation of an on-premise laundry
  - Operation of a pool or spa

Challenges for Benchmarking Water Use

- Accurately tracking water costs (water bills are confusing!)
  - Utilities typically meter incoming water use and charge for the corresponding amount of wastewater discharged
    - Sometimes not all water is not sent to the sewer (i.e., irrigation water or cooling tower evaporation) and utilities may offer a credit
  - Water bills usually include other charges besides water and wastewater (fire, storm water, etc)
  - There may be more than one water meter to account for
- An accurate understanding of water and wastewater costs is necessary to support cost effectiveness analysis from water reduction opportunities

CBECS

Commercial Building Energy Consumption Survey

- EIA conducts the Commercial Building Energy Consumption Survey every 5 years
- In 2007 they began collecting building water use data
  - 56% of all responding sampled buildings were able to report water consumption or expenditures or both
  - Reporting success varied by building type, with inpatient healthcare buildings reporting at the highest rate, 69%
- The 2012 survey will incorporate improvements based on lessons learned from 2007
  - Data collection will begin in early 2013, with results published in 2014

Commercial Building Energy Consumption Survey

- Data collected from 2007 survey:
  - Total volume of domestic water used (consumption) in 2007
  - Cost of water (expenditures)
  - Whether the volume was metered or estimated
  - How much of the water was used outside the building
  - If the building used central chillers, what volume of water was used for cooling towers
  - Whether the sewer flow was metered
  - Whether the facility had sterilizers or autoclaves
  - Whether the building had a landscape irrigation system
  - The number of commercial ice makers present
  - Heard of WaterSense

Commercial Building Energy Consumption Survey

- Changes in 2012 survey
  - Clarifies that total water use should be for all sources combined and not just related to domestic water use (metered)
  - Identifies whether sewer flow is separately metered
  - Clarifies that outdoor water use is for a landscape irrigation system
    - Asks if this water use was metered separately
  - Clarifies reporting of cooling tower water use
  - Does not ask the respondent to provide water expenditure data, only asks for a copy of the water bill

Commercial Building Energy Consumption Survey

- WaterSense is working with ENERGY STAR and EIA to align CBECS and Portfolio Manager to support future benchmarking opportunities
  - Track water use by source rather than metered supplies
  - Collect similar building operational characteristics to facilitate categorization of like facilities

Methodology for EPA's ENERGY STAR Energy Performance Scales

Cindy Jacobs

U.S. Environmental Protection Agency

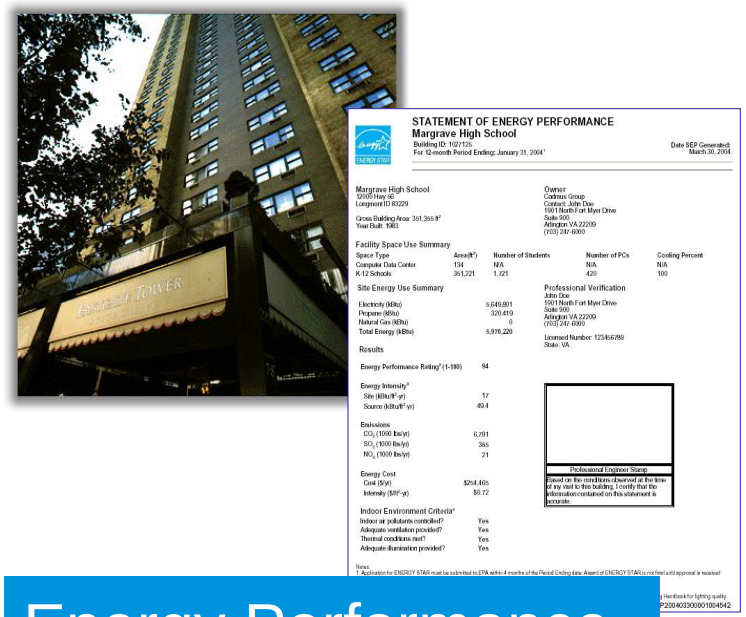
2012

Performance Scale Provides Comparative Metric

Is 60 MPG high or low for this automobile?

Fuel Efficiency: *MPG*

Is 90 kBtu/SF/YR high or low for this building?



Energy Performance Scale: *1 to 100*

ENERGY STAR Score Objectives

- Help businesses protect the environment through superior energy efficiency
- Motivate organizations to develop a strategic approach to energy management
- Convey information about energy performance in a simple metric that can be understood by all levels of the organization as well as the general public

ENERGY STAR Score Key Principles

- Measured
  - Based on actual as-billed energy data for all fuel types
  - No modeled data or extrapolations
- Whole building indicator
  - Includes all energy use in a building
  - Captures interactions of building systems not individual equipment efficiency
  - Accounts for weather and operational differences among buildings and over time
- Peer group comparison
  - Compares a building's energy performance to its national peer group
  - Tracks how changes at a building level alter the building's standing relative to its peer group

ENERGY STAR Score Statistical Methodology

- Analyze national survey data
  - Commercial Building Energy Consumption Survey (CBECS)
  - Independent industry surveys
- Develop regression models to predict energy use for specific space types based on operations
- Create scoring lookup table
  - Scores are based on the distribution of energy performance across commercial buildings
  - Compares actual energy use with predicted energy use
  - One point on the ENERGY STAR scale represents one percentile of buildings
- Buildings that perform in the 75th percentile or better can earn ENERGY STAR certification

ENERGY STAR Score Statistical Methodology

The Score Does

- ✓ Evaluate as-billed energy use relative to building operations
- ✓ Normalize for business activity (e.g., size, number of employees, cash registers, computers, climate)
- ✓ Depend on a statistically representative sample of the commercial building population

The Score Does Not

- × Sum the energy use of each piece of equipment
- × Normalize for technology choices or market conditions (e.g., type of lighting, energy price)
- × Explain why a building operates as it does

ENERGY STAR Energy Performance Scale Data Source Requirements

- Sample must, at a minimum:
  - Be random and nationally representative
    - Diverse in size
    - Diverse in geography
    - Diverse in ownership/management
    - Sufficiently large to be representative of population
  - Include measured whole building energy (and water) use data for all fuel types
  - Include data on numerous operational characteristics

ENERGY STAR Energy Performance Scale Data Sources

- CBECS
  - Bank/Financial Center, Courthouse, Hotel, House of Worship, K-12 School, Medical Office, Office, Residence Hall/Dormitory, Retail, Supermarket, Warehouse (refrigerated/unrefrigerated)
- Industry Surveys
  - Data Center – Conducted by EPA
  - Hospital – Conducted by American Society for Healthcare Engineering (ASHE)
  - Senior Care – Conducted by Assisted Living Federation of America (ALFA), American Association of Homes and Services for the Aging (AAHSA), American Health Care Association (AHCA), and National Center on Assisted Living (NCAL)
  - Wastewater Treatment Plant – Conducted by American Waterworks Association Research Foundation

Data Filters

- *Building type*
  - each model includes only one type of building, e.g., office
- *Program filter*
  - basic filter to define peer group, e.g., at least 30 hours per week operation
- *Data limitation*
  - remove buildings that do not have the necessary data for analysis
- *Analytical*
  - applied once regression analysis begins, to eliminate outlier data points

Independent Variables

- Include factors that explain *how* a building operates, e.g.:
  - Size
  - Hours per week
  - Number of occupants
  - Number of computers
- Exclude factors that explain *why* a building performs the way it does:
  - Technology factors, e.g., type of lighting
  - Market conditions, e.g., energy prices

Dependent Variable

- Source energy use intensity
  - Energy use per square foot
  - Source energy
    - Energy consumed on site + energy used in generation and transmission
    - Important because buildings use both heat and electricity, which must be put in equivalent units for equitable comparison
    - Parallel in water use?
- What is the right dependent variable for water use?

ENERGY STAR Score – Normalization Method

- Ordinary least square regression
  - simple, effective, reliable
  - Transparent
- Create the regression model

$$\text{Energy Intensity} = C_o + C_1 * \text{Operating Hours} + C_2 * \text{Workers per Square Foot} + C_3 * \text{Computer per Square Foot} + C_4 * \text{HDD} + C_5 * \text{CDD} + \ldots$$

Evaluating a Model

- Multiple factors to evaluate
  - Regression model statistics (F, p, R^2)
  - Individual variable statistics (t-stats)
  - Distribution of ENERGY STAR scores
    - By 10% bin
    - Average score
    - Number and percent above 75
  - Residual and ENERGY STAR score plots
  - Physical understanding of results
  - Magnitude of impacts
- Final model must show a good balance using all criteria

ENERGY STAR Score Example

- Two example office buildings
  - Same size and climate (*200,000 square foot; Philadelphia*)
  - Different Hours, Workers, Computers
  - Same ***Actual Energy***

	Office A	Office B
Number of Workers	700	400
Weekly Hours of Operation	112	60
Number of Computers	750	475
Predicted Energy Intensity ($kBtu/ft^2$)	353	289
Actual Energy Intensity ($kBtu/ft^2$)	200	200
Score	***81***	***67***

EPA and Fannie Mae Partnership

- Multifamily in Portfolio Manager – Over 13,000 buildings representing nearly 2 billion square feet at year-end 2011
- Signed MOU in March 2011
- Partnership Goals:
  - Improve the energy and water efficiency of the nation's multifamily housing stock
  - Explore the development of a 1-100 ENERGY STAR score and certification for existing multifamily properties using actual measured whole building data
  - Provide an energy performance scoring tool for entire multifamily industry
  - Evaluate use in underwriting and asset management of multifamily loans

Fannie Mae Data Collection Project Approach and Targets

- Survey 7,500 property owners with Fannie Mae loans for property, energy, and water data
  - Distribute survey via telephone, Web, and mail
- Approach utilities to request whole building data to minimize data gathering burden on owners
- Engage with industry associations
- Gather property, energy, and water data from organizations volunteering their data
- Deliver complete property, energy, and water data sets on 1,500 properties to EPA for analysis

Timeline

- May 2012 – December 2012 (Fannie Mae)
  - Survey 7,500 multifamily owners with Fannie Mae loans
  - Gather additional data from volunteering organizations
  - Deliver energy and water data for 1,500 multifamily properties
- January 2013 – Late-2013 (EPA)
  - Analyze data and explore development of ENERGY STAR multifamily score and certification
  - If an energy performance scale is developed, program it into Portfolio Manager
- Early 2014 (EPA)
  - Launch score and certification based on actual measured historical energy use (subject to analysis results)

PATH FORWARD

Questions

- *For utilities* - what programs do your run to improve water efficiency in commercial buildings?
- *For CI building managers* – how do commercial buildings assess and improve water efficiency now?
- *For auditors/researchers* – what are the major drivers of water use in CI buildings?

Challenges

- Outdoor Water Use
  - How account for it?
  - What are options for benchmarking given lack of data on landscape size and other factors?
  - Is it acceptable to provide a building rating without a consideration of outdoor water use?

Challenges

- Closing the data gap
  - How do we do it?
  - What are the barriers?
  - What tools do we have or do we need?

Challenges

- Motivating water efficiency
  - Is recognition a'la ES with data and rating likely to be effective for water?
  - What are the options for encouraging improvement in buildings for which there is limited data?

Next Steps

- Right now
  - How can stakeholders (WaterSense, ENERGY STAR, building owners and operators, utilities) make best use of the data being collected?
  - Are there intermediate actions we can take?