This presentation premiered at WaterSmart Innovations

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Domestic Hot Water Distribution Challenges in Multi-Family Construction

Steven Winter Associates, Inc.

Improving the Built Environment Since 1972

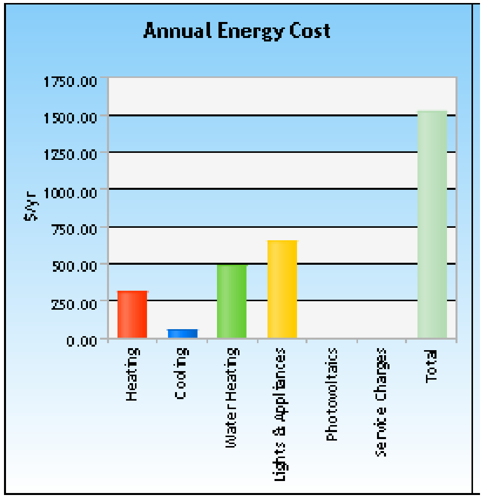
Presentation Overview

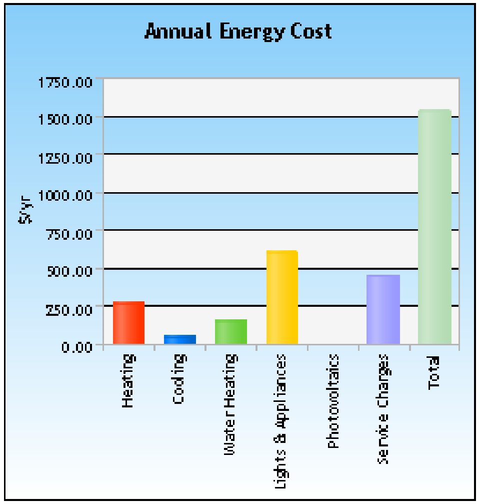
- Typical Systems
  - in-unit electric or natural gas storage or tank-less
  - heat pump water heaters per floor or cluster of apartments
  - central recirculation
  - central on demand
- Energy Savings
  - modeling predictions
  - real world results
- Water Savings
  - tools for analysis
  - continued monitoring
  - the real cost of water
- Common Practice vs. Good Design
  - typical distribution design
  - efficient layout
  - pipe insulation, fixtures
- Further Exploration On-Demand Recirculation
  - in practice: Title 24; IECC; DOE ZERH, Passive House
  - examples projects & results
- Moving Forward
  - additional research, monitoring, measuring and qualifying results
  - emerging technologies & controls

Learning objectives

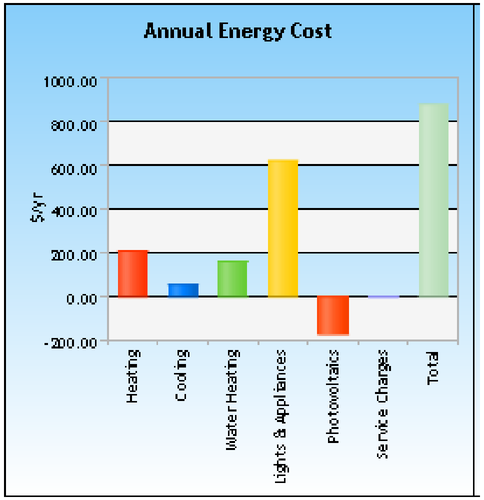
- Identify opportunities in layout, design and specifications
- Analyze tools to predict water and energy savings
- Explore alternative equipment and controls
- Evaluate success stories; verify, measure and qualify savings

What's Typical in Unit

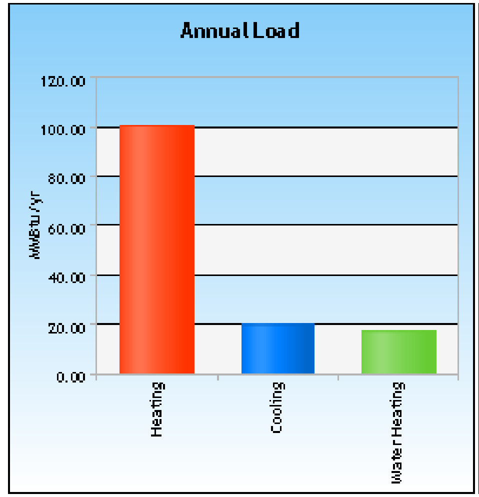


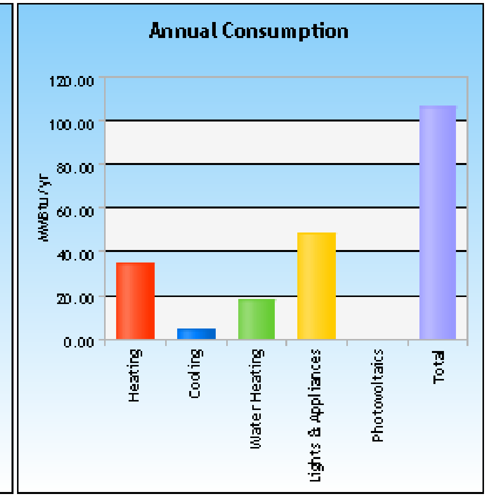


Less Typical



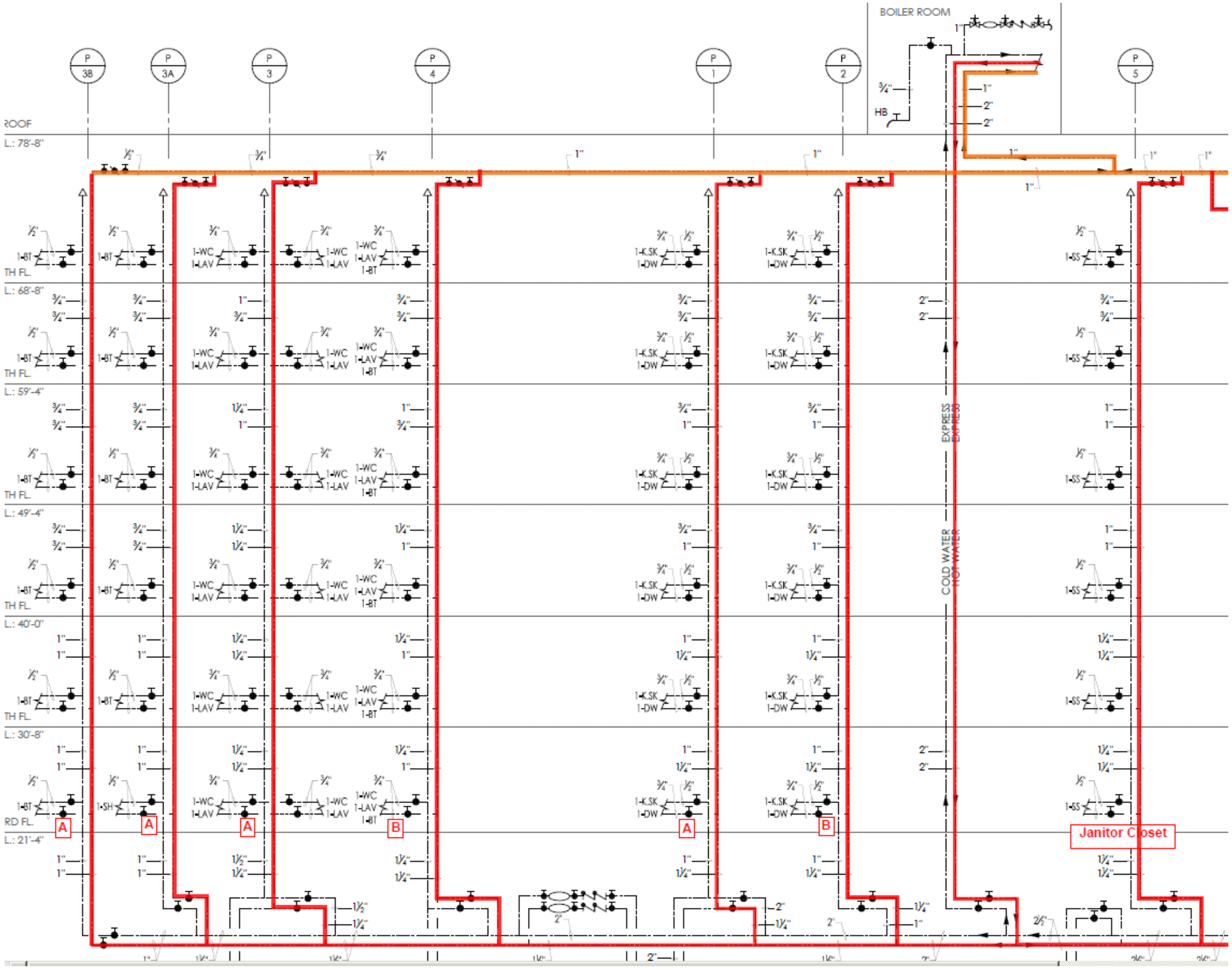
Not So Typical in Unit





Central DHW

DHW - Recirculation



DHW – Recirculation

Code Requirements

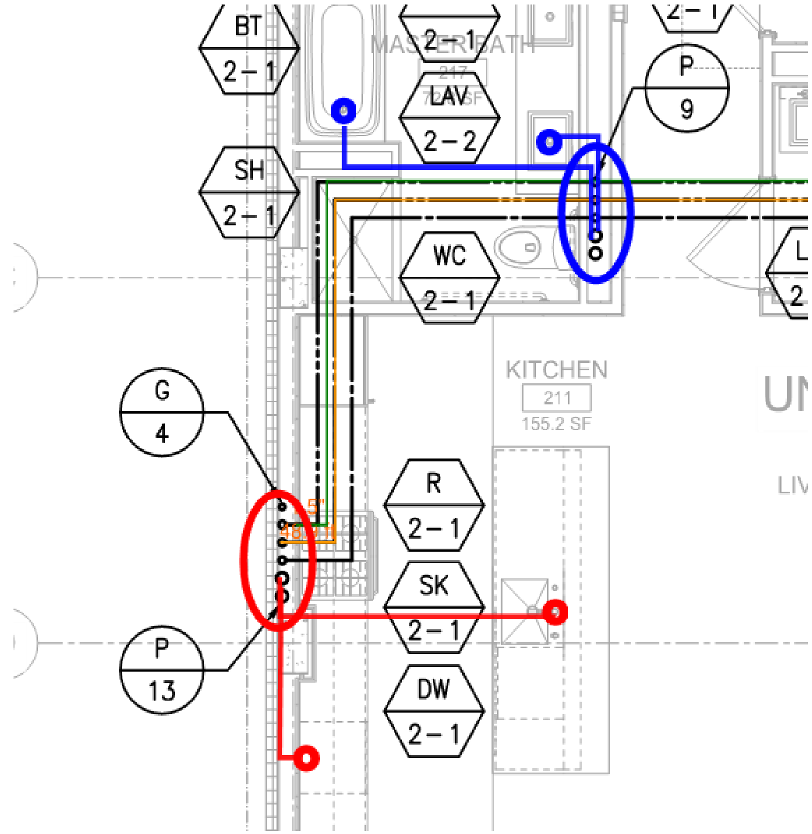
- Central must have recirculation for MF
- Individual Pipe runs from recirc. lines to taps < 20 ft.

Design

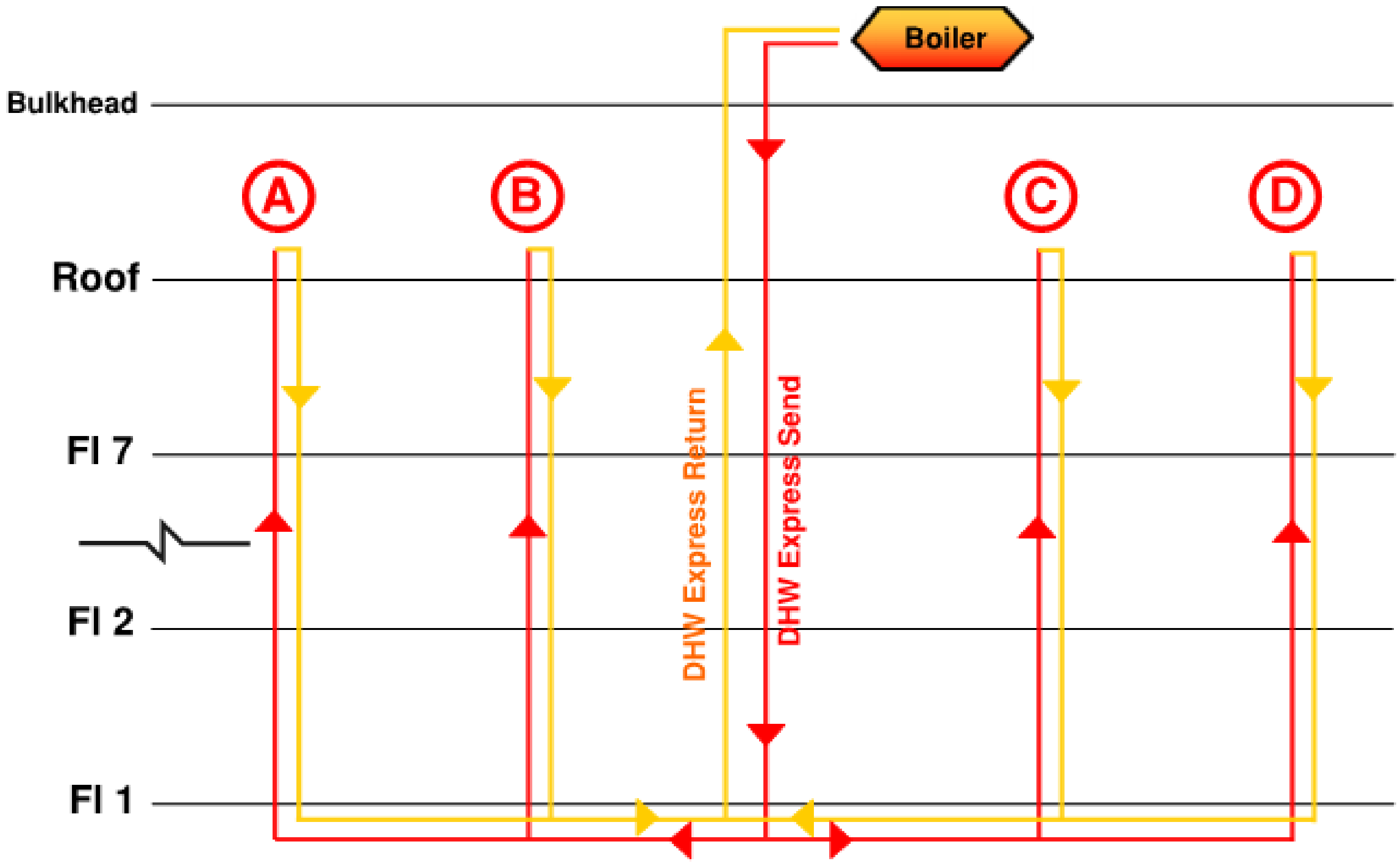
- One vertical riser per several apartments

Better Design

- Reduce # of risers
- Cluster plumbing locations when feasible
- Install Insulation R4 min

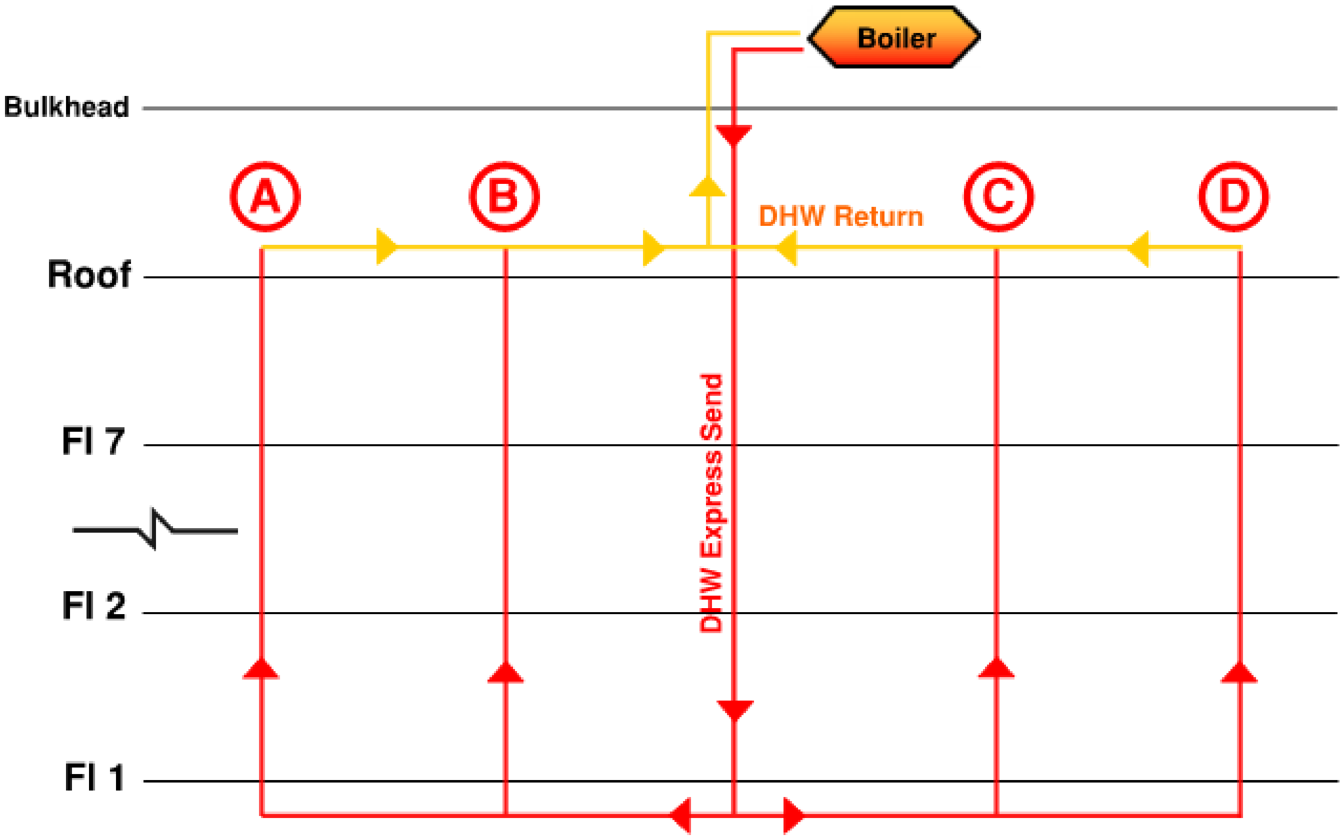


DHW - Recirculation

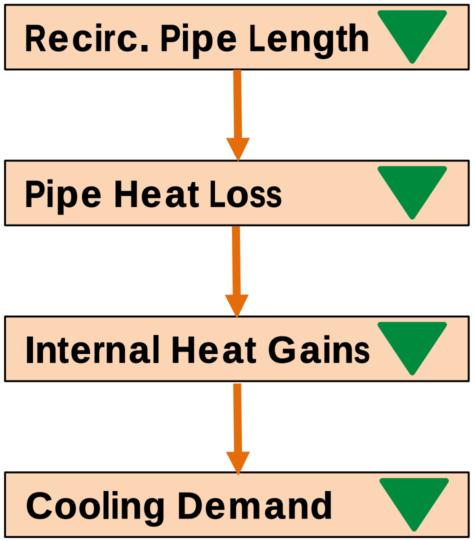


Building Section - Base Design

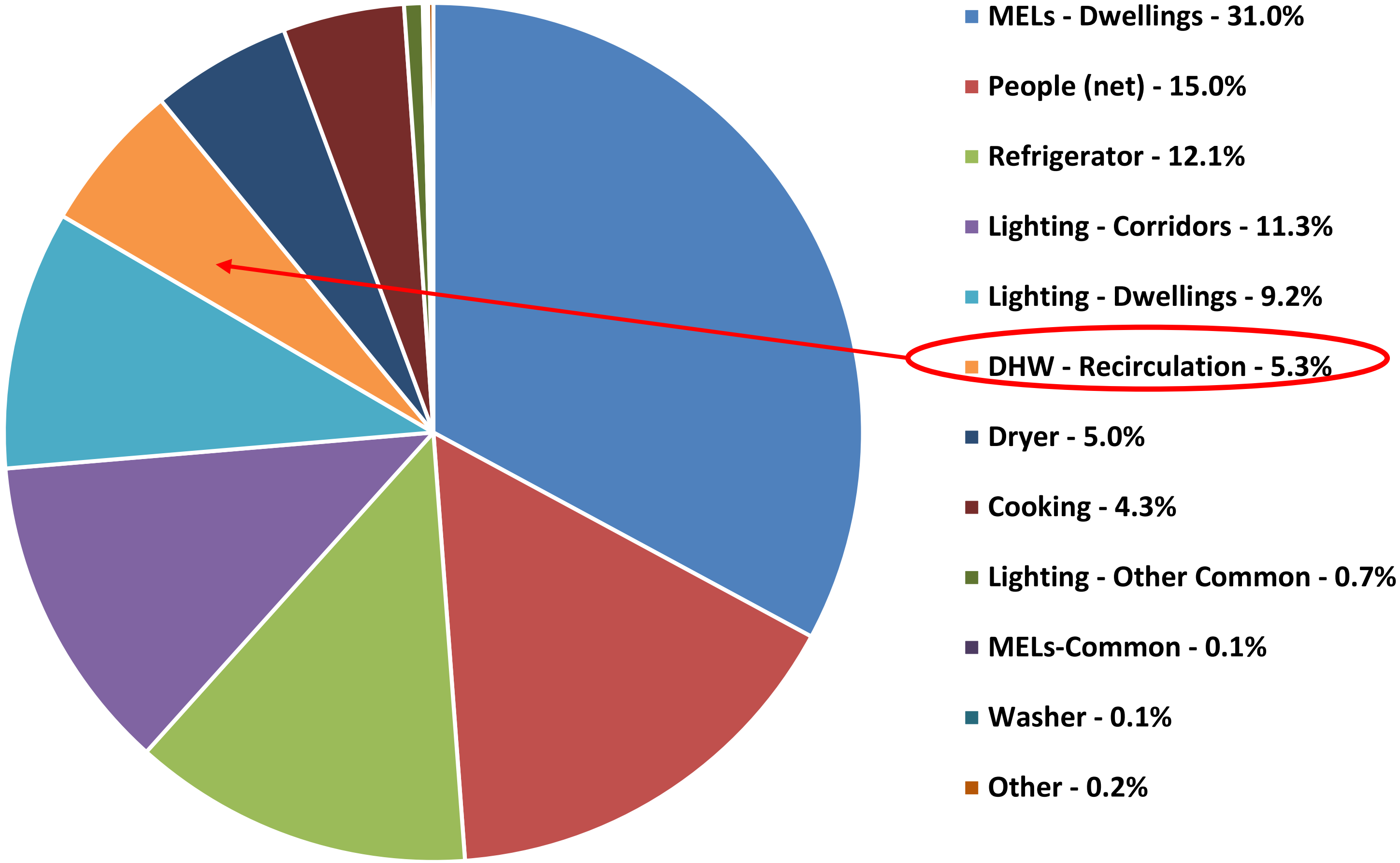
Efficient DHW - Recirculation



Building Section - Better Design



Internal Heat Gains – End Uses



Building A - Internal Heat Gains (Btu/hr)

Source: SWA PH Modeled Data, 28 Story NYC MF

Recirculation Controls

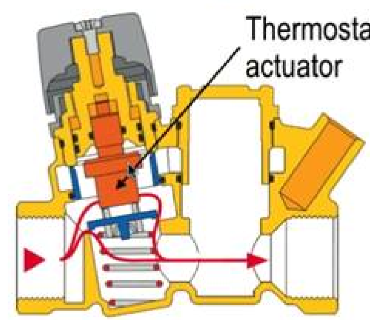
- Timer Control
- Temperature Control
- Temperature Modulation Control
- Demand Recirculation Control
- Demand + Temperature Modulation Control

Balance the System:
-Include DHW balancing specs
-Include a detail for the riser balancing valves including a check valve
-Show balancing valves on the riser diagram

On a recent 54 story 700 unit building the designer specified 5gpm auto flow balancing valves at each of 25 risers that was served by a 20gpm pump! So all of the water circulated through the first few risers leaving other risers cold.

ThermoSetter® valve options

Basic configuration



Codes & Certifications

California leads the way (as usual)

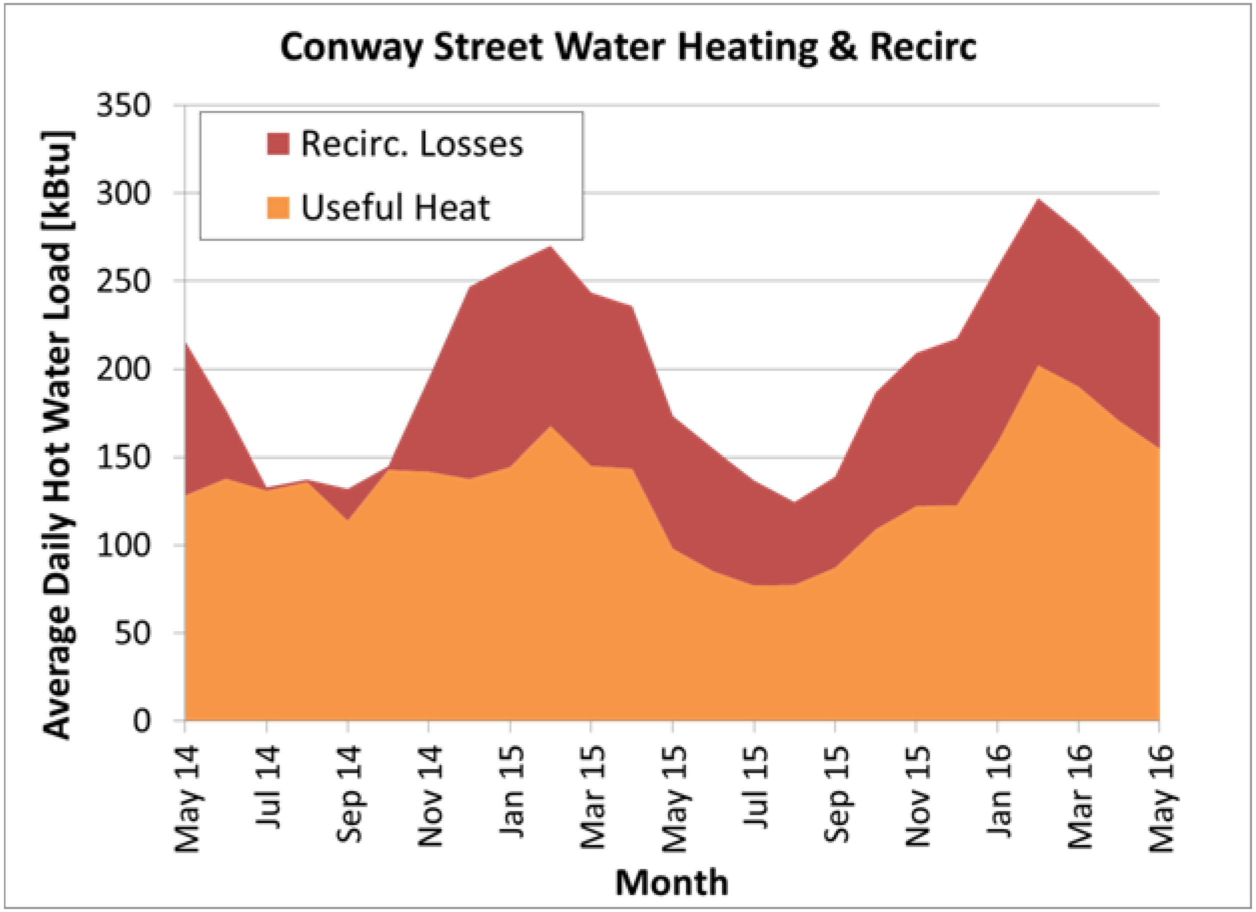
- 2016 California Plumbing Code – IAMPO
- LEED v4 BD+C Homes & Multifamily Midrise
- DOE Zero Energy Ready Homes
- Water Sense Labeled

Recirculation Controls

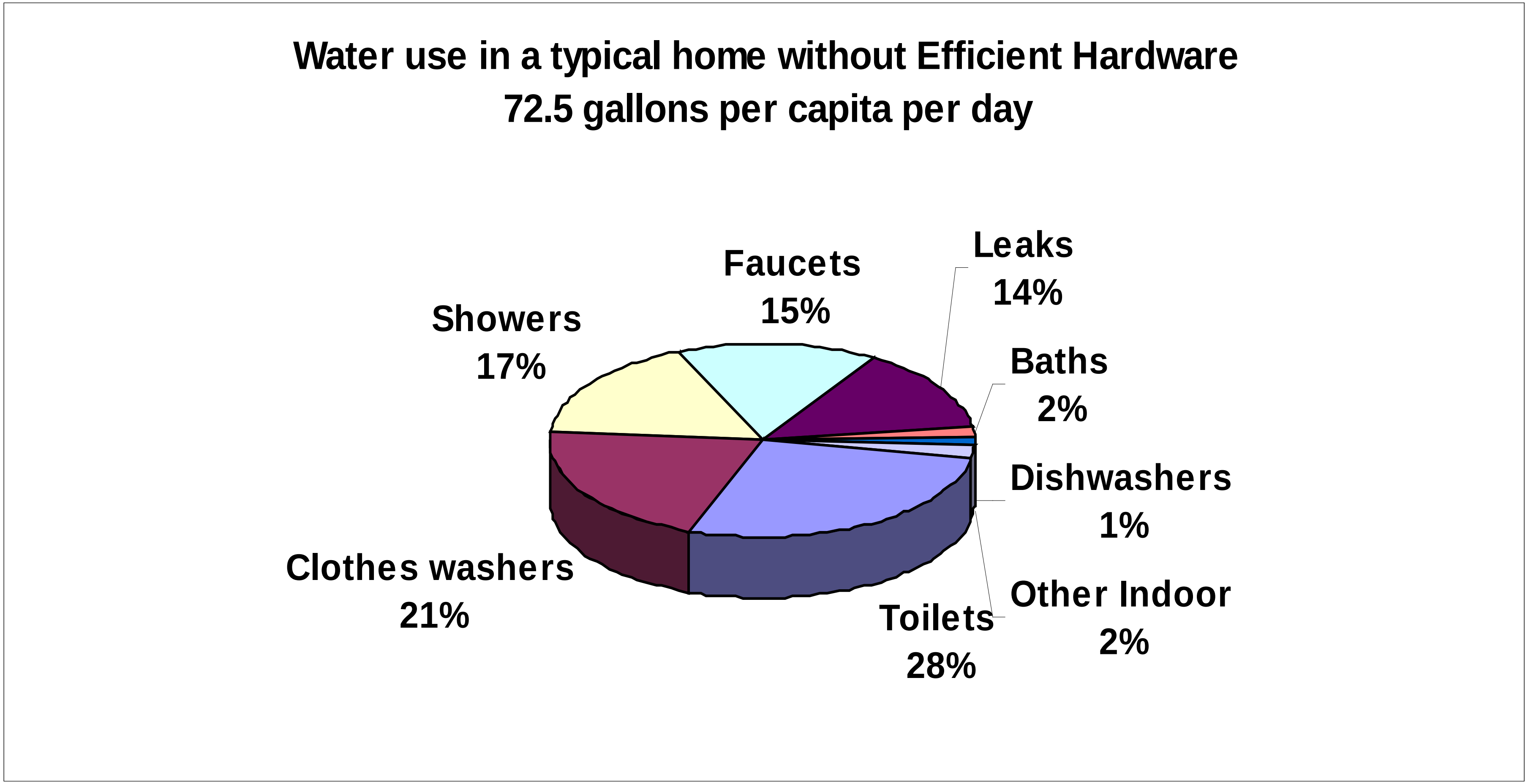
DOE Report
Conway Street Apartments: A Multifamily Deep Energy Retrofit
November 2014

Recirculation Controls

Recirculation Controls



Savings Opportunity

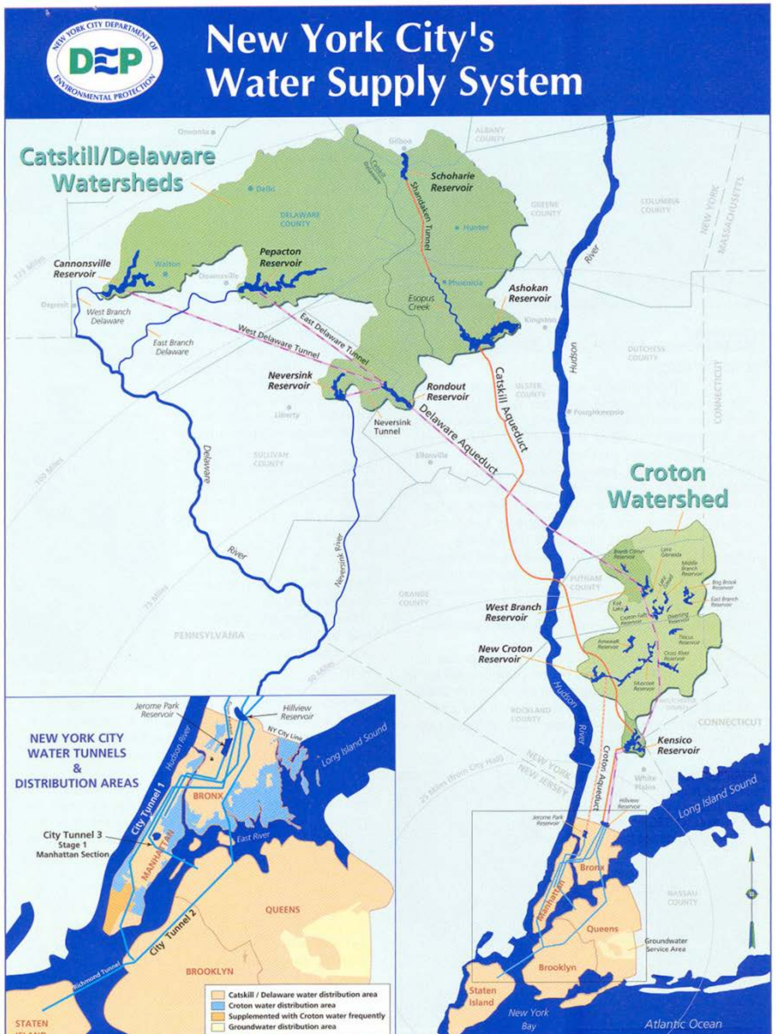


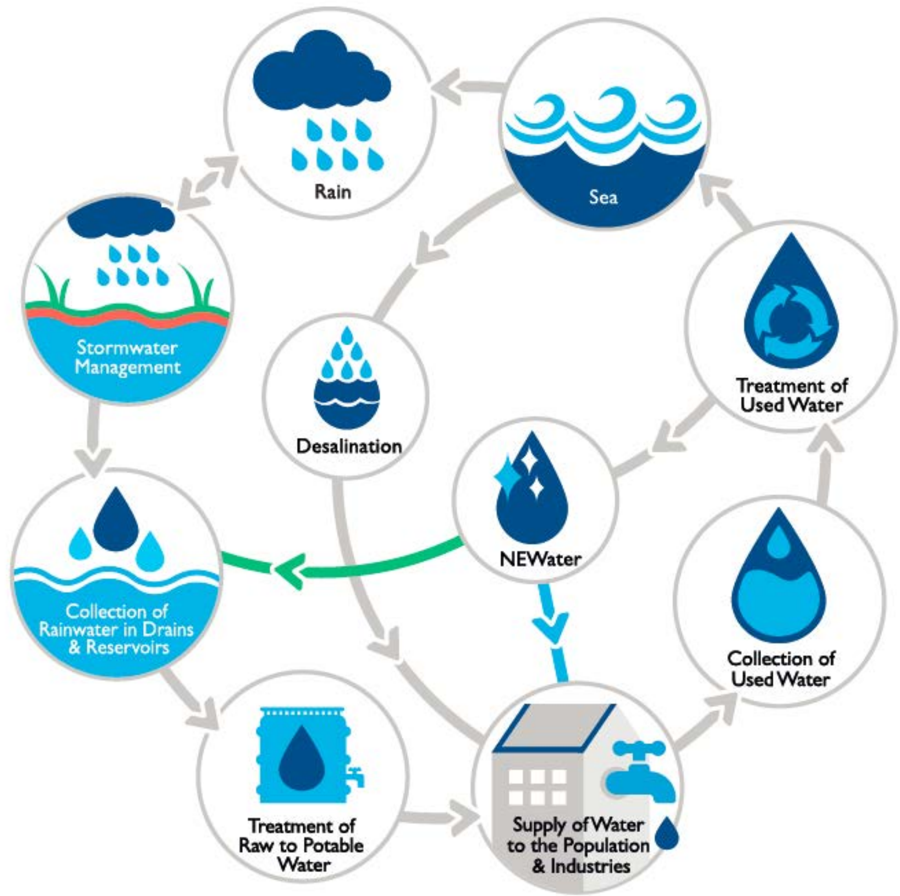
Savings Quantified

How much energy savings can be achieved in multifamily buildings?

- Independent research demonstrates 10 – 30% reduction in water heater gas usage
- 90% reduction in electricity used for pumping
- Cost payback is typically between 0.5 to 2 years
- Demand Recirculation Control
- Demand + Temperature Modulation Control

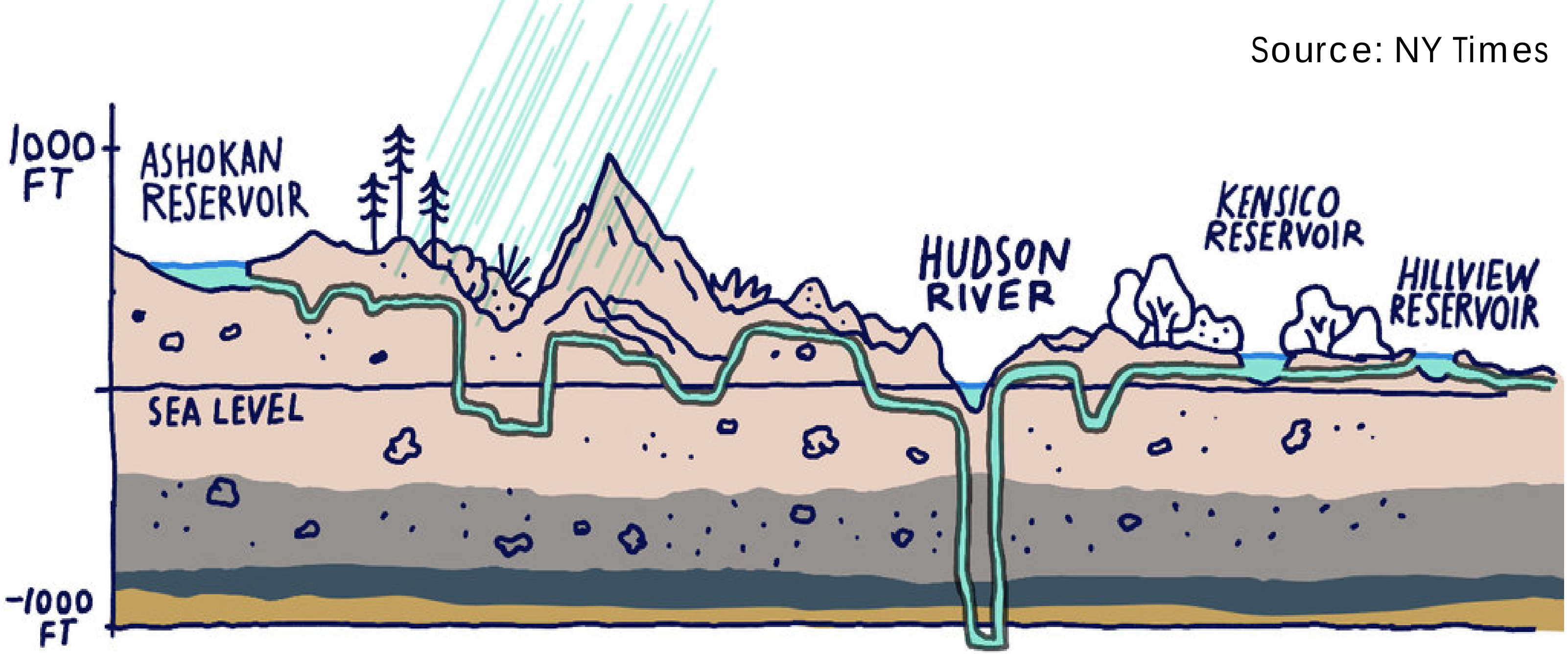
THE COST OF WATER





THE COST OF WATER

Source: NY Times



THE COST OF WATER

THE COST OF WATER

- It takes ½ gallon of water to produce 1 kWh
- To run a 60 watt bulb for 12 hours equates to using 15 gallons of water

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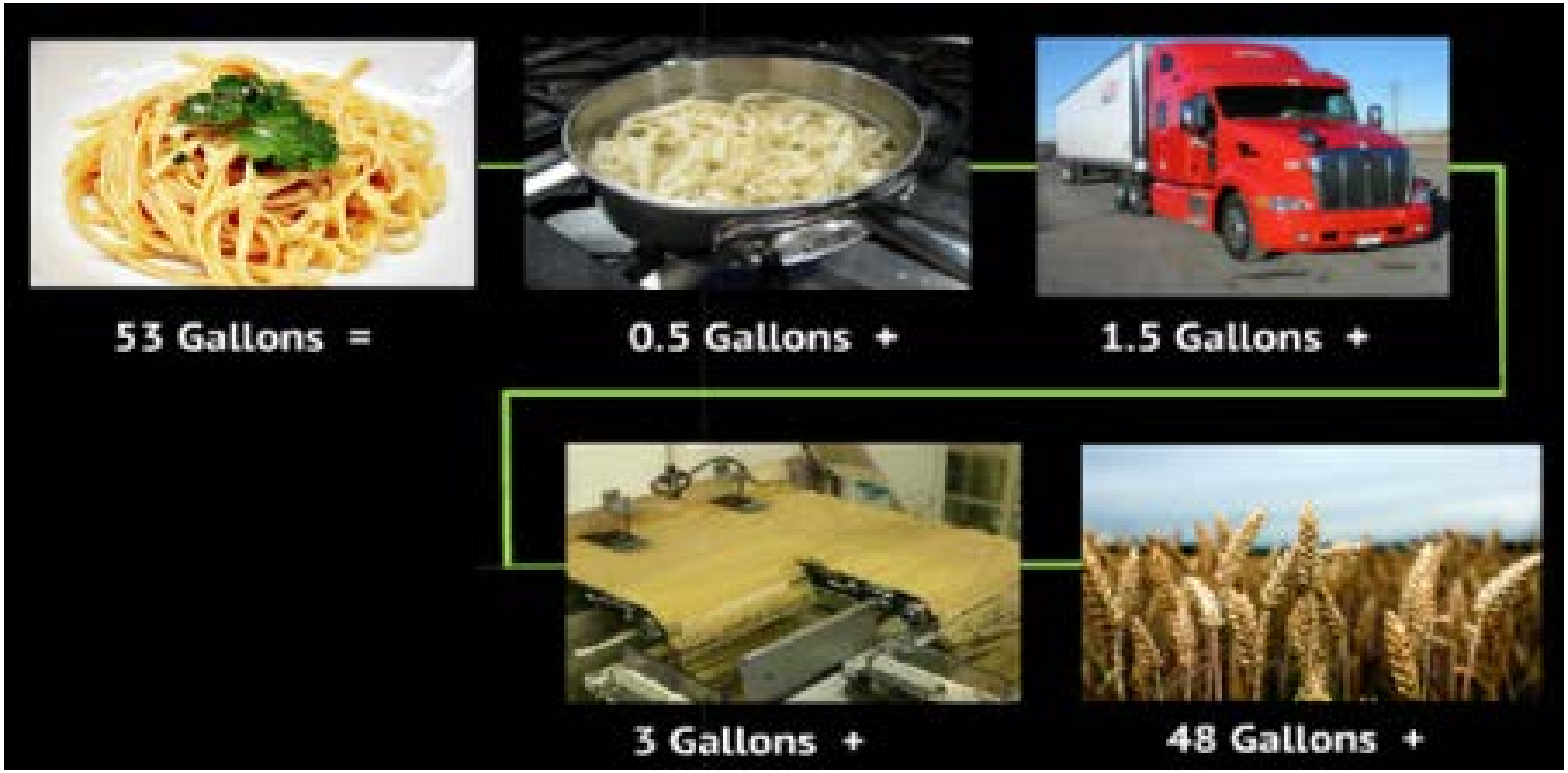
Source: Consumptive Water Use for U.S. Power Production
P. Torcellini, N. Long, R. Judkoff, NREL

THE COST OF WATER

Virtual Water Use

- The water used to create the goods and services we consume



THE COST OF WATER

Meatless Mondays save water too

- Up to 2700 Gallons!

THE COST OF WATER

https://water.usgs.gov/edu/activity-watercontent.html

How much water does it take to grow a hamburger?

What is the water content of things?

Water is needed to not only grow everything we eat but also to produce almost all the products we use every day. This water is supplied by nature as precipitation o growing and production process. You can't tell by the size of a product or the appearance of a food how much water was actually used to produce the item.

Use the form below to enter your guess about how much water is used to produce some common foods and products. Please realize this exercise is meant to give yo is needed to produce these items. It is very difficult to come up with accurate water-use numbers, and the large variety of food-growing and production techniques amount of water needed can vary a huge amount, depending on how and where the food is grown.

Yet another consideration is how far back to go in the chain of production to estimate water use. For beef, some estimates only consider drinking water for cattle, wh the water needed to grow the food that the cow eats.

The data here were taken from two sources:

- The Water Footprint Network
- Water Content of Things: The World's Water 2008-2009, Peter Gleick, The Pacific Institute

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Choose how much water it takes to make/grow:

Bread (1 pound/.45 kilogram (kg) loaf): 20 gallon	**Chicken:** 1 pound (.45 kilogram (kg)) 10 gallons	**Coffee** (1 cup): 2 gallons
Corn (1 pound): 50 gallons	**Eggs** (1 egg): 20 gallons	**Hamburger** 1/4 pounder (113 grams): 150 gallons
An orange: 1 gallon	**Paper** (1 sheet): 3 gallons	**Potato** (1 pound): 5 gallons
Cotton shirt 250 grams: 100 gallons	**Steel** (1 pound): 4 gallons	**Wheat** (1 pound) 60-100 gallons

Submit

THE COST OF WATER

https://water.usgs.gov/edu/activity-watercontent.html

The Water Content of Things:
How much water does it take to grow a hamburger?

Water is needed not only to grow everything we eat but also to produce almost all the products we use every day. This water is supplied by nature as precipitation or added by people during the growing and production process. You can't tell by the size of a product the appearance of a particular food how much water was actually used to produce the item.

Bread, 1 pound (lb) (.45 kilogram (kg)) loaf:
Your answer: 75 gallons
Correct answer: About 200 (193) gallons, 731 liters)
193 gallons is an estimated global average. Actual production and use of the wheat flour uses 80% of the water.
Source: Water Footprint

Chicken, 1 pound (.45 kg) of meat:
Your answer: 50 gallons
Correct answer: 500 gallons/pound (1,890 liters/.45 kg)
Water is needed for the chicken to drink and, to maintain the chicken house, and for growing the grains that the chicken eats.
Source: Water Footprint

Coffee, 1 cup:
Your answer: 5 gallons
Correct answer: 35 gallons (132 liters)
The world population requires about 120 billion cubic meters of water per year in order to be able to drink coffee. This is equivalent to 1.5 times the annual Rhine River runoff and constitutes 2% of the global water use for crop production.
Source: Water Footprint

Corn, 1 pound (.45 kg):
Your answer: 50 gallons
Correct answer: 110 gallons (416 liters)
Maize (corn) consumes about 550 billion cubic meters of water annually, which is 8% of global water use for crop production.
Source:: Water Footprint

Eggs, 1 egg:
Your answer: 20 gallons
Correct answer: 50 gallons (189 liters)
Most of the water is required for feeding the chickens.
Source: Water Footprint

Hamburger (beef, in general) (1/4 pound, 113 grams) :
Your answer: 1000 gallons
Correct answer: About 460 gallons for 1/4 pound of beef, or about 1,750 liters per 113 grams
Estimates vary a lot due to different conditions of raising cows.The number also varies depending on how far back in the production chain you go. It takes a lot of water to grow grain, forage, and roughage to feed a cow. Water is also needed for drinking supplies as well as for servicing the cow. Per kilogram of product, animal products generally have a larger water footprint than crop products

Orange (150 grams):
Your answer: 13 gallons
Correct answer: 13 gallons (49 liters)
One glass of orange juice (200 ml) takes about 45 gallons (170 liters) of water.
Source: Water Footprint

Paper, sheet:
Your answer: 3 gallons
Correct answer: 3 gallons (11 liters)
This number has a lot of variation and depends on the source of the wood; forest evapotranspiration and wood yield vary from forest to forest. The number will likely fall in a range of 1/2 gallon and 8 gallons per sheet (A4 size).
Source: Water Footprint

Potato:
Your answer: 10 gallons
Correct answer: 100 gallons (378 liters)
Source: Water Footprint

One cotton shirt:
Your answer: 250 gallons
Correct answer: 650 gallons (2,495 liters/250 grams shirt)
Of this total water volume, 45% is irrigation water consumed (evaporated) by the cotton plant; 41% is rainwater evaporat from the cotton field during the growing period; and 14% is water required to dilute the wastewater flows that result from th use of fertilizers in the field and the use of chemicals in the textile industry.
Source: Water Footprint

Steel, 1 pound (.45 kg):
Your answer: 4 gallons
Correct answer: 30 gallons (114 liters)
Source: The Water Content of Things, Table 19, Gleick, 1993

> Wheat:
Your answer: 110 gallons
Correct answer: 110-250 gallons (415-946 liters)
Wheat consumes about 790 billion cubic meters of water annually, which constitutes 12% of global water use for crop production.
Source: Water Footprint

THE COST OF WATER

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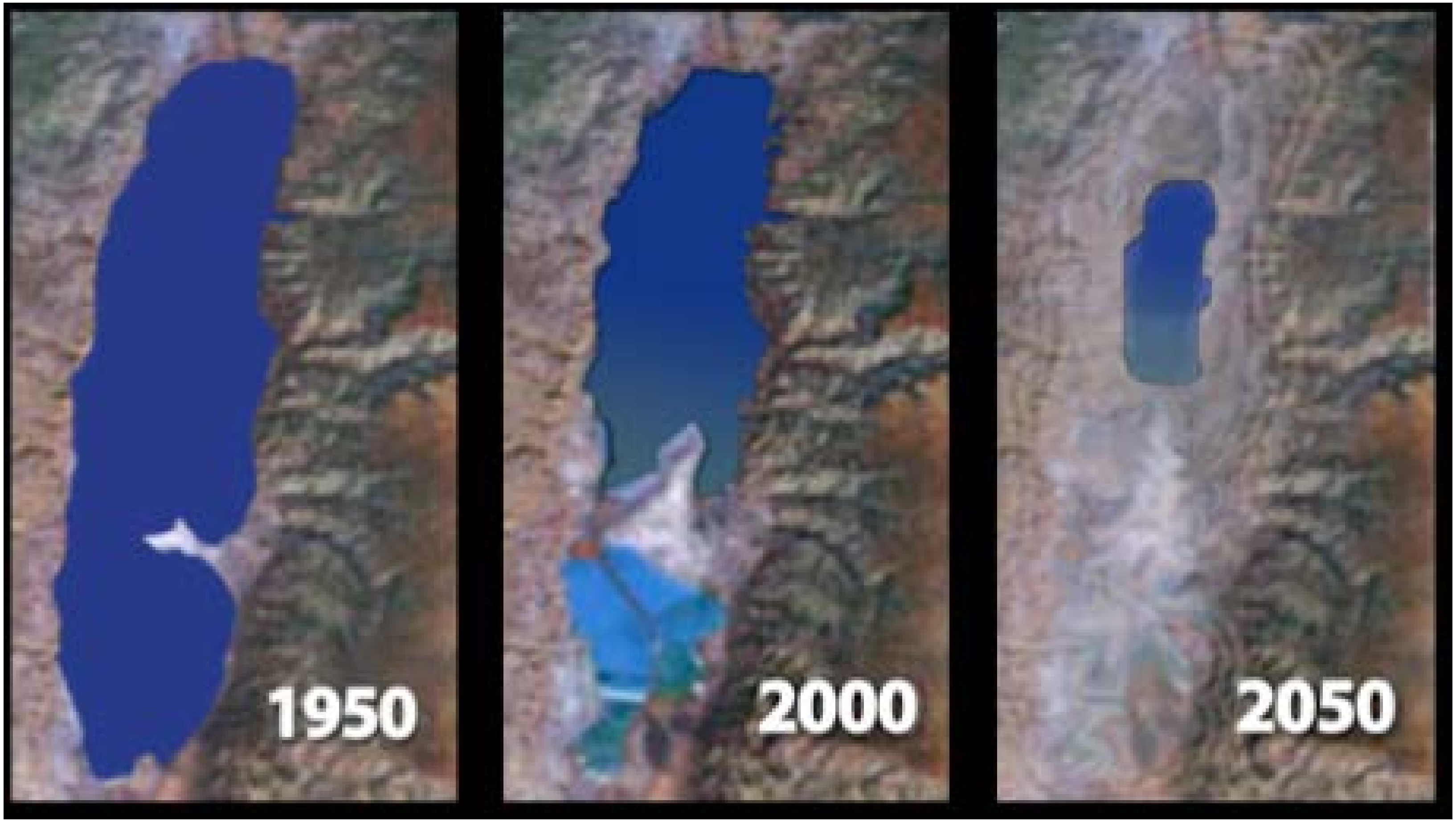

In Summary

Solutions Are Everywhere

- Low flow fixtures
- Efficient irrigation
- Efficiently delivering domestic hot water in central recirc systems requires an efficient layout
- Temperature and flow sensors placed at the source and furthest fixtures means less wasted water in the pipes
- Quantifying savings can help building owners make informed decisions

Thank You

Questions?

Karla Butterfield

Senior Sustainability Consultant

LEED AP, BD+C Homes · LEED Green Rater· HERS Rate · NGBS Master Verifier · PHIUS+ Rater & MF Verifier

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