Code Development for Water & Energy Efficiency

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Natural Resources Defense Council

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What We'll Cover

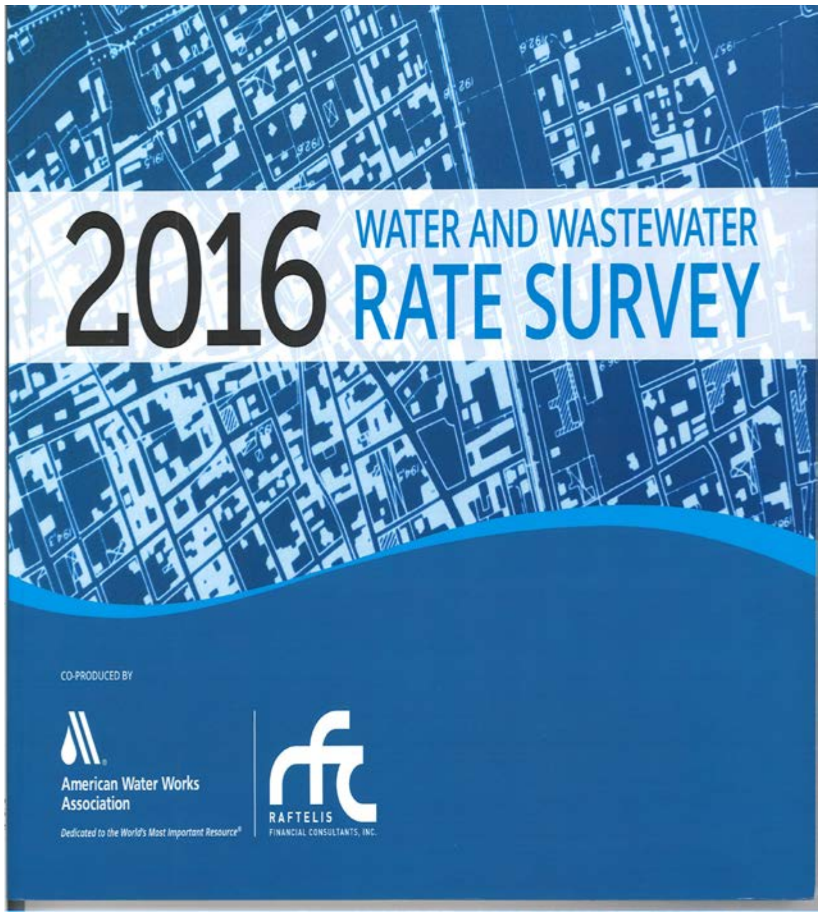
1. Contrasting water and energy utility models
2. Water use trends in the US
3. Recent code developments pertaining to water efficiency
4. Future directions for codes that save water and energy
5. Legionella in premise plumbing

Similarities and differences between water/sewer and electricity/natural gas

- Most US households get **electricity and natural gas** from an investor-owned company regulated by a state public service commission on its rates and charges and the prudency of its investments

- Most US households get **water and wastewater service** from a municipal water department or a special service district that is a public entity under state law. Oversight and approval of rates is by a local governing board (city council or district board), not the state.

Typical Rate Designs



Water (257 systems)	
Flat (non-volumetric)	7%
Uniform	29%
Decreasing block	18%
Increasing block	44%
Increasing-decreasing	2%

Wastewater (178 systems)	
Flat (non-volumetric)	19%
Uniform	62%
Decreasing block	6%
Increasing block	13%
Increasing-decreasing	0%

Trends in Fresh Water Withdrawals 1950-2015

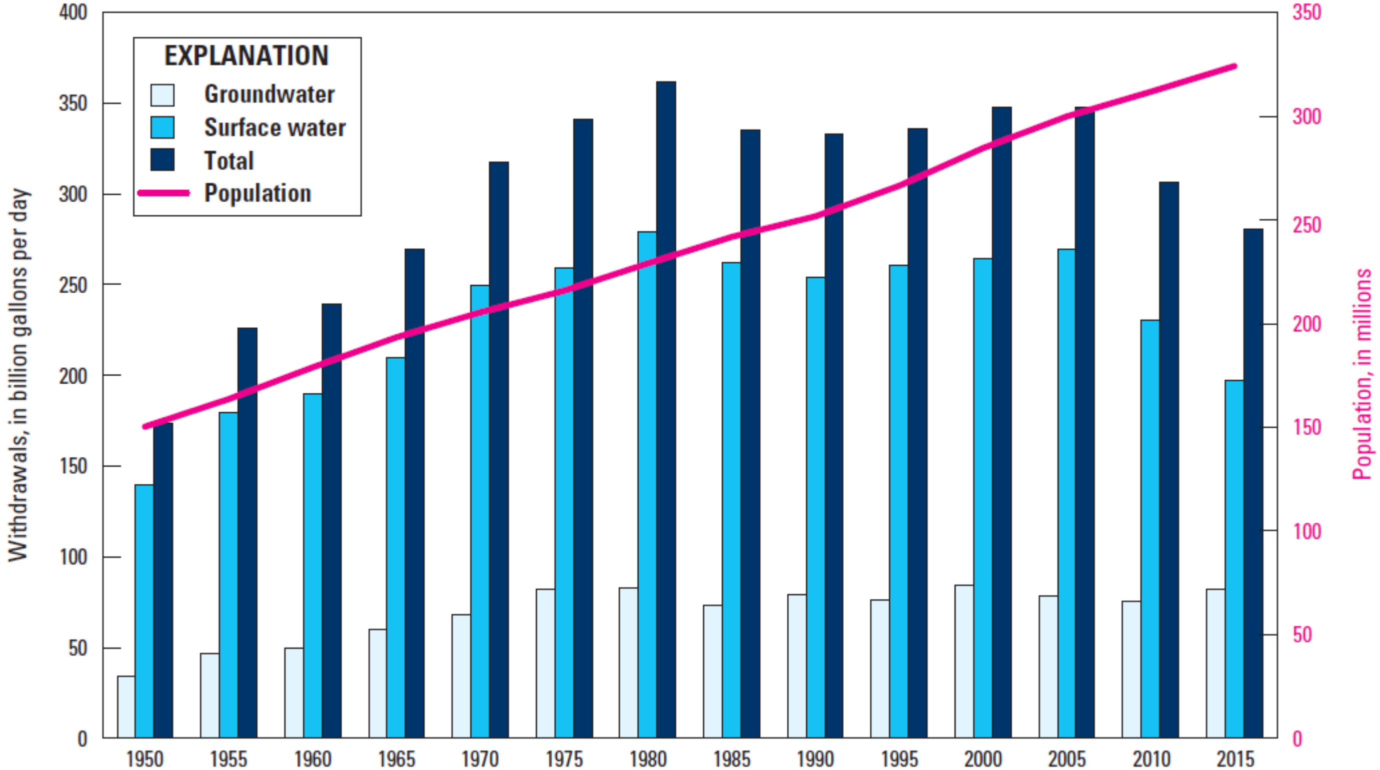


Figure 15. Trends in population and freshwater withdrawals by source, 1950–2015.

USGS (2018)

Water Use in the US (2010 & 2015)

Withdrawals:

	2010 (%)	2015 (%)
Thermoelectric power	45	41
Irrigation	33	37
Public Supply	12	12
Industrial self-supply	4	5
Mining	1	1

Consumptive Use:

Harder to measure, but irrigation is highest. (62% in 2015)

Total Urban Use Dropping as well as Residential per capita Use

Public Supply withdrawals

- 2005 44,200 Mgd
- 2010 42,000 Mgd
- 2015 39,000 Mgd ◀ lowest since 1995

Residential Use (residential public supply + self-supplied domestic)

- 2005 98 gal/c/d
- 2010 87 gal/c/d
- 2015 82 gal/c/d

Source: USGS “Water Use in the United States.” 2008, 2014, 1018.

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Urban Water Efficiency: A Well-Established Trend

Rockaway *et al* (2011):

Found a broad decline in per household water use of about 0.5% per year over a 15-year period in communities across the country -- even those without active water conservation programs.

The authors attributed about 2/3 of this decline to more efficient plumbing and water-using appliances.

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Two Model Codes: ICC & IAPMO

Most local and state governments adopt a model building code developed by one of these two organizations:

International Code Council (ICC)

Relevant to water:

Int'l Plumbing Code (IPC)

Int'l Residential Code (IRC);

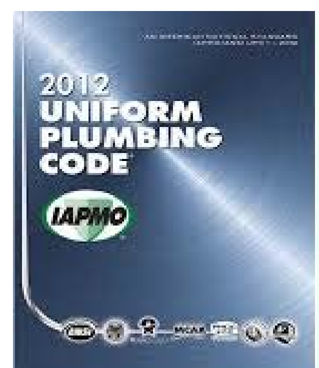
Int'l Mechanical Code (IMC)

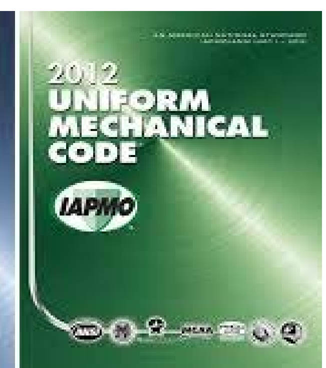
Int'l Energy Conservation Code (IECC).

International Association of Plumbing and Mechanical Officials (IAPMO)

Relevant to water:

Uniform Plumbing Code (UPC); Uniform Mechanical Code (UMC).





Recent Progress in Model Code Revisions

- Hot water pipe insulation increased in both IECC and UPC
- Minimum outlet flow rates reduced in IPC
- Shower mixing valves “rated flow” to match showerhead flowrate in UPC and (pending) IPC
- Cooling tower drift reduction requirements in IMC and UMC.

Model Codes Resist Plumbing Efficiency Proposals

Both ICC and IAPMO code committees rejected higher efficiencies for toilets and urinals in 2012 and 2015 cycles.

WaterSense-rated toilets (1.28 gpf) captured over half of US market by 2011.

Code committees consider IPC and UPC as “base codes”.

- **Saving water not deemed a purpose of these codes.**

Energy-Saving Fittings Also Blocked

IECC technical committee approved WaterSense showerheads (2.0 gpm) for commercial buildings for 2018.

Affirmed by voting membership.

Overturned by ICC Board, citing “code correlation.” IPC technical committee given exclusive jurisdiction over flow rates.

IPC technical committee had rejected 2.0 gpm in same cycle.

Code Initiatives Pending

International Residential Code - Plumbing Chapter

P 46-18 Part 2 -- **shower valve** thermal protection rating must accommodate the flow rate of the installed showerhead (to ensure safe use of high-efficiency showerheads).

RP 10-18 -- establish a maximum length for any hot water supply line (currently 50 feet in IPC)

RP 16-18 -- New **voluntary appendix** for the IRC providing enhanced efficiency requirements for **plumbing products**, **water softeners**, and **irrigation equipment**, as in the IGCC.

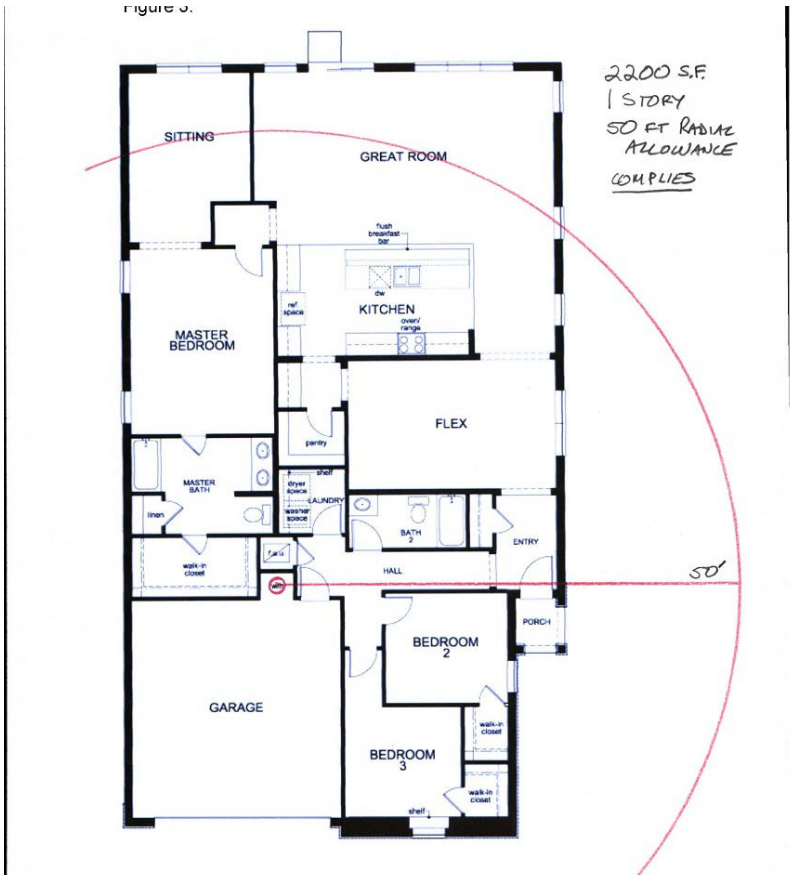
Code Initiatives Pending (cont'd)

International Plumbing Code

P 46-18 Part 1-- (endorsed and submitted by the PMG CAC) - **shower valve** thermal protection rating must accommodate the flow rate of the installed showerhead (to ensure safe use of high-efficiency showerheads).

P 121-18 -- Sets maximum water consumption of 30 gallons per year for **trap seal primers** using potable water.

Future Directions (1) – Compact DHW Design



Both water and energy wasted when cooled-down hot water is purged.

If less hot water is entrained in pipes, hot water arrives quicker, reducing waste.

Volume is a function of pipe length and pipe diameter.

Proximity of fixture outlets to the source of hot water can be a proxy for pipe length, and can be easily assessed at plan check.

Small diameter piping has been limited by code due to pressure drop, but pressure-compensating outlets can now address this concern.

Future Directions (2) – Landscape Standards

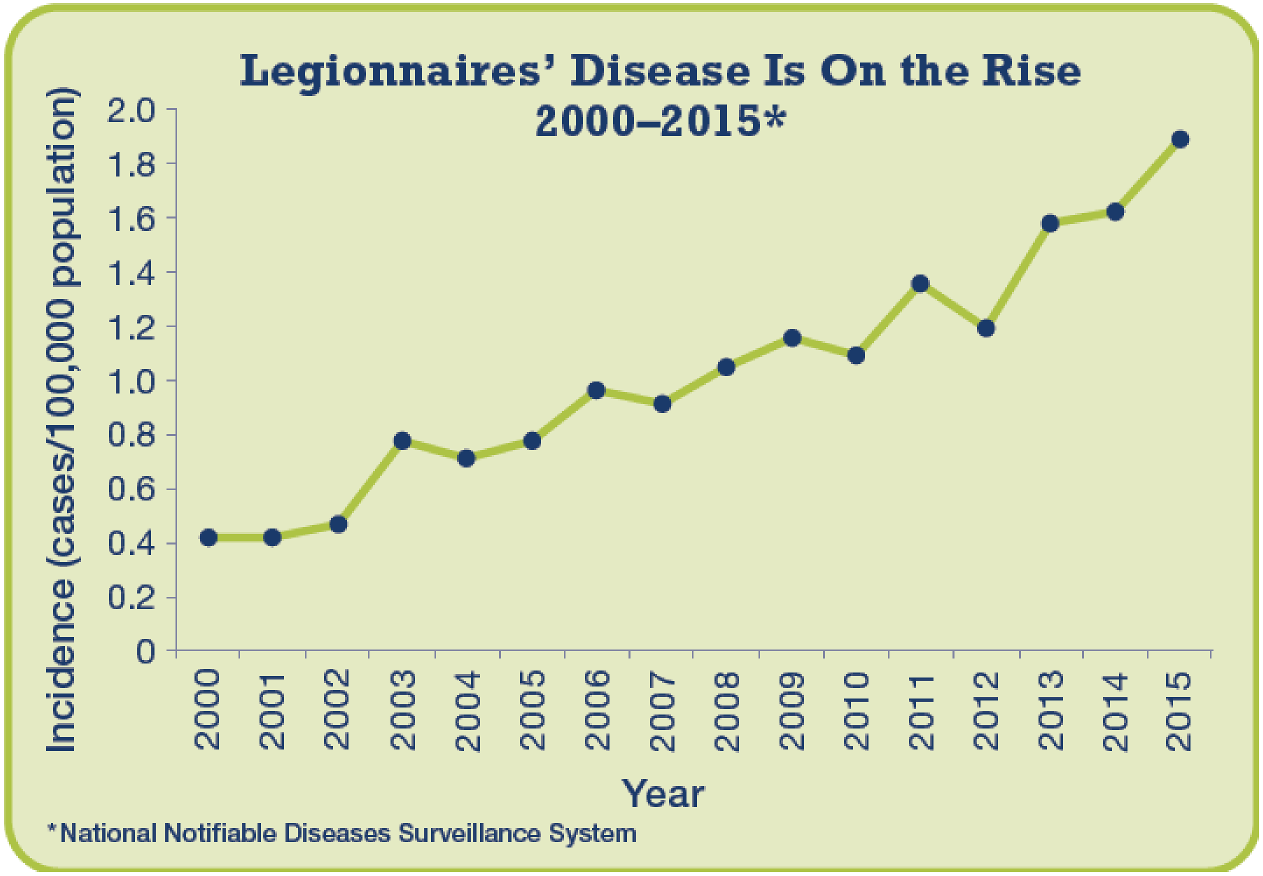
California's landscape regulations (MWELO) are heading into the State Building Standards

DWR now directed to review and update MWELO every 3 years, same as codes

Water budget approach is complicated, but allows maximum design flexibility

Prescriptive path (Appendix D) is available for projects ≤ 2500 sf.

Legionella and Premise Plumbing



Significant increases in reported cases

Legionella and Premise Plumbing

- Water "age" is a known factor in the decay of disinfectant and the increase in microbial activity
- Age can be an issue in either the public distribution system or within the building plumbing system.
- Common DHW conditions (85° – 110° F) sustain growth
- Two EPA-supported research projects (Purdue, Drexel) now underway (3-year studies)
- Risk factors greater in
  - **large buildings** with complex plumbing distribution
  - occupants with **health vulnerabilities**

Implications for Efficiency Objectives

Management:
Water management systems for both new and existing buildings to reduce risk. See ASHRAE Standard 188-2015 -- Legionellosis: Risk Management for Building Water Systems

Research:
Elements of plumbing system design, such as –

- Water age – tank capacity and performance, pipe size
- Water temperature – water heater set points
- Physical interactions – scouring, pipe materials and size
- Water biochemistry – nutrients, pipe materials, disinfectant retention

Thank you

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