DOCKETED

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2019 Building Energy Efficiency Standards
Water Heating Proposals

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Building Standards Office
Efficiency Division

2019 Pre-rulemaking
June 1, 2017

Drain Water Heat Recovery (DWHR)

Source: DEG/PG&E

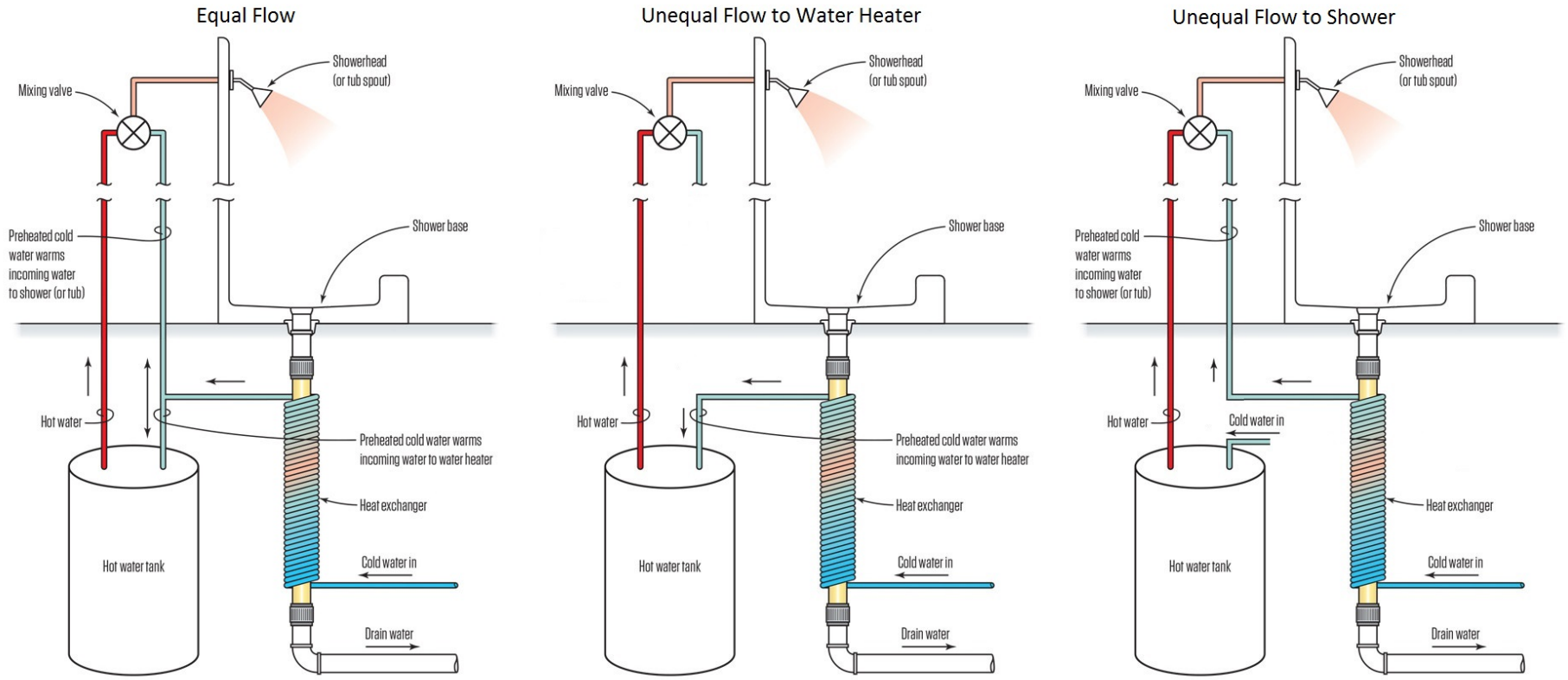
Acknowledgements

Marc Esser, NegaWatt Consulting

Bo White, NegaWatt Consulting

Peter Grant, Davis Energy Group

Introduction to DWHR



Source: Journal of Light Construction, September 2016 (edited)

Relevant Code History

- Not yet included in Title 24, Part 6
- Other Relevant Code Requirements
  - CSA B55.1
  - CSA B55.2
  - IAPMO PS 92
  - CPC Appendix L 606.1
  - Senate Bill 7
  - IAPMO IGC 346-2017 (Draft)

Proposed Code Changes

Proposed Code Change

- High-level description of the proposed code change includes:
  - Compliance options
  - Buildings types impacted: low-rise residential
  - Some differences in comparison to IECC and RESNET

Proposed Code Change

Mandatory, Addition and Alteration Requirements

- No change

Prescriptive Requirements

- New prescriptive alternative for central systems. Reduce solar fraction requirement with installation of DHWR system

Reference Appendices

- New HERS and eligibility criteria section for DWHR Credit

ACM Reference Manual

- Updates to hot water consumption and cold water inlet temperature equations for DWHR system

Why Are We Proposing This Code Change

- Additional option to achieve EDR target
- Achieve significant energy savings
- Provide builders with flexible means of compliance

Technical and Market Barriers

Technical and Market Barriers

- Accurate Installation
  - For vertical units, installation at an angle can negatively impact performance
  - In practice, this is extremely rare
  - Proposed T24 requirement for vertical units to no more than 5% tilt, similar to Manitoba and Ontario codes
  - Need additional training for plumbers

- Horizontal DHWR system
  - CSA 55.1 does not currently address horizontal units. IAPMO IGC 346-2017 still in draft form

Source:Ecodrain.com

Compliance and Enforcement

Compliance Process

Architect/Designer

- DWHR incorporated in the plumbing design layout
- Choose a CEC certified DHWR product

Plan Reviewer

- Confirm plans match CF-1R

HERS Rater

- Visual inspection of DWHR system. Verify manufacturer, model and performance certification information on product

T24, Part 6 Manufacturer Certification for Equipment, Products and devices

Building Energy Efficiency Program

The Energy Commission's energy efficiency standards have saved Californians billions in reduced electricity bills since 1977. Read more ...

2013 Standards & Forms - Effective July 1, 2014

- 2013 Standards Main Page
- Rulemaking
- Pre-Rulemaking

2016 Standards & Forms - Effective January 1, 2017

- 2016 Standards Main Page
- Rulemaking
- Pre-Rulemaking

Upcoming (2019) Standards

- 2019 Standards Main Page
- Pre-Rulemaking

Compliance Resources

- **Online Resource Center**
- Blueprint Newsletter
- Energy Standards Hotline
- External Educational Resources

Additional Resources

- Acceptance Test Technician Certification Program
- California Climate Zone Map
- Energy Efficiency in Existing Buildings (AB 758)
- Enforcement
- HVAC Changeout
- Local Ordinances
- Building Energy Use Benchmarking and Public Disclosure Program (AB 1103)
- Requirements for Manufacturer Certified Equipment, Products and Devices

T24, Part 6 Manufacturer Certification for Equipment, Products and devices

Manufacturer Certification for Equipment, Products and Devices

Manufacturers certify to the Energy Commission that the following listed equipment, products or devices meet the indicated requirements under Title 24, Part 6 and associated appendices. The Energy Commission makes no claim that the listed equipment, products or devices meet the indicated requirements or, if tested, will confirm the indicated results. By being included on these lists, the Energy Commission confirms only that a manufacturer certification has been submitted and accepted.

Manufacturer Certified Equipment, Products and Devices Classifications

- Air Economizers
- Airflow Measurement Apparatus - Forced Air Systems
- Airflow Measurement Apparatus - Ventilation Systems
- Air-to-Water Heat Pump Systems
- Economizer Fault Detection and Diagnostics
- Intermittent Mechanical Ventilation Systems
- Low Leakage Air-Handling Unit
- Occupant Controlled Smart Thermostats

If you have questions about the Standards and documents, please contact the Energy Standards Hotline.

2016 Manufacturer Certification for Equipment, Products and Devices

Low Leakage Air Handling Units

To qualify as a low leakage air-handling unit for use for compliance with applicable performance compliance credits, the air-handling unit shall be certified to the Energy Commission according to the requirements contained in Joint Appendices 9.2.1, 9.2.2, 9.2.3, and 9.2.4, using the the following declaration statement:

» Declaration

References

JA9 - Qulaifications Requirements for Low Leakage Air Handling Units

Submit forms and questions to CertifiedtoCEC@energy.ca.gov
or contact Danny Tam at (916) 654-8435

Note that the requirements for this equipment have not changed from the 2013 to the 2016 version of the Standards. Products certified to this list are compliant with both versions. Currently certified products are not required to be re-certified or re-tested.

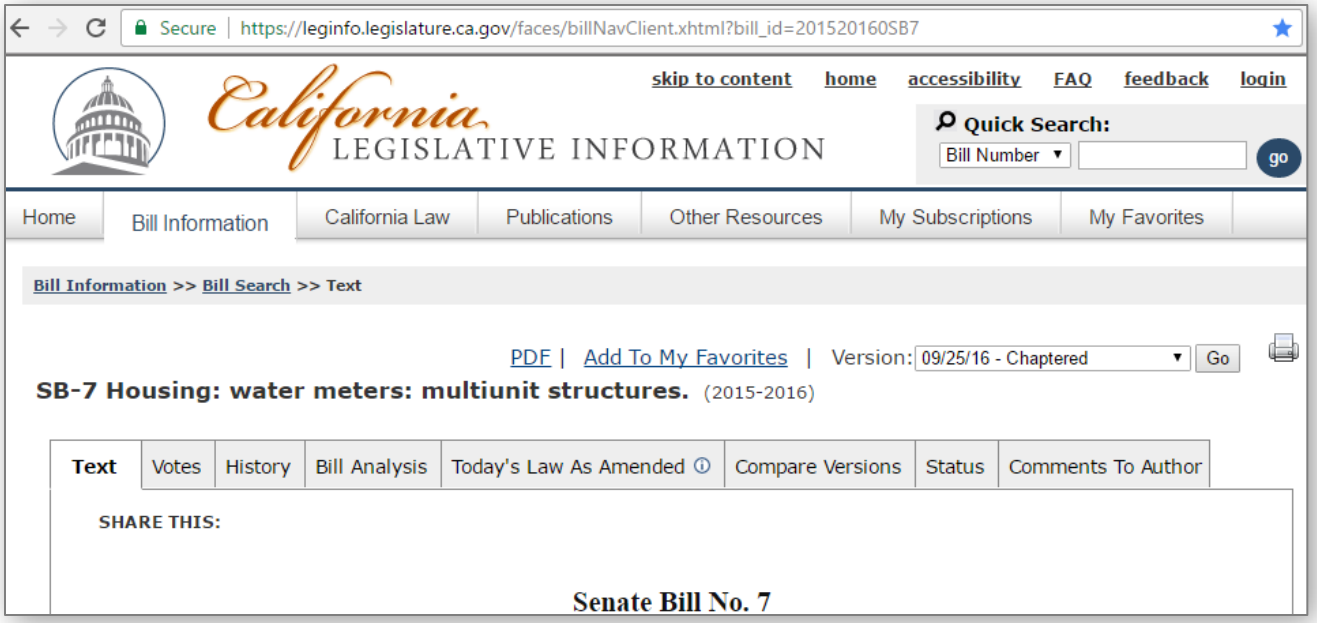
» **Download the List of Low Leakage Air Handling Units certified to the Energy Commission**
Updated: May 16, 2017

Compliance and Enforcement Barriers

- Relatively new to CA market
  - Require additional training to building departments and HERS raters
  - Coordination needed from design through final inspection phase
- Accessibility
  - DWHR manufacturer report of product failure are negligible
  - Manitoba and Ontario codes do not address accessibility
  - Current T24 proposal do not require accessibility.

Compliance and Enforcement Barriers

- Senate Bill SB-7
  - Creates new requirements for sub-metering of water usage per dwelling unit in multifamily buildings
    - Exceptions for low-income housing, elderly residential care facilities, student housing, time-share property
  - Effective January 1, 2018
  - Could nullify cost-effectiveness in some multifamily buildings



Energy Savings

Definition of Baseline and Proposed Conditions

Baseline Conditions

- Minimally compliant with 2016 Standards
- 2,700 ft^2 and 6,960 ft^2 residential prototypes
- 8760 operating hours
- 16 climate zones
- 115 ^{0}F at hot-side of shower valve
- CBECC-Res hot water schedules
- Hourly weather dependent cold water temperatures

Proposed Conditions

- Lab derived DWHR effectiveness algorithms
- 46.6% CSA rated effectiveness
- All shower fixtures in single family prototype located on the 2nd floor and connected to one device in equal flow configuration
- All shower fixtures on the 2nd floor of the multifamily prototype connected to one device in unequal to shower configuration
- No water meters included

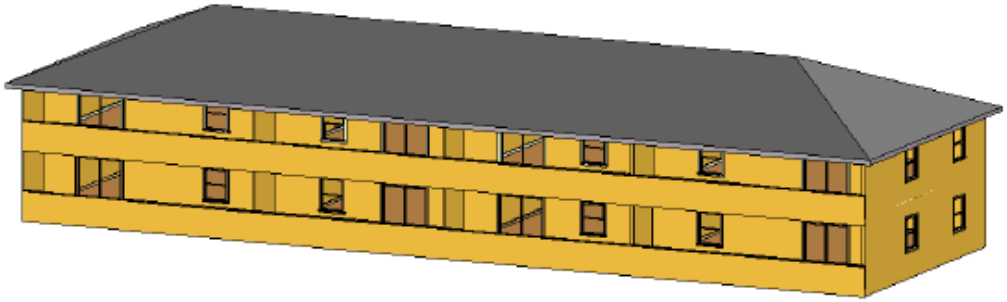
Prototypes

Figure A-4: Two-Story Prototype Front View

Figure A-5: Two-Story Prototype Back View

Figure A-8: Multifamily Prototype Front View

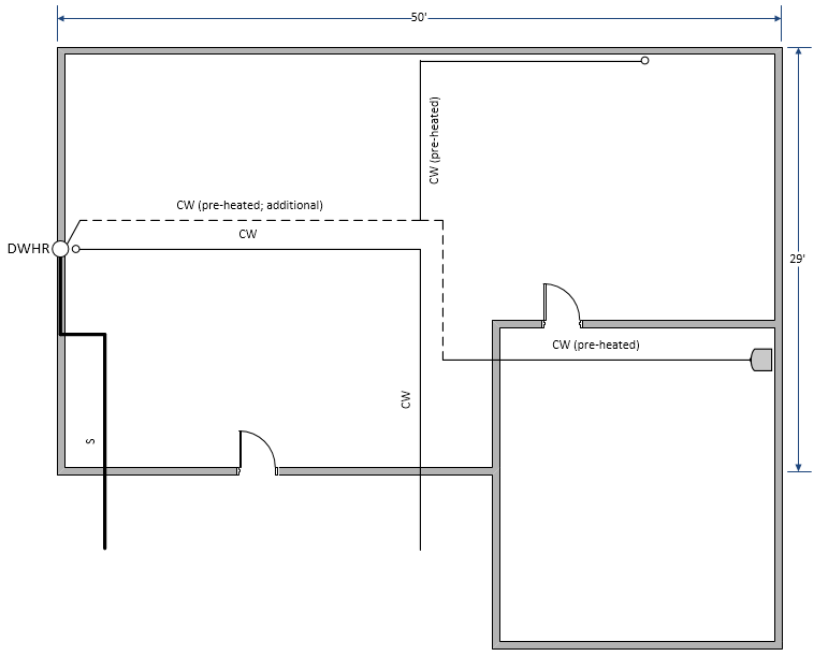
Figure A- 9: Multifamily Prototype Back View



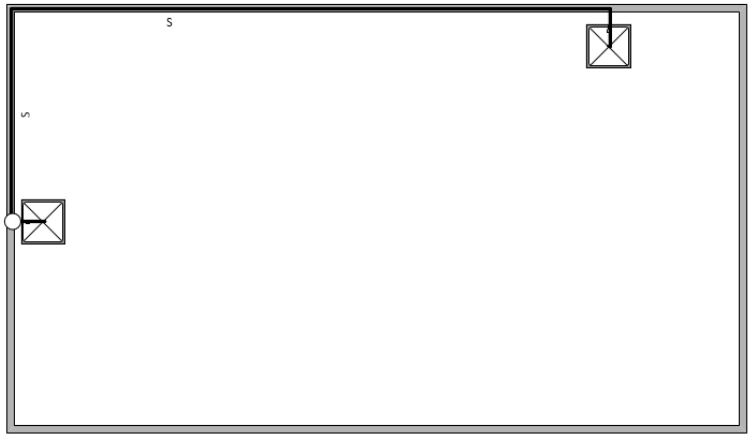
Source: CEC, 2016 ACM Approval Manual

Example DWHR Piping Diagram for 2-story Single-Family Prototype

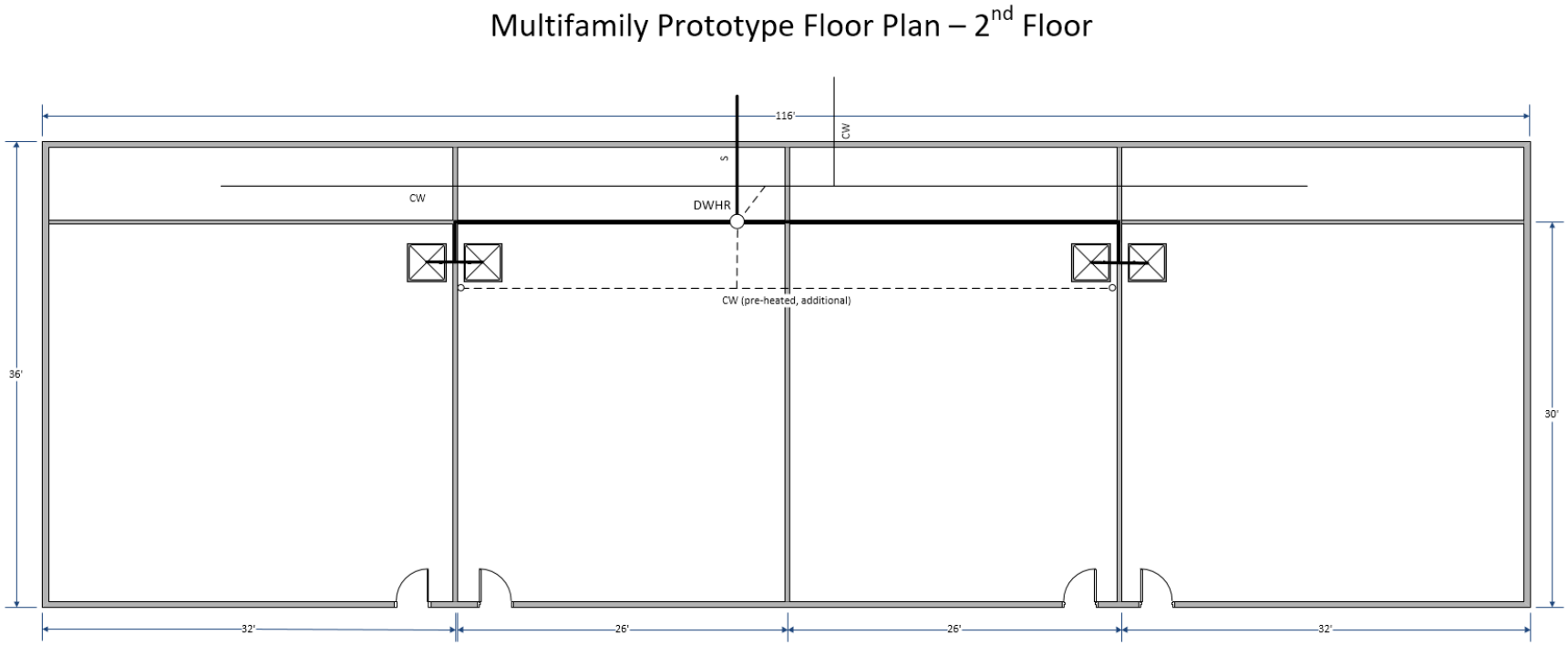
Two-Story Prototype Floor Plan – 1st Floor



Two-Story Prototype Floor Plan – 2nd Floor



Example DWHR Piping Diagram for Multifamily Prototype



Annual Energy Savings Per Prototype Building

Climate Zone	Single Family Prototype 2700; Equal Flow; 2”ø or 3”ø		Multi-Family Prototype 6960; Unequal to Shower; 3”ø	
	TDV Energy Savings (TDV kBtu/yr)	30 Year TDV Energy Cost Savings ($2020)	TDV Energy Savings (TDV kBtu/yr)	30 Year TDV Energy Cost Savings ($2020)
1	5,158	$893	8,021	$1,389
2	4,652	$806	7,416	$1,285
3	4,666	$808	7,445	$1,290
4	4,444	$770	7,152	$1,239
5	4,775	$827	7,583	$1,313
6	4,248	$736	6,915	$1,198
7	4,105	$711	6,709	$1,162
8	4,055	$702	6,654	$1,152
9	4,051	$702	6,642	$1,150
10	4,020	$696	6,303	$1,092
11	4,094	$709	6,339	$1,098
12	4,319	$748	6,662	$1,154
13	4,009	$694	6,237	$1,080
14	4,168	$722	6,441	$1,116
15	2,869	$497	4,664	$ 808
16	5,141	$890	7,577	$1,312

Annual Energy Savings Per Prototype Building

Climate Zone	Single Family Prototype 2700; Equal Flow; 2”ø or 3”ø Annual Natural Gas Savings (therms/yr)	Multifamily Prototype 6960; Unequal to Shower; 3”ø Annual Natural Gas Savings (therms/yr)
1	26.1	40.5
2	23.4	37.3
3	23.5	37.5
4	22.3	35.9
5	24.1	38.2
6	21.3	34.6
7	20.9	34.1
8	20.3	33.3
9	20.2	33.1
10	20.0	31.4
11	20.4	31.6
12	21.6	33.3
13	19.9	31.0
14	20.6	31.9
15	14.0	22.8
16	25.6	37.8

Annual Gas Savings [therms/yr] (3”ø, 46.6% effectiveness)

	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8	CZ9	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
Equal Flow																
1BR	17.5	15.7	15.8	15.0	16.2	14.3	14.1	13.6	13.6	13.5	13.6	14.5	13.4	13.8	9.4	17.2
2BR	20.4	18.3	18.4	17.5	18.9	16.6	16.3	15.9	15.8	15.7	15.9	16.9	15.6	16.1	10.9	20.0
3BR	22.9	20.6	20.7	19.6	21.2	18.7	18.4	17.8	17.8	17.6	17.9	19.0	17.5	18.1	12.4	22.5
4BR	26.1	23.4	23.5	22.3	24.1	21.3	20.9	20.3	20.2	20.0	20.4	21.6	19.9	20.6	14.0	25.6
5BR	29.7	26.7	26.9	25.5	27.5	24.3	23.9	23.1	23.1	22.9	23.2	24.7	22.8	23.5	16.0	29.2
MF	60.8	54.5	54.8	52.0	56.2	49.6	48.7	47.3	47.1	44.6	45.3	48.1	44.4	45.9	31.2	57.1
Unequal Flow to WH																
1BR	16.3	14.5	14.6	13.8	15.0	13.1	12.9	12.4	12.4	12.3	12.5	13.3	12.2	12.6	8.3	16.0
2BR	19.0	16.9	17.0	16.1	17.5	15.3	15.0	14.5	14.4	14.3	14.5	15.5	14.2	14.7	9.7	18.6
3BR	21.4	19.0	19.1	18.1	19.6	17.2	16.9	16.3	16.3	16.1	16.4	17.5	16.0	16.6	11.0	21.0
4BR	24.3	21.7	21.8	20.6	22.4	19.5	19.2	18.6	18.5	18.3	18.7	19.9	18.3	18.9	12.5	23.9
5BR	27.8	24.8	24.9	23.6	25.6	22.4	21.9	21.2	21.2	21.0	21.4	22.8	20.9	21.7	14.3	27.3
MF	57.3	51.1	51.4	48.6	52.7	46.1	45.3	43.8	43.7	41.3	42.1	44.8	41.1	42.6	28.2	53.8
Unequal Flow to Showers																
1BR	11.3	10.4	10.5	10.1	10.7	9.7	9.6	9.3	9.3	9.2	9.3	9.8	9.1	9.3	6.7	11.0
2BR	13.2	12.2	12.3	11.8	12.5	11.3	11.2	10.9	10.9	10.8	10.8	11.4	10.6	10.9	7.8	12.9
3BR	14.9	13.8	13.8	13.3	14.1	12.8	12.6	12.3	12.3	12.1	12.2	12.9	12.0	12.3	8.9	14.5
4BR	17.0	15.7	15.8	15.1	16.1	14.6	14.4	14.0	14.0	13.9	13.9	14.7	13.7	14.1	10.1	16.6
5BR	19.6	18.1	18.2	17.4	18.5	16.8	16.5	16.1	16.1	15.9	16.0	16.9	15.7	16.2	11.6	19.1
MF	40.5	37.3	37.5	35.9	38.2	34.6	34.1	33.3	33.1	31.4	31.6	33.3	31.0	31.9	22.8	37.8

Ratio of Unequal to Equal Flow Savings (3”ø, 46.6% effectiveness)

	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8	CZ9	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
Unequal Flow to WH / Equal Flow																
1BR	93%	92%	92%	92%	93%	92%	92%	91%	91%	91%	91%	92%	91%	92%	89%	93%
2BR	93%	92%	92%	92%	93%	92%	92%	91%	91%	91%	92%	92%	91%	92%	89%	93%
3BR	93%	92%	93%	92%	93%	92%	92%	91%	91%	91%	92%	92%	91%	92%	89%	93%
4BR	93%	93%	93%	92%	93%	92%	92%	92%	92%	91%	92%	92%	92%	92%	89%	93%
5BR	93%	93%	93%	92%	93%	92%	92%	92%	92%	92%	92%	92%	92%	92%	89%	93%
MF	94%	94%	94%	93%	94%	93%	93%	93%	93%	93%	93%	93%	93%	93%	90%	94%
Unequal Flow to Showers / Equal Flow																
1BR	65%	66%	66%	67%	66%	68%	68%	69%	69%	69%	68%	67%	68%	68%	71%	64%
2BR	65%	67%	67%	67%	66%	68%	68%	69%	69%	69%	68%	68%	68%	68%	72%	64%
3BR	65%	67%	67%	68%	66%	68%	69%	69%	69%	69%	68%	68%	68%	68%	72%	65%
4BR	65%	67%	67%	68%	67%	69%	69%	69%	69%	69%	68%	68%	69%	68%	72%	65%
5BR	66%	68%	68%	68%	67%	69%	69%	70%	70%	70%	69%	69%	69%	69%	72%	65%
MF	67%	68%	68%	69%	68%	70%	70%	70%	70%	70%	70%	69%	70%	69%	73%	66%

Questions?