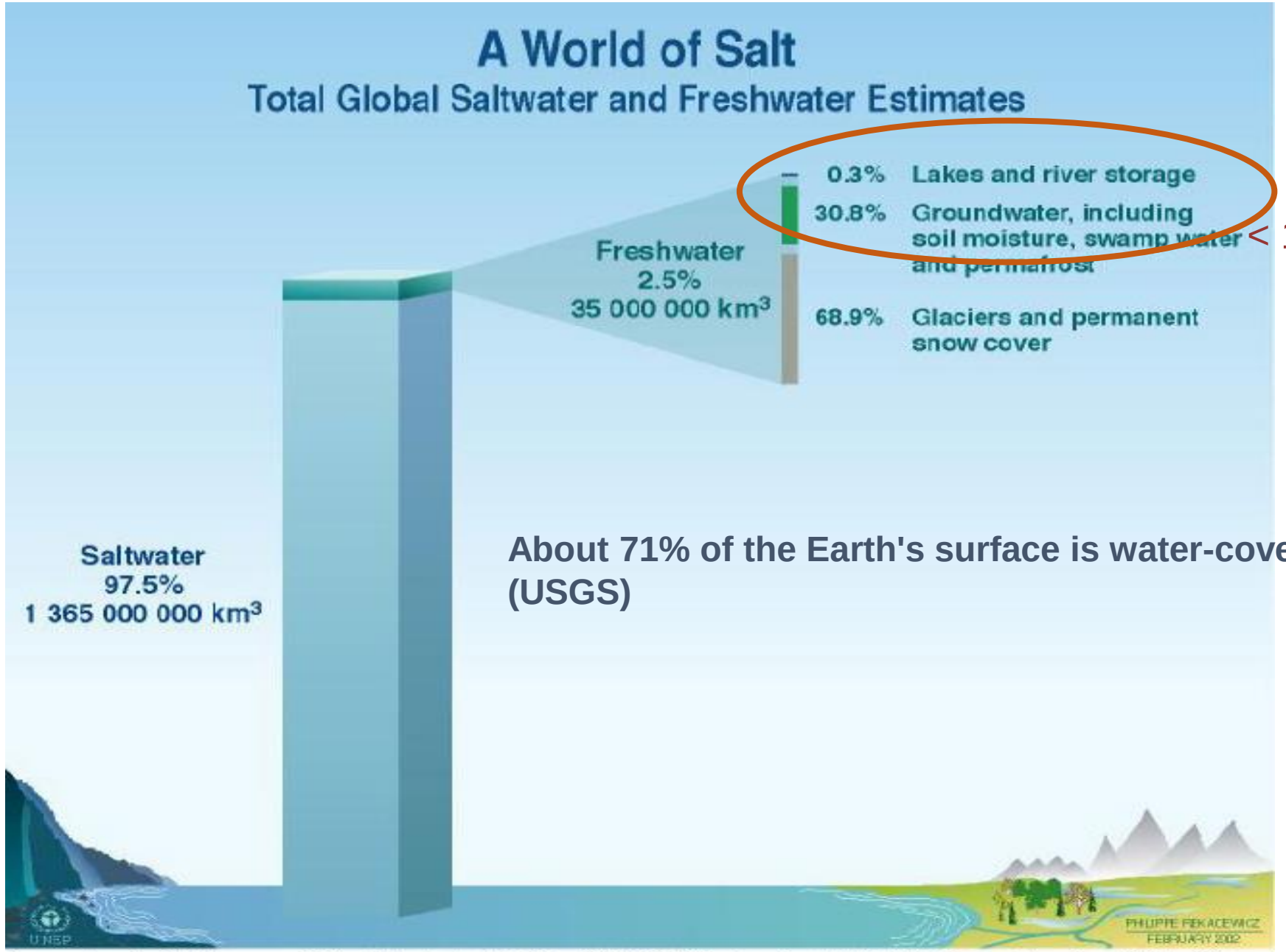
Water Why It Matters and What We Can Do Introducing Standard 1101 and $HERS_{H2O}$

Dave Walls
International Code Council

Water-Why It Matters

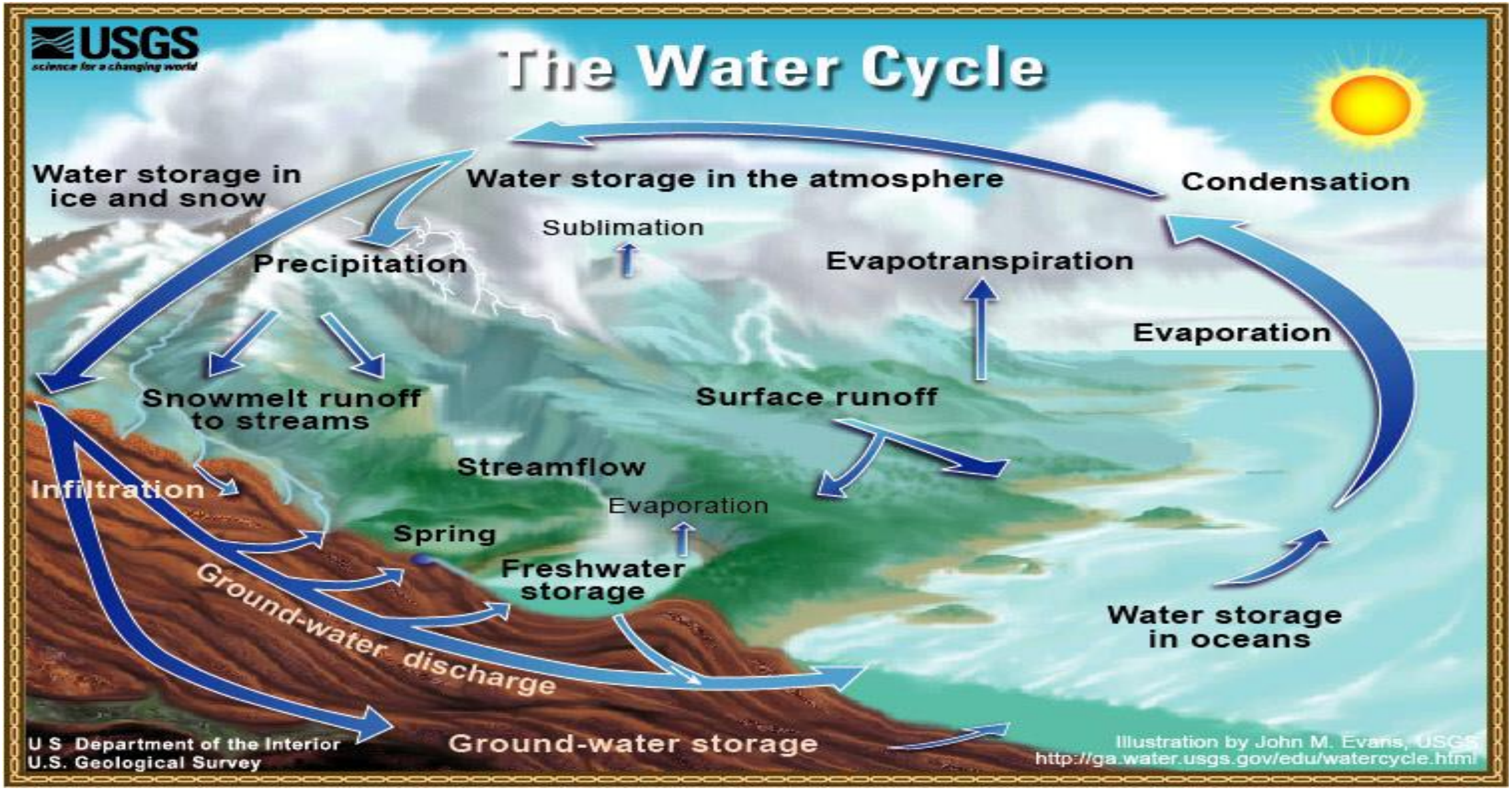
The World *Runs* on Water!

- Water is the most vital natural resource on the planet.
- The average adult human body is 50-65% water, averaging around 57-60%
- It is necessary for human survival and a critical input into our food, manufacturing, and energy systems.
- It sustains the ecosystems and climates upon which both our built and natural world rely.
- We are putting more pressure on freshwater resources than ever.
- Est. world population 7.6B (2018)



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

< 1% usable


USGS
science for a changing world
The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Sublimation
Precipitation
Evapotranspiration
Evaporation
Snowmelt runoff to streams
Surface runoff
Streamflow
Infiltration
Evaporation
Spring
Freshwater storage
Ground-water discharge
Water storage in oceans
U S Department of the Interior
U.S. Geological Survey
Ground-water storage
Illustration by John M. Evans, USGS
http://ga.water.usgs.gov/edu/watercycle.html

The Water Energy Nexus

- Water-related uses account for 19% of a western state's electricity consumption
- 30% of its natural gas and
- 88 billion gallons of diesel fuel every year.
- Water-efficiency measures can reduce water and sewer costs by up to 30 percent.
- Significant savings in energy, chemical and maintenance expenses often follow.

What we can do

- Water Use Habits
  - Over irrigating landscaping
  - Long showers, letting water run unnecessarily, etc.
- Codes
  - International Plumbing Code
  - International Green Construction Code
  - Water Efficiency Provisions
- Standards
  - ICC/CSA Rainwater
  - BSR/RESNET/ICC

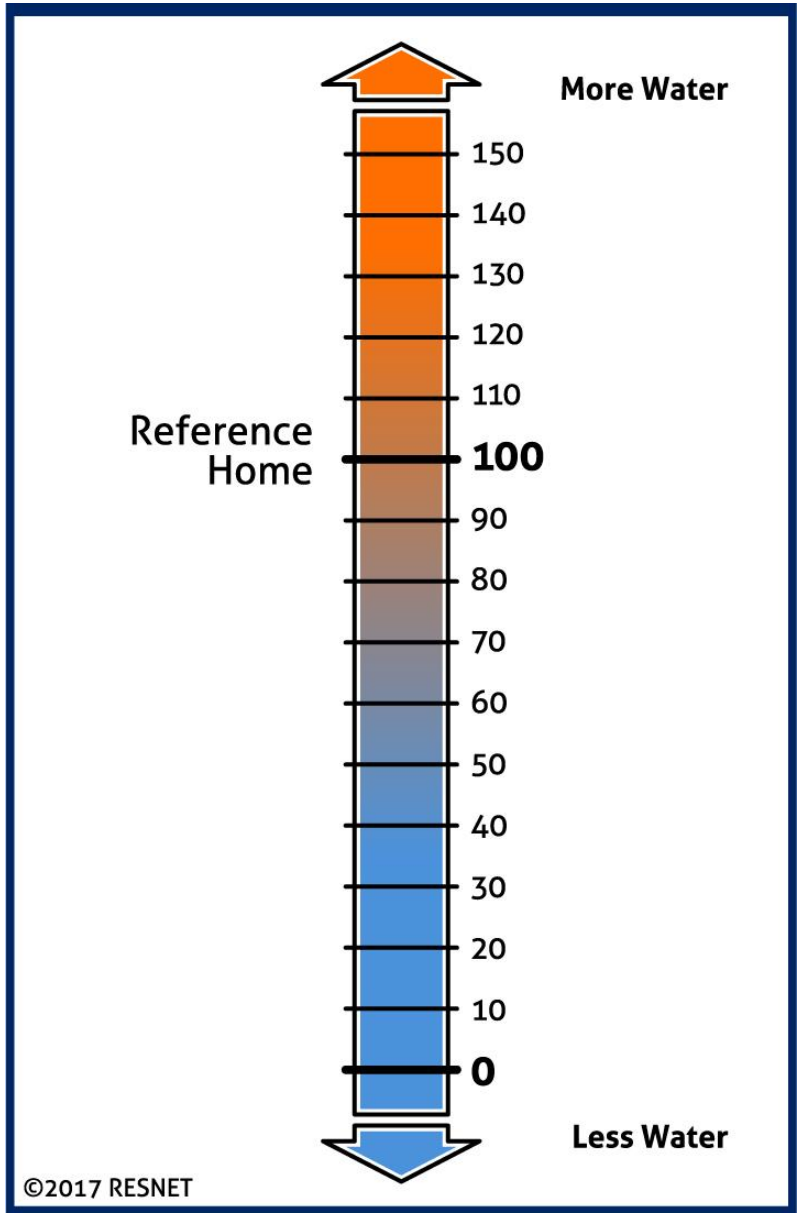
Charge from the RESNET Board - 2015

Create an index that:

1. **Leverages the advances made in the HERS standard (ICC-301-2014) Appendix A**
   - Calculates hot and cold water for all principle fixtures and appliances, requires additional outdoor uses
   - Has compelling technical support
2. **Is inline with the general HERS methodology**
   - Generates a score by comparing the rated home to a reference
   - Reference home is representative of new construction circa 2006
3. **Provides a low bar for participation by HERS Raters**
   - Can be added to a HERS rating for a reasonable incremental cost

Key Objectives for $HERS_{H2O}$

- Nationwide applicability
- Suitable for both new and existing homes
- Encompasses both indoor and outdoor water efficiency
- Practical and affordable to administer
- Scores usable for quantitative comparison



Timeline of Development

2015

- RESNET Board Approves Program
- Advisory Council Formed

2016

- $HERS_{H2O}$ Working Group Formed
- $HERS_{H2O}$ Working Group Technical Subcommittees formed
- Initial work begins

2017

- Technical Guidelines Drafted and Underwent Public Review and Comment Process
- Inspection Checklist completed
- Inspection guidance doc drafted
- RESNET/ICC ANSI SDC Formed
- Planning for Field Testing of Technical Guidelines
- Working draft of ANSI Standard started

2018 and 2019 Activities

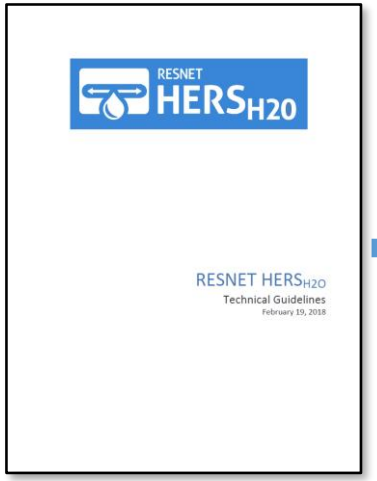
2018

- **Guidelines approved by RESNET Board**
- **Development of WRI Standard**
  - Review of draft Standard by SDC
  - Public Comment Period
  - Review/respond to Public Comments
- **Development of $HERS_{H2O}$ Implementation Standards**
  - Quality Assurance
  - Registry
  - Training
- **6 month pilot phase**

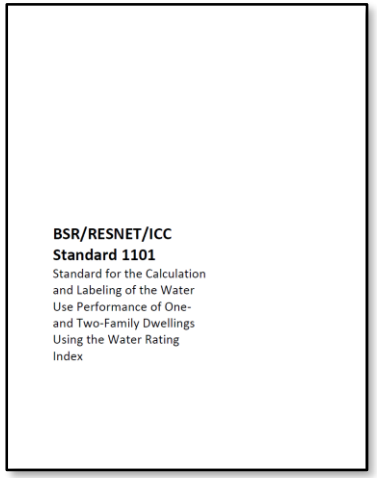
2019

- **Second round of public comments on Standard 1101**
- **Revisions to Inspection checklist and guidance doc**
- **Development of $HERS_{H2O}$ training**
- **Finalize $HERS_{H2O}$ implementation standards**
- **$HERS_{H2O}$ data in RESNET Registry**
- **Publication of Standard 1101**

Development Process



Technical Guidelines



ANSI Standard

CODE

Reference in Codes and other Standards ??

Technical Guidelines serve as the basis for the Water Rating Index Standard (BSR/RESNET/ICC 1101-201x).

How do Standard 1101 and $HERS_{H2O}$ Relate?

BSR/RESNET/ICC Standard 1101:

- Developed through an ANSI consensus-based process
- RESNET's Standard Development Committee 1100 is responsible for the development of this standard
- Technical subcommittee also provides recommendations
- Eligible to be adopted by code development and adopting entities

$HERS_{H2O}$:

- RESNET program that will be based on Standard 1101
- Additional program requirements to include:
  - Certification of raters
  - Accreditation of rating providers
  - Quality Assurance oversight
  - Approval of software

Update on Standard 1101

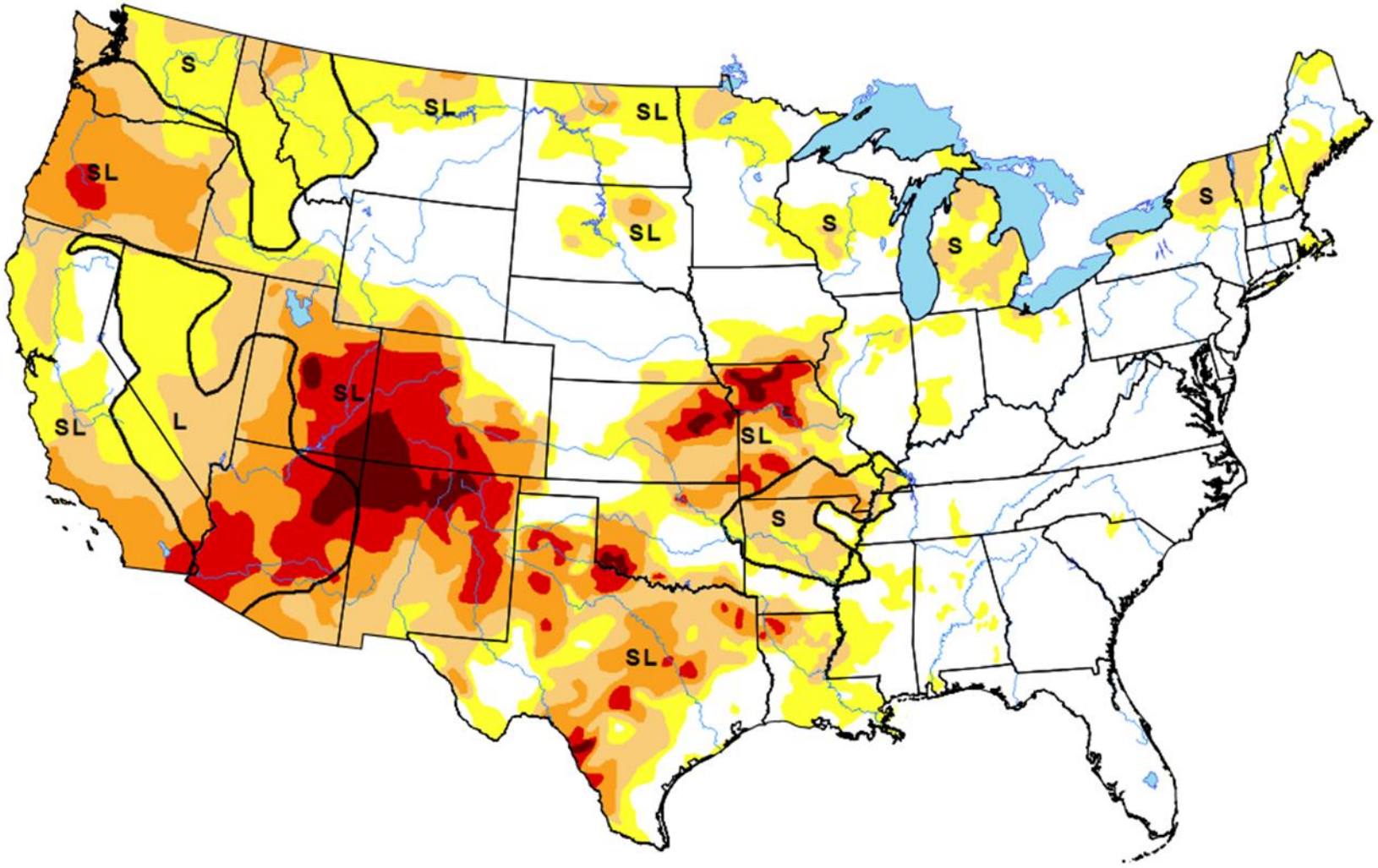
- Summer/Fall-2018: Public comment on PDS-01 .
- Spring 2019: Public comment on PDS-02
- Subcommittee has reviewed comments on PDS-02
- SDC 1100 needs to approve response to comments and changes to the standard
- Potential 3rd round of public comments
- Expected final publication later in 2019

Introduction to $HERS_{H2O}$

Drought- Not the Only Driver for Water Efficiency Efforts

Map for August 16, 2018

Data valid: August 14, 2018 | Author: Richard Heim, NOAA/NCEI

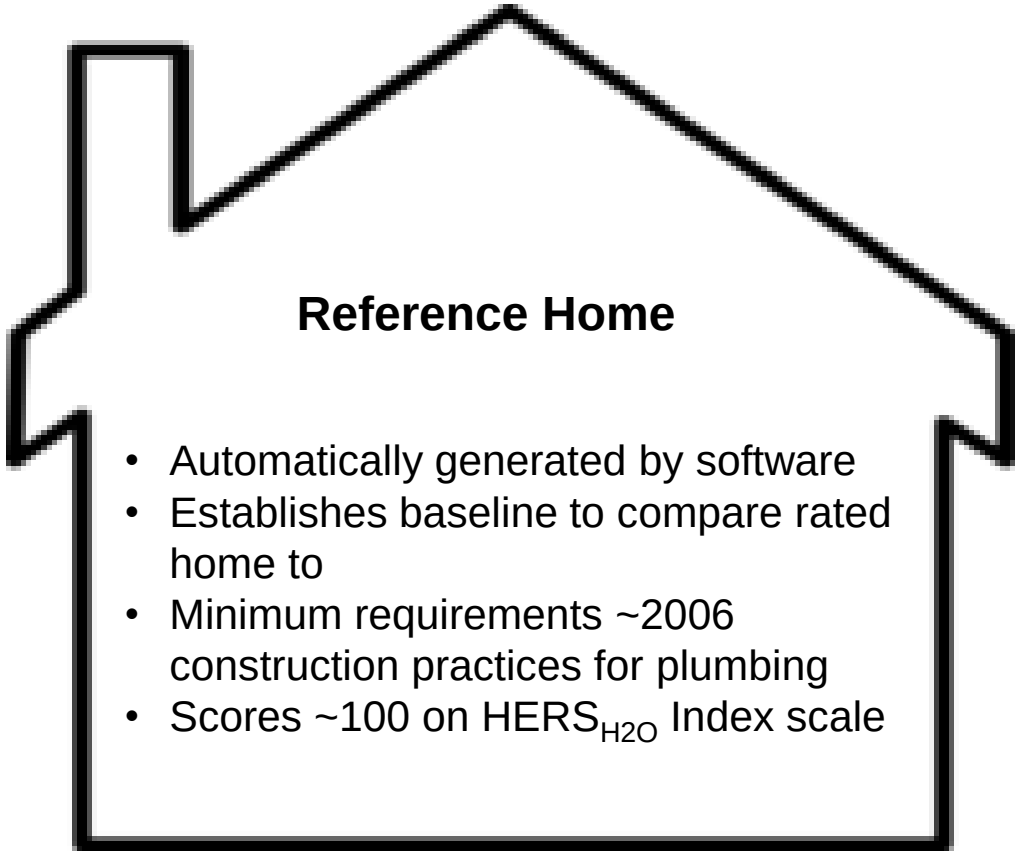


Increases in Water Costs

Water cost increases from 2000-2012:

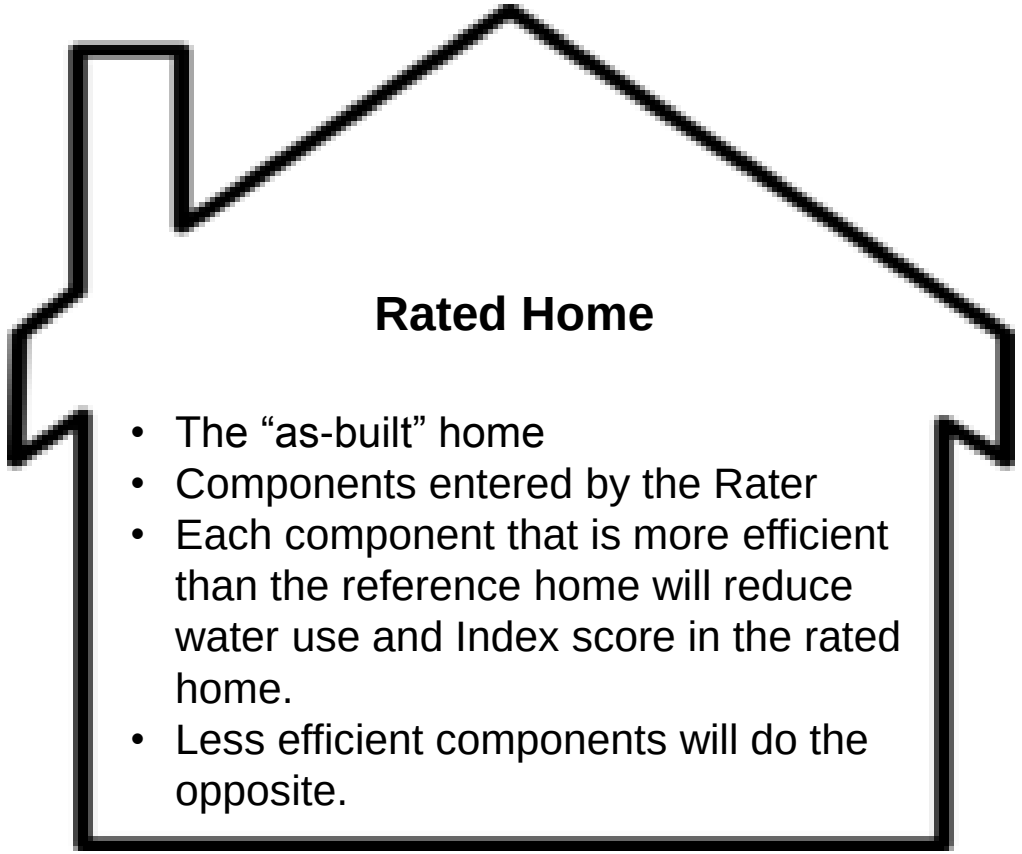
1. Atlanta: 233%
2. San Francisco: 211%
3. Wilmington: 200%
4. Philadelphia: 164%
5. Portland: 161%
6. Wichita: 153%
7. New York: 151%
8. Waterloo, IA: 145%
9. Binghamton, NY: 143%
10. San Diego and Augusta: 141%

Basic Concept of a Rating



Reference Home

- Automatically generated by software
- Establishes baseline to compare rated home to
- Minimum requirements ~2006 construction practices for plumbing
- Scores ~100 on $HERS_{H2O}$ Index scale



Rated Home

- The “as-built” home
- Components entered by the Rater
- Each component that is more efficient than the reference home will reduce water use and Index score in the rated home.
- Less efficient components will do the opposite.

Scope of the Standard

This Standard will provide a uniform methodology for evaluating, rating and labeling the indoor and outdoor water use performance of one- and two-family dwellings.

Components of a Water Rating

Shower Heads

Kitchen Faucet

Lavatory Faucets

Clothes Washer

Toilet Flush Volume

Water Softener

Leaks/Other Water Use

Excess Pressure

Irrigation

Pool or Spa

Other Factors Included in the Rating

House Size

Geographic Location

Number of Bedrooms

Lot & Landscape Size

Hot Water Distribution Layout

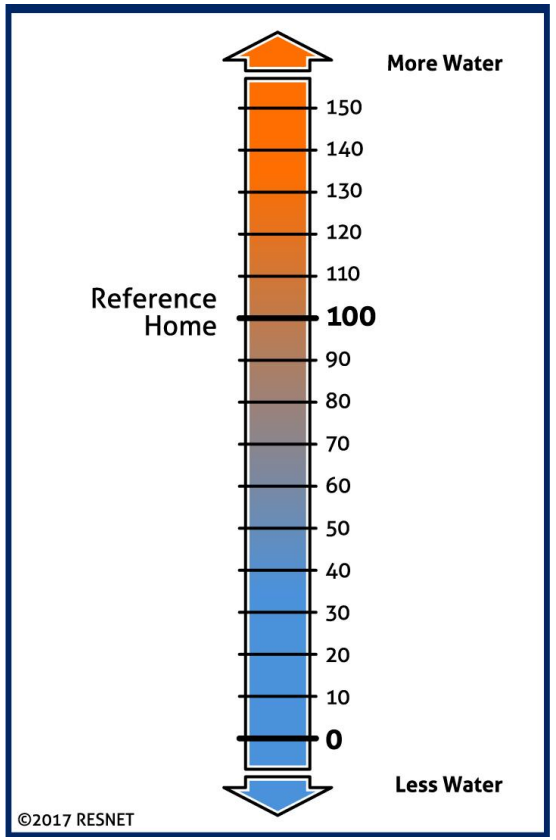
Hot Water Pipe Insulation

Rainwater and Gray Water

- Not addressed in the Standard
- Explanation included in the Forward
- Committee decision:
  - Insufficient reliable data to quantify the impact of alternative water sources on a home's potable water use
- Goal to include in future revisions
- Reclaimed/Recycled also not included

Calculating the Index Score

$$\textbf{HERS}_{\textbf{H2O}}\ \textbf{Index} = \frac{indoor\ and\ outdoor\ gpd\ for\ the\ rated\ home}{indoor\ and\ outdoor\ gpd\ for\ the\ reference\ home} * 100$$



Rating Calculation Methodology

- Grounded in water use data as much as possible
- Indoor reference home based primarily on HERS
- Outdoor reference home based on Residential End Uses of Water Study
- Number of bedrooms used as predictor of occupancy
- Built upon ANSI/RESNET/ICC Standard 301-2014 and Addendum A

Rated Home Credits

Indoor model will respond to:

- More efficient plumbing products
- Efficient Appliances
- More efficient plumbing distribution

Outdoor model will respond to:

- Smaller landscapes (the reference landscape is fixed based on lot size)
- More efficient irrigation technology
  - Smart controllers
  - More efficient emitters, as expressed by the Residential Irrigation Capacity Index (RICI)

Calculation Spreadsheet

Indoor Calculation Fields

Example Water Use Calculations

User input fields are yellow	
Location (pull down)	Castle Rock, CO
Distribution system	std
HW pipe Insulation	none
Shower (gpm)	2.5
Kitch Faucet (gpm)	2.2
Lav Faucet efficiency	std
Std sys pipe length	89
Recirc sys loop length	159
Recirc sys branch length	10
Recirc pumpWatts	50
DW heat recovery?	no
Lot Area (ft2)	5,000
Landscaped Area (ft2)	2,348
% Outdoor H2O =	*34%*
Ref_Irr_Area =	*2,348*
Tot_Ref_Irr_ratio =	*47.0%*
Net_Lscape_ratio =	*61.8%*
Lot size (acres) =	0.115
Ref std sys pipe length =	*89.3*
Ref recirc sys loop length =	*158.6*

Water Use	Cold Wtr	Hot Wtr	Total Wtr
Shower_gpd	7.0	17.1	24.1
KitchF_gpd	4.1	10.1	14.2
LavF_gpd	1.8	4.5	6.4
Waste_gpd	4.5	11.2	15.7
CW_gpd	20.6	3.9	24.5
DW_gpd		4.3	4.3
Toilets_gpd	21.9		21.9
Soft_gpd	0.0		0.0
Other_gpd	15.7	2.1	17.8
EP_gpd	0.0	0.0	0.0
Indoor_gpd	75.7	53.2	128.9
Outdoor_gpd	67.8	0.0	67.8
Total_gpd	143.5	53.2	196.6
Ref_In =	75.7	53.2	128.9
Ref_Out =	67.8	0.0	67.8
Ref_Tot =	143.5	53.2	196.6
Save_Tot =	0.0	0.0	0.0
H2O_in =	100	100	100
H2O_Out =	100	100	100
H2O_Tot =	100	100	100
$HERS_{H2O}$ =	100	H2Osave* =	0
		$save** =	$0

* Gallons per year

** $ per year

Home characteristics:	
CFA	2400
Nbr	3
Nfl	2
Bsmt	0
Appliances:	
Dishwashe	std
Clothes washe	std
W	9.5
Toilets:	
gp	1.6
Water Softener	
Softene	no
gal/removed	5.0
Outdoors:	
Inground Pool?	no
Irrigation?	no
Smart controller?	no
Use RICI?	no
Zone flow rates	25.2
Prof Audit?	no
Static Pressure	90
H2O Price	$3.90

Drain Water Heat Recovery:	
Showers connected	all
Equal flow?	yes
CSA 55.1 $DWHR_{eff}$	54.0%
Tmains =	*55.9*
WHinTadj =	*0.00*
WHinT =	*55.9*

allons/1,000 grains removed

Sum of irrigation zone flow rates

$/CCF (1 CCF = 748.05 gallons)

Outdoor Water Use

Outdoor Water Use Accounts For:

- Lot size
- Irrigated Area of rated home
- Location of the home (climate)
- Whether or not there is an automatic irrigation system
- Features of the irrigation system (weather-based controller, flow rates)
- Presence or absence of a swimming pool or spa

What is RICI?

Residential Irrigation Capacity Index

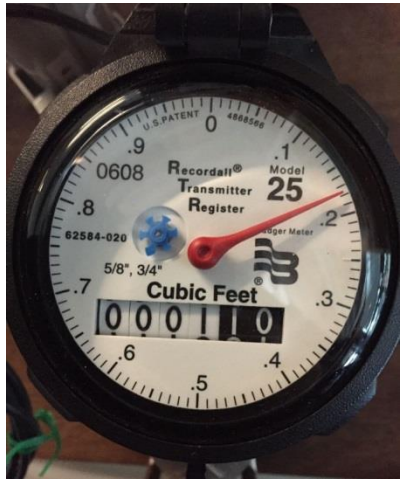
- Developed by the Southern Nevada Water District
- An index within an index
- Estimate irrigation use without knowledge of plantings
- Baseline RICI is set to 5 based on data
- Each 1-point reduction from baseline = 10% reduction in outdoor water use
- Optional method to further reduce outdoor water use

$$RICI\_rat = \frac{sum\ of\ flow\ (gpm) of\ all\ irrigation\ valves}{square\ feet\ irrigated\ area} * 1{,}000$$

Testing for RICI

Determine the irrigated area.

- Start with lot area
- Subtract the footprint of the home and any hardscaping
- Subtract any other areas that will not receive irrigation (artificial turf)

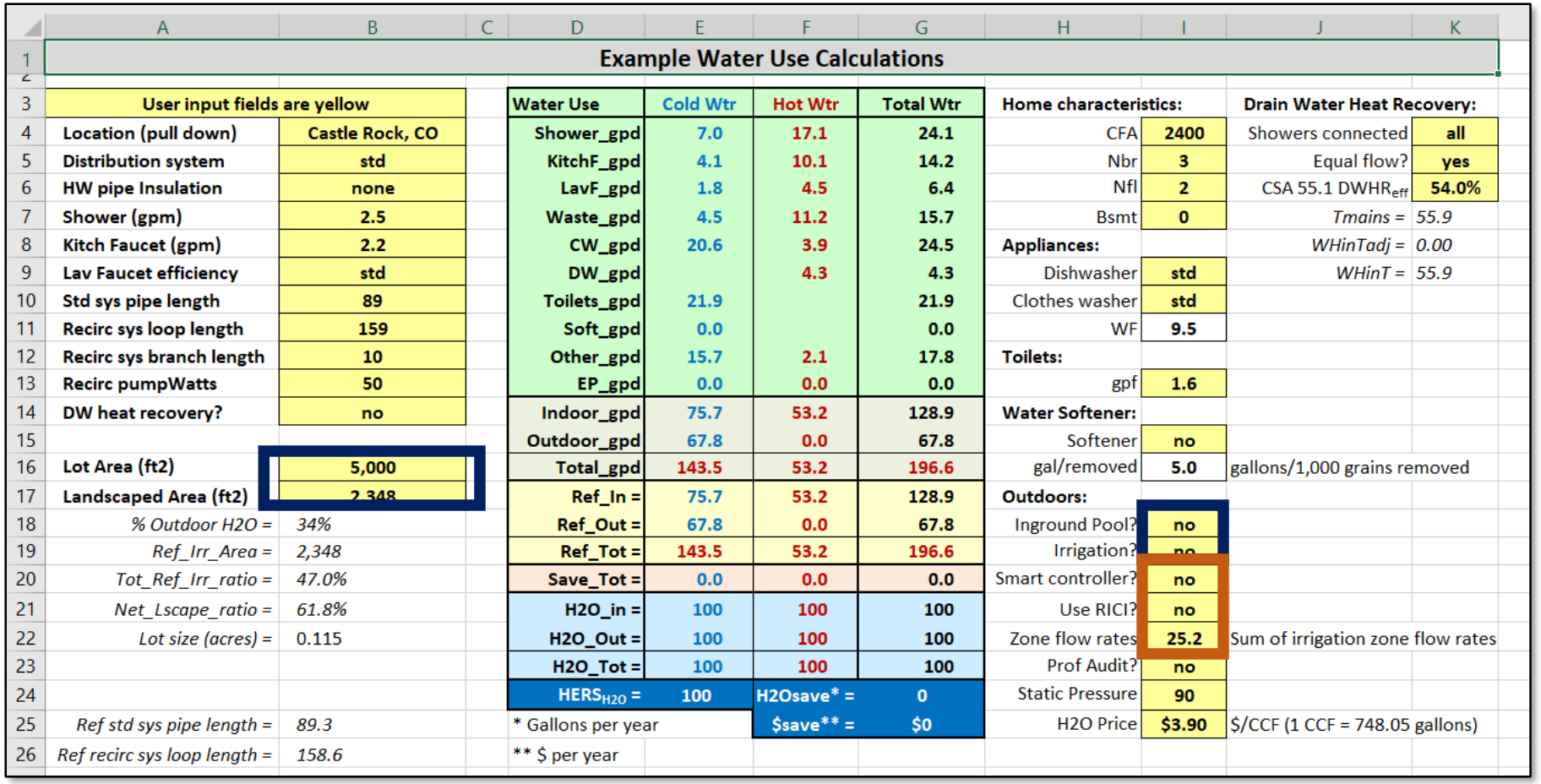


Determine Irrigation Flow Rates

- Turn off all fixtures and appliances
- Set irrigation controller to run each zone for a few minutes (equalize system)
- Measure flow rates by noting start reading of the meter
- Watch for 30 seconds and multiply water used by 2
- Sum together flow rates in gpm.
- Enter this number into the $HERS_{H2O}$ calculation spreadsheet

Calculation Spreadsheet

Outdoor Calculation Fields



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Irrigation?	no
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Showers connected	all
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gallons/1,000 grains removed

Sum of irrigation zone flow rates

$/CCF (1 CCF = 748.05 gallons)

- Estimating Irrigation Impact. Only need: Lot area, landscaped area and “yes” for irrigation
- Smart controller and Professional Audit are optional
- Only enter zone flow rates when “yes” is selected for RICI (documentation provided)

Example of Climate Differences

Lot: 5,000 ft^2

House: 2,400 ft^2, 3 bedroom, 2 floors

Landscape: 2,348 ft^2 with automatic irrigation

	Duluth, MN	Phoenix, AZ
Annual water use	~60,000 gallons	~140,000 gallons
Indoor water use	~80%	~33%
Water savings from installing WaterSense labeled plumbing products	~10%	~4%
Approaches to achieve 30 percent reduction	Both indoor and outdoor improvements	MUST make substantial outdoor improvements

WaterSense

WaterSense 2.0 Mandatory Requirements:

- Max. water pressure: 85 psi
- Hot water piping: Same as Reference Home
- Toilets: 1.28 gpf
- Kitchen Faucet: 2.2 gpm
- Showerhead: 2.0 gpm
- Lav Faucets: Low Flow
- Dishwasher: Same as Reference Home
- Clothes Washer: Same as Reference Home
- Water Softeners: Not installed
- Irrigation: Same as Reference Home

Rating WaterSense Requirements in $HERS_{H2O}$

Indoor Water Use
Target Score=70

Location	WaterSense Requirements	Energy Star Clothes Washer and Dishwasher	1.5 gpm Shower and Kitchen	Toilet @ 0.8 gpf	Eff. Hot Water Distribution	Best Available Clothes Washer & Dishwasher
Park City, UT	93	88	81	77	73	69
Phoenix, AZ	96	92	92	86	83	81
Tampa, FL	93	87	79	76	71	67
Denver, CO	94	89	83	80	76	73
Riverside, CA	95	90	84	84	78	75

Outdoor Water Use in $HERS_{H2O}$

Location	Irrigation = "YES"	Prof. Audit & Weather-based controller	20% Reduction in Irrigated Area	Use RICI (6 gpm all zone flow rates)
Park City, UT	77	68	62	56
Phoenix, AZ	86	73	63	55
Tampa, FL	75	67	61	56
Denver, CO	80	70	62	56
Riverside, CA	82	71	63	56

Impact of RICI and Irrigation on HERS H2O

- Total Lot Size: 5,000 sq. ft.
- Reference Irrigated Area: 2,348 sq. ft.
- Indoor set to WaterSense 2.0 Requirements.

Location	WaterSense 2.0 Requirements	Ref. Irr Area & 25% Flow Reduction (8.8 gpm all zones)	Ref. Irr Area & 50% Flow Reduction (5.9 gpm all zones)	Reduce Irrigated Area by 20% and Add Weather-based Controller
Park City, UT	93	89	84	75
Phoenix, AZ	96	89	80	68
Tampa, FL	93	90	85	77
Denver, CO	94	89	83	73
Riverside, CA	95	89	82	71

Inspection Process

Two Inspection Resources

- **Inspection Checklist**
- **Inspection Guidance Document**

Item	Section	Home Criteria	Yes	No	NI	Doc
Indoor Water Efficiency Criteria						
Leaks	1	Pressure-loss test on all water supplies detected no leaks				
		No visible leaks from hot water delivery system				
		No visible leaks from tank type toilets from dye test				
		No visible leaks from bathroom faucets				
		No visible leaks from kitchen faucets				
		No visible leaks from showerheads				
		No visible leaks from other fixtures or appliances				
		Check meter with all systems off for system leak				
Service Pressure	2	Pressure tank installed and set ≤ 60 psi OR				
		Pressure Regulating Valve installed upstream of fixtures and pressure test ≤ 60 psi OR				
		Written documentation from water supplier that pressure ≤ 60 psi OR				
		On-site static pressure test: _____ psi				
Hot Water	3	Is there a hot water recirculation system present? If so, what type:				
Toilet	4.1	Flush volume Marker*				Req.
	4.1.1	Single Flush Flush Rate** gpf				Req.
	4.1.2	Dual Flush Flush Rate** gpf				Req.
		Non-water consuming toilet				
Bathroom sink faucet	4.2	Flow Rate Marker* gpm				Req.
Kitchen sink faucet	4.3	Flow Rate Marker* gpm				Req.
Showerhead***	4.4	Flow Rate Marker* gpm				Req.
Dishwasher	4.5	Check for documentation of Water Factor				Req.
Clothes washer	4.6	Check for documentation of Water Factor				Req.
Water softener	4.7	Certified to NSF/ANSI Standard 44, including if available voluntary efficiency rated claim (stamped on data plate or indicated in the product manual)				Req.
	4.7.1	Verify water hardness of area or conduct test				Req.

Inspection Tools

- Stop watch/ cell phone timer
- Digital thermometer such as a digital food thermometer
- Pressure gauge
- Bucket or flow bag with volume measures marked
- Dye tablets for toilets
- Tape measure
- Water Hardness Tester

Typical Inspection Process- Indoor

It’s anticipated this will be done during a typical HERS rating final inspection

Inspection Process:

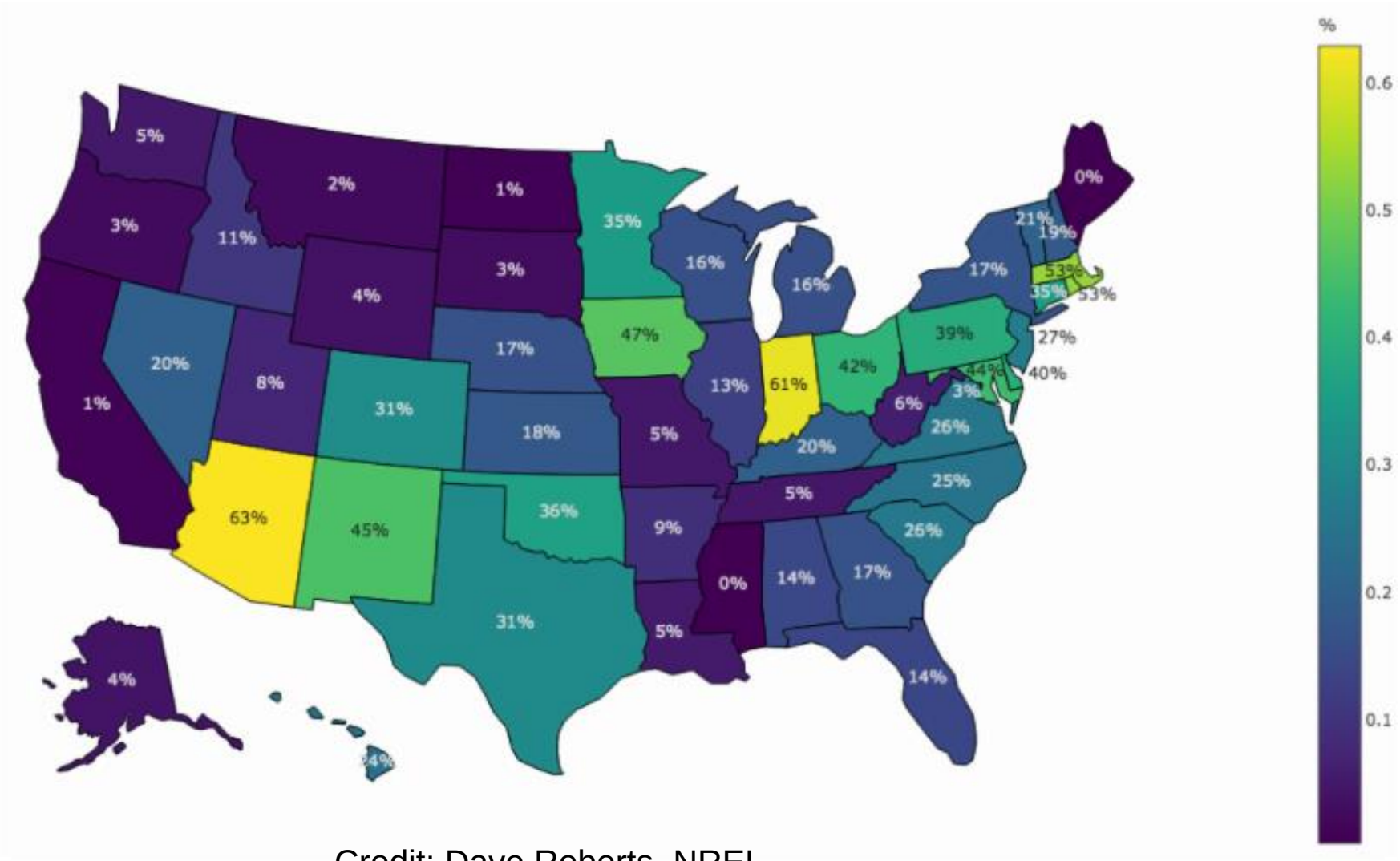
1. Put dye tablets in toilets
2. Verify flow rates of fixtures
3. Record make/model of dishwasher (if installed)
4. Record make/model of clothes washer (if installed)
5. Record make/model of water softener system (if installed)
6. Go back and check toilets for leaks (flush toilets to clear dye)
7. Verify flush rates stamped on toilets
8. Check house water pressure (or obtain documentation from builder)

Potential Impact

Popularity of HERS

Percentage of New Homes HERS Rated

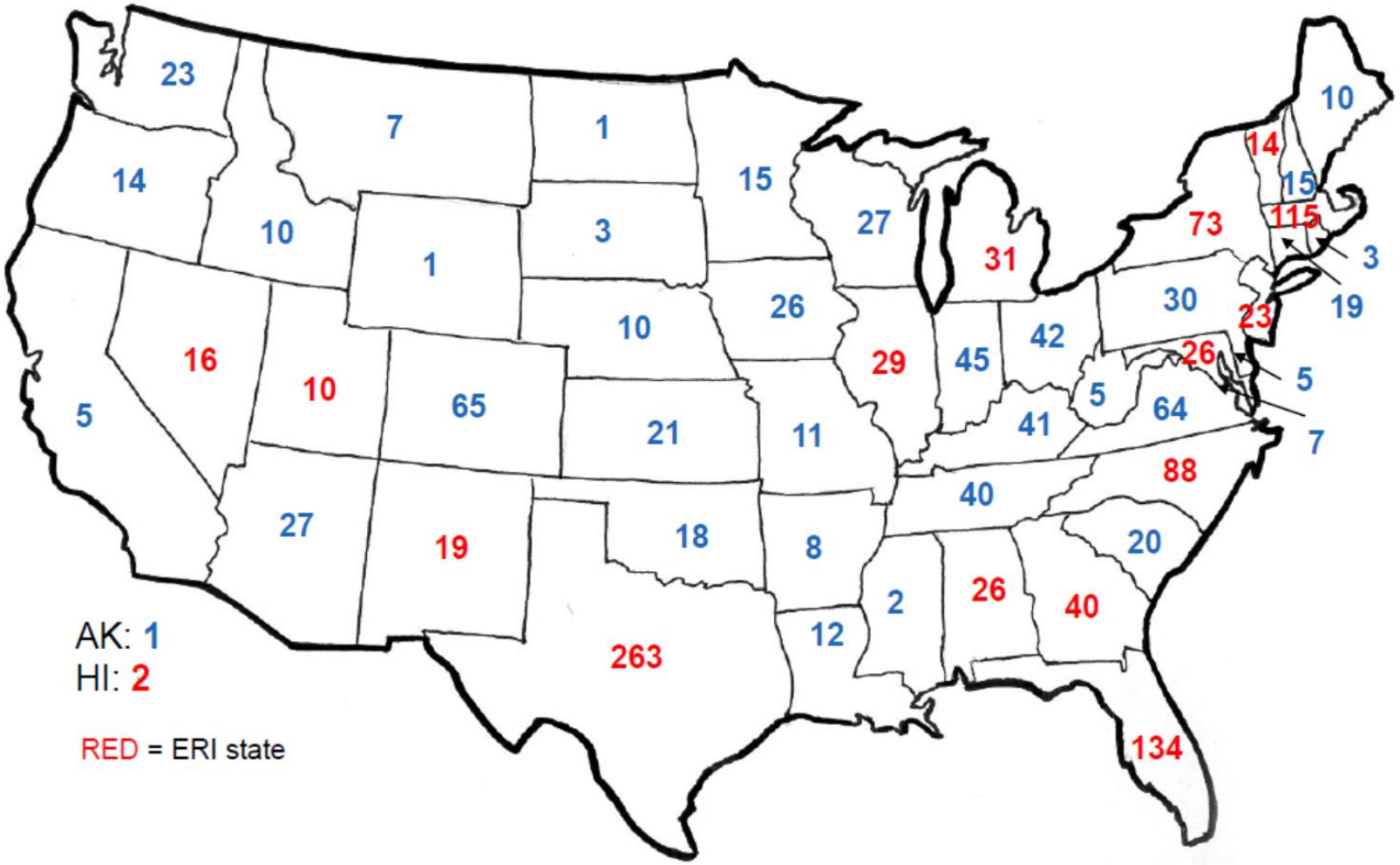
23% of all new homes in 2017 were HERS Rated!



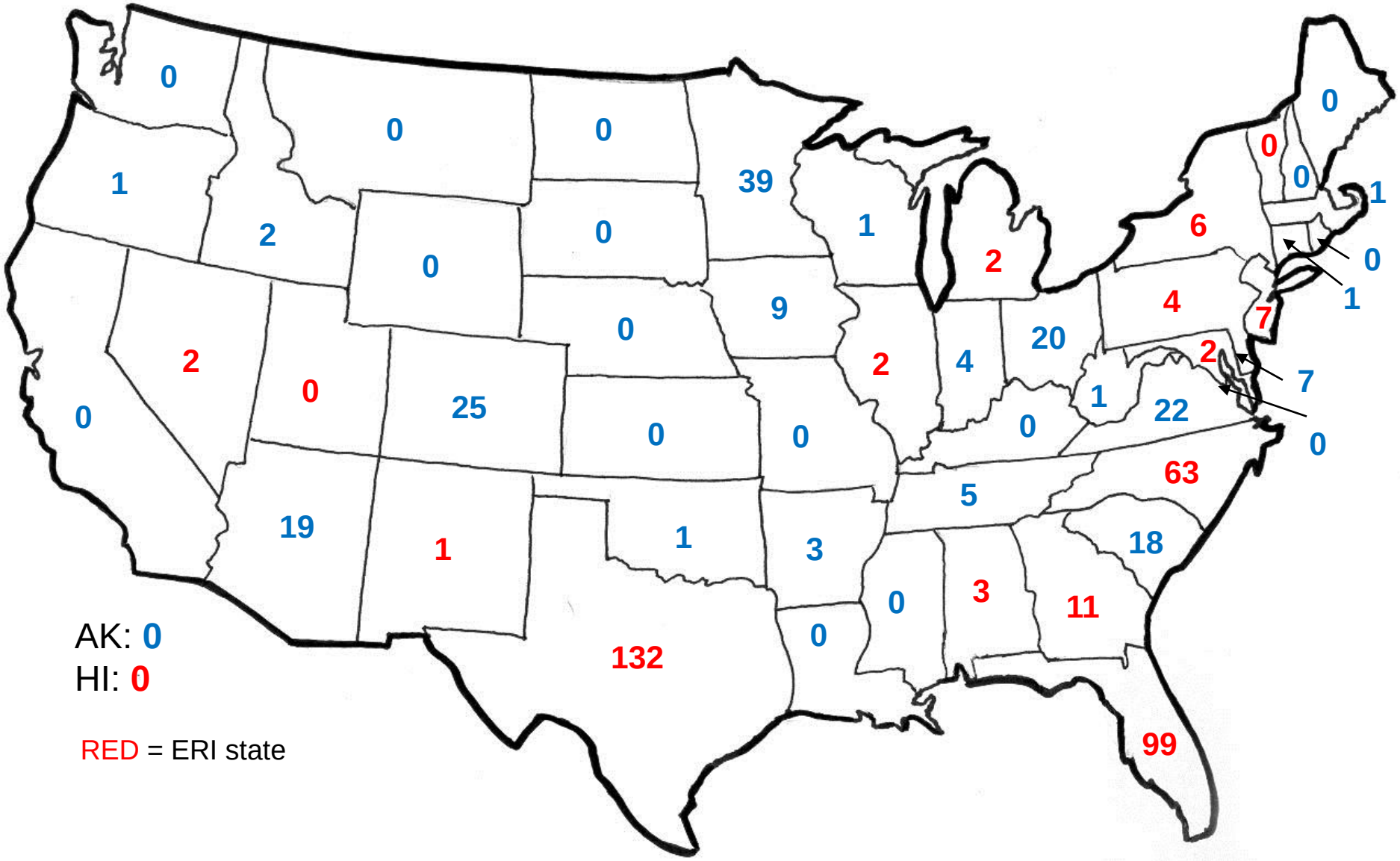
Credit: Dave Roberts, NREL

Can Scale Quickly

Over 1,900 Active RESNET Certified HERS Raters



Rating Field Inspectors By State



AK: 0
HI: 0

RED = ERI state

~800 RFIs

Interested Parties

Know someone interested in staying up to date on the water efficiency work of RESNET?

- Have them email ryan@resnet.us.
- Will receive periodic updates
- Notices of public comment periods and webinars
- Monthly “Water Update Newsletter”.

Thank you!

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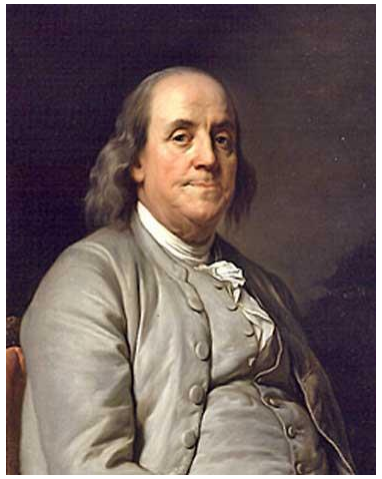

“We shall all know the value of water - when the well runs dry.”