

Incorporation of Hot Water Demand Reduction into HERS

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Building Performance Conference**

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What Reduces Hot Water Use?

- Insulating hot water supply piping
- End uses closer to water heater(s)
- Lower flow rate plumbing fixtures
- Lower volume plumbing appliances
- Using waste heat running down the drain to preheat cold water
- Truly “Instantaneous” water heaters
- Warmer incoming cold water
- Anything else?

What Increases Hot Water Use?

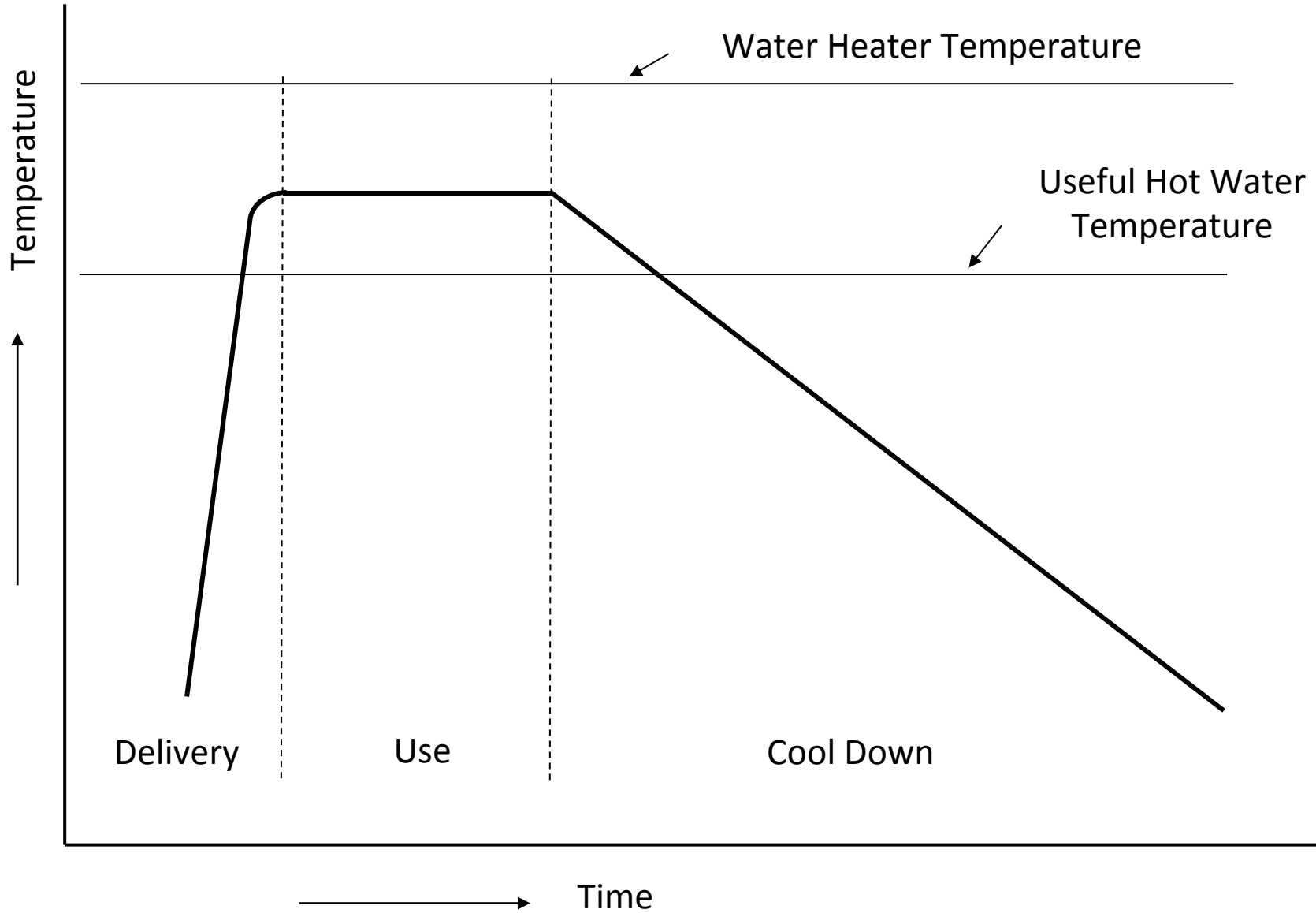
- Uninsulated hot water supply piping
 - More uses start out with colder water
- End uses further from water heater(s)
 - More volume to clear
- Lower flow rate plumbing fixtures
 - Increases waste while waiting for hot water to arrive
- “Instantaneous” water heaters
 - Cold water runs through while ramping up to temp
- Colder incoming cold water
 - Increases the percent of hot water in the mix
- Anything else?

What Increases Customer Satisfaction?

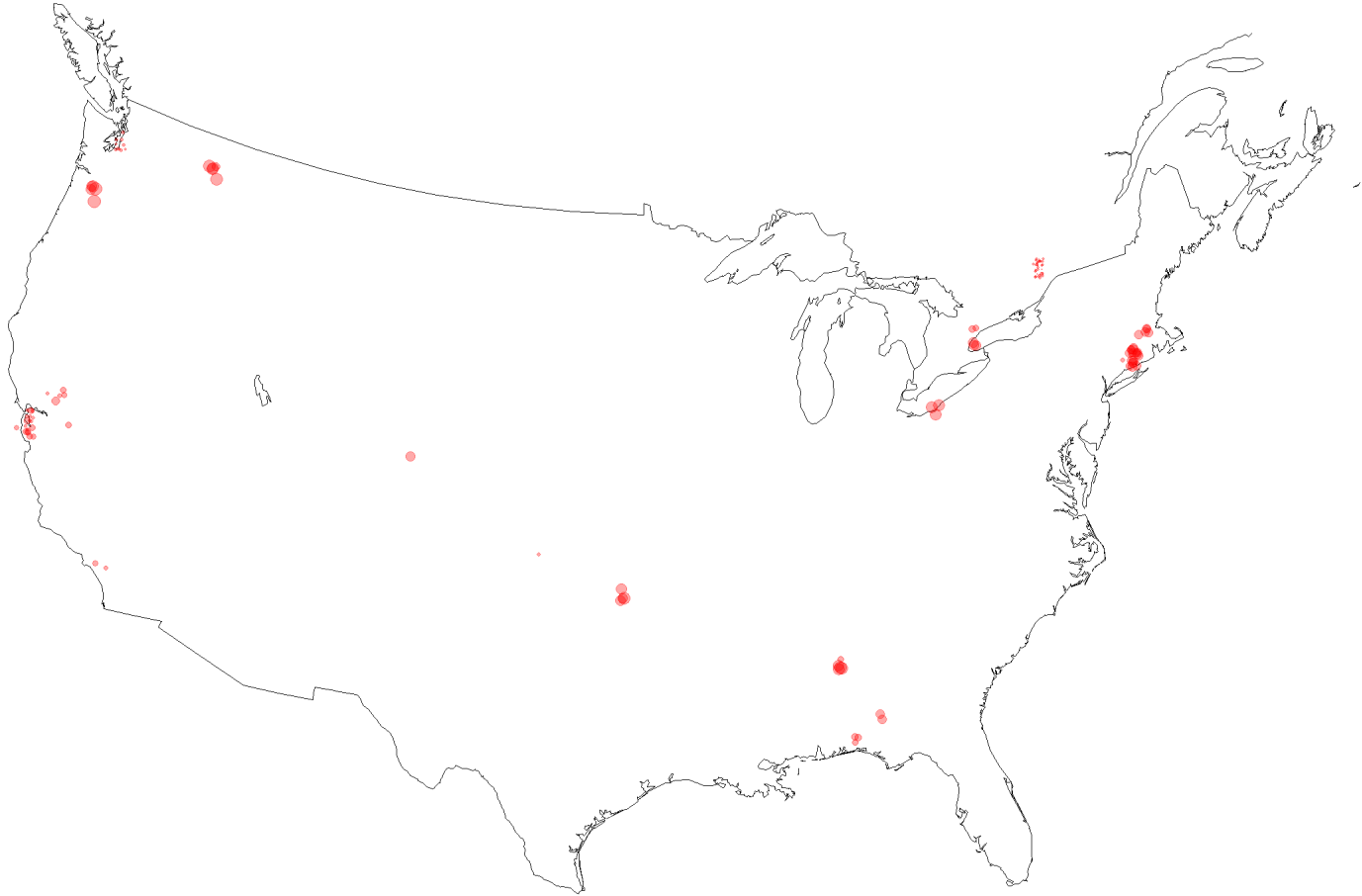
- Instantaneousness
- Continuousness
- Hot water systems that are predictable and easy to “learn”
- Plumbing fixtures that provide rated flow even at low pressures
- Plumbing appliances that do their job with lower amounts of water.
- Lower energy bills for their hot water
- Anything else?

What We Have Learned About Hot Water Use

Typical Hot Water Event



Field Studies of Hot Water Use

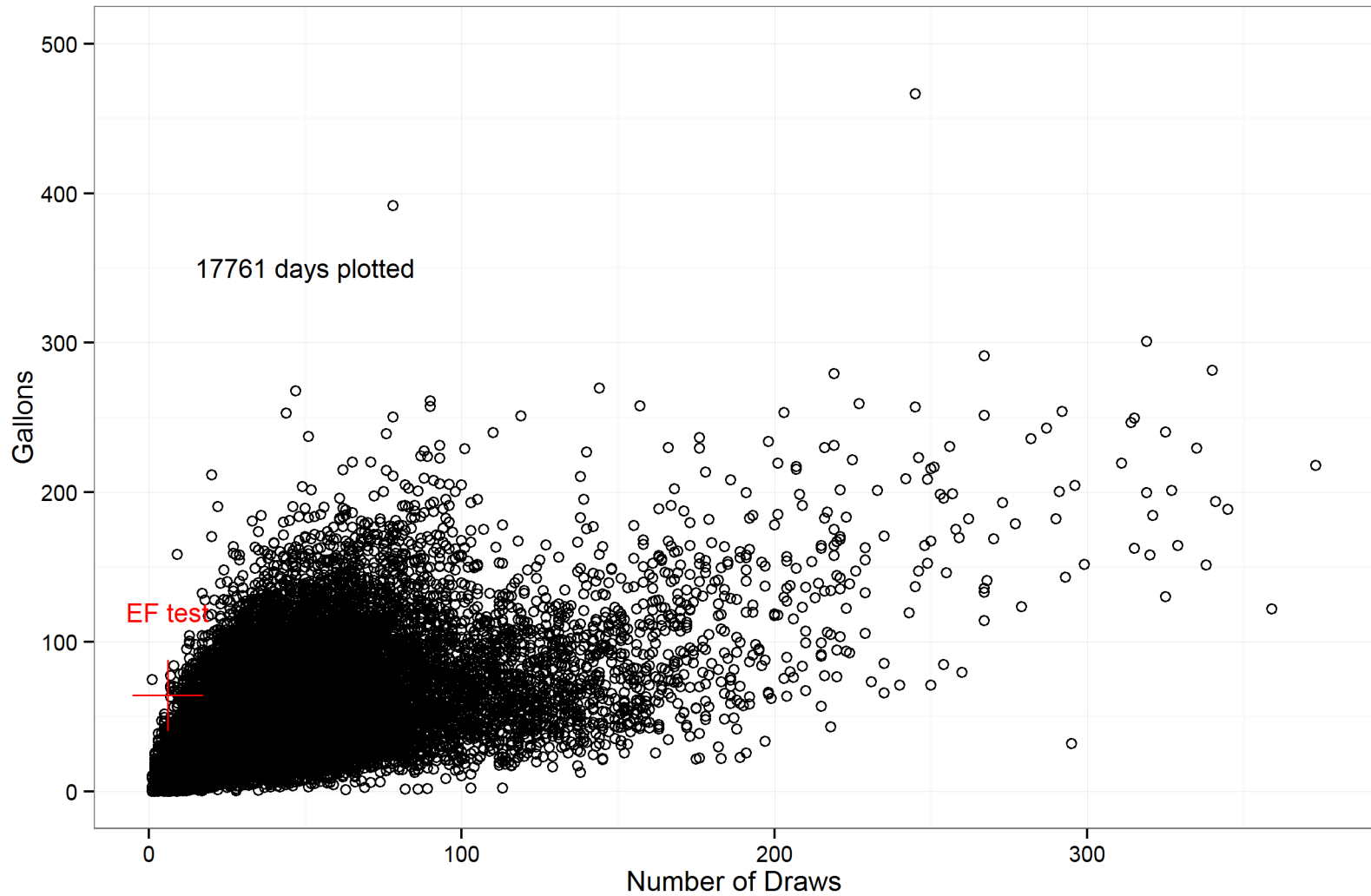


Summary of Field Studies

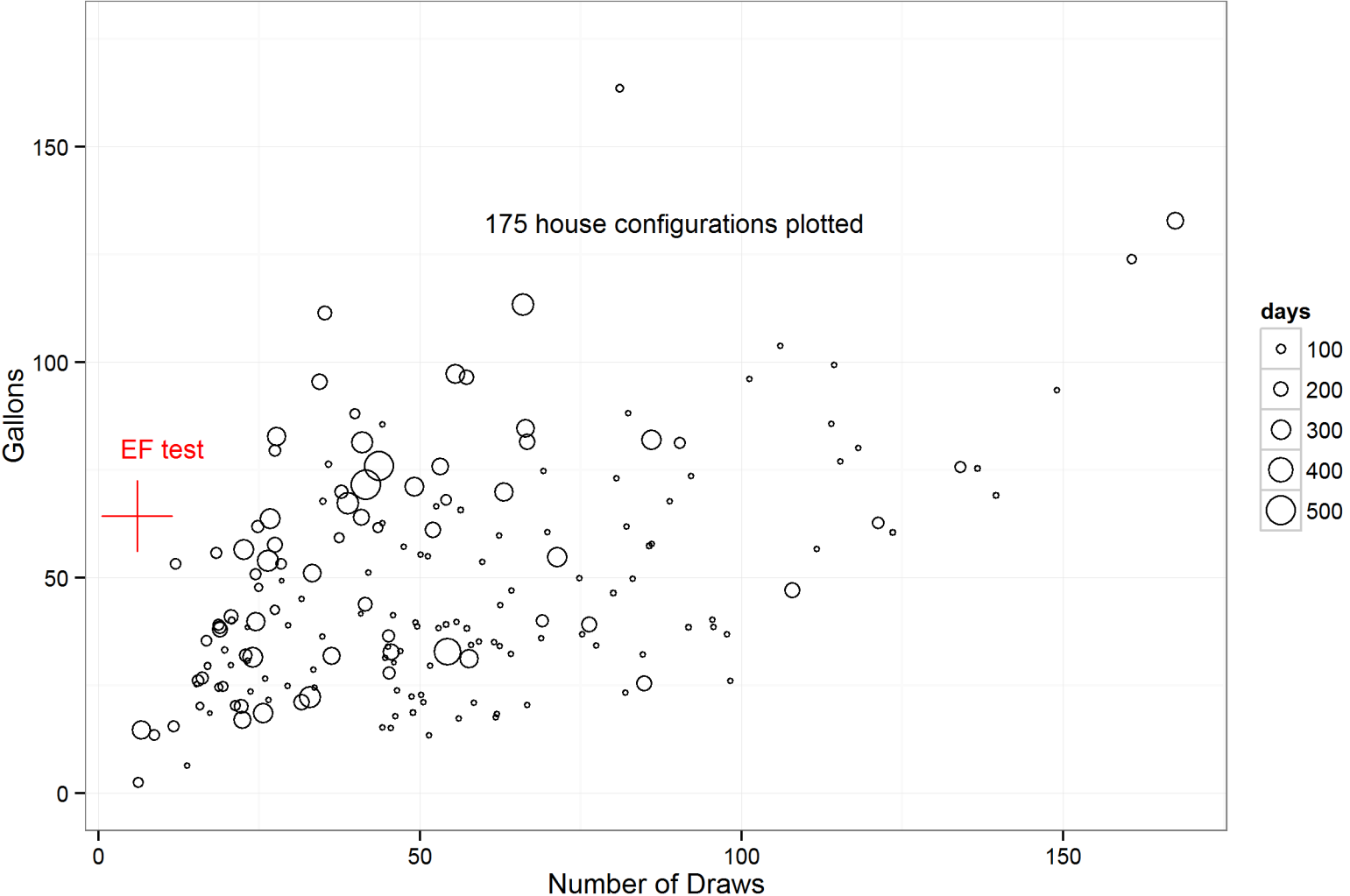
- 11 studies
- 152 monitored houses,
- 236 monitored configurations
(of water heaters and hot water end uses)
- 17,761 days of monitoring
- 865,552 hot water draws
- 6,920,463 records of hot water flow

Meta-study analysis provided by James Lutz, jdLutz@lbl.gov

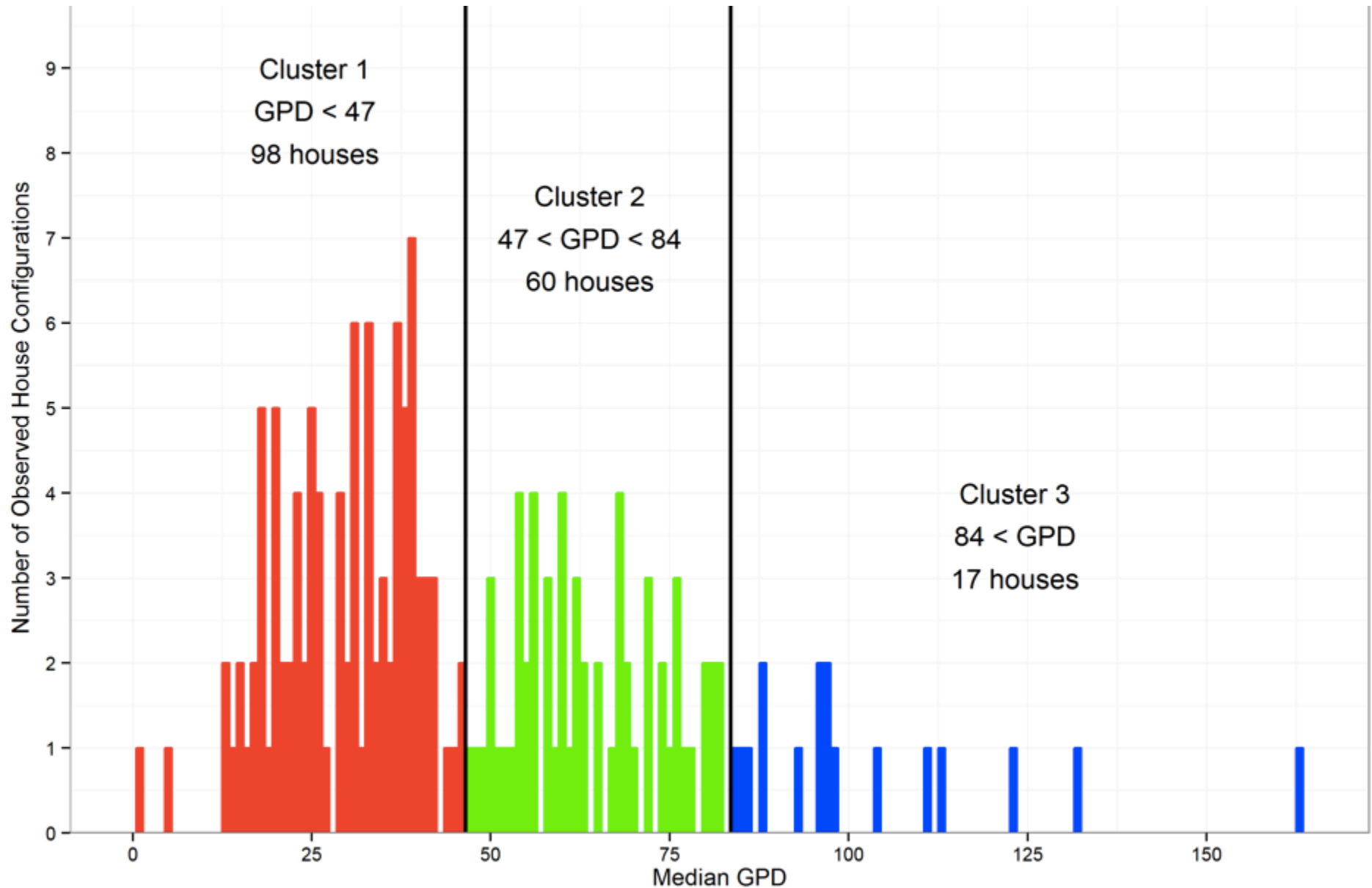
Daily Hot Water Use



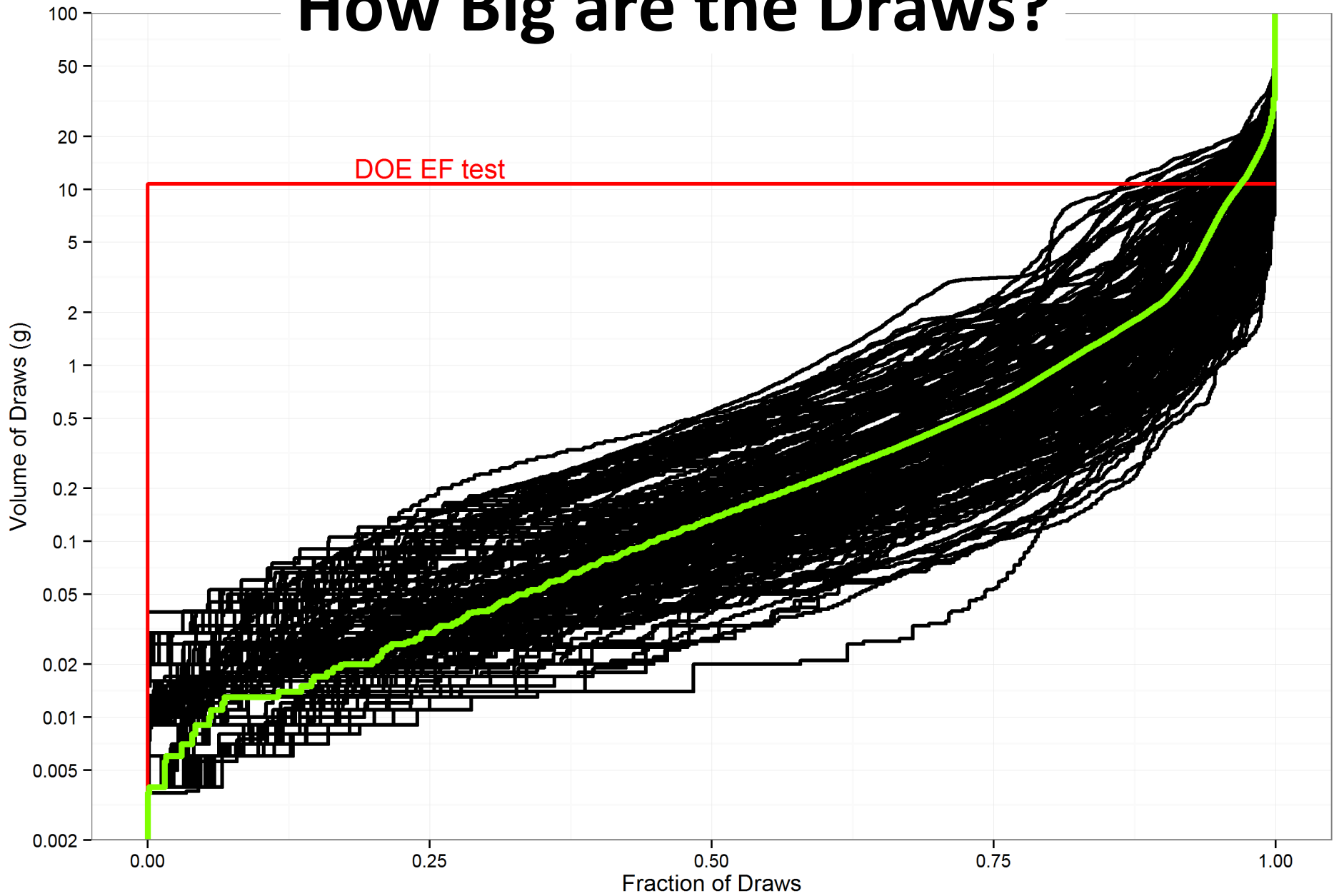
Median Daily Hot Water Use



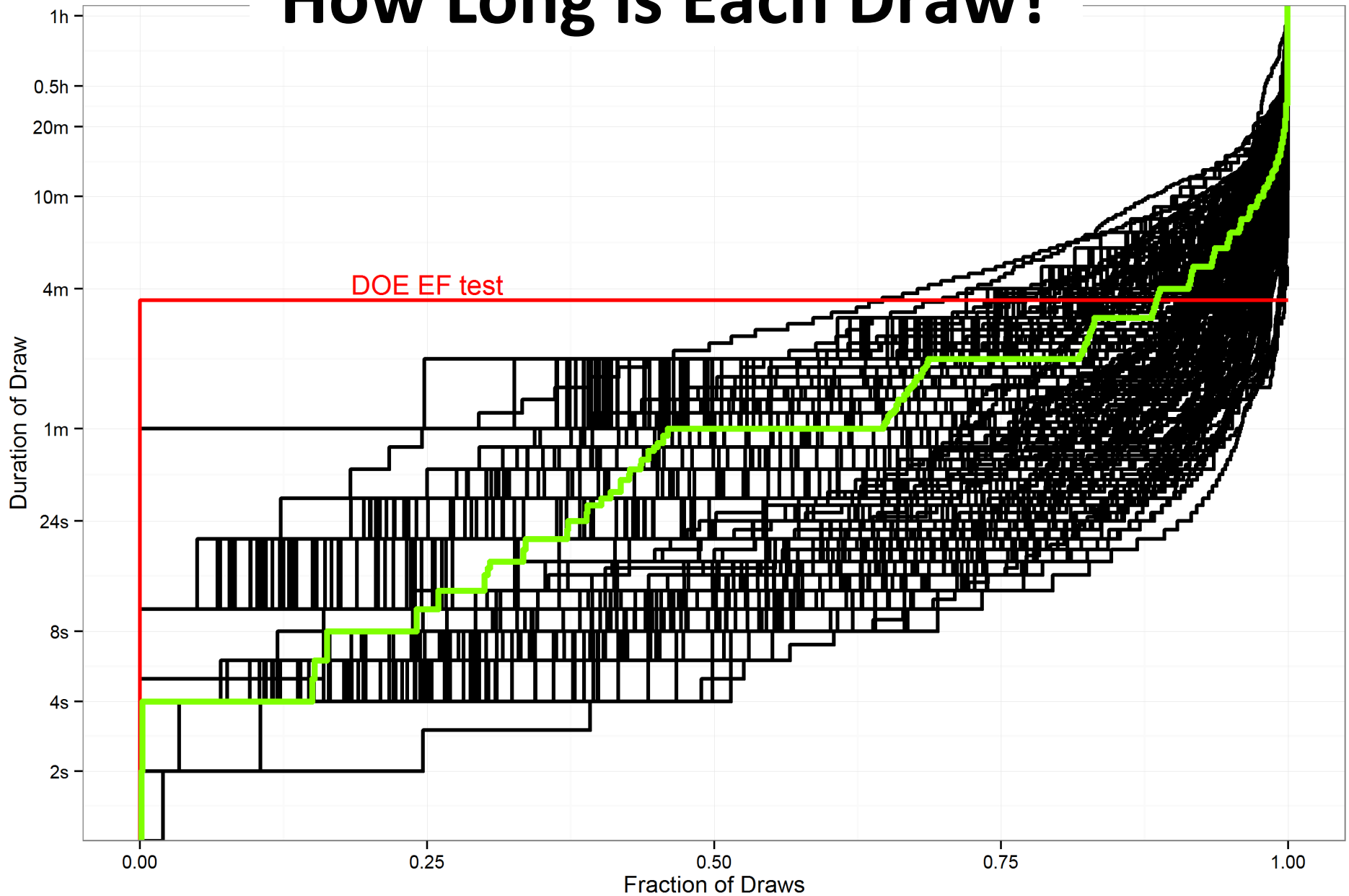
Clustered Median Daily Hot Water Use



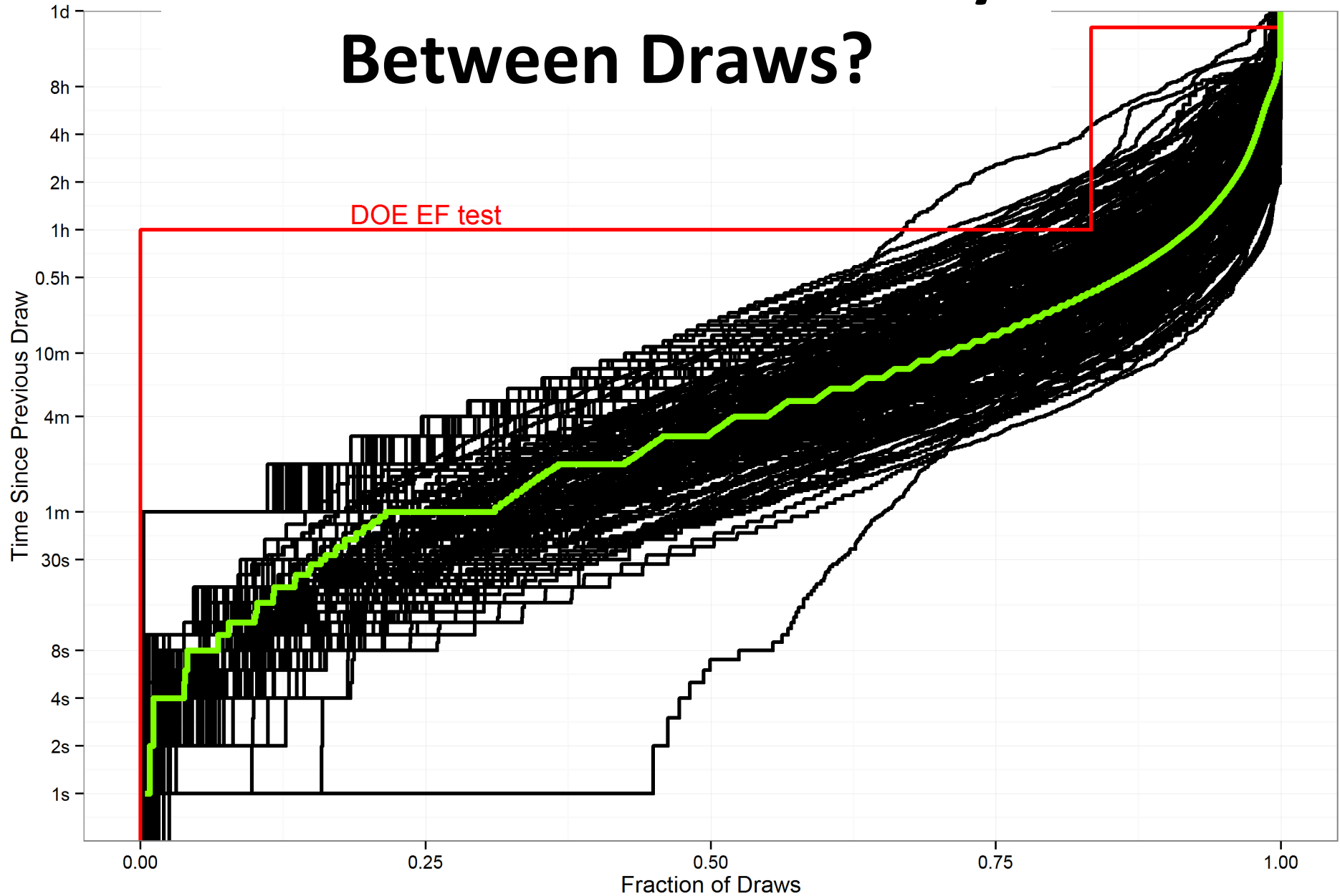
How Big are the Draws?



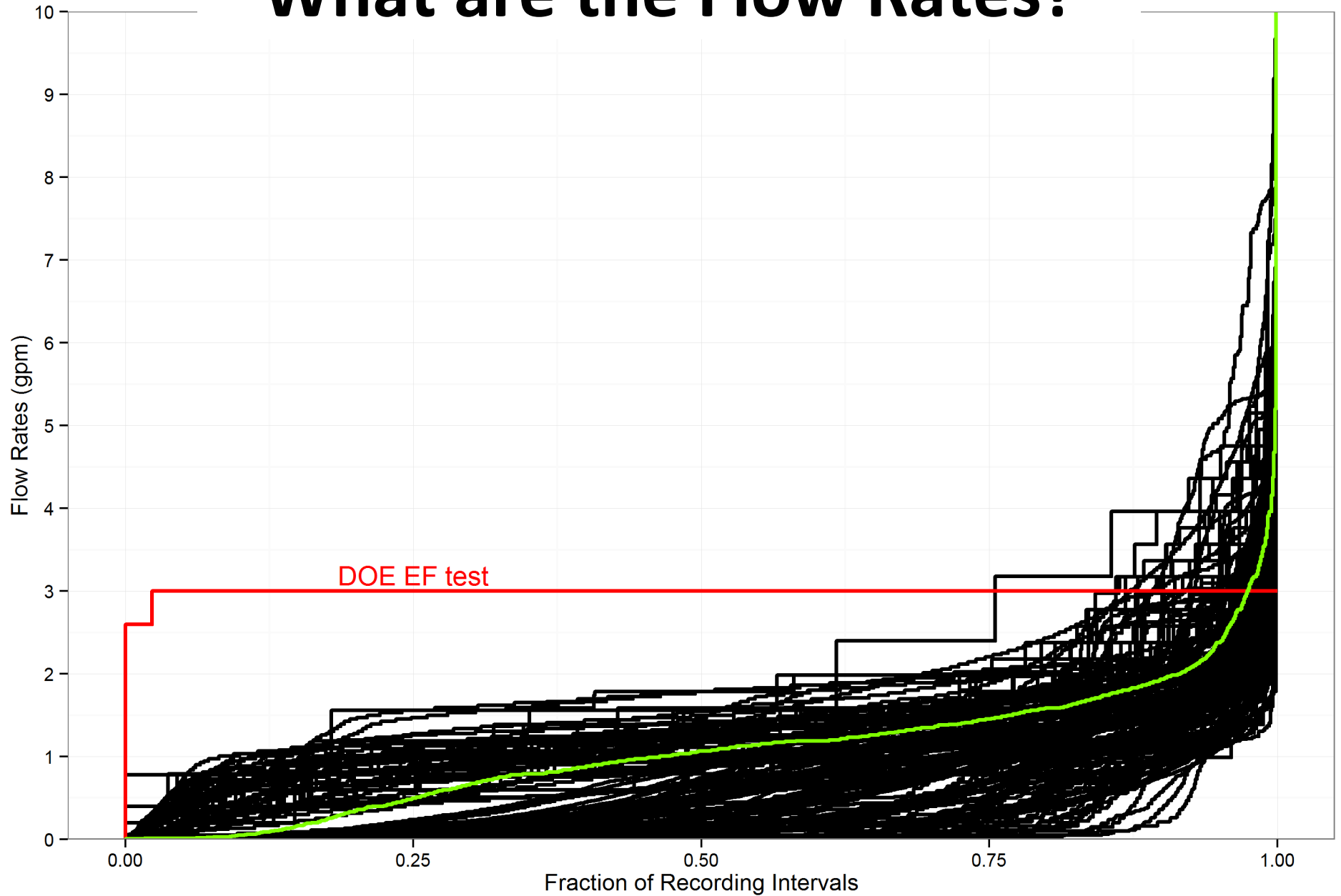
How Long is Each Draw?



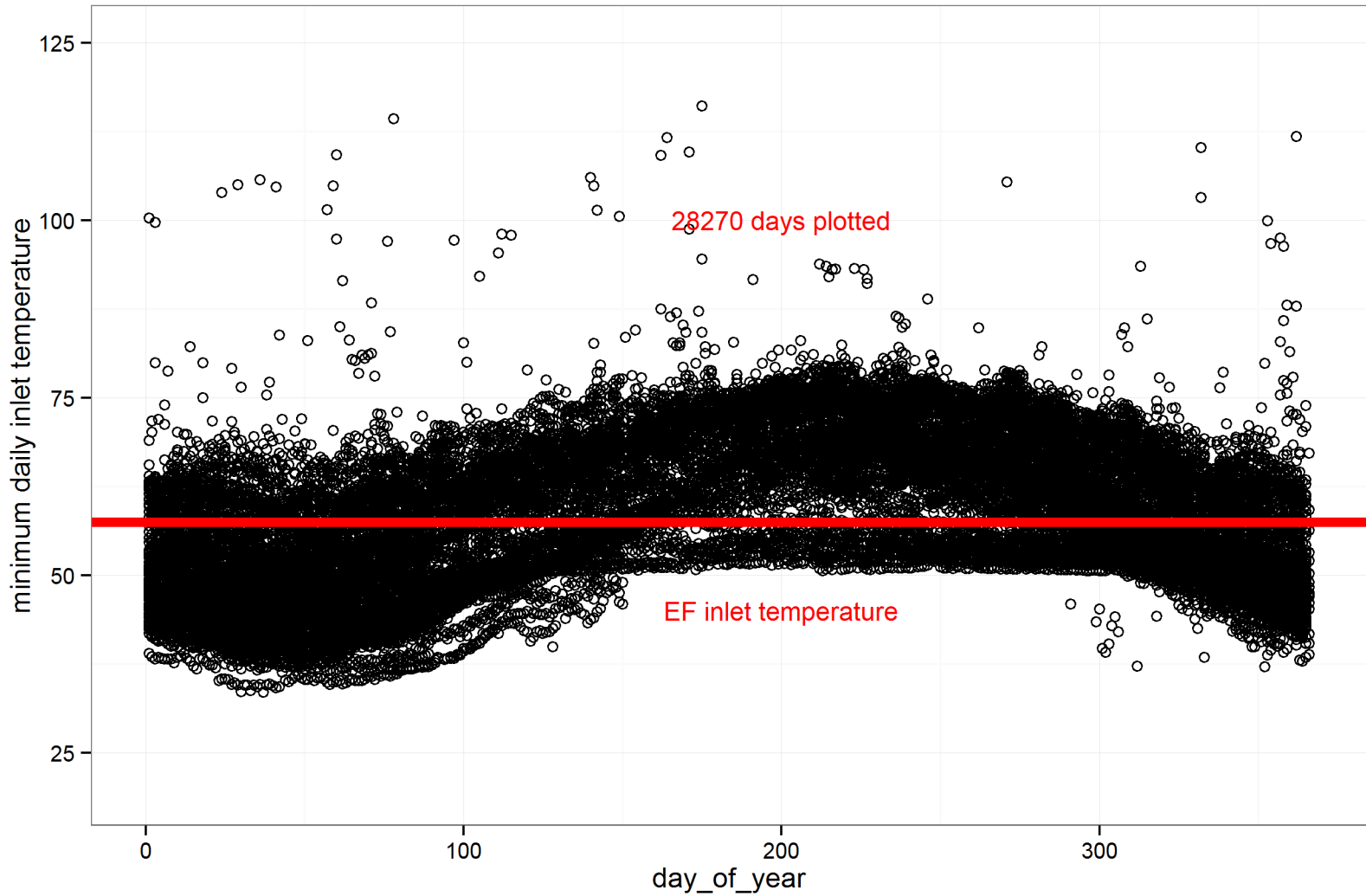
How Much Time Goes By Between Draws?



What are the Flow Rates?



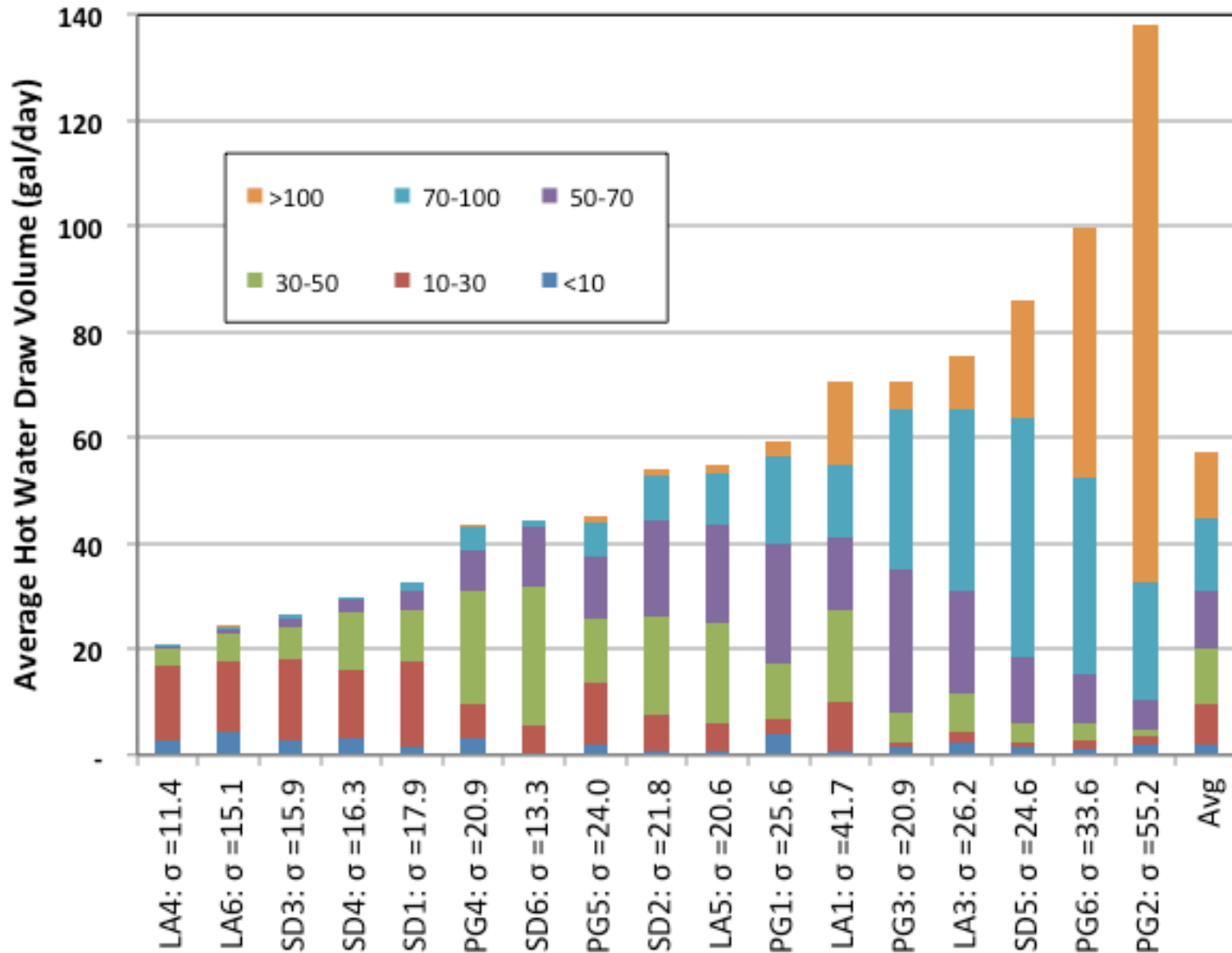
Inlet Water Temperatures



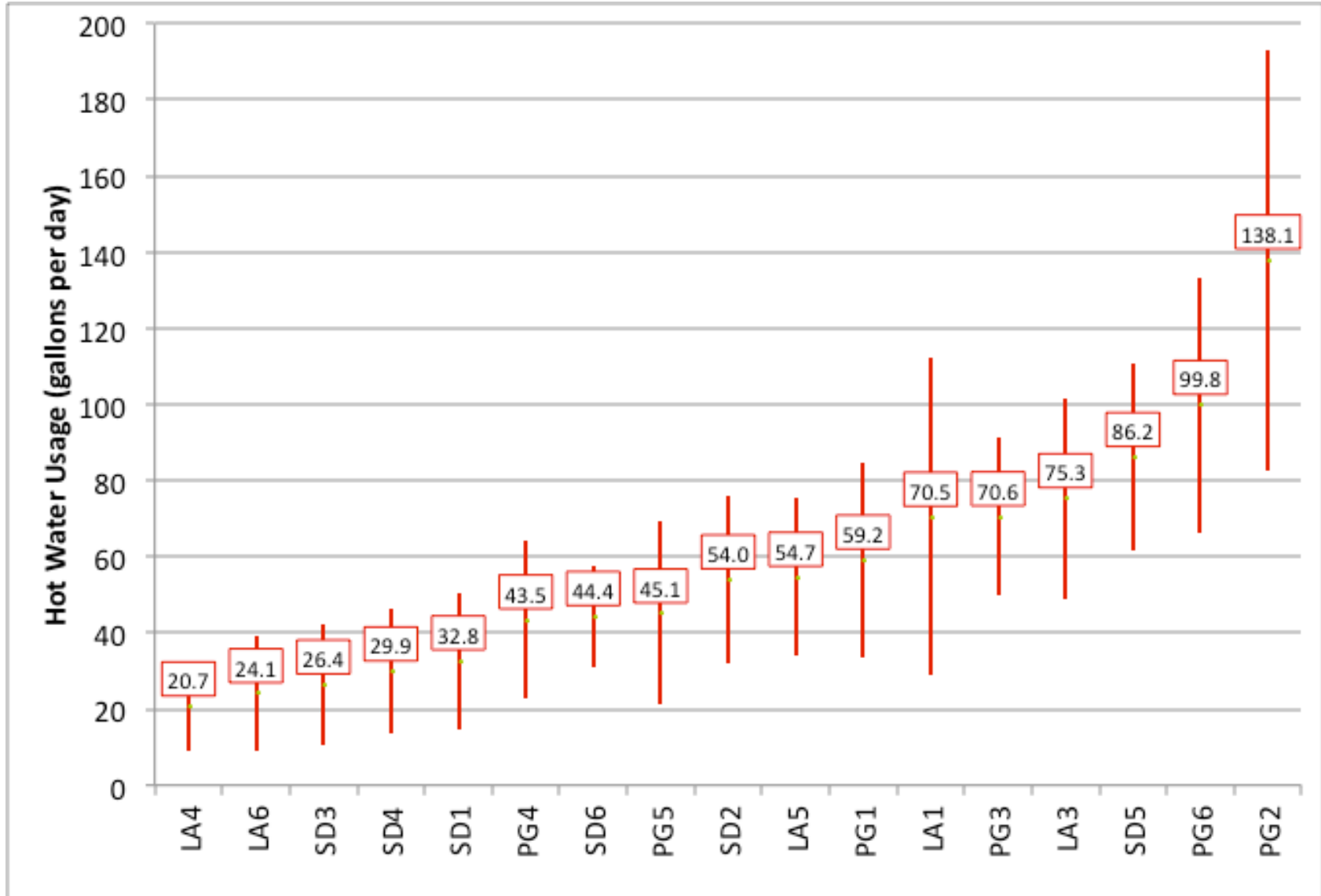
California Hot Water Research

- Residential Water Heating Program, Prime Contractor – Gas Technology Institute
- Funded by California Energy Commission, CEC 500-08-060
- 36 month study
- Field Studies – hot water use in 18 homes, distribution piping in 100 homes, surveys
- Laboratory Studies – water heaters, distribution piping

Daily Hot Water Use (Gallons)



Daily Hot Water Use (Gallons)



Given These Use Patterns....

- What best practices can you come up with?
- What should become code?
 - IPC
 - IECC
 - IRC
 - UPC
 - T-24
 - Other?
- What should be included into HERS, Energy Star, LEED?

Best Practices

- Understand the hot water use patterns for each occupancy.
 - The key is that hot water use is generally extremely variable within and among households.
 - Hot water events are clustered together within windows of opportunity based on the schedules of the occupants.
 - Flow rates are generally low and simultaneity is much smaller than assumed in current plumbing codes
- Understand the “service(s)” of hot water desired by these occupants
 - People want Instantaneousness and Continuousness. They expect safety and reliability.
 - Provide these services in the most water and energy efficient way

Best Practices

- Locate source(s) of hot water close to the uses
 - Sometimes the source of hot water is a water heater or boiler, sometimes it is the trunk line or the supply portion of a circulation loop or a heat traced pipe.
 - Sometimes more than one water heater or more than one hot water distribution system is needed. Sometimes both.
- Keep the volume from the source(s) to the uses small
 - This is critical when the volume per event is small and time between events is long; for example hand washing in restrooms in office buildings.
 - New washing machines and dishwashers have flow rates while filling of less than 1.5 gpm, so they are similar to faucets and showers.
 - Fixture branch piping (twigs) should contain less than 2 cups from the trunk line to the fixture fittings or appliances.
- Minimize pressure drop and optimize velocity in the piping
 - Size fixture branch piping (twigs) in accordance with the flow rate of the fixture fitting or appliance that it serves.
 - Use wide radius sweeps or bend the pipe into “swoops” instead of using hard 90-degree elbows wherever possible.

Best Practices

- Insulate hot water piping
 - Insulate all of it because the patterns of use are so variable and likely to change over the life of the piping within the building.
- Provide a method to prime trunk lines with hot water shortly before use
 - Demand controlled pumping systems are the most energy efficient way to accomplish this.
 - They can be installed in a circulation loop with a dedicated return pipe or they can be installed to use the cold water line as a temporary return.
- Utilize (hot) water use efficient fixture fittings and appliances
 - Lower flow rate faucets and showers and lower fill volume washing machines and dishwashers will be more satisfactory to consumers when installed in conjunction with the hot water distribution system described above.
 - In areas with low pressure, specify pressure compensating aerators, particularly for showers.

Best Practices

- Capture waste heat from hot water running down the drain and use it to preheat incoming cold water
 - Preheat the cold water going to the water heater(s)
 - Preheat the cold water going to the shower(s)
 - Preheat the cold water going to both the water heater(s) and the shower(s)
- Combine energy requirements for water heating and space heating into one thermal engine.
 - In thermally efficient housing, which can be found in all climate zones, the emphasis should be on the water heating load
 - It is likely to be necessary to help justify the higher cost of more efficient water heating.
- Select water heaters (or boilers) matched to these uses and patterns
 - Pay attention to the lowest flow rates and the smallest volumes – which happen with great frequency – as well as to the peaks – which happen much less often.
 - Maintain this water heater so it lasts a very long time.

How Do We Verify Installation?

- Lower flow rate faucets and showers
- Water efficient dishwashers and washing machines
- Insulated hot water supply piping
- Drain water heat recovery devices
- More water, energy and time efficient floor plans
- More water, energy and time efficient piping layouts
- **New construction different than existing?**

Upcoming Events

- BE 13
 - March 5, Boston
- Habitat for Humanity
 - March 10, Atlanta
- IAPMO Technical Committee Meetings
 - April 29-May 3, Salt Lake City
- IECC and IRC Code Development Hearings
 - April 21-April 30, Dallas
- PGE Classes
 - May 16 San Jose Pipe Trades
 - All-day class and Evening Class
 - May 23 Roseville
 - All-day class

Thank You!

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