"Water Wastage of Instantaneous Gas Water Heaters"

A report for the Water Efficiency Labeling and Standards Scheme

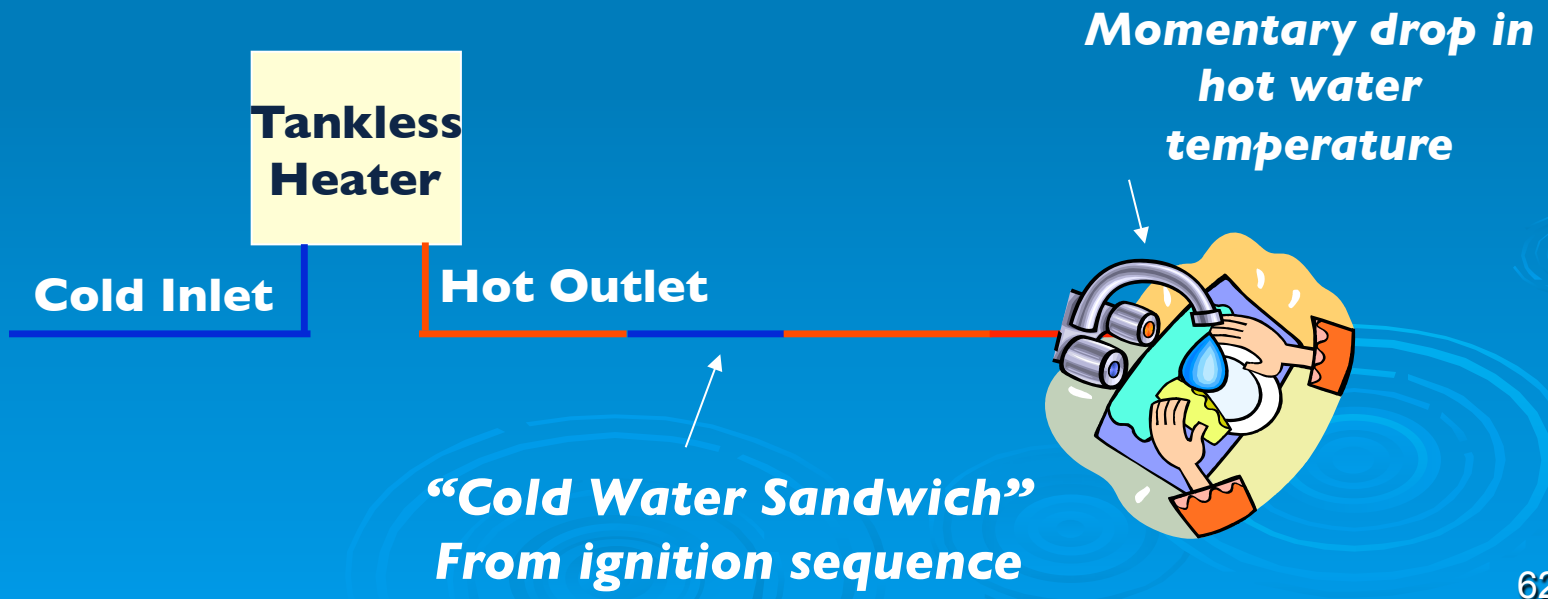
- A report written by Aleksander Szann for the Department of Environment, water, Heritage and the Arts of the Australian Government.
  - Conclusions:
    - "Instantaneous gas water heaters waste substantial quantities of water" (up to 25 gallons per day)
    - "There are significant differences in water wastage from different water heaters"

- Recent field tests in the U.S. suggest that water use increases are modest. This is clearly life-style dependent.

Gas Tankless Water Heaters

"Cold Water Sandwich Effect"

- The introduction of cold water into the hot water line during frequent on/off operation
- Cold water flows through the water heater during the ignition sequence delay (~ 10 sec),
- Two causes:
  - Drop in flow rate below minimum firing rate
  - Intermittent use



Gas Tankless Water Heaters

Manufacturer Recommended Solution to the "Cold Water Sandwich"

Add a small electric buffer tank after the tankless water heater

- Costs more to purchase and install
- Increases energy use
- This improves performance, but how cost effective and energy efficient is it?

Gas Tankless Water Heaters

Manufacturer Recommended Solution to get "Instantaneous" Hot Water

Add a circulation pump to the small electric buffer tank

- Costs still more to purchase and install
- Effectively the recirculation loop is kept hot with electric resistance heating
- Increases energy use
- This improves performance, but how cost effective and energy efficient is it?

Note: Many manufacturers have models which are "recirculation compatible" which should minimize these issues

Gas Tankless Water Heaters

Installation in New Construction

- Installation is only a little more expensive than gas storage type
  - Larger diameter gas pipe (> ½ inch)
  - Larger diameter vent pipe
  - More make up air
    - (Bigger burner = more make up air and bigger flue)
  - Stainless steel vent pipe
  - Need a 110 VAC outlet near the heater
  - Can select location for heater to minimize costs
- Labor is similar to tank type
- Tankless units are more expensive than storage units.
- Total installed cost is more than for a storage water heater but not outrageous.

Gas Tankless Water Heaters

Installation in Retrofit

- Varies greatly and can be much more expensive than tank type
  - Almost always need to replace the gas pipe from the meter to the water heater with larger diameter
  - Bigger burner needs more make-up air
  - Venting can cost more than the heater
    - Larger diameter flue pipe
    - Stainless steel vent pipe
  - Need to bring 110 VAC to the heater
- Labor can be much more than tank type
- Tankless units are more expensive than storage units.
- Total installed costs can be much more than for a storage water heater.

Gas Tankless Water Heaters

Life Expectancy

- 10-15 years are claimed…with regular maintenance
  - No data available to support this claim in North America
- Potential Issues
  - Thin-walled heat exchangers
  - Lots of structural stress during normal operations (expansion and contraction)
  - Small passageways for the water are likely to scale up in areas with hard water
    - Where does the scale go?
- Service
  - Simple cleaning of filters required annually unless water is hard. With hard water, acid cleaning of the heat exchanger is often recommended.
    - What will repeated acid cleaning do to the copper heat exchangers?

Gas Tankless Water Heaters

Warranty

- Typical warranty is 7 to 10 years
- Many ways to void the warranty: hard water conditions, standard recirculation systems, and ownership changes…read the warranty before purchasing!

Gas Tankless Water Heaters

Expected energy savings

- According to the DOE, the average household will save 41 Therms/year by using an Energy Star gas tankless rather than an Energy Star conventional water heater.
  - If water usage is much lower than average (64 gals/day), a tankless is more advantageous.
  - If water usage is high, a condensing storage water heater will cost less to install and less to operate.

Gas Tankless Water Heaters

Expected cost savings

- The projected cost savings of 41 Therms/year must be compared to:
  - An increased installed cost (according to Energy Star) of between $605 and $1635
  - The manufacturer's recommendation of regular maintenance.

Gas Tankless Water Heater Performance

Pro

- Energy Savings
- Small appliance
- "Endless" hot water
- Minimal standby losses

Con

- Expensive Appliance
- Install can be expensive
- Wastes water
- "Cold Water Sandwich"
- Minimum flow requirements (limits pre-heating)
- Requires regular maintenance

Atmospheric Gas Storage Water Heater Performance

Pro	***Con***
Inexpensive	Mediocre Energy Efficiency
Standard installation	Large, heavy tank
Instant hot water	Limited hot water volume
Flow rate independent	Standby losses
Maintenance free	Tank will eventually leak

How do you Choose?

Tank or Tankless

Remember What People Want

Hot Water Now = "Instantaneousness"

- Need hot water available before the start of each draw.
- Need the source of hot water close to each fixture or appliance

Never Run Out in My Shower = "Continuousness"

- Need a large enough tank or a large enough burner or element
- Or, a reasonable amount of both

Cost-Performance Comparisons

- Difficult to make accurate comparison due to the many assumptions needed.
- We must make some comparisons to make sense of all the options available
- The following are based on WRH's best estimates of costs, etc. except annual service costs have not been predicted.

Cost-Performance Comparisons

- You really need to put your own assumptions into your comparisons
- A “Water Heater Cost Comparisons” Excel spreadsheet is available upon request at whoover@wi.rr.com
- Get a copy of it and put in your own assumptions so you have confidence in the comparisons you make.

Cost - Performance Comparisons Natural Gas Water Heaters

Technology	Unit Cost	Install Cost	Annual Energy Use	Annual Cost*	Total 12 yr. Cost*	Payback Period, Yrs.
0.62 Standard Atmospheric	$400	$400				
0.67 Power Vent (E Star)	$800	$800				
0.82 Tankless	$1000	$2000				
0.90 Tankless	$1500	$1200				

*Based on $1.20/Therm for natural gas and no maintenance costs

Cost - Performance Comparisons Natural Gas Water Heaters

Technology	Unit Cost	Install Cost	Annual Energy Use	Annual Cost*	Total 12 yr. Cost*	Payback Period, Yrs.
0.62 Standard Atmospheric	$400	$400	242 Therms			
0.67 Power Vent (E Star)	$800	$800	224 Therms			
0.82 Tankless	$1000	$2000	183 Therms			
0.90 Tankless	$1500	$1200	161 Therms			

*Based on $1.20/Therm for natural gas and no maintenance costs

Cost - Performance Comparisons Natural Gas Water Heaters

Technology	Unit Cost	Install Cost	Annual Energy Use	Annual Cost*	Total 12 yr. Cost*	Payback Period, Yrs.
0.62 Standard Atmospheric	$400	$400	242 Therms	$290		
0.67 Power Vent (E Star)	$800	$800	224 Therms	$268		
0.82 Tankless	$1000	$2000	183 Therms	$219		
0.90 Tankless	$1500	$1200	161 Therms	$193		

*Based on $1.20/Therm for natural gas and no maintenance costs

Cost - Performance Comparisons Natural Gas Water Heaters

Technology	Unit Cost	Install Cost	Annual Energy Use	Annual Cost*	Total 12 yr. Cost*	Payback Period, Yrs.
0.62 Standard Atmospheric	$400	$400	242 Therms	$290	$4,280	
0.67 Power Vent (E Star)	$800	$800	224 Therms	$268	$4,820	
0.82 Tankless	$1000	$2000	183 Therms	$219	$5,631	
0.90 Tankless	$1500	$1200	161 Therms	$193	$5,020	

*Based on $1.20/Therm for natural gas and no maintenance costs

Cost - Performance Comparisons Natural Gas Water Heaters

Technology	Unit Cost	Install Cost	Annual Energy Use	Annual Cost*	Total 12 yr. Cost*	Payback Period, Yrs.
0.62 Standard Atmospheric	$400	$400	242 Therms	$290	$4,280	N.A.
0.67 Power Vent (E Star)	$800	$800	224 Therms	$268	$4,820	37
0.82 Tankless	$1000	$2000	183 Therms	$219	$5,631	28
0.90 Tankless	$1500	$1200	161 Therms	$193	$5,020	15

*Based on $1.20/Therm for natural gas and no maintenance costs

Which would I choose today?

- It depends!
  - Whole-home retrofit…..definitely gas storage
  - New Construction….probably gas storage but maybe gas tankless in a warm climate
  - New Construction low use….gas tankless

Which will prevail?

- Tankless will have a market share:
  - First adopters
  - Perceived “green” impact
  - Infrequent or low hot water usage
  - Where space is an issue
- Condensing storage water heaters are significant competition
  - More efficient
  - Less expensive
  - Less water usage

Which will prevail?
Neither Tank or Tankless is the Answer

A combination of the two might be better:

- Burner
  - Sized for some amount of continuous use
    - Approximately 1.5-3 GPM
    - 60-120,000 Btu Natural Gas
- Modest tank
  - Hot water available at the beginning of every draw
  - Some volume for peak conditions
  - Enables a simpler burner control strategy
- Pick the right combination of burner or element and storage?

Which will prevail?
Neither Tank or Tankless is the Answer

- What is the sweet spot? (WRH's guess)
  - 80,000 – 120,000 BTU/hr burner
  - 10-30 gallon tank

What water heaters can we expect to see in the next few years?

- Advanced conventional gas water heaters
- Condensing storage water heaters (NAECA)
- Heat Pump Water Heaters
  - Integrated
  - Add-on units
- Hybrid

Summary

- Tankless water heaters are an expensive way to save a little energy and waste a little water.
- Standard storage water heaters are very cost effective even though they are not energy efficient.
- Stay tuned….many new alternatives will arrive within a few years.

Resources

- Electric and Gas Storage Water Heater Manufacturers
  - A.O. Smith: www.hotwater.com
  - Bradford White: www.bradfordwhite.com
  - Rheem: www.rheem.com
- Electric Tankless Water Heater Manufacturers
  - Seisco-Microtherm: www.seisco.com
  - Stiebel-Eltron: www.stiebel-eltron-usa.com
  - Bosch: www.boschhotwater.com
  - EE Max: www.eemaxinc.com

Resources

- Gas Tankless Water Heater Manufacturers

  Takagi: www.takagi.com
  Rinnai: www.foreverhotwater.com
  Noritz: www.noritz.com
  Paloma: www.palomatankless.com

- Water Heater Maintenance
  - www.waterheaterrescue.com

- Energy Star for Water Heaters

  http://www.energystar.gov/index.cfm?c=new_specs.water_heaters