# Distributed verse Non-Distributed Domestic Hot Water Heater Applications

Traditional vs. Instantaneous

By: Bob Barrett, CEM, LEED AP
Wallace Eannace Associates
WWW.WEA-INC.CO

# Domestic Hot Water Decisions…

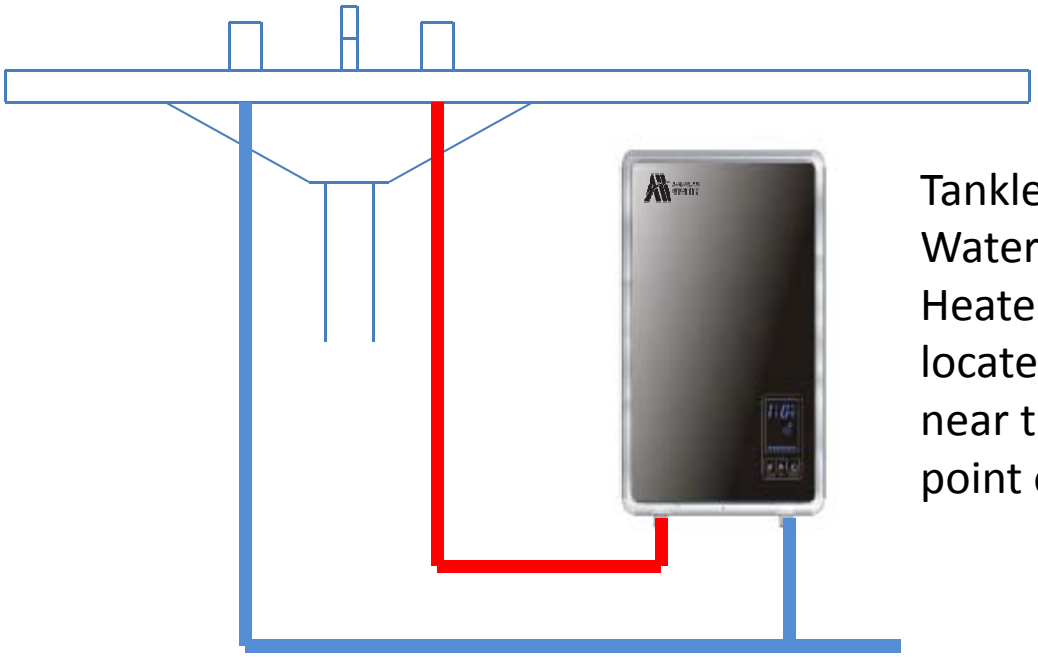
# To distribute or not to distribute? That is the question…

**which of course leads to more questions…**

# Non-Distributed refers to:

## “Tankless”
## “Instantaneous”
## “Point of Use”

# Typical Installation



Tankless Water Heater located near the point of use

# Drivers for Tankless Water Heating

- Cost savings*
  - Builders
  - Home Owners
- Life style*
- Energy efficiency*
- Water efficiency*
- Green mandates*

* Maybe

# Tankless Water Heating Applications:

- Hotel Rooms
- Schools
- Office Buildings
- Factories
- Apartments/Condos
- Townhomes
- Single Family Homes
- Laboratories
- Hospitals
- Retail Locations
- Airports

How do you compare Distributed DHW verse Point of Use DHW?

Is it worth comparing?

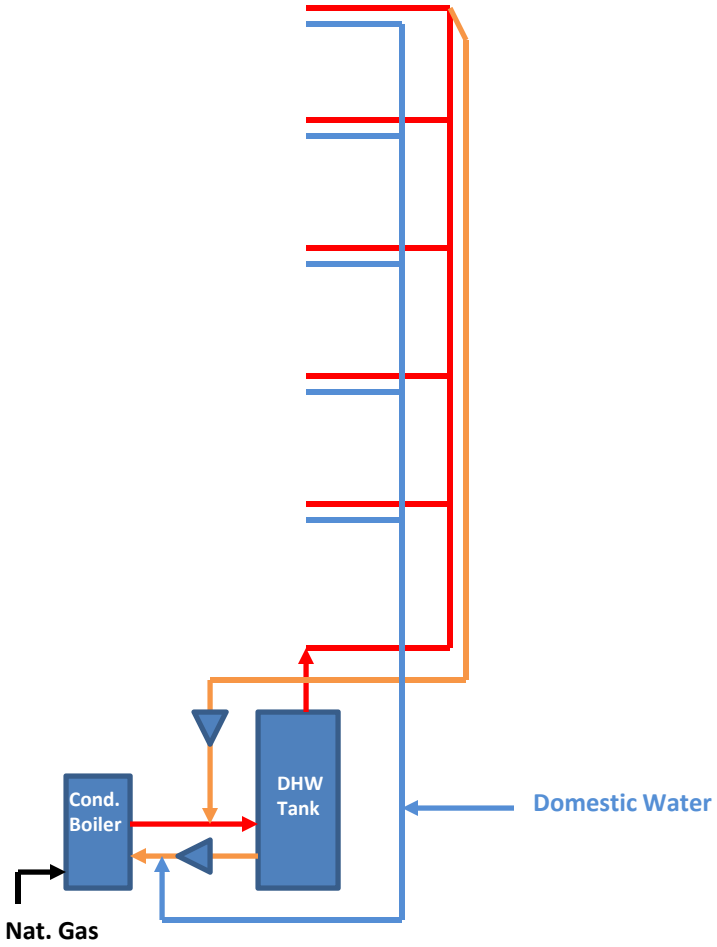
If you choose Point of Use should you use Electric or Gas?

Which is Greener…. Electric or Gas?

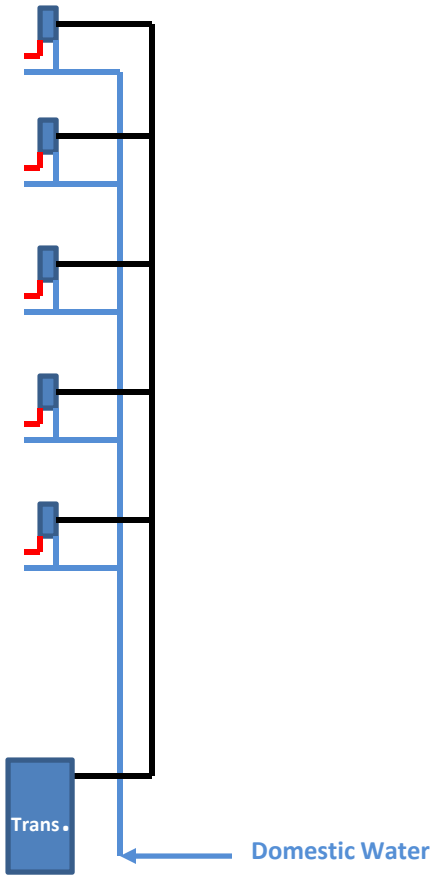
Which is more Cost Effective… Electric or Gas?

# Let's zoom out and take a look…

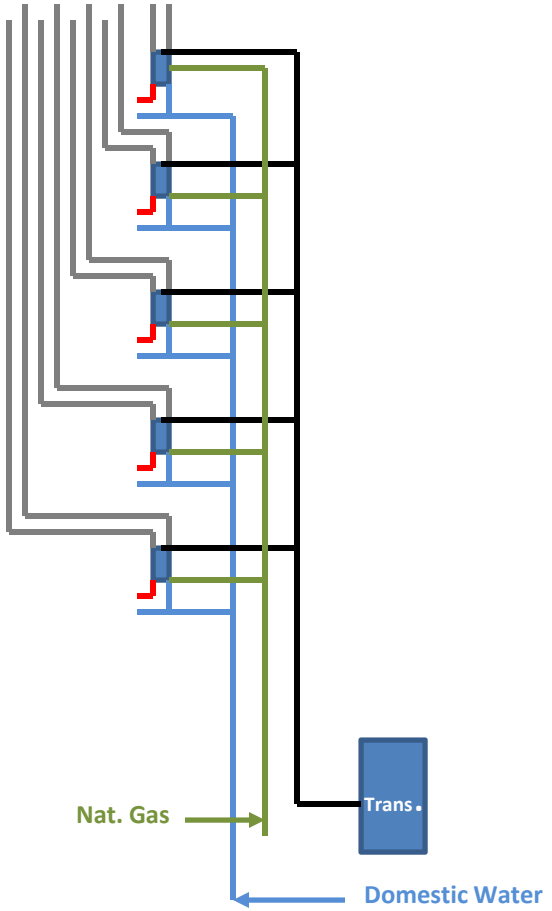
Traditional DHW
Distributed System




Point of Use (electric)
Non-Distributed System




Point of Use (gas)
Non-Distributed System



# Sizing the System

**Traditional DHW**
**Distributed System**

1) Calculate the maximum flow rate – based on fixture counts & using a diversity factor

2) Size system for 1-hour of use at assumed worse case demand. Assume 40F EWT and 140F Storage Temp (delta-T = 100F)

3) Select a storage tank for 2/3 of this load and a boiler capacity for 1/3 of this load

**Sized for 1-hrs of load but includes diversity factor & storage**

**Point of Use**
**Non-Distributed System**

1) Size each Tankless heater for the full flow of each fixture. Assume 40F EWT and desired LWT~105F (delta-T = 65F)

**Sized for load per minute, requires no storage, but does not include diversity**

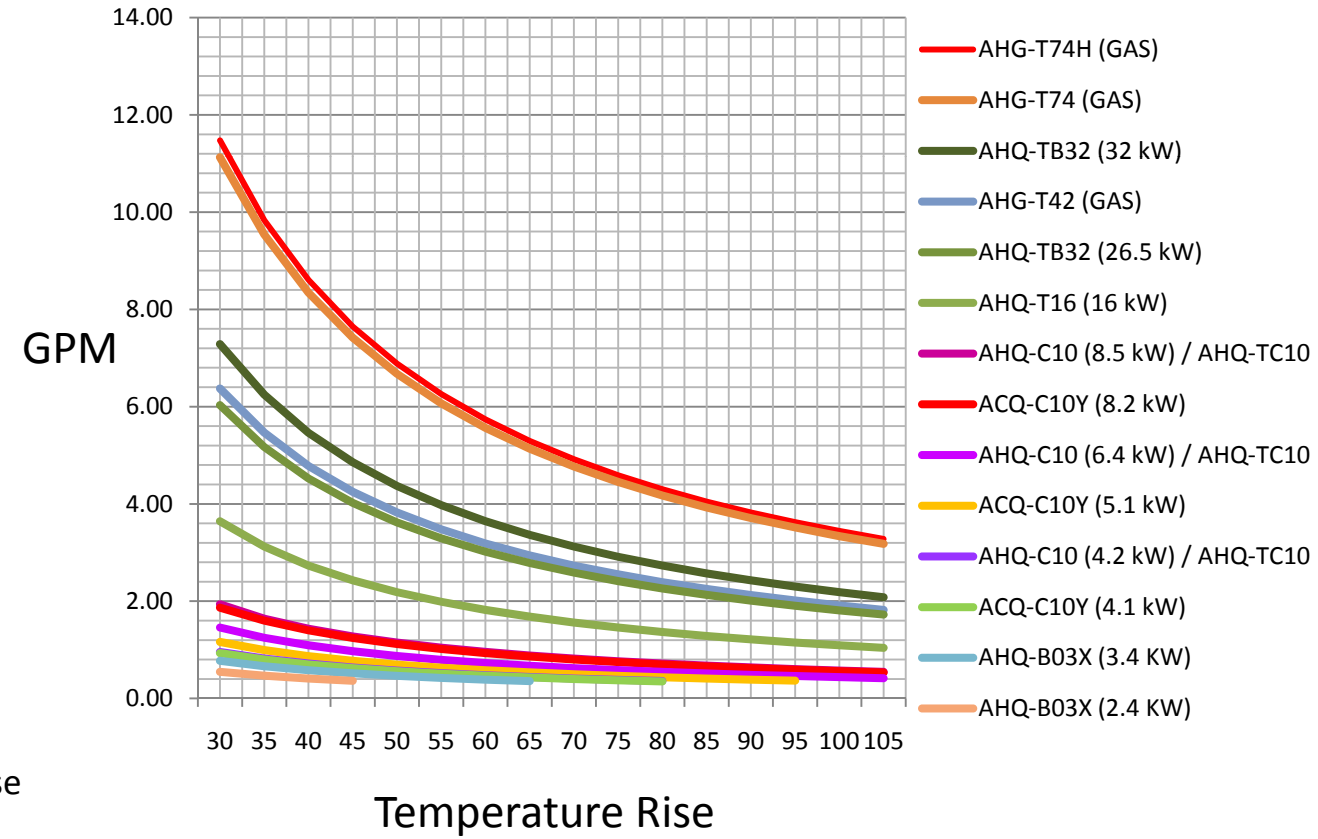
**So… The total DHW heater capacity purchased can be higher for the instantaneous water heater system, even though first cost may be lower.**

# Sizing Tankless Heaters

Select units based off required flow rate and differential temperature

1. Look at the Temperature rise needed to raise the incoming water temperature to the desired usage temperature.
2. Look at the GPM required
3. Select the Model who's power curve is intersected by both these values.

Note: Remember that most often all fixtures are not in use at the same time.



# Let's do the numbers….

| | Traditional DHW Distributed System | Point of Use Non-Distributed System |
|---|---|---|
| Heater Efficiency | 94% - 98%<br>(assumes Cond. Boilers)<br>80% - 85%<br>(assumes Non-Cond. Boilers) | 95% - 99%<br>(assumes Electric)<br>80% - 92%<br>(assumes Nat. Gas Non-Cond. – Cond. Boilers) |
| Other Component Efficiencies | 30% - 50%<br>(small circulator pumps)<br>(fractional hp) | |
| Other System Losses | Stand-by heat losses<br>(Hot water piping)<br>(Hot water tank)<br>$$$$ | Electrical losses<br>(Transformer or Fans)<br>$ |
| First Cost | $$$$$$ | $$ **(electric)** $$$$$ **(gas)** |

# Benefits: Point of Use (POU)

- Less Piping (~ half) - Single cold water system only
  - Splitting hot and cold at point of use
- Water efficiency? … no waiting for hot water
- Energy savings
  - No stand-by losses
- Flexibility
  - Serve different temperature requirements at the same time
- Lower Liability
  - In the event of a failure, only one location is down
  - Short down time, quick change out

# Types of Tankless Water Heaters

## Electric

### Immersion Coil
(Wire Coil immersed in water)

- **Smallest Footprint**
- **Heats up water in 2 seconds**
- **Low cost**
- *** tend to scale quickly**
- *** requires water softner**
- *** typically fixed input power**

### "Coilless" or Indirect
(Quartz glass tubes with resistant coating)

- **Mitigates scale build-up**
  - → No efficiency or capacity deterioration
  - → Long equipment lifetime
  - → No water softener required
- **Power consumption adjustable**
- **User Temperature setting**
- **Heats up water in 2 seconds**
- **Suitable for all water conditions**
- **Low to No Maintenance Required**

## Gas

### Condensing
(High Efficiency)

- **Provides 10% to 15% greater efficiencies compared to non-condensing**
- *** higher 1st cost**

### Non-Condensing
(Standard Efficiency)

- **Can handle larger loads compared to electric**
- **Used to avoid large electrical loads**

# Selecting a Tankless: Fuel Consideration

## Challenges

- ELECTRIC
  - Power requirements
  - Scaling (immersion coils)
  - Efficiency/Capacity* reduction with use due to scaling
- GAS
  - Gas availability
  - Venting requirements
  - Condensation
  - Higher unit cost
  - Scaling
  - Start/Stop cycles (time delays)

## Advantages

- ELECTRIC
  - Ease installation
  - Point of use flexibility
  - Lower unit cost
  - Lower installation cost
- GAS
  - Higher capacity units
  - Low impact on electrical loads

# Control of Tankless Water Heaters

## Input Power

(Unit provides input power)

- **May be fix**
- **May be variable based on manual input**
- **May stage down automatically if high limit temperature is reached**

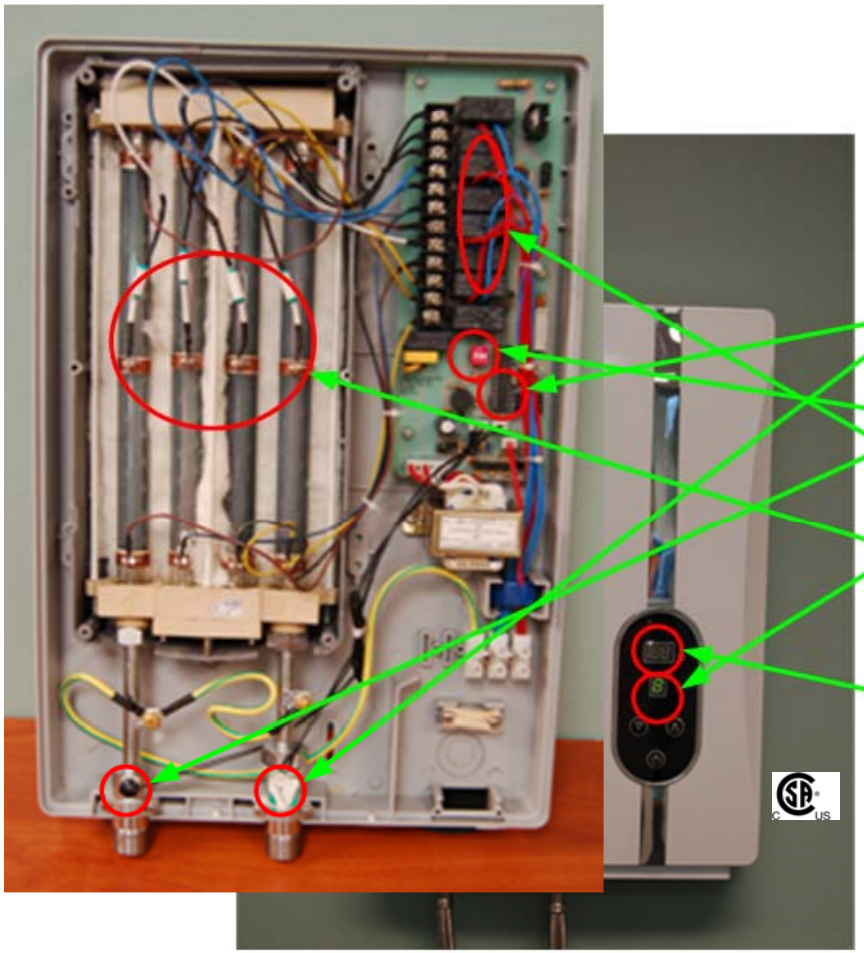

## Temperature Priority

(Unit controls stages of heat to maintain set-point temperature)

- **Provides set-point temperature (+ ) or (-) 2-degrees**
- **Automatically stages heat**
- **Power is based on demand**
- **Adjustable set-point**

# “Coilless” / Indirect

(Quartz glass tubes with resistant coating)



## How does it work?

- Flow is sensed by the Flow switch **(1)**
- System Microprocessor **(2)** initiates the following sequence:
  - Begins continual sensing of Temperature sensor (3) and Flow switch (1)
  - Reads power selection dip switch (4) setting
  - Reads Power selection from front panel (5)
  - Energizes corresponding Digital heating power control relays (6)
  - Water is now being heated by heating tubes (7)
  - System continues to operate monitoring flow and output temperature.
  - Output temperature is displayed on front panel (8)
- System remains on until no flow is detected then enters standby mode once more waiting for flow.

# Electric Tankless Safety

* Based on American Hometec Units

## Six levels of protection (standard):

1. Temp high limit
2. Overheat
3. Electrical leakage
4. High voltage
5. High water pressure (when pressure relief valve is installed)
6. Freeze protection on units with less than 8.5kw

# $H_2O$ Saver Technology™

* Based on American Hometec Units

- Timer allows hot water consumption control
- Water volume setting send alarm to alert user when the tub is filled up with pre-set water volume of the tub

# Tankless in Green Standards

Green Building Standards:

- LEED (USGBC) US Green Building Council.
  - Achieve points in three areas (Energy Savings, Water Savings, & Design)
- Green Building Standard (NAHB and ANSI) National Association of Home Builders and American National Standards Institute.
  - Achieve points in two areas (Energy savings and Water Savings)
- Watersence
  - (Water savings)

# Solar

**(Limited Real Estate)**

Hot Water Solar

Hot Water Storage Tank with
(1) integral heat exchanger

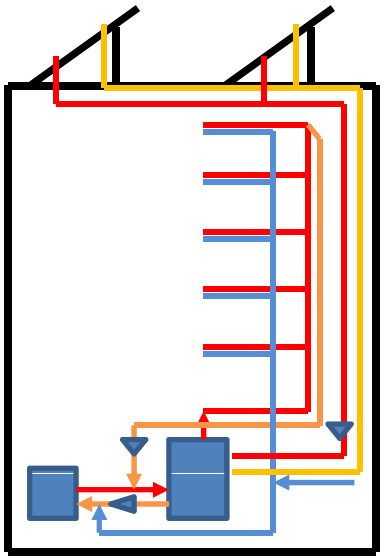
* Requires “Booster” Heater

Gas  Electric

- If small load (low flow)-> Tankless
- If large load (high flow)-> Trad. Boiler

Photo Voltaic Solar (PV)

Lends itself to Electric Tankless
DHW system



Hot Water Solar

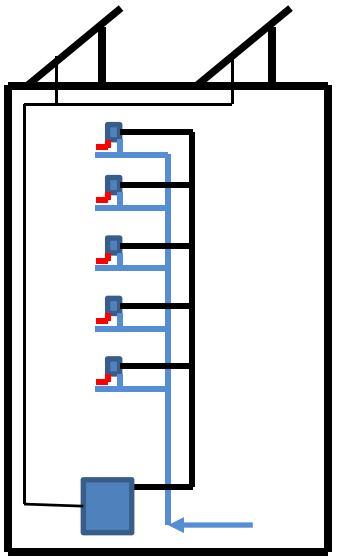
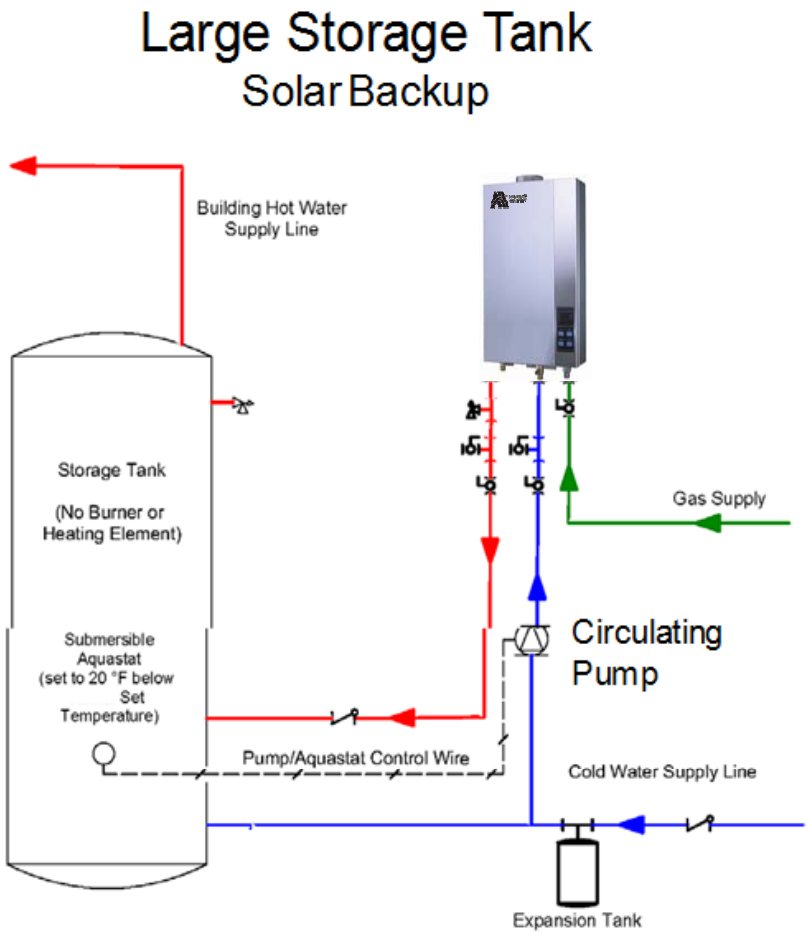


Photo Voltaic Solar (PV)

# Hot Water Solar

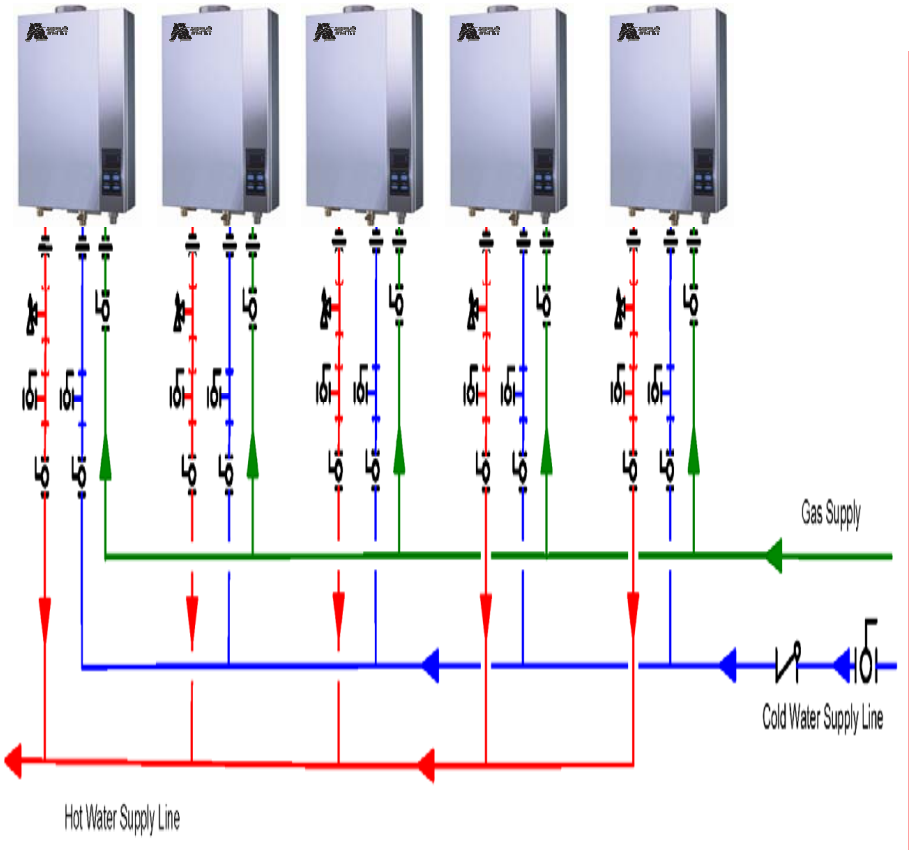



- Oversize the storage tank
- Provide ample insulation
- Allows for smaller "booster" heater

# Tankless High Demand Installations

**Drench Shower**

5 units in parallel




Why heat water and waste energy when you don't have too?

Gas shown but Electric could be used as well

# Hybrid Installations

**Traditional Distribution DHW + Tankless**

Use Tankless Water Heaters to:

- Boost temperatures for special requirements
  - Commercial Dishwashers, etc
- To provide DHW for sinks, shower, etc far away from main DHW supply
  - Eliminates line losses
- To add on to existing system
  - Provides cost effective install
- To provide redundancy
  - Critical system applications

# High Temp or High Flow Applications

- Electric  Units and all Gas Units can be installed in **SERIES** in areas where the inlet water temperature can become extremely cold or higher output temperatures are required.
  - Note: when connecting in series water head pressure is increased which might cause a decrease in water pressure.

- All Units can be configured in **PARALLEL** to support high flow demands.
  - Note: when configuring the units in Parallel the units must be identical, the head pressure is reduced resulting in half the flow through each of the units. Therefore; the minimum flow to operate the unit will double for two units and triple for three and so on.

# Cost Analysis

| Cost Analysis - NG Gas Tank vs. Coillless Technology Electric Tankless (Student Housing Project: SUNY ESF, 212 Rooms) | | |
|---|---|---|
| Water Heater Type | 400G NG Water Heater | Coilless Technology Electric Tankless |
| Water Heater Maker/Model# | AO Smith/BTP-400-1500 | American Hometec/ EVQ-T16 |
| Capacity | 1039 GPH @80°F rise | 102GPH @65°F rise (need lower rise due to closer installation to the point of use and user desired temperature set capability) |
| Efficiency | 80% | 95% |
| Gross Weight (lbs) | 4277 | 15 |
| Hot water Consumption/day (Gallons) | 12100 | 12100 |
| Energy Input | | |
| BTU/unit | 1500000 | |
| Kw/unit | | 16 |
| Efficiency | 80% | 95% |
| Units | 2 | 222 |
| Equipment cost/Unit | $ 75,600.00 | $325 |
| hot water pipe+ recirculation system +distribution system | $324,523.50 | |
| Electric wiring | | $109,313 |
| **Total installed cost** | **$400,123.50** | **$181,462.80** |
| NG Price (per 100 Cu ft, Gateway Energy) | 0.93 | |
| Electric Price (KW, EnergyPlus) | | 0.0594 |
| BTU Consumption/day | 13,402,970 | 6,896,363 |
| **Operating Cost** | **$122.20** | **$110.92** |
| | | |
| First Year Total Cost | $444,727.80 | $225,233.31 |
| | | |
| **First Year Up-front Savings** | | **$219,494.49** |
| **Annual Savings after first year** | | **$833.79** |
| **5 Year savings** | | **$222,829.65** |
| **Life time savings (15 years)** | **Assuming this tank lasts for 15 years** | **$231,167.54** |

# Cost Analysis

| Cost Analysis - NG Gas Tank vs. Coillless Technology Electric Tankless (Medium Hotel: 72 with Restaurant Bar, Catering and Coffee Shop) | | |
|---|---|---|
| Water Heater Type | 85G NG Water Heater | Coilless Technology Electric Tankless |
| Water Heater Maker/Model# | AO Smith/BTR-500 | American Hometec/ 10 16 26 units |
| Capacity | 1039 GPH @80°F rise | 102GPH @65°F rise (need lower rise due to closer installation to the point of use and user desired temperature set capability) |
| Efficiency | 80% | 95% |
| Gross Weight (lbs) | 857 ea | 15 |
| Hot water Consumption/day (Gallons) | 5025.5 | 5025.5 |
| Energy Input | | |
| BTU/unit | 500000 | |
| Kw/unit | | 16 |
| Efficiency | 80% | 95% |
| Units | 4 | 90 |
| Equipment cost/Unit | $ 50,000.00 | $35,600 |
| hot water pipe+ recirculation system +distribution system | $221,901.29 | |
| Electric wiring | | $53,384 |
| **Total installed cost** | **$271,901.29** | **$88,984.00** |
| NG Price (per 100 Cu ft, Gateway Energy) | 0.93 | |
| Electric Price (KW, EnergyPlus) | | 0.0594 |
| BTU Consumption/day | 6,114,220 | 2,864,271 |
| **Operating Cost** | **$55.75** | **$49.81** |
| | | |
| First Year Total Cost | $292,249.05 | $107,163.23 |
| | | |
| **First Year Up-front Savings** | | **$185,085.82** |
| **Annual Savings after first year** | | **$2,168.53** |
| **5 Year savings** | | **$193,759.96** |
| **Life time savings (15 years)** | **Assuming this tank lasts for 15 years** | **$215,445.31** |

# So…

Tankless water heaters can make sense even on large commercial applications

# But…

It requires a little bit of work to figure that out

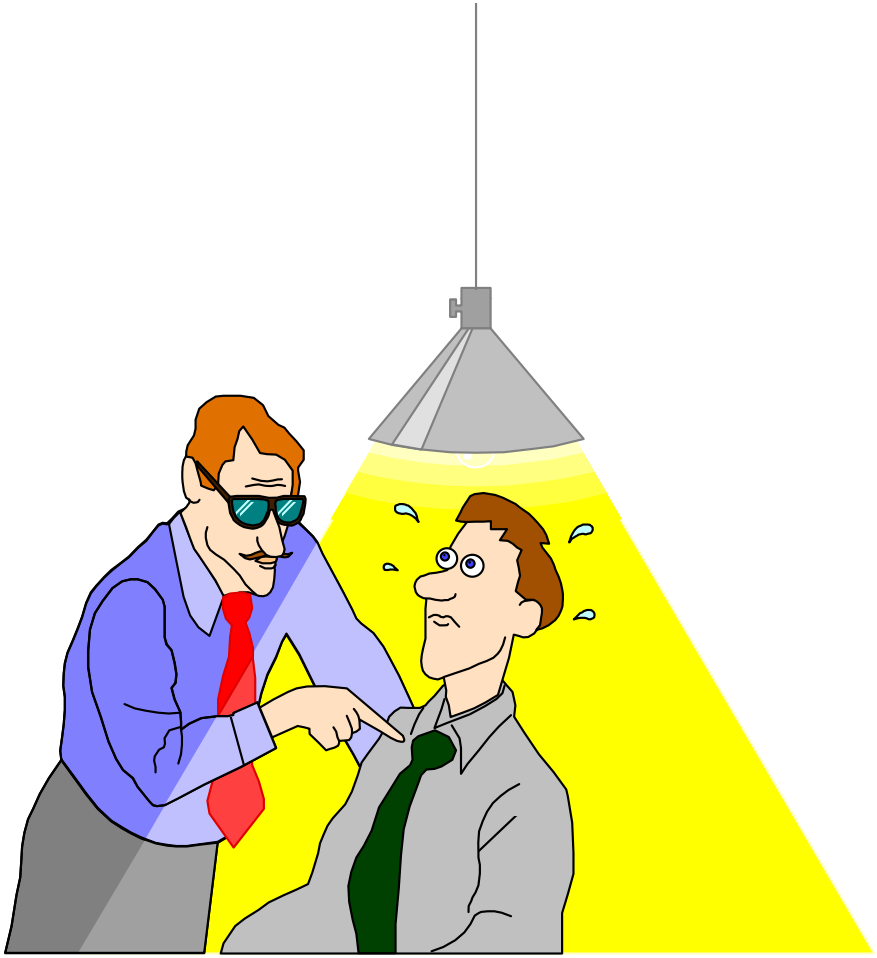
# Which is better?

No easy answer….

You have to evaluate:

1) Energy cost differences between fuel options
2) The costs of standby energy losses
3) Availability of onsite energy
4) First cost of each system
5) Customer requirements (i.e. - consequences of downtime, etc.)

# Questions?



# Distributed verse Non-Distributed Domestic Hot Water Heater Applications

Thank you!

**Bob Barrett**
**Wallace Eannace Associates**
**WWW.WEA-INC.COM**