



Optimizing a Hybrid Gas Water Heating Approach

- > *Combining the Best Features of Tankless and Storage Water Heating*

June 3, 2008

Panel on Status of Breakthrough Technologies
at ACEEE Forum on Water Heating in
Sacramento, CA

Douglas Kosar, Gas Technology Institute

Problem ... and Solution?

> Current Problems

– Storage water heaters

- > standby losses
- > inadequate for large total draws
- > require more space

– Tankless water heaters

- > lag time for hot water
- > high minimum flow rates
- > variable temperatures
- > increased gas line size/upgraded flue
- > expensive burner modulation controls

> Proposed Solution is a Hybrid Optimized Tankless (HOT) Water Heater (WH)

Technical Objective

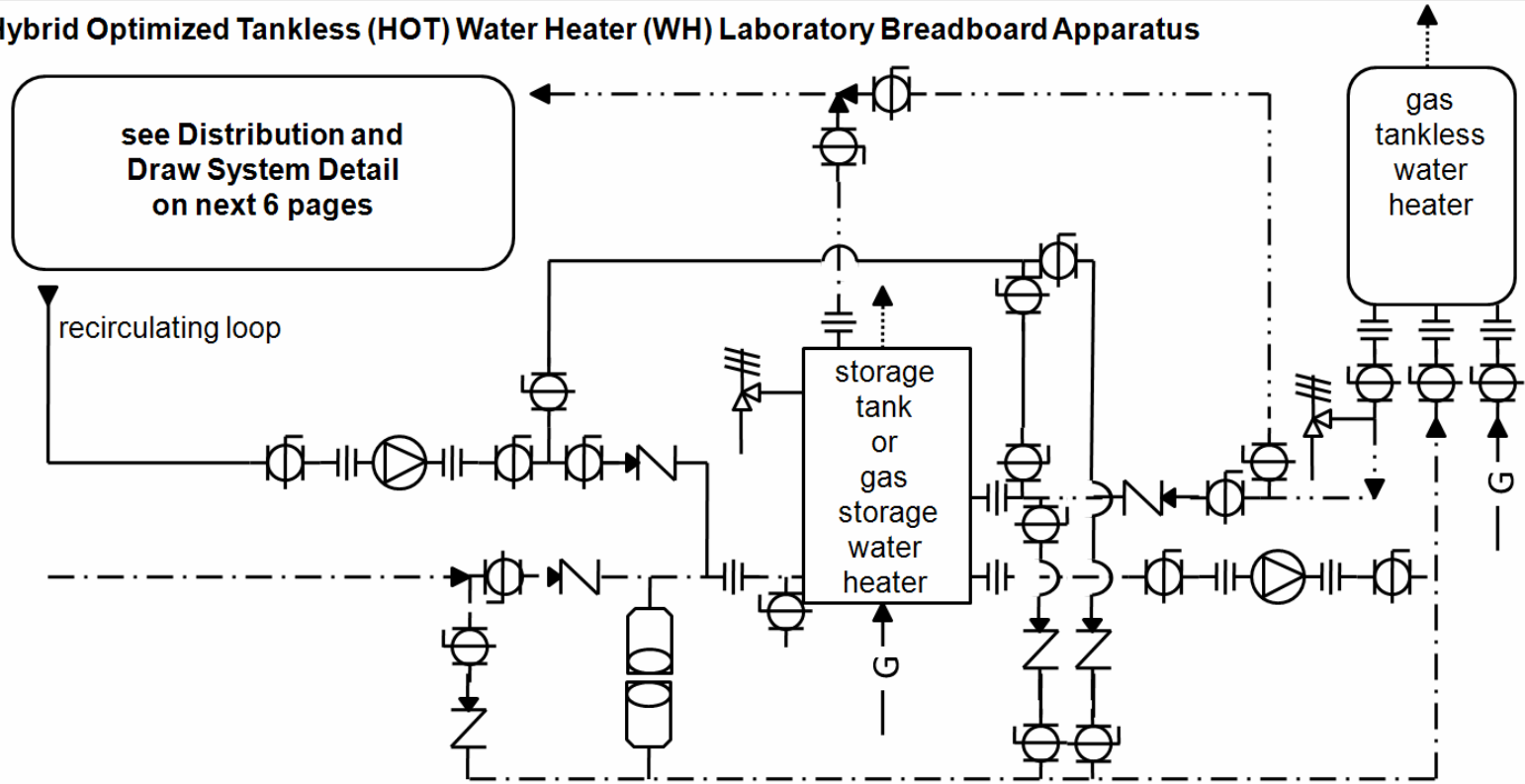
- > Develop High Efficiency HOT WH Based on Tankless Designs with Integrated “Buffer” Devices and Controls Strategies
- > Design and Breadboard Test Prototype Configurations in Current First Phase
 - First part of test plan
 - > Tankless designs with various buffer options
 - > Impacts of draw profiles
 - Second part of test plan
 - > distribution system losses
 - > point of use device effects
- > Prototype Evaluations, Qualification Testing, and Field Testing In Future Phases













Requirements : HOT WH will

- > be cost competitive with current WHs
- > support easy retrofit installation
- > encourage water conservation by supporting low flow draws
- > minimize cold water sandwich effect
- > support simultaneous hot water draws for normal residential hot water uses
- > have energy efficiency comparable to current tankless water heaters
- > have strong potential for meeting the CA SCAQMD NOx emissions regulations

Lab Breadboard Layout . . .

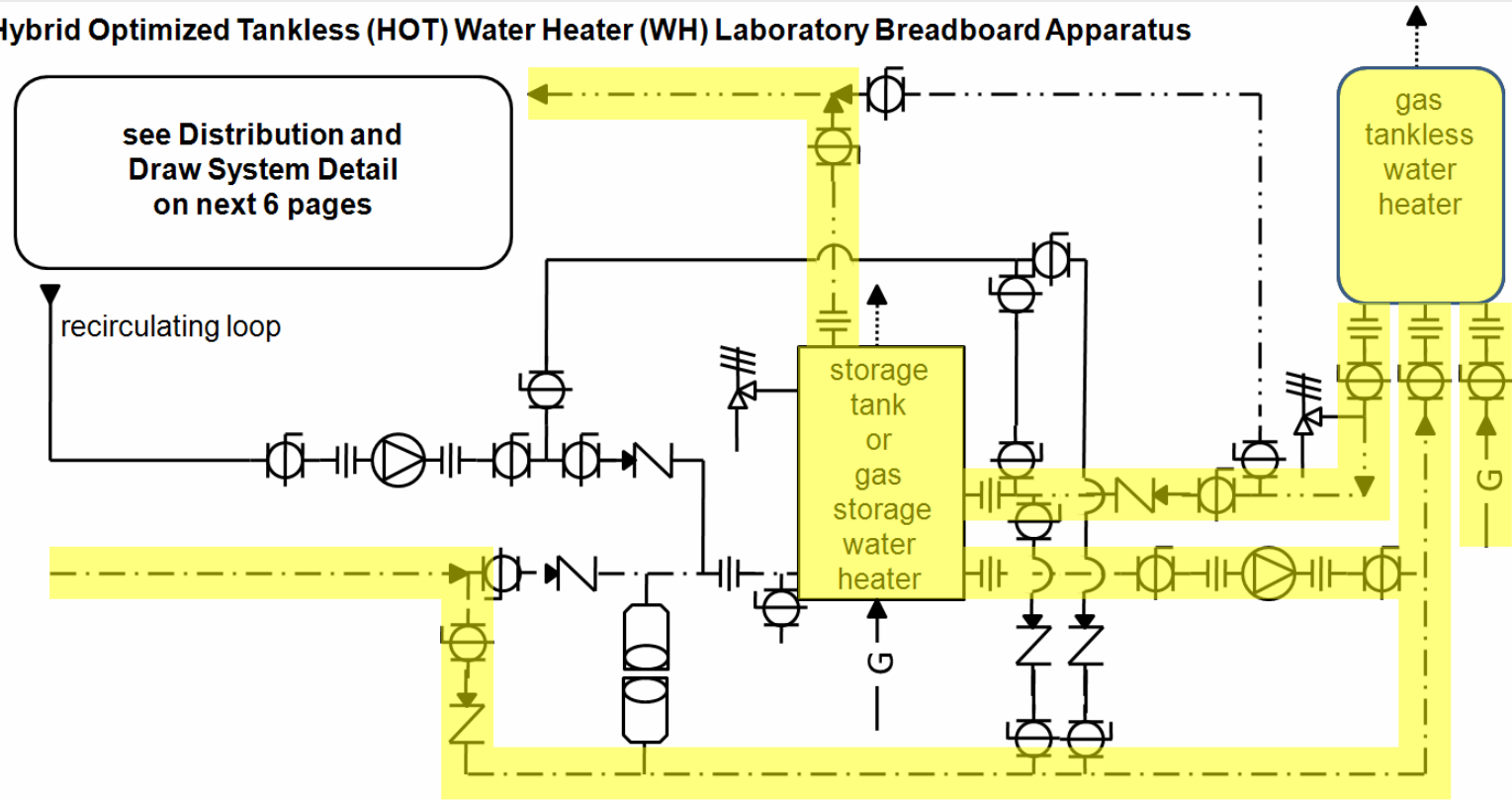
Hybrid Optimized Tankless (HOT) Water Heater (WH) Laboratory Breadboard Apparatus



Pump		Ball Valve		Solenoid Valve		Pressure Relief Valve		Cold Water Line		Hot Water Line	
Expansion Tank		Check Valve		Meter		Union		Vent Line		Gas Line	

... Allows Flexible Prototyping

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System #5
Gas Tankless Water Heater
with Storage Tank

Active Piping/Components

. . . and Broader Matrix Testing

- > Water Heating System
 - Tankless modulating/non-modulating firing rate
 - Storage only tank size w/ or w/o recirculation
- > Distribution System
 - Water draw profiles
 - Point of use devices
 - Recirculating loops
- > System Test Procedures
 - DOE standard tests
 - Alternative realistic 24 hour usage pattern tests
 - Short design extreme 15 minute profile tests
 - Emerging “component” efficiency tests?

Test Plan Matrix

Firing Rates and Controls

75,000 to 175,000 Btu/hr

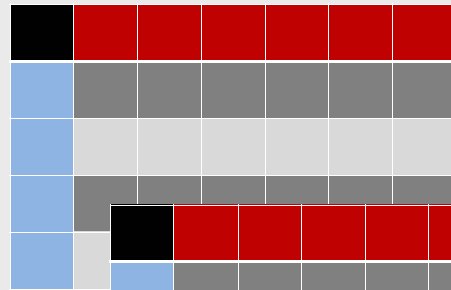
Non-modulating/Staged/Fully (10 to 1) modulating

Buffer Storage Tank Size and Temperature

2 to 40 Gallons

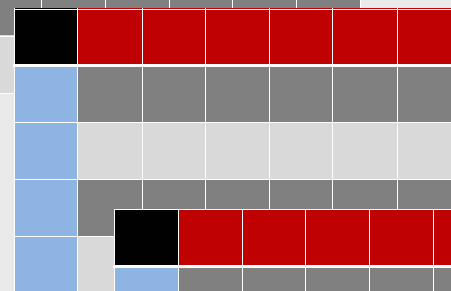
120 to 140 °F

Matrix Execution



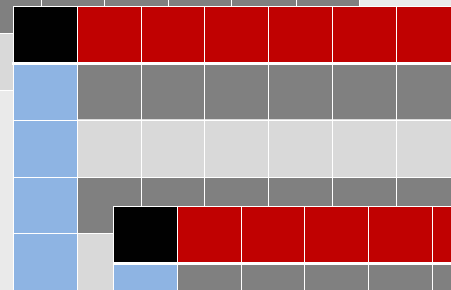
Draw Profile #1 – DOE 24 Hr Standard

- baseline storage and tankless WHs (systems 1 & 3)
- hybrid WH matrix to left (20 variants of system 5)



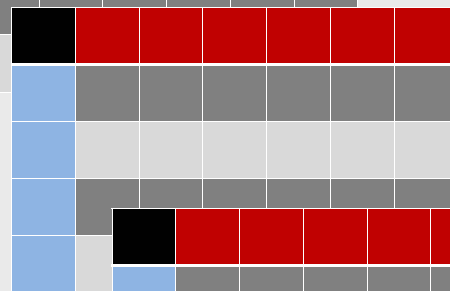
Draw Profile #2 – GTI Low 24 Hr Usage

- baseline storage and tankless WHs
- hybrid WH matrix to left



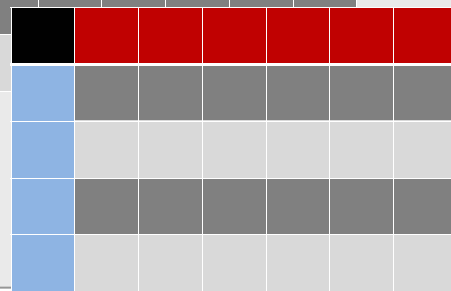
Draw Profile #3 – GTI Average 24 Hr Usage

- baseline storage and tankless WHs
- hybrid WH matrix to left



Draw Profile #4 – GTI High 24 Hr Usage

- baseline storage and tankless WHs
- hybrid WH matrix to left



Draw Profile #5+ – 15 Min Usage

- baseline storage and tankless WHs
- hybrid WH matrix to left

Milestones

- > System Design Options June 2008
- > Breadboard Fabrication July 2008
- > Breadboard Lab Testing December 2008
- > Prototype Evaluation June 2009
- > Field Test December 2009

Questions ... for YOU

- > Past and present hybrid products?
- > New product requirement emphasis?
- > Optimization process paths
 - Experimentation?
 - Simulation?