Northwest Power and Conservation Council

October 28, 2010

MEMORANDUM

TO: Power Committee

FROM: Ken Corum

SUBJECT: Comparison of ancillary and other services available from extended thermal storage water heaters

The Power Committee first discussed the potential for some loads to provide ancillary services nearly two years ago. Since then the Council included action items in the Sixth Power Plan to explore this potential, and the Council has contributed to one of several pilot programs in the region that are beginning to test the idea.

Staff has begun to explore the combinations of services that such loads as water heaters could provide to the system, both ancillary services and others. This presentation examines the potential for water heaters to provide incremental and decremental reserves for load and wind balancing, and to reduce peak loads at times when it is advantageous to utilities. The presentation will illustrate tradeoffs among the possible services.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Northwest Power and Conservation Council

Comparison of Multiple Services from Thermal Storage Water heaters

NWPCC Power Committee
Ken Corum

"Conventional" Demand Response

- Reductions in load at or near peak
- Dozens of hours/year
- Mostly avoids capacity cost

Northwest Power and Conservation Council

DR for Ancillary Services (includes wind integration)

- Includes both increases and decreases in load
- Needed virtually every hour of year
- Avoids capital and operating costs
- Requires quick response, flexibility
- E.g. water heaters w/ expanded thermal storage, controls

Northwest Power and Conservation Council

System Operators' Job

- Given forecast load and scheduled generation, match load and generation
  - Loads are uncertain and volatile
  - Generators are not perfectly reliable and e.g. wind, solar have variable output
  - Adjustments every few minutes

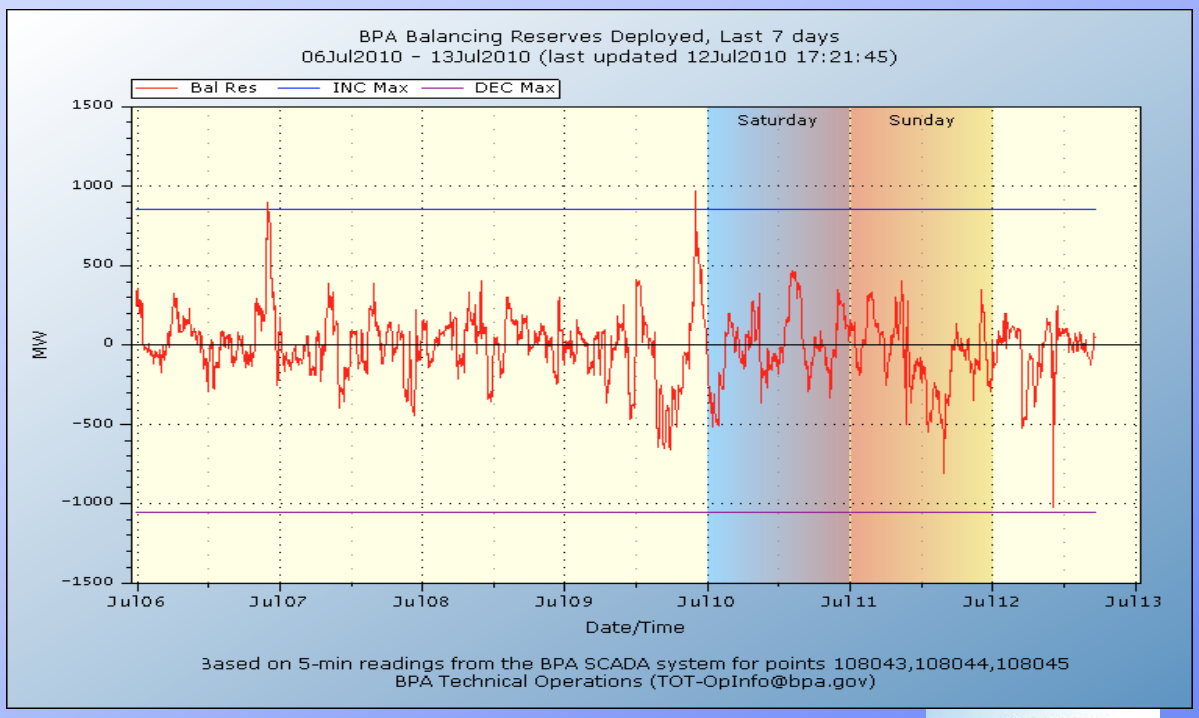
Northwest Power and Conservation Council

System Operators' Tools

- Resource reserves, e.g.:
  - Simple cycle gas turbine or hydroelectric generator running at 80% of capacity
  - Capable of increasing to 100% and decreasing to 60% quickly

Northwest Power and Conservation Council

Balancing Reserves



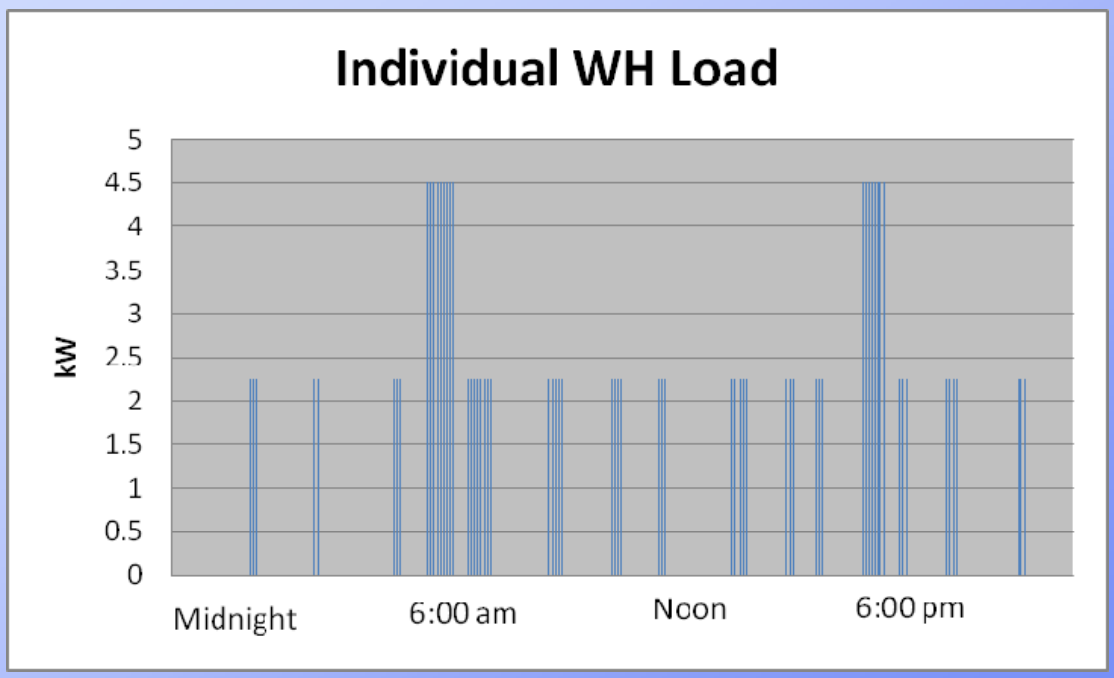
Northwest Power and Conservation Council

Potential Services from WH examined

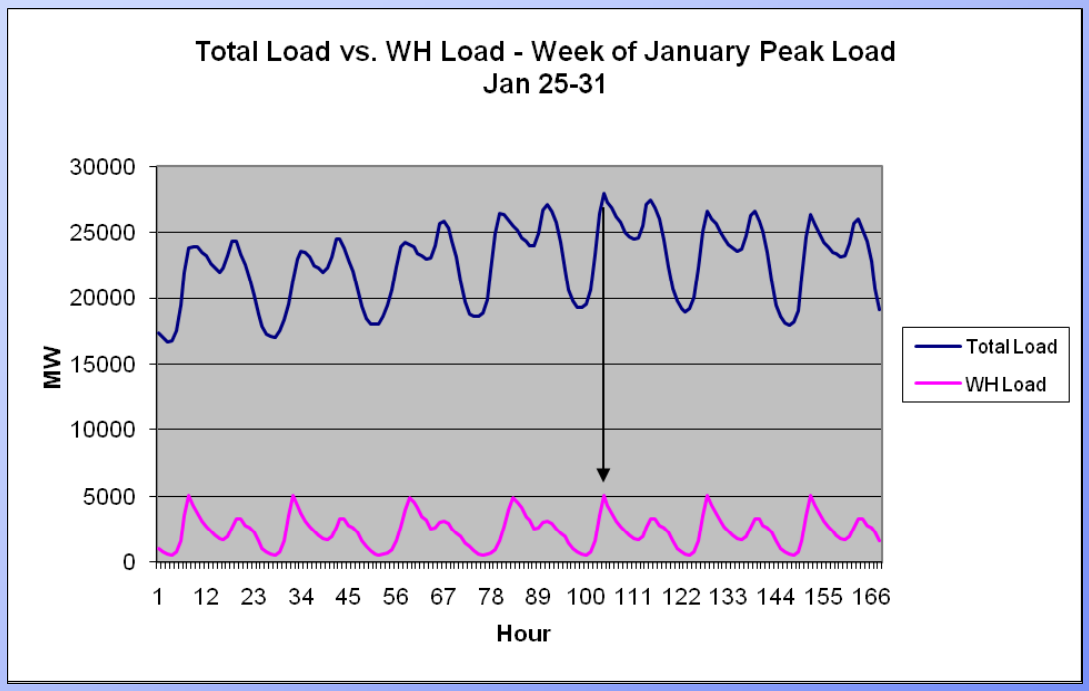
- Incremental reserves ("Incs")
  - Load changes equivalent to increase in generation (= decrease in load)
- Decremental reserves ("Decs")
  - Load changes equivalent to decrease in generation (= increase in load)
- Reductions in peak load

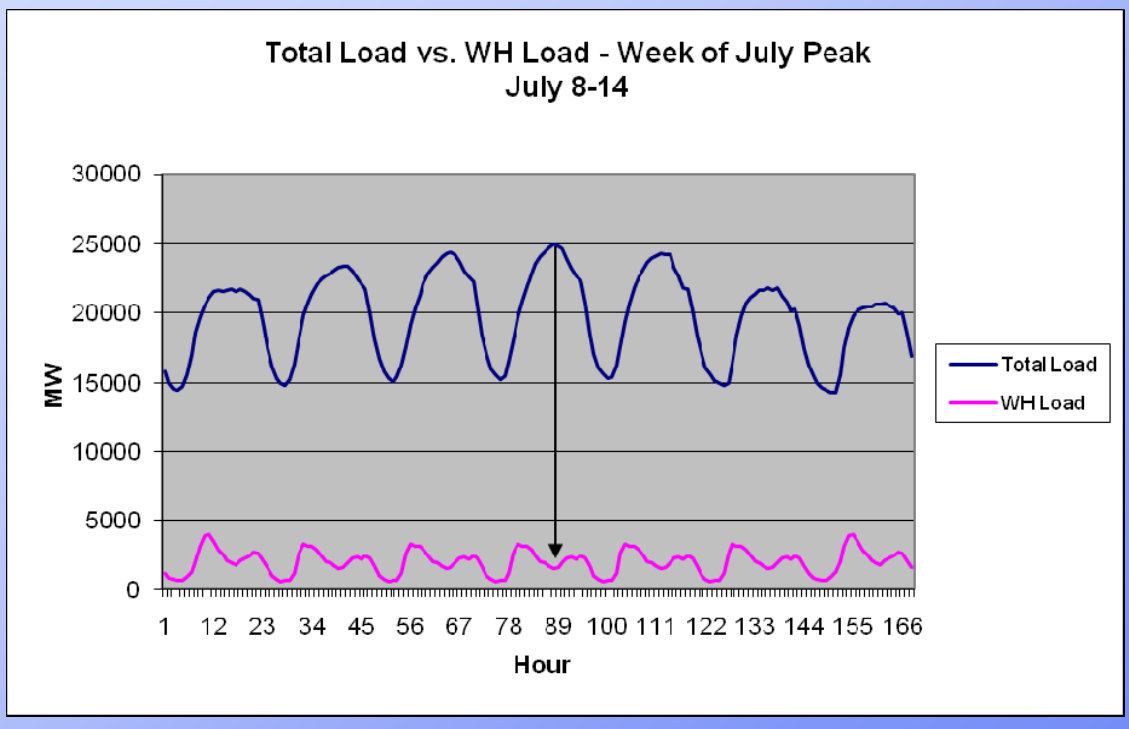
Incs = Gen↑ = Load↓
Decs = Gen↓ = Load↑

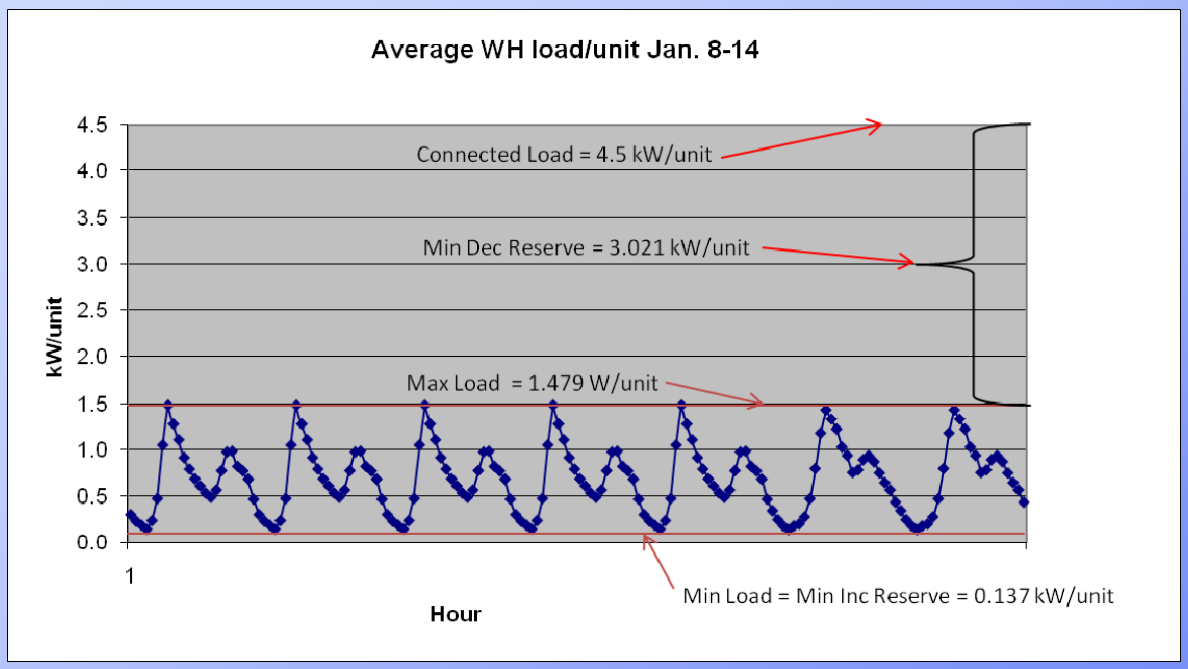
Northwest Power and Conservation Council



Northwest Power and Conservation Council

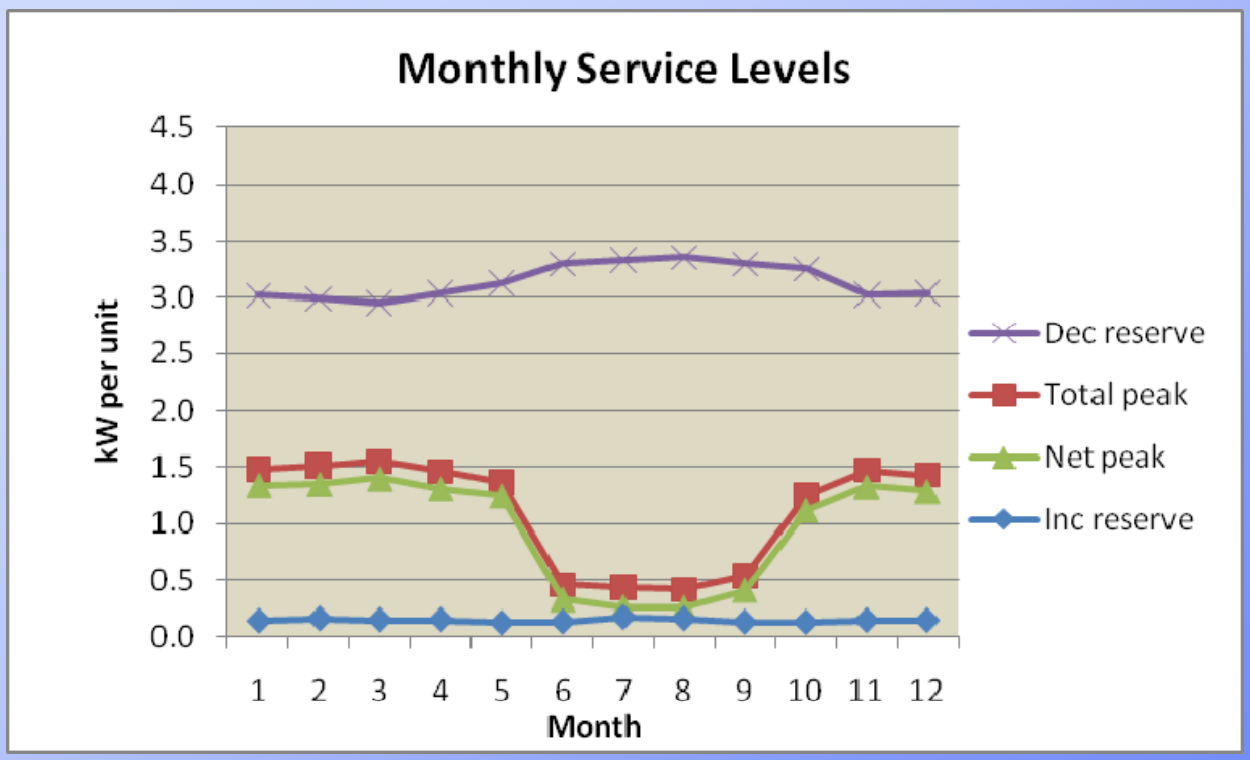

Total Load vs. WH Load - Week of January Peak Load
Jan 25-31
30000
25000
20000
15000
10000
5000
0
MW
1 12 23 34 45 56 67 78 89 100 111 122 133 144 155 166
Hour
Total Load
WH Load


Total Load vs. WH Load - Week of July Peak
July 8-14
30000
25000
20000
15000
10000
5000
0
MW
1 12 23 34 45 56 67 78 89 100 111 122 133 144 155 166
Hour
Total Load
WH Load



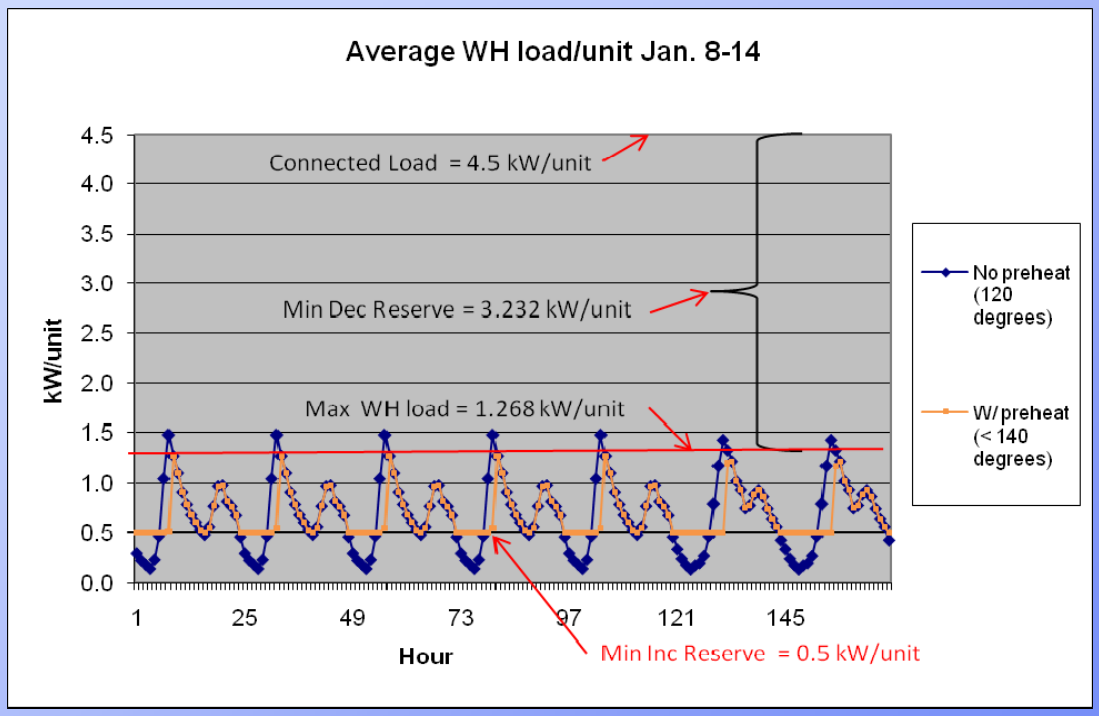
Incs = Gen↑ = Load↓
Decs = Gen↓ = Load↑

Northwest Power and Conservation Council

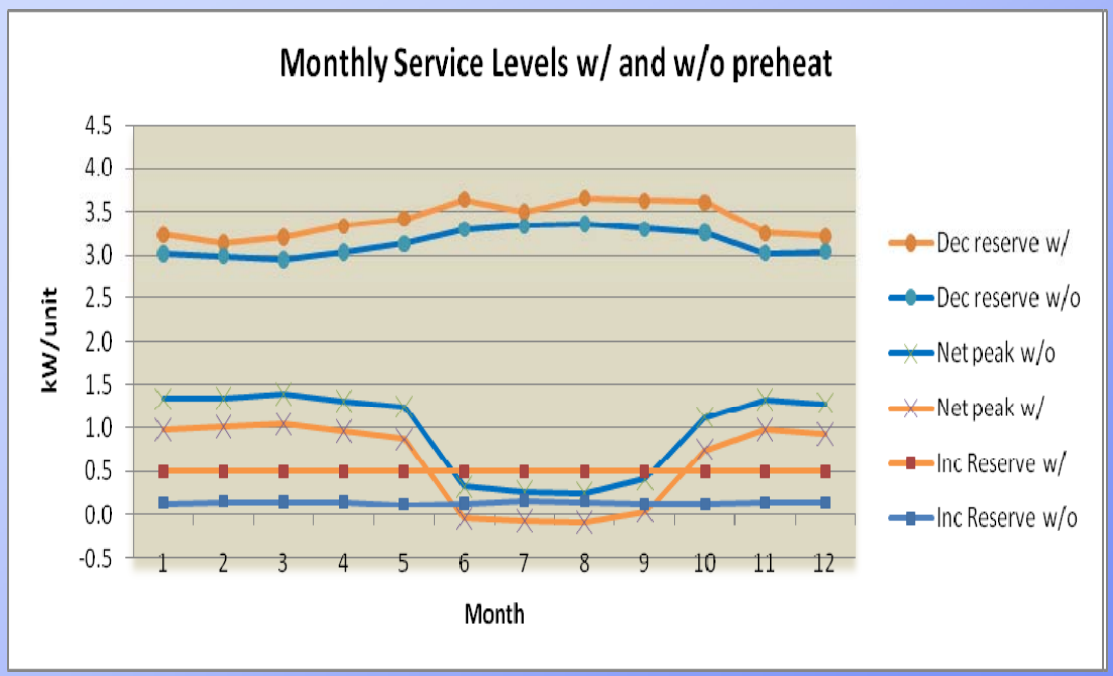


Incs = Gen↑ = Load↓
Decs = Gen↓ = Load↑

Northwest Power and Conservation Council



Incs = Gen↑ = Load↓
Decs = Gen↓ = Load↑



Incs = Gen↑ = Load↓
Decs = Gen↓ = Load↑

Summary

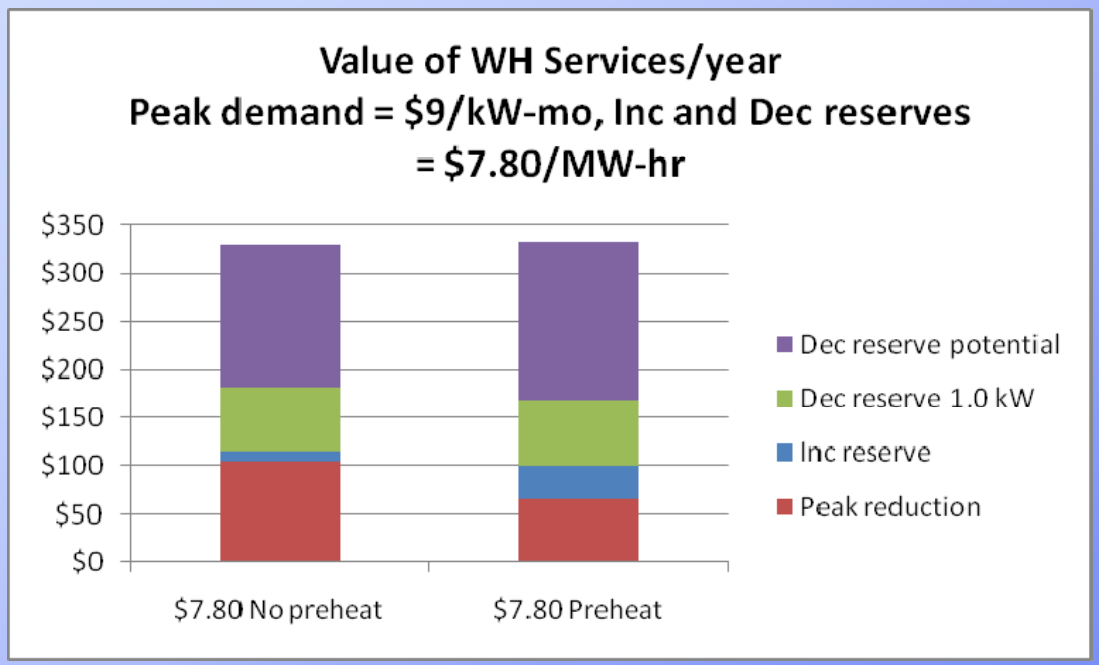
- WH can provide various combinations of services
- Mix of services that is best depends on values of services
- Potential for dec reserves is large (thousands of MWs)
- Reasonable range of values examined per unit is $200 - $600 per year

THE END

- Except for more detailed numbers and graphs, if anyone's interested

Value of Services per Thermal Storage Water Heater ($ per year)					
Inc Reserve	Net peak reduction	Dec reserve 1.0 kW/unit	Dec reserve Full potential	Total Value 1.0 kW/unit dec	Total Value Dec full potential
Inc and Dec Reserves $7.80/MW-hr, Peak demand $9.00/kW-mo					
No preheat					
$9.66	$104.88	$68.33	$215.02	182.87	329.56
With preheat					
$34.16	$66.16	$68.33	$232.41	168.65	332.73
Inc and Dec Reserves $17.50/MW-hr, Peak demand $9.00/kW-mo					
No preheat					
$21.68	$104.88	$153.30	$482.42	279.86	608.97
With preheat					
$76.65	$66.16	$153.30	$521.43	296.11	664.24

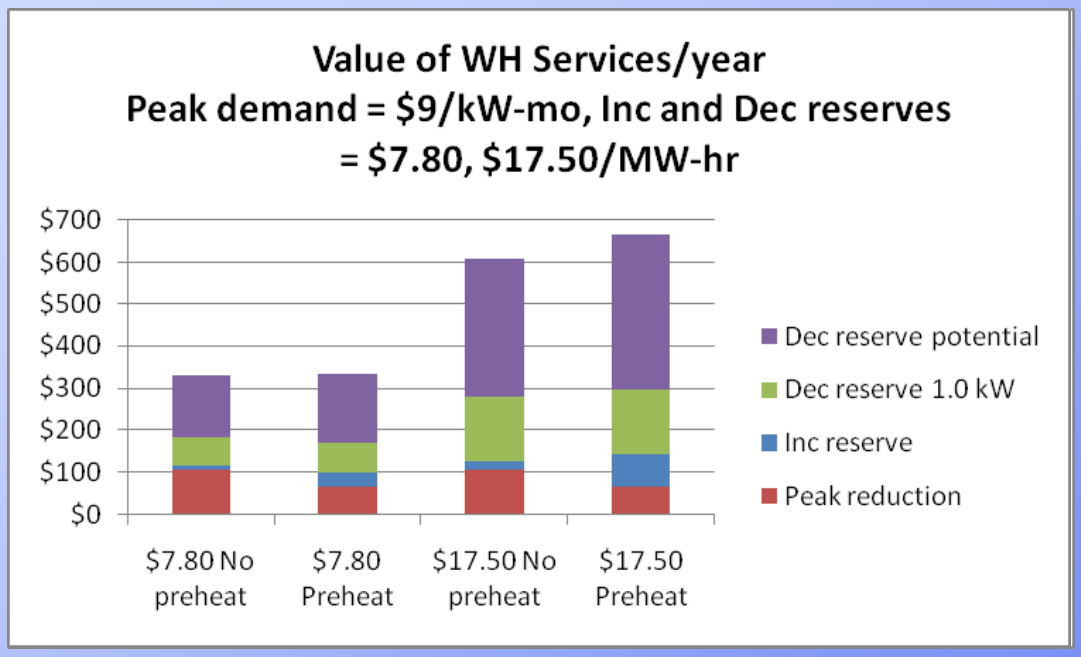
Northwest Power and Conservation Council



Incs = Gen↑ = Load↓

Decs = Gen↓ = Load↑

Northwest Power and Conservation Council



Incs = Gen↑ = Load↓

Decs = Gen↓ = Load↑

Northwest Power and Conservation Council