Northwest Power and Conservation Council

January 29, 2009

MEMORANDUM

TO: Power Committee

FROM: Ken Corum

SUBJECT: Assumptions for Smart Grid and Demand Response in 6th Power Plan

The Smart Grid will be included in the 6th Power Plan as new technology that covers a wide range of sensor, communication, and control devices. Its effect on the power system is likely to be substantial, through enabling demand response and utility operational improvements. While we cannot predict all the effects of the smart grid on future power system structure and operation, Tom Karier suggested that staff outline some likely scenarios. By now you are familiar with the potential use of plug-in hybrid vehicles (PHEVs) as storage devices to absorb energy from, and provide energy to, the power system as it is needed, enabled by smart grid technology. I will discuss two other cases, clothes dryers and water heaters, which could be very attractive and represent potential action items for the 6th Plan.

We have learned a lot about demand response since our analysis in the 5th Power Plan. We are now aware of more things that we do not know, and are able to ask more questions that we do not yet have answers to. I will describe the assumptions staff will use in the Regional Portfolio Model (RPM) for a number of demand response programs, and make some distinctions between demand response that can be treated in the RPM and demand response that cannot.

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Assumptions for Smart Grid and Demand Response

Power Committee
Feb. 10, 2009

Ken Corum

Smart Grid

- In general more and cheaper:
  1. Information on state of system
     - Meters
     - Sensors
  2. Communication
  3. Intelligence and control

Smart Grid

- Like computers, internet, hard to predict all future applications of improved technology, HOWEVER
- SG will enable many actions not practical until now
  - Demand response
  - System operation
    - Energy saving
    - Long run capital saving

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Illustrative Possibilities w/ Smart Grid

- Clothes dryers
- Water heaters

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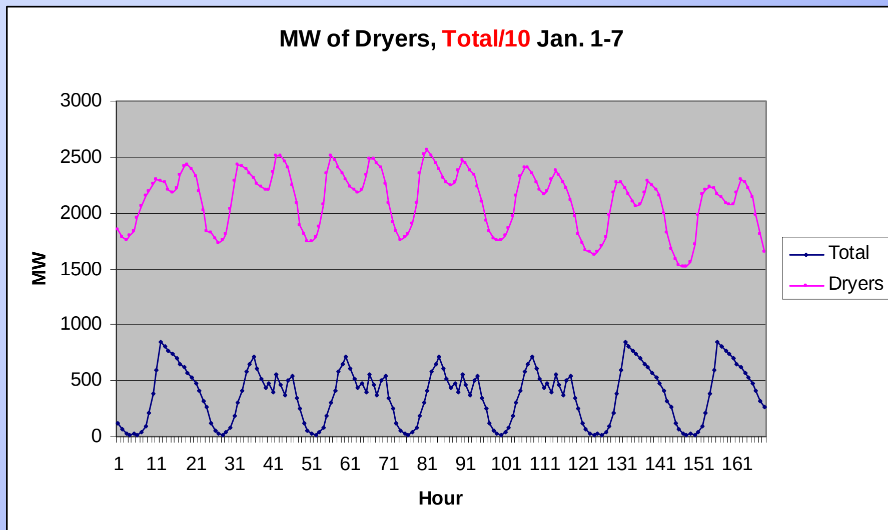

Dryers FC for 2010, Total/10 from 2002

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Clothes Dryers w/ Smart Grid

- 300-500 MW winter load in peak period
- 250-380 MW summer load in peak period
- SG control based on “underfrequency” limited to few minutes
- Control based on utility signal could delay start for longer (w/ override)

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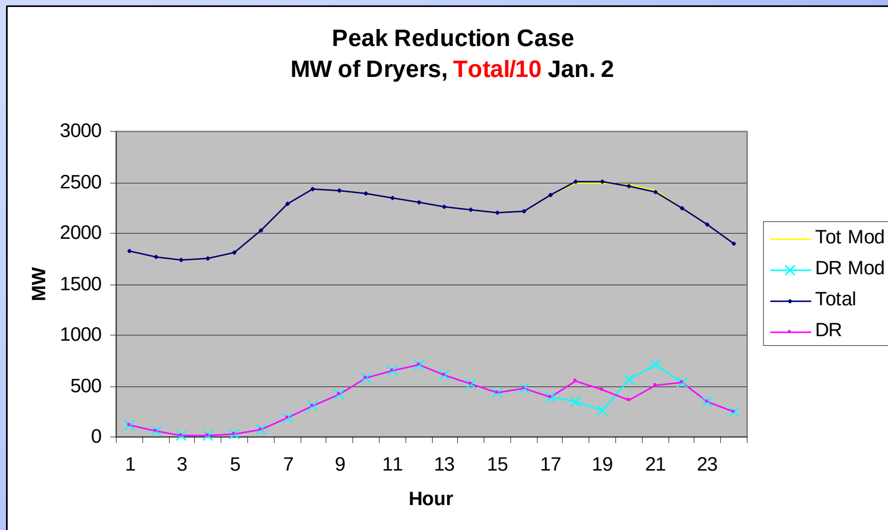
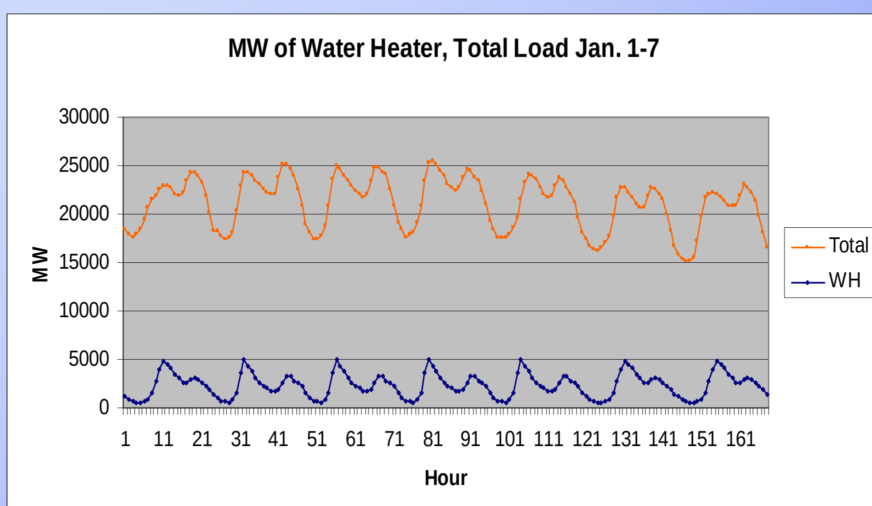


200 MW Reduction in peak 2 hours



System peak hrs 9, 18-19

WH loads 4312, 2614, 3292 MW

Water Heater w/ Smart Grid – 1 Peak Reduction

- 4.3 million water heaters FC for 2010
- 19,350 MW connected load
- Min load ~400 MW (hour 4, May)
- Max load ~5300 MW (hour 8, March)

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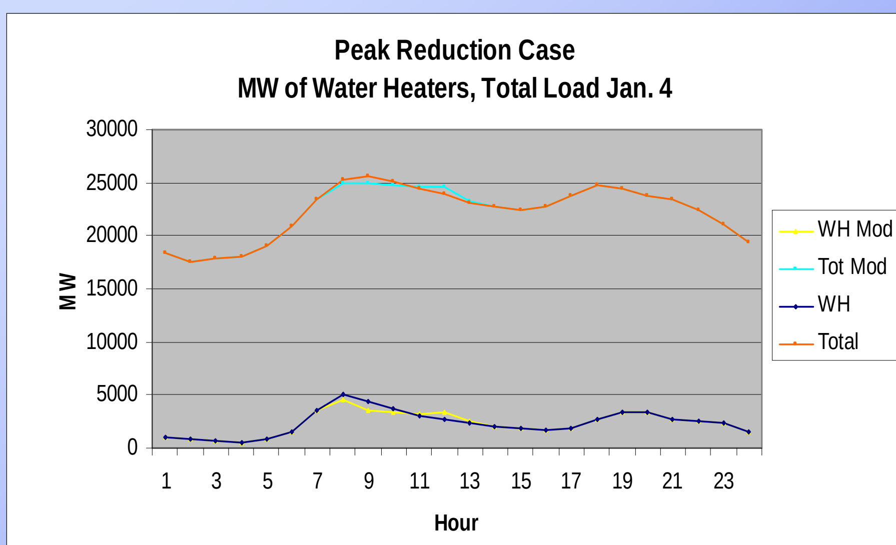

~700 MW reduction in peak load

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Water Heater w/ Smart Grid – 2
Ancillary Services

- For <u>“down” load following</u>, max of 18,950 MW available (19,350 - 400), min of 13,650 (19,350 - 5,300)
- For <u>“up” load following</u>, as much as 5,300 MW available
- Value depends on low communication and control costs (i.e. Smart Grid, ideally installed at factory)

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Water Heat w/ Smart Grid – 3
Energy Storage

- As energy storage “battery” 4.3 million water heaters can store 2600 MWh by allowing storage temp to rise 5 deg F
- 5200 MWh w/ 10 deg F, etc.
- Returns energy by supplying hot water when needed, recovering to original set point

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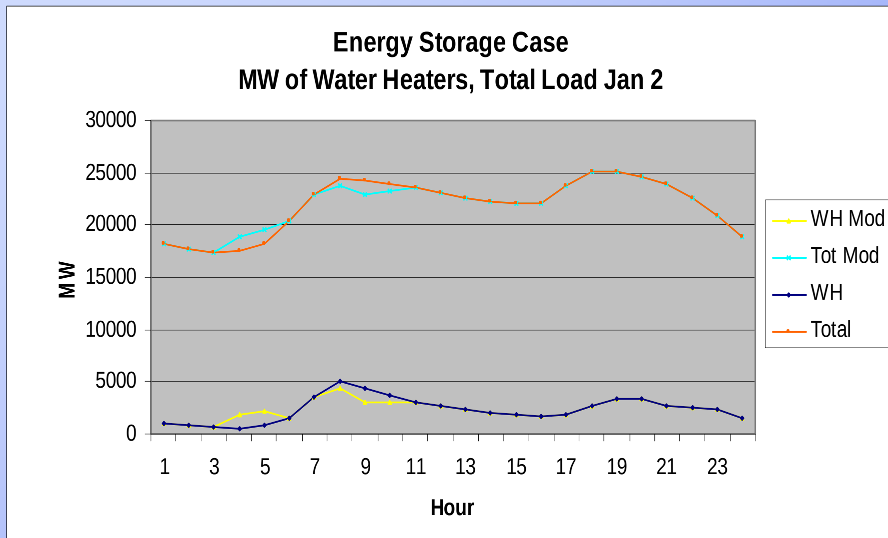

Absorbed 1300 MW for 2 hours, returned to system 3 hours later (standby loss ~40 MWh)

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Demand Response

- Important for portfolio model
  - Total MW over 20 years
  - Costs – fixed costs and variable costs
  - Availability – seasonal MWh
- Some DR not modeled in portfolio model
  - Ancillary services (reserves and load following)

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Total MW

- 5% of total peak a common target
  - ~ equal to Council's assumption in 5th Plan
  - PacifiCorp, NY ISO, New England ISO have achieved 5% already
  - Pacific Gas and Electric has a target of 5% from price programs alone
- If anything, seems somewhat conservative for 20 year figure

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Allocation of DR to programs

- Dispatchable standby generation
- Direct load control
- Interruptible rates
- Demand buyback

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Dispatchable Standby Generation

- Portland General Electric has most advanced program in region
- ~53 MW now
- ~200-250 more available current stock
- ~100-200 more in 20 years' growth
- =>350-500 in PGE in 20 years
- Less experience in rest of region, but 2 X PGE seems conservative
- 1000 MW assumed for region

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Direct Load Control - AC

- AC currently ~100 MW, PAC and IPC (most of PAC out of region) - more available in UT and ID, little experience in rest of region
- Rest of region less attractive, but over 20 years costs should come down – assume 200 MW incremental
- Limits on hours dispatched –100 hr/yr

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Direct Load Control - Irrigation

- ~100 MW now in PAC, IPC
- Est. for PAC 100 MW more
- Extrapolating from BPA study, IPC potential, assume 100-150 MW more in rest of region

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Direct Load Control - SH/WH

- Utilities cautious about safety in winter
- Little experience
- BUT temperature setbacks are possible
- 200 MW as placeholder

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Direct Load Control – Water Heater

- So far evidence is smaller reductions, higher costs than AC
- More value if ancillary services are possible as well, with Smart Grid

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Direct Load Control - Aggregators

- Aggregators take risks, guarantee results – attractive to utilities
- Mostly in commercial, residential
- RFPs out right now for PAC, PGE
- Placeholder, 300 MW winter/summer

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Interruptible Rates

- Traditional tool for handling part of peak load problem
- 300 MW w/ one utility now, utilities sometimes reluctant to disclose
- Placeholder, 600 MW, summer/winter

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Demand Buyback

- Used effectively in 2000/2001
- Effective elsewhere
- Utilities would prefer more certainty
- Programs still exist, but not treated as firm resource
- Buyback competes with rate structures, other programs
- Placeholder, 400 MW winter/summer

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Program	Max MW	Fixed cost	Var cost or hr/yr limit	Sum/Winter
DSG	1000	$20-$40 /kW-yr	$175-300 /MWh	Both
AC DLC	200	$60/kW-yr	Limit 100 hr/yr	Summer
Irrigation	200-250	$50-60 /kW-yr	Limit 50 hr/yr	Summer
SH/WH DLC	200	$100/kW-yr	Limit 50 hr/yr	Winter
Aggregators	300	$80/kW-yr	$150-200 /MWh	Both
Interruptible Contracts	600	$90/kW-yr	Limit 40 hr/yr	Both
Demand Buyback	400	$5-10 /kW-yr	$150-$300 /MWh	Both

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Price Structures

- Much interest in California (PG&E target above)
- No transparent spot market for base
- Competes, overlaps w/ programs, potential double counting
- Regarded as non-firm
- No plans to simulate in portfolio model
- Will be taken up in Pacific Northwest Demand Response Project (PNDRP)

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Conclusions

- Illustrations of potential benefits of SG
- Dispatchable standby generation significant source of DR, but not captured in portfolio analysis
- Nearly 2000 MW of other DR will be included in portfolio analysis

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