Northwest Power and Conservation Council

MEMORANDUM

TO: Oregon Climate Allocation Task Force Technical Advisory Committee

FROM: Charlie Grist

SUBJECT: Conservation Potential Beyond 5th Power Plan

DATE: 14 April 2006

I did a bit on analysis on regional conservation potential beyond what's in the Council 5th Power Plan. It is summarized here in four sections. The first section of this memo considers conservation potential already identified in the 5th Plan, but not considered cost-effective. The second section considers the measures proposed by Charlie Stephens. The third section starts a list of other measures not in the 5th Plan that should be considered. And the fourth section is the start of a list that should be removed from the Council supply curves because they are already in place.

1. There is Roughly 1300 MWa Of Achievable but Non-Cost-Effective Conservation Potential Identified In The 5th Power Plan.

Total Identified Conservation Potential is 4600 MWa by 2025. This plan identifies over 4,600 average megawatts of technically available conservation potential in the medium-demand forecast by the end of the forecast period. About half of the potential is from lost-opportunity measures, which must be captured at the time new buildings are built or new appliances and equipment is installed. The other half is discretionary with regard to timing. Discretionary conservation can be deployed any time within practical limits.

Achievable Conservation is 3900 MWa. For the purpose of illustrating conservation potential, the Council assumes 85 percent or 3,900 average megawatts, of the estimated 4,600 average megawatts of cost-effective conservation is achievable over the course of the twenty-year planning period. The supply curve is in Figure 1.

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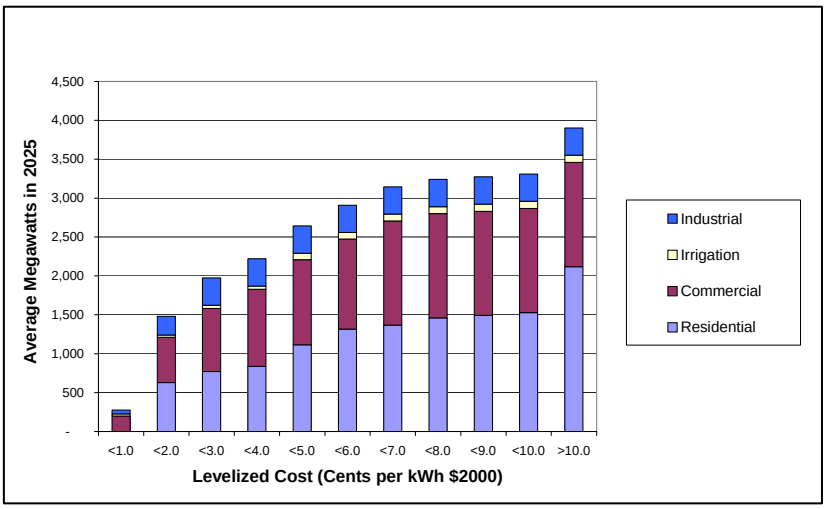
Figure 1: Achievable Conservation Supply Curve by Sector



Cost-Effective Conservation. Depending on future conditions, the Council's portfolio model develops different amounts of cost-effective conservation. The amount developed varies depending on prices, carbon taxes, loads and other key uncertainties. However, over all the 750 futures evaluated, the mean amount of conservation developed is about 2600 MWa. If we consider 2600 MWa as an estimate of the amount of cost-effective conservation, with the embedded price and carbon cost assumptions, we can estimate that there's another roughly 1300 MWa of achievable conservation potential in the Council's supply curves that was not considered cost-effective under medium-case assumptions.

What Are These Non-Cost-Effective Measures? Of that estimated 1300 MWa of non-cost-effective conservation, about 700 MWa is at a levelized cost of between 5 and 10 cents per kWh. Most of the measures in the 5 to 10 cent per kWh range are simply applications of measures that are cost-effective under some conditions but not others. For example, these include residential space-heating conversions from electric resistance to heat pumps in warmer climate zones. It also includes commercial lighting measures that are not cost-effective in some applications due to relatively low hours of operations, or relatively efficient baseline lighting systems in some building types.

The remainder of the non-cost-effective conservation in the supply curves, about 600 MWa, is at prices significantly greater than 10 cents per kWh. About 40 percent of this is solar water heating and customer-side solar photovoltaic systems. Another 40 percent is conversions of residential zonal electric resistance or electric furnaces to heat-pumps in various climate zones and base cases. The remaining 20 percent includes bi-radiant ovens, some Energy Star dishwashers, and some refrigerator models.

2. Measures Not In The Fifth Power Plan: From Charlie Stephens'

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Low-Temp Air to Air Heat Pumps (Residential) *Tom Eckman to fill in. Much of this is already in the 1300 MWa achievable but not cost-effective. Might warrant an additional ProCost run at different costs supplied by Stephens.*

Low Temp Air to Water Heat Pumps (Residential) *Tom Eckman to fill in. Much of this is already in the 1300 MWa achievable but not cost-effective. Might warrant an additional ProCost run at different costs supplied by Stephens.*

CO2 heat pumps: *Tom Eckman to fill in. Might be able to estimate based on geothermal HP.*

Heat Pump Water Heater Add On (Residential) This measure is in the 5th Plan at 200 MWa and 4.3 cents per kWh with a B/C ratio of 1.1. The Council assumes a 25% penetration for HP water heaters on electric water heaters remaining in the stock in 2025. Getting such a measure in code could allow it to reach much higher penetration, perhaps eventually nearing 85 percent of remaining electric water heater load or something on the order of 600 MWa.

Indirect Evaporative/DX hybrid HVAC (Commercial) This measure was reviewed in the 5th Plan but, not incorporated due to lack of available equipment. The measure applies to packaged roof-top cooling units common in many commercial building types. Total cooling loads in these types of buildings averages 1 to 5 kWh/sf/year for office and retail with most in the 2-3 kWh/sf range. There are higher cooling loads for restaurants, but restaurants are a small fraction of the stock. The measure overlaps with 50 MWa of achievable savings from fixing economizers and tuning up HVAC systems already in the 5th Plan.

I used Ecotope estimates of savings estimates from DOE2 runs on one prototype office and two retail buildings in three climate zones, because I had the data available. The Ecotope savings were for larger systems and based on seasonal EERs significantly less than what Charlie Stephens proposed. The savings ranged from about 0.5 to 2.0 kWh/sf depending on building type and climate zone for hybrid evaporative systems as increment over direct expansion cooling with a modestly-well functioning economizer. Savings as a percentage of cooling loads were 48-56% for direct evaporative cooling and 24 to 38% for indirect evaporative cooling depending on climate zone and building type.

I assumed regional estimates, by building type, for fraction of the stock with packaged roof-top HVAC units (about 50% weighted average) and for fraction of floor area cooled (about 60% weighted average). These data were from the 2001 Commercial building Stock Assessment.

I assumed incremental installed costs from Charlie Stephens of $400 per ton. This translates to $1/sf based on typical equipment density of 400sf/ton. I do not know if this cost includes incremental water costs, or structural costs for heavier machines that should be factored in. Nor did I include any additional cost for retrofitting the measure on existing buildings. I assumed half the units were direct evaporative cooling and half indirect.

Under these assumptions, total achievable savings potential is about 130 MWa in 2025 if all new stock and all existing stock were converted. Two-thirds of the savings is in retrofit or replacement of existing HVAC units. One third of the savings is in new floor area. It's an expensive measure. Most of the savings (~80%) is at a levelized cost of above 10 cents per

kWh. About 50 MWa of the savings potential identified for evaporative cooling with packaged HVAC units is already in the 5th Plan in the form of a different measure, repairing economizers. So achievable savings potential, above what's already in the 5th Plan, is 60 to 100 MWa

I tested the sensitivity to the assumptions on portion direct versus indirect evaporative cooling. If we assume 100% direct evaporative cooling we add an extra 20 MWa to achievable potential. On the other hand going to 100 percent indirect evaporative cooling, the potential drops by about 20 MWa. I also tested the sensitivity to EER assumptions. If seasonal EERs are as high as those provided by Charlie Stephens, net savings could increase by nearly 100 MWa, with half below 7 cents per kWh levelized cost. But we'd need to do pay somebody to do some DOE2 runs to confirm those savings estimates.

3. Other Measures Not in the 5th Power Plan

Conservation voltage Reduction (CVR) There's some promising research being done by the Alliance on CVR. Savings potential in the range of one percent of system loads may be possible. But findings are preliminary and the Council has not done a region-wide analysis. One percent of system loads is in the range of 200 MWa. No supply curve with cost information is available yet.

4. Measures Already Captured That Should Be Removed From Council Supply Curves

EPACT 2005 Appliance Standards: *To Be Determined*
State Appliance Standards: *To Be Determined*

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