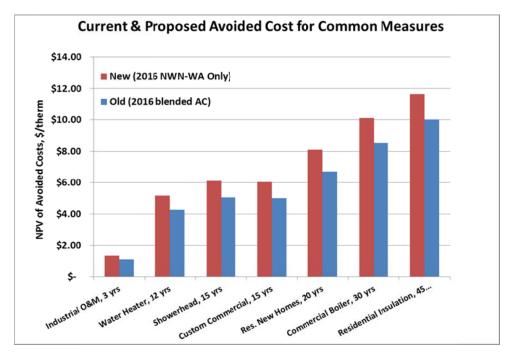
Summary

This memo details an analysis of the cost-effectiveness of Energy Trust energy efficiency measures in Northwest Natural's (NWN) Washington service territory using two different sets of avoided cost (AC) values. Historically, since Energy Trust began delivering energy efficiency programs to NWN's Washington customers, the Washington territory has been considered an extension of the Oregon territory and has been delivered by Energy Trust's existing programs in order to capture and benefit from economies of scale in delivery and outreach and maintain a consistent market structure.

Energy Trust has always used an 'Energy Trust AC', which is a weighted blend of AC values from NWN and the other gas company in our territory, Cascade Natural Gas. We take each company's ACs, weighted average cost of capital (WACC), and inflation assumptions, weight these values by % of Revenue (91% NWN, 9% CNG in 2014), then apply the 10% conservation act adder and most recently a premium (hedge) value developed by NWN in May, 2015. ACs provided to us in the past from NWN have been 'system-wide', and have covered both states. Energy Trust uses a discount rate of 4.5%, which is the weighted average of the WACCs of all the investor-owned utilities in Energy Trust's service territory.

Energy Trust most recently updated its blended AC in June, 2015 using the methodology described above. We utilized AC streams from NWN and Cascade Natural Gas's 2014 and 2015 respective IRPs to screen prescriptive and custom measures for the 2016 program year. The base (start) year for NWN's 2014 20-year stream of values was simply moved forward, thus Energy Trust's 2016 blended AC begins using NWN's 2016-year value (and do not use the 2014-15 years) and hold the 18th year constant into the 70th year to cover all potential measure lifetimes. Energy Trust 2016 program planning and measure screening has already been completed with Energy Trust's 'blended' ACs.

Recently, at the request of the Washington Utility and Transportation Commission (WUTC), NWN has developed ACs that are specific to their Washington territory and include a capacity cost value to represent several expected capital-intensive distribution projects that specifically serve the Washington territory. This AC uses the same 20 year stream of values published in the 2014 IRP (and used by the Energy Trust in their base blended AC) moved forward two years. It is converted into 2016 real dollars and uses a Washington-specific discount rate of 5.09% and does not include the premium (hedge) value added to Energy Trust's blended AC. So essentially it is the same as the Energy Trust blended AC but with the hedge value removed and the capacity cost deferral value added in. Both ACs have the 10% Conservation Act adder. The following analysis reviews the differences and impacts that these Washington-specific ACs have and do not have on the cost effectiveness of Energy Trust's Washington measures and program as developed using the 'blended AC'.



Residential Programs

This section covers the Residential programs of the Washington territory, which includes the Existing Homes, New Homes and Products programs.

Residential: UCT

After running the measures through our cost effectiveness tool with each set of AC values, the 'blended' and the 'Washington-specific', we found the impact to ACs on a per measure basis ranging between 16% and 22% for Residential measures. The three key drivers of this range of values are the measure life, discount rate and the load profile of the particular measure, though the measure life has the most significant impact. The Washington-specific AC 20-year stream of values is proportionately higher in the early years than the 'blended' values, and not quite as high in the later years. This results in measures with lives around 20 years and less being in the 20%+ range and measures with lives of over 25 years being in the high teens.

Table 1 below shows the range of % change to AC encountered in the residential measure mix. Because there are a limited number of load profile and measure life combinations, there are a limited number of % changes to the AC, and Table 1 shows these % changes and the number of measures affected. It also shows the % of the total number of measures impacted. Something to bear in mind is that because AC is the only assumption on the Benefit side of the UCT ratio, the % change to AC and the measure's UCT score are identical. The distribution of this impact is shown in Table 1.

Table 1. Showing the range of % change to AC and UCT. Includes # and % of measures impacted.

% Change AC/UCT	# of affected measures	% of Total
16%	6	16%
17%	2	5%

21%	21	57%
20%	4	11%
19%	1	3%
22%	1	3%
18%	2	5%
Grand Total	37	100%

Table 1 shows that 29% of residential measures have less than a 20% change to their AC and UCT score, 71% have a 20% - 22% impact. Since all planned measures were at or above the 1.0 UCT threshold, no planned measures move above or below the 1.0 UCT threshold due to AC changes. Several however, as shown in Table 2, do become more comfortably cost effective.

Table 2 below shows the 5 measures with the lowest UCT scores in the 2016 EE mix and was filtered to capture those below a 1.2 UCT BCR. It shows the program, measures description, the change in UCT BCR from 'Blended' AC to 'WA-only' AC, and the % change in AC and UCT that the measure experienced when switching from Energy Trust's 'Blended' AC. It also shows the % of savings contributed in 2014 (most recent year with a full year of data). Only one of these measures (windows) contributed a significant amount of savings (4%) in 2014 and includes one measure that is new for 2016.

Table 2. Measures with UCT Scores at or below a 1.2 in 2016 mix. Showing % change in UCT from ETO Blended AC to WA-Only AC and the % of 2014 Savings these measures contributed.

Program	Measure Description	Change in UCT BCR	% change in AC/UCT	% of 2014 Savings
Existing Homes	Water Heater, Gas .6769 \$100 2016	From 0.98 to 1.19	21%	New Measure
Existing Homes	Water Heater, Gas .6769 \$125 2014	From 0.99 to 1.2	21%	0.5%
Existing Homes	Water Heater, Gas .70 \$125, 2016	From 1.06 to 1.28	21%	0.2%
Existing Homes	Windows - GAS - U .2830	From 1.15 to 1.34	16%	4%
Existing Homes	SF Air Sealing, \$150 Gas 2013	From 1.15 to 1.38	21%	0.2%

Two measures score slightly below the 1.0 threshold when showed to the hundredth digit (Energy Trust reports to the 'tenth' digit, at which point these measure round to 1.0), a 2014-15 legacy 0.67-0.69 gas tank water heater measure, which scores a 0.98 and the new 2016 0.67-0.69 measure, which scores a 0.99. There was a 21% impact to these measure's AC, which bumped them to a 1.2. In this case its worth noting that from a Planning perspective, this makes the measure a more positive contributor to the entire program. Planning typically recommends that programs set incentives to levels resulting in a 1.5 UCT or greater to account for 'fixed' budgetary costs such as delivery, administration, management, marketing, etc...The main point being that if too many measures set their incentives around a 1.0 the program as a whole may run the risk of falling out of compliance.

Residential: TRC

The impact to TRC on a per measure basis ranges between 3% and 22%, though the bulk of measures fall within the 15%-22% range. Unlike the UCT, the impact to AC and the TRC score differ in a number of measures because of the presence of NEBs on the benefit side of the ratio. Table 3 below shows the distribution of % change encountered when applying the Washington-only AC.

Table 3. Showing the range of % change to TRC BCR. Includes # and % of measures impacted.

% Change TRC	# of affected measures	% of Total
3%	1	3%
12%	1	3%
15%	1	3%
16%	9	24%
14%	5	14%
21%	11	30%
20%	3	8%
22%	1	3%
4%	5	14%
Grand Total	37	100%

Table 3 shows that 17% of residential measures were impacted by a 3-4% change when the Washington-specific AC is applied. 41% of residential measures are impacted by 20% or greater, and the remaining 42% are impacted by a 12-16% impact.

Table 4 below shows the ten Residential measures with the lowest TRC scores in the 2016 EE measure mix. It shows the change in TRC score when going from the Energy Trust 'Blended' AC to the 'WA-only' AC, and the % change the TRC score shifted. Only two of these measures (Energy Star Homes & Attic Insulation) contributed a significant level of savings (8.7% and 1.4%) in 2014 (most recent year with a full year of data) and a few that are new for 2016.

Table 4. Ten measures with lowest TRC Scores in 2016 mix. Showing % change in TRC from ETO Blended AC to WA-Only AC and % savings contributed to Sector in 2014

Program	Measure Description	Change in TRC BCR	% change in TRC	% of 2014 Savings
Existing Homes	SF Floor Insulation/SQFT, Gas Heat, Zone 1 2014	From 0.25 to 0.29	16%	0.10%
Existing Homes	Water Heater, Gas .70 \$125, 2016	From 0.31 to 0.37	21%	0.20%
Existing Homes	SF Gas Boiler	From 0.31 to 0.37	20%	0.05%
New Homes & Products	SW WA EPS Path 5	From 0.34 to 0.39	14%	New Measure
New Homes & Products	SW WA EPS Path 4	From 0.35 to 0.4	14%	New Measure

New Homes	SW WA Energy Star New Homes -	From 0.36	16%	8.70%
& Products	2015	to 0.41		
Existing	SF Knee Wall Insulation/SQFT, Gas	From 0.36	16%	0.05%
Homes	Heat, Zone 1 2014	to 0.42		
Existing	Water Heater, Gas .6769 \$100	From 0.49	21%	0.50%
Homes	2016	to 0.59		
Existing	SF Attic Insulation/SQFT, Gas Heat,	From 0.63	16%	1.40%
Homes	Zone 1 2014	to 0.73		
Existing	Water Heater, Gas .6769 \$125	From 0.62	21%	0.50%
Homes	2014	to 0.75		

There are 15 measures in the Residential portfolio that have a TRC score of less than 1.0. All but 2 of these have scores below 0.9 and a change in AC did not move them into a more or less cost-effective range. Two measures, however, the EPS Path 2 new home and 90-94%+ AFUE gas furnace, did however move from TRC scores of between 0.90 and 0.92 with Energy Trust Blended ACs to 1.04 and 1.10 with Washington-specific ACs. The furnace measure is from 2014 though, and will only be used in the first 90 days of 2016 to meet customer expectations and cover the transition to the new 95%+ AFUE measure created for 2016. The new 95%+ measure's approval as an offering in the program did not make this list, and is not significantly affected by the increase in AC due to its low TRC score of .77 with the WA-only AC.

Table 5 below provides some insight into the highest-savings measures in the residential sector, showing the % of savings they contributed in 2014, the % change in AC they are impacted by when changing to Washington-only AC, and their UCT and TRC scores. This table shows that the measures responsible for a significant amount of program savings are highly cost effective and are generally not impacted by the new AC.

Table 5. Top 4 Savings measures in the Residential Sector with their % of 2014 Savings, % change in AC and UCT and TRC scores with Washington-only ACs.

Program	Measure Group	Measure Description	% of 2014 Savings	% change in AC	UCT (WA- only AC)	TRC (WA- only AC)
Products	Showerhead	NWNWA 2.0 gpm Showerhead	14%	21%	6.7	23.06
Existing Homes	Gas Fireplace	Gas Hearth .70+ FE with Intermittent Pilot Light	9%	21%	3.5	866.0
New Homes	Builder Option Package	SW WA Energy Star New Homes - 2014 ONLY	9%	19%	2.2	0.41
Existing Homes	Gas Furnace	Gas Furnace \$100 Incentive	7%	20%	3.6	0.77

Potential Residential Program Impact

Evaluation of the impacts of using the Washington specific AC on "top ten measures with lowest UCT score", and the "Ten measures with lowest TRC Scores in 2016 mix" has showed little to no impact on

the risk of cost effectiveness of the measures, though it does make them more 'comfortably' cost effective and will contribute to the continued compliance of the portfolio. The evaluation has also determined that no significant additional measures could be added to the Program portfolio. Similarly the resulting data shows that no measures are at risk of being lost due to falling below the cost effectiveness screening threshold of 1.0 using the UCT.

The results of this analysis can also be used to determine the effect of Washington specific AC on the max allowable incentive per measure. Because the impact to the cost effectiveness per measure is around 20%, the impact on max allowable incentive for some of the measures will be around 20%. Max incentive is typically defined by the lesser of two costs, the incremental (TRC) cost or the AC value of the measure's savings (to ensure we do not pay more than the incremental cost of the efficient measure over the baseline measure). Based on deemed savings per measure and the forecasted quantity of each measure realized, the Program has projected that proposed incentives would not be altered in order to continue market consistency across the Portland Metro area (including Clark County, WA) and to maintain the overall program and portfolio cost effectiveness. That said, this new AC will allow for bonuses to be run on measures with Max Incentive flexibility to drive savings as deemed appropriate through the 2016 program year.

Commercial Program

This section covers the Commercial Sector of the Washington territory, which includes the Existing Buildings Program. This section primarily discusses 'Prescriptive' measures, which are screened for cost effectiveness in advance of the program year. Custom measures, which are screened for cost-effectiveness on an individual project basis, are discussed separately after the prescriptive measures.

Commercial: UCT

After running the measures through our cost effectiveness tool with each set of AC values, the 'blended' and the 'Washington-specific', we found the impact to ACs on a per measure basis ranging between 18-22%. Because AC is the only assumption on the Benefit side of the UCT ratio, the % change to AC and the UCT score are identical. The range and distribution of these % changes when moving from one AC to the other is shown in Table 6 below. As discussed in the beginning of the Residential Sector, the % change was most impacted by the number of years the measure life is rated to last. The Washington-specific AC 20-year stream of values is proportionately higher in the early years than the 'blended' values, and not quite as high in the later years. This results in measures with lives around 20 years and less being in the 20%+ range and measures with lives of over 30 years being in the high teens.

Table 6. Showing the range of % change to AC and UCT. Includes # and % of measures impacted.

% Change AC/UCT	# of affected measures	% of Total
18%	3	6%
19%	5	9%
21%	27	51%
22%	18	34%
Total	53	100%

Table 5 shows that 85% of Commercial Sector measures had their AC value increase by 21-22% while 15% increased by 18-19%.

Table 7 below shows the 10 measures in the Existing Buildings Program with the lowest UCT BCR scores. It also shows the % change that occurred to that UCT score when the Washington-only AC were applied. Only two of these measures contributed a significant amount of savings in 2014 (most recent year with a full year of data) and those that went unused or did not exist are labeled 'N/A' or 'New Measure'.

Table 7. Ten measures with lowest UCT Scores in 2016 mix. Showing % change in UCT from ETO Blended AC to WA-Only AC and % of savings contributed in 2014.

Program	Measure Description	Change in UCT BCR	% change in AC/UCT	% of 2014 Savings
Existing Buildings	Dishwasher - Under counter - gas high temp	From 0.9 to 1.1	22%	N/A
Existing Buildings	Steam Traps: Effective January 1, 2016 Schools Only.	From 0.99 to 1.21	22%	New Measure
Existing Buildings	Commercial Clothes Washer-Gas Water Heat	From 1.03 to 1.26	22%	N/A
Existing Buildings	Infrared (IR) polyethylene greenhouse cover	From 1.14 to 1.39	22%	N/A
Existing Buildings	Boiler Vent Damper	From 1.22 to 1.48	22%	N/A
Existing Buildings	Gas Griddle	From 1.24 to 1.5	21%	N/A
Existing Buildings	Roof Insulation R-5 to R-20 gas heat	From 1.28 to 1.52	19%	3.30%
Existing Buildings	Attic Insulation R-19 to R-38 gas heat	From 1.42 to 1.69	19%	0.50%
Existing Buildings	Domestic Tankless Water Heaters - Food service	From 1.42 to 1.72	21%	N/A
Existing Buildings	Gas Combination Ovens	From 1.63 to 1.98	21%	1.00%

One planned measure moves above the 1.0 UCT threshold due to changes in the value of AC. The dishwasher measure moved from a 0.90 to a 1.10 with the Washington-only AC. This measure appears to have escaped updating by our engineering team over the last year or two, likely due to its low priority/customer uptake (No uptake in 2014-2015). Occasionally, measures remain slightly below their cost-effective threshold when ACs change, until they are reviewed the following year. This measure's incentive was set to match the offering in Oregon and with water NEBs has a strong TRC. The WA-only AC has a material impact on the measure's current status by pushing it above a 1.0 but does not alter the program's plan or incentive level. The steam trap measure for schools scores slightly (insignificantly) below the 1.0 threshold when showed to the hundredth digit (Energy Trust reports to the 'tenth' digit, at which point these measure round to 1.0) and is measurably impacted by the WA-only AC. Its UCT moves to a 1.2 and strengthens the measure, but its incentive would not be changed due to using either AC value.

Commercial: TRC

The impact to TRC on a per measure basis ranges between 1-22%. The impact to AC and the TRC score differ in some measures because of the presence of NEBs on the benefit side of the ratio. The distribution of this impact is shown in Table 8.

Table 8. Showing the range of % change to TRC BCR. Includes # and % of measures impacted.

% Change TRC	# of affected measures	% of Total
1%	2	4%
2%	2	4%
3%	4	8%
5%	1	2%
7%	1	2%
13%	5	9%
18%	3	6%
19%	5	9%
21%	22	42%
22%	8	15%
Total	53	100%

Table 8 shows that 20% of Commercial Sector measures will have an increase in AC value of less than 8%, while 57% increase by over 20%. The remaining 23% increase by 13-19%.

Table 9 below shows the change in BCR to the 10 measures with the lowest TRC scores in 2016 and the % change in TRC when the Washington-only AC were applied. None of these measures contributed a significant (>1%) share of savings in 2014 (most recent year with a full year of data) and most went unused in 2014.

Table 9. Ten measures with lowest TRC Scores in 2016 mix. Showing % change in TRC from ETO Blended AC to WA-Only AC

Program	Measure Description	Change in TRC BCR	% change in TRC	% of 2014 Savings
Existing Buildings	Gas Griddle	From 0.42 to 0.5	21%	N/A
Existing Buildings	Attic Insulation R-19 to R-38 gas heat	From 0.47 to 0.56	19%	0.50%
Existing Buildings	Domestic Tankless Water Heaters - Food service	From 0.72 to 0.87	21%	N/A
Existing Buildings	Boiler Vent Damper	From 0.81 to 0.99	22%	N/A
Existing Buildings	Warm-Air Furnace < 225 kBtuh input	From 0.92 to 1.11	21%	N/A
Existing Buildings	Turbo Pot with Lid	From 0.97 to 1.18	22%	N/A

Existing	Wall Insulation - Gas heating	From 0.97	19%	N/A
Buildings		to 1.15		
Existing	Domestic Tankless Water	From 1.11	21%	N/A
Buildings	Heaters - Lodging	to 1.34		
Existing	Pipe Insulation - Hot water -	From 1.16	21%	N/A
Buildings	Pipe Diameter > 1.5"	to 1.41		
Existing	Pipe Insulation - Hot water -	From 1.16	21%	N/A
Buildings	Pipe Diameter ≤ 1.5"	to 1.41		

There are 7 measures that have a TRC score of less than 1.0. Of the 7 measures, 4 of these have scores that are measurably impacted by the new AC and move from below a 1.0 to a 1.0 or greater (Boiler Vent Damper, Warm-Air Furnace, Turbo Pot with Lid, and Wall Insulation). In each of these cases however, a change in AC did not impact their availability or the incentive amount that the program offered since the program's primary test is the UCT and the incentive amount does not interact with the TRC test.

Commercial: Custom Measures

Because custom measures are vetted for cost effectiveness on a project by project basis prior to their approval, it is more difficult to assess what impact a change to AC will have on savings acquisition. In 2014 (the last year that we have a complete year's data) 12 of 15 of the custom projects had measure lives of 15 years and had a change in AC of 21%. Table 10 below shows a breakdown of custom measures with the average % change in AC and the average WA-only UCT and TRC scores. It also shows the % of savings that the given measure group was responsible for in the Commercial Sector in 2014 (last year of complete data).

Table 10. Custom measure groups showing project quantity, BCRs and average % change in AC

Custom Measure Group	Quantity	Average % change in AC	Average UCT (WA-only AC)	Average TRC (WA-only AC)	% of 2014 Savings
Custom Building Controls	5	21%	3.38	5.90	23%
Custom Gas	4	21%	5.70	29.27	2%
Custom Heat Recovery	1	21%	4.36	2.18	8%
Custom HVAC	4	21%	4.04	2.21	2%
Custom VFD	1	21%	N/A - no incentive paid	7.78	11%

There were no custom projects with a UCT BCR of less than 2.0 and the average UCT across all the projects was 4.27 (using WA-only AC). On the TRC side, 13 of the 15 total projects had individual TRC scores well over a 1.0 and the average across all projects was 3.65. Two projects had scores below 1.0, a 0.88 and 0.42. These projects share a project ID number with other measures and its possible they may have been screened together at the time the project was vetted and split apart in Energy Trust's database. In any event, the change in AC that would occur by using a Washington-only value would not have had a significant impact on those projects. It is possible that the increased AC might affect future

proposed projects though, and could increase the uptake of custom projects. That remains unclear since they are analyzed on a case by case basis.

Table 11 below provides some insight into the highest-savings measures in the Commercial Sector, showing the % of savings they contributed, the % change in AC they are impacted by when changing to Washington-only AC, and their UCT and TRC scores. In the case of the Custom VFD measure, there was only one measure and no incentive was paid for the project, resulting in the N/A for the UCT. Overall though, this table shows that the measures responsible for a significant amount of program savings are highly cost effective and are generally not impacted by the new AC.

Table 11. Top 4 Savings Measures in the Commercial Sector with their % of 2014 Savings, % change in AC and Average UCT and TRC scores with Washington-only ACs.

Program	Measure Group	Measure Description	% of 2014 Savings	Average % change in AC	Average UCT (WA- only AC)	Average TRC (WA- only AC)
Existing Buildings	Custom Building Controls	Custom Building Controls	23%	21%	3.4	5.9
Existing Buildings	Food Equipment	Gas Fryer 2014	20%	21%	3.6	2.6
Existing Buildings	Boiler	Gas-fired Condensing Boiler >= 300 kbtuh, <= 2500 kbtuh 0.9 ET	15%	18%	3.82	2.35
Existing Buildings	Custom VFD	Custom VFDs	11%	21%	N/A	7.78

Potential Commercial Program Impact

Evaluation of the impacts of using the Washington-specific AC on "top ten measures with lowest UCT score", and the "Ten measures with lowest TRC Scores in 2016 mix" has showed some general positive impact on the overall cost effectiveness of the measures and program, but does not indicate that the program as currently designed would be altered with increased incentives, but gives them a greater level of 'comfort' that they are cost effective. The evaluation has also determined that no significant additional measures could be added to the Program portfolio. Similarly the resulting data shows that no measures are at risk of being lost due to falling below the cost effectiveness screening threshold of 1.0 using the UCT.

The results of this analysis can also be used to determine the effect of Washington specific AC on the max allowable incentive per measure. Because the impact to the cost effectiveness per measure is around 20%, the impact on max allowable incentive for some of the measures will be around 20%. Max incentive is typically defined by the lesser of two costs, the incremental (TRC) cost or the AC value of the measure's savings (to ensure we do not pay more than the incremental cost of the efficient measure over the baseline measure). Based on historical performance, increased incentives to some prescriptive measures and the recent 'across the board' increase to incentive levels for custom measures in the Existing Buildings program, planned incentive levels for 2016 are already pushing the boundary of what is cost effective and would not be changed in response to the new WA-only AC. In fact, beyond the program's strong preference to maintain market consistency in the Portland Metro area (including Clark

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County), in the case of this program, AC increases of about 20% would provide a level of comfort that in the event that savings achieved were lower than forecasted.