APPENDIX 8L. INSTALLATION SCENARIO CONSIDERING USE OF ALTERNATIVE VENTING TECHNOLOGY

8L.1 INTRODUCTION

This appendix describes DOE's analysis of the potential impacts on consumers of non-weatherized gas furnaces (NWGFs) of the use of a new venting technology developed by M&G DuraVent. The DuraVent product is a patent-pending vent retrofit system that can vent a condensing residential furnace and atmospheric combustion water heater through the same vent. The DuraVent system enables reuse of the existing metal vent or masonry chimney and is comprised of a new vent cap and appropriate liner(s). The proposed design is discussed in detail in a report published by Oak Ridge National Laboratory (ORNL).[1]

The venting technology that DOE applied in the main analysis may require resizing of venting to accommodate an orphaned water heater, installing separate polyvinyl chloride (PVC) horizontal venting for the condensing furnace, and, in some cases, may require structural modifications. The DuraVent product has the potential to utilize the existing vent or chimney and thereby reduce the complexity and cost of installing a condensing furnace for some consumers.

8L.2 DESCRIPTION OF DURAVENT VENTING TECHNOLOGY

Traditionally, replacing a non-condensing NWGF with a condensing NWGF involved high installation costs, in large part due to having to install a new PVC venting system for the condensing furnace and modify the existing venting system to accommodate the orphaned water heater. The DuraVent product allows a condensing furnace and water heater to be vented concentrically through the existing vent or chimney, eliminating the need to create new penetrations in the walls or ceiling as well as avoiding separate PVC horizontal venting for the condensing furnace. The flue streams from the condensing furnace and the water heater remain separate and exhaust individually to the outside.

Figure 8L.2.1 shows the DuraVent product installed in an existing Type B double-wall metal vent. The existing vent cap is replaced with a new one that supports a flexible stainless steel liner inserted in the existing metal vent to serve as the flue for the new condensing furnace. The annular space between the liner and the original Type B vent serves as the flue for the water heater.

Figure 8L.2.2 shows the DuraVent product installed in an existing masonry chimney. The existing vent cap is replaced with a new one that supports an outer flexible aluminum liner and an inner flexible stainless steel liner. The stainless steel liner serves as the flue for the new condensing furnace. The annular space between the two liners serves as the flue for the water heater.

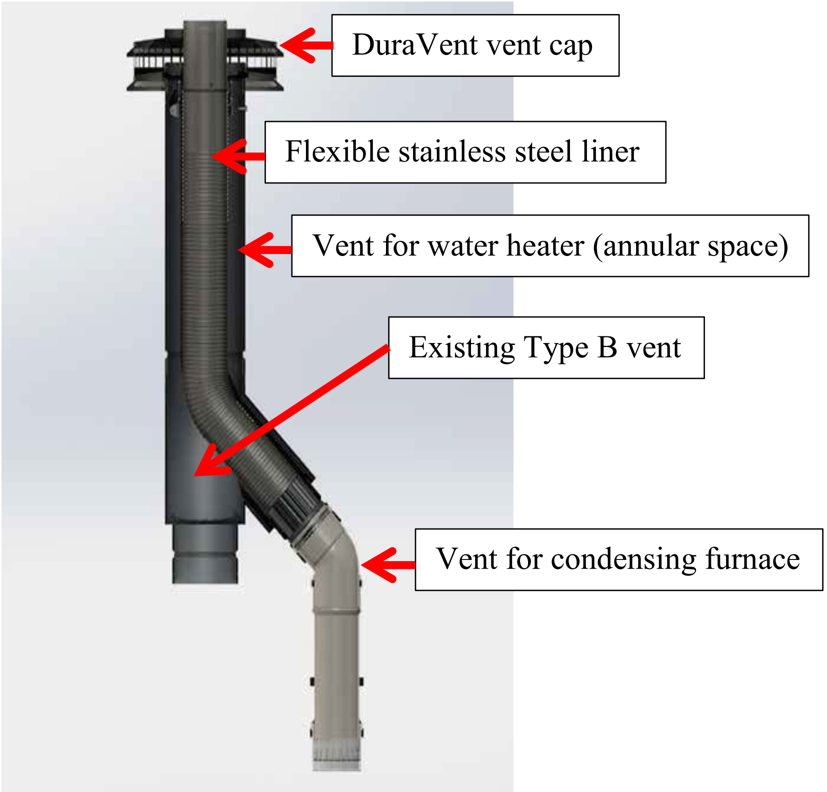

Figure 8L.2.1 Common Venting of a Condensing Furnace and an Atmospheric Combustion Water Heater in a Type B Double-Wall Metal Vent using DuraVent Retrofit[a]

[a] Source: Momen, A. M., J. Munk, K. Biswas, and P. Hughes, *Condensing Furnace Venting: Solutions Enabling Category I and IV Appliances to Vent through the Same Chimney*, 2014. Oak Ridge National Laboratory. Oak Ridge, Tennessee. Report No. ORNL/TM-2014/343.

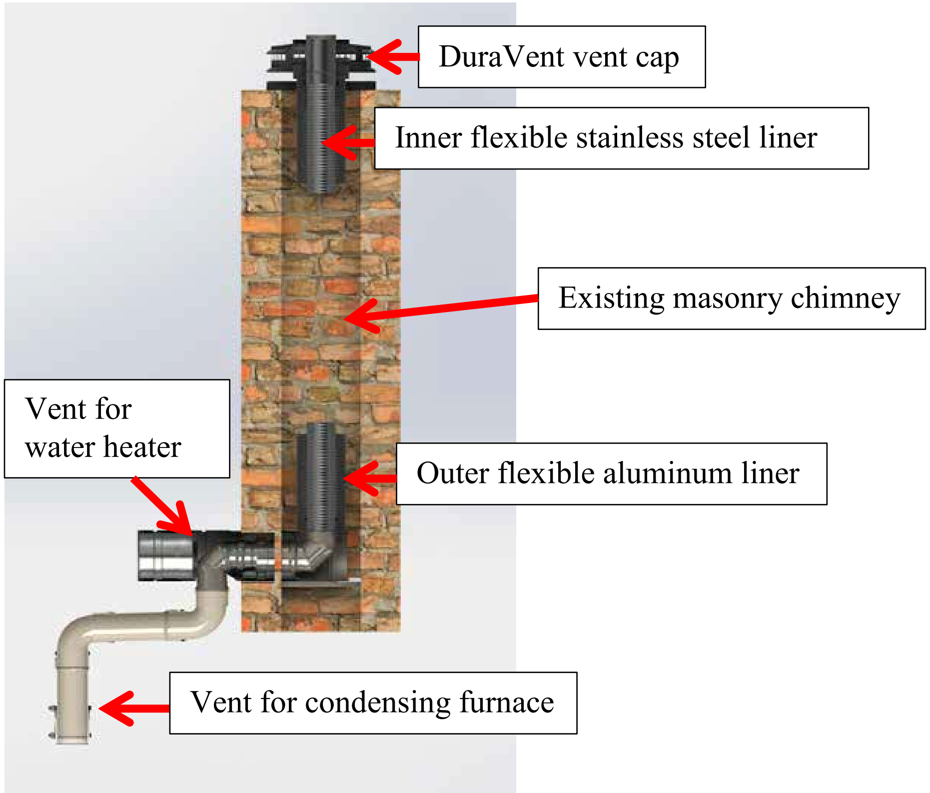

Figure 8L.2.2 Common Venting of a Condensing Furnace and an Atmospheric Combustion Water Heater in a Masonry Chimney using DuraVent Retrofit[b]

8L.3 ANALYSIS METHOD

The analysis focused on households in replacement situations with pre-existing common venting of a non-condensing NWGF and water heater, which account for approximately 7 percent of all NWGF installations. Appendix 8D describes how these households were identified. In appendix 8D, the situations for which the DuraVent technology is applicable are labeled as installation Cases C and D. These cases require vent resizing, chimney relining, or a new water heater vent connector to accommodate the orphaned water heater. Case C represents 6.3 percent of the installations, while Case D represents 0.4percent. Many of these households are in the North, where common venting is much more prevalent than in the Rest of Country. These two cases can also be identified in Figure 8L.4.1 and Figure 8L.4.2.

For households with common venting, DOE applied costs for the DuraVent technology based on communication with the authors of the ORNL report Table 8L.3.1.[2] Table 8L.3.1 presents a summary of the DuraVent installation costs. The relevant costs from Table 8L.3.1

[b] Id.

were applied to each specific situation, depending on whether the house has a masonry chimney or a Type B metal vent.

Table 8L.3.1 ORNL Installation Costs for DuraVent Installation Scenario

Component	Chimney	Type B with 2" PVC	Type B with 3" PVC
Flexible Liner ($/foot)	16.56*	9.90	10.88
All Other Components ($)	440.27	142.61	158.17
Labor Hours (hr)	10.30	6.50	6.50

* This cost includes $10.88 for 3" FasNSeal Flex and $5.68 for 3" Aluminum Flex

Table 8L.3.2 shows the average venting installation cost based on existing venting technologies (Reference Case) compared to the DuraVent technology. The average savings from the DuraVent technology is $453. The actual range of installation cost varies depending on the venting type (masonry chimney or a Type B metal vent) and PVC venting diameter (which mostly depends on the input capacity of the furnace as explained in appendix 8D).

DOE determined that the DuraVent design would be less expensive than the existing venting technologies for 85 percent of households with pre-existing common venting of a non-condensing NWGF and water heater. The DuraVent design is especially beneficial for a small subset of households that includes high cost row houses and condos (0.4 percent of all installations). [c] The DuraVent design is also beneficial for households where separate venting of the condensing furnace requires significant cost (due to vent length or whether house modifications are needed) and/or in some cases when the common masonry chimney or a Type B metal vent is very long (such as in houses with two or more stories).

Table 8L.3.2 Average Venting Installation Costs for Households where DuraVent Technology is Applicable (Installation Cases C and D)

Installation Type	2013$			
	Reference Case	DuraVent Scenario	Difference	Fraction Benefiting
Replacement of Common Vent (+Need to Resize Orphaned Water)*	$1,206	$753	-$453	85%

* These cases require orphaned water heater vent resizing, chimney relining, or new water heater vent connector.

8L.4 RESULTS

DOE used the LCC spreadsheet developed for the rulemaking analysis to analyze the impacts on consumers of applying the DuraVent technology. The analysis accounts for cases where the household is projected to switch to an electric heating product (electric furnace, heat pump) instead of installing a condensing furnace. For approximately 6 percent of the households in replacement situations with common venting, switching is preferable to applying the

[c] As explained in appendix 8D, high cost row houses and condos are cases which have a common vent and the house structure shares one or more walls with another house. For a fraction of these households the installation requires significant installation cost due to potential house modifications and very long vents.

DuraVent technology, according to the switching criteria applied in the analysis (see appendix 8J and Figure 8L.4.2).

Table 8L.4.1 compares average LCC savings and simple payback between the reference case (the default installation costs used in the analysis) and the DuraVent scenario. The results are presented for the entire household sample, the target household sample, and the high-cost row house/condo sample. The entire household sample includes all households used in the analysis, with the DuraVent technology applied to a fraction of the replacement households. The target household sample refers to all households in replacement situations with pre-existing common venting of a non-condensing NWGF and water heater (installation cases C and D), which represents 7 percent of all installations. The high-cost row house/condo sample refers to very high cost households that are a subset of the target household sample, which represents 0.4 percent of all installations.

The difference in LCC and PBP results between the reference case and the DuraVent scenario is largest for the row house/condo sample, and next largest for the target household sample. For the target household sample, the average LCC savings go from negative to positive at most of the considered efficiency levels, and the PBP declines substantially. The percent of consumers that experience net cost declines modestly in the DuraVent scenario for all three samples.

For the entire household sample, the average LCC savings are $27-$32 higher in the DuraVent scenario than in the reference case, and the PBP is 1.0 to 1.5 years lower. The percent of consumers that experience net cost is only slightly lower (one percent or less) in the DuraVent scenario.

For the target household sample, the average LCC savings are approximately $164-$176 higher in the DuraVent scenario than in the reference case, and the PBP is 6 to 8 years lower. The percent of consumers that experience net cost is 5 to 6 percent lower in the DuraVent scenario.

Table 8L.4.1 Comparison of LCC and Payback Period Results for Reference Case and DuraVent Installation Cost Scenarios for Non-Weatherized Gas Furnaces

EL (AFUE)	Average LCC Savings *2013$*		Simple Payback Period *Years*		% of Consumers that Experience Net Cost	
	DuraVent Scenario	Reference Case	DuraVent Scenario	Reference Case	DuraVent Scenario	Reference Case
Entire Household Sample						
1 (90%)	$264	$236	6.7	8.2	21%	22%
2 (92%)	$332	$305	5.9	7.2	19%	20%
3 (95%)	$419	$388	6.3	7.4	23%	24%
4 (98%)	$473	$441	7.3	8.3	39%	40%
Target Household Sample						
1 (90%)	-$35	-$199	17	25	33%	38%
2 (92%)	$32	-$141	14	22	30%	36%
3 (95%)	$102	-$74	13	19	32%	38%
4 (98%)	$160	-$16	13	19	51%	56%
High Cost Row House/Condos Sample						
1 (90%)	-$51	-$297	18	32	38%	42%
2 (92%)	$84	-$243	15	27	38%	40%
3 (95%)	$178	-$205	14	25	38%	42%
4 (98%)	$204	-$180	14	25	57%	60%

Figure 8L.4.1 and Figure 8L.4.2 show the total installed cost differential, the shipments fractions and the product switching results for the reference case and the DuraVent scenario, respectively. The results are shown separately for households where resizing of the vent system has a high cost (Case C) and for households where resizing could be accomplished at low cost (Case D). For both Cases C and D, the total installed cost differential between installing a condensing furnace and a base-case furnace, along with the shipments fraction, is shown for several household types (All types = all household or building types; Type A = Single Family Detached; Type B = Single Family Attached; Type C = Multi-Family; and Type D = Commercial Buildings).

Figure 8L.4.1 and Figure 8L.4.2 also show the fraction of the considered installations that would or would not switch to other product types (*i.e.*, heat pump (HP), electric furnace (EF), or electric storage water heater (ESWH)). For the fraction of households that switch space and/or water heating products, Figure 8L.4.1 and Figure 8L.4.2 show the switching fractions to different electric product types (HP, HP + ESWH, EF, EF + ESWH, or ESWH only) for the reference case installation costs and the DuraVent technology installation costs, respectively. In addition, for the high-cost row house/condo subset (a subset of case C), Figure 8L.4.1 and Figure 8L.4.2 separately show the total installed cost differential, the shipments fractions and the product switching results. See appendix 8J for more details on the product switching methodology.

Case C households see a decrease from $1,446 total installed cost in the reference case compared to $1,228 total installed cost in the DuraVent scenario, which results in a decrease in product switching from 21.7 percent to 17.9 percent. Case D households see a decrease in total installed cost from $651 in the reference case to $615 in the DuraVent scenario, which results in a small decrease in product switching. High-cost row house/condo households see a decrease in total installed cost from $1,965 in the reference case to $1,178 in the DuraVent scenario, which results in a decrease in product switching from 37.5 percent to 5.0 percent.

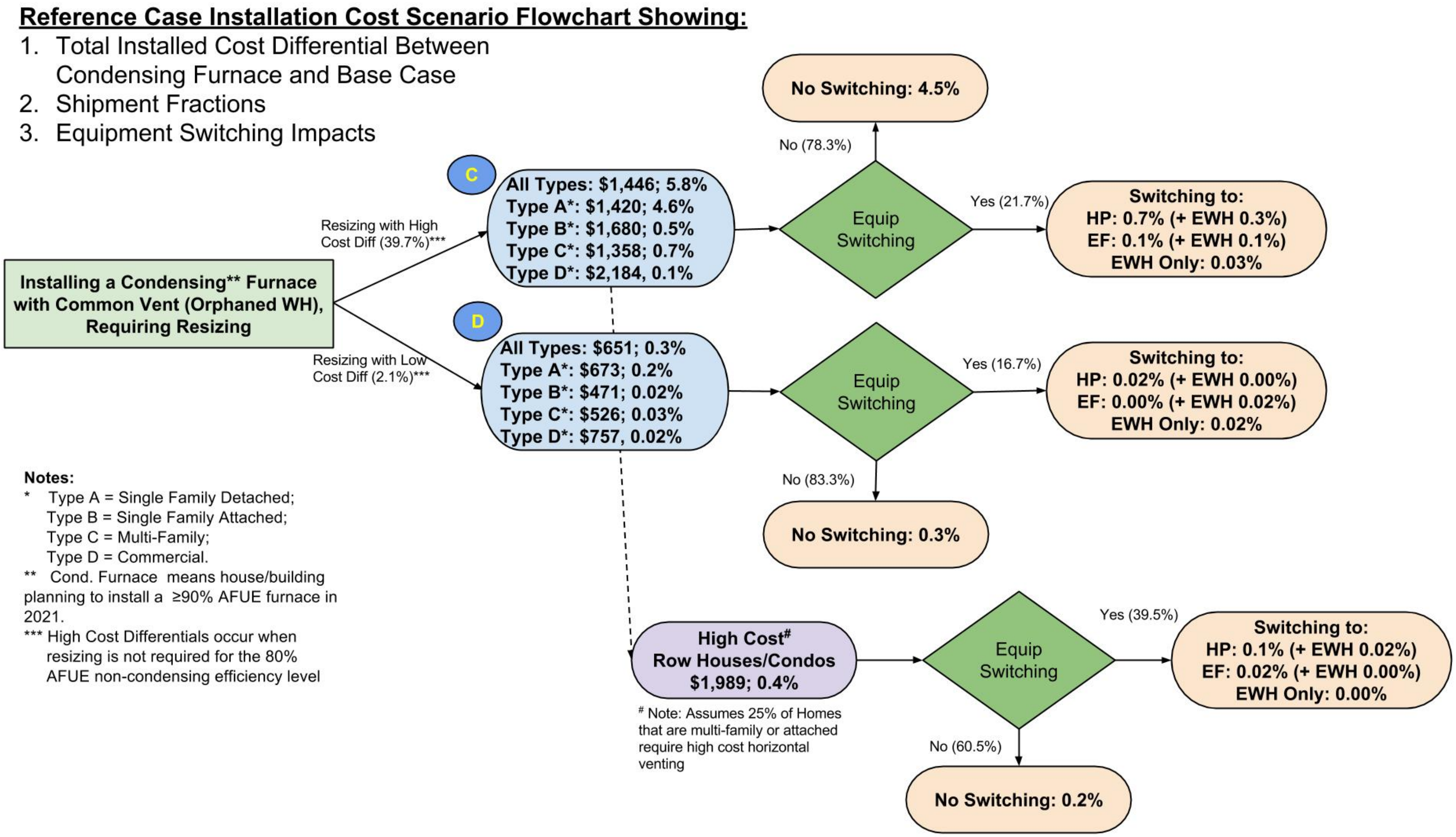

Figure 8L.4.1 Total Installed Cost, Shipment Fractions, and Switching Impacts for Installation Cases C and D Using Reference Case Installation Costs

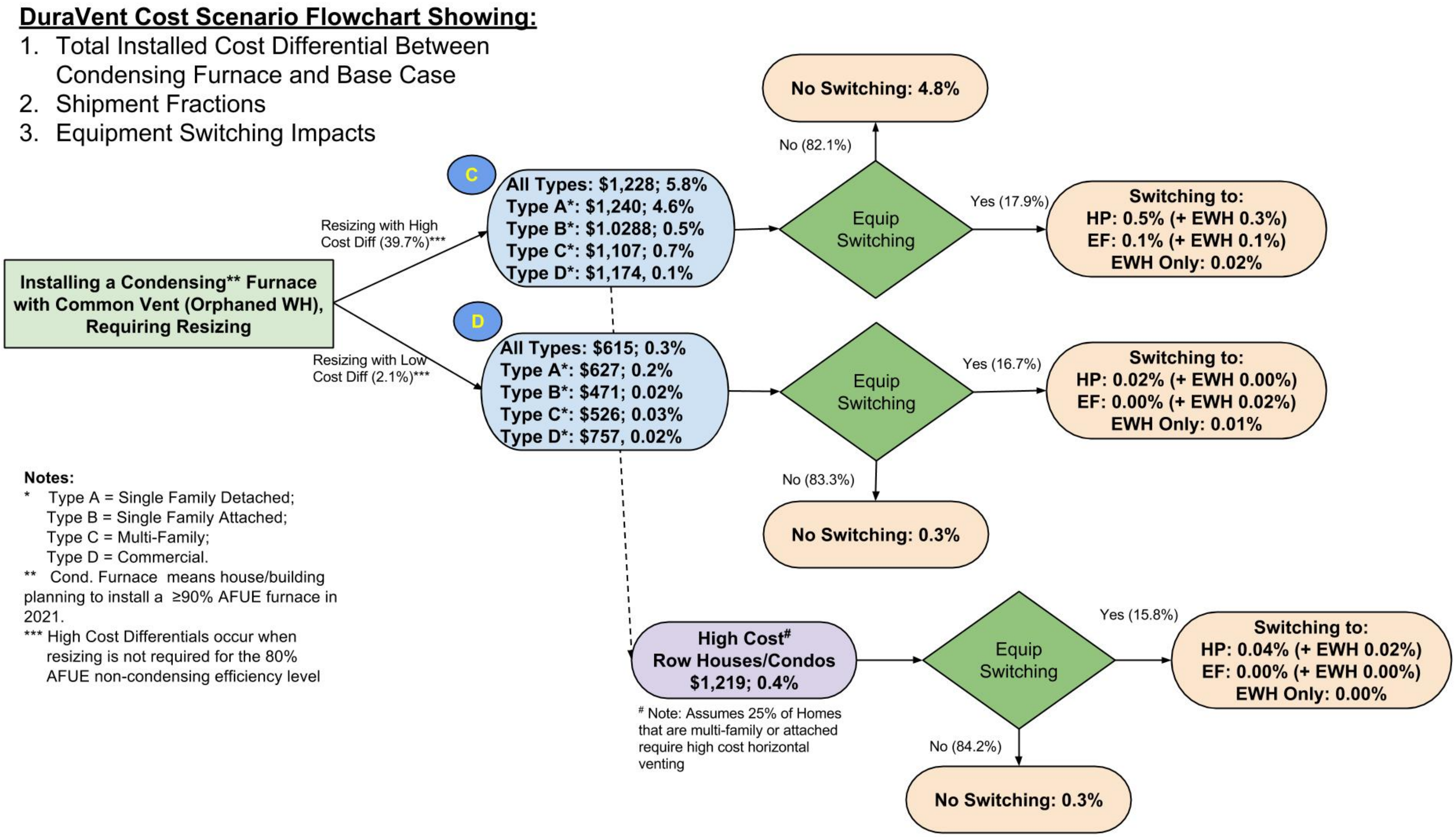

Figure 8L.4.2 Total Installed Cost, Shipment Fractions, and Switching Impacts for Installation Cases C and D Using DuraVent Scenario

REFERENCES

1. Momen, A. M., J. Munk, K. Biswas, and P. Hughes, *Condensing Furnace Venting Part 1: The Issue, Prospective Solutions and Evaluation Methodology*, 2014. Oak Ridge National Laboratory. <http://web.ornl.gov/sci/buildings/docs/2014-10-03-ORNL-Furnace-Venting-Report.pdf>

2. Hughes, P., *Personal communication. E-mail to LBNL,* August 2014, 2014. Oak Ridge National Laboratory. Oak Ridge, TN.