Rates and Regulatory Affairs
Facsimile: 503.721.2532

NW Natural
220 NW 2ND AVENUE
PORTLAND, OR 97209
TEL 503.226.4211
www.nwnatural.com

October 18, 2005

VIA FILING CENTER

Public Utility Commission of Oregon
550 Capitol Street, N.E., Suite 215
Post Office Box 2148
Salem, Oregon 97308-2148

ATTN: Filing Center

Re: Commission Order 03-507: A Report on the Functioning of WARM, Including Any Proposed Refinements to the Program

Evaluation Conducted on behalf of NW Natural by Christensen Associates

Enclosed for filing is NW Natural's WARM Report in the above-referenced order.

Please contact me if you have any questions.

Sincerely,

/s/ Joseph M. Ross

Joseph M. Ross
Rate Economist/Planning Analyst

JMR/cmt
enclosures

cc: UM 1056 Service List

CHRISTENSEN ASSOCIATES ENERGY CONSULTING

A Review of the Weather Adjusted Rate Mechanism as Approved by the Oregon Public Utility Commission for Northwest Natural

Daniel G. Hansen
Steven D. Braithwait

October 18, 2005

Christensen Associates Energy Consulting, LLC
4610 University Avenue, Suite 700
Madison, WI 53705-2164

Voice 608.231.2266 Fax 608.231.2108

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1. INTRODUCTION AND BACKGROUND

Natural gas utilities incur two types of costs in order to serve customers: fixed costs and variable costs. For residential and small commercial customers, these costs are typically recovered through two types of charges: a customer charge and an energy price. Customer charges are a fixed monthly dollar amount (or, alternatively, a fixed dollar amount per day in the billing period) per customer that is unrelated to the amount of natural gas consumed by the customer. The energy price is simply a dollar per therm charge for the natural gas usage metered at the customer's site.

It is common in the natural gas industry for the customer charge to be less than the monthly fixed cost per customer. To make up the difference, the energy price is increased to a level such that total fixed costs are recovered if customer usage is at expected levels. Because a large percentage of natural gas usage is devoted to space heating, changes in winter weather conditions can produce large fluctuations in customer usage. Therefore, natural gas utilities tend to face significant risk of fixed cost recovery due to uncertainty about weather conditions. In unusually cold winters when usage levels are high, the utility will over-recover its fixed costs. Conversely, in mild winters, the utility will under-recover its fixed costs. While weather-induced financial effects will tend to cancel out over time (provided that the forecast of expected customer usage is not biased), the fluctuations in cash flows can impose costs on the utility. For example, as revenue risk increases, the utility may need to increase the size of its financial lines of credit in order to withstand the revenue reductions in mild weather years.

Weather-sensitive utility customers also face weather risk. In unusually cold winters, customers will over-pay for fixed cost recovery (which is the cause of the utility's over-recovery). Because the customers' risk is in the opposite direction of the utility's risk—that is, when weather makes the utility worse off, customers are better off, and vice versa—mechanisms have arisen that "swap" the risk between the two parties. Effective mechanisms can reduce the weather risk for both the utility and its customers.

The simplest way of eliminating fixed cost recovery risk is to increase the customer charge so that it fully recovers fixed costs. In this case, weather fluctuations would still affect customer bills and utility revenues, but only to the extent that the *variable* costs (i.e., the fuel costs) change. However, this solution has not been widely adopted. One possible reason for this is a perception (that may or may not be correct) that customer usage is positively correlated with income, and therefore a high customer charge would have regressive income effects (that is, the high customer charge would disproportionately affect low income customers).

Other, frequently more complicated mechanisms have also been used to mitigate fixed cost recovery risk, including revenue decoupling mechanisms and weather normalization programs. These programs are described in detail in Section 4.

In 2003, the Oregon Public Utility Commission (Commission) approved the Weather Adjusted Rate Mechanism (WARM) as a means of reducing weather-related risk for both

Northwest Natural Gas Company (NW Natural) and its customers. In 2004, WARM was altered in two ways. First, limits were placed on the size of the WARM adjustment in any one month (though the full adjustment is still recovered in subsequent months). Second, the calculation of the WARM adjustment was altered so that it is determined using customer-specific weather instead of class-wide weather.

Commission Order 03-507 calls for "a report on the functioning of WARM, including any proposed refinements to the program." This report is intended to fulfill the Commission requirement.

The report is organized as follows. Section 2 provides an overview of WARM, including a description of the calculations and its expected risk and incentive effects. Section 3 provides an overview of our research design for this report. Section 4 reviews other weather normalization programs in the United States. Section 5 presents an analysis of the weather sensitivity of NW Natural customers, including a comparison of WARM participants and customers who opted out of WARM. Section 6 contains simulations of financial outcomes under the current version of WARM as well as some proposed alternative designs. Section 7 discusses the financial implications associated with using an incorrect definition of normal weather. Section 8 describes service quality issues associated with WARM. Section 9 discusses issues surrounding WARM's opt-out provision. Finally, Section 10 presents our conclusions and recommendations.

2. OVERVIEW OF THE WEATHER ADJUSTED RATE MECHANISM

2.1 Description of Mechanism

As described above, the Commission approved WARM in 2003 as a means of reducing weather-related risk for both NW Natural and its customers. Equation 2-1 shows the formula used to calculate the WARM adjustment (prior to the application of maximum bill change provisions). It is calculated for each customer based on their billing cycle usage and weather data from the closest available weather station (among the eight established district weather stations used by NW Natural). The WARM adjustment is applied to bills for which the meter is read on or after November 15th and on or before May 15th.

Equation 2-1: WARM Adjustment = $\Sigma_d \, (HDD^N_d - HDD^A_d) * \beta * M$.

In this equation, d indexes the days of the customer's billing month; HDD^N_d is normal heating degree days (HDDs) for day d of the billing month, based on a 25-year average ending in 2000; HDD^A_d is the actual heating degree days for day d of the billing month; β is the weather-sensitivity parameter (an estimate of the change in customer usage with respect to a one unit change in HDDs); and M is the distribution margin in dollars per therm.

β is statistically estimated as part of the class load forecasting process. Its units are in therms per HDD, and the same value for β is used for all customers within a class. For residential customers, the WARM adjustment is capped at the lesser of $12 or 25 percent of the volumetric portion of the bill. For commercial customers, the WARM adjustment is capped at the lesser of $35 or 25 percent of the volumetric portion of the bill. However, the portion of the WARM adjustment that exceeds the cap is collected in subsequent months. While WARM is the default service for residential and commercial customers, customers may opt out of the program.

2.2 Expected Risk Effects

From NW Natural's perspective, WARM is an effective means of reducing weather-related distribution cost recovery risk during the WARM adjustment period provided that few customers decide to opt out of the program. The effect of the opt-out provision upon NW Natural's risk depends upon the characteristics of the customers that opt out relative to those of the class. A more detailed discussion of the effects of the opt-out provision is included later in this section. Under the assumption that no customers opt out of the program, WARM will be effective in reducing NW Natural's weather risk provided that β accurately reflects the average customer response to weather variations, and that the definition of normal weather is correct.[1] In Section 2.5, we discuss whether WARM risk coverage can be improved by expanding the WARM adjustment period relative to its current November 15th through May 15th definition.

From a customer perspective, WARM is a less effective tool for reducing risk. This is because β is set on a class-wide basis and is constructed in units of therms per HDD. Thus, the amount of risk coverage varies across customers. Customers who are smaller or less weather sensitive than the class average are *over-insured* by WARM.[2] Conversely, customers who are larger or more weather sensitive than the class average are *under-insured* by WARM. The added provisions that cap the amount of the WARM adjustment in any month do not alter our conclusions about over- or under-insurance because the total WARM adjustment is collected from each customer in subsequent months. In Section 2.5 below we discuss the potential value of re-designing the weather adjustment parameter so that it is either in units of *percentage* changes in therms per HDD, or set on a customer-specific basis.

2.3 Expected Incentive Effects

The WARM program does not alter NW Natural's behavioral incentives. This is because WARM affects only weather-related fluctuations in distribution revenues, and weather is out of NW Natural's control. Therefore, the incentives for NW Natural to promote conservation, load growth, the addition of new customers, and the provision of high quality customer service are not affected.

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[1] However, if DMN and WARM use the same definition of normal weather, the errors in the revenue recovery for DMN and WARM due to an incorrect definition of normal weather largely cancel out. This reduces the incentive for the utility or regulator to "game" the definition of normal weather.

[2] Because WARM only intends to cover the risk associated with distribution fixed cost recovery, it is unlikely that customers will be over-insured against the weather risk associated with their *entire* bill. That is, any over-insurance on the distribution component will likely be smaller than the remaining weather risk on the energy component of the bill.

WARM also does not affect participating customers' incentives with respect to consumption. WARM may provide customers with benefits through a reduction in their bill variability, but the customers' marginal cost of changing usage levels is not affected by WARM. However, if WARM uses a definition of normal weather that is "too cold" (i.e., normal heating degree days, or HDDs, are too high), customers have an incentive to opt out of the program because WARM will, on average, lead to a surcharge on their bills.[3]

2.4 Possibilities for Gaming the Mechanism

Neither the Commission nor NW Natural has an incentive for β to deviate from its true value. (This is true whether WARM is considered by itself or in combination with DMN.) Setting the value correctly ensures that the WARM adjustments have the appropriate magnitude. A value that is too high introduces more weather risk (relative to the "correct" value of β) for both NW Natural and its customers (on average). Setting β too low leads to an adjustment that under-insures NW Natural and its customers (on average).

When WARM is considered by itself, the Commission and NW Natural have an incentive to manipulate the definition of normal heating degree days. Setting HDD^N below its "true" value (i.e., too warm) leads to a situation in which, on average, WARM produces refunds to customers. (If HDD^N equals its true value, WARM will not, over time, affect the total revenue flows between NW Natural and its customers.) Conversely, if HDD^N is set above its true value (i.e., too cold), WARM will tend to increase customers' bills.

However, when WARM is evaluated in combination with DMN, the incentive to game the definition of normal heating degree days is dramatically reduced, provided that both programs use the same definition. An example will help to illustrate this effect.[4] To simplify the example, the timeframe of the analysis is reduced to one month and we will assume that the residential class consists of only one customer who uses 100 therms in normal weather conditions. Furthermore, we will assume that there is no price change (and therefore no DMN elasticity adjustment to the baseline quantity), and that the customer does not deviate from its non-weather related usage. Consider the following case, in which the tariff value for HDD^N is higher than the true value, and actual heating degree days (HDD^A) match the true value:

"True" $HDD^N = 400$
Tariff $HDD^N = 500$
$HDD^A = 400$
$\beta = 0.1958$

[3] WARM may still produce refunds when normal HDDs are set too cold, but the refunds will be smaller than they would have been if normal HDDs were set correctly. Over time, a normal HDD definition that is too cold will produce more (and larger) surcharges than refunds.
[4] Details on DMN and its calculations can be found in Section 2 of "A Review of Distribution Margin Normalization as Approved by the Oregon Public Utility Commission for Northwest Natural" from March 31, 2005. The example shown here is based on the example shown in Section 3.4 of that report. However, the DMN calculations have been modified to replace the 90% adjustment factor with 100%, consistent with Order 05-934.

M = \$0.42569.

In this case, both the "true" WARM and DMN adjustments are zero. That is, weather is at normal conditions and there is no non-weather related usage change, so the mechanisms do not affect revenue collection. However, because the tariff contains an incorrect value of HDD^N, both DMN and WARM lead to non-zero adjustments, as shown below.

DMN deferral amount = $(QPC^{B,P} - Q^{WN}/C) * M * C$
$Q^{WN} = Q^{A,S} + \beta * \Sigma_d (HDD^N{}_d - HDD^A{}_d) = 100 + 0.1958 * (500 - 400) = 119.58$
DMN deferral amount = (100 – 119.58) * \$0.42569 * 1 = -\$8.34
WARM adj. = $\Sigma_d (HDD^N{}_d - HDD^A{}_d) * \beta * M$ = (500 – 400) * 0.1958 * \$0.42569 = \$8.34.

These equations show that, while WARM over-collects by \$8.34, DMN offsets the over-collection. This example slightly overstates the effectiveness of the off-set, as DMN's weather normalization is based on a weighted average of HDDs across NW Natural's service territory, while WARM's weather adjustment is based only on the weather site closest to the customer. Despite this, this example illustrates how the combination of DMN and WARM reduces the incentive to game the definition of normal weather.

This example highlights an additional incentive problem caused by setting HDD^N too high. That is, given that customers may opt out of WARM, setting HDD^N too high provides customers with an opportunity to game rates. If the customer believes that WARM is established in way that will be more likely to produce surcharges to their bills, they will rationally opt out of the program. This decreases the effectiveness of WARM in reducing weather risk, and negates the offsetting effects of DMN and WARM described above. In the example above, if the customer opts out of WARM, the \$8.34 refund produced by DMN remains, but the offsetting surcharge of \$8.34 generated by WARM is lost, leaving NW Natural with reduced overall revenues. (Alternatively, if HDD^N were set too low, rational customers would *not* opt out of WARM, as its persistent refunds would offset the persistent surcharges created by DMN, which does not allow them to opt out.) This example therefore highlights the beneficial effects of combining DMN and WARM in terms of compensating for inaccuracy in the program parameters.

2.5 Potential Improvements in the Mechanism

2.5.1 Alternatives to the Class-Wide β

The use of a class-wide value of β reduces the economic value of WARM for many customers, increasing the potential that customers will opt out of WARM. NW Natural's benefits from WARM decline when customers opt out of WARM.

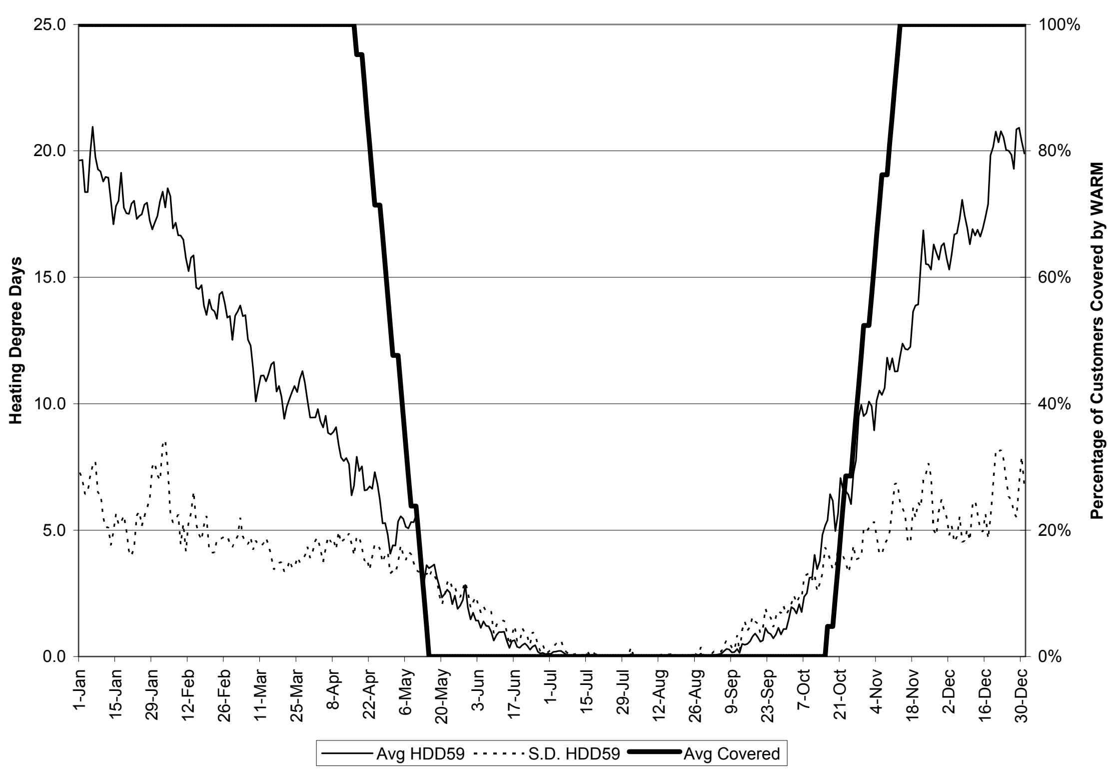
Two options exist for addressing this problem. First, NW Natural could continue to use a class-wide value of β, but instead calculate it as a *percentage* change in the usage per HDD. This would address the customer size problem (that small customers tend to be over-insured by WARM in its current form). For example, if β were expressed in percentage terms, smaller customers would experience lower WARM adjustments to their bill than under the current system.

The second option is to calculate *customer-specific* values of β for use in calculating the WARM adjustments. This approach would address two problems: the inaccurate treatment of customers with respect to size, and the inaccurate treatment of customers with respect to weather sensitivity. Calculating customer specific β parameters would also have the effect of automatically excluding non-weather sensitive customers from the WARM program. The effects of these alternative WARM designs on NW Natural and its customers are addressed in Section 6.

2.5.2 Expand the WARM Adjustment Period

Currently, WARM adjustments are applied to bills for which the meter is read on or after November 15th and on or before May 15th. Because of the variations in billing cycles, the risk coverage provided by this definition does not exactly coincide with this time period. For example, in 2004 a customer in billing cycle 1 had WARM coverage that ended on April 28th and started on October 29th. (The first meter read on or after November 15th was on November 30th, which included usage beginning on October 29th.) Figure 2-1 illustrates the WARM coverage period in 2004. In this figure, the solid line indicates the daily average heating degree days (weighted across the NW Natural weather stations) from January 1, 1976 through March 31, 2005 using a 59 degree threshold.

Figure 2-1: WARM Coverage Period in 2004 using the Current Tariff

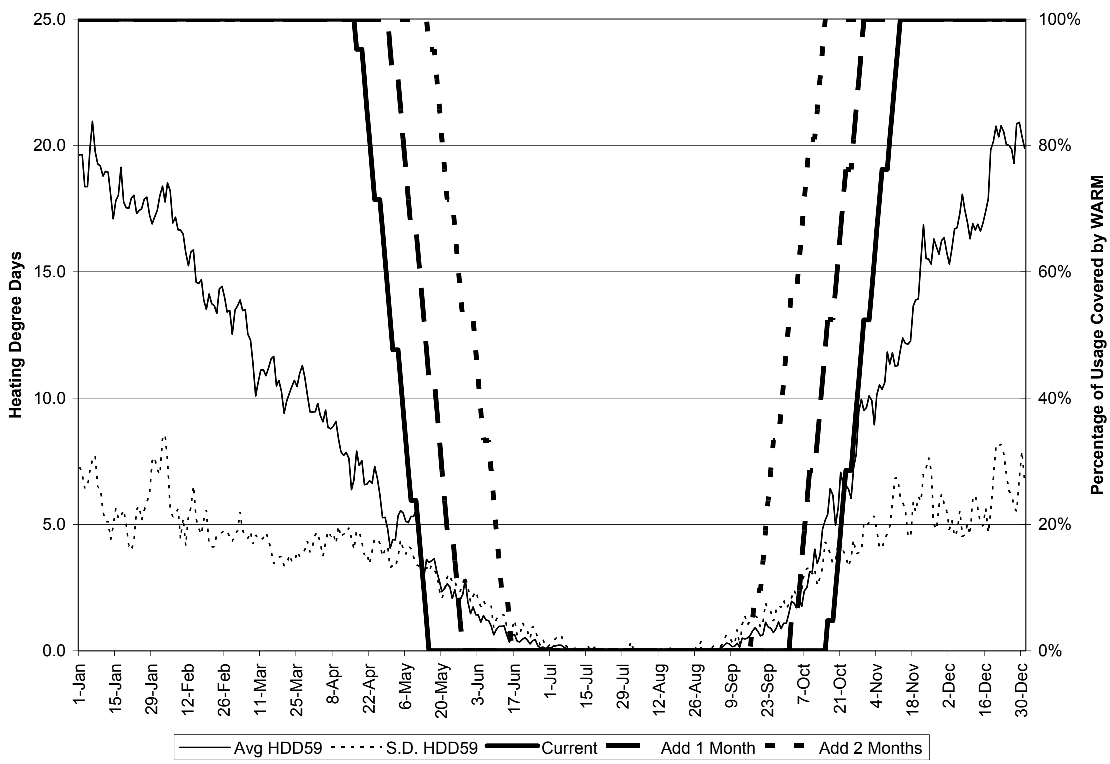


In Figure 2-1, the dotted line represents the standard deviation of HDDs for the same time period. The bold solid line shows the percentage of customers that are covered by WARM on each day using the 2004 meter reading schedule. We assume that an equal number of customers are in each of the twenty-one billing cycles and that every customer in a billing cycle is read on the same day.

In this figure, WARM coverage begins to decline on April 17th and is below 50 percent by May 1st. In the fall, coverage begins to increase on October 16th and is above 50 percent by October 30th. As the figure shows, there is a period of time in both the spring and fall in which heating degree days are expected, but WARM provides little or no coverage.

Figure 2-2 shows the increase in WARM coverage as the WARM time period is expanded. The solid, dotted and bold solid lines in Figure 2-2 are replicated from Figure 2-1. The bold dashed line illustrates WARM coverage if the coverage period is expanded to begin November 1st and end on May 31st. The bold dotted line illustrates WARM coverage if the coverage period is expanded to begin on October 15th and end on June 15th.

Figure 2-2: A Comparison of Alternative Definitions for the WARM Coverage Period using 2004 Billing Cycle Information



The data underlying Figure 2-2 can be used to calculate the weather risk coverage provided by the alternative definitions of the WARM time period. Across the entire year there are 2,852 expected heating degree days. (This is equal to the area under the solid line in Figures 2-1 and 2-2.) The current definition of the WARM time period (November 15^{th} to May 15^{th}) covers 2,546 of the total expected HDDs, or 89.3 percent. Expanding the definition to November 1^{st} through May 31^{st} increases the HDD coverage to 94.8 percent. Expanding the definition to October 15^{th} through June 15^{th} further increases the HDD coverage to 98.2 percent.

Figure 2-2 shows that WARM's effectiveness in reducing weather-induced risk in fixed cost recovery and customers' bills can be improved by expanding the time period during which WARM adjustments are applied to bills. The first increment, covering the remainder of November and May, provides a significant increase in coverage (5.5 percent). The second increment, covering half of October and June, provides a slightly smaller increment in risk coverage (3.4 percent).

3. SUMMARY OF RESEARCH DESIGN AND DATA SOURCES

This section summarizes the data and research methods that will be used in Sections 4 through 9. To study other weather normalization programs in the United States (Section 4) and assess WARM's opt-out provision (Section 9), we will rely on information originally gathered by the American Gas Association (AGA) and augmented by additional research by NW Natural and CA Energy Consulting staff. The sources of the additional information are tariff sheets, conversations with utility representatives, and the experience of the CA Energy Consulting staff.

Three sources of information are used to analyze service quality issues. First, we have a database of customer complaints registered with NW Natural and/or the Commission from 2003 through 2005. The initial list of complaints was provided by NW Natural and then verified by Commission Staff. The other sources are two customer surveys conducted in late 2003 by NW Natural.

To analyze WARM revenue effects for NW Natural and its customers, we were provided with billing data from January 2001 through March 2005. In studying the distribution of weather sensitivity across customers, we used data on all eligible residential and commercial customers for whom we had sufficient data to estimate a value. In simulating financial effects of alternative WARM designs, we limited the sample to include only residential customers in billing cycle 1 with complete data in the 2003 to 2004 heating season. The sample includes approximately 22,000 customers. While this is far short of a simulation of NW Natural's entire system, it is sufficient to allow for a comparison of the financial effects of alternative program designs.

Much of the research design is based on the theoretical examination of WARM in Section 2 above. The insights from this section provide the basis for alternative WARM designs that are analyzed in detail in Section 6. We then use NW Natural customer-level data to examine whether the foundation of our theoretical findings is correct (i.e., that there are significant differences in weather sensitivity across customers) and to evaluate alternatives that we propose.

The performance of WARM is evaluated in three ways. First, we summarize administrative problems that the program has encountered since its inception. Second, we use customer-level data to analyze the financial effects of WARM (and alternative designs). Third, we examine customer attitudes towards WARM. More detailed descriptions of specific analyses are included in the appropriate sections below.

4. REVIEW OF WEATHER NORMALIZATION PROGRAMS IN THE UNITED STATES

A variety of programs have been used by natural gas utilities in the United States to address the weather adjustment of fixed cost recovery. This section summarizes those programs, including a summary of key features such as whether customers are allowed to opt out of the program, whether a class-wide or customer-specific weather adjustment parameter is calculated, and whether the weather adjustment is specified as a line item on the bill or rolled into a change in the rate or billed therms.

4.1 Natural Gas Weather Normalization Programs

Tables 4-1a and 4-1b below summarize our review of weather normalization programs used by natural gas utilities in the United States.

The utilities are organized by state, with the bulk of the list being generated from the "AGA Update of Member Company Weather Normalization and Other Weather Related Rate Design Mechanisms" from May 2005. The AGA document contained only a list of utilities and an indication of whether the mechanism affects current customer bills or worked through a deferral account (the "Affect Current Bill?" column in Tables 4-1a and 4-1b). In some cases, we were unable to obtain additional information about the program.

The third column, labeled "Customer-Specific Factor?" indicates whether the program adjusts usage and/or bills using customer-level information, or whether an aggregate factor (such as WARM's current β) is used. Of the 35 programs on which we could collect information on this topic, only 8 use a customer-specific weather adjustment factor.

The fourth column, labeled "Adjust Rate, Bill, or Volume" indicates the method used to incorporate the weather normalization in customer bills. Of the 35 programs on which we could collect information on this topic, 16 adjust the rate, 6 adjust the billed volume, and 13 adjust the bill. While WARM currently adjusts the customer's rate, this method is somewhat misleading because the dollar value of the WARM adjustment is independent of billed therms (i.e., the bill change depends only on actual and normal HDDs and the class-wide value of β).

The fifth column, labeled "HDD band?" indicates whether the program adjusts revenues for all deviations from normal weather, or if a "dead band" is used. For example, one program requires that HDDs be 2.2 percent different from normal values before the

Table 4-1a: Natural Gas Weather Normalization Programs in the United States: Alabama through New Jersey

State	Utility	Customer-Specific Factor?	Adjust Rate [R], Bill [B], or Volume [V]	HDD Band?	Affect Current Bill?	Line Item?	Opt Out?
AL	Alabama Gas	--	--	--	Y	--	--
AR	CenterPoint Energy	N	R	N	Y	Y	N
CA	Pacific G&E	--	--	--	N	--	--
	San Diego G&E	--	--	--	N	--	--
	Southern Calif. Gas	--	--	--	N	--	--
CT	Southern Connecticut	N	V	N	--	N	N
GA	Atmos Energy Corp. (United Cities Gas)	N	R	N	Y	--	N
KS	Atmos Energy	N	R	N	Y	--	N
	Kansas Gas Service	N	R	N	Y	--	N
KY	Atmos Energy	N	R	N	Y	--	N
	Columbia Gas	Y	B	N	Y	--	N
	Delta Natural Gas	N	V	N	Y	--	N
MD	Columbia Gas	N	V	N	Y	N	N
MS	Atmos Energy	Y	R	N	Y	N	N
NJ	Elizabethtown Gas Co.	N	B	Y	N	--	N
	New Jersey Natural Gas	N	B	Y	N	--	N
	South Jersey Gas Co.	N	B	Y	N	--	N

weather normalization program affects bills. Of the 36 programs on which we could collect information on this topic, 12 include an HDD dead band and 24 do not. WARM does not incorporate an HDD band.

The sixth column, labeled "Affect Current Bill?" indicates whether the program adjusts current customer bills for deviations from normal weather. The alternative is to accumulate revenue changes in a deferral account that affects bills in subsequent months or the following year. Of the 40 programs on which we could collect information on this topic, 32 affect the current month's bill and 8 use a deferral account. WARM affects current customer bills (but DMN uses a deferral account for non-weather related revenue adjustments).

Table 4-1b: Natural Gas Weather Normalization Programs in the United States: New York through Wyoming

State	Utility	Customer-Specific Factor?	Adjust Rate [R], Bill [B], or Volume [V]	HDD Band?	Affect Current Bill?	Line Item?	Opt Out?
NY	Brooklyn Union	N	B	N	Y	N	N
	Consolidated Edison Co.	Y	R	Y	Y	N	N
	Long Island Lighting Co.	N	B	Y	Y	N	N
	National Fuel	N	B	Y	Y	Y	N
	Niagara Mohawk Power	N	B	Y	Y	Y	N
	Orange & Rockland Utilities	N	B	Y	Y	Y	N
	Rochester G&E	Y	B	Y	Y	--	N
NC	Piedmont Natural Gas	N	R	N	Y	--	N
	North Carolina Natural Gas	N	R	N	Y	--	N
	Public Service Co. of NC	N	R	N	Y	--	N
OK	CenterPoint Energy	--	--	--	Y	--	--
OR	Northwest Natural	--	R	N	Y	N	O
PA	Philadelphia Gas Works	Y	V	Y	Y	Y	N
SC	Piedmont Natural Gas	N	R	N	N	N	N
	South Carolina Electric & Gas	Y	R	N	Y	--	N
TN	Atmos Energy	N	R	N	Y	N	N
	Chattanooga Gas Co.	N	R	N	Y	N	N
	Piedmont Natural Gas	N	R	N	Y	N	N
	United Cities Gas	N	B	N	Y	Y	N
TX	Atmos Energy	N	R	N	Y	--	N
UT	Questar	Y	V	N	Y	--	O
VA	Atmos Energy	N	--	Y	N	--	N
	Roanoke Natural Gas	--	B	Y	Y	Y	--
WY	Questar	Y	V	N	Y	--	N

The seventh column, labeled "Line Item?" indicates whether the program's revenue adjustments are included as a separate line item on the bill. When the adjustment is not listed as a line item, it typically means that the rate or billed therms are adjusted instead.

Of the 18 programs on which we could collect information on this topic, 7 list revenue adjustments as a line item and 11 do not.

The final column indicates whether the customers can opt out of the weather normalization program. Of the 35 programs on which we could collect information on this topic, only 2 allow for opt out (one being WARM). In many cases, we found no explicit indication that customers are required to remain in the program. In these cases we assume that the program is mandatory because no opt-out provision is listed.

In every category except the presence of an opt-out provision, WARM resembles the majority of the programs. The findings with respect to the use of the opt-out provision are particularly interesting given the difference in views between NW Natural and the Commission Staff on the topic. This issue is discussed further in Sections 9 and 10.

4.2 Fixed Bill Products

Some utilities offer fixed bill products, which can serve some of the same purposes as a weather normalization program. Fixed bill products are optional products that operate much like the Equal Pay program, but without the true-up month. That is, a fixed bill product uses a customer's historical billing and weather data to calculate a bill amount that is charged to the customer in each month. There is no true-up at the end of the year to resolve differences between actual and expected usage. Therefore, in mild winters when the customer uses less than expected, the fixed bill product will have collected more revenue from the customer than the utility would have collected under the standard tariff. Conversely, in cold winters when customers use more than expected, the utility will collect less revenue from the customer under the fixed bill product than it would have under the standard tariff.

Fixed bill products have the following features:

- A risk premium is included so that a customer who uses its expected usage amount will pay more than it would have under the standard tariff.
- Some, but not all, fixed bill programs limit the allowed deviation from forecast usage. For example, a customer may not be allowed to use more than 10 percent above the weather-adjusted forecast of their usage. Customers who exceed the threshold either pay a premium or are removed from the program.
- Fixed bill offers are locked in for one year and re-calculated using the most current data for the renewal offer. Therefore, customers who increase their usage (after adjusting for weather) on the fixed bill product will be offered a higher fixed bill amount in their renewal offer.
- Customers must have sufficient billing data (typically 12 months or so) to be eligible for the product.
- The product is offered to residential and/or small business customers.

In contrast to most weather normalization programs, fixed bill products are voluntary. However, each participant in the fixed bill program offers more weather insurance for the utility relative to the amount obtained from a weather normalization program. That is, a weather normalization program only insures against weather-driven changes in *fixed cost* recovery. In contrast, a fixed bill product insures the customer against the weather-driven changes in its *entire* bill. Given that natural gas utilities typically sell energy as a pass through to customers, the fixed bill product presents a risk to the utility. (Cold weather may prevent the utility from recovering its variable energy costs to serve a fixed bill customer.)

However, if only a fraction of customers (10 to 25 percent) are on a fixed bill product, while the remainder are on the standard tariff, the net effect can be a risk reduction comparable to that of a weather normalization program. That is, most of the utility customers (i.e., those on the standard tariff) present the full fixed cost recovery risk. A smaller number of fixed bill customers are *over-insured* (from the utility perspective) on an individual basis. Combining customers with no insurance with others that are over-insured can lead to a product portfolio that contains the appropriate amount of aggregate insurance for the utility against weather risk. Of course, the effectiveness of a fixed bill product in accomplishing the hedging goal (as opposed to being implemented to improve customer satisfaction by offering an array of products) depends upon having the right mix of standard tariff and fixed bill customers.

Examples of fixed bill programs in the natural gas industry include: Alliant Energy, CenterPoint Energy Minnesota Gas, Northern Indiana Public Service Company, Cinergy (pending), and Xcel Energy (pending).

4.3 Weather Hedges

In addition to fixed bill programs, the utility can purchase weather hedges as an alternative means of reducing weather-driven fixed cost recovery risk. One form of weather hedge is a swap, which contains the following contractual elements:

- The time period covered by the agreement;
- the method of measuring weather, e.g., heating degree days with a 59 degree Fahrenheit threshold;
- a location at which weather (HDDs) will be measured;
- the up-front payment, or premium, for obtaining the swap;
- the HDD “strike amount,” below which the utility receives money and above which the utility pays money; and
- the “strike price,” or the dollars per HDD deviation from the strike amount (e.g., $5 per HDD).

The utility purchases the weather swap from a third party. The utility can specify the dollar per HDD swap amount that is appropriate to offset the risk they are hedging against. An HDD strike amount that is set at normal (or expected) weather means that the expected payments from the swap are zero.

There are three issues that make weather swaps less appealing than weather normalization programs.

1. The weather derivatives market is young and thinly traded, so it can be difficult to obtain a swap for the appropriate region.
2. Weather derivatives are currently quite expensive (i.e., high premiums) because of the thinness of the market.[5]
3. Customers face the opposite risk of the utility, providing an opportunity for a costless swap of risks between the utility and its customers.

That is, weather swaps perform the job of reducing risk well, but they can be expensive because they must be purchased from a party that is willing to take on the weather risk. Utility customers, however, provide an opportunity for a win-win situation in which the utility swaps its weather risk for the customer's weather risk through a weather normalization program. The weather risk of both parties is reduced in the transaction, so little or no premium should be required for the program.

5. WEATHER SENSITIVITY OF NW NATURAL CUSTOMERS

WARM applies a single weather sensitivity parameter (β) to all customers in order to calculate bill adjustments. β, which is in units of therms per HDD, reflects an assumption about how much a customer's usage will change as the weather changes. While the current version of WARM assigns all customers within a class the same value for β, it is likely that significant differences exist in weather sensitivity across customers. If this is the case, then the WARM bill adjustments experienced by many customers will not reflect the variation in their contribution to fixed cost recovery caused by deviations from normal weather.

The use of a single β might also affect whether customers opt out of the program. To use an extreme example, suppose that a residential customer is not at all weather sensitive and therefore their true $\beta = 0.0$ (where the current tariff value is 0.1958). This customer will likely want to opt out of WARM, as the weather-driven bill adjustments that WARM produces *introduce* weather risk for the customer instead of offsetting it.

This section uses customer-level data to examine the diversity of weather sensitivity across NW Natural's customers. This is the first step in improving our understanding of whether it is appropriate to use a class-wide β value. In addition, we will compare customer-specific β estimates between WARM customers and those who opted out of WARM. Theory predicts that less weather sensitive customers are more likely to opt out of WARM because the bill adjustments caused by WARM may over-insure these customers against weather risk. In Section 6, we will use these estimates to simulate

[5] That is, the counterparty typically must be paid to take on the weather risk. In a more mature market, the counterparty might be able to lay the risk off on another party, reducing the premium required. However, weather derivatives will likely always carry higher premiums than most financial hedges because of the locational aspect. For example, to cover a swap sold to NW Natural, the counterparty would ideally like to find a balancing hedge related to Oregon weather.

changes in NW Natural revenues and customer-level bills as WARM program parameters are changed, including adopting customer-specific β values.

5.1 Methods for Calculating Customer-Specific Weather Sensitivity Parameters

We use two methods for calculating weather sensitivity. The first is an econometric approach that uses historical billing data to estimate the weather sensitivity of each customer.[6] The second method uses customer-level usage data from the prior summer to approximate each customer's weather sensitivity. This approach is consistent with the methods used in other weather normalization programs in the United States, such as Rochester Gas & Electric's Weather Normalization Adjustment program.

5.1.1 Econometric Approach

NW Natural provided monthly customer-level billing data for January 2001 through March 2005. We used these data to estimate the following regression for each customer that is eligible for WARM.

Equation 5.1 $Therms/Day_{c,m} = \alpha_c + \beta_c * HDD/Day_{w,m} + \varepsilon$, where

$Therms/Day_{c,m}$	=	therms consumed by customer *c*, divided by the number of days in the billing month *m*;
α_c	=	the estimated constant term for customer *c*;
β_c	=	the estimate of weather sensitivity, or the change in therms/day for a one unit change in HDD/day for customer *c*;
$HDD/Day_{w,m}$	=	heating degree days per day for weather station *w* (which is the station to which customer *c* is nearest) during billing month *m*; and
ε	=	error component of the econometric model.

To be consistent with the WARM tariff, we use a heating degree day base of 59 degrees for residential customers and a base of 58 degrees for commercial customers. In the analyses below, we compare the estimated values of β_c to the β used in the WARM tariff, as they are in the same units and are intended to represent the same effect.

5.1.2 Unit Consumption Approach

In this approach, which is based on methods that we observed in other weather normalization programs, a baseline (or non-weather sensitive) usage level is set according to usage in July and August (see equation 5.2a below). A separate weather-sensitivity parameter is then set for each month using equation 5.2b below.

Equation 5.2a $Q^B_c = (Therms_{Jul,c} + Therms_{Aug,c}) / (Days_{Jul,c} + Days_{Aug,c})$, where

Q^B_c = baseline therms per day consumed for customer *c*;

[6] This approach is consistent with the methods that CA Energy Consulting uses to estimate customer-level weather sensitivity for use in calculating fixed bill offers.

$Therms_{Jul,c}$	=	billed therms in July for customer *c*;
$Therms_{Aug,c}$	=	billed therms in August for customer *c*;
$Days_{Jul,c}$	=	number of billing days in July for customer *c*; and
$Days_{Aug,c}$	=	number of billing days in August for customer *c*.

Equation 5.2b $F_{m,c} = (Q_{m,c} - Q^B{}_c * Days_{m,c}) / HDD^A{}_{m,c}$, where

$F_{m,c}$	=	weather sensitivity factor in month *m* for customer *c*;
$Q_{m,c}$	=	billed therms in month *m* for customer *c*;
$Q^B{}_c$	=	baseline therms per day for customer *c*;
$Days_{m,c}$	=	number of billing days in month *m* for customer *c*; and
$HDD^A{}_{m,c}$	=	actual heating degree days in month *m* for customer *c*.

The theory behind this method is that customers' non-weather driven usage is fairly stable throughout the year, and is best measured in warm months such as July and August. During the heating season, weather-sensitive usage is calculated as the difference between metered usage and baseline usage (adjusted for the number of billing days). The weather sensitivity parameter is then calculated as the weather sensitive usage divided by the number of heating degree days. New customers without data in July and August may be assigned a class average value or removed from the program until they have adequate data. To ensure that data errors do not produce anomalous bill changes, limits may be set for the allowed customer-specific parameters. For example, the program might force the parameter to be between 0.0 and 0.5 therms per HDD.

5.1.3 Comparison of the Two Approaches

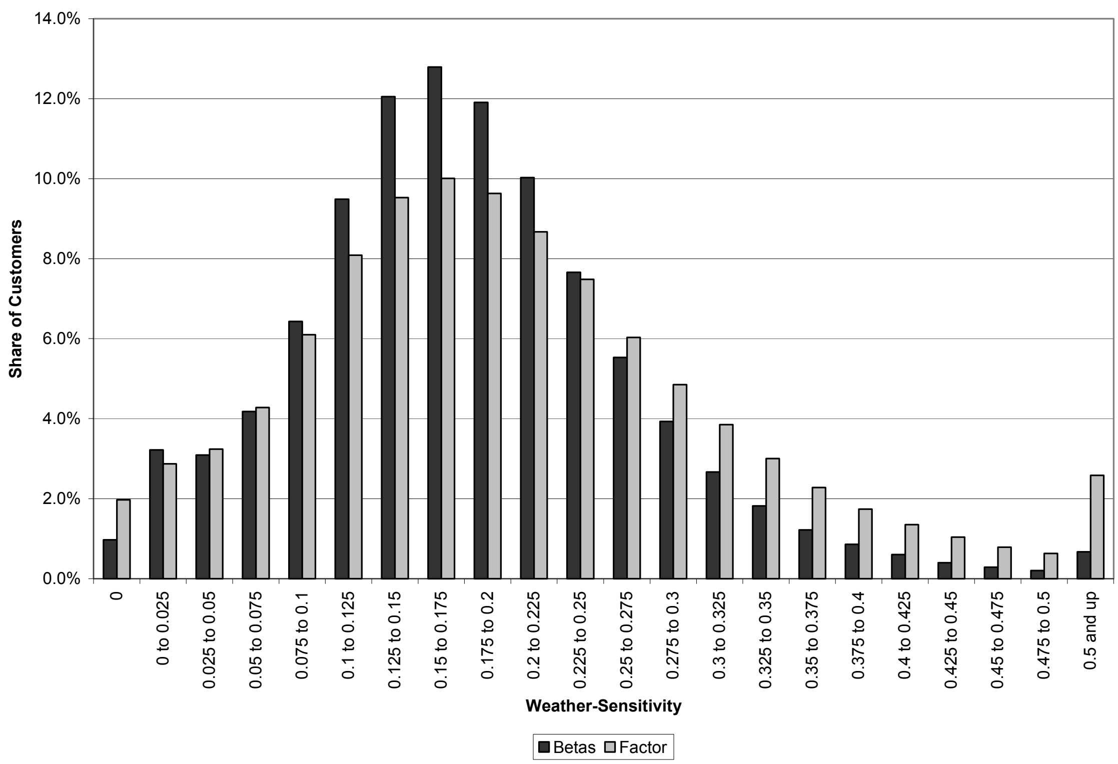
The econometric approach is superior to the unit consumption approach in its ability to easily incorporate data from many months, which will tend to produce more precise estimates of customers' weather sensitivity. However, the unit consumption approach has the advantage that it is easier to calculate and understand. It is useful to compare the results of the two approaches to determine whether the relative simplicity of the unit consumption approach is offset by a significant reduction in precision.

The econometric estimates of individual customer weather sensitivity (β_c) were developed using data from January 2001 through March 2005 billing data. We eliminated customers who did not have more than 12 months of data. The unit consumption weather sensitivity factors were estimated using July and August 2003 billing data and examined only the 2003 to 2004 heating season. While a separate factor is calculated for each month in the heating season, for comparison purposes we use the average of the unit consumption factors across the months.

In our estimates, the residential unit consumption factors tend to be higher than β_c, with the average unit consumption factor equal to 0.201 and the average β_c equal to 0.180. A partial explanation for this difference could be that the unit consumption factors are estimated from more recent data than the β_c values and recently constructed homes are likely to be larger and more likely to have natural gas space heating than existing homes. However, if the difference between methods is "real", the implication would be that the unit consumption factor approach would likely lead to slightly larger WARM adjustments than the econometric approach.[7]

Figure 5-1 shows a side-by-side comparison of the distributions for the unit consumption factors and β_c values. The figure shows that the unit consumption factors are both higher on average and more dispersed than the β_c estimates.

Figure 5-1: Estimated Weather Sensitivity of Residential Customers: Econometrically Estimated Betas and Unit Consumption Factors



Because the econometric approach incorporates more data and should therefore provide a more precise measure of weather sensitivity, we use the β_c values to illustrate the distribution of weather sensitivity across customers and to compare customers who opt out of WARM to WARM participants (in Sections 5.2 and 5.3, respectively). However, because of the comparative simplicity of the unit consumption approach, and the fact that it has been used by other utilities, we recommend that NW Natural consider adopting this approach in Section 10.2. Therefore, we use the unit consumption approach to conduct the financial simulations in Section 6.

[7] The difference between the two methods might also be reduced if the estimates of β_c incorporated only more recent data, which would better account for customer growth over time.

5.2 Distribution of Customer-Specific Weather Sensitivity Parameters

In this section, we examine the distribution of customer-specific weather sensitivity parameters (β_c). A finding that the distribution is "tight" within a customer class—meaning that there are not large differences across customers—would provide support for the current method used in WARM, which applies one value of β to all customers within a class. Alternatively, finding large differences in β_c within a customer class indicates that WARM might produce better effects for customers if customer-specific values of β are used to adjust bills.

Table 5-1 shows the average of β_c by region. The last row contains the value currently used in WARM. Note that this value is below the average estimated values for both the residential and commercial classes. This is because the values in the table are calculated as averages across all customers and not using aggregate class level data. That is, because larger (i.e., higher therm use) customers tend to have higher β_c values, the average value across individual customers will tend to be lower than a value estimated from aggregate class-level data.

Table 5-1: Average Customer-Level Weather Sensitivity Parameters by Region and Customer Class

Region	Residential	Commercial
Albany	0.165	0.566
Astoria	0.153	0.424
The Dalles - Oregon	0.137	0.567
Eugene	0.150	0.663
Lincoln City	0.139	0.352
Portland	0.185	0.705
Salem	0.167	0.637
All	0.178	0.662
WARM Tariff	0.1958	0.7669

Both residential and commercial customers in Lincoln City have lower than average weather sensitivity, while Portland customers (who account for the majority of the total customers) tend to be more weather sensitive than customers in other regions.

Figure 5-2 contains a histogram of the β_c values for residential customers, replicated from Figure 5-1 above. About 62 percent of customers are less weather sensitive than is assumed in the WARM tariff (0.1958 therms per heating degree day). Approximately 18 percent of customers are less than *half* as weather sensitive than the assumed WARM tariff value. On the other end of the distribution, about 2 percent of customers are more than twice as weather sensitive as the assumed value.

Figures 5-3 and 5-4 show the distribution of weather sensitivity for commercial customers. The results for this customer class are split across two figures to accommodate the large differences in β_c across customers. That is, relative to residential customers, there are large differences in average usage and weather sensitivity across commercial customers. Therefore, the estimated weather sensitivity of commercial customers ranges from 0 (i.e., not weather sensitive) to over 10 therms/HDD.

Figure 5-2: Estimated Weather Sensitivity of Residential Customers

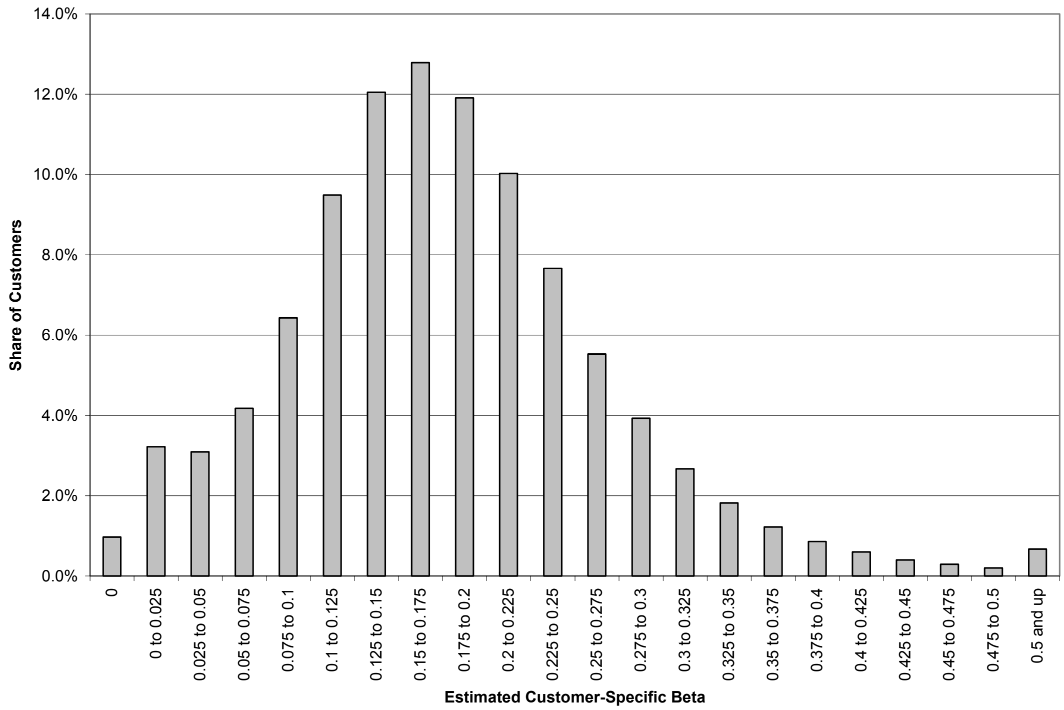


Figure 5-3 shows the distribution of commercial customer weather sensitivity for relatively low levels of β_c over the range of values shown for residential customers in Figure 5-2. A comparison of Figures 5-2 and 5-3 shows that the residential weather sensitivity is much more concentrated around the average class value.

Figure 5-4 shows the distribution of commercial customer weather sensitivity for relatively high levels of β_c. This figure shows that commercial weather sensitivity can be much higher than the level assumed in the tariff (0.7669 therms/HDD), but relatively few customers have a parameter that exceeds 1.5 therms/HDD. Note that the customer shares in Figures 5-3 and 5-4 must be added together to sum to 100 percent.

Overall, the figures in this section show that the use of a class-average value of β will lead to WARM bill adjustments that are too high or too low for many customers. This is of particular concern for customers that are less weather sensitive than the tariff value. For customers that are not at all weather sensitive (0.4 percent of residential, and 4.3 percent of commercial customers), WARM will *increase* the weather risk to which the customer is exposed, which is the opposite of its intended effect.

Figure 5-3: Estimated Weather Sensitivity of Commercial Customers: Below 0.5 Therms/HDD

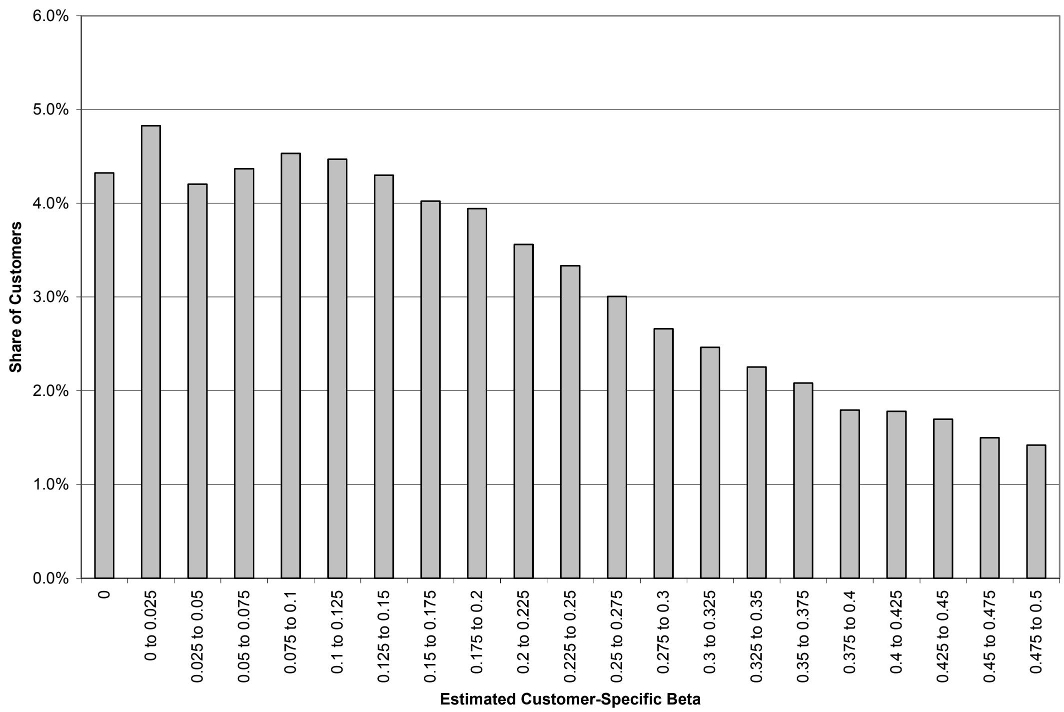
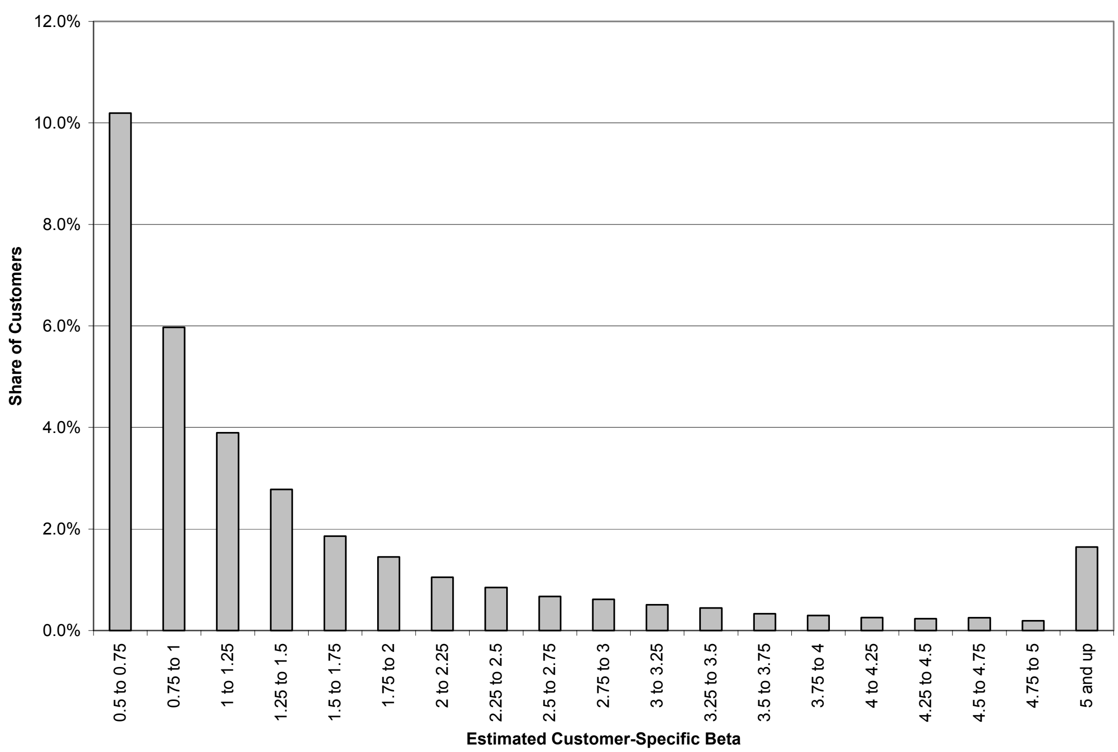


Figure 5-4: Estimated Weather Sensitivity of Commercial Customers: Above 0.5 Therms/HDD



Note that customers face weather risk on their *total* bill (i.e., variable energy and fixed distribution costs) while WARM is intended to address only the weather risk associated with the fixed distribution costs. Therefore, even if a customer is over-insured by WARM (i.e., because they are less weather sensitive than the tariff value) with respect to fixed cost recovery, the WARM bill adjustment may not be "too large" relative to the total weather risk faced by the customer.

To see this, consider a customer for whom β_c = 0.10, and a month in which HDDs are 100 higher than expected. (Assume that β_c is estimated correctly, and can therefore be used to calculate usage changes due to changes in HDD.) The current WARM bill adjustment would be -100 HDDs * 0.1958 therms/HDD * $0.42569 per therm = -$8.34. If the WARM bill adjustment was instead based on the customer-specific value of 0.10 therms/HDD, the bill adjustment would be -$4.26. However, assuming a cost of gas of $0.54 per therm, the change in the energy portion of the customer's bill would be 100 HDDs * 0.1 therms/HDD * $0.54 per therm = $5.40. In this case, the bill reduction in the current version of WARM ($8.34) is less than the *total* change in the customer's bill due to the unusually cold month ($4.26 + $5.40 = $9.66), demonstrating that WARM does not over-insure this customer against its total weather-induced bill risk.

5.3 Comparison of WARM Participants and Opt-Out Customers

As explained in Section 2.3, the design of WARM contains incentives for small and/or non-weather sensitive customers to opt out of WARM. This is because the WARM bill adjustments are based on a therm/HDD factor (β) that is the same for all customers within a class. There are other, perhaps more compelling reasons to opt out of WARM, such as a belief that the definition of normal HDDs is "too cold" (which, if true, would mean that WARM is not a "fair bet" for the customer). This section compares the weather sensitivity and average therm use of WARM participants and opt-out customers to help assess why customers decide to opt out of WARM.

Customers may opt out of WARM prior to September 30th. To perform the comparison of WARM participants to opt-out customers, we needed to link WARM status to premise IDs. Assigning WARM status to a premise is complicated by the fact that WARM status can change from year to year[8] and we examine weather sensitivity estimates using data from multiple heating seasons. We therefore used WARM status from February 2004. This month was chosen because it is in the most recent heating season (and therefore reflects recent attitudes about the program) and is in the middle of the heating season, eliminating any concern that the WARM status is incorrect because the billing period falls outside of the heating season. (All customers were coded as non-participants outside of the heating season.)

Of the residential customers for whom we could estimate β_c and match WARM status, approximately 7.5 percent opted out of WARM. The average β_c for the two groups of

[8] WARM status can change either because the customer changes WARM status, or because a new owner changes the WARM status for the premise.

customers is similar, with WARM participants averaging $\beta_c = 0.180$ and opt-out customers averaging $\beta_c = 0.176$. Because the sample of customers is large, this difference is highly statistically significant, even though the magnitude of the difference is small in practical terms.

The average monthly therm use of WARM participants is 58.9 therms, while opt-out customers use 56.9 therms per month on average. As in the case of β_c, this difference is small in practical terms, but is highly statistically significant.
Table 5-2 shows opt-out percentages by region. In addition, we show the average monthly therm use and average estimated weather sensitivity by region to see if these factors help explain the variations in the percentage of customers opting out across regions. Albany and Eugene have the highest rates of opt out, but it does not appear that this result is driven by particularly low average weather sensitivity or usage levels.

Table 5-2: Percentage of Residential that Opt-Out of WARM by Region

Region	**Opt-Out Percentage**	**Average Therms per Month**	**Average β_c**
Albany	10.6%	54.63	0.165
Astoria	6.5%	51.30	0.153
The Dalles - Oregon	6.4%	53.48	0.137
Eugene	9.7%	52.74	0.150
Lincoln City	8.7%	44.88	0.139
Portland	7.0%	59.90	0.185
Salem	7.2%	56.82	0.167
All	7.4%	58.21	0.178

The findings of this section indicate that WARM participants and opt out customers are not very different in terms of their weather sensitivity or average natural gas use. This suggests that customers opt out for other, less observable reasons. These could include:

- The customer believes that the normal heating degree definition is "too cold," which, if true, would cause them to pay more in WARM surcharges than they would receive in WARM refunds over time;
- The customer believes that WARM is "gambling on the weather" instead of providing a hedge against existing weather-induced risk; or
- The customer does not want a hedge against weather-induced risk.

Section 8 of the report will address customer complaints regarding WARM, and therefore provide some additional insight into the reasons that customers have for opting out of WARM.

6. SIMULATIONS OF PROGRAM OUTCOMES

In this section, we use customer-level data to simulate NW Natural margins and customer bills under various WARM designs. The WARM design alternatives that we consider are as follows:

1. Current WARM, using a pooled level β;
2. Pooled percentage β; and
3. Individual unit consumption weather-sensitivity factor.

Two distinctions are drawn in developing these alternatives. The first is whether a *pooled* or an *individual* weather sensitivity parameter (β in the current tariff) is used. "Pooled" simply means that the same value is used for all customers within a class, while "individual" parameters are estimated separately for each customer using their billing data. (A default class-average value is used if the customer has insufficient data to estimate the factor.) Individual parameters are proposed to account for the fact that customers have different levels of weather sensitivity.

The second distinction is between a *level* or *percentage* weather sensitivity parameter. "Level" refers to an adjustment parameter that is stated in terms of therms per HDD (e.g., 0.1958 therms/HDD). A "percentage" parameter instead adjusts the *percentage* of therms per HDD (e.g. 0.26 percent therm change per HDD). The use of a percentage weather sensitivity parameter is intended to account for the fact that low use customers tend to require small total adjustments relative to large use customers.

Option 2 above, which uses the pooled percentage factor, is included as a middle ground between the current program and an alternative program that uses customer-specific weather sensitivity parameters.[9] The percentage β parameter is calibrated to match the current WARM bill changes for the residential sample examined in this section over the 2003 to 2004 heating season.

The individual unit consumption factors are estimated using the methods described in Section 5.1.2. The base month usage is calculated from July and August 2003 billing data. The billing data made available to us contained the correct customer-level heating degree days given the customer's billing dates and applicable weather station. However, the data did not include the billing dates themselves. To better match normal heating degree day data to each customer (which had to be appended to the customer-level data from a separate data source), we examined only customers in billing cycle 1 and we eliminated customers with more than four days' deviation in billing days from cycle standard. In addition, we eliminated customers without data for all six months of the 2003-2004 WARM heating season.

[9] It is not necessary to examine individual parameters that are expressed in percentage terms instead of level terms, as the customer-specific nature of the parameter will already account for the size effect for which the pooled percentage parameter is intended to account.

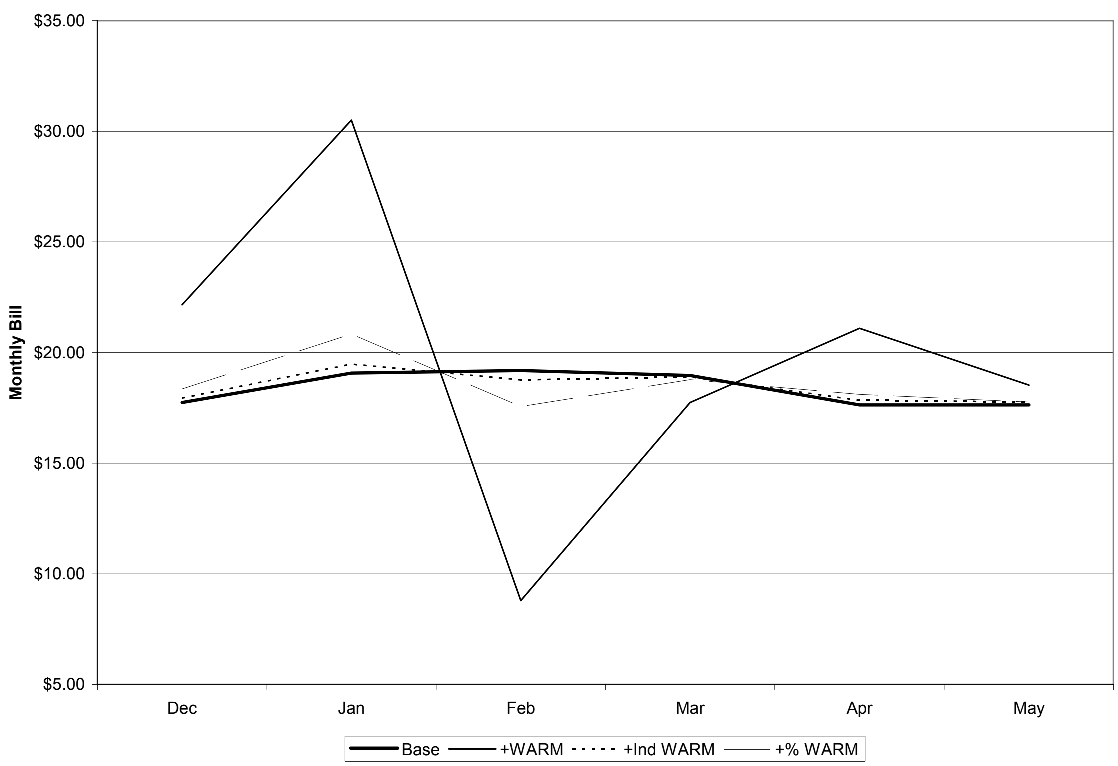
6.1 Customer-Level Program Effects

Customer-level bill changes from using the alternative WARM mechanisms are most easily illustrated using a few prototype customers. We examine three customers in Figures 6-1 through 6-3 below:

1. A small non-weather sensitive customer;
2. A small weather sensitive customer; and
3. A large weather sensitive customer.

We do not examine large non-weather sensitive customers as they appear to represent an extremely small percentage of customers. That is, the main reason that residential customers have high usage levels (and are therefore categorized as "large") is because they have natural gas space heating, which leads to substantial weather sensitivity of their consumption.

Figure 6-1: Monthly Bills for a Small Non-weather Sensitive Residential Customer

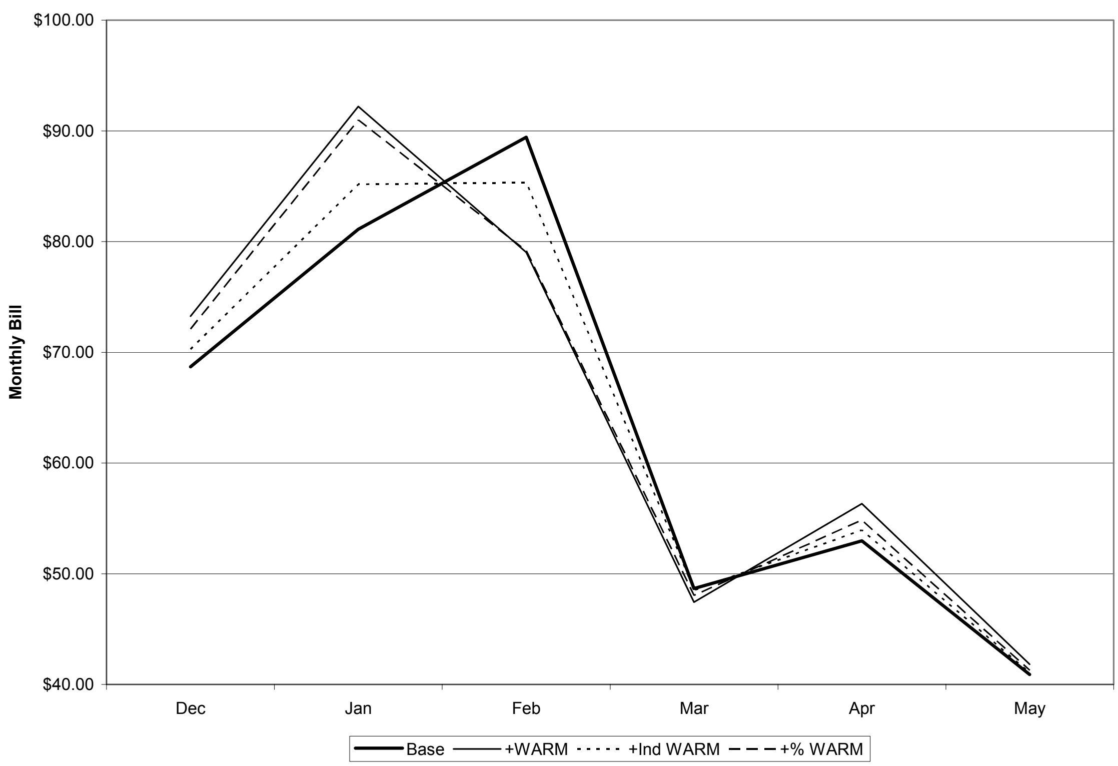


Four sets of bills are graphed in the figures. The bold solid line represents the customer's base tariff bill. Notice in Figure 6-1 that the small non-weather sensitive customer has nearly the same base bill in each month, while the weather sensitive customers in Figures 6-2 and 6-3 have base bills that vary substantially across months (in a manner that follows monthly heating degree days).

The non-bold solid line represents the base bill plus the current WARM bill adjustment. The dashed line represents the base bill plus a WARM bill adjustment based on a percentage pooled β. Finally, the dotted line represents the base bill plus a WARM bill adjustment based on individually calculated weather sensitivity factors.

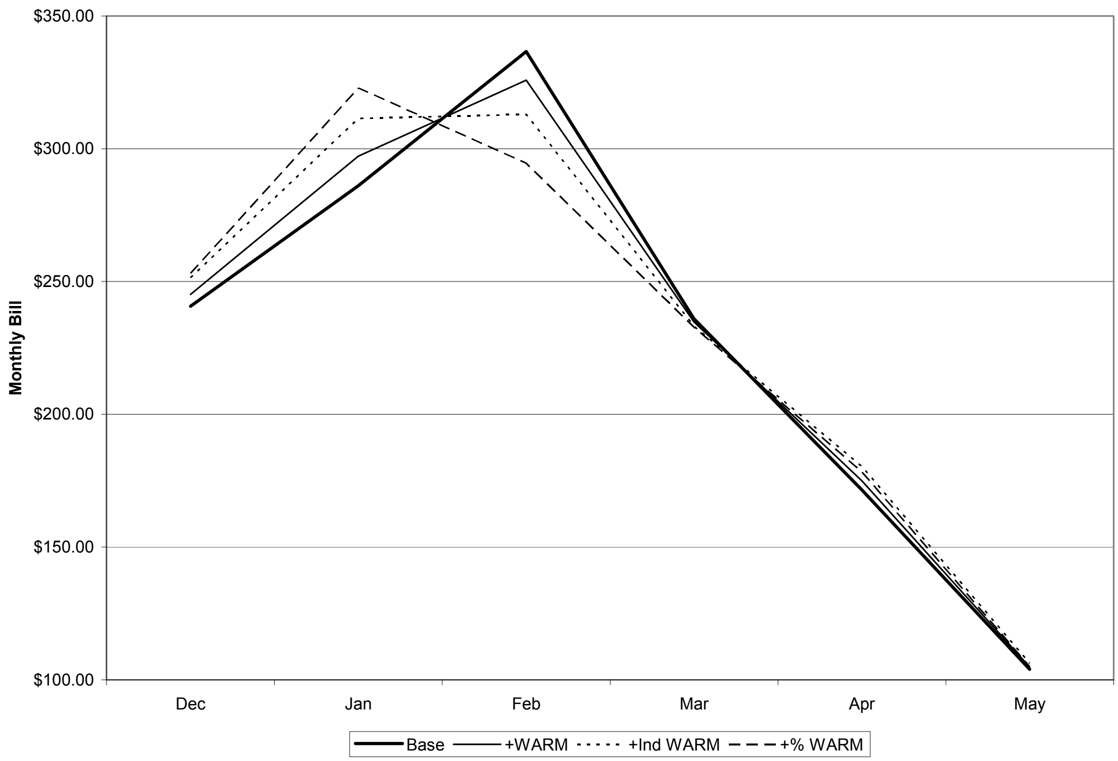
The figures illustrate some expected effects. Figure 6-1 shows that the WARM bill adjustment actually *increases* the bill variability of the small non-weather sensitive customer. This happens because WARM only acts as a hedge against weather risk if the customer actually experiences weather risk in the base tariff bill. If customer is not weather sensitive, WARM *introduces* weather risk instead of hedging against it. To get some idea of how many customers may be adversely affected by WARM in this way, we used the following criteria. "Small" customers are defined as customers who do not have any base tariff bills above $100 in the heating season. "Non-weather sensitive" customers are defined as customers who have an estimated weather sensitivity less than half of the value used in the WARM tariff (0.1958). Using these criteria, we determined that about 10 percent of residential customers may experience increased weather risk due to WARM.

Figure 6-2: Monthly Bills for a Small Weather Sensitive Residential Customer



For the weather-sensitive customers, the WARM adjustments are in the intended direction, an effect that is most easily seen in Figure 6-2. Focus on January, which was milder than normal, and February, which was colder than normal. The upward adjustment in the customer's bill in January compensates for a portion of the "under-payment" of fixed costs by the customer. Conversely, the downward WARM bill adjustment in February represents a partial refund to the customer for its "over-payment" of fixed costs.

Figure 6-3: Monthly Bills for a Large Weather Sensitive Residential Customer



The WARM variant that uses a common weather sensitivity parameter expressed as a percentage of usage, indicated by the dashed line in the figures, seems to perform better than the current version of WARM. For the small non-weather-sensitive customer, the WARM bill adjustment is dramatically reduced. However, even this modified version of WARM appears to introduce some weather risk for the customer. For the small weather-sensitive customer, the pooled percentage variant of WARM produces very similar effects as the current version of WARM. Finally, for the large weather-sensitive customer, the pooled percentage variant of WARM over-adjusts the customer's bill. This can be seen by comparing this adjustment to that of the customer-specific variant (represented by the dotted line, which is as close as we can come to representing the correct weather-adjusted bill).

The customer-specific variant of WARM, represented by the dotted line in the figures, does the best job of adjusting customer's bills for the effects of weather on fixed cost recovery. This is most easily observed in Figure 6-1, in which the customer-specific WARM adjustment is virtually zero. Therefore, for non-weather-sensitive customers, the customer-specific WARM adjustment provides a means to automatically opt customers out of the WARM. This is appropriate given that such customers are not contributing to the weather-induced fixed cost recovery risk faced by NW Natural.

Modifying WARM to use a customer-specific value of β (instead of one β per customer class) improves program performance in two ways. First, it serves as an automatic opt-out mechanism for non-weather sensitive customers, for whom WARM does not act as a hedge against weather risk. Second, it improves the WARM bill adjustments for weather sensitive customers. That is, the customer-specific weather sensitivity parameters estimated from billing data provide the best guess that the utility can make regarding the "true" amount that a customer's usage should be adjusted to account for deviations from normal weather. By calculating this change using the best available method, the customer-level WARM bill adjustments provide the "right" amount of weather hedge for each customer. Alternatively, the use of a class-wide weather adjustment factor causes some customers to be over-insured and others to be under-insured against weather-induced fixed cost payment risk.

6.2 Company-Level Program Effects

While the previous section examined customer-level bill impacts from various WARM designs, this section simulates the changes in NW Natural revenues from each proposed WARM design. For simplicity, we focus on two months: January and February of 2004. These months were selected because January was significantly warmer than normal, while February was significantly colder than normal, allowing us to examine WARM revenue effects in diverse weather conditions. In addition, we limited the analysis to residential customers in billing cycle 1 that had data in all months of the 2003 to 2004 heating season. While our initial goal was to simulate WARM financial effects for all eligible customers, this did not prove to be feasible. However, examining a subset of customers should provide an adequate indication of the magnitude of the WARM revenue effects (as a percentage of base tariff revenues), as well as the differences in revenues across alternative WARM designs.

Tables 6-1 and 6-2 show the simulated WARM revenue effects by region for January and February 2004, respectively. Table 6-1 shows that each variant of WARM increases NW Natural revenue in January. The difference in WARM revenues adjustments across regions is related to the differences between actual and normal heating degree days. In each region, actual HDDs are lower than normal HDDs, indicating that weather is milder than expected. This causes natural gas usage levels to be lower than expected, reducing fixed cost recovery. The table shows that WARM adds to the base tariff revenues (7.3 percent for the current version of WARM across all regions), which compensates for the lost margins from the mild weather.

Table 6-2 shows simulated WARM revenue effects for February 2004, which was substantially colder than expected in most regions (in the other regions, HDDs were close to normal levels). Again, the table shows impacts that one would expect. That is, when the cold weather drives up natural gas usage, WARM provides refunds to customers to compensate for the over-recovery of fixed costs.

Table 6-1 Simulated WARM Revenue Effects using January 2004 Data

Region	WARM Adjustment as a Percentage of Base Tariff Revenue			Weather Conditions	
	Current WARM	Percentage WARM	Individual WARM	Normal HDD	Actual HDD
Albany	6.6%	9.8%	5.5%	682	578
Astoria	5.0%	7.9%	4.6%	570	489
The Dalles	9.7%	12.1%	5.6%	859	730
Eugene	9.2%	12.6%	7.3%	680	546
Lincoln City	7.9%	9.3%	7.1%	490	388
Portland	7.2%	12.9%	7.8%	671	534
Salem	6.2%	9.7%	5.5%	663	560
Vancouver	9.8%	18.3%	10.9%	727	534
All	7.3%	12.9%	7.8%	668	540

Table 6-2 Simulated WARM Revenue Effects using February 2004 Data

Region	WARM Adjustment as a Percentage of Base Tariff Revenue			Weather Conditions	
	Current WARM	Percentage WARM	Individual WARM	Normal HDD	Actual HDD
Albany	-0.5%	-0.8%	-0.5%	523	532
Astoria	-1.8%	-2.4%	-1.6%	447	474
The Dalles	-8.8%	-12.7%	-5.7%	663	799
Eugene	-0.2%	-0.2%	-0.1%	520	522
Lincoln City	0.1%	0.1%	0.1%	375	374
Portland	-5.8%	-11.8%	-6.4%	504	628
Salem	-3.8%	-6.3%	-3.6%	510	577
Vancouver	-4.8%	-10.3%	-5.3%	552	662
All	-5.2%	-10.6%	-5.7%	505	605

Tables 6-1 and 6-2 allow us to compare the financial effects of alternative WARM designs. In January, shown in Table 6-1, heating degree days were 128, or 19 percent below normal. The current form of WARM produces customer surcharges equal to 7.3 percent of the base tariff bill. The "percentage" form of WARM (in which the same β is applied to all customers within a class, but β is expressed as a percentage change in usage per HDD), produces a substantially larger aggregate surcharge than the current form of WARM. Larger surcharges will tend to occur in months that have relatively large deviations from normal weather. The "individual" form of WARM, in which a separate

β is calculated for each customer, produces revenue changes that are similar to the current version of WARM.[10]

Table 6-2 shows similar differences across programs, with the percentage WARM program refunds being larger in magnitude than the refunds produced by either the current or customer-specific versions of WARM. In regions where the difference between actual and normal HDDs is small (e.g., Eugene and Lincoln City), all three WARM variants produce small changes in revenue.

6.3 Comments on Financial Effects of Other Programs

WARM was implemented to reduce the variability in NW Natural's fixed cost recovery caused by weather-driven fluctuations in customer usage (combined with the fact that the majority of fixed costs are recovered through volumetric rates). Of course, usage fluctuations from non-weather sources also affect fixed cost recovery. For NW Natural, the Distribution Margin Normalization (DMN) program is designed to recover the *non-weather* induced variation in fixed cost recovery.[11]

Revenue per Customer Decoupling (RPCD) is an alternative mechanism that reduces variations in margins, regardless of the source of the variation. Therefore RPCD is very similar to a combination of DMN and WARM in its annual revenue effects for the utility.

From a customer perspective, WARM reduces the variability in monthly bills by lowering bills in cold winter months and increasing bills in mild winter months. (However, WARM only affects variation in the portion of bills devoted to fixed cost recovery. The customer is still exposed to substantial bill variation due to changes in total energy cost.) Customers have another mechanism available to them to help with month-to-month variations in bills: the Equal Pay program.

In this section, we describe how DMN, RPCD, and Equal Pay interact with and/or compare to WARM in terms of their financial effects.

6.3.1 Distribution Margin Normalization Revenue Effects

As described above, DMN complements WARM by accounting for non-weather induced variations in fixed cost recovery. As described in Sections 2.5 and 7, DMN also compensates for an incentive problem that is present in WARM. That is, as a stand-alone mechanism, WARM gives NW Natural an incentive to set the definition of normal HDDs too low (i.e., mild winters), while regulators have the incentive to set the definition too high (i.e., cold winters). For example, if the normal HDD definition is too cold, WARM will tend to produce surcharges to customers. However, this effect is offset by the presence of DMN, which provides the opposite incentive. If the normal HDD definition is too high, DMN will tend to produce refunds to customers that offset the surcharges

[10] The differences that exist are likely due to the fact that the customer-specific β's were estimated from different data from that used to estimate the WARM tariff β, which was estimated using aggregate data from an earlier time period.

[11] Order 05-934 eliminated a 90% factor that limited the fixed cost recovery allowed by DMN. This change goes into effect in October 2005.

created by WARM. (However, WARM affects current bills, while DMN revenue changes go into a deferral account.)

6.3.2 Revenue per Customer Decoupling Revenue Effects

As mentioned above, the total revenue effects of RPCD are quite close to those of DMN and WARM combined, but the mechanism is mathematically less complex. Equation 6.1 shows how full decoupling revenue adjustments are calculated.

Equation 6.1: Margin Adjustment = $M * C * (QPC^B – QPC^A)$.

In this equation, M is the dollar per therm margin from the standard tariff; C is the number of customers to which the program applies; QPC^B is baseline use per customer; and QPC^A is actual use per customer. The key differences between this mechanism and the combination of DMN and WARM are as follows:

1. Actual use per customer is not adjusted for weather conditions. This results in an incorporation of a WARM-style adjustment in the decoupling mechanism.
2. Baseline quantities are not adjusted for prices.
3. The 90 percent factor used to reduce the amount of revenue variation covered by the DMN program (which has recently been removed) is not included.
4. Weather-induced changes in revenue recovery accumulate in a deferral account instead of flowing to bills in the same month (as WARM does).
5. Because the DMN and WARM adjustments are combined in RPCD, there is no need to set the price elasticity or define normal weather. Once the utility and the Commission agree on the allowed margin rate per customer, both parties have the incentive to select the "correct" value of baseline use per customer in order to minimize deferrals.

Because of its comparative computational simplicity, RPCD should be easier to comprehend and communicate than the combination of DMN and WARM. This could reduce customer service costs associated with confusion about bills.[12] In addition, RPCD eliminates disputes over setting parameter values about which reasonable people can disagree: the price elasticity and normal weather (heating degree days).

RPCD has a potential disadvantage with respect to the combination of DMN and WARM: under RPCD, weather-induced revenue adjustments are deferred until the following year, while WARM adjustments affect current bills. To the extent that customers want to reduce the cash flow risk associated with weather-induced fluctuations in monthly bills, WARM provides superior benefits (that may be improved through modifications to the program). In fact, RPCD could increase customers' weather risk. For example, if a mild winter is followed by an unusually cold winter, the surcharges

[12] Simplifying the mechanism would not reduce disputes about *whether* the bills should be adjusted. Complaints on this topic will be reduced by RPCD only to the extent that decoupling deferrals may be more difficult to detect than WARM bill adjustments.

caused by the mild winter could increase customer bills at exactly the wrong time.[13] In short, RPCD is not as effective as WARM in reducing customer's weather-induced bill risk. However, note that the *total* effect over time on customer bills is largely the same with RPCD as it would be under the DMN + WARM mechanism, so customer's weather-induced *wealth* risk is nearly identical under the two mechanisms.

Table 6-3 shows simulated revenue effects for RPCD, DMN, and WARM. The DMN calculations assume that the program allows for 100 percent (instead of 90 percent) recovery of non-weather related margin variations. The values are simulated over only a subset of residential customers, so they do not represent system-wide effects. However, the table does provide some useful insights.

First, notice that across the two months, the total effect of RPCD (-$285,603) is very close to the total effect of DMN combined with WARM (-$287,400). Second, notice how the margin adjustments are divided between DMN and WARM in this case. In the mild month of January, WARM creates an immediate surcharge for customer bills to account for the effect of the mild weather on revenues. However, much of this surcharge is offset by the refund that DMN adds into the deferral account. In contrast, RPCD produces a comparatively small refund to customers that will act to lower rates in the following year.

In the cold month of February, WARM provides a $201,178 refund to customers on the February bill. DMN also creates a relatively small refund that is added to the deferral account. RPCD produces a relatively large refund to be added to a deferral account.

The results in Table 6-3 demonstrate that RPCD is very similar to DMN plus WARM in terms of the total revenue effects, but quite different in terms of *when* it affects customer's bills. Only WARM can provide for immediate relief to customers in a cold winter month.

However, RPCD is much easier to calculate than DMN plus WARM. It only requires the baseline use per customer and the per therm margin as parameters, and does not require customer-specific changes to bills.[14] The complexity of WARM may have contributed to some billing errors that have occurred since its inception. These errors would be less likely to occur under RPCD.

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[13] This risk should not be overstated. An examination of annual heating degree days from 1976 through 2004 (using the weighted average across NW Natural weather stations) shows that there was only one instance in which HDDs were 7 percent or more below the 29-year average in one year and 7 percent or more above the 29-year average in the following year. (There were no instances when +/- 10 percent is used as the threshold instead of 7 percent.) This indicates that the "mild winter followed by extreme winter" scenario in which customers are adversely affected by RPCD is not likely to occur with great frequency.

[14] Although the current version of WARM uses a common value of β, the bill adjustment is calculated separately for each customer based on data from the most proximate NW Natural weather station and the customer's billing dates.

Table 6-3: Simulated Revenue Effects of WARM, DMN, and RPCD

Variable	January	February	Total
Base Use per Customer	127.1	126.0	
Actual Use per Customer	133.5	149.5	
Number of Customers	22,465	22,465	22,465
Normal HDD	668	505	1,174
Actual HDD	540	605	1,145
Weather-normalized Use per Cust.	158.6	130.0	
RPCD Adjustment	-$60,977	-$224,626	-$285,603
DMN Adjustment	-$301,425	-$37,909	-$339,334
WARM Adjustment	$253,112	-$201,178	$51,934
DMN+WARM	-$48,314	-$239,087	-$287,400

Note: the HDD figures are calculated as weighted averages across the regions, using weights provided by NW Natural.

6.3.3 Equal Pay Program Revenue Effects

The Equal Pay program fixes a customer's bill for eleven months and uses the twelfth month to "true up" the customer's annual payments to the same amount that they would have paid on the standard tariff. Because the total annual bill is the same for the customer whether or not they are on Equal Pay, it does not affect total margin recovery. However, it does provide bill smoothing for the customer. While this feature is shared with WARM (which somewhat reduces the variability in customer bills), Equal Pay is not intended to address fixed cost recovery issues, so we do not discuss this program further in this report.

7. ANALYSIS OF FINANCIAL EFFECTS OF USING AN INCCORECT NORMAL WEATHER DEFINITION

WARM revenue flows depend upon the definition of normal weather. Section 2.4 illustrates how errors in the normal definition of weather are canceled out if customers participate in both DMN and WARM. However, customers may opt out of WARM while participation in DMN is mandatory. Because of this, the accuracy of the normal weather definition is important, as customers will opt out of WARM if they believe that the normal weather definition is too cold (i.e., normal HDDs are set too high, in which case WARM will lead to more surcharges than refunds for the customer).

There has been some dispute regarding the appropriateness of the definition of normal weather currently in use. Some advocate using the current 25-year definition ending in 2000 because the long timeframe will include the full cyclical nature of weather conditions. Others believe that a more contemporary definition is appropriate, which would lead to the use of a warmer normal weather definition (i.e., fewer HDDs).

We do not take a position in this review regarding the correct definition of normal weather. However, we do examine the financial implications of setting an incorrect definition.

Our analysis uses Portland weather data spanning a 28-year period (the 1977 through 2004 heating seasons). The following assumptions are made to simulate the financial effects of WARM:

- There are 350,000 residential customers in Portland;
- Examine only residential customers, as they constitute the majority of the WARM customers;
- The per therm margin is $0.42569;
- Use the current WARM method of calculating usage changes with respect to weather, 0.1958 therms/HDD for all customers;
- "True" normal weather is the average across all years analyzed, 1977–2004;
- To calculate total margins, assume that, on average, customers use 100 therms per month during a normal heating season.

Table 7-1 shows the simulated WARM revenue effects for various definitions of normal weather, expressed as a percentage of normal margins.

Table 7-1: Simulated WARM Revenue Effects on Customer Bills Expressed as a Percentage of Normal Margins

	WARM Revenue Effects		
Normal Weather Definition	**Average across Years**	**Maximum Single Year**	**Minimum Single Year**
Correct	0.0%	12.7%	-18.4%
2.5% too cold	2.0%	14.8%	-16.3%
5% too cold	4.1%	16.8%	-14.3%
2.5% too warm	-2.0%	10.7%	-20.4%
5% too warm	-4.1%	8.7%	-22.5%

We examine the following definitions of normal weather, as shown in the first column of Table 7-1. "Correct" is the average number of heating degrees calculated from the 1977 through 2004 data. This does not correspond to the definition currently used in WARM. Rather, it is the correct *ex post* definition for the time period examined here. We then look at normal weather definitions that have 2.5 percent and 5 percent more and fewer heating degree days in each month. To provide some context for these values, note that in the 1977–2004 data, the most recent 5 years were 2 percent below the average HDDs for the 28-year period, and the most recent 10 years were 2.7 percent below average HDDs for the 28-year period.

If the correct normal weather definition is used, the average WARM revenue change across all 28 years is zero. However, effects in individual years range from a surcharge of 12.7 percent of normal margins to a refund surcharge of 18.4 percent of normal margins.

When the normal HDD definition is too cold, the average WARM bill changes are positive. This means that when normal HDDs are set too high, WARM is not a “fair bet” for customers as it leads to more surcharges than refunds. A normal HDD definition that is 2.5 percent too high will lead to approximately a 2 percent over-collection of margins over time. The opposite occurs when the normal HDD definition is set too warm, in which case WARM is not a fair bet for NW Natural, as it will consistently pay refunds to customers.

Table 7-1 only includes the financial effects associated with WARM. As described above, DMN will offset much of these effects provided that all customers participate in both programs and both programs use the same definition of normal weather. Because customers may opt out of WARM but must remain in DMN, the definition of normal weather will have a net financial effect that is not equal to zero. Rational customers will opt out of WARM if they believe that the definition of normal weather is too high (i.e., too cold), as WARM will generate more surcharges than refunds over time.

Because it includes only WARM revenue effects, Table 7-1 provides an upper bound estimate of the effects of using an incorrect definition of normal weather. That is, the values in the table represent the total financial effects if either DMN is eliminated or if all customers opt out of WARM (in which case the signs of the percentage effects should be reversed to represent the remaining effect of using an incorrect normal weather definition in DMN).

If DMN and WARM both remain in effect and WARM is made mandatory, the effects shown in the table would go to zero. Currently, about 8.5 percent of eligible customers have opted out of WARM. We can approximate the net revenue effects of using an incorrect normal HDD measure (combining WARM and DMN) by multiplying this percentage by the values in column 2 of Table 7-1. For example, the use of a normal weather definition that is 2.5 percent too cold would tend to produce surcharges equal to 2.0% * 8.5% = 0.17% of normal margins.

Provided that DMN and WARM both remain in effect, the financial implications associated with an incorrect normal weather definition may be fairly small. However, if customers opt out of WARM in large numbers based on a perception (which may or may not be correct) that the definition is too cold, the financial implications could be more substantial.

8. SERVICE QUALITY ISSUES

This section reviews three aspects of service quality related to WARM: customer complaint data, administrative problems that have occurred due to WARM and relevant customer survey data.

8.1 Customer Complaint Data

Customer complaints related to WARM were provided to us by NW Natural and confirmed by the Commission Staff. From 2003 through 2005, WARM generated 171 customer complaints. The complaints were summarized briefly in the database provided to us (as opposed to providing verbatim responses), with many complaints having more than one element (e.g., opt out and rate protest). The most common source of complaints was the opt-out provision. In the absence of additional details on these complaints, we assume that the complaints related to the fact that customers either were required to opt out of the program (as opposed to opting *into* the program) or complaining that they are not allowed to opt out of WARM during the heating season.

The second largest source of complaints was billing errors and rate protests. Many of the billing error complaints are likely to have arisen from a billing problem that occurred in 2004 that is described in the following section.

8.2 WARM Administrative Issues

Since its inception in 2003, WARM has encountered three administrative problems. In January 2004, a CIS programming error occurred. The normal temperatures used in the WARM calculation are in a single table in the CIS. The programming was supposed to have been set up so that at January 1 of each year, the program went back to the top of the table that holds the normal temperature data. The programmer failed to program that feature, so beginning with January 1, the calculation inserted zeros where it should have picked up data from the table. This affected over 250,000 bills.

In December 2004 another CIS programming error occurred. The customer's opt-in/out election is supposed to stay with the customer account even if they moved to a new premise. The program instead activated accounts at the new premise as opt-in, even if the customer was opted-out the program at the previous premise. This error only affected about 34 accounts before it was corrected.

In May 2005 an issue arose regarding Albany weather data. The problem was that the data input into the system was from a different weather station than was identified in the tariff. NW Natural has since discovered that they cannot get timely data for the station identified in the tariff and will have to adopt an alternative station and apply basis differentials to the data. However, the Albany customer bills were calculated correctly given the weather data that was available.

8.3 Customer Survey Data

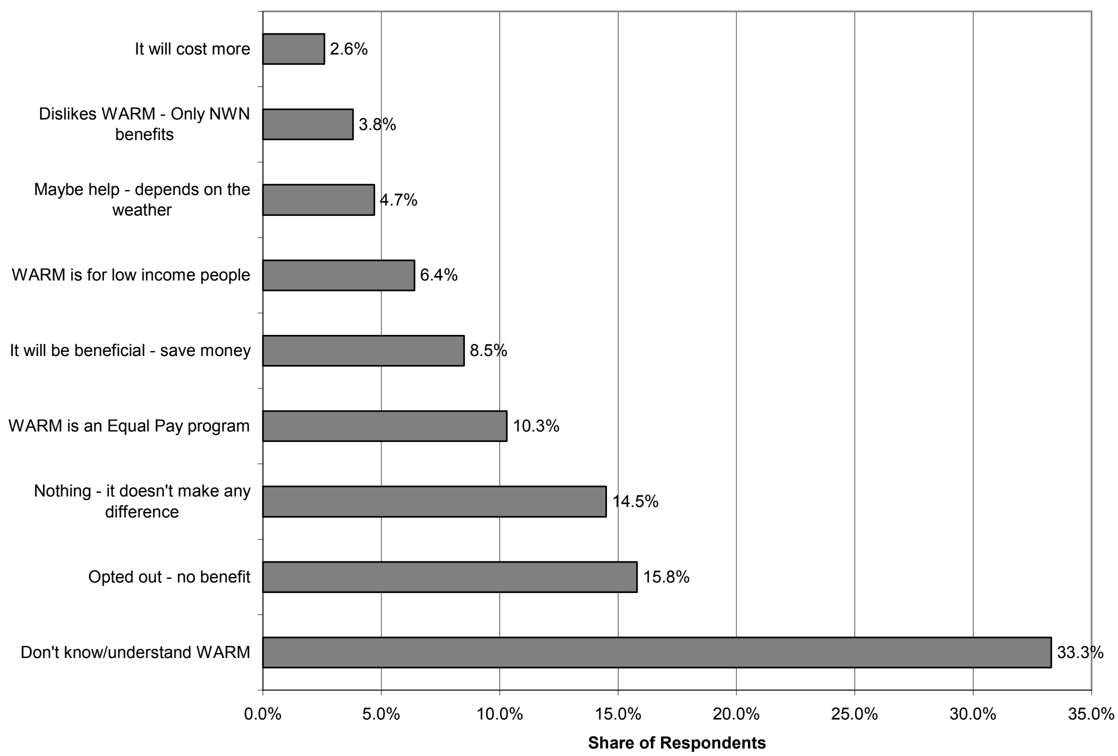
Two surveys have been conducted regarding customer attitudes towards WARM. Both surveys have two shortcomings. They were conducted shortly after WARM was introduced and the survey samples include a disproportionate share of opt-out customers. Nonetheless, they provide an indication of customer awareness and opinions of WARM.

The first customer satisfaction surveys were conducted in November and December 2003. Only 36.5 percent of the 642 customers surveyed indicated that they had heard of

WARM. The customers who indicated an awareness of WARM were then asked "What do you think the WARM program will mean to you?"

Responses to this question can be divided into nine categories, as shown in Figure 8-1 below. One third of the respondents admitted that they either did not understand WARM, or they that they had not researched it sufficiently. Another 27.8 percent fall into categories that reflect an inaccurate understanding of WARM (WARM is an Equal Pay program, WARM will save money, WARM is for low income people, or WARM will cost more).

Figure 8-1: Categorized Responses to:
"What do you think the WARM program will mean to you?



Verbatim responses from customers in the remaining categories further indicate that customers do not have an accurate understanding of WARM. Customer responses in the "Dislikes WARM, only NW Natural benefits category" included:

- "It's all a big lottery."
- "I'm not going to use my gas during the summer. So I don't like this program."
- "My bill will stay the same whether it's warm or cold and I don't like the idea!"

In the "Maybe help, depends on the weather category," responses included:

- "You're gambling when you go for WARM."
- "It means that when I have a higher bill in the summer months and lower rates in the winter."

A number of respondents (4.3 percent) said something along the lines of "I'd rather pay as I go." This could indicate that the customer is confusing the program with an Equal Pay program, or that they understand WARM, but do not value the weather hedge that it provides. A few respondents specifically mentioned an opposition to the opt-out provision. Overall, relatively few respondents expressed both an understanding and approval of WARM. This could partly be caused by the fact that the survey sample contains substantially more opt-out customers than the general population.

The second survey described here was conducted in October 2003 with a sample consisting of customers who had contacted NW Natural about WARM. NW Natural provided the following summary of the survey results, which are consistent with the findings from the survey described above.

1. Sixteen percent of all surveyed customers had a more negative opinion of NW Natural because of WARM. Of those customers who chose to opt out, 18 percent reported declining opinion levels. Conversely, 13 percent of those surveyed changed their opinion of NW Natural positively.
2. A common response to "why did you opt out?" was, "I want to pay for what I use." Customers want control of their bill and felt that WARM would affect how they handle their household budgets.
3. Another common reaction to WARM included negative perceptions of the opt-out provision. Customer responses ranged from feeling that the company was trying to pull something, to irritation that they were forced to do something to maintain status-quo, to simple puzzlement about why NW Natural would use this approach.
4. About two-of-five (39 percent) of all surveyed customers felt WARM <u>was not</u> clearly explained in the brochure.
5. While 61 percent of customers felt WARM <u>was</u> clearly explained in the brochure, verbatim comments indicate many wrong impressions. These erroneous impressions include:
    - A belief that bills would be higher in the summer. Too many customers didn't understand that WARM is limited to the heating season.
    - A common belief is that WARM and Equal Pay are equivalent programs or that if they opted to stay in WARM they could no longer continue on the Equal Pay program.
    - Too many customers remarked that they wouldn't be able to monitor their actual therm usage with WARM, even though monthly bills will report actual usage.
6. Sixty percent of surveyed customers were unaware of the OPUC approval and the support of customer advocacy groups.
7. Many opt-out customers don't understand WARM. When a re-worded version of WARM was presented to customers, close to one in four of those customers who opted out favored the concept.
8. Verbatims on Question 4b ("What information provided by your Customer Service Representative helped you decide to stay in the WARM program?") indicated that customers that spoke with a CSR obtained a better understanding of WARM and formed a more positive opinion of the company.

These surveys provide support for our contention that customers do not have a good understanding of the need for and mechanics of WARM. Given the complexity of the program in relation to the size of the potential benefits for customers, it may be reasonable for customers to not invest the time required to develop a full understanding of the program.

9. ASSESSMENT OF THE OPT-OUT PROVISION

Currently, customers are allowed to opt out of WARM prior to September 30th. For reasons described in Sections 2 and 7, program performance would be improved (from NW Natural's perspective) if customers were not allowed to opt out of WARM. Commission Staff would prefer a voluntary program, preferably *opt-in*, which would ensure that only customers who knowingly accept the terms of WARM participate in the program.

9.1 Automatic Opt Out versus Voluntary Opt Out

The use of customer-specific weather sensitivity parameters (β) may make a mandatory program more appealing to Staff and others who oppose the removal of the opt-out provision. That is, with customer-specific parameters, the program automatically opts out customers who are not weather sensitive by assigning them a β that is close to (or equal to) zero. As Figure 6-1 illustrated, the current form of WARM actually *introduces* weather risk for these customers, making it appropriate that they be excluded from the program effects.

There are several reasons that customers could choose to opt out of WARM, including the following:

1. The customer is not weather sensitive, so WARM adds weather risk to their bill;
2. The customer believes that normal HDDs are set too cold, so they do not believe that WARM is a fair bet;
3. The customer incorrectly believes that WARM is the equivalent of gambling on the weather, as opposed to providing a hedge against existing weather-induced risk;
4. The customer does not understand WARM and simply wants to "pay for what they use;" or
5. The customer does not want a hedge against weather-induced risk.

Automatic opt-out through customer-specific parameters would remove from WARM only those customers in the first category listed above. We examined customer data to determine the extent of the overlap between customers who actually opted out of WARM and customers who would be automatically opted out of a mandatory WARM program with customer-specific parameters. This indicates the extent to which customers opted out of WARM because of the first reason listed above.

We were able to match 418,506 residential customers to both a WARM status indicator and an estimate of weather sensitivity. Of these customers, 30,992 have actually opted out of WARM. The criteria that we used for automatic opt out is an R-squared less than 0.5 or a customer-specific β less than 0.025 (as compared to the class-wide tariff value of 0.1958).[15] Based on these criteria, 60,374 customers would be automatically opted out of WARM. However, only 3,245 customers (or about 10.5 percent) of the customers who actually opted out would be automatically opted out of WARM using these criteria.

For commercial customers, we were able to match 50,065 customers to both a WARM status indicator and an estimate of weather sensitivity. Of these, 1,742 have actually opted out of WARM. Using the same criteria as above, 16,827 would be automatically opted out of WARM. Only 447 customers (or about 25.7 percent) of the customers who actually opted out would be automatically opted out of WARM using these criteria.

9.2 Discussion of Mandatory Program Alternatives

The results in Section 9.1 and information taken from survey data indicate that most customers are opting out of WARM for reasons other than their own lack of weather sensitivity. While the rate of opt out has been relatively low (about 8.5 percent), the information available to us indicates that customers do not seem to recognize the potential benefits of WARM. (The low rate of opt out is likely due to a lack of awareness of the program.) Although the available survey information is somewhat limited, it indicates that customers do not understand the need for WARM (i.e., that fixed costs are recovered through volumetric rates), the mechanics of WARM, or the potential benefits that they can obtain from WARM (through risk reductions). In fact, many surveyed customers believed that WARM is a gamble on the weather as opposed to a hedge against existing weather risk.

There are at least two possible reasons for the apparent low level of customer knowledge with respect to WARM. First, the program is not well advertised, which is partly illustrated by the fact that WARM billing adjustments are rolled into a rate change instead of listed as a separate line item. Second, customers could be exercising what might be called "rational ignorance." That is, a full understanding of the need for and mechanics of WARM requires somewhat detailed knowledge of utility costs, how those costs are recovered through rates, and the mechanics of weather normalization. Given the relatively small size of the WARM bill impacts, it may simply not be worth a customer's time to develop an adequate understanding of WARM.

This situation makes it unlikely that a large percentage of customers would voluntarily opt into WARM in the absence of a significant financial incentive. Despite this, there are several reasons to support a mandatory WARM program.

1. A well-designed WARM program (i.e., using customer-specific weather adjustment parameters) reduces customer risk and does not affect the expected

[15] The R-squared value comes from the customer-specific regression of usage per day on HDDs per day and a constant term. It ranges from zero to one and indicates the extent to which usage variations can be explained by weather. We used the weather-sensitivity parameters calculated using the regression approach instead of the unit consumption approach because of the relative ease of calculating values for all customers, and not only customers in billing cycle 1.

bill (provided that normal HDDs are set correctly or DMN is in effect as well). Therefore, barring administrative errors it is difficult to argue that customers are harmed by this program.

2. Mandatory WARM participation removes the adverse revenue effects associated with an inaccurate definition of normal HDDs. If normal HDDs are set too cold, the opt-out provision allows customers to benefit at NW Natural's expense. (That is, by opting out of WARM customers could avoid the surcharges that WARM would produce on average, but continue to collect the refunds – through rate reductions – that DMN would produce on average.)
3. NW Natural may share the benefits of WARM with customers through a rate reduction in exchange for mandatory participation. This would be a feasible alternative if NW Natural derives more benefits from WARM than its customers.

Additional discussion of the third point is warranted. NW Natural experiences significant weather-induced variations in cash flow. WARM is effective in reducing this risk, which could have value for NW Natural by increasing its stock price or reducing the financial costs imposed by the risk (e.g., the ability to reduce the size of its lines of credit). WARM provides a reduction in weather-induced bill risk for customers as well. However, the relative magnitude of the risk reduction is smaller for customers than it is for NW Natural. A typical customer might see a WARM adjustment of $10 in a month, which will not have a large effect on the finances of most customers. However, when that adjustment is aggregated over all customers, the financial effect on NW Natural is large. Therefore, it might be appropriate for NW Natural to reduce customer rates in exchange for mandatory WARM participation. This might provide benefits to NW Natural through improved customer satisfaction.

In summary, the conversion of WARM to a mandatory program can be justified solely by the fact that the current opt-out provision gives customers the ability to reduce NW Natural margin recovery (on average) if normal HDDs are set too cold. A mandatory program can be further justified by the fact that a well-designed program provides a risk reduction for both NW Natural and its customers. The fact that the vast majority of natural gas weather normalization programs in the United States do not allow customers to opt out can be interpreted as a validation of our theory that the program's benefits are not easily recognized by customers. Finally, if NW Natural or the Commission Staff are concerned about customer satisfaction with respect to WARM, it might be appropriate for NW Natural to share some of the benefits it derives from WARM through a rate reduction.

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

From NW Natural's perspective, WARM provides an effective means of reducing the variability of fixed cost recovery due to weather. In mild winter months, WARM provides upward adjustments of NW Natural revenue to cover the shortfall in fixed cost recovery from volumetric rates. Conversely, in unusually cold winter months, WARM provides customers with refunds, preventing NW Natural from over-recovering its fixed costs. However, the performance of WARM for NW Natural could be improved by expanding the WARM coverage period by 1 to 2 months (i.e., 15 to 30 days on each end point).

From a customer perspective, WARM has been more of a mixed bag. In theory, customers should be made better off by WARM because of the reduction in risk. That is, customers are exposed to the opposite weather risk of NW Natural, so a mechanism that reduces NW Natural's risk will also reduce the risk for the participating customer classes. However, the use of a class-wide weather sensitivity parameter distributes the overall customer benefit unequally across customers. We demonstrated how small non-weather sensitive customers can actually experience an increase in weather-induced risk under WARM. Conversely, customers whose consumption is larger than the class average are under-insured by WARM. While this problem exists in the current form of WARM, it can be remedied by modifying WARM to use customer-specific weather sensitivity parameters (for which there is precedent in programs at other utilities) as described in Section 5.1.2.

Despite the relatively low rate of opt out (about 8.5 percent), survey data indicate that customers do not seem to recognize the potential benefits of WARM. Survey data indicate that customers do not understand the need for WARM, the mechanics of WARM, or the potential benefits that they can obtain from WARM. In fact, many surveyed customers believed that WARM is a gamble on the weather as opposed to a hedge against existing weather risk.

There are at least two possible reasons for the apparent low level of customer knowledge with respect to WARM. First, the program is not well advertised, which is partly illustrated by the fact that WARM billing adjustments are rolled into a rate change instead of listed as a separate line item. Second, given the relatively small size of the WARM bill impacts, it may simply not be worth a customer's time to develop an adequate understanding of WARM.

While it is unlikely that a large percentage of customers would voluntarily opt into WARM, making WARM mandatory can be justified by the fact that because customers must participate in Distribution Margin Normalization (DMN), a high level of participation in WARM has the benefit of reducing or eliminating adverse financial effects that may arise from a using an incorrect definition of normal weather. In fact, if the normal weather definition is set too cold, customers have the incentive to opt out of WARM, which will, on average, reduce NW Natural's margin recovery below allowed levels.

In addition to creating customer confusion, the complexity of WARM contributed to several administrative errors (though only one of them was significant in scope). That is, WARM and DMN require the setting of a normal weather definition, and that actual weather is tracked for a variety of stations and mapped into customer bills for the appropriate billing days. An alternative to the combination of DMN and WARM called

Revenue per Customer Decoupling (RPCD) produces aggregate financial effects (across customers and months of the year) that are very similar to DMN plus WARM. However, RPCD eliminates most of the complexity inherent in DMN and WARM, and therefore reduces the potential for billing problems. That is, RPCD only requires the setting of baseline usage per customer values, and changes in margins are then based on deviations from the baseline usage, regardless of the source of the deviations.

In theory, RPCD should be less appealing to customers than DMN and WARM because RPCD does not affect current bills, while WARM does. Therefore, WARM should reduce the variance of *monthly* bills, while RPCD just reduces the variance of bills across years. However, survey data do not indicate that customers have a widespread awareness and/or appreciation of this potential benefit of WARM.

10.2 Recommendations

A well-designed weather normalization program can reduce risk for both the customer and the utility. Because of this opportunity for both parties to be made better off, we recommend that WARM continue in some form. However, we believe that the program can be improved.

The manner in which the program is improved depends upon how one values various aspects of the alternatives. If simplicity is valued, Alternative 1 below (replace DMN and WARM with RPCD) is preferred. If a desire to reduce customers' weather-induced bill risk is preferred, Alternative 2 below (modify WARM to use customer-specific weather adjustments) is preferred. In the text below, we provide a more detailed assessment of the advantages and disadvantages of each alternative.

We preface the description of the alternatives by noting that the weather-driven fixed cost recovery risk would disappear if NW Natural's base tariff recovered all fixed costs through the fixed monthly charge (or customer charge) and all variable costs through the volumetric energy rate. If the perceived adverse distributional impacts of this rate structure can be reduced by indexing the customer charge to a measure of customer size, such as maximum daily usage in previous billing months, it could be made more palatable to customers and the Commission. This rate structure would simplify rates, improve revenue and bill stability, and satisfy customers who indicated in surveys a desire to "just pay for what they use." In the absence of the willingness or ability to adopt this base tariff rate structure, the following alternatives are appropriate for reducing the weather risk inherent in the current base tariffs.

10.2.1 Alternative 1: Replace DMN and WARM with Full Decoupling

The first alternative is to replace DMN and WARM with full decoupling (RPCD, as described in Section 6.3.2) and require customers to participate in the program. This would produce very similar annual financial effects for NW Natural as WARM and DMN, but produce somewhat different effects for individual customers. First, RPCD would not affect bills in the current month (as WARM does), with adjustments instead contributing to a deferral account that is recovered or refunded through rates in the following year. RPCD's deferral mechanism can have some distributional effects as well. For example, suppose that a heating season is unusually cold, creating a refund in the deferral account. If a customer doubled the size of their home following the heating season, it would receive a larger share of the refund than it is entitled to. That is, the refund acts to reduce rates in the following year. The customer may have been overcharged for fixed costs based on usage of 100 therms, but receive a refund as though they had consumed 200 therms. WARM reduces the magnitude of this potential problem (which, admittedly, may not be of much significance, particularly if relative customer usage is stable across years). That is, WARM removes the weather portion of the redistribution by applying its effects to current bills. DMN deferrals remain subject to this potential redistribution of surcharges and refunds.

The principal advantage of RPCD is its simplicity, which has the potential to produce several benefits:

- Reduce customer service costs because RPCD takes less time to explain to customers than DMN and WARM;
- Reduce billing errors because fewer parameters and less data are required; and
- Improve customer satisfaction because rates are affected only once a year and customers are more likely to be able to understand the mechanism.

Mandatory participation on the part of customers will ensure that NW Natural reduces its fixed cost recovery risk, essentially locking in the amount of fixed cost recovery per customer. However, the timing of the refunds and surcharges could adversely affect customers. For example, consider an example in which a mild winter is followed by an unusually cold winter. In the mild winter, a surcharge accumulates in the deferral account, which acts to increase rates in the following year. In this case, the increase in bills due to cold weather in following year is already burdensome on customers. The rate increase from the previous year's deferral account acts to further increase customer bills at a time when they can least afford it.[16]

Because of the potential for outcomes such as this, it is reasonable to expect NW Natural to share some of the benefits that it receives from RPCD with its customers. Specifically, in exchange for mandatory participation in RPCD, customers should pay somewhat lower rates. The amount of the discount should be determined by the cost savings (e.g., associated with reduced lines of credit) or other benefits (e.g., increased share price due to less variable cash flow) derived from RPCD.

10.2.2 Alternative 2: Customer-Specific β, Mandatory Participation in WARM

In this alternative, WARM is retained with three modifications: bill adjustments are calculated using customer-specific weather-sensitivity parameters (using the method described in Section 5.1.2), the WARM coverage period is extended beyond November 15th through May 15th, and customer participation is mandatory. While customers are not allowed to opt out of the program, the use of the customer-specific values of β has the

[16] Please see footnote 13.

effect of automatically opting out customers who do not have weather sensitive usage. This alternative has the following benefits relative to Alternative 1:

- Reduces weather risk for customers, as well as NW Natural, by affecting current bills; and
- Eliminates the weather portion of the potential redistribution of surcharges and refunds.

An advantage that this alternative has relative to RPCD is that each customer receives the appropriate amount of risk reduction from WARM. (Even customers who do not value this risk reduction should, on average, be made no worse off relative to the standard rate.) To the extent that NW Natural values the risk reduction more than customers do, it may be appropriate for NW Natural to share its benefits with customers through a rate reduction (in exchange for mandatory participation). However, the rate reduction should be smaller than what would occur under Alternative 1 because of the additional value that WARM offers customers.

The disadvantages of this alternative relative to Alternative 1 are associated with the greater complexity of WARM and DMN relative to RPCD. Specifically, relative to RPCD, this version of WARM combined with DMN:

- May have higher customer service costs because of the need to explain the more complicated mechanism;
- May have a higher incidence of billing errors; and
- May lead to lower customer satisfaction because customers do not understand how their bills are affected by the mechanism.

Note that all of these disadvantages relative to RPCD are shared by the current version of WARM.

10.2.3 Additional Discussion of the Opt-Out Provision

We understand that there is contention over the opt-out provision, with NW Natural favoring a mandatory program and the Commission Staff favoring an optional program (opt out or opt in). As indicated in Alternatives 1 and 2 above, we support a mandatory program with automatic opt out for non-weather sensitive customers and a rate reduction for participating customer classes.

We list two primary reasons to support our position. The first is related to the fact that customers are required to participate in DMN but may opt out of WARM. If customers believe that the definition of normal weather (which is shared by DMN and WARM) is too cold, they will opt out of WARM if they understand the financial implications. By doing this, they avoid the surcharges that they believe WARM would create for them on average over time. It is important to note that customers do not need to be *correct* about the definition of normal weather. The limited survey data that is available indicates that at least some customers have opted out of WARM due to their belief in global warming. If this behavior were to become more widespread, two effects would occur. First, the effectiveness of WARM in reducing NW Natural's weather risk would decline as fewer customers participate. Second, the imbalance between DMN and WARM participation (i.e., everyone must participate in DMN, but only some customers participate in WARM) would create imbalances in revenue flows due to errors in the normal definition of HDDs. If customers are correct and normal HDDs are too high (i.e., too cold), then DMN would consistently produce refunds for all customers, but only recover the balancing surcharges on the remaining WARM participants. Conversely, if normal HDDs are too low (contrary to customer expectations), DMN would consistently produce surcharges for all customers that would not be fully refunded to customers through WARM.

To summarize, customers are likely to share a belief that average HDDs over a 25-year period ending in 2000 are not representative of future HDDs because of a shared perception that global warming has increased temperatures over time. Whether they are correct about this or not, if they opt out of WARM based on this belief, any actual errors in defining normal weather that result (which are inevitable because the "true" definition of normal weather going forward is unknowable *ex ante*) will no longer be fully offset between DMN and WARM.

The second reason for our support of a mandatory program (with automatic opt out) relates to customers' incentives to be fully informed about the WARM program and its effects. As described above, a full understanding of the need for WARM, its calculations, and its risk effects requires somewhat detailed knowledge in a number of areas. Most customers lack the incentive to spend the time required to develop this understanding, and we do not expect that a large percentage of customers would voluntarily sign up for a program that they do not fully understand.

However, Commission Staff and NW Natural are better positioned to recognize the opportunity for both the utility and its customers to reduce their exposure to weather risk. That is, we know that the two parties face the opposite weather risk: when NW Natural over-recovers fixed costs (a good outcome for them), it is because its customers are over-paying (a bad outcome for them). Because of this, the weather risk can be "swapped" by the parties, reducing the risk for both. To the extent that the utility values the risk reduction more than its customers (either because the benefits are larger, or because it is more risk averse), a discount could be offered in exchange for mandatory participation.

The current program implicitly recognizes the difficulty that customers have in understanding WARM by reducing the visibility of the program by, among other things, embedding WARM bill changes in the monthly rate (even though the total dollar amount of the WARM bill change is independent of current customer usage) and not listing WARM as a separate line item on the bill. The rationalization for this is that increased customer awareness of the program would produce an increased volume of customer service calls, each of which would be relatively time consuming (and therefore costly) due to the complexity of the program.

The mandatory WARM program that we recommend (i.e., Alternative 2) would likely be less objectionable to customers than the current WARM program for several reasons.

First, an opt-out program leaves customers with the feeling that they have been "slammed" by the utility onto a product that benefits the utility but not the customer. Alternatively, a mandatory program with Commission support sends the message that the program is in the best interest of the customers. Second, customers should experience less weather-induced bill risk relative to the current program because of the use of customer-specific weather adjustments. This automatically excludes customers from WARM if the program is not appropriate for them, and improves the amount of risk insurance provided to individual customers (relative to the current program's "once size fits all" approach). Third, customers may receive a rate reduction in exchange for a reduction in NW Natural's risk. Customers are more likely to be satisfied with a program if they are given a larger share of its benefits.

While we recommend a mandatory program, we would note that a voluntary WARM program (whether opt in or opt out) is better than no program at all. NW Natural could offer some rate discount as an incentive to participate, although this discount would likely be smaller than a mandatory program discount given that a mandatory program is less costly to administer (i.e., there would be no need to track program participation or market to customers to increase awareness and encourage participation).[17]

However, for reasons described above, we would recommend that if WARM remains optional, further investigation be made with regard to the definition of normal weather. This would include both a technical component (i.e., developing an expectation of future weather based on data and forecasting models) and a customer attitude component. That is, if there is a widespread belief among customers that global warming is increasing temperatures over time, it would be advisable to match the definition of normal HDDs used in WARM and DMN to this expectation. This would help to increase participation in the program because customers should rationally opt out of WARM if they believe that it will tend to produce a surcharge (which occurs if normal HDDs are set too cold). As program participation increases, the importance of the accuracy of the normal weather definition diminishes because of the offsetting effects of DMN and WARM.

[17] In addition, a mandatory program might provide higher benefits per participating customer. For example, cost reductions due to changes in corporate risk management methods may not be realized with low WARM participation rates, but they might be obtained with high participation rates.