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STATE OF MINNESOTA

BEFORE THE PUBLIC UTILITIES COMMISSION

In the Matter of the Application of Northern States Power Company for Authority to Increase Rates for Electric Service in Minnesota

Docket No. E002/GR-13-868
OAH Docket No. 68-2500-31182

DIRECT TESTIMONY OF

PAUL CHERNICK

ON BEHALF OF

SIERRA CLUB,

MINNESOTA CENTER FOR ENVIRONMENTAL ADVOCACY,

FRESH ENERGY,

NATURAL RESOURCES DEFENSE COUNCIL, AND

IZAAK WALTON LEAGUE MIDWEST OFFICE

("CLEAN ENERGY INTERVENORS")

Resource Insight, Inc.

JUNE 5, 2014

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I. IDENTIFICATION AND QUALIFICATIONS

Q: Mr. Chernick, please state your name, occupation and business address.

A: I am Paul L. Chernick. I am the president of Resource Insight, Inc., 5 Water Street, Arlington, Massachusetts.

Q: Summarize your professional education and experience.

A: I received an SB degree from the Massachusetts Institute of Technology in June 1974 from the Civil Engineering Department, and an SM degree from the Massachusetts Institute of Technology in February 1978 in technology and policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a utility analyst for the Massachusetts Attorney General for more than three years, and was involved in numerous aspects of utility rate design, costing, load forecasting, and the evaluation of power supply options. Since 1981, I have been a consultant in utility regulation and planning, first as a research associate at Analysis and Inference, after 1986 as president of PLC, Inc., and in my current position at Resource Insight. In these capacities, I have advised a variety of clients on utility matters.

My work has considered, among other things, the cost-effectiveness of prospective new generation plants and transmission lines, retrospective review of generation-planning decisions, ratemaking for plant under construction, ratemaking for excess and/or uneconomical plant entering service, conservation program design, cost recovery for utility efficiency programs, the valuation of environmental externalities from energy production and use, allocation of costs of service between rate classes and jurisdictions, design of retail and wholesale rates, and performance-based ratemaking and cost recovery in restructured gas and electric industries. My professional qualifications are further described in Exhibit____PLC-1.

Q: Have you testified previously in utility proceedings?

A: Yes. I have testified more than two hundred and eighty times on utility issues before various regulatory, legislative, and judicial bodies, including utility regulators in thirty-three states, six Canadian provinces, and two U.S. Federal agencies.

Q: Have you testified previously before the Commission?

A: Yes. I testified in Docket No. ER-015/GR-87-223, a Minnesota Power Rate Case, on behalf of the Department of Public Service, on excess capacity and MP's planning for Boswell 4. I also prepared the report "Conservation Potential in the State of Minnesota," (with Ian Goodman) for the Department of Public Service, June 1988. I assisted the Izaak Walton League in drafting comments on NSP's Generic RFP in 1993, and for Docket No. E002/M-02-633, on the Xcel Metro Emissions Reduction Project.

II. INTRODUCTION

Q: On whose behalf are you testifying in this rate case proceeding?

A: My testimony is sponsored by the Sierra Club, Minnesota Center for Environmental Advocacy, Fresh Energy, the Natural Resources Defense Council, and the Izaak Walton League of America – Midwest Office.

Q: What issues does your testimony address?

A: My clients asked that I design an inclining-block rate ("IBR") for the residential class of Northern States Power Company, Minnesota (NSPM, also referred to as Xcel Energy, after the name of its holding company). In response to that request, I explain the reason for using an IBR, develop a design for the IBR to support current revenue levels, and suggest approaches for revising the base IBR to reflect any revenue increase granted as a result of this proceeding. I also address concerns that may be raised about an IBR, and explain why the customer charge should not be increased as Xcel has proposed.

III. THE RATIONALE FOR AN INCLINING-BLOCK RATE

Q: Please explain what you mean by an inclining-block rate.

A: An inclining-block rate, or IBR, for electricity consists of two or more energy prices, with a lower price charged for the first kWh block in each month, and a higher price charged in each subsequent kWh block. If a customer uses less than the cutoff for the first kWh block in a month, it is charged only the first-block rate; if the customer uses more than the first-block cutoff it is charged the first-block rate for the first-block kWh, and the second-block rate for any additional kWh.

In addition, an IBR may include a fixed monthly customer charge.[1]

Q: What are the driving forces behind the adoption of IBRs?

A: The basic motivation of an IBR is to encourage and reward conservation, by offering lower prices for smaller-use customers and higher marginal prices for the larger-use consumers who have more opportunities for conservation

[1] Additional complexity can be introduced by time-of-use charges, demand charges and other features that are not normally used for residential and small commercial customers.

and energy efficiency.[2] An IBR reinforces existing incentives for customer conservation, and decreases the payback period for energy efficiency and distributed generation investment by customer

An important conclusion of micro-economics is that overall benefits of a market are maximized when the marginal price paid by consumers for incremental usage equals the social cost of that usage. An IBR allows for marginal rates that approximate long-term marginal costs, including environmental externalities, without charging the residential class more than its allocated revenue requirement.

Q: How does an IBR increase conservation incentives?

A: The customers whose consumption includes at least some usage in an energy block with a price higher than the average flat rate will have a higher incentive to conserve, and that incentive applies to all the customer's consumption, not just the kilowatt-hours in the high-priced blocks. The smaller-use customers see lower marginal rates, and have lower incentive to conserve, but that lower incentive only applies to their low usage. In addition, these smaller-use customers may already be relatively efficient in their use of electricity.

This reality is best explained through an example. Table 1 shows two rate designs that generate the same total revenue. The flat rate charges 8¢/kWh for all energy, while the IBR charges 5¢/kWh for the first 700 kWh per month and 12¢/kWh for additional kWh. The average bill is 700 kWh/month. Of the 200,000 customers, 150,000 use less than 700

[2] In approving the Minnesota Power five-block IBR, the Commission noted that "there are more potential opportunities for aiding a household with high usage than one with low usage." (Minnesota PUC Docket No. E-015/GR-09-1151, Order of November 2, 2010, page 66)

kWh/month, with an average of 300 kWh, and the remaining 50,000 use an average of 1,900 kWh/month.

Table 1: Simple IBR Example

	Usage	Block	Price	Customers	Average Use kWh/month	Total Use GWh/year
Flat Rate						
	Total		$0.08	200,000	700	1,680
Inclining Block Rate						
	700	1st	$0.05	150,000	300	540
	>700	1st	$0.05	50,000	700	420
		2nd	$0.12	50,000	1,200	720
		sum			1,900	1,140
	Total			200,000	700	1,680

With the inclining-block rate, the larger-use customers pay 12¢/kWh for their usage over 700 kWh; any reduction in energy use by one of those large-use customers will save the customer 12¢/kWh.[3] Hence the conservation incentive for the IBR is 12¢/kWh for 1,140 GWh and 5¢/kWh for 540 GWh, averaging out at 9.8¢/kWh, 22% higher than the 8¢/kWh incentive from the flat rate. The customers as a whole still pay an average of 8¢/kWh, but their average saving from reducing usage is 9.8¢/kWh.[4]

The IBR allows for higher conservation incentives, without increasing revenues, and, at the same time, decreases rates for a majority of customers.

[3] The saving would fall to 5¢/kWh if the large customer reduces usage below 700 kWh, but that would require a reduction of more than half for the average large customer.

[4] In addition, the large customers probably have more options for reducing usage than the small customers, and can respond more effectively to the price signals.

Q: How does an IBR relate to traditional rate-design objectives?

A: Inclining blocks are consistent with traditional objectives for rate design, as expressed by Bonbright (1988, 383–384):[5]

> *Revenue-related Attributes:*
>
> 1. Effectiveness in yielding total revenue requirements under the fair-return standard without any socially undesirable expansion of the rate base or socially undesirable level of product quality and safety.
>
> 2. Revenue stability and predictability, with a minimum of unexpected changes seriously adverse to utility companies.
>
> 3. Stability and predictability of the rates themselves, with a minimum of unexpected changes seriously adverse to ratepayers and with a sense of historical continuity.
>
> *Cost-related Attributes:*
>
> 4. Static efficiency of the rate classes and rate blocks in discouraging wasteful use of service while promoting all justified types and amounts of use:
>
> (a) in the control of the total amounts of service supplied by the company;
>
> (b) in the control of the relative uses of alternative types of service by ratepayers (on-peak versus off-peak service or higher quality versus lower quality service).
>
> 5. Reflection of all of the present and future private and social costs and benefits occasioned by a service's provision (i.e., all internalities and externalities).

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5 James C. Bonbright, Albert L. Danielsen and David R. Kamerschen, Principles of Public Utility Rates (2nd Ed.; Public Utilities Report, Inc.: Arlington, Virginia, 1988), pages 383 to 384. While Bonbright is a common reference work in the ratemaking community, it has some important limitations. For example, the list of “the desirable characteristics of utility performance” reproduced above appears to refer to both allocation of costs between rates and design of rates within classes, without clearly indicating which attributes Bonbright would apply to which ratemaking step. Bonbright’s rate-design and cost-allocation examples (pp. 396–405) primarily describe the evolution of rate design in the conditions from the late 19th century into the 1960s, rather than conditions of the last four decades.

6. Fairness of the specific rates in the apportionment of total costs of service among the different ratepayers so as to avoid arbitrariness and capriciousness and to attain equity in three dimensions:

(1) horizontal (i.e., equals treated equally);

(2) vertical (i.e., unequals treated unequally); and (3) anonymous (i.e., no ratepayer's demands can be diverted away uneconomically from an incumbent by a potential entrant).

7. Avoidance of undue discrimination in rate relationships so as to be, if possible, compensatory (i.e., subsidy free with no intercustomer burdens).

8. Dynamic efficiency in promoting innovation and responding economically to changing demand and supply patterns.

Practical-related Attributes:

9. The related, practical attributes of simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application.

10. Freedom from controversies as to proper interpretation.

Both flat and inclining-block rates easily meet some of Bonbright's objectives, including his attributes 1, 4(b), 6, 9 and 10.[6] Attribute 2 (revenue stability) will be met by Xcel's proposed revenue decoupling, and Attribute 3 requires only a reasonable phase-in and education program.

An IBR is able to satisfy attributes 4(a), 5 and 8 better than a flat rate. In particular, an IBR allows the price signal to customers to approach full long-term marginal cost, without increasing the total revenue burden on customers.

[6] Attribute 7 is difficult to interpret, since it basically says that rates should be fair, without defining fairness.

Q: Are there other reasons for the Commission to adopt an IBR rate structure in this rate case?

A: Yes, Minnesota's utility law requires that "[t]o the maximum reasonable extent, the commission shall set rates to encourage energy conservation…" Minn. Stat. § 216B.03. The inclining-block rate structure will encourage significantly more conservation than Xcel's proposed flat rate structure. Indeed, Xcel's proposed increase in the fixed customer charge would tend to discourage conservation, by absorbing some of the class revenue requirement and thus reducing the variable energy charge.

Q: Are IBRs used by other electric utilities?

A: Yes. As this Commission is aware, Minnesota Power's residential rates have included inclining energy blocks for many years, including a five-block structure since 2010. In addition, I have identified 55 other utilities in 29 US and Canadian jurisdictions that have residential inclining-block rates, listed in Table 2.

Table 2: Utilities with Inclining-Block Rates

State	**Utilities with IBRs**
Alabama	Alabama Power
Arizona	Arizona Public Service, Tucson Electric Power
Arkansas	Entergy, Southwest Electric Power
California	PG&E, SCE, SDG&E, LA DWP, SMUD, PacifiCorp, Liberty Utilities
Colorado	Xcel/Public Service of Colorado, Fort Collins Utilities, Longmont Power & Communications
District of Columbia	PEPCo
Georgia	Georgia Power
Florida	Progress Energy, Florida P&L, Tampa Electric
Hawaii	Hawaiian Electric
Idaho	PacifiCorp, Idaho Power
Kansas	Westar

Massachusetts	National Grid
Michigan	Consumers Energy, DTE, Indiana-Michigan Power
Minnesota	Minnesota Power
New Jersey	Jersey Central P&L, PSEG
New Mexico	Public Service of New Mexico
New York	Long Island Power Authority, Con Edison
Oklahoma	OG&E, PS Oklahoma
Oregon	PacifiCorp, Portland GE
South Carolina	South Carolina Electric and Gas, Duke
Tennessee	Memphis LG&W
Texas	Austin Energy
Utah	PacifiCorp
Virginia	Dominion
Washington	PacifiCorp, Avista, Puget Sound Energy, Seattle City Light
Wyoming	PacifiCorp
Alberta	City of Medicine Hat
British Columbia	BC Hydro, Fortis BC,
Ontario	HydroOne, Toronto Hydro, Hydro Ottawa
Quebec	Hydro Quebec

This list is not exhaustive, since identifying all such rate designs would be very time consuming.

I attach as Exhibit____PLC-2 a summary of 39 IBRs, as filed by BC Hydro in November 2013.

Q: What considerations should guide the setting of the block rates?

A: The objective of an IBR is to encourage conservation, so the central objective is to increase the energy-weighted conservation incentive. Ideally, the average incentive to conserve would be close to the marginal cost of providing additional energy over the long term (including marginal fuel, O&M, capital investment, purchased power, reserve margin, emission compliance costs, load-related transmission and distribution costs, line losses, externalities, and supply-side risks). In order to provide that incentive on average, the tail-block rate must be above marginal cost.

Q: What are Xcel's estimates of the long-run marginal costs of serving residential load?

A: Xcel does not seem to have a comprehensive estimate. The response to MCEA IR 12 indicates that Xcel:[7]

- Estimates system average incremental energy costs (in $/kWh) for only five years;
- Reports the Commission's decision on the range of values for "the range of likely costs of CO_2 regulation" (*see* MCEA IR 12, Attachment E) but does not convert those values to $/MWh, let alone add them to the incremental energy costs;
- Ignores the capitalized energy costs of future gas combined-cycle plants;
- Includes transmission costs related to adding new power plants, but excludes marginal load-related transmission costs (*see* MCEA IR 12(c));
- Does not estimate marginal distribution costs in any form (*see* MCEA IR 12(d)).

The response to MCEA IR 12(e) indicates that Xcel computes some sort of line losses (probably average rather than marginal), but that those losses are only used in load forecasting:

[7] The responses to all information requests ("IRs") cited are included in Exhibit____PLC-7.

> Historical line losses are calculated annually and used as a representative for future line loss estimates. The energy and demand forecasts used by Resource Planning account for line losses, thus no further modeling of lines losses is applied.

Even when asked specifically in MCEA Information Request No. 24 for "the pricing terms of Xcel's current and pending long-term purchases from Manitoba Hydro," Xcel provided only "pricing terms applicable during the 2014 test year," rather than the long-term prices of the current and pending purchases.

In summary, Xcel offers (and apparently has) very little information regarding its direct marginal costs of meeting higher load.

Q: Does Xcel provide any information on the externality costs of additional generation?

A: In response to MCEA IR 12, Xcel provides only the $/ton emission values approved by the Commission, without converting those values to $/MWh values for incremental generation.

Q: What is the result of Xcel's failure to develop reasonable estimates of marginal costs?

A: The result is that the Commission does not have specific targets for average effective conservation incentives or tail-block rates. I have thus proposed a rather modest IBR, with an average conservation incentive under 11¢/kWh and tail-block rates under 15¢/kWh in the summer and 11¢/kWh in the winter. The full marginal costs may be higher than 11¢/kWh or even 15¢/kWh; once Xcel or other parties develop reasonable estimates of marginal costs, the Commission can consider whether the inclining blocks should be revised.[8]

Q: Is an IBR redundant with utility-sponsored energy-efficiency programs?

A: No. Energy-efficiency programs primarily focus on facilitating investments in more efficient buildings and equipment, while an IBR affects both customer usage and investment decisions. An IBR, along with a supporting communication strategy, will encourage customers to use the smart thermostats and power strips installed through the energy-efficiency program, turn off the lights and media when leaving a room, shorten showers, open and close curtains at appropriate times, and otherwise reduce the use of whatever equipment the customer has installed. The IBR should also reduce the payback period for efficiency investments, increasing participation and reducing required incentives for energy-efficiency programs.

A. Effect Of Marginal Rates On Energy Use.

Q: Is it widely accepted that residential customers respond to price signals?

A: Yes. Any suggestion that customers do not respond to rate design would be counter-intuitive, inconsistent with experience, and contrary to a century of rate design

Many econometric studies have estimated the response of residential electricity consumers to price. That response is usually expressed as the price elasticity, the percentage change in load resulting from a 1% increase in price. In other words, if the price of electricity goes up by 5% and

[8] Reasonable marginal costs are also essential for the evaluation of energy-efficiency programs, which should be major contributors to Xcel's compliance with the pending EPA greenhouse gas rules, as well as reducing consumer bills.

consumers, as a result, use 1% less electricity, the elasticity is said to be 0.01 ÷ 0.05 = –0.2.

The following surveys compiled estimates of residential electric price elasticities, both in the short run (e.g., over one year) and long run (e.g., over decades):

- A review by Espey and Espey (2004) of 36 articles on residential electricity demand published between 1971 and 2000 reports short-run price elasticity estimates range from -0.004 to -2.01 (with a central tendency of -0.35) and long-run price elasticities range from -0.04 to -2.25 (with a central tendency of -0.85).[9]
- EPRI (2008) reviewed nine studies from 1980 to 2002, and reported short-run elasticities of –0.2 to –0.6 and long-run elasticities of –0.7 to –1.4.[10]
- Alberini et al (2011) reviewed 16 studies, published between 1999 and 2010, with short run price elasticities ranging from -0.08 to -1.1.[11]

In response to MCEA IR 23, Xcel provided its estimate of the elasticity of residential load as a function of average price, which it uses in the "Residential without Space Heating sales model." The elasticity figure used by Xcel was marked confidential and is **[TRADE SECRET BEGINS…**

9 Espey, J. A, and M. Espey. 2004. Turning on the Lights: A Meta-Analysis of Residential Electricity Demand Elasticities. *Journal of Agricultural and Applied Economics* 36 (1), 65-81.

10 EPRI. 2008. "Price Elasticity of Demand for Electricity: A Primer and Synthesis," Palo Alto, California, January 2008.

11 Alberini, A., W. Gans, D. Velez-Lopez. 2011. Residential consumption of gas and electricity in the U.S.: The role of prices and income. *Energy Economics* 33, 870-881.

…TRADE SECRET ENDS]. Xcel does not specify the period over which it believes this price effect is reflected in residential consumption, but since price is computed as a "12 month moving average," it is probably an estimate of short-run elasticity.

Q: Would you expect marginal or tailblock energy rates to affect customer usage decisions?

A: Yes. If customers only paid attention to their total bill or average rate, they would not alter their consumption regardless of whether Xcel's rate design were changed to $1/month plus 15¢/kWh or $100/month plus 1¢/kWh. That outcome is implausible.

In response to IR 601.1 from the Office of the Attorney General, Xcel provided the results of a survey of CenterPoint Minnesota residential gas customers (*see* OAG IR 601.1, Attachment D). The results indicate that 21% of gas customers report pay "very close attention" to the parts of their bills, and 25% pay "fairly close attention," versus 46% and 29% for total bills. Hence, the number of consumers paying attention to parts of the bill is about two-thirds of the number paying attention to total bill. This certainly supports the idea that Minnesota customers would be interested in and respond to the component parts of an IBR, especially with utility efforts to explain role of the block rates.

Q: Have any other utilities estimated the effect of residential IBR on usage?

A: Yes. Without having conducted a comprehensive literature review, I am aware of two such studies, from Xcel's Colorado affiliate (Public Service of Colorado or Xcel PSCo) and British Columbia Hydro.

Xcel has done an analysis of its IBR program in Colorado. (*See* "Impact Analysis of Residential Two Tier, Inverted Block Rates." 11/05/2012, MCEA IR 6 Attachment 1.) Xcel's report describes Xcel PSCo's two-block summer inclining-block rate, first implemented in 2010, which has rates of 4.6¢/kWh for the first 500 kWh in a billing period, and a rate of 9¢/kWh all additional use. Xcel PSCo estimated that the IBR resulted in summer savings of about 1.9% in 2010 and 4.4% in 2011 and 4% in 2012.[12]

Xcel PSCo estimated that summer energy use would decrease by 0.26% for each 1% increase in the marginal price attributable to tiered rates (an elasticity of –0.26). Based on that elasticity estimate, Xcel PSCo expected to observe a 3.65% reduction in consumption; the first-year response was about half that estimate and the second and third years were somewhat higher than the forecast, suggesting a marginal elasticity of about -0.3.

As described in Exhibit____PLC-3, BC Hydro implemented a two-block residential IBR in October 2008 (the beginning of fiscal year 2009), with a break at 675 kWh/month (90% of median residential consumption). The prices charged in each block each year 2009 to 2012 are graphed on page 18 of Exhibit____PLC-3, along with the comparable non-IBR rate; by 2012, the two blocks were priced around 6¢/kWh and 9.6¢/kWh. BC Hydro estimated that the elasticity in the second block was -0.08 to -0.13, in addition to an elasticity of -0.05 for class average price elasticity. BC Hydro found that consumption by small customers (averaging 370 kWh monthly)

[12] Xcel PSCo did not examine whether the conservation incentives in the summer affected usage in the winter months. In its ex ante analysis, Xcel "assumed that usage in all other months would decrease by 0.13% for each 1.0% decline in those rates." (MCEA IR 6, Attachment 1, p. 3).

did not increase, while consumption by the large customers (averaging about 1,350 kWh monthly) fell, for cumulative savings of 1.1% to 2.5% of BC Hydro's 18,000 GWh total residential use by 2012.

Q: Have you identified any other studies of the price response of residential customers to tailblock rates?

A: Yes. Reiss and White, Exhibit____PLC-4, used data from California utilities to estimate an average marginal price elasticity of -0.39, along with estimates for various subsets of the data.[13] The authors observed that "The smallest effect is associated with baseline use, and is effectively zero. All other appliance price sensitivities are of considerable practical significance. For example, …a one cent per kilowatt-hour ("kWh") increase in the marginal price would reduce a household's annual utilization of pool pumps and motors by approximately 330 kWh per year, which is 15% of a pool's typical electricity use" and that customers with electric heat and air conditioning also have much higher elasticities than customers without them.

Herriges and King, Exhibit____PLC-5, used data from a controlled experiment with 227 Wisconsin Electric customers on four IBRs, using two different break points (250 kWh and 500 kWh) and two first-block rates (each of which determines the second-block rate).[14] Each experimental rate applied to only 50 or 60 customers; another 143 customers were on the flat rate. Only participants using less than 1,500 kWh monthly were included.

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[13] Household Electricity Demand, Revisited; Peter C. Reiss and Matthew W. White, Review of Economic Studies (2005) 72, 853–883.

[14] Residential Demand for Electricity under Inverted Block Rates: Evidence from a Controlled Experiment; Joseph A. Herriges and Kathleen Kuester King; Journal of Business & Economic Statistics, Vol. 12, No. 4 (Oct., 1994), pp. 419-430.

The experiment appears to have been run for a year or less. Given the small sample and the short period for behavior to adapt to the block rates, it is not surprising that the coefficients were not consistently statistically significantly different from zero, but most of the price elasticities for groups with significant usage in the second block were estimated to be in the –0.14 to –0.18 range in the summer and –0.32 to –0.36 in the winter.

Faruqui, Exhibit____PLC-6, reviewed the previously described studies and reported on a simulation of the effects of four two-block IBRs. Faruqui estimates that the rate designs most similar to the rate I propose below would reduce sales 2%–6% in the short term and 7%–18% in the long term.[15]

Q: What do you consider a reasonable estimate of the elasticity of demand with respect to marginal price?

A: While the exact value is uncertain, and probably varies with a number of factors, a conservative range of values over one to four years might be –0.1 to –0.3. Longer-term effects may be twice as high.

IV. DEVELOPMENT OF AN INCLINING-BLOCK RATE

A. An Inclining-Block Consistent With Current Rates.

Q: Have you developed an IBR proposal for Xcel's residential class?

A: Yes. While there are a number of options for designing an IBR, I started with the following guidelines:

- Retaining the existing revenue level by season.

[15] Inclining Toward Efficiency, Ahmad Faruqui, Public Utilities Fortnightly, August 2008, pp. 22–27.

- Excluding the non-summer use of space-heating customers to avoid burdening large space-heating customers, who may have limited options in the near term.
- Maintaining the existing customer charge.
- Using no more than 4 pricing blocks.
- Limiting to about 15% the bill reduction for customers with use of half that of the average customer.
- Slightly reducing the bill for a customer with average use.
- Increasing the bill for a very large customer (defined as one with four times the average use) by about 20%.
- Increasing the marginal price, averaged over all kWh use, by about 20%.

Q: What IBR design did you develop?

A: I started with the current regular residential energy charge of $86.71/MWh (8.671¢/kWh) in the summer and $73.93/MWh (7.393¢/kWh) in the winter. I used the billing determinants from MCEA IR16 Attachment A; for the summer, I used all residential sales, while for the winter I used only “regular” (non-space heating) sales. I selected the size of each block and price change for each block (compared to the existing seasonal rate) to meet the objectives listed above. The resulting designs are shown in Table 3 and Table 4.

Table 3: Design of Summer IBR, all Residential Sales

block	Price Change	Block Price	Block kWh’s	Bills ending in Block (1,000s)	MWh billed	MWh influenced
1	-30%	6.070¢	0–350	1,015	1,364,819	213,547
2	10%	9.538¢	351–700	1,346	909,211	700,448
3	20%	10.405¢	700–1,200	1,217	627,968	1,117,010
4	46%	12.684¢	>1,200	660	416,921	1,287,915

Table 4: Design of Winter IBR, non-heating Residential Sales

block	Price Change	Block Price	Block kWh's	Bills ending in Block (1,000s)	MWh billed	MWh influenced
1	-25%	5.545¢	0–300	2,051	2,158,681	374,927
2	10%	8.132¢	301–600	2,624	1,374,880	1,165,701
3	20%	8.872¢	602–1,000	1,965	877,799	1,514,549
4	28%	9.434¢	>1,000	1,245	820,847	2,177,030

Q: What is the difference between the "MWh billed" and "MWh influenced" columns in Table 3 and Table 4?

A: The "MWh billed" lists the number of MWh billed at that rate, while the "MWh influenced" lists the number of MWh in bills in this block. For example, a winter bill of 500 kWh would have 300 kWh billed at the Block 1 rate and 200 kWh billed at Block 2 rate, but all 500 kWh are influenced by the Block 2 rate. As noted above, while the higher block rate applies only to those MWhs falling within that block, the customer facing the higher block rate experiences that rate as their marginal cost for all usage.

Q: What is the average conservation incentive for this IBR?

A: Using the computation of the marginal block prices, weighted by the MWh influenced as in Table 1 above, average 10.827¢/kWh in the summer and 8.703¢/kWh in the winter, for an annual average of 9.527¢/kWh. Compared to the current residential energy rates of 8.671¢/kWh in the summer and 7.393¢/kWh in the winter, averaging 7.889¢/kWh over the year, these effective conservation signals represent increases of 25% in the summer, 18% in the winter, and 21% annually. For the same average price, the IBR would provide significantly stronger conservation price signals.

Q: What effect would you expect on customer loads due to this IBR?

A: A 21% increase in the sales-weighted effective marginal price would probably result in a load reduction of 2% to 6% over the first few years of the IBR, given the elasticities I discuss in I.A. That would be similar to the effect estimated by Xcel PSCo.

Q: How would this rate design affect bills?

A: Table 5 shows the total bills for various customers, with consumption ranging from half of average to four times average, for the existing flat rates and my proposed IBR. For reference, average residential consumption is 771 KWh in summer and 654 KWh in winter. The total bill includes the $8 monthly regular overhead customer charge and fuel charges of $28.54/MWh in the summer and $27.71/MWh in the winter, from Xcel's "Rate Structure and Design Information," Tab B, page 1 of 20.[16]

Table 5: Bills with Flat and Inclining Rates

Use as %	kWh/Mon		Flat Energy Rates			Inclining Block Rates			
Avg	**Summer**	**Winter**	**Summer**	**Winter**	**Annual**	**Summer**	**Winter**	**Annual**	**Change**
50%	385	327	$52	$41	$540	$44	$36	$462	-14.4%
100%	771	654	$97	$75	$983	$92	$72	$944	-4.0%
150%	1156	981	$141	$108	$1,427	$143	$110	$1,453	1.8%
200%	1542	1309	$186	$141	$1,871	$202	$150	$2,007	7.3%
300%	2313	1963	$275	$208	$2,758	$322	$230	$3,125	13.3%
400%	3084	2617	$363	$274	$3,646	$442	$310	$4,243	16.4%

[16] All the bills would be increased by $2/month for underground and space-heating customers, and $4/month for space-heating customers served from underground distribution, moving the bill changes for those customers ever-so-slightly closer to zero.

Q: How many customers fall into each of the six pricing groups you list in Table 5?

A: Table 6 shows the number of bills in each pricing group.[17] Notably, over 60% of customers have bills below average, only 2%–3% of bills reflect more than three times average consumption, and only about 1% of bills are for more than four times the average consumption. It also shows the usage of the median customer summer and winter, and the usage at which a customer would break even between the IBR and a flat rate, paying the same amount on either rate.

Table 6: Distribution of Monthly Bills

Usage as % Average	kWh/Mon		# Bills		% Bills	
	Summer	Winter	Summer	Winter	Summer	Winter
<50%	385	327	1,159,806	2,307,553	26.9%	28.9%
50%–100%	771	654	1,432,533	2,743,754	33.3%	34.3%
100%–150%	1,156	981	916,969	1,530,942	21.3%	19.1%
150%–200%	1,542	1,309	439,028	699,141	10.2%	8.7%
200%–300%	2,313	1,963	269,261	484,613	6.3%	6.1%
300%–400%	3,084	2,617	53,697	134,056	1.2%	1.7%
>400%	>3084	>2617	33,473	96,640	0.8%	1.2%
≤Median	<640	<514	2,152,384	3,998,350	50%	50%
≤Breakeven	<1050	<825	3,267,966	5,913,376	76%	74%

The median customer (with a 50-percentile bill of 640 kWh in the summer and 514 kWh in the winter, about 80% of average) would see a bill decrease of about 8%. So more than half the customers would experience bill reductions of more than 8%. The 75% of customers with bills less than 1,050 kWh/month in the summer and 825 kWh/month in the winter (about a third more than average usage) would see lower bills under the IBR. Only 25% of

[17] Each customer would have four summer bills and eight winter bills.

customers would have usage above that breakeven point and see an increase in their bills.

B. IBR Design With Xcel's Requested Rate Increase.

Q: You have described how your proposed IBR would be structured for current rate levels. How would you propose that the rates change if Xcel is granted an increase in its residential revenue requirement?

A: I recommend that the rate increase be accomplished through a proportional increase in the energy charges, leaving the customer charge at its current value.

Q: What would be the effect of that proportionate change if the Commission grants Xcel its entire requested rate increase?

A: Xcel's proposed residential revenue requirement, with an $8 customer charge, would result in flat rates of 9.763¢/kWh in the summer and 8.418¢/kWh in the winter. Table 7 provides the rate design I would recommend for Xcel's proposed rates, including the percentage change of each block from the equivalent flat energy price.

Table 7: Inclining-Block Rate with Proposed Residential Revenue Requirement

	Summer		Winter	
block	**Price Change**	**Block Price**	**Price Change**	**Block Price**
1	-30%	6.834¢	-25%	6.314¢
2	10%	10.739¢	10%	9.260¢
3	20%	11.716¢	20%	10.102¢
4	46%	14.281¢	28%	10.742¢

The percentage differences between the flat rate and the IBR with Xcel's proposed residential revenues would be very similar to the corresponding differences in Table 5, for existing revenues.

Q: How would the rate design affect bill increases for various size customers with Xcel's proposed rate increase?

A: That depends on the size of the increase. If Xcel were granted its requested increase in residential revenues (which I calculate to be a 9.2% increase for the residential overhead non-heating rate over two years), then those using 50% of average energy consumption would see approximately an 8.2% decrease from current bills; the median bill would rise about 0.7%; a customer with the average bill would see a 4.4% increase; and customers with roughly the highest quarter of bills would accordingly see higher increases.

C. Concerns About IBR.

Q: What concerns have been expressed about adoption of an IBR?

A: The concerns generally involve equity and effectiveness.

1. Equity

Q: What are the equity concerns?

A: I have seen concerns about the effect of an IBR on low-income populations, especially where low-income customers are overrepresented among large users, and on customers with electric space heating. An IBR could have large bill effects for heating customers, who may have limited ability to reduce their heating usage in the short term.

Q: How can the equity concerns regarding an IBR be mitigated?

A: The most effective mitigation strategies for potential effects on large low-income customers are to target those customers with rate discounts and (even better) energy-efficiency programs. I understand that the equity impacts of IBR generally, and my proposed IBR, will be addressed in more detail in the

Direct Testimony of Roger Colton, filed on behalf of the Energy CENTS Coalition.

The concern about space-heating customers can be addressed by lower space-heating rates, such as Xcel's 23% discount for space heating customers' winter loads. Another option is to phase in the IBR more slowly, allowing time for as customers to reduce space-heating use through improved building efficiency and replacement of resistance heat with heat pumps and high-efficiency gas furnaces, either on their own or through utility- or government-sponsored programs. In addition, the deeply discounted space heating rate can be closed to new business and new space-heating customers can be placed on the regular residential rate or (once Xcel develops an appropriate set of marginal costs) a cost-based space-heating rate.

For the current case, I have proposed to exclude the winter usage for space-heating customers. I recommend that extending the IBR to space-heating customers be considered in Xcel's next rate case.

2. Effectiveness

Q: What are the effectiveness concerns with IBR?

A: Some observers worry that customers do not understand their bills well enough to react to an IBR. That concern can be mitigated through an education and communication program, which I discuss further in Section V. That concern has not proven convincing to the many regulators who have approved IBRs, including this Commission. The Centerpoint survey (Attachment D to OAG IR 601.1) also indicates that many customers do pay attention to the components of the bill.

Another concern is that the customer receives a price signal after the fact, when the bill arrives and the customer scrutinizes it. The communication plan should include features, especially on bills or bill enclosures, that remind customers who had high usage in the upcoming season in the previous year that they can disproportionately reduce their bills with efficiency investments and efficient behavior. In addition, for customers who are interested in the data, Xcel can develop options for monitoring usage during the billing month and predicting the customer's marginal price block.[18]

V. COMMUNICATING THE IBR

Q: You mentioned previously that the effectiveness of the IBR will vary with the quality of the explanations provided to consumers. Has Xcel provided any information supporting your observation?

A: Yes. In response to OAG IR 601.1, Xcel provided a general discussion paper of issues related to rate design in Texas's peculiar form of restructuring. (*See* OAG IR 601.1, Attachment 3) That paper provides some relevant observations.

> Either behavioral response [to average or marginal price] is possible depending on consumer knowledge of the tariff function and the type of information that is saliently reported on customer bills. Utility bills often do a poor job of clearly displaying the marginal price of an additional kWh of power …. Casual empiricism suggests that utility customers are better informed about the total monthly expenditures on gas/electricity rather than the marginal price… (*Id.*, p. 6)

> …if normative prescriptions from academic research focus on "getting the marginal price right," then they should also advocate for bill design that saliently displays this price signal. (*Id.*., p. 7)

[18] Some customers way be more interested in energy efficiency (or anything else), if they can monitor progress and identify challenges on their smart phone or tablet.

Q: Have you prepared detailed recommendations regarding that communication plan?

A: No. Xcel is responsible for effective communication with ratepayer and should be primarily responsible for devising the messaging plan for the IBR. Xcel should work with interested parties to develop the communication plan.

VI. THE RESIDENTIAL CUSTOMER CHARGE

Q: What has Xcel proposed regarding the residential customer charge?

A: Xcel proposes to increase the customer charge by $1.25/month, from $8/month to $9.25 for regular overhead customers. The $2/month surcharges for underground service and for space-heating customers would remain unchanged.

A. Effects Of A Higher Customer Charge.

Q: What effect would Xcel's proposed increase in the customer charge have on the conservation effect of the rates?

A: For a flat rate, the $1.25/month increase in the customer charge would reduce the energy rate by about $2/MWh, or about 2%. The effect on an IBR's energy charges (assuming proportional distribution of the rate reduction across blocks) would be similar. Hence, a higher customer charge will result in somewhat weaker price signals, offsetting about a tenth of the benefit of my proposed IBR.

Q: Would the higher customer charge result in any cost savings for Xcel and its customers?

A: Increasing the customer charge is unlikely to save any costs, for two reasons. First, the only way to avoid the customer charge is to discontinue being an Xcel customer. Few residential customers are likely to drop their Xcel service to avoid the customer charge. And few residential customers who would be inclined to add to Xcel's customer number (adding service for a new building, or adding a meter for an ancillary apartment or outbuilding) will be discouraged from doing so by any reasonable customer charge.

Second, even if some customers did decide to go off the grid, perhaps by relying on solar energy and batteries, or micro-cogeneration, that would not save Xcel much beyond the costs of issuing the bill. When asked about whether, following termination of service by a residential customer, Xcel normally removes and reuses (or sells) various types of distribution equipment, the Company responded as follows:

> The Company typically does not abandon or remove the distribution facilities mentioned above (primary, secondary, or line transformer) due to the loss of a single customer. This is because such facilities are typically installed to provide service to multiple customers at a time, not just a single customer. However, even in the few cases where a primary line, secondary line, and a transformer are installed to serve a single customer, we would not likely remove these facilities unless the dwelling or facility being served was to be demolished and redeveloped (in case another customer ultimately occupies the facility). (MCEA IR 25)
>
> Even in the case of facilities that service a single customer (e.g. meter and service drop), loss of a customer does not necessarily lead to the removal of these facilities when the residence/facility is still present because of the likelihood that another owner/tenant will occupy the facility. (MCEA IR 28)

Hence, the customer charge cannot be expected to provide any useful price signals or reduce Xcel's costs.

B. Xcel's Cost Basis For The Customer Charge.

Q: How does Xcel justify its proposed increase in the customer charge?

A: Exhibit MAP-1, Appendix A provides Xcel's version of "the costs …used to support the customer charge for each customer class." This calculation is actually the "Customer Related Revenue Requirement," which I understand to be the costs that Xcel functionalizes as customer-related for each class in the cost of service study. The results are provided on page 28 of Exhibit MAP-1, Appendix A, including a value of $15.82/month for the residential class, higher than the proposed $9.25/month for the non-heating overhead customers, and even the $13.25/month proposed for underground heating customers.

Q: Is this an appropriate computation for the residential customer charge?

A: No, for two reasons. First, this computation only measures embedded costs, not marginal costs, and hence is of little relevance for rate design. There is little if any marginal distribution cost related to the typical residential customer.

Second, even if the embedded costs from the cost-of-service study were relevant for rate design, the computation in Exhibit MAP-1, Appendix A includes distribution costs that are not driven by the number of customers. Even if the Xcel cost-of-service study allocates to the residential class a reasonable share of area-spanning costs, such as poles and lines, using customer number as a proxy for the class contribution for the need to cover the service territory, an additional customer rarely increases these costs.[19] As shown in Xcel's response to MCEA IR20, a majority of the plant costs included in Xcel's customer-charge computation are for the area-spanning costs.

[19] I am not endorsing the cost-of-service study allocation, including Xcel's implementation of the minimum-system analysis. The standard minimum-system analysis assumes that all the conductors and transformers would be needed for the minimum system, even though the length of conductor and number of line transformers are driven by load, as well as the areas spanned and the number of customers served.

In response to MCEA IR 21, which requested a computation of the customer costs excluding ~~the costs of~~ the area-spanning costs, Xcel computed a residential customer charge of $6.51/month. Thus, it appears that the existing customer charge is more than enough to cover the costs of transformers, service drops, meters, billing and allocated overheads. Since the customer charge should only include the costs required for the smallest customers, such as apartment residents, the customer charge should reflect substantial sharing of service drops (which MCEA IR 26 and MCEA IR 27 indicate is not reflected in the cost-of-service study) and transformers. Those modifications would push the embedded customer cost even lower.

VII. RATE DESIGN FOR THE DECOUPLING ADJUSTMENT

Q: How does Xcel propose to recover the rate adjustments resulting from the revenue-decoupling mechanism from residential customers?

A: As shown in Exhibit DGH-1 Schedule 5, Xcel proposes to divide the revenue-decoupling charge or credit for a class by the sales to that class, and apply the resulting $/MWh value to all energy use in the class. An example of that computation is shown for residential non-heating customers in Exhibit DGH-1 Schedule 4: a 2015 shortfall of $10,798,545, divided over 8,064,433 MWh in April 2016 through March 2017, results in a decoupling charge of $1.339/MWh.

Q: Is this approach appropriate with an IBR?

A: No. With the IBR, customers with usage in the higher blocks will save more money from a 1% reduction in load, and pay more for a 1% increase in load, than would small customers. Hence, it makes sense for the decoupling adjustment to be shaped like the underlying IBR.

Q: How would you change the decoupling computation for consistency with your IBR?

A: I suggest that the adjustment be an equal percentage for all energy charges in the rate. For Xcel's residential non-heating example, I would divide the $10,798,545 shortfall by the forecast $718,002,489 energy revenues in 2016/17, producing an energy adder of 1.504%. That adder could be applied on the bill as an inclining-block decoupling adjustment, but it would be simpler to add a single decoupling charge of 1.504% times the customer's total energy charge.

Q: Does this conclude your direct testimony?

A: Yes.