Appendix A-2

City of Glencoe System Demand and Capability Data

Certificate of Need Load and Energy Forecast for Glencoe

Central Minnesota Municipal Power Agency

2/25/2010

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Overview

The Central Minnesota Municipal Power Agency (CMMPA) was asked to develop a forecast of Glencoe's peak load and energy requirements for the period 2010-2030. Estimates are typically developed both as a member service in itself and in service of wider CMMPA resource planning objectives among other uses.

Study results suggest that peak demand is expected to hold essentially level for the foreseeable future around a level of 21 MW.[1] Energy sales in 2030 are expected to be comparable to system sales in 2006, which is to say that they are expected to remain roughly level except for a 2010 snapback thanks to an expected economic recovery. The result is explained by the offsetting forces of conservation, rising electricity prices, and a return to baseline economic growth. Historical and forecasted estimates by month of peak load, energy requirements, and load factors are reported, respectively, in **Table 1**, **Table 2**, and **Table 3**. Yearly system peak demand is reproduced in **Figure 1**.

Methodology

Forecasted load and energy requirements were developed in light of recent changes in load patterns as well as the emergence of new data sources and upgraded CMMPA staffing, allowing the application of new and improved statistical methods.[2] Since the 2006 BSII CON proceeding, there have been economic recessions, two mild summers, and changes in electricity prices. While results were not extensively reported for Glencoe specifically in the last CON proceeding, a discussion of them provides useful context for the current forecast results and methodology.

The February 2010 CMMPA load forecast for Glencoe, like its predecessor, developed an econometric model of total energy, and then estimated a statistical model of load factors that was then used to develop forecasted peak values. The model of energy for Glencoe represented CMMPA's judgment and experience as to the largest load drivers on Glencoe's network.[3] These drivers were cooling degree days, heating degree days, gross regional product, dummy variables accounting for monthly patterns of industrial load, and retail electricity prices. The latter two factors were advancements over the previous load model, and paid off for Glencoe in that both factors provided an improvement in describing industrial load. While demographic data were tested, non-economic factors were not used.[4] Population growth *per se* was not found to be separable from existing measures of system income; estimates of energy elasticity to household data did not show a statistically defensible relationship.[5]

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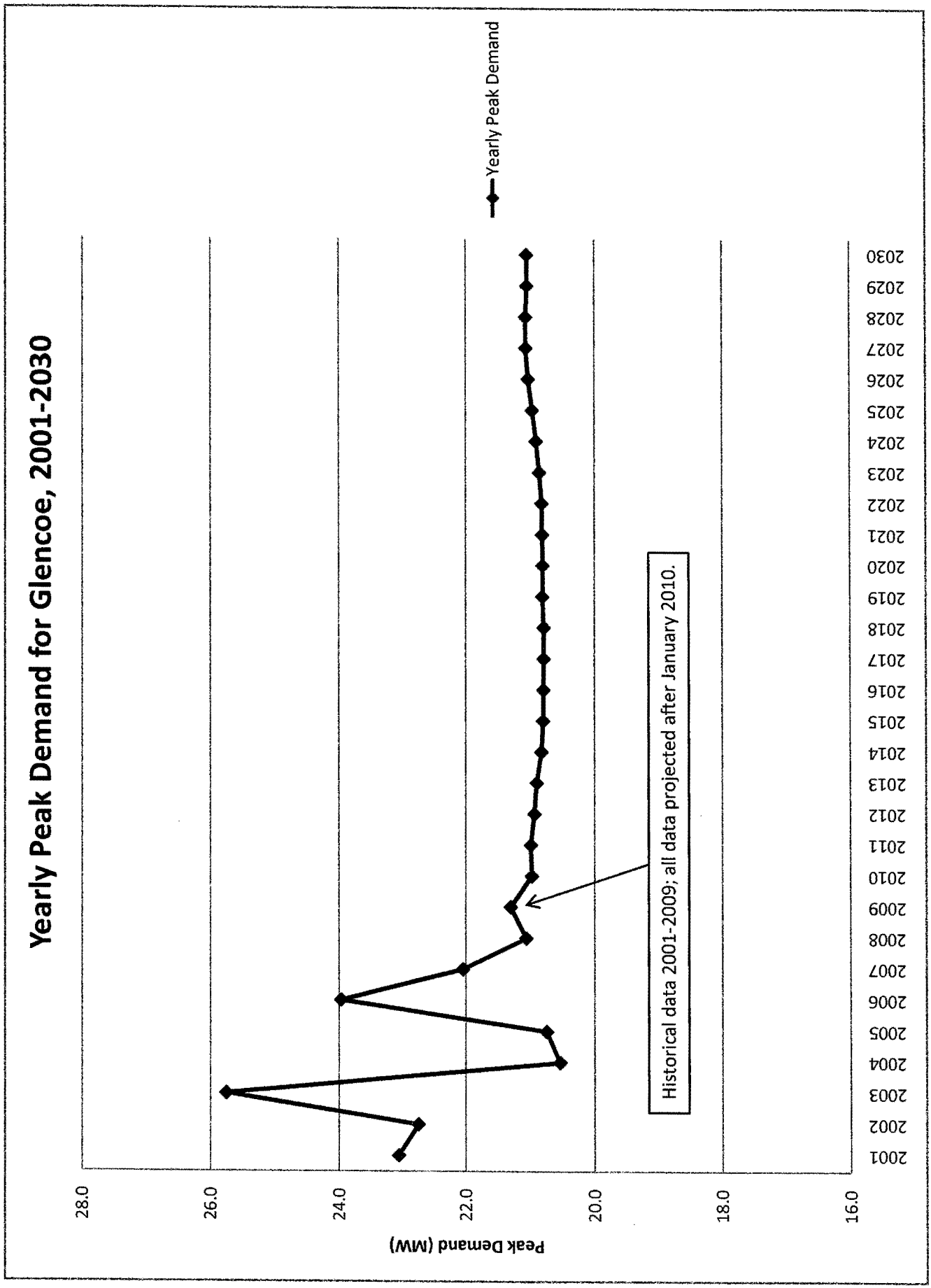
[1] Given a normal weather year and expected economic growth.

[2] A corollary is that these new methods have not been in place long enough for *ex post* assessments.

[3] Very similar models are used for other members of our organization. Models and results are independent between members.

[4] Nor were they used in the BSII proceeding.

[5] Econometric estimates, including those carried out using EIA Form-861 data from 1990-2007, implied a negative correlation between energy usage and population. In any event, there are no obvious reasons to believe


Yearly Peak Demand for Glencoe, 2001-2030
Yearly Peak Demand
Historical data 2001-2009; all data projected after January 2010.
Peak Demand (MW)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
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2030

Table 1

Historical and Forecasted Peak Load for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Winter Peak (MW)	Summer Peak (MW)
	2001						15.8	20.2	23.1	19.5	9.7	10.2	10.3	10.3	23.1
	2002	10.1	9.8	9.8	10.5	11.4	18.7	22.7	20.8	22.3	9.9	10.3	10.8	10.8	22.7
	2003	10.4	10.3	10.0	9.8	10.1	17.3	19.6	25.8	24.9	13.8	9.8	10.6	13.8	25.8
	2004	10.5	10.1	9.5	9.4	10.2	14.3	20.5	17.9	19.8	14.7	9.6	10.1	14.7	20.5
Historical	2005	10.1	9.9	9.3	8.8	8.8	16.2	18.2	20.7	19.3	10.7	10.1	11.0	11.0	20.7
	2006	9.8	9.4	9.1	8.9	12.9	15.0	24.0	21.2	18.8	16.6	10.0	10.6	16.6	24.0
	2007	9.7	10.0	8.9	9.3	10.4	16.6	22.0	21.9	20.3	9.2	9.7	10.0	10.0	22.0
	2008	10.5	9.8	9.3	8.9	9.3	12.1	19.2	21.1	19.0	16.9	9.4	10.7	16.9	21.1
	2009	10.5	9.9	9.4	8.9	10.8	15.8	15.0	21.3	18.9	14.1	9.1	10.3	14.1	21.3
	2010	10.4	10.3	9.3	9.9	10.8	19.8	19.3	21.0	16.8	11.5	10.3	10.0	11.5	21.0
	2011	9.7	10.4	9.4	10.0	10.9	19.9	19.3	21.0	16.8	11.6	10.4	10.1	11.6	21.0
	2012	9.7	10.0	9.3	9.9	10.8	19.7	19.3	20.9	16.8	11.6	10.4	10.0	11.6	20.9
	2013	9.7	10.4	9.3	9.9	10.8	19.7	19.3	20.9	16.8	11.6	10.4	10.0	11.6	20.9
	2014	9.6	10.4	9.3	9.9	10.8	19.6	19.2	20.8	16.7	11.6	10.3	10.0	11.6	20.8
	2015	9.6	10.4	9.3	9.9	10.8	19.6	19.2	20.8	16.7	11.6	10.3	10.0	11.6	20.8
	2016	9.7	10.0	9.3	9.9	10.8	19.6	19.1	20.8	16.7	11.6	10.4	10.1	11.6	20.8
	2017	9.7	10.4	9.4	10.0	10.8	19.6	19.1	20.8	16.7	11.6	10.4	10.1	11.6	20.8
	2018	9.7	10.4	9.4	10.0	10.8	19.6	19.1	20.8	16.7	11.6	10.4	10.1	11.6	20.8
	2019	9.7	10.4	9.4	10.0	10.8	19.6	19.2	20.8	16.8	11.7	10.4	10.1	11.7	20.8
	2020	9.7	10.1	9.4	10.0	10.8	19.6	19.2	20.8	16.8	11.7	10.5	10.1	11.7	20.8
Forecasted	2021	9.8	10.5	9.4	10.1	10.8	19.6	19.2	20.8	16.8	11.7	10.5	10.2	11.7	20.8
	2022	9.8	10.5	9.5	10.1	10.9	19.7	19.2	20.8	16.8	11.8	10.5	10.2	11.8	20.8
	2023	9.8	10.6	9.5	10.1	10.9	19.7	19.2	20.9	16.9	11.8	10.6	10.3	11.8	20.9
	2024	9.9	10.3	9.6	10.2	11.0	19.8	19.3	20.9	16.9	11.9	10.6	10.3	11.9	20.9
	2025	10.0	10.7	9.6	10.3	11.0	19.8	19.3	21.0	17.0	12.0	10.7	10.4	12.0	21.0
	2026	10.0	10.8	9.7	10.3	11.1	19.9	19.4	21.0	17.1	12.1	10.8	10.5	12.1	21.0
	2027	10.1	10.8	9.7	10.4	11.2	19.9	19.4	21.1	17.1	12.1	10.8	10.5	12.1	21.1
	2028	10.1	10.5	9.8	10.4	11.2	20.0	19.4	21.1	17.1	12.1	10.9	10.5	12.1	21.1
	2029	10.1	10.9	9.8	10.4	11.2	19.9	19.4	21.1	17.1	12.2	10.9	10.6	12.2	21.1
	2030	10.2	10.9	9.8	10.4	11.2	19.9	19.4	21.1	17.1	12.2	10.9	10.6	12.2	21.1
Average Peak Load,															
2001-2010 (Historic)		10.2	9.9	9.4	9.3	10.5	15.8	20.2	21.5	20.3	12.8	9.8	10.5	13.1	22.4
2010-2020 (Forecasted)		9.7	10.3	9.4	10.0	10.8	19.7	19.2	20.9	16.8	11.6	10.4	10.1	11.6	20.9
2020-2030 (Forecasted)		10.0	10.6	9.6	10.2	11.0	19.8	19.3	21.0	17.0	12.0	10.7	10.4	12.0	21.0

Table 2

Historical and Forecasted Energy for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Annual Energy (MWH)	Growth
	2001						6,061	8,991	10,897	9,261	5,316	5,069	5,631		
	2002	5,765	5,147	5,646	5,266	5,292	7,057	9,252	10,988	10,072	5,406	5,367	5,861	81,121	
	2003	6,095	5,435	5,616	5,188	5,326	6,946	9,761	11,777	9,001	5,834	5,172	5,734	81,886	0.9%
	2004	5,907	5,321	5,489	5,109	5,149	5,858	7,853	7,913	9,148	5,899	4,982	5,560	74,190	-9.9%
Historical	2005	5,638	4,846	5,193	4,722	4,869	6,642	8,274	10,582	9,820	5,121	5,127	5,741	76,574	3.2%
	2006	5,521	5,046	5,287	4,902	5,577	7,197	9,509	11,152	9,690	5,587	5,115	5,449	80,031	4.4%
	2007	5,609	5,156	5,195	5,043	5,231	7,121	9,972	10,378	8,778	5,273	5,067	5,536	78,358	-2.1%
	2008	5,681	5,321	5,303	4,845	4,912	5,386	9,243	10,483	9,813	7,242	5,002	5,715	78,944	0.7%
	2009	5,689	4,973	5,279	4,822	4,912	6,057	7,774	9,872	10,184	5,646	4,816	5,622	75,644	-4.3%
	2010	5,659	5,336	5,296	5,304	5,377	8,244	8,658	10,186	7,952	5,282	5,354	5,407	78,054	3.1%
	2011	5,418	5,377	5,338	5,346	5,397	8,279	8,669	10,194	7,966	5,325	5,375	5,427	78,110	0.1%
	2012	5,410	5,364	5,331	5,328	5,365	8,224	8,649	10,167	7,954	5,333	5,369	5,414	77,908	-0.3%
	2013	5,413	5,366	5,332	5,330	5,364	8,212	8,635	10,149	7,946	5,335	5,372	5,417	77,873	0.0%
	2014	5,401	5,353	5,319	5,317	5,347	8,181	8,602	10,113	7,920	5,322	5,360	5,405	77,639	-0.3%
	2015	5,407	5,359	5,324	5,323	5,350	8,173	8,592	10,099	7,916	5,328	5,366	5,412	77,648	0.0%
	2016	5,416	5,367	5,332	5,330	5,355	8,172	8,590	10,098	7,919	5,336	5,375	5,421	77,710	0.1%
	2017	5,425	5,375	5,340	5,338	5,359	8,172	8,587	10,096	7,922	5,344	5,384	5,431	77,773	0.1%
	2018	5,437	5,386	5,350	5,348	5,366	8,173	8,587	10,097	7,927	5,354	5,396	5,442	77,864	0.1%
	2019	5,455	5,403	5,366	5,365	5,380	8,182	8,595	10,105	7,939	5,371	5,414	5,461	78,037	0.2%
	2020	5,465	5,412	5,375	5,374	5,385	8,181	8,593	10,103	7,943	5,380	5,424	5,471	78,104	0.1%
Forecasted	2021	5,480	5,426	5,389	5,388	5,396	8,187	8,597	10,108	7,952	5,395	5,439	5,487	78,246	0.2%
	2022	5,494	5,440	5,402	5,401	5,405	8,190	8,599	10,111	7,960	5,408	5,453	5,502	78,364	0.2%
	2023	5,522	5,466	5,428	5,428	5,429	8,209	8,617	10,130	7,982	5,435	5,481	5,530	78,657	0.4%
	2024	5,554	5,498	5,459	5,459	5,458	8,234	8,641	10,154	8,010	5,466	5,514	5,563	79,008	0.4%
	2025	5,591	5,534	5,495	5,495	5,491	8,263	8,670	10,183	8,042	5,503	5,551	5,600	79,418	0.5%
	2026	5,629	5,571	5,532	5,532	5,526	8,294	8,700	10,213	8,076	5,541	5,589	5,639	79,843	0.5%
	2027	5,658	5,599	5,559	5,560	5,551	8,313	8,718	10,232	8,100	5,569	5,619	5,669	80,147	0.4%
	2028	5,672	5,613	5,572	5,573	5,559	8,315	8,718	10,233	8,106	5,582	5,633	5,684	80,259	0.1%
	2029	5,679	5,618	5,577	5,578	5,559	8,307	8,707	10,224	8,104	5,587	5,640	5,691	80,270	0.0%
	2030	5,696	5,634	5,591	5,593	5,570	8,310	8,709	10,226	8,112	5,602	5,656	5,708	80,406	0.2%
Average Monthly Sales, 2001-2009 (Historic)		5,729	5,156	5,376	4,987	5,158	6,481	8,959	10,449	9,530	5,703	5,080	5,650	78,257	-1.0%
2010-2020 (Forecasted)		5,425	5,372	5,337	5,337	5,368	8,199	8,614	10,128	7,937	5,337	5,381	5,428	77,862	0.0%
2020-2030 (Forecasted)		5,586	5,528	5,489	5,489	5,485	8,255	8,661	10,174	8,035	5,497	5,545	5,595	79,338	0.3%

Table 3

Historical and Forecasted Load Factors for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Average Factor
	2001						53.2%	59.8%	63.5%	65.8%	73.8%	69.1%	73.5%	
	2002	76.4%	78.0%	77.7%	69.4%	62.5%	52.4%	54.7%	71.1%	62.7%	73.3%	72.5%	73.0%	68.6%
	2003	78.5%	78.4%	75.2%	73.8%	71.0%	55.8%	67.1%	61.5%	50.3%	56.8%	73.5%	72.8%	67.9%
	2004	75.8%	75.8%	77.6%	75.8%	67.6%	57.0%	51.4%	59.3%	64.2%	53.9%	72.1%	73.7%	67.0%
Historical	2005	75.4%	73.2%	75.1%	74.4%	74.7%	56.8%	61.2%	68.6%	70.5%	64.5%	70.3%	70.3%	69.6%
	2006	76.1%	79.8%	78.3%	76.2%	58.2%	66.8%	53.3%	70.6%	71.6%	45.3%	71.2%	69.4%	68.1%
	2007	77.3%	76.8%	78.3%	75.4%	67.9%	59.4%	60.8%	63.8%	60.2%	77.2%	72.3%	74.7%	70.3%
	2008	72.6%	78.0%	76.4%	75.5%	71.3%	62.0%	64.7%	66.9%	71.9%	57.7%	73.9%	71.6%	70.2%
	2009	73.1%	75.1%	75.2%	75.0%	61.1%	53.4%	69.6%	62.3%	74.7%	53.7%	73.5%	73.4%	68.3%
	2010	73.1%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.6%
	2011	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2012	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2013	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2014	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2015	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2016	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2017	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2018	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2019	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2020	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
Forecasted	2021	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2022	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2023	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2024	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2025	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2026	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2027	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2028	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2029	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
	2030	75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
Average Load Factor,														
2001-2009 (Historic)		75.4%	76.9%	76.7%	74.4%	66.8%	57.4%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
2010-2020 (Forecasted)		75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%
2020-2030 (Forecasted)		75.4%	76.9%	76.7%	74.4%	66.8%	57.9%	60.3%	65.3%	65.8%	61.8%	72.1%	72.5%	68.8%

This result reflects the primacy of industrial load for Glencoe in general and the proportion of Glencoe's load accounted for by seasonal industrial load in particular.

Conservation was considered for inclusion into the econometric model as a load-modifying resource, but a lack of *ex post* energy and peak savings estimates[6] fatally limited the scope of research. *Ex ante* load adjustments had to be made instead. Informed by a 2009 study specifying an expected path for reductions from baseline energy usage, it was presumed that Glencoe would begin in 2010 to meet a 1.5% reduction goal (established in Minnesota's *Next Generation Energy Act* of 2007) but would not attain this goal until 2015.[7]

An advantage of an econometric model over trend analysis is the ability to decompose variations in load by load driver, such as weather or economic growth. To that end the model yielded results emphasizing the primacy of industrial load and the insensitivity of system load to weather variation. The inelasticity to weather in general was due in part to a high penetration of natural gas for heating uses. The relatively easy recognition of weather insensitivity was an advantage displayed by the model which would not have been shared by an end-use engineering model, whose estimates would have been sensitive to atypical penetration assumptions. Unlike the BSII model, preliminary model testing indicated that a linear functional relationship and not a log-transform was the most useful model specification. This functional relationship is the most mathematically tractable as well as the easiest to interpret among the candidates.

Table 4 reprints the econometric model used for monthly energy for Glencoe. This model was estimated by a Prais-Winsten methodology assuming AR(1) residuals. Estimates for model parameters were correctly signed and were generally reasonable in practical terms given previous experience and comparison with other CMMPA members. In regards to a given variable's inclusion in the model, while statistical significance was a consideration, practical significance of the model parameter[8], the possibility of omitted variable bias, and the variable's justification on the basis of economic and practical theory were held to be together more important. Estimates generally reflect the large share of industrial load in Glencoe: Relative weather-insensitivity, sensitivity to retail electricity prices and economic growth, and strong estimates (in both statistical and practical terms) representing industrial demand. Autocorrelation was corrected for by using the Prais-Winsten estimation methodology. Multicollinearity between variables denoting industrial load and those of all other explanatory variables was a reasonable explanation for the statistical insignificance of most explanatory variables; best efforts were made to

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meaningful demographic changes will likely occur in Glencoe; according to the Minnesota State Demographic Center (Minnesota Department of Administration), household growth is expected to average .93% per year between 2010 and 2030, close to 2005-2010's annual average of .91%.

[6] Glencoe's energy requirements fall well short of EIA Form-861 DSM reporting thresholds.

[7] The study's conclusions point to a maximum incremental conservation improvement of 1.27% in 2019.

[8] *i.e.* It's estimated strength as a load driver.

Table 4

Econometric Model of Glencoe System Usage, 2001-2010

Dependent Variable: Monthly Energy (MWH)
Estimation Method: Prais-Winsten Regression
Estimation Period: June 2001 - January 2010

	cdda65	hdda65	grp	canning	canning2	pea	Constant
Coefficient	4.638	0.064	1.476	2578	1855	-224	4861
Standard error	(1.688)	(0.253)	(2.321)	(340.669)	(311.589)	(238.451)	(2357.227)
Elasticity	0.033	0.008	0.303			-0.232	
Observations	104						
R-Squared	0.760						
Rho	0.257						
Durbin-Watson	1.896						
RMSE	846						

Variable Key:

cdda65	Cooling Degree Days, Base 65
hdda65	Heating Degree Days, Base 65
grp	Gross Regional Product
pea	Retail Electricity Price, All Customers
canning	Dummy variable, primary cycle of Glencoe canning plant
canning2	Dummy variable, secondary cycle of Glencoe canning plant
Constant	Constant term

dull this effect by assuring a maximal number of observations[9]. Heteroskedasticity was not a focus of research due to its lack of influence upon point estimates.

Peak load was calculated as historical and projected energy requirements for Glencoe scaled by a monthly load factor. Forecasted load factors were estimated using projections from an econometric model of load factor which essentially used dummy variables representing each month. A Prais-Winsten regression was used for model calculation due to its theoretical advantage[10] of allowing the flexible shifting of peak load across months, which is important given the heavy concentration of industrial load in Glencoe. The inclusion of a dummy variable representing the outlier month of June 2009 was an additional advantage over merely using mean load factors insofar as it allowed an adjustment for the unusually low load factor for that month. See **Table 5** for estimation results. Load factor data represented the most recent 8 years of load data for Glencoe, taking into account the higher-than-normal load factors of the cool summers of 2008 and 2009.

Stata statistical software was used for both model estimation and dataset compilation.

Data

Load and energy data was based upon hourly SCADA metered values assessed for Glencoe. Sufficient time was available to include all BTM generation into the respective estimation datasets, and all data reflect losses at the transmission, distribution, and transformer stages.[11] Load and energy data were adjusted by a 3.6% loss factor before modeling to reflect transmission and transformer losses.[12] Reliable data began in June of 2001 and the latest available data extended through January 2010, which gives 104 data points for model estimation. While data by customer class would be desirable and is the subject of future efforts, load, customer, and energy data was only available in the aggregate for the system. SCADA values were used because it was the easiest way to be certain that distribution losses were included; additionally, it was considered important to include the varied load patterns visible in 2008 and 2009 data that otherwise would not have appeared in the dataset.

Economic and demographic data was obtained from the Woods & Poole Economics Minnesota State Profile for 2010 (W&P). Gross Regional Product (GRP), which is the county-level counterpart to Gross Domestic Product (GDP), was chosen as the base for the sole economic variable due to its ease of interpretation, strength as a statistic summarizing a variety of economic activity, and econometric robustness. W&P released its GRP estimates as already adjusted for inflation (*i.e.* real). Historical monthly estimates of gross regional product were in fact yearly State Profile values adjusted to a quarterly shape by the normalized quarterly shape of BEA real GDP for a given year. Yearly estimates of

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[9] Goldberger (1989) prefers "micronumerosity" as a term for the phenomenon, arguing that multicollinearity is essentially a pretentious way of describing the phenomenon of "small sample size." The use of monthly as opposed to yearly data in model estimation blunted this effect.

[10] As reflected in the estimate of rho, the habit persistence coefficient.

[11] The SCADA system was positioned on the distribution side of the transmission/distribution transformer. Thus, distribution losses were already included.

[12] 2.6% transmission losses per MISO's most recent available SAWG (Supply Adequacy Working Group) estimates, as well as a 1.0% transformer losses factor, per correspondence with Glencoe's engineering department.

Table 5

Econometric Model of Glencoe System Peak Demand, 2001-2010

Dependent Variable: Load Factor
Estimation Method: Prais-Winsten Regression
Estimation Period: June 2001 - January 2010
January dummy omitted due to collinearity

	_lmonth_2	_lmonth_3	_lmonth_4	_lmonth_5	_lmonth_6	_lmonth_7	_lmonth_8	_lmonth_9	_lmonth_10	_lmonth_11	_lmonth_12	lf09	Constant
Coefficient	0.0159	0.0136	-0.00912	-0.085	-0.175	-0.151	-0.101	-0.0958	-0.136	-0.033	-0.0287	-0.0408	0.754
Standard error	(0.026)	(0.025)	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.026)	(0.054)	(0.017)

Observations	104
R-Squared	0.696
Rho	-0.115
Durbin-Watson	1.971
RMSE	0.051

Variable Key:

_lmonth_2	Dummy variable for month of February
_lmonth_3	Dummy variable for month of March
_lmonth_4	Dummy variable for month of April
_lmonth_5	Dummy variable for month of May
_lmonth_6	Dummy variable for month of June
_lmonth_7	Dummy variable for month of July
_lmonth_8	Dummy variable for month of August
_lmonth_9	Dummy variable for month of September
_lmonth_10	Dummy variable for month of October
_lmonth_11	Dummy variable for month of November
_lmonth_12	Dummy variable for month of December
lf09	Dummy variable for June of 2009
Constant	Constant term

GRP were forecasted by applying CMMPA's economic growth forecast to 2008 State Profile values. CMMPA's internal growth forecast eschewed a model, representing instead the agency's judgment as to the most likely path of yearly real GRP growth for the state of Minnesota. Historical and forecasted estimates of GRP are given in **Table 6(a)**; in a similar manner to the calculation of load shapes, forecasted monthly GRP was calculated from the corresponding quarterly BEA real gross domestic product (RGDP) historical values.

Dummy variables representing industrial load in general and canning load in particular were calculated based upon discussions with member cities. For Glencoe, two processes were assumed: One which operated at the same level only for the months of June through September, and a second that operated only for the month of August (with the past exception of 2004). Our estimates imply that industrial load historically accounted for approximately 5,000 MWh of load variation between August and May.

Retail electricity prices[13] were derived from historical and near-term forecasted EIA Short-Term Energy Outlook (STEO) data from the February 2010 release. Forecasts of prices after 2011 (the last year data was available data for the December 2009 STEO) used historical averages of all STEO data provided in the release to provide a monthly shape to yearly values taken from the EIA Annual Energy Outlook (AEO) release for 2009. Historical and forecasted estimates are reprinted in **Table 6(b)**.

The weather variables of Cooling Degree Days (CDD) and Heating Degree Days (HDD) were mapped to Glencoe from the nearby Hutchinson weather station and were obtained from the NCDC/NOAA Annual Climatological Summaries. All forecasted values assumed a 30-year normal weather year and used monthly data starting in January 1978 through the most recently released ACS data of October 2009. CDD and HDD each represent a measure of average temperature relevant to HVAC usage, and in mathematical terms each is defined as the sum of daily average temperature deviations from a temperature base. In this application, both CDD and HDD had a dry-bulb temperature base of 65 degrees Fahrenheit, which is the most commonly available form in Minnesota. Historical and forecasted estimates are reprinted in **Table 6(c)**.

Considerations and Assumptions

Conservation improvements were assumed to have a conservatively-estimated effect upon demand. Conservation improvements are expected to start in 2010 with a constant .25% decrease in load in all hours, increasing to 1.5% in 2015, and holding thereafter at the level established in Minnesota's *Next Generation Energy Act* of 2007. Improvements are also expected to hold equally across hours due to the lack of current or imminent system demand response and dynamic pricing programs which might induce higher system load factors.

Retail electricity prices are expected to increase at an average rate of 2.1% over the next 20 years. Given that the estimated elasticity of load to price in the system is approximately -20%, this would imply an upward adjustment of roughly 8% of energy if electricity prices remained level between 2010 and 2030.

[13] All customers, West North Central region (includes Minnesota). All units in cents per kilowatt hour.

Table 6 (a)

Historical and Forecasted Real Gross Regional Product (GRP) for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	GRP millions of 2004$	Growth
	2001	1,119	1,119	1,119	1,126	1,126	1,126	1,123	1,123	1,123	1,127	1,127	1,127	1,124	
	2002	1,181	1,181	1,181	1,187	1,187	1,187	1,193	1,193	1,193	1,193	1,193	1,193	1,188	5.6%
	2003	1,231	1,231	1,231	1,241	1,241	1,241	1,262	1,262	1,262	1,273	1,273	1,273	1,252	5.2%
	2004	1,257	1,257	1,257	1,266	1,266	1,266	1,275	1,275	1,275	1,286	1,286	1,286	1,271	1.5%
Historical	2005	1,296	1,296	1,296	1,302	1,302	1,302	1,312	1,312	1,312	1,319	1,319	1,319	1,307	2.8%
	2006	1,318	1,318	1,318	1,323	1,323	1,323	1,323	1,323	1,323	1,333	1,333	1,333	1,324	1.3%
	2007	1,310	1,310	1,310	1,320	1,320	1,320	1,332	1,332	1,332	1,339	1,339	1,339	1,325	0.1%
	2008	1,340	1,340	1,340	1,344	1,344	1,344	1,335	1,335	1,335	1,317	1,317	1,317	1,334	0.7%
	2009	1,295	1,295	1,295	1,292	1,292	1,292	1,300	1,300	1,300	1,318	1,318	1,318	1,301	-2.5%
	2010	1,319	1,319	1,319	1,329	1,329	1,329	1,337	1,337	1,337	1,346	1,346	1,346	1,333	2.4%
	2011	1,356	1,356	1,356	1,367	1,367	1,367	1,375	1,375	1,375	1,385	1,385	1,385	1,371	2.8%
	2012	1,397	1,397	1,397	1,408	1,408	1,408	1,417	1,417	1,417	1,427	1,427	1,427	1,412	3.0%
	2013	1,436	1,436	1,436	1,447	1,447	1,447	1,456	1,456	1,456	1,466	1,466	1,466	1,451	2.7%
	2014	1,473	1,473	1,473	1,485	1,485	1,485	1,494	1,494	1,494	1,504	1,504	1,504	1,489	2.6%
	2015	1,514	1,514	1,514	1,526	1,526	1,526	1,535	1,535	1,535	1,546	1,546	1,546	1,530	2.7%
	2016	1,554	1,554	1,554	1,566	1,566	1,566	1,575	1,575	1,575	1,586	1,586	1,586	1,570	2.6%
	2017	1,595	1,595	1,595	1,607	1,607	1,607	1,617	1,617	1,617	1,628	1,628	1,628	1,612	2.6%
	2018	1,637	1,637	1,637	1,649	1,649	1,649	1,660	1,660	1,660	1,671	1,671	1,671	1,654	2.6%
	2019	1,680	1,680	1,680	1,693	1,693	1,693	1,703	1,703	1,703	1,715	1,715	1,715	1,698	2.6%
	2020	1,724	1,724	1,724	1,737	1,737	1,737	1,748	1,748	1,748	1,760	1,760	1,760	1,742	2.6%
Forecasted	2021	1,769	1,769	1,769	1,783	1,783	1,783	1,794	1,794	1,794	1,806	1,806	1,806	1,788	2.6%
	2022	1,816	1,816	1,816	1,830	1,830	1,830	1,841	1,841	1,841	1,854	1,854	1,854	1,835	2.6%
	2023	1,864	1,864	1,864	1,878	1,878	1,878	1,890	1,890	1,890	1,903	1,903	1,903	1,884	2.6%
	2024	1,913	1,913	1,913	1,928	1,928	1,928	1,940	1,940	1,940	1,953	1,953	1,953	1,933	2.6%
	2025	1,963	1,963	1,963	1,979	1,979	1,979	1,991	1,991	1,991	2,004	2,004	2,004	1,984	2.6%
	2026	2,015	2,015	2,015	2,031	2,031	2,031	2,043	2,043	2,043	2,057	2,057	2,057	2,037	2.6%
	2027	2,068	2,068	2,068	2,084	2,084	2,084	2,097	2,097	2,097	2,111	2,111	2,111	2,090	2.6%
	2028	2,123	2,123	2,123	2,139	2,139	2,139	2,152	2,152	2,152	2,167	2,167	2,167	2,145	2.6%
	2029	2,178	2,178	2,178	2,195	2,195	2,195	2,209	2,209	2,209	2,224	2,224	2,224	2,202	2.6%
	2030	2,236	2,236	2,236	2,253	2,253	2,253	2,267	2,267	2,267	2,283	2,283	2,283	2,260	2.6%

Average Quarterly Values,						
2001-2009 (Historic)	1,261	1,267	1,273	1,278	5,078	1.8%
2010-2020 (Forecasted)	1,517	1,529	1,538	1,548	6,132	2.7%
2020-2030 (Forecasted)	1,970	1,985	1,998	2,011	7,964	2.6%

Table 6 (b)

Historical and Forecasted Retail Electricity Prices, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Average (cents/kwh)	Growth
	2001	5.4	5.6	5.6	5.7	6.1	6.6	6.9	6.8	6.1	5.7	5.5	5.5	6.0	
	2002	5.5	5.6	5.6	5.6	5.9	6.6	6.8	6.6	6.2	5.6	5.6	5.5	5.9	-0.6%
	2003	5.4	5.6	5.7	5.8	6.1	6.6	6.8	6.8	6.2	5.7	5.5	5.6	6.0	1.0%
	2004	5.7	5.7	5.8	5.8	6.2	6.7	7.0	6.9	6.4	5.9	5.8	5.8	6.1	2.6%
Historical	2005	5.7	5.8	5.9	6.0	6.3	7.0	7.1	7.1	6.7	6.1	6.0	6.0	6.3	2.7%
	2006	6.1	6.2	6.1	6.2	6.6	7.3	7.6	7.4	6.9	6.5	6.2	6.1	6.6	4.5%
	2007	6.2	6.3	6.4	6.5	6.7	7.6	7.7	7.6	7.0	6.5	6.4	6.4	6.8	2.6%
	2008	6.4	6.5	6.6	6.7	7.1	7.9	8.2	8.0	7.5	7.0	6.9	6.9	7.1	5.3%
	2009	6.9	7.1	7.3	7.3	7.6	8.3	8.5	8.5	7.8	7.3	7.0	7.0	7.6	5.6%
	2010	6.8	6.9	7.0	7.0	7.3	8.1	8.4	8.3	7.7	7.2	6.9	6.8	7.4	-2.5%
	2011	6.8	6.9	7.0	7.0	7.4	8.1	8.5	8.4	7.8	7.2	7.0	6.9	7.4	0.7%
	2012	7.0	7.2	7.2	7.3	7.8	8.5	8.8	8.7	8.0	7.4	7.2	7.2	7.7	3.7%
	2013	7.2	7.4	7.4	7.5	8.0	8.7	9.0	8.9	8.2	7.6	7.4	7.4	7.9	2.5%
	2014	7.5	7.6	7.7	7.7	8.2	9.0	9.3	9.2	8.5	7.8	7.7	7.6	8.2	3.3%
	2015	7.6	7.8	7.9	7.9	8.4	9.3	9.5	9.4	8.7	8.0	7.9	7.8	8.3	2.3%
	2016	7.9	8.0	8.1	8.1	8.7	9.5	9.8	9.7	9.0	8.2	8.1	8.0	8.6	2.9%
	2017	8.1	8.2	8.3	8.4	8.9	9.8	10.1	10.0	9.2	8.5	8.3	8.2	8.8	2.9%
	2018	8.3	8.5	8.6	8.6	9.2	10.1	10.4	10.3	9.5	8.7	8.5	8.5	9.1	2.7%
	2019	8.5	8.7	8.8	8.8	9.4	10.3	10.6	10.5	9.7	8.9	8.8	8.7	9.3	2.4%
	2020	8.8	8.9	9.0	9.1	9.7	10.6	10.9	10.8	10.0	9.2	9.0	8.9	9.6	2.9%
Forecasted	2021	9.0	9.2	9.3	9.3	9.9	10.9	11.2	11.1	10.3	9.4	9.2	9.2	9.8	2.6%
	2022	9.2	9.4	9.5	9.6	10.2	11.2	11.5	11.4	10.5	9.7	9.5	9.4	10.1	2.7%
	2023	9.4	9.6	9.7	9.8	10.4	11.4	11.7	11.6	10.8	9.9	9.7	9.6	10.3	2.0%
	2024	9.6	9.8	9.9	9.9	10.6	11.6	12.0	11.8	11.0	10.1	9.9	9.8	10.5	1.9%
	2025	9.8	9.9	10.1	10.1	10.8	11.8	12.2	12.0	11.1	10.2	10.0	10.0	10.7	1.7%
	2026	9.9	10.1	10.2	10.3	10.9	12.0	12.4	12.3	11.3	10.4	10.2	10.1	10.9	1.7%
	2027	10.2	10.3	10.4	10.5	11.2	12.3	12.6	12.5	11.6	10.6	10.4	10.3	11.1	2.2%
	2028	10.5	10.6	10.8	10.8	11.5	12.7	13.0	12.9	11.9	11.0	10.7	10.6	11.4	2.8%
	2029	10.8	11.0	11.1	11.2	11.9	13.1	13.4	13.3	12.3	11.3	11.1	11.0	11.8	3.2%
	2030	11.1	11.3	11.4	11.5	12.2	13.4	13.8	13.7	12.7	11.6	11.4	11.3	12.1	2.8%
Average Monthly Prices, 2001-2009 (Historic)		6.0	6.0	6.1	6.2	6.5	7.2	7.4	7.3	6.8	6.3	6.1	6.1	6.5	3.0%
2010-2020 (Forecasted)		7.8	7.8	7.9	7.9	8.4	9.3	9.6	9.5	8.8	8.1	7.9	7.8	8.4	2.6%
2020-2030 (Forecasted)		9.8	10.0	10.1	10.2	10.8	11.9	12.2	12.1	11.2	10.3	10.1	10.0	10.7	2.4%

Table 6 (c)

Historical and Forecasted Cooling Degree Days for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Annual CDD
Historical	2001	0	0	0	11	36	174	310	253	44	4	0	0	832
	2002	0	0	0	15	25	209	365	183	117	2	0	0	916
	2003	0	0	0	8	16	115	221	250	74	21	0	0	705
	2004	0	0	0	4	24	59	183	50	119	3	0	0	442
	2005	0	0	0	5	4	206	296	175	91	17	0	0	794
	2006	0	0	0	5	77	165	367	182	32	15	0	0	843
	2007	0	0	0	4	63	179	259	159	108	23	0	0	795
	2008	0	0	0	0	7	79	233	142	44	0	0	0	505
	2009	0	0	0	4	35	117	122	116	68	0	0	0	462
	2010	0	0	0	5	40	145	247	172	59	5	0	0	674
Forecasted	2011	0	0	0	5	40	145	247	172	59	5	0	0	674
	2012	0	0	0	5	40	145	247	172	59	5	0	0	674
	2013	0	0	0	5	40	145	247	172	59	5	0	0	674
	2014	0	0	0	5	40	145	247	172	59	5	0	0	674
	2015	0	0	0	5	40	145	247	172	59	5	0	0	674
	2016	0	0	0	5	40	145	247	172	59	5	0	0	674
	2017	0	0	0	5	40	145	247	172	59	5	0	0	674
	2018	0	0	0	5	40	145	247	172	59	5	0	0	674
	2019	0	0	0	5	40	145	247	172	59	5	0	0	674
	2020	0	0	0	5	40	145	247	172	59	5	0	0	674
	2021	0	0	0	5	40	145	247	172	59	5	0	0	674
	2022	0	0	0	5	40	145	247	172	59	5	0	0	674
	2023	0	0	0	5	40	145	247	172	59	5	0	0	674
	2024	0	0	0	5	40	145	247	172	59	5	0	0	674
	2025	0	0	0	5	40	145	247	172	59	5	0	0	674
	2026	0	0	0	5	40	145	247	172	59	5	0	0	674
	2027	0	0	0	5	40	145	247	172	59	5	0	0	674
	2028	0	0	0	5	40	145	247	172	59	5	0	0	674
	2029	0	0	0	5	40	145	247	172	59	5	0	0	674
	2030	0	0	0	5	40	145	247	172	59	5	0	0	674
Average Monthly CDD,														
2001-2009 (Historic)		0	0	0	6	32	145	262	168	77	9	0	0	699
2010-2030 (Forecasted)		0	0	0	5	40	145	247	172	59	5	0	0	674

Table 6 (c)

Historical and Forecasted Heating Degree Days for Glencoe, 2001-2030

		January	February	March	April	May	June	July	August	September	October	November	December	Annual HDD
Historical	2001	1,417	1,564	1,242	579	200	56	11	0	198	526	605	1,198	7,596
	2002	1,290	1,139	1,360	625	380	38	2	3	129	780	1,020	1,217	7,983
	2003	1,572	1,438	1,073	500	254	45	0	3	193	475	1,046	1,301	7,900
	2004	1,683	1,342	909	496	305	82	24	95	82	462	836	1,359	7,675
	2005	1,611	1,145	1,090	438	313	1	6	18	87	447	871	1,468	7,495
	2006	1,204	1,349	1,026	396	242	27	0	5	220	595	907	1,201	7,172
	2007	1,437	1,523	947	618	147	12	5	20	157	407	948	1,620	7,841
	2008	1,719	1,552	1,206	689	298	36	3	11	148	561	946	1,667	8,836
	2009	1,895	1,306	1,132	587	249	96	17	30	77	734	986	1,459	8,568
Forecasted	2010	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2011	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2012	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2013	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2014	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2015	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2016	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2017	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2018	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2019	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2020	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2021	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2022	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2023	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2024	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2025	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2026	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2027	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2028	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2029	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
	2030	1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048
Average Monthly HDD,														
2001-2009 (Historic)		1,536	1,373	1,109	548	265	44	8	21	143	554	897	1,379	7,896
2010-2030 (Forecasted)		1,618	1,333	1,068	571	235	46	8	22	165	538	986	1,459	8,048

Historical relationships, specifically climate, load factors and the elasticity of energy to modeled load drivers, were generally assumed to remain unchanged into the future from the model data period (2001-2010), which was justified by noting the variation already embodied within the load dataset. A corollary was that patterns in industrial load were expected to hold over the forecast horizon, which is justifiable given that openings and closings of large industrial concerns are more or less unforeseeable. Since the possibility of climate change is outside the scope of a rigorous investigation for this context, a forecasts presumed that weather patterns over the last 30 years would be representative.

Extraordinary changes in electricity usage were not reflected in the forecast. These included (a) switching of traditional non-electric energy sources to that of electricity (*e.g.* electric cars); (b) changes due to legal, legislative, regulatory, or policy actions, including prospective climate change bills; (c) Unanticipated improvements in efficiency; and (d) significant development of substitute energy sources, the most salient example of which, replacement of electric space heating by that of natural gas, is not considered in practical terms likely.