Integrated Resource Plan

Great River Energy

GREAT RIVER
ENERGY®

A Touchstone Energy® Cooperative

Elk River, Minnesota

July 1, 2005

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EXECUTIVE SUMMARY

Introduction

Great River Energy (GRE) is a generation and transmission (G&T) electric cooperative that provides electrical energy and related services to the 28 member distribution cooperatives (members) that own it. GRE's 28 members serve more than 600,000 end-use consumers throughout much of Minnesota.

GRE experiences its highest demand during the summer. In 2004, GRE experienced a summer system peak of 2,312 MW (non-weather adjusted). To serve the needs of its members during the year, GRE utilizes its generation facilities and portfolio of short- and long-term contracts.

GRE's 2,500 MW generation system is composed of a mix of baseload and peaking power plants, including coal-fired, refuse-derived fuel, natural gas and oil plants, as well as wind generation.

GRE owns approximately 4,500 miles of transmission line, including the high voltage, 436 mile direct current, or DC, transmission line that runs from Coal Creek Station to Minnesota. GRE also owns or partially owns more than 100 transmission substations.

GRE also has significant load control capabilities. During the summer, GRE is able to control about 300 MW of load. GRE's winter control capability is about 175 MW.

This is the third Integrated Resource Plan (IRP or Resource Plan) filed by GRE. Since the filing of its last resource plan, GRE has diligently pursued the items in its action plan including the pursuit of high-level DSM savings goals, a good faith effort to achieve the Renewable Energy Objectives, upgrades to existing facilities, consideration of all relevant factors in deciding to construct a new combustion turbine, and closer examination of GRE's future needs. GRE has also incorporated the advice from the Minnesota Public Utilities Commission in its order accepting GRE's 2003 resource plan.

The primary goal of GRE's resource planning process is to develop the framework and action plan to provide reliable, competitively priced energy to its members. The goal is achieved through an analytical process that complies with Minnesota statutes and the rules and requirements of all regulatory authorities which oversee GRE's operations.

GRE uses the following principles to help guide its resource planning decisions:

1. GRE will develop resource plans meeting appropriate levels of energy and capacity demands: “median energy” and “high demand”.
2. GRE will plan its power supply to minimize total costs over the long term.
3. GRE will plan its power supply to minimize risks over the long term.
4. GRE will balance modeling results, market intelligence, and practical realities in guiding its power supply choices.
5. GRE recognizes that power supply partnerships are in its future.
6. GRE will be a good environmental steward through its power supply decisions.
7. GRE will analyze power supply options with consideration of the economic risks and political concerns of climate change policy.
8. GRE will actively pursue conservation and demand response programs that are cost effective alternatives to supply side resources.
9. GRE will continue to actively pursue the development of renewable resources.
10. GRE will remain current on technological changes in the industry and lend its support to additional sound technology development efforts.

Planning Process

GRE uses a multi-step process to arrive at its preferred resource plan and the accompanying action plan.

1. GRE develops system demand and energy forecasts.
2. GRE examines the ability of current supply- and demand-side resources to meet the forecasted demand and energy requirements of its members.
3. A resource planning model utilizes a variety of generic resource options to meet the forecasted demand and energy deficits that occur when current resources are insufficient to meet forecasted requirements. The resource plans are ranked by cost as measured by the present value of revenue requirements (PVRR).
4. Six low cost plans are evaluated for risk. The risk evaluation results in a distribution of a plan’s revenue requirement when accounting for the uncertainty of input variables such as fuel prices, GRE’s energy requirements, and market electric prices.
5. Subsequently, GRE evaluates how compliance with Minnesota Statutes and environmental externality costs would influence the revenue requirement and risk of specific plans.
6. Finally, using the analysis of the resource plans and taking into account a number of practical realities such as the timing of actual project development and the preferences and risk tolerance of its

member cooperatives, GRE develops an action plan to provide GRE members with a plan that has the greatest overall economic benefit.

For purposes of this plan, GRE defines the greatest economic benefit as being the lowest cost of service to GRE's members at an acceptable level of risk in terms of the potential for changes in cost of service. While no strategy is risk free, GRE has taken care in its effort to measure the risk of each strategy considered and select a strategy that manages risk though prudent resource investments.

Load Forecast

Every two years, Great River Energy develops a Long-Range Load Forecast (load forecast). The load forecast is designed to meet the regulatory requirements of federal and state agencies as well as internal planning requirements.

GRE assists each member cooperative in preparing forecasts for each RUS consumer classification. As the end-use load served by GRE, these member systems are primarily residential; therefore the forecast number of residential consumers and the average energy use per consumer are key drivers of the load forecast and are analyzed extensively using econometric models and demographic data. GRE prepared this data and its internally developed models for each member cooperative. GRE assisted its members in understanding the models and data and choosing the appropriate model for their individual forecasts.

For the small commercial class, GRE also prepared data and an econometric model based on the relationship between residential and small commercial customers. GRE assisted its members in choosing the appropriate model for their individual forecasts.

Large commercial and industrial customers were forecast on an individual basis by GRE member cooperative systems. Seasonal, irrigation, public street and highway, public authorities, and sales for resale were forecast based on past trends and known changes.

The Great River Energy forecast is the sum of the member system forecasts plus GRE usage and line losses.

GRE's summer demand is expected to grow 95.7 MW per year, or at an average annual rate of increase of 3.0 percent. Winter demand is forecasted to grow an average of 51.2 MW over the forecast period. This is a 2.2 percent average annual rate of increase. GRE forecasted five different summer demand scenarios that are based on varying assumptions about future weather and economic conditions. For planning purposes GRE uses the demand forecast produced as “scenario 5”, normal weather with more optimistic macroeconomics assumptions.

GRE’s system energy requirement is expected to increase at an average annual rate of 2.3 percent over the forecast period.

GRE began working with its members to provide written documentation of factors that lead them to arrive at an energy forecast that deviates from statistically-derived models prepared by GRE. In addition, GRE has contracted with a consultant to prepare an estimate of the effects of GRE’s various demand side management programs that may be used in future load forecasts.

Existing Resources

<u>Demand-side Resources</u>: GRE has a strong commitment to demand-side management (DSM) and has been actively working to improve its programs. As part of these efforts, GRE has implemented many of the Department of Commerce’s recommendations from previous regulatory proceedings.

GRE has been successful in controlling demand the approximant equivalent of a 300-MW power plant. Reducing peak demands has been a major concern to GRE, since its summer peak has been driving most of its recent generation additions. GRE also estimates that its Conservation Improvement Programs (CIP) in 2004 resulted in a total energy savings of 143.7 million kWh.

<u>Supply-side Resources</u>: The figure below summarizes GRE’s existing supply-side resources, including its major purchases and sales.

Figure-1 Simplified GRE Capacity Resources and Current Summer Accredited Rating in 2005

Simplified GRE Capacity Resources and Current Summer Accredited Rating in 2005

Unit Name	Capacity MW
Owned Resources	
Pleasant Valley Station	427.3
Lakefield Junction	514.8
Cambridge CT	19.4
Maple Lake CT	19.1
Rock Lake CT	19.3
St. Bonifacius CT	50.0
Elk River Station 1	10.5
Elk River Station 2	10.6
Elk River Station 3	17.8
Stanton Station	186.7
Stanton Station diesel	1.0
Coal Creek Station 1	551.0
Coal Creek Station 2	561.0
Coal Creek Station diesel	2.0
Chandler Phase 1	0.1
Total Owned Resources:	2390.6
Major Purchase Resources	
Genoa 3	172.3
Western Area Power Administration	89.8
Manitoba Hydro Diversity Exchange	150.0
Manitoba Hydro capacity and energy	50.0
Minnesota Power Block A & B	175.0
Total Major Purchases:	637.1
Major Commitments (Sales)	
NSP (Koch)	75.0
Willmar	28.0
NSP (Diversity Exchange)	50.0
Total Major Sales:	153.0

Renewable Resources: GRE is also committed to developing renewable resources. It currently has contracts to purchase the output from 18 MW of wind resources. Also, in 2004 GRE signed a contract to purchase the output of Trimont Wind I, LLC (Trimont), a 100 MW (nameplate) wind project, which will be on-line by the end of 2005. GRE owns and operates Elk River Station, a waste-to-energy facility. The station utilizes refuse-derived fuel as its primary energy source, a renewable fuel as defined by Minnesota Statutes 216B.1691. GRE also has a contract with the Elk River Municipal Utility for the purchase of 2.4 MW of capacity and energy from a landfill gas project installed at the Elk River Landfill. Finally, GRE has contracted to purchase the output of two anaerobic digester projects under contracts that are reviewed and potentially renewed on an annual basis.

GRE markets its wind resources to its members and their customers through the Wellspring program. GRE is also making a good faith effort to achieve the Renewable Energy Objective. GRE's renewable energy that is not specifically sold, either through the Wellspring program or to other utilities, is used toward the REO.

Transmission Resources: GRE provides transmission service to its members through its ownership of approximately 4,500 miles of transmission lines as well as through other agreements. Joining the Midwest Independent Transmission System Operator (MISO) significantly changed GRE's transmission agreements. GRE's transmission facilities were integrated into the MISO network on December 1, 2004. Most of the transmission service under legacy agreements has been replaced with Network Integrated Service from MISO. MISO network service provides several benefits to GRE's members. First, it eliminates rate pancaking. Prior to becoming a MISO member, GRE had several instances where multiple contracts were necessary to provide full load-serving capabilities. Now, the single MISO tariff provides the same level of service under one single tariff rate. Also, MISO network service gives access to a larger transmission network than GRE's previous arrangements.

Resource Requirements

GRE determined its resource requirements by comparing its available resources with its forecasted demand. Figure 2 below summarizes the surpluses and deficits expected over the forecast period.

Figure-2 GRE Summer Resource Surplus/Deficit

GRE Summer Resource Surplus/Deficit	
Year	Surplus/Deficit (MW)
2005	-23
2006	-57
2007	-20
2008	-121
2009	-224
2010	-477
2011	-493
2012	-595
2013	-700
2014	-816
2015	-1097
2016	-1176
2017	-1294
2018	-1408
2019	-1524
2020	-1637

GRE has analyzed its internal structure and policies as well as external issues within the industry to identify key factors that may impact supply and demand. GRE has identified two primary areas for which it must engage in contingency planning: the provision in its Power Purchase Contract that allows member cooperatives to take a portion of their load to an alternate supplier, and future potential environmental legislation.

GRE has taken appropriate steps to adequately address the contingencies associated with the power supply decisions of its member cooperatives.

GRE is continuously assessing the direction and likelihood of new environmental initiatives or policy changes. Some of the specific issues it has analyzed and addressed include:

- Regional haze.
- National ambient air quality standards.
- Mercury.
- Multi-emissions legislation.
- Clean Air Interstate rule.
- CO2 emissions.
- Impaired waters and total maximum daily loads.
- Aquatic life protection at cooling water intake structures.

Although many of these policies are not fully developed, GRE is closely monitoring the issues and is confident that it will be ready to respond to any new policies that are implemented.

GRE's analysis of factors that could impact supply and demand strengthen its planning process. Its final assessment is that these factors will not impact the near term of the planning horizon. Thus, continued study will ensure that GRE has adequate time to respond to policy and other changes and appropriately adjust its overall resource plan.

Resource Options

Great River Energy has undertaken a comprehensive analysis of resource options available to meet its projected resource needs over the planning period.

<u>Demand-Side Resources</u>: In developing its DSM program, GRE examines the overall potential of demand resources among its end-use consumers. In 2003, GRE contracted with expert DSM consultants, Global Energy Partners LLC (Global), an Electric Power Research Institute (EPRI) affiliate company, to conduct a full DSM potentials study. GRE used the results of its DSM potential study to analyze its specific programs and consequently implemented some changes.

GRE's future direction for its DSM will be to focus on programs that best match the type of energy resources that it will need to add to its system to meet future needs. Up until now, that focus has been reducing summer peak demands. GRE will continue to offer DSM programs and incentives to reduce these peaks, but now that different types of energy resource needs have been identified, GRE is actively analyzing new programs. GRE recognizes, however, that these programs only provide incremental changes to its overall needs and will continue to address the more fundamental concerns with DSM and investigate more long term ideas to facilitate a bigger impact from demand-side resources.

<u>Supply-Side Resources</u>: On the supply side, GRE considered three types of resources using generic cost and performance data. The peaking capacity option is represented by a simple cycle combustion turbine. The intermediate capacity option is represented by a combined cycle unit. The baseload capacity option is represented by a pulverized coal plant.

These generic units were used as the basis for modeling. As GRE utilizes the modeling results in making "real world" resource acquisition decisions, it must also consider a number of practical realities, such as the real and perceived risks associated with some types of plants, the types and timing of actual project development, and the characteristics and availability of market capacity and energy. GRE is closely monitoring the MISO market as it matures to evaluate whether it might open new opportunities for meeting GRE's power needs.

Renewable Resources: GRE also evaluated a number of renewable resource alternatives, including wind, wood-fired steam generation, animal waste, whole tree burning, ethanol-fired combustion turbines, hydroelectric power, photovoltaics and landfill gas. Many of these resources are not necessarily feasible for large-scale development, but may be pursued on a more limited scale. GRE concluded that wind is the preferred renewable resource for larger development, such as would be necessary to meet the objectives in the REO.

GRE has gone further than pursuing a good faith effort to comply with the Minnesota REO. GRE currently provides 2.1 percent of its energy requirements through renewable energy resources, while the REO objective for 2005 is for one percent. GRE projects will meet the REO objectives at least through 2007 with the addition of Trimont.

GRE's modeling shows a modest improvement in the overall cost of its resource plans by continuing to meet the REO. Thus, assuming no major impacts to the costs, GRE intends to incorporate achievement of the REO in its action plan. However, GRE notes that factors (such as the discontinuation of the production tax credits) that would have a large impact on the price of wind power would result in GRE re-examining possibilities for its good faith effort to achieve the REO.

Transmission Issues: The current environment in the electric industry does not allow transmission lines to be a true alternative to generating resources in most instances. Further, any transmission development is a long and complex process. Regulatory uncertainty regarding the cost recovery of transmission investment further complicates the issue. GRE has recently teamed with other utilities[1] in the state to develop a vision for transmission infrastructure investments needed in Minnesota during the next fifteen years. Recent legislation enacted in the State of Minnesota put in place several provisions that could specifically benefit the long-term transmission situation in the state.

GRE is optimistic that through coordinated efforts the long-term transmission situation will be improved and additional necessary transmission will be built.

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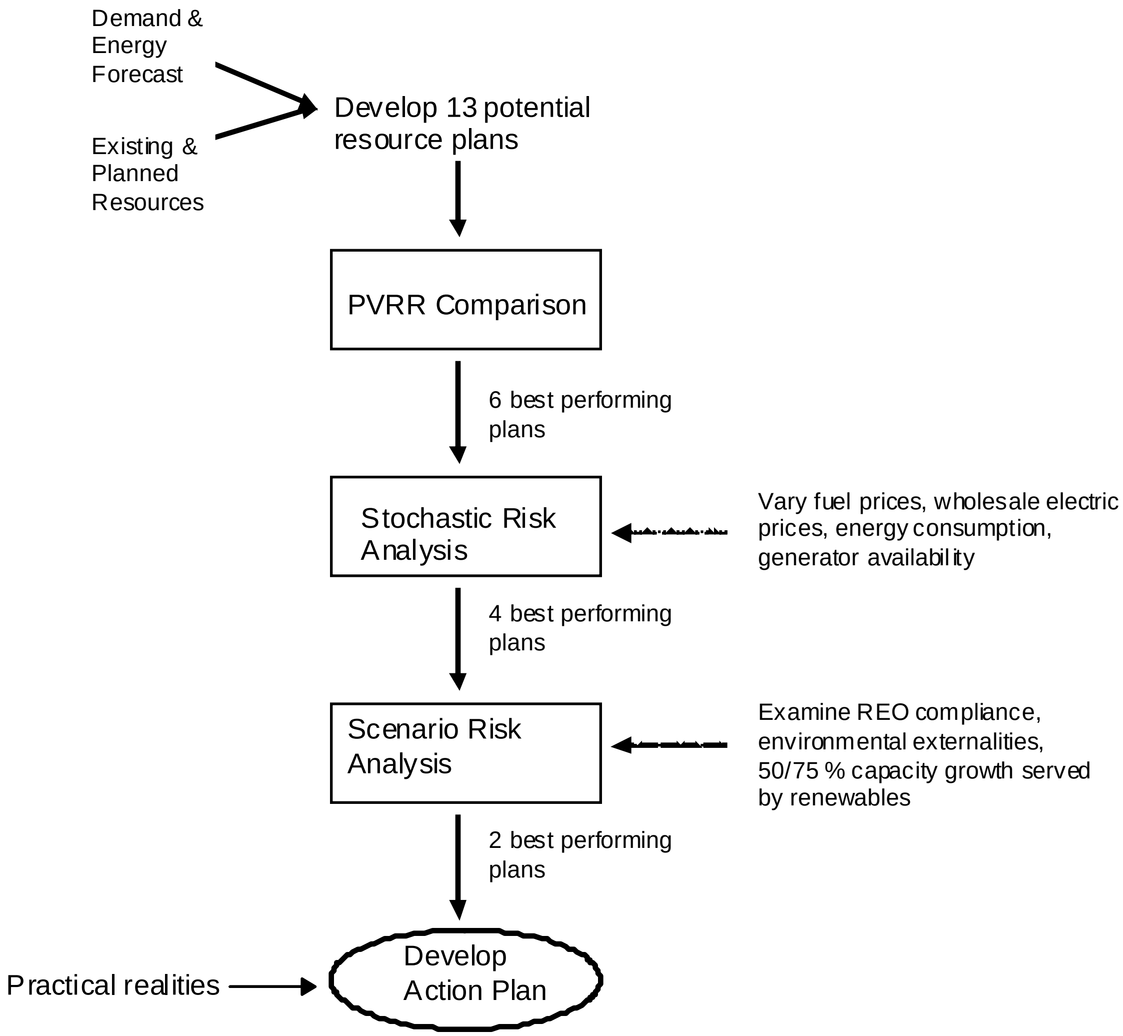
[1] Great River Energy, Minnesota Power, Otter Tail Power Company and Xcel Energy jointly formed CapX 2020 in the summer of 2004; Minnkota Power Cooperative, Missouri River Energy Services and Southern Minnesota Municipal Power Agency subsequently joined this effort. The companies are calling the effort Minnesota CapX 2020, short for Capital Expenditures by the year 2020

The industry paradigm that prevents transmission from being analyzed as a substitute to generation is unlikely to change in the near term, but resource decisions can and should consider associated transmission issues to provide a complete picture of the relative costs and risks of different potential projects.

Resource Plans

GRE contracted with Global Energy Decisions (Global Energy), formerly Henwood Energy Services Inc., to conduct its modeling for this plan. The modeling process evaluates different resource plans. First, each plan is evaluated for cost by identifying the present value of revenue requirements (PVRR). Next certain plans are evaluated further through stochastic and scenario risk analysis. The variables examined in the stochastic risk analysis include: natural gas price, fuel oil price, electricity market price, GRE load, and generator availability. The scenario analysis examined the impact on the plan of fully achieving the REO objectives, environmental externalities, and meeting 50 and 75 percent of new or refurbished capacity additions through renewable resources. The figure below illustrates the modeling process.

Figure-3 Modeling Process



The first step was to construct 13 plans capable of meeting GRE's needs over the planning horizon and compare the costs (in terms of present value of the revenue requirements or PVRR) of the plans. Although the plans have dramatically different resource additions, the difference in cost (PVRR) from least to most costly is only 5.05 percent. However small, the differences in PVRR help to narrow down the range of plans to further examine in the risk analysis.

Next, GRE directed Global Energy to conduct the risk assessment on six of the best performing plans. The variables examined in the risk analysis were: natural gas price, fuel oil price, electricity market price, GRE load, and generator availability. The risk assessment results in the calculation of

Revenue Requirements at Risk (RRaR) for each plan, which provides a measure for comparing the level of risk associated with each plan.

All else being equal, GRE would choose the plan that minimizes risk and cost simultaneously. Typically, there is some trade-off between risk and reward, so no one plan minimizes both. However, the initial modeling results showed which plans performed best considering both cost and risk.

The next step in GRE's risk analysis was to have Global Energy conduct scenario analysis to examine compliance with the REO, environmental externalities, and the plans to meet 50 and 75 percent of future capacity needs with DSM or renewables.

REO Scenario Results: The results demonstrate a modest decrease in the expected present value of revenue requirements when wind resources are included so that GRE can meet the REO. However, the effects of the additional wind capacity, from a risk perspective, are mixed.

Environmental Externality Scenario Results: This analysis shows that incorporating the low or high externality values does not significantly impact the risk v. cost analysis of the plans examined.

50/75 percent Scenario Results: Both the 50 and 75 percent plans increase the expected costs above that of the base case plans. Further, the plans also carry with them a dramatically higher risk than any of the base case plans or the REO cases.

This series of modeling runs provide GRE valuable information to be used in selecting a preferred plan. GRE first narrowed the plans based on costs. Then GRE eliminated some plans because the risks exceeded GRE's risk tolerance. Also, GRE ensured that the remaining plans performed well in its scenario analysis. Finally, GRE constructs its action plan based on further analysis of the two best performing plans in the context of other practical realities and business objectives. Therefore, after several steps of modeling and risk analysis, GRE concludes with two very similar plans as its preferred plan and from these plans develops its action plan.

Action Plan

GRE divides its action plan into three categories of resource acquisition: the near term period of this planning horizon (approximately 2008 – 2010), the mid term period of this planning horizon (2011 – 2017), and the long term period of this planning horizon (2018 and beyond).

Near Term: Peaking and Intermediate Resources

For the 2008 – 2010 timeframe, GRE's resource plan shows the need for the following resources:

- 2008 combustion turbine (peaking resource).
- 2009 combustion turbine or combined cycle (peaking or intermediate resource).
- 2010 combined cycle (intermediate resource).

GRE's strategy is to evaluate all supplier options for these resources.

In the recent past, GRE has reported that the regional market no longer has any excess capacity. Potential changes to the MAPP accreditation rules could open access to larger regional markets for capacity on a short-term, seasonal or long-term basis. GRE is closely monitoring these changes to take advantage of new opportunities to meet its near term peaking needs. GRE will also explore other market opportunities and analyze a self-build option relative to market opportunities. GRE expects to make a final decision on serving its 2008 peaking needs by the end of 2005.

From a traditional load-serving point of view, a combined-cycle plant is an expensive source of energy. Therefore, GRE's first strategy for meeting intermediate resource needs is to pursue market opportunities. In the past GRE has been successful in identifying and contracting for intermediate – power products from other regional utilities. GRE expects that these market opportunities will remain available, is currently in discussions with several potential counterparties, and is exploring a range of market opportunities.

GRE expects to have its specific strategy determined for its 2009 and 2010 needs by the end of 2005. GRE will also be closely monitoring its load shape and market opportunities to determine whether peaking or intermediate resources will best meet its 2009 needs.

Near Term: Renewable Resources

Given the lead time associated with acquiring the additional wind resources, renewable resource action items fall into the near-term time frame.

GRE modeled the addition of 100 MW blocks of wind resources in 2008, 2011, 2013, and 2015 to achieve the goals of the REO. GRE will monitor the energy requirements of our members and the performance of our existing renewable resources and modify the new resource acquisition schedule, as needed, to ensure fulfillment of Minnesota's REO. GRE's current schedule for additional wind resources is based on the modeled price of wind. If the price of future wind resources would be significantly different from the prices modeled, (for example through the elimination of the production tax credit) GRE would re-evaluate its strategy for making a good faith effort at meeting the REO.

In addition to the 100 MW blocks of wind energy identified as part of GRE's renewable resource acquisition, GRE will explore opportunities to work with smaller wind projects, including those that would qualify as C-BED (community based energy development) under law that becomes effective on August 1, 2005.

Since the next 100 MW wind addition must be online for 2008, GRE expects to issue an RFP in late 2005 or early 2006. Based on current projections for needs, it is likely that GRE will also be issuing an RFP for an additional 100 MW block of wind sometime near late 2008.

Mid Term:
GRE's preferred resource plans demonstrate that in the 2014 – 2016 timeframe GRE will need two 300 MW blocks of baseload resources. The 300 MW blocks included in this resource plan are likely to be portions of larger plants in order to capture the full economic benefit of economies of scale. This type of resource requires a long lead time to site, permit and develop. Typically, a utility would begin investigating projects approximately eight to ten years in advance and permitting would begin approximately seven years in advance.

GRE is planning for the additional resources to meet the mid-term needs identified in this resource plan. In addition to the proposed Big Stone II project that is included as a resource in this resource plan, GRE is in the process of actively investigating projects and potential partnerships to meet its mid-term needs. One project, for example, has progressed to the stage that the partners are looking at specific sites.

GRE expects to be in the permit application phase for the projects to meet its mid-term needs within the next five years. As appropriate, GRE will update the Commission as it makes further specific progress on any of its projects.

GRE also expects to procure additional renewable resources in the mid-term timeframe. The specific schedule for these additions will be determined as GRE monitors its load growth and the output from its existing renewable resources. GRE does not expect any regulatory or construction activity for such resources within the next five years.

Long Term:
GRE forecasts a growing need for demand and energy through the end of this planning horizon and beyond. GRE engages in a continuous planning process and will update its forecasts and models to reflect changing conditions in the factors that impact supply of and demand for energy and capacity. However, GRE does not foresee taking any specific actions in the next five years regarding resources that may be necessary to meet its needs

in 2018 and beyond that would require regulatory approval. GRE will continue its analysis and have a better idea of specific needs for that timeframe in subsequent resource plans and will inform the Commission as necessary.

GRE also expects to continue its commitment to renewable resources in the long term. However, it would be premature to predict any specific activities toward that end.

Additional Issues for Analysis:
GRE continues to analyze upgrades to its facilities as a strategy to meet a portion of its growing needs. However, the potential upgrades currently identified either result in very small increases or are not economically justified under the current circumstances. GRE will monitor these conditions and pursue all appropriate upgrade projects.

GRE is committed to improving the impact of DSM. Several challenges related to DSM issues were identified in this document. GRE will continue to work diligently to meet these challenges and advance the analysis and integration of DSM.

GRE is currently analyzing how the 2005 Omnibus Energy Bill may affect its resource planning efforts. For example, the 2005 Energy Bill lengthens the time allowed for the Commission to make a decision in a certificate of need proceeding for additional power supply resources. Also, GRE will be developing a C-BED tariff through which resources may be acquired to meet the REO and diversify GRE's resource base.

Conclusions:
GRE has carefully evaluated a comprehensive set of resource options, expected future market conditions, and practical realities to determine the best way to meet the resource needs identified in this plan. GRE implemented several improvements in its planning process within this IRP. It modeled significantly more potential resource plans and incorporated a more robust risk analysis. GRE presents a thoughtful, logical process for the development of its resource plan and provides many insights into its internal challenges and accomplishments.

Since specific resource acquisition decisions must be approved by the GRE Board of Directors and member cooperatives, some of the specific details regarding new resources are still under development and may be different than has been presented as GRE's preferred resource plan and accompanying action plan. However, the blueprint outlined in this action plan provides the Commission with a clear picture of how GRE intends to meet the future power supply needs of its member cooperatives and is also a solid basis for the Commission's acceptance of this resource plan as being in the public interest.

GRE's resource plan is in the public interest because:

1. It provides for adequate and reliable service.
2. It seeks to minimize costs and risks.
3. It is environmentally responsible.

GRE has a long-standing commitment to meet the resource needs of its members in a manner that is reliable, low cost and environmentally responsible. This resource plan is one step toward fulfilling that commitment. GRE respectfully requests that the Commission accept this plan as being in the public interest.

1 INTRODUCTION

1.1 Great River Energy Overview

Great River Energy (GRE) is a generation and transmission (G&T) electric cooperative that provides electrical energy and related services to the 28 member distribution cooperatives (members) that own it. GRE's 28 members serve more than 600,000 end-use consumers. GRE supplies its members with capacity, energy, transmission, and other energy service requirements under the terms and conditions of the Power Purchase Contract and the Transmission Agreement. In 2004, members approved a modified Power Purchase Contract with GRE that extends through 2045.

GRE experiences its highest demand during the summer. In 2004, GRE experienced a summer system peak of 2,312 MW (non-weather adjusted). To serve the needs of its members during the year, GRE relies on its generation facilities and portfolio of short- and long-term contracts.

GRE's 2,500 MW generation system is composed of a mix of baseload and peaking power plants, including coal-fired, refuse-derived fuel, natural gas and oil plants, as well as wind generation.

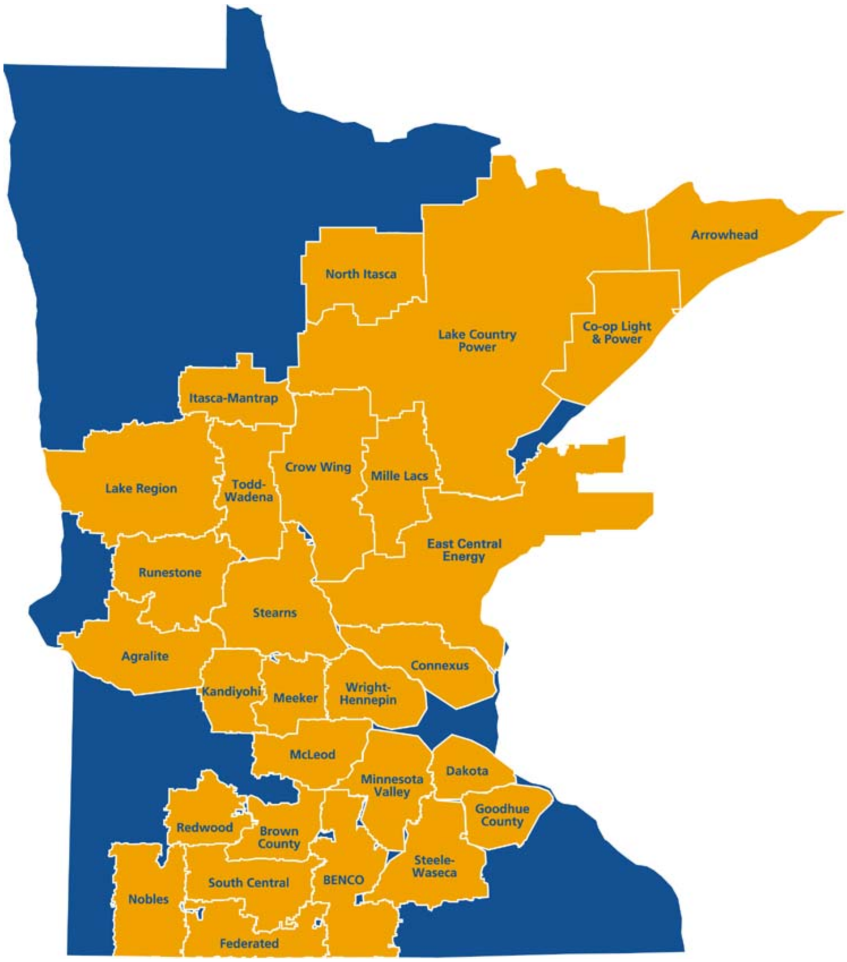
GRE owns approximately 4,500 miles of transmission line, including the high voltage, 436 mile direct current, or DC, transmission line that runs from Coal Creek Station to Minnesota. GRE also owns or partially owns more than 100 transmission substations.

GRE also has significant load control capabilities. During the summer, GRE is able to control about 300 MW of load. GRE's winter control capability is about 175 MW.

1.2 Great River Energy Service Territory

The service territories of GRE's 28 members extend from the southwest corner to the northeast corner of Minnesota. One member, East Central Energy, serves a small part of Northwestern Wisconsin (see Figure 1-1).

Figure 1-1 Great River Energy Service Territory



Great River Energy members serve the quickly growing suburban communities around the Minneapolis-Saint Paul metropolitan area, including parts of four of the 100 fastest growing counties in the United States.[2]

GRE will need to procure additional resources over the planning period to address the growing capacity and energy needs of its members. GRE's demand side management (DSM) programs will provide some of the forecasted resource needs. However, DSM will be unable to meet all of the forecasted resource needs. The needs exceeding the new demand side resources will be primarily met through new generation resources since the MAPP region does not have much excess capacity. However, this situation may improve now that the Midwest ISO operates a large, centralized energy market. GRE closely monitors the market as it matures to evaluate potential new opportunities for meeting its future resource needs.

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[2] The four counties are Scott, Sherburne, Wright, and Carver. The data is for the period July 1, 2003 through July 1, 2004, according to the most recently published report of the U.S. Census Bureau.

As resource needs are finalized GRE will evaluate self-build and purchased power alternatives. Consistent with its corporate vision, mission, and values, Great River Energy will strive to do this in both an economically efficient and environmentally sound manner.

A portion of the future needs of GRE's members will be met through projects currently being developed solely by GRE or in partnership with other local utilities. For example, GRE is in the midst of a certificate of need proceeding for an additional 170 MW of peaking capacity to be located at the site of an existing, smaller peaking resource in Cambridge, Minnesota.[3] The resource has an expected commercial operation date for the summer of 2007. In addition, GRE is working with several other electric utilities to construct a second unit at the site of Otter Tail Power Company's Big Stone generation facility that would supply around-the-clock energy as early as 2011.

1.3 Review of Great River Energy's Previous Resource Plan Filings

1.3.1 Review of the Commission's Order and GRE Commitments

Great River Energy has filed two Integrated Resource Plans (IRP) since its formation in 1999 from the merger of United Power Association and Cooperative Power. The last IRP was submitted to the Minnesota Public Utilities Commission (Commission) on July 1, 2003. Based on issues raised by parties during the 2003 resource plan, Great River Energy committed to perform additional analysis for the 2005 resource plan. Specifically, GRE agreed to:

- Address the use of historical demand side resources in the system forecast.
- Invite representatives from the Department of Commerce (Department) to observe a forecast modeling meeting with GRE members.
- Consider environmental costs when evaluating resource options.
- Discuss the criteria for evaluating demand and supply side resources.
- Assess the effect of various natural gas prices on future resource selections.
- Consider wind generation as a supply side resource.
- Consider various sizes for future resource options.
- Discuss the use of an optimization model with the Department.

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[3] GRE filed its Certificate of Need application for Cambridge Station with the Minnesota Public Utilities Commission on February 28, 2005.

- Include a combination of demand side and renewable resources for meeting the 50% and 75% objectives of Minnesota Statute § 216B.2422, subd. 2.

Each of these are addressed in the appropriate section.

On April 26, 2004, the Commission accepted GRE's 2003 resource plan in its ORDER APPROVING GREAT RIVER ENERGY'S 2003 RESOURCE PLAN, ACCEPTING COMMITMENTS FOR IMPROVEMENTS AND CONSULTATION, AND ENCOURAGING CONSIDERATION OF ENVIRONMENTAL ISSUES. The order advised GRE to consider certain additional issues, most of which GRE agreed to in that proceeding (as described above) and are included within this filing. GRE was also ordered to include the following information in its next IRP filings:

- A plan to show its good faith effort toward meeting its renewable energy objectives (REO).
- An update and summary of current environmental issues, its methods of compliance with existing regulation, and contingency plans for compliance with expected future regulations.

GRE's plan for meeting the REO is described in Section 6. Environmental issues are discussed in two places: the compliance with existing regulations is included in the description of existing resources in Section 4 and contingency plans for expected future environmental regulations are described in Section 5.

1.3.2 Assessment of Previous Action Plan

In its 2003 IRP, GRE's action plan identified several steps that it would be pursuing toward obtaining new resources. Each is discussed below.

- Pursue the mid-level DSM program (as modeled).

This aspect of the action plan was modified to reflect the Commission's order which advised GRE to pursue its high-scenario goals for demand and energy savings. GRE's DSM consultant (see Section 6.1) advised that the primary way to increase demand and energy savings would be through higher rebates and incentives. GRE increased its rebates as well as its overall budget and marketing efforts for DSM programs, which resulted in an expansion of these programs. In addition, GRE has worked with its member systems to explain the importance of conservation from an environmental and cost savings perspective.

- Pursue a good faith effort to meet the requirements of the Renewable Energy Objective.

GRE has gone further than pursuing a good faith effort to comply with the Minnesota REO. GRE currently provides 2.1 percent of its energy requirements through renewable energy resources, while the REO objective for 2005 is for one percent.

Recently, GRE contracted to purchase the output of Trimont Wind I, LLC, a 100 MW wind project located in Martin and Jackson Counties. Trimont Area Wind Farm (TAWF), a coalition of local citizens, was initially selected from a 2003 Request for Proposals (RFP) process. Subsequent to its selection by GRE, TAWF chose PPM Energy to develop the project on their behalf. In the RFP, GRE indicated a preference for projects located in its service territory. This project will be on-line by the end of 2005. GRE projects that its renewable resources with the addition of Trimont will provide sufficient additional renewable energy such that GRE will meet the REO objectives at least through 2007.

Also, the Minnesota state legislature classified GRE’s Elk River Station, which is fueled with RDF (refuse derived fuel), as a renewable resource for the purpose of meeting the Minnesota Renewable Energy Objective (REO.) As a waste-to-energy power plant, GRE’s Elk River Station diverts about 270,000 tons annually of municipal solid waste annually from local communities from being land filled, producing enough electricity for approximately 30,000 homes.

- Explore possible upgrades to existing facilities.

In its 2003 IRP, GRE mentioned three potential upgrades to existing facilities that it intended to pursue: upgrades to St. Bonifacius, Pleasant Valley Station, and utilization of the full capacity of the DC line. GRE pursued the upgrades to its St. Bonifacius plant as described. These will be in place by July 2005, as outlined in Section 6.2.4. GRE continues to explore the upgrade to its Pleasant Valley Station, described in more detail in Section 6.2.4, as well as additional opportunities to fully utilize the capacity of its DC line.

- Carefully consider all relevant factors in constructing or contracting for a new combined cycle or combustion turbine.

GRE reported in its 2003 IRP update, filed September 26, 2003 that it had entered into a contractual arrangement that partially fulfilled its needs for intermediate resources. Consequently, GRE chose not to pursue construction on a combined cycle unit.

GRE's Corporate Service Division issued a request for proposals (RFP) for a variety of resources in March 2004. 34 proposals from 17 entities were received in response to the Peaking and Intermediate portions of the RFP, including several proposals from GRE's Generation Division. Only five of the 34 bids included the use of existing generating sources. The remaining proposals relied on new generating sources. The RFP review process determined that the GRE self-build option for a combustion turbine was superior to the other proposals on cost and responsiveness to GRE's needs.

On February 28, 2005, GRE submitted a petition to the Commission seeking a certificate of need for the proposed 170 MW Cambridge Peaking Plant.

- Begin to more closely examine the need for a new baseload in 2011 – 2013.

GRE has been exploring options for future baseload power and has determined that one option was appropriate for further participation: the Big Stone II project for approximately 109 MW. GRE has explored other projects that are not well enough developed to report at this time. GRE has also been updating its forecast and analysis to refine the timeline that baseload will be needed. The refined forecast and resource requirements are presented in this filing.

1.4 Principles for the Development of GRE's Integrated Resource Plan

The primary goal of Great River Energy's resource planning process is to develop the framework and action plan to provide reliable, competitively priced energy to its members. The goal is achieved through an analytical process that complies with Minnesota statutes and the rules and requirements of all regulatory authorities which oversee GRE's operations.

Great River Energy uses the following principles to help guide its resource planning decisions:

1. GRE will develop resource plans meeting appropriate levels of energy and capacity demands: "median energy" and "high demand".
2. GRE will plan its power supply to minimize total costs over the long term.
3. GRE will plan its power supply to minimize risks over the long term.
4. GRE will balance modeling results, market intelligence, and practical realities in guiding its power supply choices.
5. GRE recognizes that power supply partnerships are in its future.
6. GRE will be a good environmental steward through its power supply decisions.

7. GRE will analyze power supply options with consideration of the economic risks and political concerns of climate change policy.
8. GRE will actively pursue conservation and demand response programs that are cost effective alternatives to supply side resources.
9. GRE will continue to actively pursue the development of renewable resources.
10. GRE will remain current on technological changes in the industry and lend its support to additional sound technology development efforts.

1.5 Overview of IRP

This IRP report is organized as follows:

The Executive Summary provides a non-technical overview of the resource plan filing.

The Rule Compliance section provides a checklist to demonstrate which sections of this document meet the filing requirements in the relevant statutes and rules.

Section 1: Introduction describes Great River Energy and reviews its past IRP.

Section 2: Planning Process describes the tools and assumptions used in the development of this IRP.

Section 3: Load Forecast provides a summary of Great River Energy's forecasting process and results. Additional details regarding GRE's forecast are included in Appendix B.

Section 4: Existing Resources describes the demand-side, supply-side, and transmission resources owned by Great River Energy, as well as the power purchase and sales arrangements currently in existence.

Section 5: Resource Requirements integrates the forecast with the existing resources and identifies the future resource requirements of GRE.

Section 6: Resource Options describes in depth the resource options considered by Great River Energy in this IRP process.

Section 7: Resource Plans defines the potential resource plans reviewed by GRE, including the uncertainty analyses undertaken to quantify risks, the incorporation of environmental externality costs, and the selection of a preferred resource plan.

Section 8: Action Plan provides the list and schedule of activities by which GRE's preferred resource plan will be implemented.

Appendix A: Conservation Improvement Programs describe all of GRE's CIP programs, including conservation and load management.

Appendix B: Forecasting Modeling Overview provides additional detail on GRE's forecasting process.

Appendix C: Member Cooperative Forecast Summary overviews the forecasting methodology for each of GRE's member cooperatives.

Appendix D: DOC Annual Report provides the full report in compliance with Minnesota Rules 7610.

2 PLANNING PROCESS

This section outlines GRE's process for arriving at an action plan to meet its members' future energy and demand requirements.

2.1 Overview

GRE uses a multi-step process to arrive at its preferred resource plan and the accompanying action plan.

1. GRE develops system demand and energy forecasts.
2. GRE examines the ability of current supply- and demand-side resources to meet the forecasted demand and energy requirements of its members.
3. A resource planning model utilizes a variety of generic resource options to meet the forecasted demand and energy deficits that occur when current resources are insufficient to meet forecasted requirements. The resource plans are ranked by cost as measured by the present value of revenue requirements (PVRR).
4. Six low cost plans are evaluated for their risk. The risk evaluation results in a distribution of a plan's revenue requirement when accounting for the uncertainty of input variables such as fuel prices, GRE's energy requirements, and market electric prices.
5. Subsequently, GRE evaluates how compliance with Minnesota Statutes and environmental externality costs would influence the revenue requirement and risk of specific plans.
6. Finally, using the analysis of the resource plans and taking into account a number of practical realities such as the timing of actual project development and the preferences and risk tolerance of its member cooperatives, GRE develops an action plan to provide GRE members with a plan that has the greatest overall economic benefit.

For purposes of this plan, GRE defines the greatest economic benefit as being the lowest cost of service to GRE's members **at an acceptable level of risk** in terms of the potential for changes in cost of service. While no strategy is risk free, GRE has taken care in its effort to measure the risk of each strategy considered and select a strategy that manages risk though prudent resource investments.

2.2 Development of the Planning Forecast

Great River Energy uses its 2004 Long Range Load Forecast (2004 load forecast) as the basis for this IRP. GRE develops its energy and demand forecasts contained in the 2004 load forecast by aggregating the forecasts of its members. The primary purpose of a sound forecast is to ensure that GRE will be able to serve its members as their demand for capacity and energy grows. Another purpose of load forecasting is to identify the primary forces that affect load growth, which provides important information in understanding members' needs. More details about the forecast are contained in Section 3 and Appendix B.

Any GRE forecast must acknowledge the contingency that GRE members may exercise their option to take a portion of their capacity and energy requirements from an alternate supplier. While the contingency will not make GRE short of capacity, the timing of future resource additions identified in a resource plan may be affected by a member exercising this option.

GRE uses a "high" demand scenario that assumes normal weather with more optimistic macroeconomic assumptions causing higher loads. Energy requirements are based on the base case energy scenario. The demand and energy scenarios and forecasting results are described in detail in Section 3.

2.3 Review of Current Resources

GRE's next step in the planning process is to review its existing resources, both owned and contracted, available to serve its members' needs. GRE assesses the status of these resources, as its planning forecast must make certain assumptions about the availability of current resources to operate over the planning horizon. The ability of the resources to continue to serve GRE's members may be affected by, for example, unit retirements or capacity derates or uprates.

GRE's assessment is that its current resources will continue to operate at current operating capacity and availability levels. GRE also incorporated future changes to its overall resource portfolio based on expiration dates of its current contracts as well as expected online dates for new resources to which GRE has committed.

New resources for which construction or permitting proceedings have begun (or are about to begin) to meet future GRE needs include:

- 100 MW (nameplate) wind resource in 2005 (Trimont).
- 170 MW (summer rating) natural gas-fueled simple cycle combustion turbine in 2007 (Cambridge).

- 109 MW portion of a larger coal-fueled resource in 2011 (Big Stone II).

2.4 Modeling Resources to Meet Need

The next step in the planning process is to use the forecast and available resources as inputs in the modeling process.

2.4.1 Procuring a New Resource Planning Model

In October 2004 GRE invited seven potential vendors to present the qualifications of their model and the consulting capabilities to support the modeling work necessary for an IRP filing. The vendors were evaluated on:

- Their model's ability to capture resource characteristics properly and in sufficient level of detail to differentiate some of the more nuanced resource characteristics.
- Their capability to provide credible market price forecast data for use in the model.
- Their ability to do risk analysis.
- Their consulting "stature".
- An estimated price for conducting the necessary modeling for this filing.

GRE concluded that Global Energy Decisions (Global Energy), formerly Henwood Energy Services Inc. before acquisition by Global Energy, could best provide a balance of these requirements. Global Energy proposed its Planning and Risk (PAR) model as the primary tool for this analysis.

2.4.2 Overview of Resource Planning Modeling in 2005 IRP

GRE's methodology included a continuation of a load serving approach in spite of the paradigm change that is occurring as the MISO market is starting up. Future resource plans will need to further incorporate the impact of the MISO market.

GRE's 2004 load forecast was used as the basis for the modeling.

All of GRE's existing generation resources are assumed to remain in service for the forecast period. No existing contracts (neither purchases nor sales) are renewed at the end of their term.

Three representative generic resource types are used to construct 13 representative resource plans meeting the capacity needs identified by the load forecast. In the first step of the analysis, each of 13 resource plans is evaluated on a cost basis using a base set of assumptions about selected uncertain/risk variables. In the next step of the analysis, six of the lower cost plans identified in the first step are further subjected to risk analysis. This results in a small subset of plans with suitable characteristics for further analysis to meet GRE's future power supply needs.

2.4.3 Differences from 2003 IRP filing

A key difference between GRE's 2003 and 2005 IRP filings is the number of "core" resource plans modeled. In the 2003 filing there were three plans modeled, each representing a different choice of the first resource added: a peaking resource, an intermediate resource or a baseload resource. In this 2005 IRP filing 13 resource plans are modeled, which represent a broader spectrum of possible resource plans. These plans are also more realistic in that each plan includes all of the resources needed to meet GRE's needs and the timing constraints for various resources are incorporated into each plan's development.

In the area of risk analysis, the 2003 filing only looked at electricity market prices as an uncertain variable. In the 2005 filing the analysis was expanded to include gas/oil prices and the level of energy needed as uncertain variables in addition to continuing to include electricity market prices as an uncertain variable.

2.5 Development of an Action Plan

The final step of the resource planning analysis is to develop GRE's five-year action plan. The action plan is the framework for implementing GRE's preferred plan, determined through a process of narrowing the available set of resource plans based on an analysis of cost, risk, statutory obligations, environmental externalities, and the practical realities under which GRE must operate to serve its members' needs. Some of the issues GRE considers include:

- Net present value of the revenue requirements for the resource plans over the extended planning horizon.
- Measurements of risk of the resource plans over the planning horizon.
- Risk tolerance and resource preferences of GRE's Board of Directors and member cooperatives.
- Potential partnerships and timing of projects under development.
- Socioeconomic and environmental impacts of its potential resource decisions.

3 LOAD FORECAST

This section describes GRE's system energy and demand forecasts. It begins by highlighting how GRE uses its load forecast. Next, GRE's efforts to date to comply with the forecasting recommendations made by the Minnesota Department of Commerce in GRE's 2003 IRP are discussed. After that, the results of GRE's 2004 forecast are presented. Finally, an overview of GRE's forecasting methodology is presented. Appendix B contains a detailed explanation of the methodology and data used to develop GRE's 2004 forecast.

3.1 Overview

GRE's forecast methodology is a robust process that utilizes statistical and econometric forecasting models as well as the local knowledge that our member systems are uniquely positioned to provide. GRE's "bottom up" approach is appropriate because it meets GRE's many forecasting needs, including requirements of state and federal agencies as well as transmission and power supply resource planning. The bottom up approach also benefits the member systems that require local system forecasts for distribution system planning requirements and project financing.

GRE, as an electric supplier to rural areas, is eligible to receive financing from the Rural Utilities Service (RUS) of the United States Department of Agriculture for construction and maintenance of generation and transmission facilities. As part of its lending operations, however, the RUS maintains specific requirements for eligible borrowers. For example, to support a loan application, § 1710.152 of the RUS regulations require that a prospective borrower provide the RUS with a system load forecast. The RUS also requires any borrower with a total utility plant of at least $500 million to maintain an approved load forecast with the RUS. To comply with the requirement GRE submits a new load forecast to the RUS at least every two years.

The RUS requires GRE to coordinate member system forecasting efforts which, in practice, means using the sum of the individual member system forecasts.[4] GRE utilizes its RUS forecast as the basis for resource planning. The forecast timeline demonstrates a time-intensive effort of forecast development that is produced over two years. Section B.5 in Appendix B outlines the schedule followed in the development of the 2004 load forecast. For resource planning, GRE does not produce a separate "top down" forecast

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[4] RUS regulation § 1710.200 states that the "load forecast of a power supply borrower includes and integrates the load forecasts of its member systems."

because of the intensive nature of constructing the “bottom up” forecast and its appropriateness for use in multiple filings with state and federal agencies.

3.2 Compliance Items from 2003 IRP Forecast

GRE continually examines and improves its forecasting processes to facilitate its needs and its members’ needs as well as incorporating feedback from regulatory proceedings. In GRE’s 2003 IRP, for example, the Department of Commerce recommended two changes to GRE’s forecasting process. First, the Department recommended that GRE document changes to member system forecasts when those changes are not supported by statistically-derived forecasts. Second, the Department recommended that GRE develop planning forecasts by excluding all present and forecasted DSM.

GRE has been working to address the Department’s forecasting concerns raised during the 2003 IRP. GRE began working with its members to provide written documentation of factors that lead them to arrive at an energy forecast that deviates from statistically-derived models prepared by GRE. Appendix C illustrates the modeling method used for each forecasted component for each member system. Specifically, it details the model used by the member system in its forecasting and an explanation, where necessary, when the member deviated from statistical models developed by GRE. Second, GRE has contracted with a consultant to prepare an estimate of GRE’s DSM effects. GRE has received some preliminary results, but they are not complete enough to use in this proceeding. This study is discussed further in Section 3.5.

3.3 Results

GRE forecasted demand requirements are the sum of the 28 member systems’ forecasted demand requirements for the period 2004-2023. Minnesota Rules Part 7843.0100, subp. 6 defines the relevant IRP forecast as the fifteen year period following the year that the IRP is filed. GRE performs a twenty year load forecast every two years and includes it in its entirety here.

GRE’s growth in demand and energy is driven by the increase in number of consumers, primarily residential. GRE will add an average of more than 14,000 residential members per year from 2004 to 2023. None of the models used to construct the 2004 forecast indicate a significant change in the pattern of energy usage by GRE’s consumers. The results of the GRE load factor study indicate less than a two percent change in summer and winter load factors.

When appropriate, GRE adjusts its results to reflect only the portion of its member requirements that GRE is obligated to serve. As described in Section 5, GRE member cooperatives may choose to have a portion of their capacity and energy needs served by an alternate supplier. In those cases, the portions that will not be served by GRE are not included in GRE's capacity and energy forecasts.

The following sections summarize the results of GRE's demand and energy forecasts.

3.3.1 System Demand

GRE experiences its greatest demand and load volatility during the summer season. Therefore, as described in Section 2.2, GRE's system capacity requirements are derived using the high scenario for forecasted demand. GRE's summer demand is forecasted to be 4,231 MW in 2023. For comparison, GRE's 2004 peak summer demand was projected to be 2,413 MW. This equates to an average annual increase of 95.7 MW between 2004 and 2023, or a 3.0 percent average annual increase.

The following graph and table summarize GRE's summer and winter demand forecast.

Figure 3-1 Summer and Winter Demand 1980 – 2023

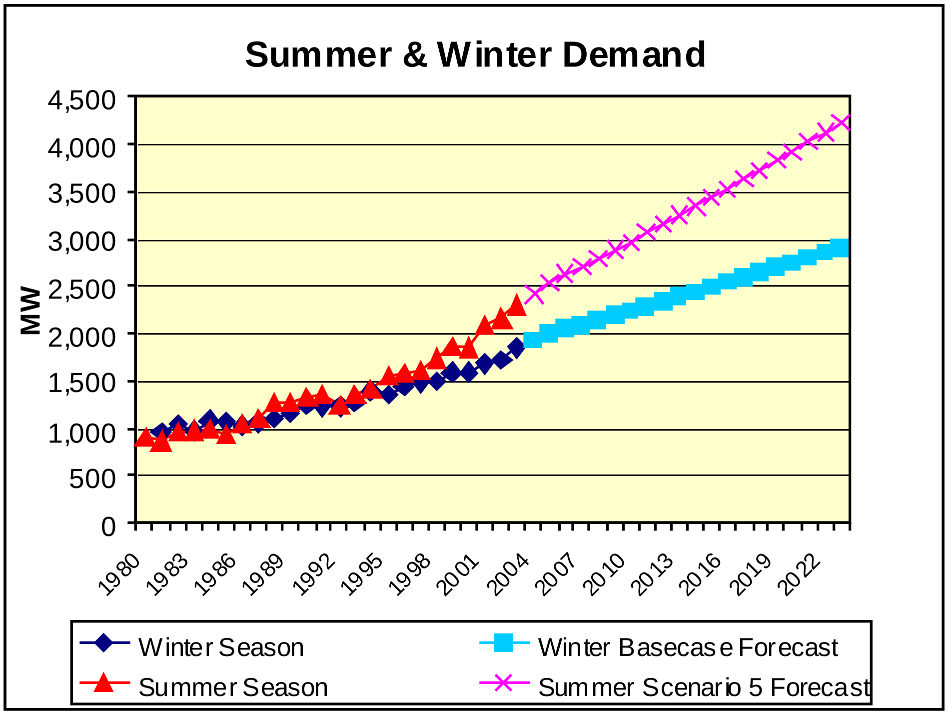


Figure 3-2 Historical and Forecast Summer Demand, 1980-2023

System Summer Demand (MW)

Summer Season	*Historical & Scenario 5 Forecast*	*Growth*	*Percent Growth*
1980	908.3		
1981	870.5	-37.8	-4.2%
1982	970.2	99.7	11.5%
1983	978.9	8.7	0.9%
1984	999.8	20.9	2.1%
1985	950.1	-49.7	-5.0%
1986	1,050.5	100.4	10.6%
1987	1,106.0	55.5	5.3%
1988	1,271.7	165.7	15.0%
1989	1,270.4	-1.3	-0.1%
1990	1,323.5	53.1	4.2%
1991	1,362.8	39.3	3.0%
1992	1,252.5	-110.3	-8.1%
1993	1,359.5	107.0	8.5%
1994	1,416.3	56.8	4.2%
1995	1,552.9	136.6	9.6%
1996	1,579.4	26.5	1.7%
1997	1,609.6	30.2	1.9%
1998	1,748.0	138.4	8.6%
1999	1,875.0	127.0	7.3%
2000	1,853.9	-21.1	-1.1%
2001	2,094.4	240.5	13.0%
2002	2,164.3	70.0	3.3%
2003	2,306.1	141.7	6.6%
2004	2,413.1	107.0	4.6%
2005	2,531.5	118.4	4.9%
2006	2,637.8	106.3	4.2%
2007	2,700.3	62.5	2.4%
2008	2,788.7	88.4	3.3%
2009	2,878.2	89.5	3.2%
2010	2,966.0	87.8	3.1%
2011	3,061.2	95.2	3.2%
2012	3,149.8	88.6	2.9%
2013	3,241.2	91.4	2.9%
2014	3,338.5	97.3	3.0%
2015	3,433.1	94.6	2.8%
2016	3,527.9	94.8	2.8%
2017	3,628.5	100.6	2.9%
2018	3,724.7	96.1	2.7%
2019	3,825.6	100.9	2.7%
2020	3,924.4	98.8	2.6%
2021	4,024.8	100.4	2.6%
2022	4,126.1	101.3	2.5%
2023	4,231.0	104.9	2.5%
2004-2023		95.7	3.0%

Figure 3-3 Historical and Forecast Winter Demand, 1980 – 2023

System Winter Demand (MW)			
Winter Season	*Total Demand*	*Growth*	*Percent Growth*
1980-1981	961.6		
1981-1982	1,058.9	97.3	10.1%
1982-1983	983.4	-75.5	-7.1%
1983-1984	1,087.4	104.0	10.6%
1984-1985	1,075.7	-11.7	-1.1%
1985-1986	1,042.8	-32.9	-3.1%
1986-1987	1,069.5	26.7	2.6%
1987-1988	1,114.3	44.8	4.2%
1988-1989	1,154.6	40.3	3.6%
1989-1990	1,249.0	94.4	8.2%
1990-1991	1,239.2	-9.8	-0.8%
1991-1992	1,234.2	-5.0	-0.4%
1992-1993	1,270.8	36.6	3.0%
1993-1994	1,394.6	123.8	9.7%
1994-1995	1,354.6	-40.0	-2.9%
1995-1996	1,455.4	100.8	7.4%
1996-1997	1,482.5	27.1	1.9%
1997-1998	1,502.5	20.0	1.4%
1998-1999	1,590.4	87.9	5.9%
1999-2000	1,601.9	11.5	0.7%
2000-2001	1,681.0	79.1	4.9%
2001-2002	1,717.4	36.4	2.2%
2002-2003	1858.6	141.2	8.2%
2003-2004	1,924.0	65.5	3.5%
2004-2005	1,993.2	69.2	3.6%
2005-2006	2,051.6	58.4	2.9%
2006-2007	2,093.6	42.0	2.1%
2007-2008	2,140.4	46.8	2.2%
2008-2009	2,190.4	50.0	2.3%
2009-2010	2,236.9	46.5	2.1%
2010-2011	2,287.2	50.2	2.3%
2011-2012	2,333.8	46.6	2.0%
2012-2013	2,381.2	47.4	2.0%
2013-2014	2,433.1	51.9	2.2%
2014-2015	2,482.8	49.8	2.1%
2015-2016	2,532.5	49.7	2.0%
2016-2017	2,584.2	51.7	2.0%
2017-2018	2,633.8	49.5	1.9%
2018-2019	2,686.1	52.3	2.0%
2019-2020	2,737.3	51.3	1.9%
2020-2021	2,789.7	52.4	1.9%
2021-2022	2,842.0	52.3	1.9%
2022-2023	2,896.1	54.1	1.9%
2003-2023		51.2	2.2%

3.3.2 System Energy

GRE's forecasted energy requirements are the sum of the 28 member system energy requirements (including distribution losses), GRE transmission losses, and GRE's own energy use. GRE forecasts total energy requirements of 18,151,100 MWh in 2023, an average annual increase of 2.3 percent from 2004 projected requirements. The increase in energy requirements is attributed primarily to an increase in the number of consumers served by the member cooperatives and not an increase in the average usage per consumer. GRE forecasts the number of end-use customers to increase from 575,903 in 2003 to 903,712 in 2023, an annual average increase of more than 16,390 customers.

The graph and table below illustrate GRE's forecasted energy requirements.

Figure 3-4 System Energy (MWh)

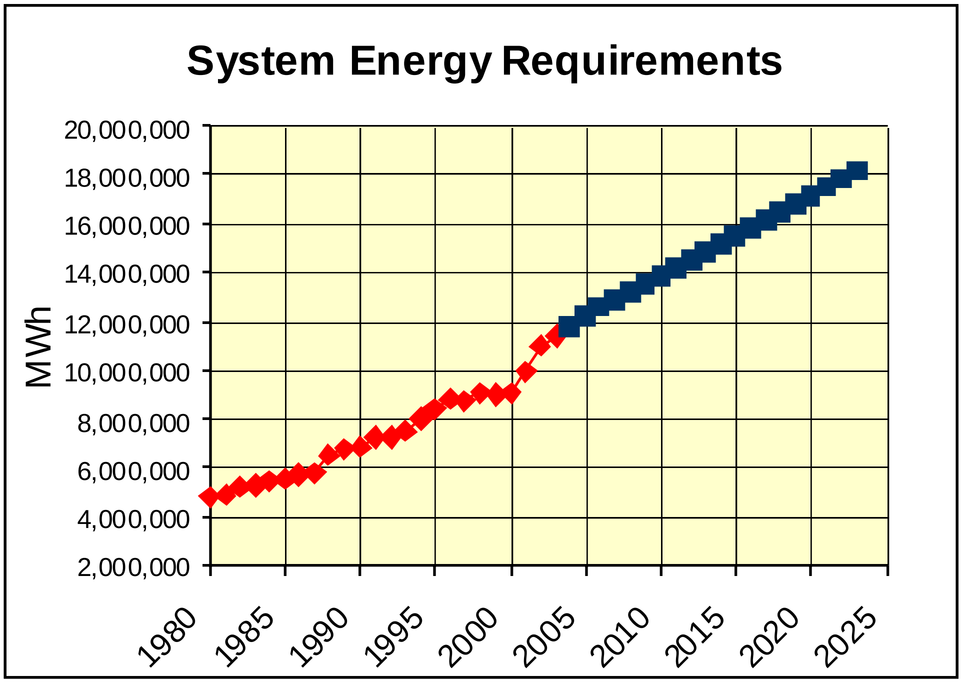


Figure 3-5 Historical and Forecast System Energy Requirements, 1980-2023

System Energy Requirements (MWh)			
Year	*Total Energy*	*Growth*	*Percent Growth*
1980	4,815,196	25,372	0.5%
1981	4,848,107	32,911	0.7%
1982	5,152,535	304,428	6.3%
1983	5,244,519	91,984	1.8%
1984	5,456,572	212,053	4.0%
1985	5,534,314	77,742	1.4%
1986	5,648,060	113,746	2.1%
1987	5,744,993	96,933	1.7%
1988	6,520,353	775,360	13.5%
1989	6,731,739	211,386	3.2%
1990	6,842,027	110,288	1.6%
1991	7,233,294	391,267	5.7%
1992	7,221,443	-11,851	-0.2%
1993	7,489,350	267,907	3.7%
1994	7,950,314	460,964	6.2%
1995	8,364,841	414,527	5.2%
1996	8,784,085	419,244	5.0%
1997	8,696,612	-87,473	-1.0%
1998	9,013,032	316,420	3.6%
1999	8,955,750	-57,282	-0.6%
2000	9,025,229	69,479	0.8%
2001	9,919,757	894,528	9.9%
2002	11,030,839	1,111,082	11.2%
2003	11,407,173	376,334	3.4%
2004	11,737,280	330,107	2.9%
2005	12,183,889	446,609	3.8%
2006	12,556,817	372,928	3.1%
2007	12,833,663	276,846	2.2%
2008	13,140,069	306,406	2.4%
2009	13,470,799	330,730	2.5%
2010	13,775,316	304,517	2.3%
2011	14,104,521	329,204	2.4%
2012	14,410,904	306,383	2.2%
2013	14,735,072	324,169	2.2%
2014	15,075,413	340,340	2.3%
2015	15,404,260	328,847	2.2%
2016	15,732,621	328,361	2.1%
2017	16,074,863	342,242	2.2%
2018	16,403,890	329,027	2.0%
2019	16,751,440	347,550	2.1%
2020	17,092,478	341,038	2.0%
2021	17,440,247	347,769	2.0%
2022	17,789,406	349,159	2.0%
2023	18,151,100	361,694	2.0%
2004-2023		337,569	2.3%

3.3.3 Demand Scenarios

GRE prepared the following five summer demand scenarios for the GRE system:

1. Most probable economic assumptions, with normal weather.
2. Most probable economic assumptions, with severe weather causing higher loads.
3. Most probable economic assumptions, with mild weather causing lower loads.
4. Normal weather with more pessimistic macroeconomics assumptions causing lower loads. (Low Demand Scenario)
5. Normal weather with more optimistic macroeconomics assumptions causing higher loads. (High Demand Scenario)

The first scenario is the median forecast, or the base case. This forecast will be exceeded half of the time due to factors such as weather and the economy.

Scenario two assumes normal economic conditions and severe weather that causes load to exceed the median load forecast. This scenario used the same percentage variation from the median forecast that was developed in the 2002 load forecast.

Scenario three assumes normal economic conditions with mild weather that assumes a smaller annual average demand increase than the median forecast. The resulting forecast is lower than the median forecast.

Scenarios four and five are the low and high planning scenarios, respectively, which reflect the effects of varying economic activity. In GRE’s 2002 load forecast, GRE calculated scenarios four and five by assuming, respectively, that annual growth would be 60 percent and 135 percent of the median forecast’s annual growth. These levels were selected after examining the historical effect of recessions and examining the potential for future variations in growth. For the 2002 load forecast the end result was that scenario four was 96 percent of the median forecast in year one and 82 percent of the median forecast in year twenty. Likewise, scenario five increased from four percent to 16 percent above the median forecast over the forecast period. To create scenario four and five for the 2004 load forecast, GRE utilizes the same percentage deviation from the median forecast for scenarios four and five as were utilized in the 2002 load forecast.

The following table and graph reflect GRE’s five forecasted summer demand scenarios.

Figure 3-6 Fixed Summer Demand Scenarios (MW)

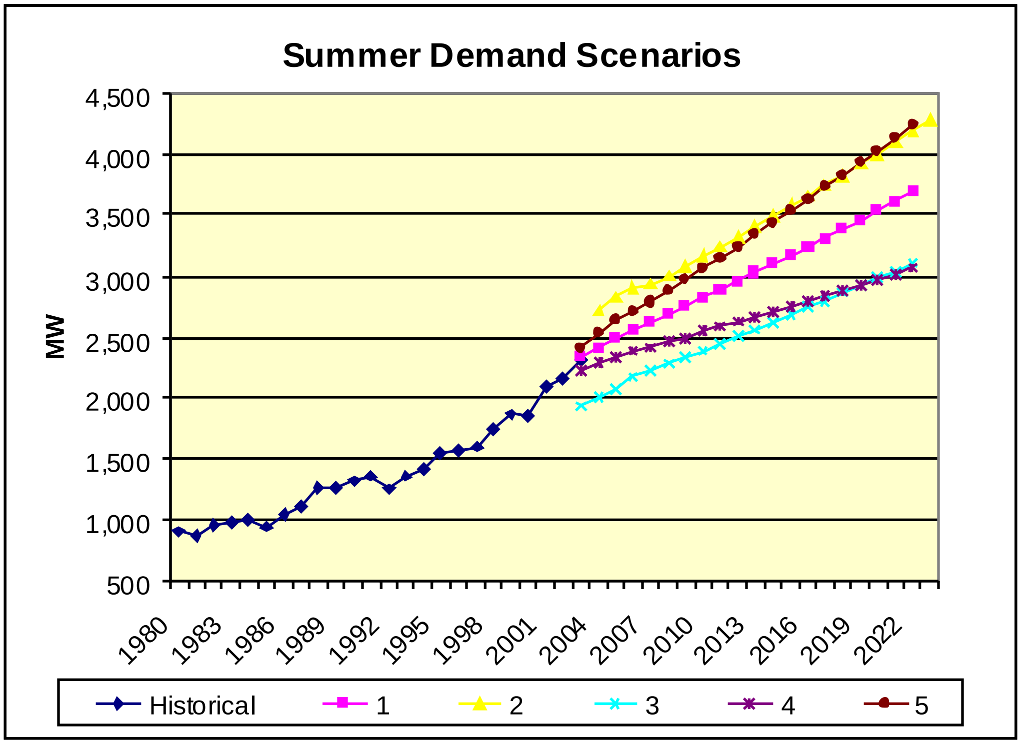


Figure 3-7 Summer Demand Scenarios

Summer Demand Scenarios (MW)

	1	2	3	4	5
2004	2,329.5	2,713.9	1,933.5	2,234.1	2,413.1
2005	2,419.1	2,819.3	2,007.9	2,290.7	2,531.5
2006	2,497.3	2,911.5	2,072.8	2,336.8	2,637.8
2007	2,552.8	2,927.0	2,170.2	2,384.2	2,700.3
2008	2,616.5	3,002.3	2,223.1	2,419.8	2,788.7
2009	2,683.9	3,081.9	2,279.0	2,461.8	2,878.2
2010	2,747.9	3,157.6	2,332.2	2,498.7	2,966.0
2011	2,819.0	3,241.7	2,391.1	2,542.2	3,061.2
2012	2,883.8	3,318.5	2,445.0	2,579.9	3,149.8
2013	2,951.9	3,399.2	2,501.5	2,621.3	3,241.2
2014	3,023.4	3,483.9	2,560.8	2,663.3	3,338.5
2015	3,093.9	3,567.4	2,619.3	2,706.3	3,433.1
2016	3,163.6	3,650.2	2,677.2	2,747.3	3,527.9
2017	3,238.7	3,739.3	2,739.5	2,793.1	3,628.5
2018	3,309.0	3,822.9	2,797.9	2,834.0	3,724.7
2019	3,383.4	3,911.3	2,859.6	2,878.1	3,825.6
2020	3,456.4	3,998.1	2,920.2	2,921.5	3,924.4
2021	3,531.0	4,086.9	2,982.1	2,966.7	4,024.8
2022	3,606.0	4,176.1	3,044.3	3,011.5	4,126.1
2023	3,684.0	4,269.0	3,109.1	3,058.9	4,231.0

3.3.4 Demand Scenario for Planning

Being unable to serve demand half of the time (as would be predicted under scenario 1) is unacceptable to GRE and its membership. As such, it is appropriate to plan system demand requirements at a higher level than predicted by the median forecast.

GRE uses Scenario Five (normal weather with optimistic economic assumptions) to forecast system demand for planning purposes. This is a conservative planning philosophy that is focused on ensuring that adequate resources are available to meet member demand. GRE determines that planning to this level is more prudent and reflects a level of risk acceptable to its members

3.3.5 Energy Scenarios for Planning

The energy forecast is used as the basis for evaluating the optimal mix of resources to meet the forecasted energy needs. GRE develops the following energy scenarios:

1. Most probable economic assumptions, with normal weather.
2. Most probable economic assumptions, with mild weather causing lower loads (low scenario).
3. Most probable economic assumptions, with severe weather causing higher loads (high scenario).

Scenario one is the median energy forecast. Scenarios two and three are the low and high scenarios, respectively. The energy requirements of scenarios two and three are approximately +/- 3% (relative to the median forecast) in the beginning years of the forecast and +/- 10% in the final years of the forecast. The percentage variations are from historic observations of GRE energy response to weather.

GRE uses the median forecast for energy planning purposes. The median energy forecast assigns equal probability to the outcome that actual energy consumption will be higher or lower than the energy forecast.

Utilizing the median energy forecast prevents the potential to bias resource selection that may occur if a higher or lower energy forecast were used for planning purposes. If the high energy scenario were used, for example, a resource with a lower variable cost, but a higher capital cost, may appear to be more cost effective than it actually is in meeting the energy requirements over the forecast period.

Figure 3-8 Energy Scenarios (MWh)

System Energy Scenarios (MWh)			
Year	*Base Case Energy*	*Low Energy Scenario*	*High Energy Scenario*
2004	11,737,280	11,385,162	12,089,399
2005	12,183,889	11,769,637	12,598,141
2006	12,556,817	12,092,215	13,021,419
2007	12,833,663	12,307,483	13,359,844
2008	13,140,069	12,548,766	13,731,372
2009	13,470,799	12,824,200	14,117,397
2010	13,775,316	13,059,000	14,491,633
2011	14,104,521	13,314,667	14,894,374
2012	14,410,904	13,560,660	15,261,147
2013	14,735,072	13,806,763	15,663,382
2014	15,075,413	14,065,360	16,085,465
2015	15,404,260	14,310,557	16,497,962
2016	15,732,621	14,568,407	16,896,834
2017	16,074,863	14,821,024	17,328,702
2018	16,403,890	15,058,771	17,749,009
2019	16,751,440	15,327,568	18,175,313
2020	17,092,478	15,571,247	18,613,709
2021	17,440,247	15,818,304	19,062,190
2022	17,789,406	16,081,623	19,497,189
2023	18,151,100	16,335,990	19,966,210

3.4 Forecast Methodology Overview

As noted in the introduction, a detailed discussion of the GRE system forecasting process is included as Appendix B.

GRE's planning forecast is the sum of the 28 member systems' energy and demand forecasts. GRE assists the member systems in the development of their forecasts by providing information and forecasts that are useful in quantifying their future loads.

After a member completes a forecast, GRE and member cooperative staff review whether or not the forecast is reasonable. The forecast is also reviewed by the member's senior staff. The member system's forecast is approved by the cooperative's member manager and the member's board of directors.

3.4.1 Process

Forecasting at the member system level is a three-step process. First, the energy requirements for each customer class are calculated. Next, a load factor forecast for each member system is created. Using the member system's forecasted energy requirements and forecasted load factor, the member system's demand is derived.

The member systems use information prepared by GRE to assist in determining if their forecast is reasonable. If a member's forecast cannot be explained using the models constructed by GRE, additional study must be performed to explain the differences and conclude which model best describes the future. A forecast may differ because of information known about the future that is not reflected in the historical data.

Each member forecasts the number of consumers and the energy usage per consumer for the following RUS-defined customer classes:

- Residential.
- Seasonal.
- Small commercial.
- Large commercial.
- Street and highway lighting.
- Public authorities.
- Sales for resale.

In addition, GRE's member cooperatives forecast their own energy requirements ("Own Use") and line losses ("System Losses") are calculated.

3.4.1.1 The importance of the residential forecast

Residential consumers represent more than half of GRE's end-use consumers and energy usage. In addition, residential consumer growth influences growth in other categories, such as small commercial, through service industries that develop to serve growing residential areas. Therefore, accurately forecasting the energy requirements of the residential customer class is the most important part of constructing GRE's forecast.

3.4.1.2 Energy forecast methodology

An energy forecast of each customer class is performed first. Energy requirements are calculated as the product of the number of consumers and the average energy usage per consumer for the respective class. GRE may prepare up to five models of number of consumers and average usage for each of the member systems. The number of models prepared is greatest for customer classes that have the largest impact on GRE's energy and capacity requirements, such as the residential and small commercial classes. Appendix C shows which model each member system used to forecast the number of members and usage per member for each customer class.

3.4.1.3 Load Factor Forecast Methodology

GRE staff provides each member systems with five load factor forecasts showing the relationship between demand and energy. A study of load factors over time is a study of changing usage patterns. For instance, a load factor forecast with no change incorporates the assumption that usage patterns will remain the same. A seven year and an eleven year trend of load factors for both the winter and summer seasons are prepared and compared. Factors affecting historical and forecast trends are identified. GRE staff also provided each member systems with an econometric model forecast of the summer season load factor. The models calculate weather adjusted trends and corrects for the addition of a known future large load addition, if necessary.

3.4.1.4 Demand Forecast Methodology

A seasonal demand forecast for each member system is constructed using the forecast of annual energy requirements and the seasonal load factors.

3.4.1.5 Adjustments to Reflect GRE's Net Obligations

The final step is making adjustments to the aggregate GRE demand and energy forecasts to net out any member load it is not obligated to serve. To accomplish this, GRE [TRADE SECRET INFORMATION BEGINS
TRADE SECRET INFORMATION ENDS].

3.5 Investigating Forecasts Excluding DSM

In past IRP filings, GRE has attempted to develop the IRP in ways that conform as closely as possible to existing GRE planning practices. In load forecasting, this has meant the use of the RUS forecasts for each member system based on observed historical data of sales by class and peak demands by system. Since the historical data used for these forecasts includes DSM impacts of both energy sales and peak demands, the resulting forecasts are also with DSM forecasts that assume continued growth in DSM at rates comparable to those experienced in the past.

In the Fall of 2004 GRE began discussions with Power System Engineering, Inc. (PSE) regarding the methods that could be used and the data that would be required to develop a baseline IRP load forecast that excludes any new DSM (the No New DSM Forecast). GRE then contracted with PSE to begin this investigation.

3.5.1 Goal

Since GRE is clearly a summer-peaking system, the study's highest priority is identifying the separable impact of each conservation and load control program on the hourly summer peaks, which regularly occur in June, July, or August. The GRE system control center has historically estimated the aggregate impact of these programs for each control event based on engineering estimates.

3.5.2 Modeling

The PSE approach to estimation of the separable load control impacts is known as a statistically adjusted engineering (SAE) methodology that specifies regression models in the general form:

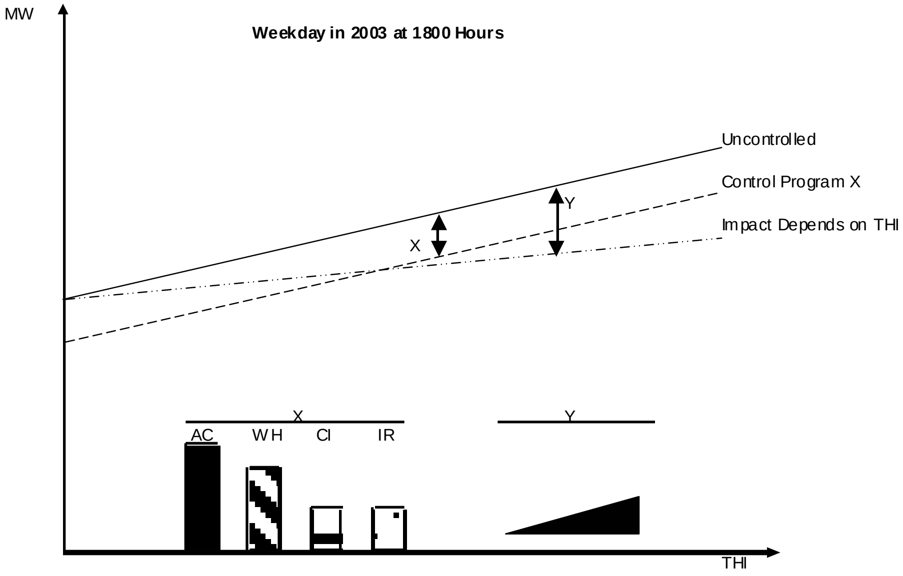
Dh = (Daytype and Hour, Daytype*THI, Control Impacts by Program/Participant, Phase Factor, Trend) where:

Dh = Demand in MW in Hour h
Daytype = Weekday, Saturday, or Sunday/Holiday
Hour = Hour of the Day (1 – 24)
THI = Hourly Temperature Humidity Index
Control Impacts = Engineering Estimate–kW Reduction/Control Point
Reliability Factor = Estimated % of Effective Installed Controls
Phase Factor = Estimated Phase-In and Restoration Impacts
Trend = Time Trend to Capture Load Growth

The statistically estimated coefficient of the Control Impact term recalibrates each of the engineering estimates to provide the best fitting equation. For example, if the generic engineering estimate of 1.0 kW per controlled central air conditioner were used and the equation coefficient were 0.8, the final estimate would be 1.0 X 0.8 = 0.8 kW per control point. The reliability factor provides an adjustment to account for the fact that not all control receivers remain operational over all control periods due either to equipment malfunctions or in some cases to customer malfeasance. The phase-in and phase-out factors provide ramp-up and ramp-down factors to recognize the control strategies under which the programs are operated and to adjust the 15 minute control periods to an hourly basis. Where appropriate, the SAE impacts have been calibrated to the average size of houses served by GRE members.

The description of the impact estimation equation is illustrated in Figure 3-9. For a particular hour (1800) of a particular summer day (Wednesday) in 2003, one can visualize the relationship of uncontrolled loads and controlled loads as simple functions of the THI. Programs like water heater control and the interruptible programs have control impacts that are not dependent on the THI. Thus, the control impacts labeled X are the same regardless of the THI and the “Uncontrolled” and “Control Program X” lines are parallel. The A/C control impacts, however, do increase at higher THIs, leading the “Uncontrolled” and “Impact Depends on THI” lines to diverge as the THI increases.

Figure 3-9 Illustrative Application of Impact Estimation Equation



3.5.3 Next Steps

PSE has provided GRE with preliminary results of each program's effect per participant for the summer season. The preliminary results illustrate that the A/C cycling program and the interruptible C&I programs have, by far, the greatest effect on GRE's peak load.

GRE staff is currently in the process of evaluating the study's SAE coefficients. The next step in the study process would be using the SAE coefficients to create a historical database of expected peak load observations for those days on which GRE implemented load control. However, there is a limit to the historical record that may be constructed. It is not feasible to analyze periods earlier than 1999 since UPA and CPA databases for the earlier periods are not compatible and cannot reasonably be combined. The study's SAE load control values may be used in a future IRP proceeding as the basis for creating a demand forecast that excludes load management, if GRE's analysis shows it to improve the overall forecast.

4 EXISTING RESOURCES

This section summarizes existing load management and conservation programs, supply-side resources, and transmission resources.

4.1 Existing Demand-Side Resources

4.1.1 Existing Load Management and Energy Conservation Programs

GRE's conservation programs are designed to assist and educate member cooperatives and their customers. The programs provide incentives to reduce energy consumption and costs. GRE promotes these programs and provides the member cooperatives assistance in implementing the programs.

Energy conservation programs can be broken into two categories. The first is indirect conservation. These are programs that educate and inform customers of ways to conserve energy, but are not always quantifiable. Some examples include: educating customers to plant trees near a home to provide shade in the summer, keeping the shades up in the winter to allow for the solar effect, or obtaining an energy evaluation or consultation.

The second category is direct energy conservation. These programs have quantifiable energy and/or capacity savings. Examples of these are air source or ground source heat pumps, high efficiency appliances, and compact fluorescent lights.

GRE's load management programs are designed to allow GRE to remotely control connected end-use loads during periods of high demand. Common examples are cycled air conditioning and interruptible commercial and industrial loads. A detailed description of each program can be found in Appendix A.

Generally GRE's conservation programs decrease energy use while load management emphasizes lowering the peak demand (i.e., MW). The increased efforts by GRE and the member cooperatives to focus on energy conservation (i.e., kWh) are illustrated by an almost doubling in dollars spent on conservation from 2002 to 2003. This substantial increase is a result of GRE and member cooperatives working together to implement conservation programs that produce energy savings. Figure 4-1 illustrates that GRE and the member cooperatives exceed the mandated minimum spending on load management and conservation programs. The reported energy and demand savings realized from the spending is detailed in the next section.

Figure 4-1 GRE and Member Cooperative Spending vs. Mandated Minimum Spending

GRE and Member Cooperative Spending vs. Mandated Minimum Spending			
	2002	**2003**	**2004**
Minimum Requirement	$7,014,375	$8,659,990	$10,310,552
Conservation Programs	$5,878,257	$10,250,441	$11,784,963
DSM Programs	$5,591,879	$2,115,065	$2,964,636
Miscellaneous	$3,088,303	$2,264,270	$170,170
Total Spending	$14,558,439	$14,929,776	$14,919,769
Spending as a Percent of Mandated Requirement	208%	172%	145 %

4.1.2 Improvements to DSM Programs

GRE has implemented many of the Department of Commerce's recommendations from previous regulatory proceedings that emphasize energy savings through conservation.

Figure 4-2 summarizes recent GRE actions to improve its DSM programs.

Figure 4-2 GRE's Actions to Improve DSM Programs

GRE's Actions to Improve DSM Programs		
Proceeding	**DOC Recommendation**	**GRE Action**
2001 IRP (RP-01-160)	Conduct a DSM potential assessment to determine the range of achievable DSM by GRE's member cooperatives given differing levels of incentives to customers.	Global Energy Partners, LLC completed Energy Efficiency Potential Assessment in June 2003. The report was included as Appendix C of GRE's 2003 IRP.

GRE's Actions to Improve DSM Programs		
Proceeding	**DOC Recommendation**	**GRE Action**
	Set energy and demand saving goals for the planning period.	For 2004 and 2005 GRE set goals in kW for cycled AC. (In the past members submitted their forecast of number of units or dollars that would be spent in that year.)
	Set up an improved DSM reporting format for its member distribution companies.	In 2002 GRE's online CIP reporting program was developed for members to report their CIP information to GRE.
	Put in place structures to operate the following conservation projects:	
	Residential Refrigeration.	Energy Star® High Efficiency appliance rebate program began in 2003. In addition to refrigeration, this program also includes clothes washer and dishwasher.
	Commercial Lighting.	The program is offered through GRE's commercial and industrial grant program.
	Industrial/Agricultural Motors.	The program is offered through GRE's commercial and industrial grant program.
	Building commissioning.	Currently using Weidt group for new and commissioning consulting on a case-by-case basis.

GRE's Actions to Improve DSM Programs		
Proceeding	**DOC Recommendation**	**GRE Action**
	Residential and Commercial air conditioning efficiency.	The program is offered through GRE's commercial and industrial grant program. GRE also provides rebates for low income AC tune-ups. The Energy Star® Residential AC rebate program was implemented in 2002.
	Ground source heat pumps.	The program is offered through GRE's commercial and industrial grant program. On the residential side, GRE provides a $300 rebate.
	Appliance load control.	GRE has always had programs designed to control load or move it from peak times to off-peak times. The projects include off-peak water/space heat, cycled air conditioning, peak shave water heat, limited interruption (dual fuel), electric thermal storage.
2003 IRP (RP-03-974)		
	Consider increasing the efficiency level of the technologies used in the DSM programs to levels supported by federal Energy Star® standards.	Converted to Energy Star® standards in 2003 for appliances. Air conditioning standards were converted in 2002.
	Consider offering a program to promote energy efficiency in the design of new buildings.	Currently offering pilot program in 2005.
Programs Instituted by GRE		

GRE's Actions to Improve DSM Programs		
Proceeding	**DOC Recommendation**	**GRE Action**
	Solar Photovoltaic pilot rebate program.	Developed a program to add support to Minnesota DOC Solar PV program. GRE matches DOC up to $4000/installation for 2005 and possibly 2006, at $2000/kW. GRE is in negotiation with four prospective customers.
	Minnesota HVAC & CAC Program	Working with WECC, Xcel Energy, MN Power, Otter Tail Power and SMMPA on state wide program for high efficiency variable speed motors for furnaces and AC units.

4.1.3 Impact of Existing Energy Conservation and Load Management Programs

Because GRE's customer base is largely residential (nearly 60% of 2003 energy sales), the daily load curve is primarily influenced by residential usage. GRE's load curve experiences two peaks, one in the morning and another occurring sometime between mid-afternoon and early evening. The afternoon peak constitutes the daily peak.

To improve its load factor, GRE has encouraged cost-effective load management and energy conservation programs that help to flatten the load curve, particularly in the summer months. Summer programs that reduce demand during peak periods include cycled air conditioning and air source heat pumps, controlled irrigation, and interruptible commercial and industrial programs. Through these efforts GRE has been successful in controlling demand the approximant equivalent of a 300 MW power plant. Reducing peak demands through load control helps to reduce GRE's need to build additional peaking resources. GRE also estimates that its Conservation Improvement Programs (CIP) in 2004 resulted in a total energy savings of 143.7 million kWh.

Figure 4-3 summarizes the capacity and energy savings of GRE's load management and energy conservation programs. The savings includes distribution and transmission losses and the MAPP 15% reserve requirement.

For 2003 and 2004, actual savings are reported, while the subsequent years are GRE's forecast of achievable savings.

Figure 4-3 2004 Load Management and Conservation Summary

2004 Load Management and Conservation Summary

Year	Summer Capacity Reduction (kW)	Annual Energy Savings (kWh)
2002	271,247	73,908,504
2003	331,073	113,424,747
2004	345,962	139,967,526
2005	364,000	168,000,000
2006	384,000	198,000,000
2007	404,000	228,000,000

4.2 Existing Supply-Side Resources

Figure 4-4 summarizes existing resources utilized by GRE.

Figure 4-4 Simplified GRE Capacity Resources and Current Summer Accredited Rating in 2005

Simplified GRE Capacity Resources and Current Summer Accredited Rating in 2005

Unit Name	Capacity MW
Owned Resources	
Pleasant Valley Station	427.3
Lakefield Junction	514.8
Cambridge CT	19.4
Maple Lake CT	19.1
Rock Lake CT	19.3
St. Bonifacius CT	50.0
Elk River Station 1	10.5
Elk River Station 2	10.6
Elk River Station 3	17.8
Stanton Station	186.7
Stanton Station diesel	1.0
Coal Creek Station 1	551.0
Coal Creek Station 2	561.0
Coal Creek Station diesel	2.0
Chandler Phase 1	0.1
Total Owned Resources:	2390.6
Major Purchase Resources	
Genoa 3	172.3
Western Area Power Administration	89.8
Manitoba Hydro Diversity Exchange	150.0
Manitoba Hydro capacity and energy	50.0
Minnesota Power Block A & B	175.0
Total Major Purchases:	637.1
Major Commitments (Sales)	
NSP (Koch)	75.0
Willmar	28.0
NSP (Diversity Exchange)	50.0
Total Major Sales:	153.0

These are the ratings for 2005. Ratings will vary from year to year based on the annual performance testing.

4.2.1 Existing Fossil-Fuel Resources

GRE's existing fossil-fuel resources can be characterized as baseload or peaking resources.

4.2.1.1 Existing Baseload Resources

GRE's existing baseload generators include the 187 MW Stanton Station and the 1,112 MW Coal Creek Station. Both are located in central North Dakota. Stanton Station switched to burning Powder River Basin subbituminous coal (PRB) from lignite in November 2004 for reasons discussed later. Coal Creek Station continues to burn lignite coal from the adjacent Falkirk mine.

4.2.1.2 Existing Peaking Resources

GRE's major peaking generation includes Lakefield Junction and Pleasant Valley Stations. Lakefield Junction is a six-unit dual fuel combustion turbine facility capable of burning natural gas or fuel oil. The station is currently rated for 515 MW in the summer and 550 MW in the winter. Pleasant Valley Station is a three-unit dual fuel combustion turbine facility capable of burning natural gas or fuel oil. The station is currently rated for 427 MW in the summer and 487 MW in the winter.

GRE also owns four oil-fired combustion turbines, three of which each have a summer rating of approximately 20 MW and a winter rating of approximately 27 MW. The fourth combustion turbine is currently rated for 50 MW in the summer and winter. The combustion turbine facilities are scattered throughout GRE's Minnesota service area.

4.2.2 Existing Long-Term Purchase Resources

GRE has the following major long-term purchase resources:

- Life-of-the-plant contract with Dairyland Power Cooperative to purchase half the output (172 MW) of the Genoa 3 coal-fired plant, which is located in Genoa, Wisconsin.
- Manitoba Hydro capacity diversity exchange for 150 MW of capacity in the summer with 15 percent planning reserves. The contract expires on April 30, 2015.

- Manitoba Hydro 50 MW capacity and energy. The contract expires on April 30, 2007.
- Northern States Power capacity diversity exchange for 50 MW of capacity in the winter. Early termination notice has been issued such that the contract expires on April 30, 2010.
- Minnesota Power 175 MW capacity and energy with 15 percent planning reserves. The contract expires on April 30, 2010.
- 12 of GRE's 28 members have been allocated hydropower from the Western Area Power Administration (WAPA) totaling 86.8 MW of summer capacity. GRE also receives 3 MW of firm summer capacity that was previously allocated to UPA. These are MAPP firm purchases that include 15 percent for planning reserves.

4.2.3 Existing Long-Term Commitments (Sales)

GRE has the following major long-term sale obligations:

- Northern States Power capacity and energy contract to serve 60 percent of the Flint Hill Resources (Koch) Refinery load (75 MW with 15 percent planning reserves). The contract expires on December 31, 2010.
- Willmar capacity contract for 28 MW in 2005 up to 30 MW beginning in 2006. The contract expires on December 31, 2015.
- Manitoba Hydro capacity diversity exchange for 150 MW of capacity in the winter with 15 percent planning reserves. The contract expires on April 30, 2015.
- Northern States Power capacity diversity exchange for 50 MW of capacity in the summer. Early termination notice has been issued such that the contract expires on April 30, 2010.

4.2.4 Existing Renewable Resources

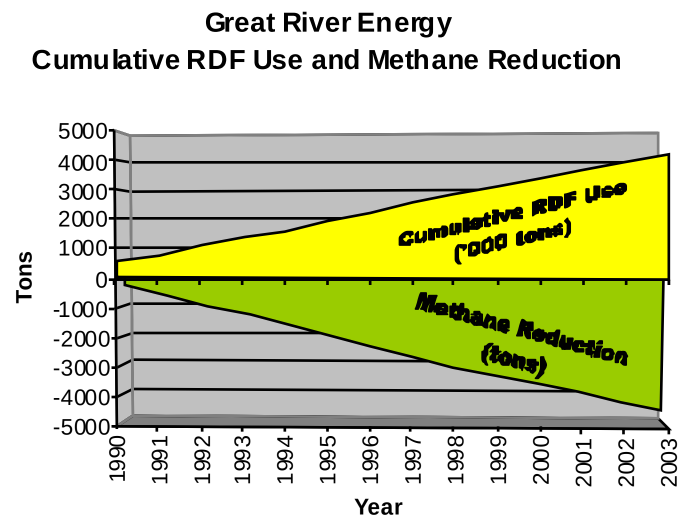
GRE provides renewable energy to its member cooperatives as part of its general energy portfolio and also through its green energy program, Wellspring® Wind Energy. Renewable resources included in GRE portfolio include wind, refuse-derived fuel, and landfill gas.

GRE began its development of wind resources to market wind energy to its distribution cooperative members and their customers through the Wellspring program. Under this program, customers can purchase wind energy in 100-kWh per month blocks at a premium over their current electric rate. GRE purchases wind resources to meet the demand for Wellspring Wind Energy and markets the remaining output to other utilities that are interested in offering green energy to their consumers. GRE is also making a good faith effort to achieve the Renewable Energy Objective. GRE's renewable energy that is not specifically sold, either through the Wellspring program or to other utilities, is used toward the REO.

GRE began its acquisition of wind resources by arranging for the development of three large wind turbines with a combined nameplate capacity of 2 MW near Chandler, Minnesota. In January 2002, GRE brought an additional 4 MW (nameplate capacity) of wind energy on line at Chandler. In January 2004, GRE began the purchase of a 6 MW nameplate wind facility in Dodge Center, Minnesota and another purchase of a 6 MW nameplate wind facility in Jackson, Minnesota. Both of these purchases continue through 2018. Most recently, in 2004 GRE signed a contract to purchase the output of Trimont Wind I, LLC (Trimont), a 100 MW (nameplate) wind project located in Martin and Jackson Counties of Minnesota. Trimont Area Wind Farm (TAWF), a coalition of local citizens, was initially selected from a 2003 Request For Proposals (RFP) process. This project will be on-line by the end of 2005.

GRE owns and operates Elk River Station, a waste-to-energy facility. The station utilizes refuse-derived fuel as its primary energy source, a renewable fuel as defined by Minnesota Statutes 216B.1691. Refuse-derived fuel is produced from municipal solid waste. Utilizing refused-derived fuel for energy recovery at Elk River Station reduces the amount of municipal waste that is land filled by between 250,000 and 300,000 tons annually. Since 1990, the station has used over 4 million tons of refuse-derived fuel. This means less land filled municipal waste and less methane production. Since methane has a global warming potential that is 21 times that of CO_2, Elk River Station has a positive impact by reducing this greenhouse gas as shown in Figure 4-5.

Figure 4-5 GRE Cumulative RDF Use and Methane Reduction



GRE also has a contract with the Elk River Municipal Utility for the purchase of 2.4 MW of capacity and energy from a landfill gas project installed at the Elk River Landfill. This project became commercially available November 7, 2002.

Finally, GRE has contracted to purchase the output of two anaerobic digester projects under contracts that are reviewed and potentially renewed on an annual basis. Haubenschild Farms Inc., a large dairy farm with approximately 1,000 dairy cows, currently operates an anaerobic digester project with one 150 kW generator in the service territory of GRE member East Central Electric Cooperative. The digester project generates approximately 1,100,000 kWh per year. Northern Plains Dairy, a large dairy farm with approximately 3,000 cows, currently operates an anaerobic digester project with two 130 kW generators in the service territory of GRE member BENCO Electric Cooperative . The digester project generates approximately 2,000,000 kWh per year.

4.3 Existing Transmission Resources

GRE is both a transmission user and a transmission provider. Through a combination of GRE-owned transmission, MISO network service and legacy contracts, GRE delivers power and energy from its generating resources to the loads of its member cooperatives as well as engages in power transactions with others.

4.3.1 GRE-Owned Transmission Resources

GRE owns significant transmission resources. Figure 4-6 summarizes the amounts and types of transmission lines owned by GRE.

Figure 4-6 GRE Transmission Facilities

GRE TRANSMISSION FACILITIES	
Voltage	**Miles**
22-kV	17
34-kV	170
41-kV	293
46-kV	25
69-kV	2465
115-kV	368
161-kV	53
230-kV	539
345-kV	92
500-kV	70
+/-400 kV DC	436
Total	**4,528**

4.3.2 Other GRE Transmission Arrangements

GRE's 2003 IRP filing described several transmission agreements through which it serves its members and other transmission customers. Since that filing, GRE joined MISO and GRE's transmission agreements have changed significantly. GRE's transmission facilities were integrated into the MISO network on December 1, 2004. Most of the transmission service under the legacy agreements has been replaced with Network Integrated Service from MISO. MISO network service provides several benefits to GRE's members. First, it eliminates rate pancaking. Prior to becoming a MISO member, GRE had several instances where multiple contracts were necessary to provide full load-serving capabilities. Now, the single MISO tariff provides the same level of service under one single tariff rate. Also, MISO network service gives access to a larger transmission network than GRE's previous arrangements.

Some of GRE's legacy agreements remain in place as a result of being grandfathered under the MISO tariff. Grandfathering allows GRE to maintain legacy transmission arrangements that continue to provide effective service to GRE's members. GRE's primary grandfathered agreements are: (1) the transmission arrangements to deliver power and energy to and from Manitoba Hydro; and (2) the transmission arrangement to deliver the output of Stanton Station to Xcel and Otter Tail Power in North Dakota in return for their supply of power and energy to GRE loads in Minnesota. Finally, GRE's arrangement to use its dedicated DC transmission line to deliver the output of Coal Creek Station to its Minnesota load remains in place. Because the DC line is utilized as generation outlet, it is not classified as part of GRE's transmission system which has been placed under the MISO tariff.

4.4 Operational Highlights of Existing Resources

Clean Air Act Title IV Requirements

Coal Creek Station and Stanton Station, as well as several of GRE's combustion turbines, have affected units under the Federal acid rain regulations (Title IV of the Clean Air Act Amendments).

These regulations limit NO_X levels at Coal Creek Station to 0.40 lb/MMBtu at each unit, and at Stanton Station to 0.46 lb/MMBtu for Unit 1 and 0.45 lb/MMBtu for Unit 10. Stanton Station's Unit 10 chose early election, which means that its allowable NO_X emissions level will be further reduced to 0.40 lb/MMBtu beginning in 2008. The facilities have complied with their applicable limits through the installation of low NO_X burners and other combustion controls including over-fire air.

The acid rain program also places limits on emissions of SO_2 and creates a market for SO_2 emission allowances. Under this program, the U.S. Environmental Protection Agency allots a specified number of SO_2 allowances to each unit for each year. Utilities are free to "under-control" and buy allowances, "over-control" and sell allowances, hold allowances for future use; trade or transfer allowances in power sales or other transactions, pool allowances with other utilities to mitigate risk, and use allowance futures contracts and options to hedge against future price changes. Coal Creek Station's two units are allotted 44,497 allowances per year. Stanton Station's two units are allotted 8,781 allowances per year. Upgrades have been made to the scrubbers on both units at Coal Creek Station and on Unit 10 at Stanton Station.

No additional modifications should be required for continued compliance with the SO_2 provisions of the acid rain program. However, Great River Energy has completed some projects that have resulted in reduced emissions and is in the process of planning other projects that will further reduce emissions.

The most significant project completed in 2004 was switching from lignite to PRB coal at Stanton Station. Switching to PRB provides several advantages. The plant will handle and burn less coal because of PRB coal's higher heat content, resulting in lower emissions. In addition, ash generation and handling will be reduced because PRB has an ash content that is one-half that of lignite. The fuel switch occurred in late 2004 and the plant is still evaluating its operational improvements and levels of emission reductions.

Great River Energy is also planning a pollution control, energy recovery and emission reduction project at Coal Creek Station whereby the plant will provide steam for an adjacent ethanol plant. More details on this project are provided later in this section.

Fly Ash Sales

Since 2003, GRE has been a champion of EPA's Coal Combustion Products Partnership (C^2P^2) to promote the benefits of coal combustion products – including fly ash. As a C^2P^2 champion, GRE has developed and committed to goals to increase the use of fly ash.

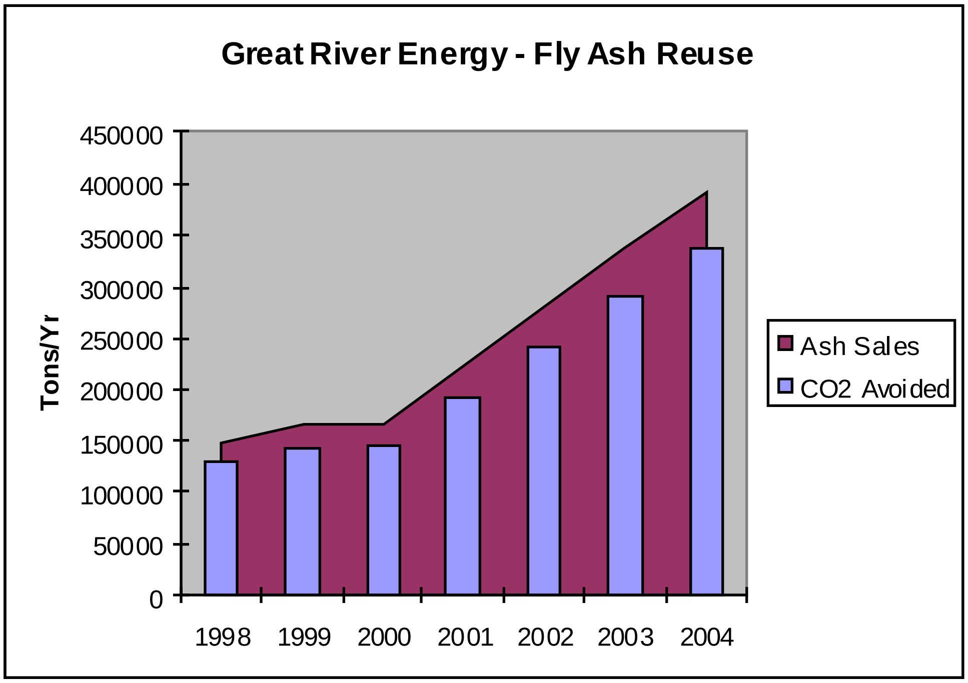
As a by-product of coal combustion, GRE generates approximately 440,000 tons of fly ash per year at Coal Creek Station. Historically, fly ash was stored in landfills, but over the last several years GRE has been very successful in finding alternative uses for it. It is primarily used as a partial replacement for cement, which makes the concrete stronger and more durable than concrete made with cement alone.

Re-using the ash avoids cement production, reducing CO_2 emissions in the cement production process. For each ton of fly ash that is used as a cement replacement, greenhouse gas emissions are estimated to be reduced by just over 0.8 tons. Since 1998, nearly 1.5 million cumulative tons of CO_2 have been avoided through GRE's ash re-use.

By re-using the ash, GRE also avoids storing the ash in landfills, resulting in cost savings of approximately $3.75 per ton. Since 1998, nearly $7 million in cumulative landfilling costs have been avoided through re-use.

In 2003, GRE completed construction on a 100,000-ton fly ash dome at Coal Creek, which can store up to two months' production. Through contractual agreements, GRE also has storage capabilities near Buffalo, Minnesota and Denver, Colorado. This storage capacity allows GRE to better meet fluctuating demand for fly ash while maximizing the amount of ash re-used.

Figure 4-7 GRE-Fly Ash Reuse



Cogeneration for an Ethanol Plant

GRE is working on a project at Coal Creek Station to allow the plant to provide steam to an adjacent ethanol plant. In addition to the benefit of using low pressure steam that would normally be unused, the project will result in much lower emissions than a stand-alone ethanol project.

The primary benefit of locating the ethanol plant adjacent to Coal Creek Station is to allow for beneficial use of low level energy from Coal Creek Station by the ethanol facility. Approximately 60 percent of the process steam for the ethanol facility will come from recovery and use of low pressure steam at Coal Creek Station that has no value in Coal Creek Station's steam cycle and that would normally be rejected to the cooling towers as heat. Remaining steam needs for ethanol facility production also will come from Coal Creek Station.

As part of the cogeneration project, several improvements will be completed at Coal Creek Station that will result in large emission reductions. With respect to SO_2 emissions, these include installation of liquid distribution rings, upgrades to the mist eliminator wash system, and the addition of air heater seals. These improvements are expected to reduce net SO_2 emissions from the station by approximately 900 tons per year. With respect to NO_X

emissions, the improvements include installation of new manual tilt drives on the Unit 1 Separated Over-Fire Air compartments. The new tilt drives in conjunction with the reduced air heater leaks are expected to reduce net NO_X emissions by approximately 600 tons per year.

Coal Drying Project

In January 2003, the U.S. Department of Energy selected Great River Energy's Coal Creek Station to participate in a clean coal technology project. Through the project, Coal Creek Station will conduct a large-scale coal-drying study to determine if it is feasible to dry larger quantities of lignite for use at the plant. Lignite has a high moisture and ash content. By reducing the moisture and ash content, less coal is required to generate the same amount of electricity. This also results in fewer emissions. Through the project, the moisture content of lignite will be reduced from 38 percent to under 30 percent. This will improve the quality of lignite - making it closer to the quality of sub-bituminous coal from Montana and Wyoming. As a result, efficiencies will increase by 2.8 to 5 percent. Sulfur dioxide emissions are expected to decrease by 25 percent sulfur dioxide and mercury, carbon dioxide, nitrogen oxide and particulate emissions are expected to each decrease by seven percent.

5 RESOURCE REQUIREMENTS

The next step in the planning process is to determine GRE's net resource requirements after considering the forecasted demand and existing resources.

5.1 GRE's Summer Resource Situation

Figure 5-1 below illustrates the GRE summer resource situation. The demand forecast is Scenario 5, as described in Section 3. The net resources include all of GRE's available resources, contracted and owned, prorated down to account for reserve requirements. (i.e. reserve requirements are subtracted from the resource numbers rather than added to the demand level.)

Figure 5-1 GRE Summer Resource Situation

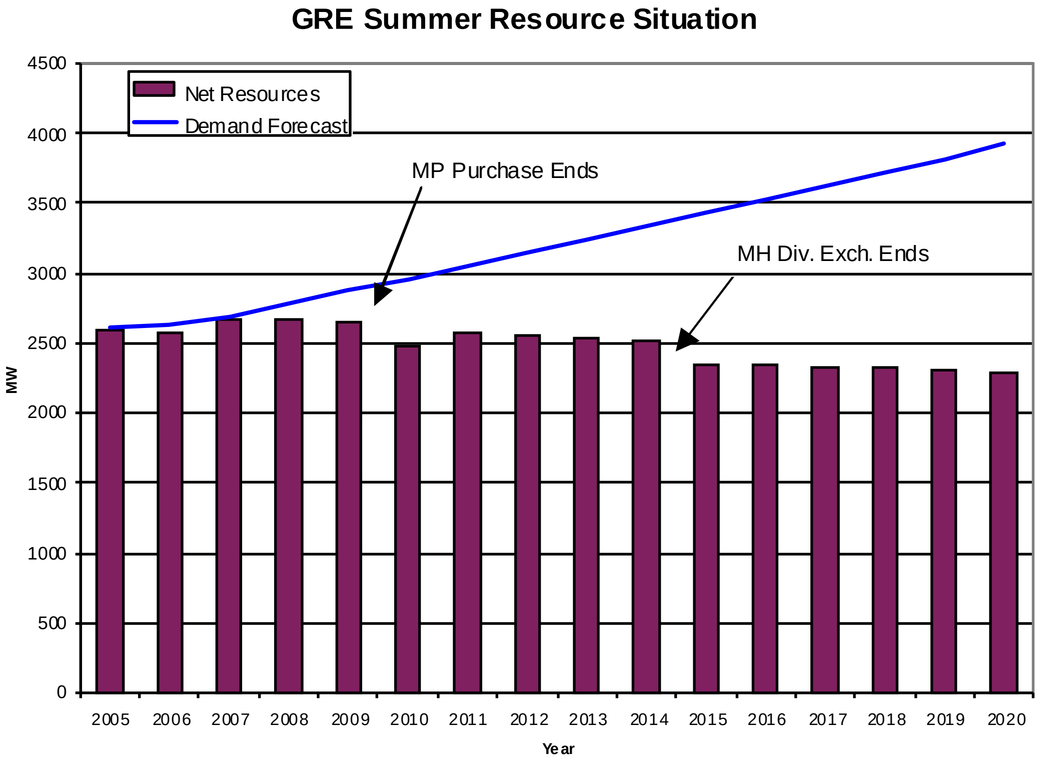


Figure 5-2 below lists the deficits over the planning horizon. Although GRE shows deficits for the entire planning horizon, the deficits are large enough to consider resource additions beginning in 2008. GRE's modeling reflects this information in its assumptions, as described in Section 7.

GRE notes that these deficit numbers are derived by simply subtracting the Scenario 5 demand forecast from available resources. This is a sound long-term planning strategy. However, GRE bases its short-term planning on different factors. One or two seasons in advance, GRE evaluates recent actual load levels, expected weather and economic trends, market conditions, and other factors to determine its short-term capacity needs. GRE has already conducted this short-term analysis for the 2005 summer season and has concluded that it has more than adequate capacity to meet its summer peak needs. The difference between existing resources and scenario 5 is not the relevant assessment for the current year. It becomes increasingly relevant in the mid-term and longer-term portions of the planning horizon.

Figure 5-2 GRE Summer Resource Surplus/Deficit

GRE Summer Resource Surplus/Deficit	
Year	**Surplus/Deficit (MW)**
2005	-23
2006	-57
2007	-20
2008	-121
2009	-224
2010	-477
2011	-493
2012	-595
2013	-700
2014	-816
2015	-1097
2016	-1176
2017	-1294
2018	-1408
2019	-1524
2020	-1637

5.2 Contingencies that May Impact Supply and Demand

GRE has analyzed its internal structure and policies as well as external issues within the industry to identify key factors that may impact supply and demand. GRE has identified two primary areas for which it must engage in contingency planning: the provision in its Power Purchase Contract that allows member cooperatives to take a portion of their load to an alternate supplier, and future potential environmental legislation.

5.3 Existing Power Purchase Contract Requirements

GRE's Power Purchase Contract requires its member cooperatives to choose one of two power supply options from GRE: All-Requirements Purchase or Fixed Purchase.

5.3.1 All-Requirements Purchase Option

This standard power supply option requires the member to purchase all of their current and future capacity and energy requirements from GRE.

5.3.2 Fixed Purchase Option

[TRADE SECRET INFORMATION BEGINS

TRADE SECRET INFORMATION ENDS]

5.4 Future Environmental Regulations

GRE provided a comprehensive overview of potential future environmental regulations in its 2003 resource plan filing. In its order accepting that plan, the Commission ordered GRE to include an update and summary of current environmental issues and contingency plans for compliance with expected future regulations[5]. The policies have not changed significantly since the 2003 filing. Therefore, GRE provides an overview and brief summary in this section.

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[5] The Commission also ordered GRE to summarize its methods of compliance with existing regulation. This summary is included in Section 4.

5.4.1 Regional Haze

The U.S. Environmental Protection Agency (EPA) published final regional haze regulations in 1999. The goal of these regulations is to improve visibility in certain national parks and wilderness areas to reach more natural conditions by 2064. The rule will require certain power plants to install Best Available Retrofit Technology (BART) to control SO_X and NO_X. On April 15, 2005, EPA and Environmental Defense filed an agreed stipulation in court extending the deadline for EPA's issuance of a final BART rule by two months, to June 15, 2005 (Environmental Defense v. Leavitt, D.D.C., No. 03-1737, 8/3/04). The stipulation states that, "EPA has committed to conduct additional technical analyses in developing the final BART Rule."

Until North Dakota establishes BART requirements, it is difficult to develop a specific regional haze compliance strategy. Some questions that need to be answered are:

- What is the reasonable incremental cost for SO_2 removal?
- Will SO_2, NO_X and PM emission reductions be required?
- What depreciation rate will be allowed in determining a unit shutdown date?
- What visibility improvement will result from BART?

5.4.2 National Ambient Air Quality Standards

In 1997, the U.S. Environmental Protection Agency (EPA) revised the national ambient air quality standards (NAAQS) for ozone and particulates. The ozone standard was changed from 0.12 parts per million as a one-hour standard to 0.08 parts per million as an eight-hour standard. A new fine particulate matter (PM2.5) standard was created at a maximum annual average of 15 micrograms per cubic meter and a maximum 24-hour average of 65 micrograms per cubic meter. The form of the old PM10 standard was also effectively relaxed. Several lawsuits were filed over the standards. On March 26, 2002, the Court of Appeals ruled in EPA's favor, denying the petitions for review that challenged the eight-hour ozone and PM2.5 standards. The court required EPA to change its 8-hour ozone implementation policy, however, and to address evidence regarding beneficial aspects of ground-level ozone, i.e., shielding from ultraviolet (UVB) radiation. The court also denied challenges by environmental groups that the daily PM2.5 standard was not stringent enough.

Minnesota and North Dakota are already in attainment with the revised ozone and PM2.5 NAAQS. As such, the NAAQS change is not expected to directly impact GRE's operating plants. Indirectly, the Clean Air Interstate Rule (CAIR) developed to assist non-attainment areas come into compliance with the limits, could affect GRE's Minnesota facilities. More discussion of CAIR is provided in Section 5.4.5.

5.4.3 Mercury

The EPA published its Clean Air Mercury Rule (CAMR) on March 15, 2005. The rule relies on a market-based cap-and-trade approach under Section 111 of the Clean Air Act (CAA) to require a two-phase reduction in mercury emissions. In 2010, mercury emissions are capped at 38 tons, and in 2018, the cap is reduced to 15 tons. EPA does not believe that full-scale mercury-specific technologies can be developed and widely implemented within the next five years; however, it believes it is reasonable to assume this can be accomplished over the next thirteen years. The timing of the Phase II cap is such that new technologies can be developed, installed, demonstrated and commercially deployed with little overall economic impact.

The rule allocates each state a mercury allowance budget. States have the flexibility to meet their state budgets by participating in a trading program or establishing another methodology for mercury emissions reductions from coal-fired electric generating units. Minnesota's allocation is 0.695 and 0.274 tons in Phase I and II, respectively. North Dakota's allocation is 1.564 and 0.617 tons, respectively.

The CAMR also establishes mercury emission standards for new coal-fired units as follows:

- Bituminous units: 0.0026 ng/J (21 x 10^{-6} lb/gross MWh)
- Subbituminous units:
    - wet FGD 0.0055 ng/J (42 x 10^{-6} lb/gross MWh)
    - dry FGD 0.0103 ng/J (78 x 10^{-6} lb/gross MWh)
- Lignite units: 0.0183 ng/J (145 x 10^{-6} lb/gross MWh)
- Coal refuse units: 0.00017 ng/J (1.4 x 10^{-6} lb/gross MWh)
- IGCC units: 0.0025 ng/J (20 x 10^{-6} lb/gross MWh)

GRE's mercury reduction efforts have been focused on research to investigate and develop emission control technologies. To date, GRE has committed to participating in over $20 million worth of research focused on developing mercury emission controls for coal-fired power plants. Several of the studies have been conducted at GRE's North Dakota power plants, and another full-scale sorbent injection testing will be conducted during summer 2005 at its Stanton Station.

5.4.4 Multi-Emissions Legislation

Multi-emissions legislation could dramatically change the regulatory atmosphere under which electric generators must operate. Currently, GRE is expected to conduct long-term planning under the existing myriad of complex environmental regulations and policies. A single multi-emission regulatory policy would help all electric generators plan least-cost strategies for complying with environmental regulations.

Several bills have been proposed to cap emissions of SO_X, NO_X , and mercury to varying degrees. Some bills have also included caps on carbon dioxide (CO_2). In addition, each bill, to varying degrees, would meet the emission caps through trading programs. While each bill prescribes emission caps, the details of allocating emission credits is not well defined. Until such time that details are provided, GRE can only speculate on the impact of any one bill versus another.

Due in part to the lack of multi-emissions legislation, EPA has promulgated the Clean Air Interstate Rule (CAIR), a multi-emissions, multi-state rule that will impact GRE's emission sources in Minnesota.

5.4.5 Clean Air Interstate Rule

The Clean Air Interstate Rule (CAIR), a two-emission rule, was signed March 10, 2005 by the EPA Administrator. CAIR requires reductions in emissions from states that will contribute significantly to non-attainment of, or interfere with the maintenance of, the PM2.5 and/or the 8-hour ozone National Ambient Air Quality Standards (NAAQS). Minnesota has been identified as a significant contributor in the PM2.5 NAAQS and will be required to reduce SO_2 and NO_X emissions. CAIR emissions reductions will be implemented in two phases: Phase I will begin in 2009 and 2010 for NO_X and SO_2, respectively, and Phase II will begin in 2015.

CAIR emissions reductions are based on Title IV Phase II allowance levels for SO_2 and NO_X. Required SO_2 emissions reductions are 50 percent in 2010 and 65 percent in 2015. Required NO_X emissions reductions are approximately 56 percent in 2009 (from units in existence from 1999 - 2002) and 64 percent in 2015.

The states have 18 months from the date of publication of the rule in the Federal Register to revise their state implementation plans (SIP) to accommodate CAIR provisions. The state has full discretion on the types of industry to be regulated and the extent to which they will be regulated. The emission reductions listed previously could be different depending on each state's SIP. Until the Minnesota SIP is finalized, GRE cannot determine what its allowance allocations will be.

5.4.6 CO_2 Emissions

There is currently no state or federal regulation of CO_2 emissions. The United States has not signed the Kyoto Protocol and it is not likely to sign any international agreement under the current administration. Nevertheless, GRE continues to evaluate its greenhouse gas emissions and assess opportunities for carbon sequestration.

GRE continues to be a funding member of the Energy & Environmental Research Center's Plains CO_2 Reduction Partnership (PCORP). GRE contracted with EPRI Solutions to have a comprehensive greenhouse gas emissions inventory completed for all of its operations. In assessing generating technologies to meet its customers' needs, GRE includes externality costs for CO_2 emissions.

5.4.7 Impaired Waters and Total Maximum Daily Loads

Every two years the United States Environmental Protection Agency (EPA), under the Clean Water Act, requires states to publish and submit an updated list of waters that do not meet designated uses due to pollutant impacts. The impaired waters list, 303(d) list, includes lakes, streams and rivers with impairments for the use as drinking water, fishable waters, swimming, industrial use and/or irrigation.

Once the water body is listed, the state must begin the process of addressing the impairment. The first stage of this process is development of a total maximum daily load. A total maximum daily load (TMDL) is the total maximum daily pollutant load a water body can receive from all sources while maintaining applicable water quality standards and supporting the water body's designated uses.

The development of a TMDL is designed to assess the load on a water body from point sources, non-point sources, and natural background conditions. Once these loads are quantified, each source can be assigned a given amount of pollutant load expected to ensure the receiving water body will meet water quality standards and designated uses.

At this time states are generally in the water body assessment phase, but TMDLs have either been developed or are in development for an increasing number of water bodies. As this process proceeds, TMDLs will likely be developed for water bodies to which GRE either has or is seeking permitted discharges. This could change discharge limits, result in limits for additional analytical parameters or even possibly preclude permitting of a new or expanded discharge to a given water body. The most likely affected parameters include mercury, phosphorous, total suspended solids, and temperature.

In many instances the impairments mentioned above have significant contributions from non-point and natural background sources. Due to the difficulty in controlling the loads from these sources, significant reduction goals may be allocated to point sources such as GRE's permitted discharges. Retrofitting existing facilities and implementing new pollutant reduction technologies will likely require significant capital expenditure to achieve relatively small reductions for a given pollutant. Based on this it appears pollutant trading and restoration projects will play a significant role in the TMDL process. GRE will continue to monitor TMDL development and assess potential impacts to our facilities.

5.4.8 Aquatic Life Protection at Cooling Water Intake Structures

Section 316(b) of the Clean Water Act requires that the location, design, construction, and capacity of a cooling water intake structure (CWIS) reflect the best available technology (BAT) for minimizing environmental impact including threat to aquatic life. As part of a settlement agreement EPA began development of new regulations to address impacts to aquatic life at CWISs. The new regulations consist of three phases. Phase I (released December 18, 2001) applies to new facilities with a CWIS. Phase II became final July 9, 2004 and applies to existing utility power plants that have an NPDES permit and a CWIS with a design capacity of greater than 50 million gallons per day (mgd). Phase III was proposed November 24, 2004 and applies to non-utility CWISs greater than 50 mgd.

Phase I of the rule applies to any new facilities with an NPDES permit and a CWIS design of greater than 2 mgd. The rule provides a two-track decision making process of either installing highly protective intake technologies or conducting a site-specific analysis of aquatic life impacts of the proposed CWIS. The study must demonstrate the proposed CWIS will be adequately protective of aquatic life. Any new projects planning to utilize surface water for cooling purposes will have to address Phase I of the rule.

Phase II of the rule is for existing utility CWISs based on the parameters mentioned above. The rule applies performance standards based on the size of the intake, the amount of water it withdraws and the source water body type. In general, the rule establishes that impingement mortality must be reduced 80 percent to 95 percent from a baseline of an unmodified CWIS located at the shoreline. For certain water body types and withdrawal rates, facilities must also reduce entrainment mortality by 60 to 90 percent below baseline. Compliance with the rule is required by the end of 2007 or the next NPDES permit renewal, whichever is sooner. An extension is possible for facilities with pending permit renewals.

The new requirements will affect Elk River Station and Stanton Station. Currently both stations have completed initial strategy analysis for compliance with the new rule and are in the process of planning baseline studies to determine the most cost effective BAT.

5.5 Summary

GRE's analysis of factors that could impact supply and demand strengthens its planning process. Its final assessment is that these factors will not impact the near term of the planning horizon. Thus, continued study will ensure that GRE has adequate time to respond to policy and other changes and appropriately adjust its overall resource plan.

6 RESOURCE OPTIONS

This section considers a comprehensive set of demand- and supply-side resource options that could be implemented to meet GRE's resource requirements.

6.1 Demand Side Options

6.1.1 DSM as a Resource

GRE has put significant efforts into using Demand Side Management (DSM) to reduce its needs for supply-side resources. GRE's member cooperatives have installed over 200,000 controlled loads, which give GRE the capability of reducing its summer peaks by approximately 300 MW or nearly twelve percent of its peak.

GRE's commitment to DSM remains strong, evidenced by its increasing program rebates and incentives. GRE's DSM and conservation program rebate and incentive budget is nearly 3.6 million dollars for 2005; this is a two million dollar increase from 2002. The additional budget dollars are used for energy conservation measures including Energy Star® appliance and air conditioning rebates, cycled air conditioning rebates, compact fluorescent lighting rebates, and commercial and industrial energy improvement grants. These programs are marketed under the banner of Energy Wise®.

Program participation and market penetration of the programs is encouraged by evaluating and, when necessary, changing or adding programs to ensure a better fit with market realities and GRE requirements. For example, GRE recently modified its commercial and industrial energy improvement grant program to include rebates for energy efficient lighting, motors and variable speed drives. GRE's member cooperatives provided feedback that the previous grant process was too onerous and time consuming for something as simple as lighting or motor efficiency improvement. Today, the commercial and industrial energy improvement grant program is used mainly on a case-by-case basis for unique energy efficiency improvement measures.

GRE continues to promote is its very successful cycled air conditioning program. Of GRE's nearly 600,000 end-use consumers, approximately one half have central air conditioning in their homes. Today, GRE cycles over 100,000 of these central air conditioners on hot summer days. This represents a 33% customer participation in the cycled air conditioning program. Air conditioner use is a primary driver behind GRE's summer peak.

Thus the cycled air conditioning program is one of GRE's best demand-side resources to reduce its annual peak.

Despite GRE's commitment to DSM, obstacles can prevent DSM from being used interchangeably with supply side resources. In particular, DSM is difficult to model identically to supply-side resources. For example:

- As the Department of Commerce has identified in previous filings, GRE's forecast assumes a continuation of DSM programs at their same relative levels. To remove DSM and put it on "equal footing" with supply side resources may be theoretically appealing, but relies upon a series of assumptions that may overall weaken the forecast. (GRE is further investigating this concept as described in Section 3.)
- DSM resources are difficult to characterize in the same way as supply-side resources for modeling inputs (e.g. developing cost profiles of fixed capital costs and variable costs.) The costs for achieving DSM are not linear (i.e. the costs per kW or kWh vary depending on the total achievements based on program costs, saturation rates and other factors.) In most models DSM must be treated through scenario analysis. Developing a significant number of scenarios with varied DSM levels can be a costly and time consuming undertaking.
- Relying on the future achievement of additional DSM is riskier than relying on future planned supply-side resources. Since DSM is based on consumer actions rather than construction schedules, the actual achievement is less easily controlled and monitored by utilities. Most models do not have a methodology for capturing that type of risk.

To improve the integration of demand-side resources in its planning process, GRE has embarked upon internal analysis to systematically address and remove as many of these obstacles as possible. To date, GRE has made some progress in this area (for example the forecasting issue described in Section 3.5). Until these challenges have been adequately addressed, GRE is reluctant to rely equally upon yet unachieved DSM savings as it does upon more measurable resources such as existing and known load control and supply side resources. The consequences of coming up short during GRE's peak demand are too great.

6.1.2 DSM Program Development

In developing its DSM program, GRE examines the overall potential of demand resources among its end-use consumers. To do this, GRE analyzes the following:

- Technical Potential: The study starts with the entire universe of programs that can reduce demand for capacity and energy.

- Economic Potential: This step narrows the scope to the programs that pass certain cost-benefit tests.
- Achievable Potential: This final step considers more intangible factors such as consumer preference and saturation of programs.

In 2003, GRE contracted with expert DSM consultants, Global Energy Partners LLC (Global), an Electric Power Research Institute (EPRI) affiliate company, to conduct a full DSM potentials study. This study was reported in GRE’s 2003 IRP. However, this is the first IRP that integrates those findings into its overall DSM programs. Some key results of this study include:

- Global did not identify any economic programs missing from GRE’s portfolio.
- Global helped demonstrate to GRE the practical limits to achievable potential because of customer preference and saturation of programs.
- Global showed GRE that some of its existing programs could be modified (e.g. higher rebates or overall budgets) to increase savings and maximize their potential to reduce GRE’s capacity and energy needs.

GRE used the results of its DSM potential study to analyze its specific programs. Changes implemented included a large increase in GRE’s budget for DSM and conservation program rebates. In 2005, GRE’s DSM and conservation program rebate and incentives budget is nearly 3.6 million dollars; this is a two million dollar increase from 2002. The additional budget dollars are used for energy conservation measures including Energy Star® appliance and air conditioning rebates, cycled air conditioning rebates, compact fluorescent lighting rebates, and commercial and industrial energy improvement grants. These programs are marketed under the banner of Energy Wise®.

DSM can present GRE with unique challenges; it’s different than other types of energy resources, and not every program that is economical can achieve the predicted goals. Existing programs have momentum, perhaps beyond their usefulness and new programs take time to create new momentum. In the cooperative environment, not all members benefit equally from different program designs, so implementation becomes a situation of compromise at times. GRE has no end-use customers so gaining the necessary support from the member cooperatives to adopt and actively promote the programs can be a challenge. However, GRE is committed to its DSM efforts and will continue to seek ways of improving its use of load management and conservation. As results from GRE’s DSM efforts are analyzed and quantified, GRE will be summarizing and reporting them in future Conservation Improvement Program reports and integrating the results in future resource planning.

GRE’s future direction for its DSM will be to focus on programs that best match the type of energy resources that it will need to add to its system to meet future needs. Up until now, that focus has been reducing summer peak demands. GRE will continue to offer DSM programs and incentives to reduce these peaks, but now that different types of energy resource needs have been identified, GRE is actively analyzing new programs. GRE recognizes, however, that these programs only provide incremental changes to its overall needs and will continue to address the more fundamental concerns with DSM and investigate more long term ideas to facilitate a bigger impact from demand-side resources.

6.2 Supply Side Options

6.2.1 New Resources as Modeled

Three generic supply-side options are described in this section as they are included in the modeling of possible future resource plans.

- Peaking: Combustion Turbine - Whether fired by natural gas or oil, combustion turbines are a low capital cost, peaking resource. Their relatively high production cost makes them less attractive if significant amounts of energy (rule of thumb: >10-15% annual capacity factor) are required from this type of resource.

- Intermediate: Combined Cycle - This resource is typically fired with natural gas and for a relatively modest increase in initial capital cost this resource is significantly more efficient than a simple cycle combustion turbine. The intermediate resource becomes more attractive when there is a need for more energy from a new capacity resource than a peaking resource would be expected to supply.

- Baseload: Coal Based Resources – This resource is based on supercritical pulverized coal technology. This resource is suitable when a resource is to provide energy at a 75 percent annual capacity factor or higher.

Figure 6-1provides descriptive information about the generic supply resource options.

Figure 6-1 Characteristics of Generic Generation Alternatives

[TRADE SECRET INFORMATION BEGINS

TRADE SECRET INFORMATION ENDS]

6.2.2 Practical Realities of Resource Options

Resource planning modeling is somewhat of a "perfect world" approach; it is difficult to capture all of the real world issues in a model. In this section, GRE describes some of these real world issues impacting GRE's resource decisions that are difficult to incorporate directly into the resource planning process via modeling.

Peaking: The combustion turbine modeled is representative of what is available for build or purchase options. As explained in Section 6.3, GRE is also exploring potential new market opportunities for purchasing capacity. However, GRE must also monitor and analyze the impact of MISO markets on the dispatch and operation of its peaking plants. These changes may impact the overall cost structure of these resources.

Intermediate: The characteristics of a combined cycle as modeled are typical of an intermediate resource. At present, this region contains little combined cycle power. Intermediate power often comes from resources typically characterized as baseload but with lower capacity factors or higher costs resulting in the resource being dispatched equivalent to an intermediate resource. GRE has success in defining market products to meet its intermediate resource needs. Further, from a traditional load-serving point of view building a combined-cycle plant may be expensive and financially risky. However, the MISO market would dispatch the resource when the market price exceeds its variable cost, which may make a combined-cycle plant more economically feasible.

Baseload: Typically baseload plants are assumed to carry extremely high capacity factors, such as those of GRE's Coal Creek and Stanton plants. However, GRE performs additional analysis when choosing specific generating facilities to determine at what capacity factor coal-based generation or "baseload" is economically superior to other resources such as combined cycle and combustion turbines. For the financial profile of a RUS-borrower cooperative, a baseload resource is preferred in situations as low as a 50 percent capacity factor. Although GRE is not presenting any specific projects in this filing, it offers this example as representative of the type of analysis it prepares before participating in specific projects to ensure that they are GRE's preferred alternative.

6.2.3 Renewables

GRE's approach to supply-side renewable resources addresses state requirements and GRE's commitment to environmentally-benign supply resources. In this section, GRE will first address renewable options and then specifically address the renewable energy objective.

6.2.3.1 Renewable Resource Options

Wind

Wind energy is currently the most cost-effective renewable energy resource in Minnesota. The wind resource is viable within the state, and there has been particular success in developing wind energy on the Buffalo Ridge in southwestern Minnesota.

Nonetheless, there are a number of concerns associated with developing this amount of wind energy for the GRE system. Wind is an intermittent resource that will require the use of other dispatchable resources or purchases to follow fluctuations in wind output and GRE load. This may raise costs of operating other facilities and increase the wear on facilities that are used to follow the wind.

There are two primary ancillary cost impact components for integrating wind generation:

- Operating cost impact of the variability of the wind generation - additional costs associated with other dispatchable resources accommodating the inherent fluctuations of wind generation at all times. The additional cost is incurred even if the future wind generation fluctuations are known.
- Operating cost impact of the uncertainty of the wind - additional cost associated with supplying control area load in real-time due to the difference between forecasted and actual wind generation. This cost may include the cost of additional operating reserves, the cost of utilizing less efficient resources, the cost associated with control performance degradation, or the cost of the unserved energy.

Biomass

Biomass is an energy resource derived from organic matter. At present, wood wastes and agricultural residues are the major sources of biomass for the generation of electrical energy. To be practical, there must be a continuous and plentiful supply of biomass to support generation.

GRE has analyzed the following technologies:

- Animal waste. There are currently two types of projects underway that exemplify the use of animal waste for electricity generation.

  FibroMinn, a subsidiary of Fibrowatt Ltd., is developing a generating station in Benson, Minnesota that will be fueled by poultry litter. The litter is burned at high temperatures in a boiler to produce steam for a conventional steam-turbine generator. Fibrowatt claims that this process is more environmentally benign than other generating technologies, with the added advantages of resolving waste disposal problems and encouraging improvements in poultry farming methods.[6] The output of the FibroMinn facility will be sold to Xcel Energy in partial fulfillment of Xcel's requirement to purchase biomass capacity and energy. GRE continues to monitor the progress of the FibroMinn project for future consideration of this technology in GRE's resource mix.

  Anaerobic digester projects use methane, created by animal manure stored in covered lagoons, to fuel conventional generating systems. The digested solids from the digester process are then spread on agricultural fields as fertilizer. Anaerobic digesters are distributed generation applications that will likely be small in size (<1 MW) and few in number because they require a large farming operation to supply sufficient fuel for the project. GRE sponsors a grant program for retail members of its member distribution cooperatives in order to provide adequate incentives for constructing of anaerobic digesters projects. GRE has approved grants under this program for two projects (Haubenschild Farms and Northern Plains Dairy) and purchases the full output, as described in Section 4. GRE continues to work with all interested parties on the development of additional anaerobic digestion facilities.

- Whole tree burning. This technology, which has not yet been commercially demonstrated, burns whole trees to operate a conventional steam turbine. The fuel source is grown on dedicated plantations where trees are continuously replaced as they are harvested. This creates a "closed-loop" system of fuel supply that is considered to be CO_2 neutral. GRE's analysis

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[6] Fibrowatt Web Site, www.fibrowatt.com/environbenf.html

of whole tree burners, however, indicates that they will have high capital costs, high O&M costs and require extensive environmental controls to meet air quality standards.

- Ethanol-fired combustion turbines. This technology uses ethanol, rather than oil or natural gas, to fuel a combustion turbine. The ethanol fuel can be derived from biomass and used in a dual fuel peaking unit capable of burning either ethanol or distilate fuel oil. This technology would have higher capital costs and higher fuel costs than a conventional combustion turbine. In addition, it is questionable whether a sufficient ethanol supply would exist within hauling distance of the plant. For this reason, GRE has not considered ethanol-fired combustion turbines as part of its IRP.

- Mixed Municipal Solid Waste. GRE does not have any plans to develop sources of power generated using mixed municipal solid waste, but may be approached by government agencies that are developing projects and would like to sell the electric output to GRE. GRE will evaluate such proposals if they should materialize.

Hydroelectric Power

Since the end of the 19th century, the energy contained in falling water has been harnessed to produce electric energy. Today there are a number of options for the development of new hydroelectric facilities:

- Building a new facility
- Upgrading an existing operational facility
- Restoring old, inoperative facilities

Because there are no fuel costs, hydroelectric generation results in a low incremental production cost. The high capital cost of building new hydroelectric plants can make the total cost of electricity from the facility expensive. Upgrading and restoring existing facilities can often be done at a fraction of the cost of a new facility. However, environmental regulations can make it very difficult to site new hydroelectric facilities and even the re-licensing of existing facilities can be problematic. The cost of additional capacity at new or existing sites is highly variable depending upon site-specific conditions. Depending upon the water resources a hydroelectric plant may be accredited as intermittent or firm capacity.

The small size and limited availability of development sites reduce the role that hydroelectric power can play in GRE's future resource mix. In addition, the cost of new hydroelectric power is far above that of other renewables such as wind power.

Photovoltaic Power

Photovoltaic cells convert solar energy into electrical energy. They are used in space applications, consumer products and in specialized applications. Improvements in system design and manufacturing processes have reduced the cost of photovoltaic systems but as a supply option for electric generation, the capital cost is still much higher than that of other supply options.

This resource will be treated as an intermittent resource by MAPP for accreditation purposes. As a result the high capacity cost of photovoltaics will be amplified by the accreditation process. Due to the high capital cost, this option was not considered for IRP modeling. The potential for significant cost declines as the technology evolves continues to warrant monitoring of this option as a potential green energy marketing candidate. GRE continues to monitor the developments of the industry that would make sense in GRE's generation portfolio.

Landfill Gas

As refuse decomposes in a landfill, a gas that is primarily methane is released. This gas can be flared or used to fuel an internal combustion engine to generate electricity. Landfill gas is tapped by drilling a series of wells in the landfill and connecting the wells with header pipes to direct the gas to the generating site. Because the landfill gas has a relatively low heating value compared to natural gas, the generating equipment must be located at or very near the landfill.

Landfill gas can be tapped from a closed landfill or a closed section of an operating landfill. The rate of production of gas will vary over time and will eventually decrease to a point where its use for generation of electricity is not economically feasible. As described in Section 4, GRE currently has a contract with Elk River Municipal Utility to purchase the output of a landfill gas project. GRE will continue to negotiate and contract for purchase of landfill gas as it becomes available in its service territory.

6.2.3.2 Renewable Energy Objective

In 2001, the Minnesota Legislature enacted the Minnesota Energy Security and Reliability Act (MN Laws 2001, Chapter 212). Article 8 of this act, codified as Minn. Stat. §216B.1691, requires all utilities within the state to make a good faith effort to obtain at least 1 percent of their energy from renewable sources by 2005, and to increase that percentage by 1 percent each year for a total of 10 percent by 2015. GRE refers to this statute as the "renewable energy objective" or "REO."

The following resources are defined as "eligible energy technology" for the purpose of meeting the REO:

- Solar.
- Wind.
- Hydroelectric with a capacity of less than 60 MW.
- Hydrogen.
- Biomass.

Currently, GRE generates a part of its electric requirements through wind and biomass resources.

Biomass: GRE's Elk River Station burns refuse-derived fuels from municipalities to produce energy and qualifies as an eligible energy technology. GRE purchases energy from anaerobic digesters located at the Haubenschild farm located in Princeton, MN and Northern Plaines Dairy, located in St. Peter, MN. GRE also purchases the output from the Elk River landfill.

Wind: GRE purchases the output from 18 MW of wind resources from small developers in Jackson, Dodge, and Murray counties. In addition, in 2004 GRE signed a contract to purchase the output of Trimont Wind I, LLC (Trimont), a 100 MW (nameplate) wind project located in Martin and Jackson Counties of Minnesota. Trimont is expected to be online by the end of 2005.

GRE will continue to pursue the least-cost renewable resource facilities that allow it to meet the environmental stewardship goals of its members and Minnesota statute. However, for a number of reasons described in the previous section, GRE has modeled wind as the preferred renewable generation resource. The generation technology of wind turbines is the most mature and least-cost utility-scale resource for meeting the REO. The maturity of the wind industry can be seen in the number of companies that manufacture wind turbines and provide services ranging from turbine siting and identification of prime areas. Therefore, GRE concludes that of the current renewable technologies, Minnesota's abundant wind resources are well suited for more growth and focuses on wind in developing its plan to meet the REO. (Section 7 describes the specific plan that GRE included in its modeling.)

Figure 6-2 illustrates GRE's renewable requirements in order to achieve the REO.

Figure 6-2 Renewable Energy Objective

Renewable Energy Objective			
Year	Base Case Wholesale Energy Forecast less GRE Losses(MWh)	Renewable Energy Objective (%)	Renewable Energy Objective (MWh)
2005	10,790,813	1%	107,908
2006	11,217,324	2%	224,346
2007	11,573,470	3%	347,204
2008	11,837,859	4%	473,514
2009	12,130,476	5%	606,524
2010	12,446,323	6%	746,779
2011	12,737,137	7%	891,600
2012	13,051,527	8%	1,044,122
2013	13,344,123	9%	1,200,971
2014	13,653,704	10%	1,365,370
2015	13,978,729	10%	1,397,873
2016	14,292,778	10%	1,429,278
2017	14,606,363	10%	1,460,636
2018	14,933,204	10%	1,493,320
2019	15,247,425	10%	1,524,743
2020	15,579,335	10%	1,557,934

GRE's modeling shows a modest improvement in the overall PVRR of its resource plans by pursuing the REO. (See Section 7 for a full description of the modeling results.) Thus, assuming no major impacts to the costs, GRE intends to incorporate achievement of the REO in its action plan. However, GRE notes that factors (such as the discontinuation of the production tax credits) that would have a large impact on the price of wind power would result in GRE re-examining possibilities for its good faith effort to achieve the REO.

Figure 6-3 illustrates GRE's specific plan for REO achievement.

Figure 6-3 REO Compliance

REO Compliance

Year	Existing Resources (MWh)	Planned Resources (MWh)	Total Resources (MWh)	GRE's Renewable (%)
2005	222,006	0	222,006	2.1%
2006	222,006	350,400	572,406	5.1%
2007	228,822	350,400	579,222	5.0%
2008	228,822	700,800	929,622	7.9%
2009	228,822	700,800	929,622	7.7%
2010	228,822	700,800	929,622	7.5%
2011	56,707	1,051,200	1,107,907	8.7%
2012	56,707	1,051,200	1,107,907	8.5%
2013	56,707	1,401,600	1,458,307	10.9%
2014	56,707	1,401,600	1,458,307	10.7%
2015	56,707	1,752,000	1,808,707	12.9%
2016	56,707	1,752,000	1,808,707	12.7%
2017	56,707	1,752,000	1,808,707	12.4%
2018	56,707	1,752,000	1,808,707	12.1%
2019	56,707	1,752,000	1,808,707	11.9%
2020	56,707	1,752,000	1,808,707	11.6%

“Existing Resources” include GRE’s Elk River Station, the Elk River Municipal Utilities landfill gas facility, and portions of current wind generation facilities. GRE excludes energy generated from wind resources that support GRE’s green pricing program (Wellspring) and wholesale sales to third parties toward achievement of the REO.

Minnesota Statute § 216B.1691, subd. 2 (b) requires that 0.5 percent of a utility’s renewable energy production come from a biomass generation resource in 2005. The requirement increases to 1.0 percent of the renewable energy production in 2010. GRE’s Elk River Station qualifies as a biomass technology and will fulfill the biomass component of the REO.

6.2.3.3 Community Based Energy Development Projects

Recently passed legislation requires that a utility include “a description of its efforts to purchase energy from C-BED [Community Based Energy Development] projects, including a list of the projects under contract and the amount of C-BED energy purchases.” Although this legislation does not go into effect until August 1st, GRE includes this description in the interest of completeness.

GRE is unaware of any planned C-BED wind projects at this time and none have been included in this IRP. GRE plans to develop C-BED tariff rates in accordance with the recently-passed legislation and will explore future C-BED projects as part of GRE's good faith effort to satisfy the REO.

6.2.4 Incremental Upgrades

Whenever possible, GRE endeavors to undertake capital projects at its legacy generation facilities that add or "free-up" incremental capacity. Over time, GRE has found that it can be less expensive to build incremental capacity at existing facilities rather than developing new resources. That philosophy of adding incremental capacity has been proven in recent history.

The following examples demonstrate GRE's commitment to continuous analysis of potential upgrades and improvements to its generating facilities.

6.2.4.1 Historical Upgrades

In the fall of 2001, General Electric (GE) sent notification to GRE recalling the 17th stage compressor blades on each of the six combustion turbines at Lakefield Junction Station. Since the units were being disassembled to replace the recalled equipment, it became economically feasible to engage in a power upgrade project to each of the six units at the same time. The overall efficiency of each unit was improved by 2.2 percent. Further, the total capacity of Lakefield Junction Station was increased by 25 to 30 MW depending on ambient temperature and humidity.

In April 2002, GRE transmission completed significant upgrades to its DC Line and associated converter stations. The MAPP Design Review Subcommittee (DRS) approved the upgrades and granted GRE approval to increase the rating of the DC Line in April, 2003. The rating increase has subsequently allowed GRE to accredit the full net capability of both Coal Creek Station units, adding 32 MW of accredited capacity to GRE's summer and winter capability.

In 2002, the Minnesota Pollution Control Agency and the Minnesota Environmental Quality Board both approved a modification to the air permit at GRE's Saint Bonifacius (St. Boni) peaking plant to allow for operation of that facility above 50 MW. Subsequently, GRE worked with MAPP to determine what transmission upgrades would be necessary for St. Boni to operate above 50 MW. It is anticipated that the transmission upgrades and reconfiguration will be completed by July 2005. As a result of the environmental permit change and transmission work, GRE should realize 6 MW of additional capacity in the summer and 20 MW of additional capacity in the winter at St. Boni.

6.2.4.2 Future Upgrades

At this time, there are very few upgrades currently available to existing GRE generating facilities.

GRE has analyzed adding inlet fogging power augmentation to St. Boni. Inlet fogging is a process that adds small water droplets to the inlet air on a combustion turbine; thus, increasing the mass flow into the compressor. It is estimated that inlet fogging could add 4 to 5 MW of additional capacity at less than $100/kW of installed cost. It is likely that GRE will undertake this power upgrade after a related transmission constraint is lifted.

GRE has also considered adding wet compression power augmentation to Pleasant Valley Station units 11 and 12. Wet compression is another process where water droplets are introduced to the compressor inlets; thus, increasing mass flow by cooling the inlet air and adding water mass. It is estimated that wet compression could add 15 to 20 MW of capacity per unit. In order for the upgrade project to be economical, the upgrade would have to be installed along with some other maintenance activity requiring disassembly of the compressors and turbines. This project carries additional risk because it has not been completed on any other turbines of its kind. GRE will monitor whether circumstances arise that make this project reliable and cost effective.

Finally, GRE has also analyzed adding inlet cooling and water injection power augmentation to each of its three oil-fired GE Frame 5 combustion turbines – Cambridge, Maple Lake and Rock Lake. It is estimated that such power upgrades could add 2.7 to 4.3 MW per unit. However, GRE estimates that the power upgrades to those legacy facilities would cost twice as much as adding capacity by building a new combustion turbine. Since it is not cost effective, GRE will not pursue these upgrades at this time.

GRE will continue to analyze all upgrade possibilities. At this time, none of the upgrades in progress or identified for potential future projects are appropriate to meet GRE’s immediate needs.

In November of 2004, GRE switched fuels at its Stanton Station from lignite to Powder River Basin (PRB) sub-bituminous coal. The fuel switch was undertaken [TRADE SECRET INFORMATION BEGINS
TRADE SECRET INFORMATION ENDS]

6.3 Market Options

Great River Energy continues to evaluate and purchase short-term capacity as generating resources and transmission availability exist. In recent filings, GRE has indicated that the market for excess capacity has all but disappeared in the MAPP region. Some utilities have proposed changes to the MAPP capacity accreditation rules that could open up the entire MISO market region for meeting capacity requirements. GRE is monitoring the potential rule change closely and re-examining potential market opportunities that could become available in the larger market.

6.3.1 MAPP Resources

The May 1, 2004 MAPP Load and Capability Report described the regional capacity situation. This report compiled MAPP member load forecasts, existing resource capabilities and projected resource additions in order to calculate the regional capacity. The report indicated that MAPP members need to build additional capacity. Under the minimum reserve requirements of the pool, deficits are indicated as early as 2010. Capacity additions will be needed to maintain reserve levels that meet the MAPP minimum.

Figure 6-4 MAPP Summer Season Reserve Margins

MAPP SUMMER SEASON RESERVE MARGINS		
Year	**Reserve Margin MW**	**Reserve Margin Percent**
2005	1250	17.8 %
2006	921	16.8 %
2007	1588	19.0 %
2008	1417	18.5 %
2009	1118	17.4 %
2010	-94	13.7 %
2011	-819	11.6 %
2012	-1487	9.7 %
2013	-2060	8.1 %

The projected growth in MAPP deficits indicates that the underlying load forecast is growing approximately 600 MW per year.

6.4 Transmission Resources

Electric transmission issues can greatly influence the selection and siting of new resources. The regional transmission system is being utilized to its limits because of changes in the industry and the lack of significant recent investment in new facilities. Nearly any new generation would require transmission investment, but the current industry paradigm does not position transmission as a practical alternative to generation. Transmission facility additions or modifications may also be required to provide the necessary transmission capability without compromising the reliability of the regional system. However, all additions must be done in the larger context of regional planning.

6.4.1 Transmission as a Resource

The current environment in the electric industry does not allow transmission lines to be a true alternative to generating resources in most instances. However, new transmission could be considered an alternative if it provided access to existing generating resources in other regions that are currently inaccessible because of the lack of transmission infrastructure. The key obstacle of this alternative is that the existing timelines for planning, permitting and constructing additional transmission would not allow the necessary facilities to be online in a timely manner to meet GRE’s immediate needs. In addition, the policies and processes associated with planning and constructing transmission create additional uncertainties.

The planning process for new transmission is done on a regional basis, overseen by a regional authority (the Midwest ISO for this region), rather than being integrated with generation planning within individual utilities. In fact, the process does not directly address transmission as a substitute for generation. In some instances, the transmission planning process might address existing pervasive bottlenecks in the regional bulk transmission system. These may have the indirect effect of making existing power elsewhere in the region available to meet GRE’s needs. However, a variety of factors make potential future accessibility to generating resources hard to precisely identify.

6.4.2 Complexities of Adding New Transmission

At any given time, many studies are underway to identify new or upgraded transmission facilities required to deliver the output of possible new generating resources. These studies may identify conditions that indicate that larger or different facilities should be constructed from those required to eliminate the existing bottlenecks, but the construction of such facilities is uncertain as many generating projects do not come to fruition. For long-term planning purposes, GRE must rely on projects that have firm transmission arrangements or MISO studies identifying upgrades necessary for interconnection and delivery of new resources.

Regulatory uncertainty further complicates this issue of transmission upgrades. The current methodology for recovering investments in the transmission system generally assigns costs equally to all customers within a transmission zone, with some provisions for direct assignment. This methodology has created barriers to the development of certain types of transmission projects, including many high voltage projects that deliver power across zones or transmission developed for economic rather than purely reliability issues. Industry groups are looking at appropriate methods for identifying benefits and assigning costs but the issue remains very much unresolved.

In addition, major inter-state transmission projects require coordination of permitting and other regulatory approvals in multiple states. While this does not necessarily introduce delay, it could result in longer timelines or risk for a transmission project, particularly if different jurisdictions perceive the benefits differently. Industry groups are also looking to streamline the processes for inter-state activities and reduce risk, but this is in the early stage of development

6.4.3 CapX 2020

GRE has recently teamed with other utilities[7] in the state to develop a vision for transmission infrastructure investments needed in Minnesota during the next fifteen years. The companies are calling the effort Minnesota CapX 2020, short for Capital Expenditures by the year 2020.

CapX 2020 will produce a study to determine the projected transmission facilities needed to serve customer demand levels in 2020 in and around Minnesota from projected generation resources and expected load-serving needs. It also will look at ways to relieve transmission congestion. The CapX 2020 vision is also to create an environment that allows the necessary projects to be developed in a timely, efficient manner, consistent with the public interest.

Recent legislation enacted in the State of Minnesota put in place several provisions that could specifically benefit the long-term transmission situation in the state. New cost recovery mechanisms reduce the investment risk for

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[7] Great River Energy, Minnesota Power, Otter Tail Power Company and Xcel Energy jointly formed CapX 2020 in the summer of 2004; Minnkota Power Cooperative, Missouri River Energy Services and Southern Minnesota Municipal Power Agency subsequently joined this effort.

utilities. Commission authority over all major regulatory aspects of transmission permitting provides for a one-stop shop. Both of these provisions remove roadblocks to transmission construction. Also, recognition of independent transmission companies under the state regulations makes that type of entity an alternative for making additional transmission investment in the state.

6.4.4 Transmission Conclusions

GRE is optimistic that through coordinated efforts such as CapX 2020, the long-term transmission situation will be improved and additional necessary transmission will be built. The industry paradigm that prevents transmission from being analyzed as a substitute to generation is unlikely to change in the near term, but resource decisions can and should consider associated transmission issues to provide a complete picture of the relative costs and risks of different potential projects.

6.5 Resource Options Conclusion

GRE has thoroughly evaluated a number of demand- and supply-side resource options in formulating this resource plan. The practical implementation of this analysis will be presented in the action plan.

7 RESOURCE PLANS

7.1 Key Modeling Assumptions

Future resource requirements will be driven by capacity and energy deficits identified as the difference between future supply and demand. Determining these deficits is the basis for resource plan modeling. This section will describe the key assumptions regarding supply and demand.

7.1.1 Demand Forecast

MAPP members are required to maintain a 15% planning reserve margin. In the comparison of load and resources, the resources must exceed the load by 15%. This is reflected in Figure 7-4 and is the basis for capacity planning. Each MAPP member must also submit after the fact data showing they met the 15% reserve margin on an actual basis. If a member fails to maintain the reserve margin they are assessed a financial penalty from MAPP.

As described in Section 3, GRE uses Scenario 5 from the 2004 load forecast as the basis of its capacity planning. GRE concludes that Scenario 1, the base case or nominally the 50th percentile scenario, is inadequate for capacity planning purposes. Given GRE's demand volatility, GRE must plan to a higher level of expected demand in order to be assured of having sufficient capacity resources to meet peak demands that may result from a relatively short string of hot summer days. As few as three or four consecutive extremely hot summer days could lead to a record peak demand. Scenario 5 is approximately four percent higher than Scenario 1 at the beginning of the period covered by the 2004 LRLF and approximately 16% higher at the end of the period.[8]

Since GRE uses Scenario 5 (the high demand forecast) the uncertainty about meeting future member demand is largely, but not completely, captured. In GRE's judgment, this is an appropriate level for capacity planning purposes. That does not guarantee sufficient capacity will be available for all possibilities. Peak demand could exceed even this higher forecast under historic extreme weather conditions. In that case, one or more MAPP utilities could go capacity deficit. This does not necessarily mean "the lights will go out." Going capacity deficit means, at minimum, that the planning reserves

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[8] The demand forecast used for resource planning purposes also reflects the impact of two GRE member cooperatives choosing to exercise their option to use an alternate supplier for some of their energy and capacity as described in Section 5.

designed to cover such contingencies will be tapped to actually supply energy and those deficit utilities would be assessed a financial penalty from MAPP.

7.1.2 Energy Forecast

GRE uses the base energy forecast in this resource plan filing. The demand forecast is significantly more volatile than the energy forecast. While three or four consecutive hot summer days can set an extreme peak, they have little effect on the total annual energy needs. Therefore, the base case energy forecast is appropriate for energy planning purposes.

7.1.3 Existing Resources

GRE assumes its current supply-side resources will remain in service and continue operating at current capacity factors and availabilities during the planning period. However, GRE assumes that all existing long-term contracts are not renewed even though there may be opportunities to renew some of them in the future.

7.1.4 New Resources

The modeling includes all future resources for which GRE's participation or contract has been approved by its board. Three new resources expected to become operational during the planning horizon were included in all plans: Trimont wind plant in 2005, the 170 MW (summer rated) Cambridge Station in 2007 and 109 MW[9] of the proposed 600 MW Big Stone II coal plant in 2011.

7.1.5 Resources Examined

Three resource types are modeled for meeting the future capacity and energy requirements of GRE's members. These resources are intended to be representative of the types of generating facilities available for GRE buy or build options. The three resource types are a conventional simple cycle combustion turbine (SCCT or GT) (primarily natural gas fueled), a conventional combined cycle (CC) (natural gas) and a supercritical pulverized coal (SCPC) plant. The combustion turbine is evaluated as 100 percent GRE owned (150 MW) and has characteristics similar to the proposed Cambridge Station unit. The combined cycle is modeled as 50 percent GRE ownership of a 465 MW plant. The coal plant is modeled as 50 percent GRE ownership of

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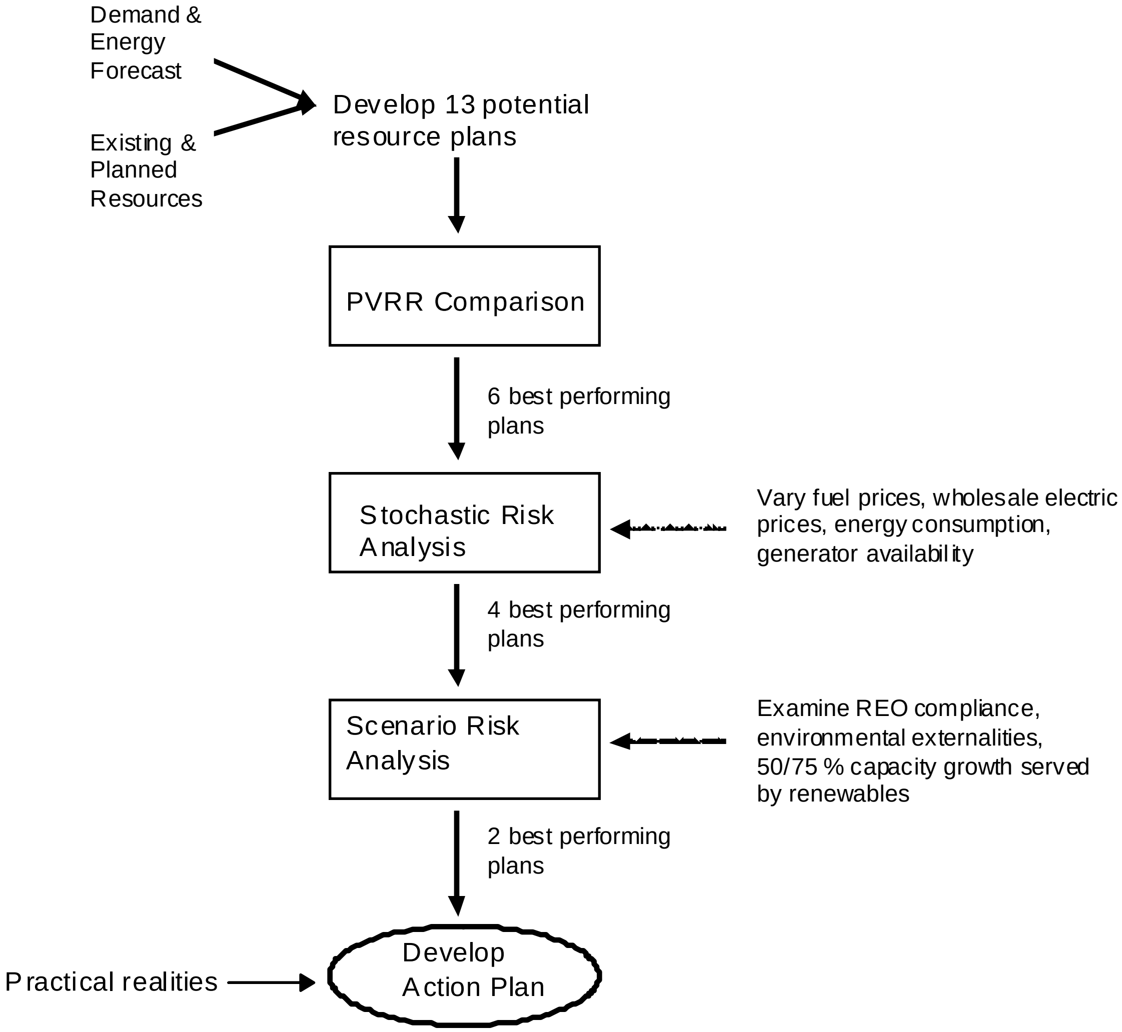
[9] GRE's exact MW share is yet to be determined and may vary by a small number of MWs as the details of participation are finalized.

a 600 MW plant. No new coal plants are included before 2013 because of the long lead time required to permit and build such plants.

7.2 Modeling Process

GRE contracted with Global Energy to conduct its modeling for this plan. The modeling process uses the assumptions above to evaluate different resource plans. First, each plan is evaluated for cost by identifying the present value of revenue requirements (PVRR). Next certain plans are evaluated further through stochastic and scenario risk analysis. The variables examined in the stochastic risk analysis include: natural gas price, fuel oil price, electricity market price, GRE load, and generator availability. The scenario analysis examined the impact on the plan of fully achieving the REO objectives, environmental externalities, and meeting 50 and 75 percent of new or refurbished capacity additions through renewable resources. Each of these steps is described in detail.

Figure 7-1 Modeling Process



7.2.1 Resource Plans

GRE directed Global Energy to model three resource types in thirteen different plans that are representative of different combinations and timings for resource additions. The plans are grouped into three strategies.

Strategy One is primarily coal focused. Since a key assumption in this strategy is that the coal-based resources are not commercially available until 2013, several peaking resources that are not coal-based are required in the early years in order to serve load growth. Figure 7-2 shows the specific resource additions in these plans.

Strategy Two is comprised solely of natural gas-fueled resources, either simple-cycle peaking or combined cycle units. Figure 7-3 shows the specific resource additions under this strategy.

Strategy Three is a balanced strategy, incorporating all three resource types. Figure 7-4 shows the resource additions using this strategy.

The total capacity additions for each plan are not identical. This is because the information provided for the IRP assumes a shorter decision period than the planning horizon used in the modeling to arrive at the PVRR values. Over the modeled planning horizon the same amount of capacity is added which provides for an apples-to-apples comparison of the plans. The PVRR included above are for GRE's entire planning horizon (2006-2028), not the IRP forecasting period of 2005-2020. Calculating the PVRR for a period longer than the forecast period deals with the potential problem of "end effects" in the analysis. If the calculation is done for an arbitrarily shorter time period (such as the IRP planning horizon) and the plans within that period are different due to lumpiness of the resources being added, then the calculated PVRR may be skewed as a result. Calculating the PVRR over a longer period of time minimizes the possibility of seeing such effects.

Figure 7-2 Strategy One – Coal and GT

Strategy One – Coal and SCCT.

Strategy 1	1-1	1-2	1-3	1-4	1- 5
2005	Trimont	Trimont	Trimont	Trimont	Trimont
2006					
2007	Cambridge	Cambridge	Cambridge	Cambridge	Cambridge
2008	1 GT	1 GT	1 GT	1 GT	1 GT
2009	1 GT	1 GT	1 GT	1 GT	1 GT
2010	1 GT	1 GT	1 GT	1 GT	1 GT
2011	Big Stone II	Big Stone II	Big Stone II	Big Stone II	Big Stone II
2012					
2013	1 GT	1 COAL	1 COAL	1 GT	1 GT
2014	1 GT			1 GT	1 GT
2015	2 GT	1 COAL	1 COAL	2 GT	2 GT
2016					
2017	1 GT	1 COAL	1 GT	1 COAL	1 GT
2018	1 GT		1 GT		1 GT
2019	1 GT	1 COAL	1 GT		
2020	1 GT		1 GT	1 COAL	1 COAL
Total (MW)	1,929	1,929	1,929	1,929	1,929

Figure 7-3 Strategy Two – CC and GT

Strategy Two-CC and GT.				
Strategy 2	**2-1**	**2-2**	**2-3**	**2-4**
2005	Trimont	Trimont	Trimont	Trimont
2006				
2007	Cambridge	Cambridge	Cambridge	Cambridge
2008	1 GT	1 GT	1 GT	1 GT
2009	1 CC	1 GT	1 GT	1 GT
2010	1 CC	1 GT	1 GT	1 GT
2011	Big Stone II	Big Stone II	Big Stone II	Big Stone II
2012				
2013		1 CC	1 GT	1 GT
2014	1 CC		1 GT	1 GT
2015	1 CC	2 CC	2 GT	2 GT
2016				
2017	1 CC		1 CC	1 GT
2018		1 CC		1 GT
2019	1 CC		1 CC	1 CC
2020		1 CC		
Total (MW)	1,824	1,892	1,794	1,862

Figure 7-4 Strategy Three – Coal, CC, and SCCT

Strategy Three - Coal, CC, and SCCT.				
Strategy 3	**3-1**	**3-2**	**3-3**	**3-4**
2005	Trimont	Trimont	Trimont	Trimont
2006				
2007	Cambridge	Cambridge	Cambridge	Cambridge
2008	1 GT	1 GT	1 GT	1 GT
2009	1 CC	1 CC	1 CC	1 GT
2010	1 CC	1 CC	1 CC	1 CC
2011	Big Stone II	Big Stone II	Big Stone II	Big Stone II
2012				
2013				
2014				1 COAL
2015	1 COAL	1 COAL	1 COAL	1 COAL
2016	1 COAL	1 CC	1 COAL	
2017				
2018		1 CC	1 CC	1 COAL
2019	1 COAL			
2020		1 CC	1 CC	1 COAL
Total (MW)	1,794	1,892	1,959	2,012

7.2.2 Calculating the PVRR of Available Resource Plans

The first step in modeling is to determine the PVRR for each of the plans given the assumptions provided in the model. These values are listed in Figure 7-5.

Figure 7-5 PVRR Results

PVRR Results		
Plan	**PVRR ($ millions)**	**Difference from lowest PVRR**
1-1	$10,225	5.05%
1-2	$10,004	2.79%
1-3	$10,016	2.91%
1-4	$10,095	3.71%
1-5	$10,169	4.48%
2-1	$9,744	0.11%
2-2	$9,839	1.09%
2-3	$10,075	3.52%
2-4	$10,171	4.50%
3-1	$9,822	0.91%
3-2	$9,733	0.00%
3-3	$9,774	0.42%
3-4	$9,956	2.29%

Although the plans have dramatically different resource additions, the difference in cost (PVRR) from least to most costly is only 5.05 percent. While a five percent variation sounds small, it is $500,000,000 in present value dollars, a large enough number to deserve full attention. This relative closeness in the results to the analysis of the plans is due to the fact that many of GRE's total resources have already been constructed and are therefore common to all of the plans. GRE's past resource decisions have been sound, so the generation already in place is well matched to GRE's needs. This IRP is focused on determining what incremental resources need to be added to the GRE resource portfolio so it is not surprising that the range of results has such a small variation. However small, the differences in PVRR help to narrow down the range of plans to further examine in the risk analysis.

7.2.3 Risk Analysis

Although it serves its members at cost-based rates, GRE operates in a competitive, market-based environment, in which there is much uncertainty or risk. Because of this environment, GRE identifies risk analysis as being equally important as cost analysis. This section describes the risk analysis included in GRE's resource plan modeling.

7.2.3.1 Risk Characterization

Risks can be broadly categorized as stochastic, scenario or paradigm. The attributes of each of these risk categories are summarized in the table below.

Figure 7-6 Risk Characterization

Risk characterization			
Risk	**Feature**	**Analytic Approach**	**Example(s)**
Stochastic	Statistically quantifiable	Explicitly represent in the analysis as an uncertain variable	Electric Load, Fuel Prices, Wholesale Electricity Prices
Scenario	Measurable but not statistically quantifiable	Represent as "sensitivity cases" and contrast to a Base Case analysis	Future environmental regulations
Paradigm	Describable but difficult to represent numerically	Address qualitatively outside the modeling process	Electric industry regulation

Stochastic risks (also known as probabilistic risks) are risks for which there is enough information to allow planners to make reasonable assumptions regarding their uncertainty. The probability distributions and associated "stochastic parameters" used in such an analysis are usually drawn from analysis of historical information, although such analysis can be tempered by expert knowledge. Fuel and electricity prices, electric demand and generating unit performance risks fall into this category and are directly captured in the risk analysis done for GRE's resource plan modeling.

Scenario risks typically have less information available; however, enough data is available to allow planners to make reasonable assumptions about potential future states of these risks. For example, while the timing or magnitude of a potential carbon tax is uncertain, enough literature is available to construct a scenario. Such risks are then represented by deterministic "scenarios" of the future, which are then overlaid on the stochastic market analysis platform.

Paradigm risks are those risks that are so inherently uncertain that any quantification could be considered speculative. For example, while there is no clear dividing line between scenario risks and paradigm risks, the uncertainty regarding the eventual establishment of a capacity market in MISO is a paradigm risk for GRE. Paradigm risks do not lend themselves to be modeled in this resource planning type of analysis. Rather, they are to be considered in contingency planning and the practical realities that provide a context for developing an action plan. GRE will continue monitoring situations that pose paradigm risks and as those situations come into focus they can be incorporated into future scenario risk modeling.

GRE's IRP relies upon stochastic analysis and scenario analysis to capture the range of risks it faces. This modeling uses stochastic analysis to examine risk associated with natural gas and fuel oil prices, wholesale power prices, and GRE load energy consumption. This modeling uses scenario analysis to examine compliance with the REO, environmental externalities, and the plans to meet 50 and 75 percent of future capacity needs with DSM or renewables.

7.2.3.2 Stochastic Risk Analysis

As discussed above, short term uncertainty in key fundamental variables, specifically natural gas prices, load, generator availability and wholesale power market energy prices are represented "stochastically;" that is, the state of these variables at any point in time is explicitly recognized to be uncertain. By incorporating this uncertainty into the economic analysis, GRE captures the impact these uncertainties can have on generation system operations and, ultimately, the cost of serving its members.

The alternative to conducting a stochastic analysis is called a "deterministic" analysis. A deterministic approach treats all variables as certain, and GRE's PVRR forecasts are developed utilizing this single view of the future. In the stochastic analysis, the uncertainty in these forecasts is explicitly acknowledged and accounted for by representing multiple iterations of the future. In each future, the uncertain variables changes in value over time, within certain limits.

The key features of the stochastic model used in Global Energy's analysis are:

- A general stochastic price process capable of representing both electricity prices and fuel prices.
- Use of the deterministic forecasts for fuel prices, load, wholesale power market prices and generator availability as "expected values" for each time period.
- The ability to use two distinct stochastic factors for each price variable—for short-term price level and long-term growth (drift) rate shocks[10].
- Distribution assumptions for the uncertain variables are: lognormal for electricity prices and fuel prices, normal for load, and uniform for generator outages.
- An allowance for contemporaneous correlation of stochastic factor shocks between each uncertain variable.
- An allowance of seasonal varying volatility and correlation parameters to handle the well-known cyclical price patterns of energy commodities.

7.2.3.3 Results of Stochastic Analysis

GRE directed Global Energy to conduct the risk assessment on the lowest cost plan from both the gas and coal strategies and all of the plans from the balanced strategy. The six plans chosen are:

- Plan 1-2.
- Plan 2-1.
- Plan 3-1.
- Plan 3-2.
- Plan 3-3.
- Plan 3-4.

The variables of interest treated stochastically for GRE's resource planning are:

1. Natural gas price.
2. Fuel oil price.
3. Electricity market price.
4. GRE load.
5. Generator availability.

These variables are chosen because they have the greatest degree of variability in the future and the greatest impact on GRE member rates. The risk assessment modeling includes 100 iterations to come up with

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[10] The long term stochastic factors were applied only to wholesale power market prices. The long term risk associated with load growth and natural gas prices was captured in the scenario analysis.

stochastically selected combinations of these uncertain variables. This allows for calculation of Revenue Requirements at Risk (RRaR) for each plan, which provides a measure comparing the level of risk associated with each plan. Figure 7-7 illustrates the PVRR and RRaR for the six plans included in the risk analysis.

Figure 7-7 Costs (PVRR) and Risks (RRaR)

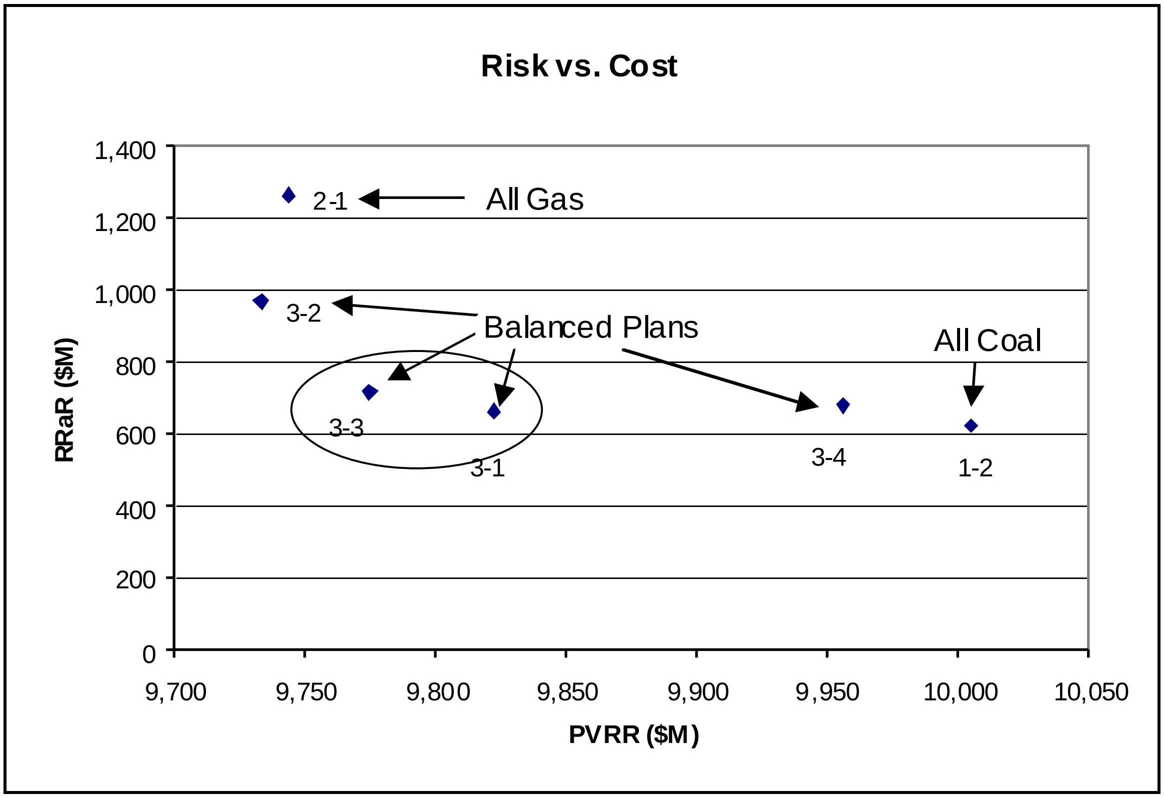
PVRR and RRaR		
	PVRR ($ millions)	**RRaR ($ millions)**
Plan 1-2	10,004	621
Plan 2-1	9,744	1,266
Plan 3-1	9,822	660
Plan 3-2	9,733	970
Plan 3-3	9,744	719
Plan 3-4	9,956	678

The higher the RRaR, the greater the risk of the plan's actual PVRR will be different from the expected PVRR. The variation in risk across the plans is significant; the riskiest plan has a RRaR nearly twice as high as that of the least risky plan.

7.3 Risk v. Cost analysis

Figure 7-8 illustrates the relationship between the risk and revenue requirement of the six plans. The graphic representation assists in identifying the optimal resource plan.

Figure 7-8 Risk vs. Cost



All else being equal, GRE would choose the plan that minimizes risk and cost simultaneously, which is identified as the point that is the closest to the origin. Typically, there is some trade-off between risk and reward, so no one plan minimizes both. In this IRP, the plans represented by the data points within the oval come closest to the ideal plan, and would be the preferred resource plans. Plans 2-1 and 3-2, for example, would be excluded from further consideration by GRE because they are significantly riskier even though they have a lower expected revenue requirement. Plan 1-2, on the other hand, is the least risky plan of the six but it has the highest expected value cost, albeit less than three percent higher revenue requirement than the lowest cost plan. Plan 1-2 illustrates that reducing risk usually carries additional cost, similar to an insurance policy.

Three of the four lowest risk plans are from Strategy Three.

7.4 Scenario Analysis

GRE directed Global Energy to conduct scenario analysis to examine compliance with the REO, environmental externalities, and the plans to meet 50 and 75 percent of future capacity needs with DSM or renewables.

7.4.1 REO Considerations

Under current Minnesota law GRE is required to make a good faith effort to meet the REO of supplying 10 percent of its energy sales with energy from eligible renewable sources by 2015. GRE has taken several steps in this direction. Prior to the REO law enactment GRE was already voluntarily adding wind resources to both support green marketing programs as well as in its general rate base. The 100 MW (nameplate capacity) Trimont wind project began construction in the spring of 2005 and is expected to be in commercial operation later in 2005 and is included in all scenarios that were modeled.

The plan for meeting the REO using wind resources is modeled by overlaying enough wind to meet the REO on top of the six plans previously selected for more detailed analysis. That is, although wind resources are added, neither the timing nor size of the six resource plans' proposed additions are modified. Wind resources, as part of the REO or otherwise, were not included in the original modeling steps because wind provides practically no capacity and therefore is not a reasonable alternative for capacity planning.

Figure 7-9 shows the wind additions that were included in the REO modeling.

Figure 7-9 GRE Wind Additions to Meet REO (10 percent by 2015)

GRE Wind Additions to Meet REO (10 percent by 2015)		
	Addition (MW)	**Cumulative (MW)**
2005	100	100
2006	0	100
2007	0	100
2008	100	200
2009	0	200
2010	0	200
2011	100	300
2012	0	300
2013	100	400
2014	0	400
2015	100	500

The impact of the REO on cost and risk is illustrated in Figure 7-10.

Figure 7-10 Comparison of PVRR and RRaR for resource plans with and without meeting the REO

Comparison of PVRR and RRaR for resource plans with and without meeting the REO				
REO Results			**Change from Base Scenario**	
	PVRR ($ millions)	RRaR ($ millions)	PVRR ($ millions)	RRaR ($ millions)
Plan 1-2	9,941	927	-64	306
Plan 2-1	9,666	976	-78	-290
Plan 3-1	9,754	810	-68	150
Plan 3-2	9,653	784	-80	-186
Plan 3-3	9,706	751	-68	32
Plan 3-4	9,905	952	-51	274

The results demonstrate a modest decrease in the expected present value of revenue requirements when wind resources are included so that GRE can meet the REO. However, the effects of the additional wind capacity, from a risk perspective, are mixed. The plans with only natural gas supply additions show an improved risk picture while those plans with greater reliance on coal have a poorer risk picture. Wind prices will typically be lower than the variable cost of production for natural gas fueled resources and higher than the variable cost of production for a coal fueled resource. If a wind resource happens to displace operation of a gas fueled resource, the result is lower costs and less variation in those costs (risk.) If the wind resource displaces a coal fueled resource the result is higher costs and greater variation in those costs. The risk in the plans including coal seems to be tied to the energy sales markets. The available wind energy creates more opportunities for off-system sales – these go up about five percent in the all-gas plans and about ten percent in the coal-inclusive plans. Since the sales markets are modeled with volatility, this increased level of sales increases the RRaR for the coal-inclusive cases.

7.4.2 Environmental Externality Considerations

All of the results presented to this point have included an underlying base assumption about environmental costs related to sulfur dioxide and nitrogen oxide emissions. Markets exist to determine the value/cost associated with these emissions. These costs need to be reflected in evaluating tradeoffs for controlling these emissions.

In addition, GRE develops alternative scenarios covering environmental externality costs to test a series of potential resource plans to see if the choice of a preferred resource plan is affected. These alternative scenarios are characterized as low and high scenarios. Each scenario includes a different combination of costs for SO_2 and NO_X as well as the Commission’s externality values.

Figure 7-11 provides the results of evaluating four of the plans under the low and high scenarios for environmental externality costs.

Figure 7-11 Environmental Externality Scenarios

Environmental Externality Scenarios		
Scenario	**PVRR ($ millions)**	**RRaR ($ millions)**
Plan 1-2, Low	10,264	609
Plan 2-1, Low	10,014	1,275
Plan 3-1, Low	10,086	460
Plan 3-4, Low	10,217	652
Plan 1-2, High	11,699	668
Plan 2-1, High	11,255	1,516
Plan 3-1, High	11,451	706
Plan 3-4, High	11,627	720

Cost, as measured by PVRR, shifts in an expected manner. The apparent cost of the plans evaluated rise under both externality scenarios. Under both externality scenarios the lowest cost plan (2-1) is a plan entirely dependent on natural gas-fueled additions, mostly the more efficient CC technology. This represents a shift from the original PVRR analysis (see Figure 7-5) that determined that a plan with at least some coal resources would be the lowest cost (plan 3-2). However, as measured by RRaR, plan 2-1 carries with it the greatest risk because of the uncertainty of future natural gas prices. This analysis shows that incorporating the low or high externality values does not significantly impact the risk v. cost analysis of these plans.

7.4.3 50/75 Percent Renewable Resource Plans

GRE is in the midst of studying the feasibility of separating DSM impact from its load forecast. That means that for this IRP, the impacts of DSM currently remain embedded in the data used to construct GRE's future load forecast. As explained in Section 6.1, GRE continues to make strong investment in expanding its DSM efforts but at this time it is not realistic to expect new DSM to be a significant enough resource to fulfill either 50 or 75 percent of new demand. Therefore these plans focused on fulfilling those needs with renewable resources.

The modeling for these cases uses wind as the least cost renewable. As described in Section 6, GRE continues to analyze the availability and cost effectiveness of other renewable resources, but at this time, wind is the strong favorite. The plans covering meeting 50 and 75 percent of future capacity needs are constructed based on using wind having 15 percent of nameplate rating as the accredited capacity. The balance of the capacity need is fulfilled with natural gas-fueled simple cycle combustion turbine facilities. The plans are detailed in Figure 7-12.

Figure 7-12 Plans for Fulfilling 50 and 75 Percent Growth with Renewable Resources

Plans for Fulfilling 50 and 75 Percent Growth with Renewable Resources				
	50% Plan		75% Plan	
	Wind	CT	Wind	CT
2006				
2007				
2008				
2009	800	150	1,300	
2010	900	150	1,200	150
2011	-		-	
2012	100		100	
2013	300		600	
2014	400	150	600	
2015	1,000		1,400	150
2016	200	150	400	
2017	400		600	
2018	400	150	600	
2019	400		600	
2020	400		600	150
Total	5,300	750	8,000	450

Figure 7-13 contains the modeling results.

Figure 7-13 PVRR and RRaR for Plans for Meeting 50 and 75 Percent Growth with Renewable Resources

PVRR and RRaR for Plans Meeting 50 and 75 Percent Growth with Renewable Reserouces		
Plan	PVRR ($ millions)	RRaR ($ millions)
50% Renewables	10,102	2,023
75% Renewables	11,683	2,556

Both the 50 and 75 percent plans increase the expected costs above that of the base case plans. Further, the plans also carry with them a dramatically higher risk than any of the base case plans or the REO cases. GRE concludes that the 50 and 75 percent plans do not represent a viable means of meeting GRE's future energy and capacity needs. These cases represent dramatically higher penetrations of wind than the REO cases. The REO cases show improved expected costs and in some case reduced risk. However, the wind levels represented in the 50 and 75 percent cases exceeds a cost effective level and carry a risk profile that is vastly contrary to GRE's conservative planning strategies.

7.5 Modeling Conclusions and Choosing a Preferred Plan

In developing this IRP, GRE analyzes a series of modeling runs examining costs and risks of potential resource plans. The modeling results provide GRE valuable information to be used in selecting a preferred plan.

GRE first narrowed the plans based on PVRR. Next, GRE eliminated Plan 2-1 (the one remaining plan from the gas strategy) and Plan 3-2 (a plan from the balanced strategy) because the risks exceeded GRE's risk tolerance. GRE also eliminated Plan 1-2 (the one remaining plan from the coal strategy) because it was the costliest of the plans undergoing additional analysis. Finally, GRE eliminated Plan 3-3 from the balanced strategy because it is nearly identical to Plan 3-1, with the difference being a combined cycle plant in the later years of the planning horizon. GRE's view is that combined cycle units will not be the preferred technology in that time period and thus removed that plan from consideration.

Finally, GRE constructs its action plan based on an analysis of Plans 3-1 and 3-4 in the context of other practical realities and business objectives. Therefore, after several steps of modeling and risk analysis, GRE concludes with two very similar plans as its preferred plan and from these plans develops its action plan, which is described in Section 8.

8 ACTION PLAN

GRE identifies the following action items for meeting the needs identified in this resource plan. Since the resource planning rules require a five-year action plan, this section focuses on items that will require specific action between now and 2010.

8.1 Resource Acquisition

GRE divides its action plan into three categories of resource acquisition: the near term period of this planning horizon (approximately 2008 – 2010), the mid term period of this planning horizon (2011 – 2017), and the long term period of this planning horizon (2018 and beyond).

8.1.1 Near Term

8.1.1.1 Peaking and Intermediate Resources

For the 2008 – 2010 timeframe, GRE's resource plan shows the need for the following resources:

- 2008 combustion turbine (peaking resource).
- 2009 combustion turbine or combined cycle (peaking or intermediate resource).
- 2010 combined cycle (intermediate resource).

GRE's strategy is to evaluate all supplier options for these resources.

In the recent past, GRE has reported that the regional market no longer has any excess capacity. As described in this resource plan, potential changes to the MAPP accreditation rules could open access to larger regional markets for capacity on a short-term, seasonal or long-term basis. GRE is closely monitoring these changes to take advantage of new opportunities to meet its near term peaking needs. GRE will also explore other market opportunities and analyze a self-build option relative to market opportunities. GRE expects to make a final decision on serving its 2008 peaking needs by the end of 2005.

From a traditional load-serving point of view, a combined-cycle plant is an expensive source of energy. Therefore, GRE's first strategy for meeting intermediate resource needs is to pursue market opportunities. In the past GRE has been successful in identifying and contracting for intermediate –

power products from other regional utilities. GRE expects that these market opportunities will remain available, is currently in discussions with several potential counterparties, and is exploring a range of market opportunities.

GRE expects to have its specific strategy determined for its 2009 and 2010 needs by the end of 2005. GRE will also be closely monitoring its load shape and market opportunities to determine whether peaking or intermediate resources will best meet its 2009 needs.

8.1.1.2 Renewable Resources

Given the lead time associated with acquiring the additional wind resources, renewable resource action items fall into the near-term time frame.

GRE modeled the addition of 100 MW blocks of wind resources in 2008, 2011, 2013, and 2015 to achieve the goals of the REO. GRE will monitor the energy requirements of our members and the performance of our existing renewable resources and modify the new resource acquisition schedule, as needed, to ensure fulfillment of Minnesota's REO. GRE's current schedule for additional wind resources is based on the modeled price of wind. If the price of future wind resources would be significantly different from the prices modeled, (for example through the elimination of the production tax credit) GRE would re-evaluate its strategy for making a good faith effort at meeting the REO.

In addition to the 100 MW blocks of wind energy identified as part of GRE's renewable resource acquisition, GRE will explore opportunities to work with smaller wind projects, including those that would qualify as C-BED (community based energy development) under law that becomes effective on August 1, 2005.

Since the next 100 MW wind addition must be online for 2008, GRE expects to issue an RFP in late 2005 or early 2006. Based on current projections for needs, it is likely that GRE will also be issuing an RFP for an additional 100 MW block of wind approximately in late 2008.

8.1.2 Mid Term

GRE's preferred resource plans demonstrate that in the 2014 – 2016 timeframe GRE will need two 300 MW blocks of baseload resources. The 300 MW blocks included in this resource plan are likely to be portions of larger plants in order to capture the full economic benefit of economies of scale. This type of resource requires a long lead time to site, permit and develop. Typically, a utility would begin investigating projects approximately eight to ten years in advance and permitting would begin approximately seven years in advance.

GRE is planning for the additional resources to meet the mid-term needs identified in this resource plan. In addition to the proposed Big Stone II project that is included as a resource in this resource plan, GRE is in the process of actively investigating projects and potential partnerships to meet its mid-term needs. One project, for example, has progressed to the stage that the partners are looking at specific sites.

GRE expects to be in the permit application phase for the projects to meet its mid-term needs within the next five years. As appropriate, GRE will update the Commission as it makes further specific progress on any of its projects.

GRE also expects to procure additional renewable resources in the mid-term timeframe. The specific schedule for these additions will be determined as GRE monitors its load growth and the output from its existing renewable resources. GRE does not expect any regulatory or construction activity for such resources within the next five years.

8.1.3 Long Term

As identified in Chapter 3, GRE forecasts a growing need for demand and energy through the end of this planning horizon and beyond. GRE engages in a continuous planning process and will update its forecasts and models to reflect changing conditions in the factors that impact supply of and demand for energy and capacity. However, GRE does not foresee taking any specific actions in the next five years regarding resources that may be necessary to meet its needs in 2018 and beyond that would require regulatory approval. GRE will continue its analysis and have a better idea of specific needs for that timeframe in subsequent resource plans and will inform the Commission as necessary.

GRE expects to also continue its commitment to renewable resources in the long term. However, it would be premature to predict any specific activities toward that end.

8.1.4 Additional Issues for Analysis

GRE continues to analyze upgrades to its facilities as a strategy to meet a portion of its growing needs. However, the potential upgrades currently identified either result in very small increases or are not economically justified under the current circumstances. GRE will monitor these conditions and pursue all appropriate upgrade projects.

GRE is committed to improving the impact of DSM. Several challenges related to DSM issues were identified in this document. GRE will continue to work diligently to meet these challenges and advance the analysis and integration of DSM.

GRE is currently analyzing how the 2005 Omnibus Energy Bill may affect its resource planning efforts. For example, the 2005 Energy Bill lengthens the time allowed for the Commission to make a decision in a certificate of need proceeding for additional power supply resources. Also, GRE will be developing a C-BED tariff through which resources may be acquired to meet the REO and diversify GRE's resource base.

8.2 Schedule of Key Activities Including Construction and Regulatory Filings

GRE will evaluate all options, demand and supply, to meet its forecasted need during the coming five years. The schedule below contains GRE's expected regulatory filings for "self-build" supply resources if other supply resources cannot be acquired from the market or RFPs at terms and prices that are acceptable to GRE.

Figure 8-1 Timeline for GRE's Future Resource Acquisitions

Timeline for GRE's Future Resource Acquisitions			
Resource	**Timeframe**	**Regulatory Filing**	**Other actions**
2008 Peaking Resource	Fall 2005		Negotiate contracts for 2008 need or Issue RFP
	Summer 2006	CoN (if necessary)	
	Summer 2007		Construction begins (if necessary)
2008 Wind	Late 2005/early 2006		Issue 100 MW wind RFP , Online by 1/1/2011
	Summer 2006	CoN	
	Summer 2007		Construction begins
2009 Intermediate or Peaking Resource	Fall 2005		Issue RFP
	Summer 2006 (later if peaking resource is chosen)	CoN	
	Summer 2007 (later if peaking resource is chosen)		Construction begins
2010 Intermediate Resource	Summer 2006		Issue RFP
	Summer 2007	CoN	
	Summer 2008		Construction begins
2011 Wind	Late 2008		Issue 100 MW wind RFP , Online by 1/1/2008
	Summer 2009	CoN	
	Summer 2010		Construction begins
2014-2016 Baseload Resources	Late 2007 – 2009	CoN for baseload or associated transmission	
	2010		Construction begins

8.3 Commitment to Update the Commission

GRE commits to providing the Commission with timely notice of significant changes or deviations from the information presented in this plan.

8.4 Great River Energy's Resource Plan is in the Public Interest

GRE has carefully evaluated a comprehensive set of resource options, expected future market conditions, and practical realities to determine the best way to meet the resource needs identified in this plan. GRE implemented several improvements in its planning process within this IRP. It modeled significantly more potential resource plans and incorporated a more robust risk analysis. GRE presents a thoughtful, logical process for the development of its resource plan and provides many insights into its internal challenges and accomplishments.

Since specific resource acquisition decisions must be approved by the GRE Board of Directors and member cooperatives, some of the specific details regarding new resources are still under development and may be different than has been presented as GRE's preferred resource plan and accompanying action plan. However, the blueprint outlined in this action plan provides the Commission with a clear picture of how GRE intends to meet the future power supply needs of its member cooperatives and is also a solid basis for the Commission's acceptance of this resource plan as being in the public interest.

GRE's resource plan is in the public interest because:
1. It provides for adequate and reliable service.
2. It seeks to minimize costs and risks.
3. It is environmentally responsible.

GRE has a long-standing commitment to meet the resource needs of its members in a manner that is reliable, low cost and environmentally responsible. This resource plan is one step toward fulfilling that commitment. GRE respectfully requests that the Commission accept this plan as being in the public interest.

APPENDIX A CONSERVATION IMPROVEMENT PROGRAMS

This section describes all of the programs implemented as part of GRE's Conservation Improvement Program (CIP). GRE provides a more extensive report of its CIP programs in its biennial filing to the Department of Commerce.

A.1 Existing Energy Conservation, Load Management and Renewable Energy Programs

Great River Energy (GRE), through its predecessors Cooperative Power (CP) and United Power Association (UPA), has a long history of implementing load management, conservation, and renewable energy programs. Prior to the merger of CP and UPA, each had been implementing these types of programs since the late 1970's.

Historical (2002 – 2004) and projected (2005 – 2007) energy conservation and load management are summarized in the table below. The savings include the distribution and transmission losses and the MAPP 15 percent reserve requirement.

Figure A-1 Historical and Projected Energy Conservation and Load Management Summary

Historical and Projected Energy Conservation and Load Management Summary

Year	Summer Capacity Reduction (kW)	Annual Energy Savings (kWh)
2002	271,247	73,908,504
2003	331,073	113,424,747
2004	345,962	139,967,526
2005	364,000	168,000,000
2006	384,000	198,000,000
2007	404,000	228,000,000

These programs have contributed to a more efficient allocation of resources and have helped to delay the need for additional capacity. A summary of the participants and kWh savings for GRE's 2004 conservation and load management programs is listed in the table below.

Figure A-2 2004 Energy Conservation and Load Management Summary

2004 Energy Conservation and Load Management Summary		
Summary by Program End-Use	**Participants**	**kWh**
Energy Conservation Programs		
Air Source Heat Pump (Direct)	6,615	16,737,500
Commercial Ground Source Heat Pump (Direct)	45	7,709,268
Commercial & Industrial (C&I-A) – Energy Grant (Direct)	473*	27,003,318
Commercial & Industrial (C&I-A) Electrical Evaluation and Consultation (Direct)	652*	N/A
Energy Education (Indirect)	11,106*	N/A
Fluorescent Bulb Recycling (Indirect)	3,306*	N/A
Home Light (Direct)	77,484	5,113,944
Low Income Air Conditioner Tune-up (Direct)	798	92,101
Residential Appliance Rebate – Energy Star® (Direct)	12,828	3,703,512
Residential Ground Source Heat Pump (Direct)	2,264	31,696,000
Residential High-Efficiency Air Conditioner Rebate (Direct)	20,537	4,101,563
Street and Security Lighting (Direct)	24,445	7,537,940
Energy Conservation Total	160,553	107,388,574
Load Management Programs (All are Direct)		
Interruptible Commercial and Industrial Loads	1,119	
Interruptible Irrigation	2,545	
Cycled Air Conditioning Off-Peak Space Heating – Dual Fuel	143,806	9,587,080
Off-Peak Space Heating - Electric Thermal Storage (ETS)	12,736	
Off-Peak Water Heating - Electric Thermal Storage (ETS) and Peak Shave Water Heating (PSWH)	88,951	26,685,300
Load Management Total	**249,157**	**36,272,380**
Grand Total	**409,710**	**139,967,526**
*New participants only.		

A.2 Energy Conservation and Load Management Program Descriptions

The primary purposes of Great River Energy's diverse portfolio of conservation and load management programs are to reduce peak demand, encourage energy conservation and improve energy efficiency. Descriptions of the programs are provided under the following program headings:
- Indirect conservation programs.
- Direct conservation programs.
- Direct load control programs.

A.2.1 Indirect Conservation Programs

GRE and its member distribution cooperatives have adopted conservation programs which include assisting consumers in addressing conservation methods, training cooperative employees, and providing energy audits that reduce energy use.

A.2.1.1 Energy Audits

GRE and its member systems offer free or reduced cost energy audits for residential and commercial customers. Many member systems have staff specifically trained to conduct basic audits. In addition to the basic audits participating members work with local Community Action Programs (CAP) agencies to target low-income households that could benefit from energy conservation education.

Commercial consumers are provided with either a walk-through energy audit performed by cooperative staff or a more comprehensive audit performed by a professional consultant. Costs for the comprehensive audit are typically shared 35 percent by GRE, 35 percent by the distribution cooperative and 30 percent by the customer.

Home Energy Check is a residential energy efficiency program that includes in-home energy audits and conservation workshops for consumers. Beyond educating consumers on how to make their homes more energy-efficient, this program offers other assistance including low-interest financing. If necessary, outside auditors are hired to do more complex studies. This program has been expanded to include the implementation of conservation measures prescribed by the audit.

A.2.1.2 Energy Education

Member cooperatives assist residential and commercial and industrial customers gain awareness of the available energy conservation and energy efficiency programs through brochures, bill inserts, radio advertisements, newsletters, workshops, fairs, trade shows, and one-on-one consultation. The member distribution cooperatives provide a variety of services including:

- Explaining to customers the benefits of purchasing energy efficient appliances including lighting, heating systems, ventilation systems, and air conditioners.
- Providing answers to customers on electric energy usage questions.
- Educating customers on how appliances, lighting, heating, cooling, and general usage habits affect their energy bill.
- Recommending energy reduction measures.
- Providing simple energy usage calculation tools and energy cost guidelines.

A.2.1.3 Residential Electrical Evaluation and Consultation

The residential electrical evaluation and consultation program is targeted at customers who contact their member cooperative and express concern over their electrical usage. When a customer contacts their cooperative representative, the representative reviews general appliance usage and costs with the customer. The review provides an overview of the customer's energy usage and provides suggestions on various means by which the customer can conserve energy. If the representative determines that additional actions should be taken, the customer may be scheduled for an on-site audit. The audit may include:

- Energy bill analysis.
- Customer education.
- Building shell assessment.
- Blower door test.
- Mechanical and electrical equipment assessment.
- Recommendations.

A.2.2 Direct Conservation Programs

Direct conservation programs result in quantifiable energy (kWh) and capacity savings (kW). Direct conservation program reduces the amount of kWh that would have normally been consumed if the program was not available. Other conservation programs are designed to reduce peak loads by directly controlling a customer's consumption at times of peak system demand.

A.2.2.1 Air Source Heat Pump (ASHP)

ASHPs provide summer cooling and spring/fall heating in residential or commercial installations. ASHPs are sized for cooling. In the cooling mode, the ASHP functions as a central air conditioner and is load managed during the summer per GRE's cycled air conditioning control strategy. In the heating mode, the ASHP provides very efficient space heating to a temperature of approximately 20 degrees F. At this temperature the ASHP automatically shuts off and the secondary heating system (typically a natural gas or liquid propane furnace) heats the home. If conditions should require load control, Great River Energy also has the ability to control ASHPs during the heating season. ASHPs help Great River Energy improve load factor, reduce peak capacity requirements, and improve system efficiencies.

A.2.2.2 Commercial Ground Source Heat Pump (GSHP)

GSHPs have proven to be one of the most efficient space conditioning options with the added potential of significant energy savings. Acceptance of this technology continues to grow nationwide. GSHPs use the latent heat in the earth as a heat sink and heat source. By utilizing a series of buried heavy-duty plastic pipes filled with a food-grade antifreeze solution as the heat transfer medium. GSHPs are highly efficient in both the heating and cooling modes. This high efficiency results in the reduction of kWh usage in the cooling season and can also significantly reduce the total energy used to heat a building when compared to alternative heating systems. Currently GRE and its member distribution cooperatives serve schools, churches, and other commercial and industrial buildings heated and cooled with GSHPs.

A.2.2.3 Commercial, Industrial & Agricultural (CI&A) – Energy Grant and Rebate

The Commercial, Industrial & Agricultural (CI&A) energy grant and rebate program provides cash incentives to qualified applicants for energy efficiency improvements to their business, industry, or farm. Interested customers must complete a grant application form, which describes the intended energy efficiency improvement measures and calculates the expected energy and demand savings. The individual member cooperative evaluates the proposal for viability and cost effectiveness; those that rank the highest are awarded grants to help offset the cost of their project. Grant funds are typically used for the installation of high efficient lighting, motors, adjustable speed drives, refrigeration compressors, high efficient air conditioning, and other energy conserving equipment. The program also includes a New Construction

Rebate for Lighting and Motors. This rebate is on a per fixture basis or on the horsepower rating of the motor.

A.2.2.4 Commercial, Industrial, & Agriculture (CI & A) Electrical Evaluation and Consultation

The commercial, industrial, and Agriculture electrical evaluation and consultation program is targeted at GRE's member cooperatives' customers that have substantial electric energy requirements. A member distribution cooperative representative meets with the customer on-site to review general electric usage patterns of the business. The customer's electric usage patterns may be available through a web-based load profiling service that GRE has made available to its member cooperatives. The review includes suggestions on ways to conserve energy and details of GRE's energy efficiency grant program. If the representative determines that additional actions should be taken, the customer may be scheduled for an on-site audit. This audit might include:

- Energy bill analysis.
- Lighting and motor load review.
- Customer education.
- Building shell assessment.
- Mechanical and electrical equipment assessment.
- Recommendations.

If the member cooperative representative determines that a more detailed audit is required, an independent auditing firm may be hired. The costs for a more detailed audit are generally shared between the customer and the member distribution cooperative.

A.2.2.5 High Efficiency Electric Water Heater Rebate

Customers replacing old inefficient electric water heaters with new high efficiency electric water heaters receive a cash rebate from a participating distribution cooperative. The minimum acceptable water heater has insulation of R16 or greater, and an energy efficiency factor of 0.92. The average water heaters replaced has an efficiency factor of 0.82 or less.

A.2.2.6 Home Lighting – Energy Star®

Lighting makes up ten percent of a typical home's electricity consumption; the home lighting program is an energy conservation program in the form of a rebate that encourages the conversion from incandescent lighting to more energy efficient lighting – particularly compact fluorescent lighting (CFL). GRE's member distribution cooperatives provide a $2 rebate to residential customers that purchase an Energy Star® rated CFL.

A.2.2.7 Cycled Air Conditioning or ASHP

The cycled air conditioning program provides customers with an incentive to allow GRE to cycle (15 minute on, 15 minute off) their central air conditioner during periods of high peak demand. The cycling provides approximately one kW of demand reduction per air conditioner. Air conditioning is a critical load to the member distribution cooperatives and to GRE. The program helps improve system load factor, reduce peak capacity requirements, and improve system efficiencies.

A.2.2.8 Light Emitting Diode (LED) Traffic Signal Retrofit

In addition to replacing old mercury vapor street lamps with high efficiency High Intensity Discharge (HID) lamps, GRE member distribution cooperatives encourage and provide rebates to federal, state, city, and county governmental units, as well as railroads to substitute incandescent-type lamps at traffic signals and warning makers with LED lights.

A.2.2.9 Low Income Air Conditioner Tune-Up

Participating member distribution cooperatives offer air conditioning tune-ups to low-income customers in conjunction with local Community Action Program (CAP) agencies. The roles of a CAP agency is to help identify customers that would benefit from this service and to provide instruction to local HVAC service vendors authorized under this program to provide tune-ups. The tune-up service includes:

- Cleaning condenser coil.
- Checking Freon level and pressures.
- Checking indoor filter.
- Testing all controls.
- Blowing out drain line.
- Visually inspecting the entire system.

- Educating homeowner on operation.

The low-income air conditioner tune-up program improves the air conditioner's efficiency, which in turn lowers the customer's energy bill.

A.2.2.10 Low Income Grant/Rebates

Participating member distribution cooperatives provide grants or rebates to low income families to purchase or invest in energy efficient appliances or technologies that will have measurable energy savings.

A.2.2.11 Renters Program Grants, Lighting and Air Conditioner Tune-Ups

Participating member distribution cooperatives provide renters or rental property owners with grants to be used to improve the energy efficiency of the property. Programs include high efficient space heating and cooling, lighting retrofit, and air conditioner tune-ups.

A.2.2.12 Residential Appliance Rebate – Energy Star®

In addition to water heating, Energy Star® has identified dishwashers, refrigerators, and clothes washers as the most promising appliances for electric energy and demand savings. For this reason, Great River Energy, through its member distribution cooperatives, provides Energy Star® refrigerator, dishwasher and clothes washer rebates to cooperative customers. Member cooperatives are also endeavoring to educate their customers and builders on Energy Star® and the value of high efficiency appliances and the long term benefits of conservation through Energy Star®. A variety of media (television and radio ads, point of purchase displays, home builder magazines, etc) and customer education opportunities are made available through Energy Star® rebate program. Great River Energy's member cooperatives are administering the program including the verification of installation and the distribution of rebates to customers.

A.2.2.13 Residential Ground Source Heat Pump (GSHP)

GSHPs have proven to be one of the most efficient space conditioning options with the added potential of significant energy savings. Acceptance of this technology continues to grow nationwide. GSHPs use the latent heat in the earth as a heat sink and a heat source. By utilizing a series of buried heavy-duty plastic pipes filled with a food-grade antifreeze solution as the heat transfer medium, GSHPs highly efficient in both heating and cooling modes. This high efficiency results in reduced kWh usage in the cooling season and can also significantly reduce the total energy used to heat a home when compared to alternative heating systems. Along with the kWh savings there is capacity savings when the GSHP is part of the load management program that allows the member cooperative to control loads during peak times.

A.2.2.14 Residential High-Efficiency Air Conditioner Rebate – Energy Star®

Residential air conditioning is a critical load to Great River Energy and its member distribution cooperatives. High-efficiency air conditioners improve system load factor, reduce peak capacity requirements, improve system efficiencies, and lower customer's cooling costs. Great River Energy, through its member cooperatives, provides a $300 customer, or installing contractor rebate for central air conditioners that have a Seasonal Energy Efficiency Ratio (SEER) of 13 or greater. Room air conditions are eligible for a $35 rebate. This increased efficiency results in energy and demand savings during GRE's critical summer period.

A.2.2.15 Street and Security Lighting

The street and security lighting program ensures that only energy efficient high-pressure sodium (HPS) lighting equipment is installed. In new installations, HPS is the accepted standard. Conversion to HPS in older mercury vapor lighting systems occurs at the time of failure or at the customer's request.

A.2.3 Load Management Control (Direct) Program Descriptions

GRE offers a wide variety of direct load control programs that allow GRE to reduce its summer and winter peak demand. These programs are described next.

A.2.3.1 Electric Thermal Storage (ETS) Pool Heating and Electric Vehicles

The ETS, pool heating, and electric vehicle program uses electric energy to heat water or charge batteries. Swimming pools or electric vehicles such as fork lifts and golf carts can be heated or charged during the nightly eight-hour off-peak charge time. As a result of the off-peak program participants are eligible for a reduced electric rate from Great River Energy through its member distribution cooperatives. The pool heater or electric vehicle must be metered as an ETS load and energized only during the nightly eight-hour ETS charge time. The electric vehicle must be able to operate "around-the-clock" from the nightly eight-hour ETS charge.

A.2.3.2 Interruptible Commercial and Industrial Loads

The interruptible commercial and industrial loads program provides a reduced electric rate to C&I customers that can reduce their demand by a minimum of 25 kW during periods of high demand. Prior to the control periods the customer is automatically alerted so they can reduce their demand to a predetermined level or completely eliminate the load. The program improves GRE’s system load factor, reduces peak capacity requirements, and improves system efficiencies.

A.2.3.3 Interruptible Irrigation

Interruptible commercial irrigation systems – generally agricultural, turf growers, or golf courses can be interrupted once per day for up to four hours. The program improves GRE’s system load factor, reduces peak capacity requirements, and improves system efficiencies. Since most irrigation systems are manual restart, GRE makes every effort to only schedule irrigation control during extremely high peak demand periods and, if possible, at consistent times. This makes the manual restart of the systems easier for the irrigation operator.

A.2.3.4 Off-Peak Space Heating - Dual Fuel

Dual fuel space heating systems are a combination of interruptible electric and non-electric space heating. The dual fuel space-heating program helps GRE reduce winter peak capacity requirements. Reducing peak requirements improves load factor and system efficiencies. Conventional electric (generally, baseboard or a plenum heater) is the primary heating system and fuel oil, natural gas, liquid propane, or in some cases wood is the secondary heating system. Both the primary and secondary heating systems are sized for the entire heating load of the home. During periods of high electric demand, the interruptible electric heating system is shut off and the secondary heating system heats the home.

A.2.3.5 Off-Peak Space Heating - Electric Thermal Storage (ETS)

The off-peak or ETS space heating program uses off-peak electric energy to provide for 100% of a home's heating requirements. During the nightly eight-hour ETS charge time heat is stored in a water or ceramic medium. There are three commonly available storage heating configurations: central furnaces, room or dispersed heaters, and slab. Customers receive a special off-peak rate in return for allowing GRE to control their systems each day during the on-peak hours. The off-peak or ETS space heating program helps GRE improve load factor and system efficiencies.

A.2.3.6 Off-Peak Water Heating - Electric Thermal Storage (ETS) and Peak Shave Water Heating (PSWH)

Off-Peak or ETS Water Heating and Peak Shave Water Heating addresses water heating - the second largest user of energy in the average home.

The off-peak or ETS water heating program uses off-peak electric energy coupled with a high efficient water heater with sufficient storage capacity to supply the user's hot water needs during a 16 hour on-peak period. Customers receive a special off-peak rate in return for allowing GRE to control their water heaters each day during the on-peak hours. The off-peak or ETS water heating program helps GRE improve load factor and system efficiencies.

A second option available to customers is the PSWH program. PSWHs can be interrupted during periods of high electric demand for up to eight hours per day. Customers receive a special interruptible rate in return for allowing GRE to control their water heaters during peak periods. The PSWH water heating program helps GRE improve load factor and system efficiencies.

A.3 Renewable Energy Program Descriptions

Minnesota's conservation improvement program rules allow for the inclusion of certain programs promoting the use of renewable resources. GRE has two such programs, described in this section.

A.3.1 Renewable Energy – Biomass Grant

GRE provides a Biomass Grant to encourage the development of farmer-owned anaerobic digesters in its member cooperative service territories. Anaerobic digesters are containers that hold manure at a given operating temperature for a period of time that is long enough to allow a steady-state growth of methane-producing bacteria. Anaerobic digesters reduce farm odor and produce gas that is used to fuel electric generators. Great River Energy's biomass grant provides, on a case-by-case basis, a cash grant to help offset construction costs. In addition to the grant, Great River Energy may enter into a power purchase agreement with the project owner for the purchase of all or excess energy that is generated from the project.

A.3.2 Renewable Energy – Photovoltaic Rebate (State Calls it Solar Rebate Program)

GRE member cooperatives' electric members can receive a rebate on grid-connected solar electric systems. GRE's Rebates are limited to one per customer for any project that has a minimum of one kW and a maximum output of two kW and will "piggyback" on the State of Minnesota Solar Electric Rebate Program. The GRE rebate will be $2,000 per kW for a professionally installed and connected customer owned solar project.

APPENDIX B FORECASTING MODELING OVERVIEW

B.1 Introduction

The appendix is organized as follows. First, GRE's energy sales to customer classes and member systems are shown. Second, a detailed overview of GRE's forecasting methodology is presented, including an explanation of the models used for the various customer classes as well as the demographic data and variables used. A discussion of load management and the forecasting process concludes the section.

The summary demand and energy forecasts in Section 3 are GRE's net obligations taking into account any of its members' decision to have a portion of its needs served by an alternate supplier. However, the details presented in this appendix represent GRE's entire system.

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B.1.1 GRE's Energy Sales by Customer Class

The tables and graphs below illustrate GRE's sales of energy by customer class and by member. More than 80 percent of GRE's energy sales to members are sold at retail to residential and small commercial customers. The six remaining RUS-defined customer classes accounted for less than 20 percent of energy sold by GRE to its members during 2003.

Therefore, from a forecasting perspective, residential and small commercial consumers are the most important customer classes. GRE and the member systems spend the bulk of forecasting efforts on the two classes through preparation of various forecasts as discussed in more detail below.

Figure B-1 2003 Energy Sales by Customer Class

[TRADE SECRET INFORMATION BEGINS

TRADE SECRET INFORMATION ENDS]

Figure B-2 Forecast of 2023 Energy Sales by Customer Class

[TRADE SECRET INFORMATION BEGINS

TRADE SECRET DATA ENDS]

Figure B-3 Sales to Members by Customer Class, 2003

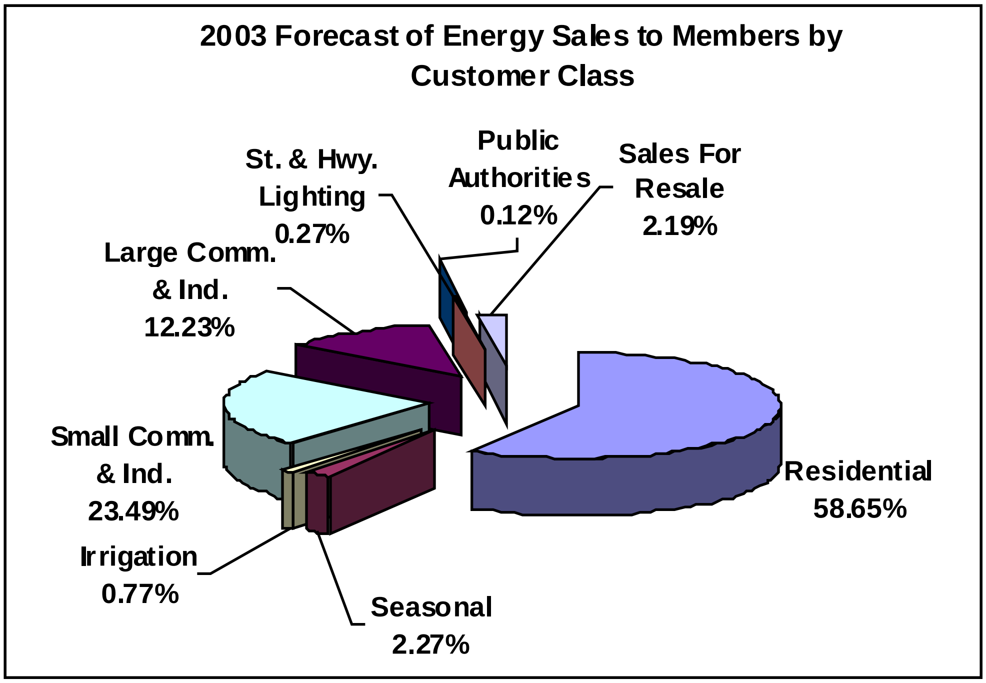
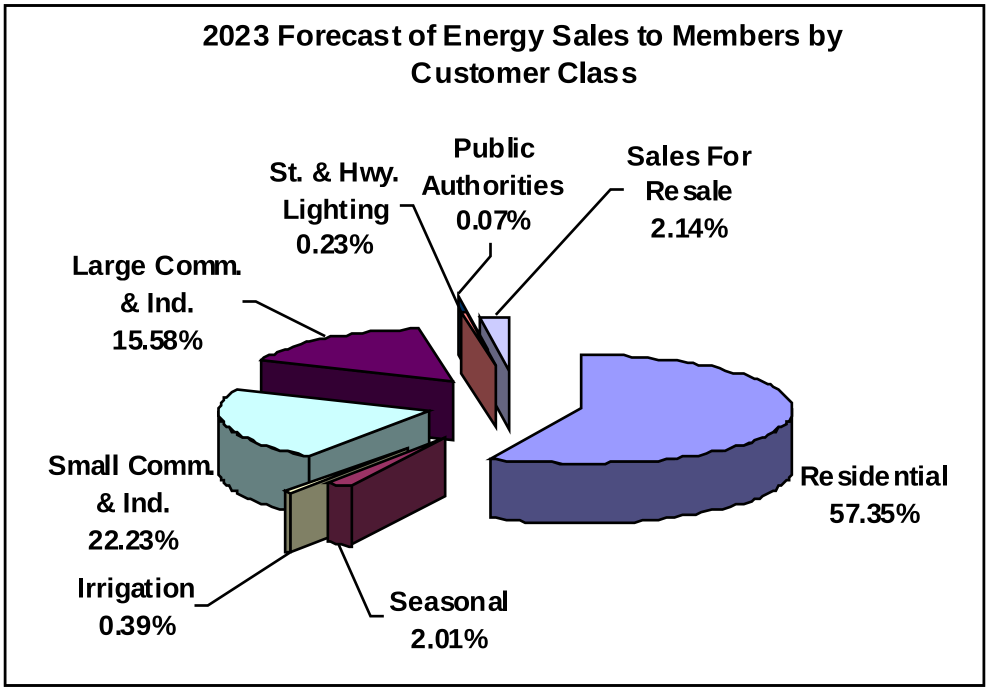


Figure B-4 Forecast of Sales to Members by Customer Class, 2023



B.2 Forecasting Overview

GRE's forecast methodology is best described as a collaborative process of communication between GRE and its member systems. The forecasting process provides a framework to examine and monitor factors that affect electricity usage. This leads to an understanding of the factors affecting growth. The collaborative process allows local service area knowledge of expected large load additions or subtractions to be incorporated into the member system's forecast. The result is a substantially improved forecast that complements econometric techniques with known and significant load changes.

Three processes are performed to calculate a member's energy and demand forecasts.

First, the member cooperative forecasts the number of consumers and the average energy usage per consumer for each consumer class. The resulting product of the two forecasts is the member system's energy forecast for that class of consumers. The class forecasts along with distribution losses are summed to arrive at the member's energy forecast.

Next, seven load factor forecasts are produced by GRE for the member system. GRE constructs a seven year trend (summer and winter), and eleven year trend (summer and winter), and an econometric model (summer). If one of the forecasts is assumed to be accurate it is used. However, if the member cooperative is small and knows that a large industrial customer with a high load factor will locate in its service area, for example, a higher load factor forecast may be created.

Finally, the member's demand forecast is derived from the cooperative's energy and load factor forecasts.

This section is laid out in two parts. First, two figures illustrate how GRE constructs its energy and demand forecasts. Next, the forecasting models used to develop a member's customer class energy forecasts are discussed.

Figure B-5 GRE Demand Forecasting Methodology

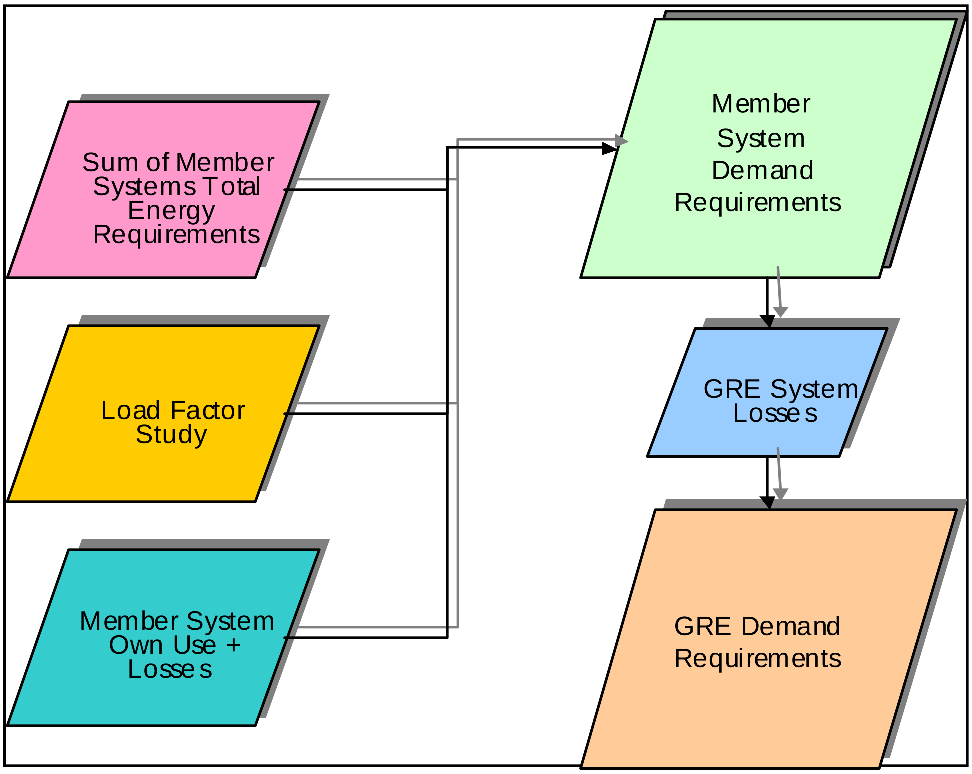
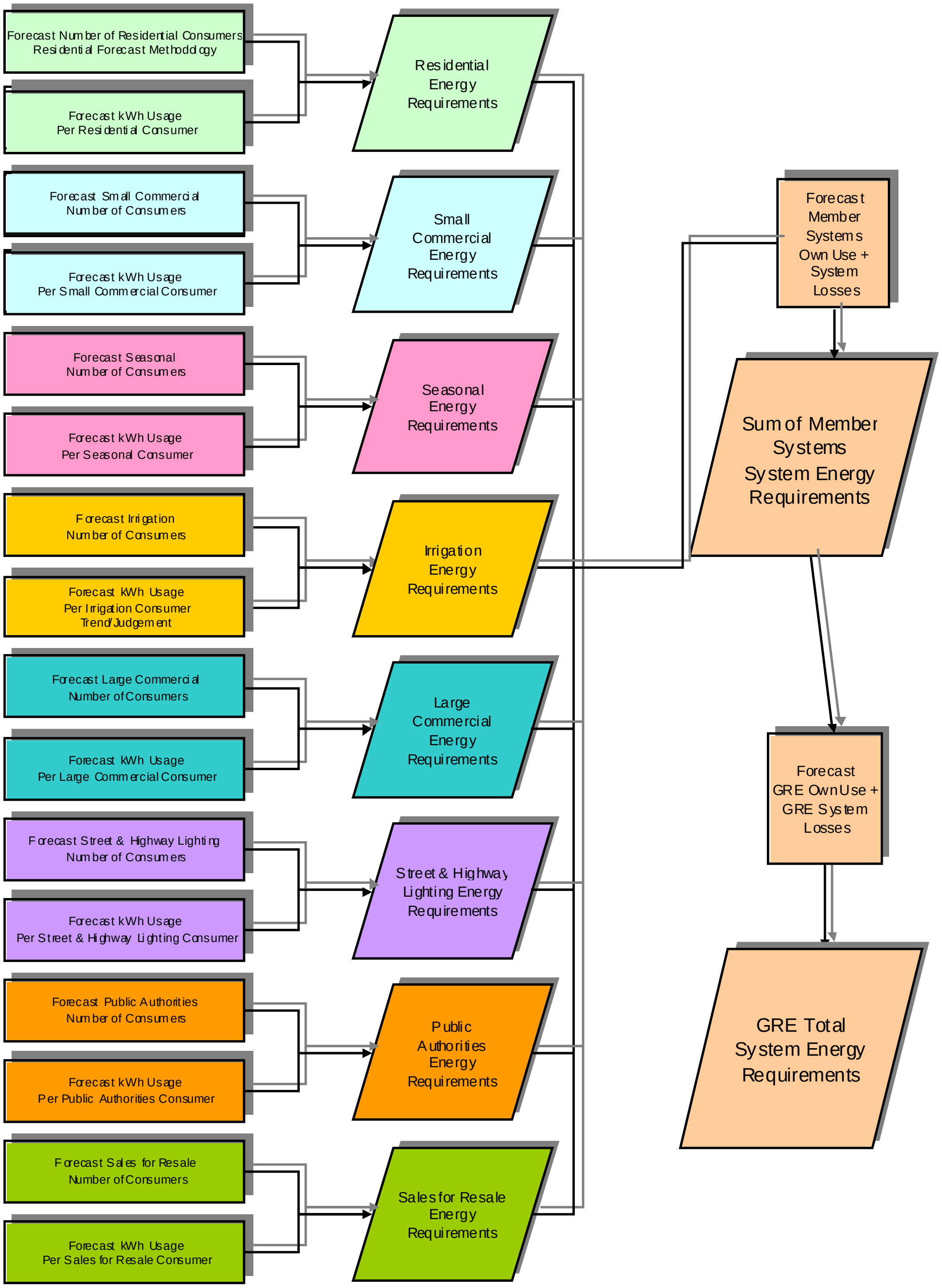


Figure B-6 GRE Energy Forecasting Methodology



B.2.1 Forecasting Models by Customer Class

B.2.1.1 Residential Modeling

GRE assists member system staff to identify, examine, and quantify the factors that affect residential consumer growth. A two-step process is used to arrive at the member system's forecast of residential energy requirements. First, each member system used the GRE econometric models and demographic data set as a tool to forecast number of residential consumers. Next, each member system used one of three models for forecasting usage per residential consumer. The final forecast is calculated by multiplying usage by forecasted consumers.

The method used for forecasting the number of residential consumers is a framework for identifying, examining, and quantifying the factors that affect residential consumer growth. This methodology allows the incorporation of local service territory knowledge to supplement the information from the long-term demographic studies and econometric models.

Next, the member systems used the trend and econometric models generated by GRE as information to prepare the forecast of energy usage per residential consumer.

Number of Residential Consumers.

For each member system, GRE staff prepared up to five forecasts with supplemental tables and graphs of the number of residential consumers. The basis for the five forecasts provided to the member systems by GRE was: 1) the Minnesota State Demographer, 2) Woods & Poole, and 3) the Metropolitan Council. GRE staff explained the strengths and weaknesses of each of the demographic forecasts and the resulting five models. Based on that information the member system constructed a forecast of the number of residential consumers. GRE staff reviewed the member system's forecast.

The demographic data and contributions to GRE's modeling of the number of residential consumers are described below. Then, the models of the number of residential consumers that were constructed from the demographic data are explained.

Demographic Data

To develop a forecast of the number of residential consumers for the 2004 Long-Range Load Forecast GRE staff used three demographic forecasts of the number of households by county. Two of the forecasts are statewide in scope while the third forecast concentrates on the Twin Cities metro area. The first forecast, prepared by Woods & Poole, is of households for each county in Minnesota. The second forecast, performed by the Minnesota State Demographer using 2000 census results, is also a statewide forecast of households by county. A third forecast was obtained from the Metropolitan Council and examined only those counties within the metropolitan service area.

All methodologies were found to have strengths and weaknesses and each provided different insights. The household forecast of the Minnesota State Demographer was compared with the Woods & Poole forecast of Minnesota households. While the two statewide forecasts had essentially the same number of households in Minnesota, they differed in how they allocated growth to the counties. The State Demographer's methodology relied more on history, while the Woods & Poole methodology relied more on the expected nature of the economy in each county. Therefore, further review and comparison of the assumptions used in the three demographic forecasts was conducted. An understanding of the assumptions combined with an understanding of the history of each county is necessary to assess the validity of each demographic forecast.

Staff from the State Demographers Office and the Metropolitan Council met with GRE staff and the member systems to review the forecasts on June 22, 2004. The Minnesota Department of Commerce was also represented. At this meeting GRE staff and the member system staff were able to review and compare the demographic forecast methodologies.

(i) Minnesota State Demographer

The Minnesota State Demographer issued its most recent forecast of Minnesota households by county in 2002. The Minnesota State Demographer forecast is released every ten years. The forecast is a standard cohort component methodology with migration determined by historical patterns.

(ii) Metropolitan Council

The Metropolitan Council forecasts include seven counties adjoining Minneapolis and St Paul. These counties are Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington. Metropolitan Council staff presented demographic information at a meeting with member system forecasters June 22, 2004. The accuracy of the Metropolitan Council forecasts was discussed. The factors affecting the urban-rural growth of population growth were discussed. Possible changes in the Metropolitan Council policy of sewer expansion were discussed. Any change to the Metropolitan Council's policy would be significant because sewer expansion is a key determinant of residential consumer growth.

(iii) Woods & Poole Economics, Inc. 2004 State Profile

GRE examined the Woods & Poole analysis and found the resulting forecasts to be reasonable. Therefore, Woods & Poole data was the main source of the demographic forecasts used in the 2004 forecast.[11]

The methods used by Woods & Poole to generate the county projections proceed in four stages. First, forecasts to 2030 of total United States personal income, earnings by industry, employment by industry, population, inflation and other variables are made. Second, the country is divided into Economic Areas (EAs) as defined by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). For each EA, a projection is made for employment, using an "export-based approach." The employment projection for each EA is then used to estimate earnings in each EA. The employment and earnings projects then become the principal explanatory variables used to estimate population and number of households in each EA.

Woods & Poole forecasts are used because of their reputation and their annual updates. Woods & Poole also provide forecasts of income, inflation, and other data series useful in econometric models. One major advantage of using the Woods & Poole forecast is that their economic and demographic forecasts are consistent.

Generally, the smaller the geography, the larger the Average Absolute Percent Error's (AAPE's) for all variables. For all counties, the AAPE for 8-year population projections was ±9.0%. However, for counties with population under 50,000, the 8-year projection AAPE was ±9.7%. The accuracy of the Woods & Poole projections has been comparable to the U.S. Department of Commerce Bureau of Economic Analysis and the Census Bureau.

Models Developed from Demographic Data

The forecasts prepared by GRE include seven-year linear trend, eleven-year linear trend, Woods & Poole based constant share of county growth, and Woods & Poole based linear relationship methodology. In addition, if

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[11] The documentation for the Woods & Poole forecast is maintained on a CD from Woods & Poole titled: "Minnesota State Profile 2004." This CD contains more than 900 economic and demographic variables for every county in Minnesota for every year from 1970 to 2030.

requested, a fifth forecast is prepared. The fifth forecast is the linear relationship methodology calculated on the basis of the Minnesota State Demographer forecast of households. In the end, however, member system staffs make the forecasts of residential consumers.

(i) Seven-Year Linear Trend

Assumptions: A linear or straight-line trend forecast assumes that the growth amount of consumers is constant and that the same number of consumers will be added each year in the future as was added in the past.

Method: A linear regression was created based on the historical number of customers for each member system using data from 1997 to 2003. The number of consumers was forecast into the future based on this past trend.

Use of the forecast: It is especially useful to study the graphs of residuals from linear trend models. Residuals are the difference between actual data and a straight line fit to the data; the errors. Each large residual was identified and a reason for the deviation was sought. Large errors in the beginning and ending years of trend forecasts significantly affect trend forecasts. Any linear trend forecast with large residuals in the beginning or ending years is suspect. Patterns in the residuals also detect non-linear growth. For example a system with exponential growth will have a pattern of negative residuals then positive residuals then negative. Residuals that are random and small indicate that a linear trend fits the data well. These models generally have high R squared statistics. If these conditions are met the linear trend model then provides a forecast that can be used in additional studies to assess whether growth will be higher or lower than the historical trend.

(ii) Eleven-Year Linear Trend

Assumptions: A linear or straight-line trend forecast assumes that the growth amount of consumers is constant and that the same number of consumers will be added each year in the future as was added in the past.

Method: A linear regression was created based on the historical number of customers for each member system using data from 1993 to 2003. The number of consumers was forecast into the future based on this past trend.

Use of forecast: eleven year trends are used like the seven-year trends. The eleven-year trend forecasts were compared with the seven-year trends to see if the forecasts are consistent. Differences indicate changing conditions over time or possibly a one-time event distorting one of the forecasts. Reasons for the differences between the seven and eleven-year trends were identified.

(iii) Woods & Poole Weighted County

Assumptions: The key assumption in this forecast is that the growth of residential consumers is related to the growth of county households. In this methodology the counties are weighted to avoid the situation where a member system serves only a few consumers in a very large county. A weighting methodology was developed to give proportionate influence to each county. This forecast methodology assumes that the member system’s share of residential consumers within each county will remain the same. It also requires that the Woods and Poole forecast be accepted.

Methodology: The percentage of the households served in each county for each member system was determined using 2003 data. The member system’s percentage was then multiplied by the Woods and Poole forecast household data for each forecast year in each county to arrive at a forecast of residential consumers. This is only a forecast of what will happen if consumers grow at the same rate as county households

Use of forecast: This is only a forecast of what will happen if consumers grow at the same rate as county households. This methodology should only be used if it is believed that the share of each county will remain constant. In most member systems, however, consumers have not been growing at the same rate as county households so GRE staff cautioned member system staff to use this only as a single data point among many for reference in determining their overall residential forecast.

(iv) Linear Relationship between Consumers and Woods & Poole Weighted County Data

Assumptions: This forecast uses county household growth as the independent variable and residential consumers as the dependent variable in an econometric model. This model uses the same weighted county values calculated from the Woods & Poole weighted model described above. If consumers have been growing faster than the constant weighted household series, a linear regression model will pick up the relationship. Naturally this assumes the relationship is linear. This forecast also requires the assumption that historical relationships will remain the same and that the Woods & Poole forecast is reasonable.

Methodology: The variable used to represent county households is the “constant weighted county” variable described in the Woods & Poole Weighted County methodology. It is the series that represents the “what if we had always served the 2003 percent of counties” scenario. The “constant weighted county” variable is the independent variable in a linear regression model with residential consumers as the dependant variable. This econometric model is calculated using annual data.
GRE maintains the data and documentation in spreadsheets.

Use of Forecast: This model has been in use for over twenty years and has received extensive review by academic, regulatory, and utility forecasters. It has stood the test of time and is generally well accepted. It has given good results.

The model's weakness is that the trends in the various counties served by a member system are aggregated into one variable. Therefore, it is difficult to distinguish the situation where a member system's share of one county is growing rapidly but the member's share of another county is decreasing. If the forecast growth of these counties differs, the forecast may not be accurate. Studying the graphs of data series of the model shows subtle changes in relationships between county household growth and consumer growth. These changes are studied to determine the reasons for the change in relationship.

Another tool used to analyze the number of residential consumers is the graph of the number of residential consumers added each year. Examining the number of residential consumers added each year reveals more about changes in the member system than do the graphs and tables dealing with the total number of residential consumers. Member system staff met with GRE staff and examined the causes of fluctuations in growth such as recessions and interest rates.

Energy Usage per Residential Consumer

GRE created three forecasts of average annual energy usage per residential consumer. The first two forecasts were seven and eleven year trends. The third forecast was an econometric model. It is discussed in further detail below. The three models were presented to the member systems by GRE as part of a review of the factors affecting the average usage per residential consumer. Strong model correlations were noted, especially the relationship between the historical price of electricity and the average usage per consumer.

The energy usage forecast is annual average usage constructed from monthly energy usage data for the relevant year. That is, we take the average monthly usage per consumer multiplied by twelve months to arrive at the total annual usage per consumer.

GRE staff met with member system staff to ensure a structured review of factors affecting residential energy usage. GRE staff reviewed factors that affect residential usage. These factors include heating and cooling degree-days, per capita income, competing fuel prices, demand-side programs, conservation programs, air conditioning saturation and historical and forecast electricity prices. GRE staff also discussed various appliance saturations and efficiencies with its members. GRE staff also discussed the models available for its members to forecast residential usage. Member system forecasters then completed a forecast, which was reviewed by their senior staff. GRE staff then reviewed each forecast in comparison with similar member systems.

Econometric Forecast of Usage per Consumer

The econometric models varied by member system but all used linear regression and were prepared using the MetrixND software. Annual data from 1974 to 2003 was used to prepare most models. The two key inputs to the econometric model are income and the price of electricity. When the data demonstrated a statistical relationship variables including real income per capita, real wholesale price lagged one year, heating degree days and cooling degree days were used in the models. All variables were included if they had the proper sign and a reasonable coefficient. This model, data, and documentation are maintained by GRE.

The income forecasts are based on the Woods & Poole forecast for each county served by the member system. The counties have been weighted to reflect the proportion of residential consumers served by the member in each county. Regional real per capita income has been increasing and the growth is projected to continue. The increasing income and its association with the number and types of amenity appliances were also discussed as well as the effect of recessions.

Energy prices doubled in the late 1970s with the sudden and sharp drop in average energy usage. Since the 1980s there has been increasing average energy usage along with a steady drop in inflation adjusted prices. The results of the electricity price analysis demonstrated that growth among member systems have allowed GRE to make greater use of its generation resources thereby reducing the cost of energy from those facilities. The price decrease was associated with an increase in average usage. The inflation adjusted price of electricity is not expected to continue its decline because it will be necessary for GRE to acquire new generation resources to meet member system energy needs in the near future which will, in turn, raise energy costs.

A number of non-modeled factors are significant and were reviewed. The model forecast assumes that these influences will not change. The price of competing fuels, for example, was not modeled. Increases in the price of propane, oil and natural gas have the potential to cause major changes in space and water heat usage. Currently the price of propane and oil is very high. Although competing fuel prices may remain high for several years we do not expect the price of propane and oil to remain at current levels indefinitely. GRE expect that the price of natural gas and propane will remain highly competitive with electricity for space heating. If this prediction is wrong, there may be an increase in electric power requirements. GRE will monitor the situation closely.

Increasing popularity of electrically heated floor tiles is another factor not modeled in the residential usage econometric models but will likely place upward pressure on residential electric usage.

Many efficient gas furnaces do not require a chimney because they can be vented through a wall. However, zoning laws require a chimney for gas water heaters. As a result, we expect to gain an increasing share of the water heating market because many home builders are installing electric water heat rather than constructing an expensive chimney for a gas water heater.

Finally, the residential time series cross section usage models and forecasts prepared by Power System Engineering for the 2002 Long-Range Load Forecast were also reviewed. They were only used for comparison purposes because they did not incorporate updated data.

B.2.1.2 Small C&I Models

As with residential consumers, each GRE member system develops forecasts for the small commercial and industrial sector by first forecasting the number of consumers in this category and then forecasting usage per consumer. The methodologies used in each step are described below.

Number of Consumers

GRE staff prepared several models for small C&I customers for each member system. These models and data, and their relative contributions to the forecast, are described below.

Seven-Year and Eleven-Year Regression Analysis

As with the residential class, GRE created a linear regression based on the historical number of customers for each member system using data from 1997 to 2003 and 1992 to 2003. This was used to assist in the analysis.

Residential-Consumer Based Econometric Model

GRE staff prepared an econometric model relating small commercial consumer growth to residential consumer growth. For many member systems there is a good relationship between the number of residential consumers and the number of small commercial consumers. As the residential population expands, small commercial businesses develop to serve the population. Member system staff studied the historical relationship between these forecast categories to determine whether it provided an appropriate model for their system.

Energy Usage per Consumer

GRE staff prepared three forecasts of the average annual energy usage per small commercial consumer for each member system: a seven year linear trend, an eleven year linear trend, and an econometric model forecast. The seven and eleven year trend forecasts were used as information as described previously.

Most of the econometric models calculate the effects of the expected changes in income, the price of electricity, and winter and summer weather. This standard model was used if all variables had the predicted sign. The small commercial models prepared by GRE use data from 1983 to 2003 because many of the member systems had a sharp change in 1983 due to a RUS change in the definition of small commercial members. Many of the econometric models for the member systems also included an “indicator variable” to account for historical shifts in data. These shifts are often caused by reclassifications of members.

In some member systems other factors changed energy usage such that quantification of the effects of the above variables was not possible. GRE worked with the member system to identify any relevant factors. For example, the Mystic Lake Casino is located within the service territory of Minnesota Valley Electric Cooperative. While the casino was being developed, the Mystic Lake Casino load was included in the small commercial category. The casino load caused several years of strong growth in the average energy usage among Minnesota Valley Electric Cooperative’s small commercial class. Over time the casino’s load increased to the point that it was classified as a large commercial member. Once the casino was reclassified as a large commercial member, the average usage of small commercial members declined sharply. To provide an accurate measure of average energy usage per small commercial member the Minnesota Valley model was calculated by excluding those years in which Mystic Lake Casino was classified as a small commercial member.

B.2.1.3 Large C&I Models

Each GRE member system forecasts the number of consumers and the average energy usage of large commercial consumers based on existing individual consumers' operations and plans. The addition of a new consumer or large-scale upgrades to existing operations often require additional construction or an upgrade of electric distribution facilities to meet capacity requirements. Therefore, member systems are usually notified well in advance of any plans for new construction and short-term forecasting of this consumer category tends to be quite accurate.

B.2.1.4 Other Forecasting Category Models

The remaining categories of GRE's forecast are: seasonal, irrigation, public street and highway, lighting, public authorities, and sales for resale. Together, these five categories represent 5.5 percent of GRE's 2003 energy sales. GRE uses historical trends to forecast the energy requirements of these categories. If appropriate, member knowledge of factors that would impact number of customers, usage, and load factor are incorporated into the forecast.

B.3 Schedule for Development of 2004 Long Range Load Forecast

Figure B-7 illustrates the timeline that was used for the development of the 2004 load forecast.

Figure B-7 Development of the 2004 Load Forecast

GRE’s Forecast Development	
Month	**Forecasting Task**
2004	
March	▪ GRE collects member system data ▪ GRE begins member system spreadsheet models ▪ GRE begins database update
April	▪ Begin residential models
May	▪ Residential models
June	▪ Member systems review residential consumer models ▪ Residential consumer forecast meeting
July	▪ Review small commercial consumer models
August	▪ Review remaining sector models
September	▪ Start member system demand forecast models
October	▪ Review demand forecasts ▪ Incorporate load management adjustments
December	▪ Review completed forecasts ▪ Communicate draft results to managers
2005	
	GRE prepares member system and GRE long-range load forecast reports for member system boards and RUS
2006	▪
	Prepare member system 2006 long-range load forecast

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APPENDIX C MEMBER COOPERATIVE FORECAST SUMMARY

C.1 Member Cooperative Forecasting Methodology

GRE creates a number of forecasts for member cooperatives related to the number of customers and the usage per customer. The forecasts incorporate past data and, in the case of residential customers, county-level demographic forecasts. The forecasts assist the member cooperatives when developing their forecasts. The member may conclude that a forecast created by GRE is a reasonable expectation of the future and choose to incorporate that as their forecast. Alternatively, the member may conclude that the forecast is biased by past customer reclassifications or fails to incorporate known development. In such cases the member develops their own forecast.

This section demonstrates how each member cooperative arrived at their forecast of number of customers and energy usage per customer for all customer classes served. For each forecast of each customer class, an “X” highlights whether the forecast is a GRE-developed forecast or the “cooperative forecast.” Comments are provided in those cases where the member used their own forecast to explain why the member cooperative has not used a GRE forecast. The explanations for selection of forecasts are documented in the member’s 2004 Long Range Load Forecast reports.

All member-specific information is considered to be trade secret. Therefore, the attached report is not available in the public version of this document.

[TRADE SECRET INFORMATION BEGINS
TRADE SECRET INFORMATION ENDS]

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APPENDIX D DOC ANNUAL REPORT

Attached is the forecasting and reporting information required in Minnesota Rules 7610, otherwise known as the Department of Commerce annual report (DOC report). The DOC report has been submitted, in entirety, to the Department of Commerce. Due its length, some of the portions have not been included in this resource plan, but are available upon request.

GRE notes that not all data contained in the DOC report will match precisely to the data in the resource plan. This is because of differences in the purposes of the two documents. The resource plan covers the load for which GRE has an obligation to serve. The DOC report contains information covering the complete service territories of GRE's 28 member cooperatives.

The Trade Secret portions of the DOC report are not included in public version of this resource plan filing.