CITIZENS LEAGUE

708 South Third Street, Suite 500
Minneapolis, MN 55415
Telephone: (612) 338-0791
Facsimile: (612) 337-5919
Email: info@citizensleague.net
www.citizensleague.net

Powering Up Minnesota's Energy Future:

Act Now on a Long-Term Vision

Report of the Citizens League Study Committee on
Electricity Reliability for Minnesota

December, 2002

Charge to the Electric Energy Study Committee

On March 20, 2001 the Citizens League Board of Directors provided the following charge to the study committee on electric energy in Minnesota: *With the marketplace for energy increasingly crossing state and national borders, what is the state's role in terms of supply, conservation, and market restructuring? What policies should Minnesota adopt in those areas where there is a significant state role? In preparing for Minnesota's future energy needs, how should we balance affordability, reliability and environmental soundness?*

Executive Summary

Minnesota is facing an electricity crisis. But the crisis will not be a short term supply and pricing crisis such as that experienced in California, which was caused by several major public policy errors. Unlike California, the prospective crisis that Minnesota could face will come from failing to act on long term issues, which include the need for new policy frameworks, regulatory integration, planning mechanisms, and economic stimuli to encourage appropriate infrastructure development that assures a reliable, affordable electricity supply while protecting the State's environment. Failing to prepare for federal changes in regulatory laws, especially those aimed toward improving the environment, could put Minnesota at risk for unexpected costs associated with the implementation of those changes. Failing to face up to the new realities of an ever more regionalized electric system, where Minnesota's statutes may be negated by regional and federal regulations, poses an additional risk. In order to avert this crisis, Minnesota's policy leaders, business leaders and electric consumers must act soon to adapt to the new realities, reframe the goals of state electricity policy to recognize both the challenges and practical opportunities, and initiate a plan of action to achieve those goals.

A highly reliable electric supply needs to remain one of the State's top goals. Reliability of the electric supply is clearly a touchstone for the state's economic infrastructure. All of the state's businesses, whether commercial or industrial, need highly reliable electricity for healthy business operations.

However, from both an economic and public health perspective, there are other important goals that must be more prominently reflected in State policy than they are at present. Electric production is not without costs beyond those of plant, equipment and operations. Burning fossil fuels to produce electricity is responsible for a large portion of the emission of several of the most dangerous air pollutants, including CO_2, SO_2, NO_x and fine particulates. These pollutants give rise to a range of adverse affects from environmental problems such as smog and crop damage to health problems such as increased levels of asthma and, as some recent studies have shown, increased susceptibility to some kinds of cancers. Although newer fossil fuel burning plants, which are subject to the Clean Air Act, emit lower levels of pollutants, several Minnesota power plants that were "grandfathered" in under the Act continue to pollute at higher levels than are authorized by newer regulations. Ever more cost competitive new technologies are emerging that reduce or eliminate pollution. For example, wind generation, which emits no pollutants and is readily available in Minnesota, is currently competitive in direct cost with the traditional low-cost generation sources such as coal and natural gas and, considering other

social costs, is probably less expensive.

Concerns are often raised that a greater emphasis on environmental protection will raise the price of electricity in Minnesota, which has traditionally been quite low compared with surrounding states. But the low price of electricity does not reflect the full cost of electricity, which may actually be increased by keeping the price artificially low. The state's current approach to determining cost does not include the social costs associated with remediating the health and environmental problems caused by the generation and transmission of electricity, which the citizens of Minnesota must pay for in other ways. Moreover, as the electricity system becomes more regionalized, it is likely that Minnesota's electricity pricing will have to rise to levels more comparable to the surrounding region, offering more latitude for technical innovation that would serve both the goals of reliability and environmental and health protection.

Generation of electricity is only part of the electric energy supply system. In the study committee's view, one of the greatest barriers currently to improving both reliability and environmental protection for Minnesota is the current transmission system. Wind energy has incredible potential for the state yet there is limited ability to transmit this electricity to areas of greatest consumption since the transmission infrastructure is insufficient in areas where wind potential is the greatest. Furthermore, there is very little incentive for utilities to invest in the development of more transmission capacity under current arrangements. It is expensive to build the infrastructure, it is difficult to get projects approved and sited, and it is easier to try to develop generation closer to already existing transmission facilities. However, developing generation facilities close to already existing transmission infrastructure in large part rules out taking full advantage of many of new technologies, such as efficient and cost competitive wind turbines.

The study committee came to the following conclusions:

- Despite some modest steps, neither the State of Minnesota nor the electric power industry has been sufficiently aggressive in moving toward an electricity supply system that provides an adequate and reliable supply of electric power without cumulative and unacceptable damage to the local and global environment and social impacts.

- The strong focus on keeping electrical energy prices as low as possible has deemphasized consideration of environmental concerns. This needs to be rebalanced, consistent with a reliable supply in the future.

- The State's regulatory system as currently configured is not well suited to deal with the environmental challenges and market restructuring discussed above.

- The very notion of State regulation ignores the reality that the electrical power system is increasingly a multi-state regional one.

- The State has not been a leader in the development and implementation of new technologies or new practices that could improve the efficiency of electricity generation, conserve the use of electricity, or minimize the environmental damage associated with it.

- The study committee believes there is an urgent need to act now to secure our energy future.

In order to help alleviate the current problems and decrease the likelihood that Minnesota will face an electricity crisis in the future, the committee recommends:

- **The state implement a carbon emission permit system.** Companies selling electrical energy on the retail market should be operating under a carbon emission permit system. The system should be designed to limit the aggregate release of carbon dioxide from fossil fuels in the primary production of electricity. Allowable emission levels should be set to deal meaningfully with the global warming problem with the assumption that each region will bear a "fair share" responsibility for achieving national goals for reduced CO_2 emissions from non-renewable resources.

- **The state also implement permits for other pollutants.** Emissions of other pollutants, including SO_2, NO_x, volatile organic compounds, mercury compounds, and particulates, should be regulated under a permit system that establishes allowable emission levels based upon considerations of public health and the cost of environmental remediation, as well as the cost of reducing emissions.

- **The development of efficiency benchmarks.** Minnesota's integrated electrical energy system from primary energy sources to final use should be at least as efficient as that presently projected by the federal Department of Energy laboratories as achievable with presently proven technologies.

- **Minnesota needs a flexible transmission system.** The transmission and distribution systems serving Minnesota should have the capacity and the flexibility to allow the state to take maximum advantage of renewable resources such as wind, solar, and biomass energy, distributed energy capabilities, and co-generation installations.

In order to avoid the looming electricity crisis, Minnesota should act quickly to adopt the necessary safeguards and incentives to allow for continued and increased reliability and environmental protection, while working to maintain a reasonable cost structure. The state also needs to monitor the changing environment of the region and the federal structure so that policies can be updated slowly by state mandates rather than thrust upon the state through federal requirements.

Minnesota could face a crisis in electric energy but with proper planning and continued observation, we can avoid it and assure a reliable electricity supply with an improved balance of reliability, environmental impacts and cost.

Powering Up Minnesota's Energy Future: Acting Now on a 2040 Vision

Table of Contents

Cover photo provided by the Minnesota Department of Commerce

I. Introduction

Minnesota's economy and quality of life are critically dependent on reliable, reasonably-priced electric power. Since the 1930s, Minnesota has relied on state-regulated investor-owned utilities, municipalities and cooperatives operating within designated service areas to provide electric power to our homes and businesses. Although this electric power system has served us well, state energy policies must now address several profound political, environmental and technical changes and challenges affecting a number of aspects of the power system.

- ***Technical Advances in Electric Transmission Capabilities.*** Technical advances are increasing the practical range over which the electrical power grid can be economically networked and stably controlled, so that individual states are more and more limited in their ability to regulate their electrical power systems independent of the other states in their region.

- ***Federal Regulations Restructuring the Electric Power Industry.*** Added to this technical change, action over the past several years by Congress and the Federal Energy Regulatory Commission (FERC) makes it all but certain that the traditional vertical integration structure in which regulated utilities are each responsible for their own power generation, transmission and distribution (the "natural" monopoly model) will give way to restructured, less regulated electric power markets. The California electricity crisis in 2000-2001 has done little to slow the momentum; on July 31, 2002, FERC announced its Standard Market Design, which calls for the establishment of FERC-regulated Independent Transmission Providers, organized on a *regional* basis to direct both transmission planning and long-term resource planning. In this new regulatory regime, states will not operate as autonomously as in the past and Minnesota will need to find effective ways to participate in the regional and national organizations and government agencies that will shape our energy policies.

- ***Environmental Threats.*** Scientific evidence, international commitments, and national and local social and political pressures are leading inexorably to a tighter coupling of electricity production and its environmental consequences—and are likely to require in the future a much more comprehensive cost/benefit analysis that will take into account all of the societal costs associated with electric power generation and use. Electric utilities, especially older coal-fired plants, account for 58 percent of the State's sulfur emissions, 62 percent of lead emissions, and 26 percent of greenhouse gas emissions.

- ***Practical Alternative Electricity Production Technologies.*** There are a number of new, proven and practical technologies currently available at a relatively modest price to produce and distribute electricity economically and with less environmental damage, and to improve the efficiency with which electricity is used. Despite their availability, these technologies are seriously underutilized.

- ***Innovations by Electricity Users.*** Users, particularly industrial users, are themselves developing new approaches to reducing electrical energy use, stimulated by the cost-saving potential and the

need to meet increasingly rigorous environmental standards.

In the face of these major changes, a number of states are moving aggressively to anticipate the consequences of the new environment and to take advantage of the opportunities it creates. California, Michigan, New Hampshire, Ohio, Oregon and Texas, to name just a few, are implementing tighter regulatory linkages between energy and the environment, forcing shifts away from fossil fuels, and funding research, development, and education programs to position themselves as national leaders in the energy field in the next decades. Furthermore, they are using these efforts to attract companies that are likely to be strongly affected by these historic changes or companies that see market opportunities in the new environment. These forward-looking states are offering partnerships to help companies cope with the new pressures, as well as incentives to attract a critical mass of new energy technology firms, thus establishing themselves as major centers for new energy industries.

Despite the inevitability of these economic, social, political, and technical changes, and in contrast with a number of other states, Minnesota has done very little to prepare for its energy future. Planning by power providers and State government regulators has focused primarily on meeting business-as-usual electricity demand while minimizing any increase in the energy pricing structure. Even the future of the State's nuclear power stations was put on the back burner in 2002, an election year. The State has made no significant changes in its regulatory structure to respond to the regionalization of power markets, the major increase in power producers who are not investor-owned utilities, or the obvious need to couple electricity production and environmental protection. The Legislature has thus far been unwilling to establish enforceable goals and benchmarks for a more diverse mix of primary fuel sources. And the State is simply not a serious player or partner in any program of research, development, or pilot demonstration associated with the new technologies for electricity production and use.

Through our inaction, we are setting ourselves up to be overtaken by events. As a state, we take pride in our technological prowess and our highly educated workforce, but we are losing the opportunity to be in the forefront of the development and use of important new technologies. We are intent on maintaining our relatively low electrical energy prices, but we appear indifferent to the restructuring and regionalization of electric power markets which will limit our ability to control price fluctuations and ensure reliable supplies. At the same time, we are forfeiting our position as a leader in environmental protection, as we rely on federal environmental laws to protect our air quality.

Last year, the Citizens League organized the Electric Energy Committee. The Electric Energy Committee, drawing heavily on published reports and on testimony from experts representing the many stakeholders associated with the electrical power industry, has concluded there is an urgent need for the State to break out of its present incremental, short-term approach to electrical energy policy. The Committee believes the State can adopt practical strategies to deal with technological, regulatory and market structure changes. If we act now, Minnesota can stay ahead of the curve and join those states who will lead the nation in building an affordable, reliable and environmentally sound energy future, easing its own transition, while creating new opportunities for economic development.

The Committee believes the State

needs to adopt a comprehensive, ambitious but practical electrical energy policy with goals *and strategies* focused on meeting future electrical demand a resource supply and technology mix that is flexible, reliable and affordable, and consistent preserving our natural environment and protecting public health. To meet this criteria, the Committee recommends the State adopt a long-term energy policy based on the following principles:

- *Set Production Goals for 2040.* Energy facilities are often capital intensive and require a long working life to deliver a reasonable rate or return. To plan for significant changes in the technologies used to generate and distribute electricity, a time frame must be chosen that reflects the rate of replacement of installed equipment. Based on past experience, we can expect that over a period of about 40 years, the present electric power supply system will be completely replaced. Therefore, the Energy Committee recommends that the State set energy production goals for the year 2040 because such goals would not be constrained by the present infrastructure.

- *Begin Working Now to Meet Our 2040 Goals.* The other side of the coin is that, precisely because the time frame for change is so long, it is imperative that decisions and actions be taken immediately to put us on the path to meeting the goals we set for 2040. A power generating plant installed today will still be in service in 2040. In the next ten years, generating capacity representing about 25 percent of Minnesota's power supply will be installed, either to replace old capacity or to add new capacity. Clearly, our success or failure in 2040 will be largely determined by what we do in the next decade.

- *Rely on Proven Technologies.* Because so much rests on what we do in the next ten years, practicality dictates that we should make our plans based on proven technologies. We should look to technologies already tested in at least full-scale demonstration projects.

The energy future envisioned by the Electric Energy Committee is fundamentally the same one expressed in the goals underlying the energy laws and policies enacted in Minnesota over the past 25 years:

- Increased efficiency in energy consumption;

- Development and use of renewable electrical energy sources whenever possible;

- Energy efficient buildings;

- Increased reliance on distributed generation[1]; and

- Greater attention to environmental protection.

In spite of these goals, the state's dependence on burning fossil fuels as a percentage of our fuel mix has remained roughly the same over the past decade. In fact, our dependence on coal has increased. Our use of electricity has continued to increase, and the energy intensity of our state economy (i.e., the amount of energy necessary per dollar of state product) has decreased only slightly over the past 15 years.

[1]See Appendix A for the definition of distributed generation as well as other technical terms associated with the electrical energy supply system.

The Committee believes new policies are needed to accelerate the transition to a more viable and environmentally sound energy mix. In the Committee's view, past energy policies have failed for various reasons::

- There are no clear, quantitative objectives with respect to either efficiency of energy production or use, or measurable environmental effects. Thus, there are no metrics to judge success or failure or to establish benchmarks for progress;

- The lack of leadership at the highest levels of state government and the division of responsibilities among government agencies has seriously hampered the development of an integrated approach to energy supply and environmental protection;

- Traditional organizational approaches to generation, transmission, and distribution activities have not established the appropriate incentives for the development and adoption of new technologies; and

- The focus of governmental programs on entities that generate and distribute electrical energy has limited support for the development of public-private partnerships as an alternative means to produce and conserve electric power.

In the remainder of this report, we explore a number of these issues, analyzing Minnesota's current electric power system and offering the Committee's recommendations regarding the State's future electrical energy needs.

II. Minnesota's Electric Power System[2]

For the purpose of this report, the Minnesota electric power system is taken to comprise the generation, transmission, distribution, and use of electrical energy, and the organizations, institutions, and groups that produce, sell, regulate, and buy that electricity (see Appendix A and Box 1 for some important definitions and distinctions). To understand the present state of the system and its likely changes in the next decade, it is useful to consider several different ways of describing or characterizing the system.

- First, there are the technical data—how much electrical energy does the State generate; what are the primary energy sources for that electricity; where is the energy produced; what trends can be observed in the recent past, and what is likely in the near future?

- Second, how is the system structured: what kinds of organizations are involved

Box 1

Power and Energy

Power and energy are closely related, but have different concepts, similar to the distinction between speed and total distance traveled. Power refers to the *rate* at which energy is delivered, that is, the amount of energy delivered in a given time, say, per hour. It is measured in watts (or kilowatts—1,000s of watts—or megawatts—millions of watts). The total amount of energy delivered over some period of time would be equal to the rate at which it is delivered (the power) multiplied by the time over which it is delivered. Energy is therefore measured in watt-hours—or kilowatt-hours or megawatt-hours.

In determining the electrical energy needs of the State, both concepts come into play. Since there are no practical ways of storing large amounts of energy, there must be generating capacity to deliver energy at the highest *rate* at which it may be needed when users put maximum demand on the system—so-called peak power demand (in fact, State regulations require that installed capacity exceed peak power demand by at least 15%). However, most of the time, total demand will be less than peak demand, so that not all generating units will operate at their maximum power level at all times. Some, in fact, may be used very little, brought on line only during periods of peak demand.

That distinction gives rise to the notion of two kinds of power plants: base load plants and peaking plants. The former are plants that are expected to operate at close to their maximum power for as much of the year as possible and, in total, will generate a level of power below which demand is unlikely to go. Thus, the important criteria for these plants are that they be extremely reliable, capable of almost continuous operation, and able to generate electrical energy at a relatively low price.

Continued on Page 6

[2]Much of the information in this section is drawn from the recent and very comprehensive report issued by the Minnesota Department of Commerce, titled Minnesota Energy Planning Report 2001.

Box 1 continued

Peaking plants, on the other hand, are used only intermittently, to respond to changing power needs. Generally, the design criteria for these plants are that they be capable of rapid startup and shutdown, and that they provide for small incremental adjustments in power level (either because they are, individually, small capacity plants or because their generating capacity is easily and rapidly adjusted). The cost of the electricity they provide is a secondary consideration.

Between base load and peaking plants are a group known as intermediate plants, used more often than peaking plants, but not as continuously as base load plants. Generally, these plants are brought on line when base load plants are shut down for maintenance or when system demand exceeds base load for some period of time. Their design characteristics are also intermediate between those of base and peaking plants.

On cost: generally, this is determined not by the power level, that is the *rate* of supply of energy, but by the total amount of energy produced or used. Since base load plants are on line most of the time, and peak load plants only intermittently, the average cost of electrical energy will be more heavily weighted by the cost of producing base load electricity than peak load electricity, which is why cost is of greater concern in base load plants.

A new kind of plant that fits neither base load nor peak load description, but is of growing importance, is one which is intermittent in its energy production, but whose intermittency may not necessarily match peak load needs. Wind and solar power plants are of this kind. They are attractive because they do not use fossil fuels or generate significant pollution, but they operate only when their source of energy—wind or sunlight—is available. A challenge to the electric power system is to find effective ways of coordinating the output of these plants with base and peak load plants to take maximum advantage of their (varying) capacity while meeting electricity demands which may be fluctuating in an unrelated way.

in generation, transmission, and distribution of electricity and what interests do they bring to the table?

- Third, what is the pattern of electricity usage in the State; that is, how is usage divided by sectors and what are the trends in each of these sectors? Fourth, what governmental structures and policies are in place that can or do affect any or all aspects of this system? Each of these is considered in turn in the following sections.

Minnesota Electrical Energy Generation and Use

Minnesota's energy providers have approximately 12,000 megawatts (MW) of electrical power generation capacity, with primary energy sources, or fuels, divided as shown in **Figure 1**. It is clear that coal and nuclear power dominate the picture, comprising more than 80 percent of the installed capacity.

The total amount of energy actually consumed in Minnesota in 2000 was

Figure 1: Minnesota Installed Generation Capacity

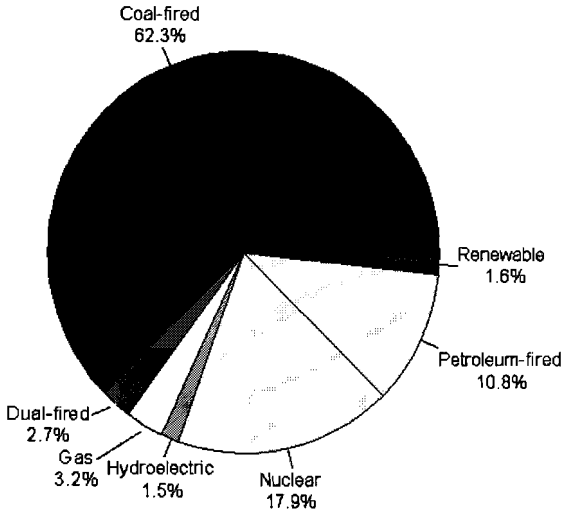
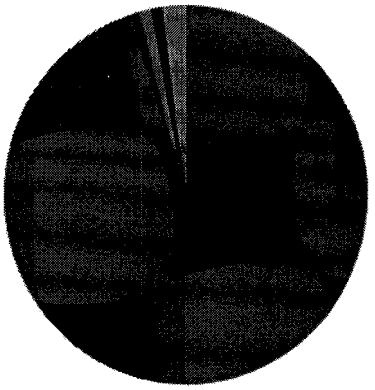
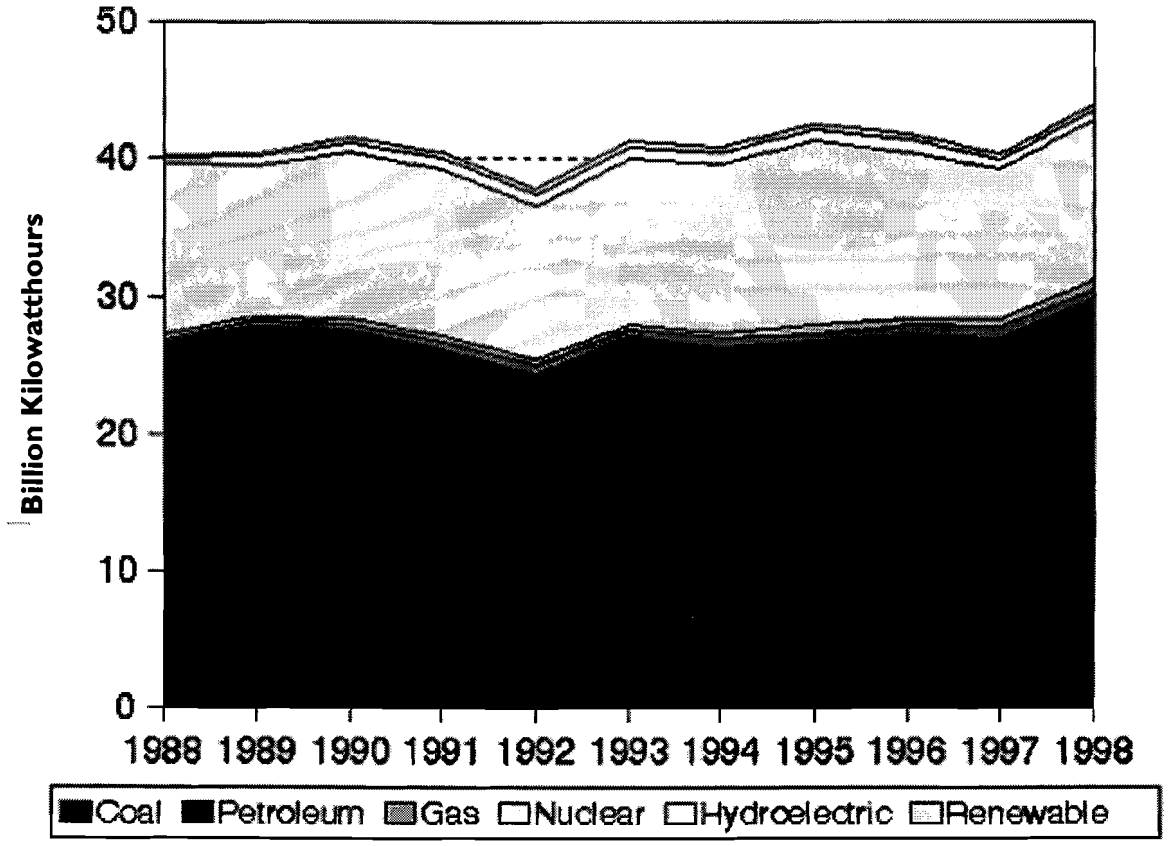


Figure 2: Fuels Used to Generate Electricity in Minnesota—2000 Source: REIS



Coal	75%	Nuclear	17%
Hydro	3%	RDF	1%
Natural Gas	1%	Wood	1%
Wind/Solar	1%	Cogeneration	1%

Figure 3: Fuel Sources Used for Electricity Generation



approximately 63,000,000 megawatt hours (MWh) and, as **Figure 2** shows, because coal is the primary base plant fuel, coal plus nuclear were even more dominant in actual energy generation, accounting for over 90 percent of electrical energy. With the exception of hydro power, no other primary energy source, including natural gas, exceeded one percent in its contribution.

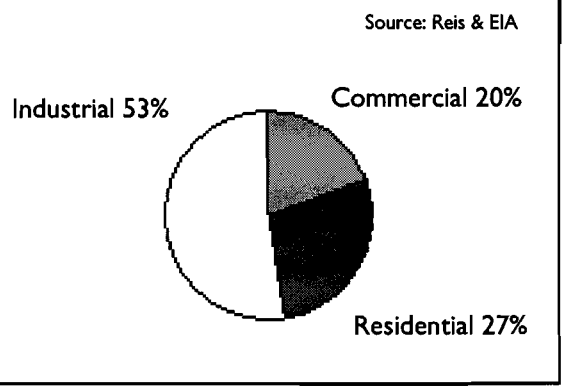
It is interesting to note, as shown in **Figure 3**, that this distribution among fuel sources has held fairly constant for over a decade. If there has indeed been any trend, it has been toward a slightly increasing dependence on coal. Thus, it seems fair to conclude that, despite recent pressures to decrease dependence on fuels that emit the most carbon dioxide per unit of energy produced, either by switching from coal to natural gas or to non-fossil fuels, little progress has been made when judged in the light of total electrical energy generation.[3]

Figure 4 depicts how electrical energy is used in Minnesota. Over half is directed to the industrial sector and about a quarter to residential use. As **Figure 5** shows, industrial use has tripled in 30 years and residential use has doubled in that same time period. Data are not easily available for the growth in the economy and in population over that entire period. However, based on the data available from about 1986 to the present, it appears that the electrical energy intensity of our economy, that is, the amount of electrical energy used per dollar of state product has decreased slightly during that time (about 7% over a 14 year period). Residential use per person, on the other has been increasing—about 38% since 1980.

Figure 5 also shows that the total energy use in Minnesota has increased more or less linearly for several decades. Indeed, **Figure 6**, which projects energy use in the next decade, suggests that the trend will continue with average annual growth in demand of about 2 percent, or about 1,200,000 MWh per year. Taken together, it would appear that programs to improve the efficiency of energy use, while not insignificant, have thus far not been of a magnitude large enough to have markedly affected these historical trends or future predictions.

This is borne out by an examination of the data on electrical energy savings for investor-owned utilities (IOU) over the past nine years (see **Table 1**). Total energy savings during that time for all conservation projects amounted to about 0.36 million MWh per year, which is approximately one percent of total energy use by IOU customers per year. The Department of Commerce predicts that energy savings as a result of conservation programs in the next ten years will actually be no more than half this rate, or about 3 million MWh over the

Figure 4: Electricity Usage in Minnesota



[3]The emission of CO_2 is neither considered nor controlled under Pollution Control Agency regulations since carbon dioxide is not considered a "pollutant" despite its role in climate change. The recent commitment by Xcel Energy to covert three of the Twin Cities plants from coal to gas fired is very welcome because the conversion will reduce the SO_2 and NO_x emissions and the release of organic compounds. However, the conversion is unlikely to have a significant effect on CO_2.

decade, and then only if municipal and cooperative utilities ramp up their conservation programs as required by 2001 energy legislation.

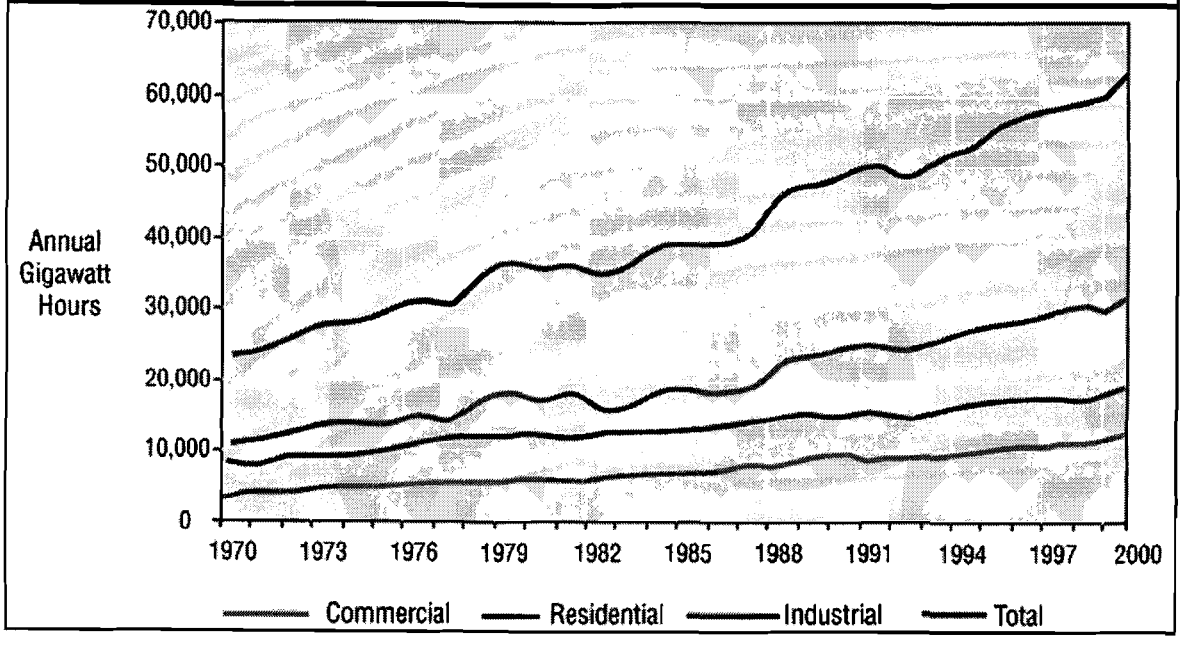
Although it is not simple to extrapolate directly from these data, the Minnesota Department of Commerce has used these and other numbers to project that Minnesota's power generation capacity will fall short of needs in 2010 by slightly more than 2,000 MW (see **Figure 7**), or about 15 percent. This does not take into account the possible need to replace nuclear power since the continued operation of the nuclear plants at Prairie Island is subject to review in 2013. Planning is under way at all utilities to deal with this projected shortfall and it appears feasible to build sufficient additional capacity to avoid any critical electrical energy shortages based on generating capacity.

The larger question, in the view of the Energy Committee, is whether building increased capacity is the proper way to avoid future shortages or whether the better approach to dealing both with a reliable electrical energy supply and environmental goals would be further improvements in efficiency of energy production, use and conservation. In most reports and discussions of the effectiveness of energy efficiency and conservation programs, the emphasis has been placed

Table 1: Investor-Owned Electric Utilities Historical CIP Savings

	Energy Savings (MWh)	Demand Savings (kW)	Average Cost per kW Saved
1992	200,393	110,223	$258
1993	344,107	180,120	$240
1994	464,610	166,500	$314
1995	495,552	150,033	$458
1996	377,209	145,315	$396
1997	487,149	150,015	$280
1998	299,418	122,649	$383
1999	214,161	94,047	$437
2000	302,906	129,364	$317
TOTAL	**3,185,505**	**1,248,266**	

Figure 5: Electricity Consumption for Minnesota, 1970-2000 Source: MN Dept. of Commerce



on the magnitude of the savings in absolute terms or the extent to which the need to build additional power plants has been avoided. Clearly, this is important, but there are other metrics that may be more telling. It is reasonable to ask, for example, how

Figure 6: Minnesota Electric Energy Usage Trend Line, 1965-2009

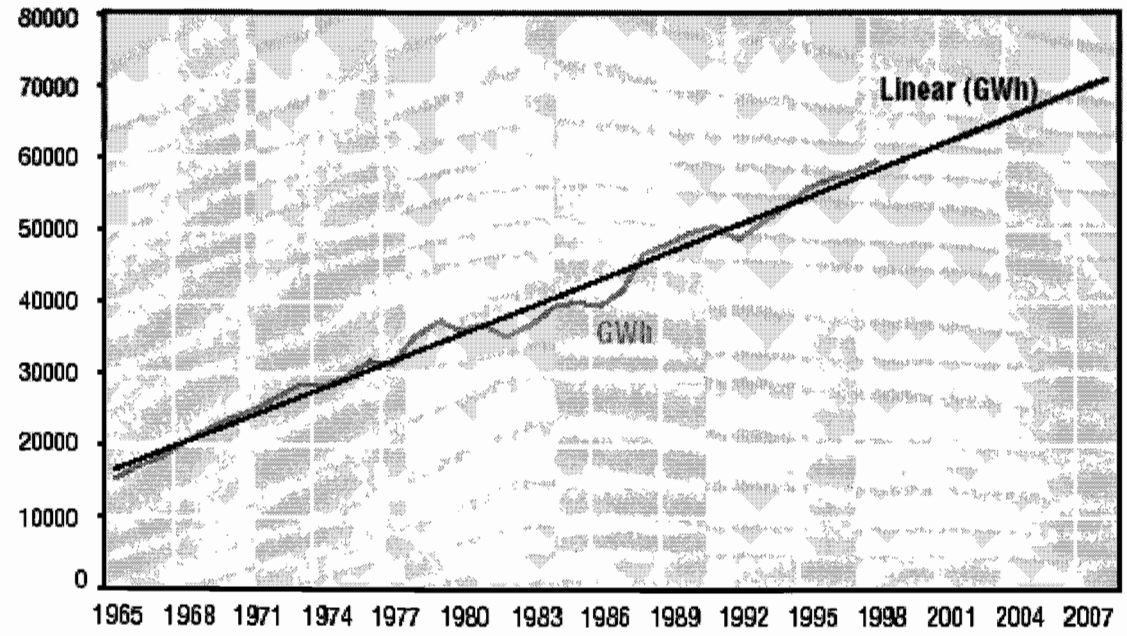
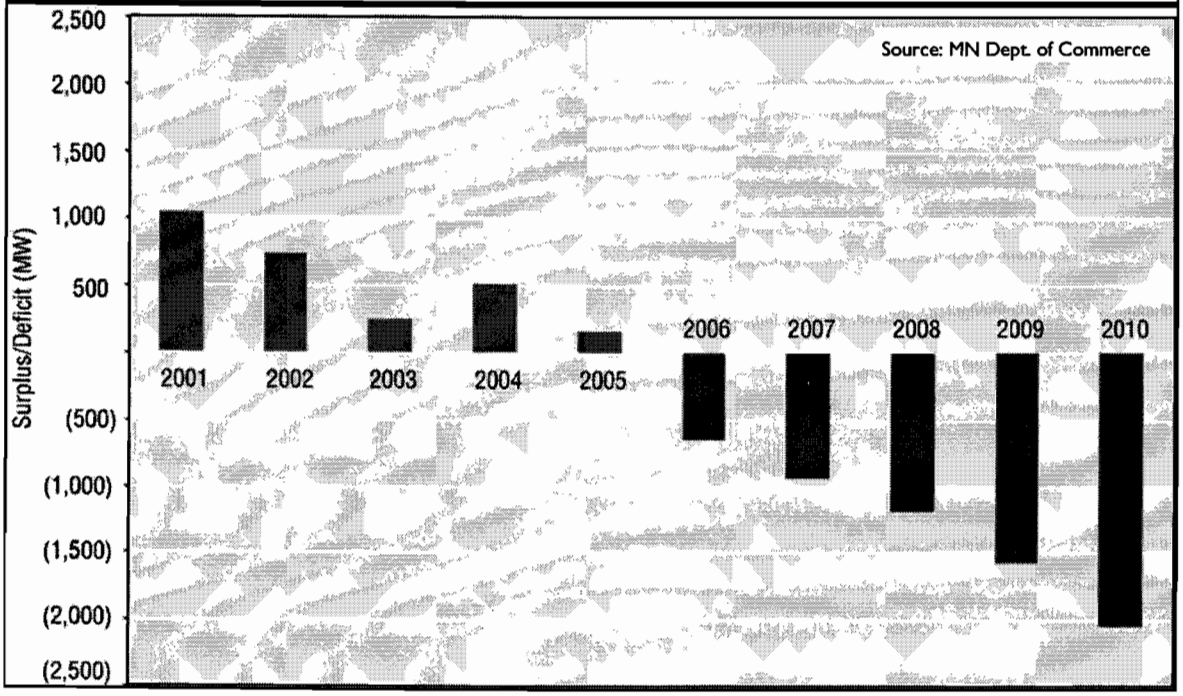


Figure 7: Major Minnesota Utility Electric Capacity Deficit 2001-2010



these savings compare with what should be achievable with current technologies. Alternatively, or additionally, it is useful to compare these efficiency improvements and conservation measures[4] with estimates of changes necessary to achieve societal goals such as the avoidance of further global warming or other environmental degradation.

For example, the Kyoto Accords would have required the U.S. to reduce carbon emissions by 2010 to a level seven percent below 1990 emissions. To achieve that goal would require that carbon emissions be reduced by approximately 30 percent from the levels presently projected for that year. It is not possible to make a direct connection between carbon emissions and electric energy use, but *if* the electric energy sector was made responsible for a proportionate share of the reduction, and *if* the primary fuel mix did not change substantially in the next decade, we would need to see efficiency improvements and conservation measures amounting to about three percent per year, which is about six times greater than that currently projected.

We do not suggest that the Kyoto Accords should or will be adopted in their present form and we recognize the very rough nature of this analysis. However, with the strengthening scientific consensus that global warming is occurring as a result of human activity, as evidenced by reports issued recently by the Intergovernmental Panel on Climate Change and the National Academy of Sciences, a consensus now recognized and accepted by the Bush Administration, the analysis is useful in establishing the approximate magnitude of the problem and in suggesting that current plans are not sufficiently aggressive to meet long term goals, even allowing for some adjustment of those goals. Indeed, even if the State set the much more modest goal of merely avoiding an increase in electrical energy consumption, efficiency measures would have to be about four times greater than presently planned.

Are such savings achievable in any practical way? In answering that question, we can introduce alternative metrics of how well the State has been doing in limiting electrical energy use and what reasonable expectations might be for the future: namely, what have other institutions been able to achieve and what do technical reports indicate is achievable with demonstrated technologies? With respect to the first of these two metrics, data from large private corporations such as 3M indicates that they have been able to achieve energy efficiencies of the order of five percent to 10 percent per year over several years.[5] These are numbers far in excess of those presently projected for the State as a whole.

The suggestion that such large savings are practical and sustainable is reinforced by an important report issued in November 2000 by the U.S. Department of Energy.[6] This report concluded that if the U.S., by 2005, implemented a carbon emission control regime with tradeable carbon allowances priced at about $50 a ton of carbon, and increased research and development expenditures by $2.8 billion annually (half federal funding from the carbon allowance in-

[4]Improvement in efficiency refers to technology changes that reduce the amount of electricity required to produce a desired service or product. Conservation measures refer to changes in behavior or practice that result in electrical energy savings.

[5]These figures were presented to the Energy Committee by representatives from 3M on February 11, 2002.

[6]Interlaboratory Working Group. 2000. Scenarios for a Clean Energy Future (Oak Ridge, TN; Oak Ridge National Laboratory and Berkeley, CA; Lawrence Berkeley National Laboratory), ORNL/CON-476 and LBNL-44029, November.

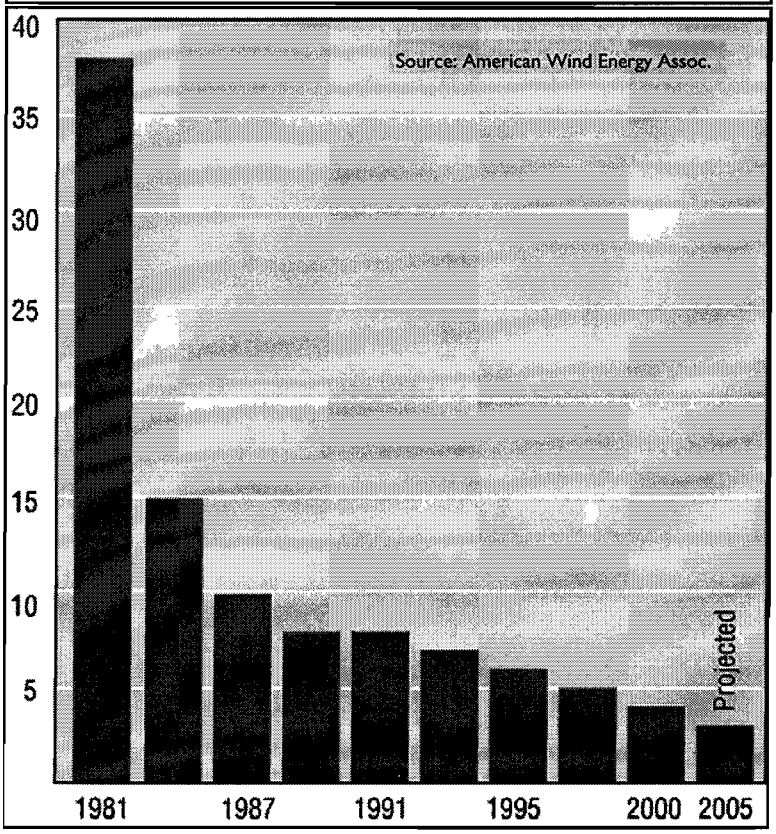
come), primary energy use in the U.S. could actually be reduced by 10-11 percent by 2010. This could be achieved by improvements in the efficiency of electricity generation, as well as building, industry and transportation (the latter not directly considered in this report) efficiencies and conservation measures. In their report, only currently available technologies were considered. If this level of savings carried over to Minnesota, it would represent a 30 percent reduction in the presently projected level of energy use in 2010; that is, about a three percent improvement per year, which, as noted earlier, is six times greater than that presently projected. The increase in the retail price of electricity associated with this program would be about eight percent.

Thus, a number of metrics suggest that more ambitious goals for energy efficiency and conservation are necessary and feasible. Moreover, the use of those metrics would lead to a more realistic assessment of progress toward long term goals and a better basis for setting benchmark targets for intermediate years such as 2010 (the time frame used by utilities and the Minnesota Department of Commerce) and 2020 (a time frame during which substantial changes in Minnesota's electric power system can be anticipated and planned for).

Although the emphasis in this discussion has been on measures that decrease the use of electric power, reducing the emissions of carbon dioxide as well as the various pollutants identified as harmful to the environment and human health, can also be achieved by changing the mix of primary fuels used to generate electricity. As pointed out earlier (see **Figure 3**), that mix has changed very little in the past decade, despite the rapid development of wind, solar, and biomass technologies, as well as the availability of natural gas as a more environmentally benign alternative to coal. Clearly, improved coal technologies have reduced the emissions of local and regional pollutants (although not reducing carbon dioxide emissions), but much greater gains seem achievable with alternative energy sources.

Many commentators have pointed particularly to wind power as an attractive alternative because of its plentiful availability in Minnesota and the technological improvements that have led to a marked reduction in

Figure 8: Cost of Wind Power (cents/kWh) 1981-2005



its cost over the past decade or so (see **Figure 8**)[7]. Distributed solar power has also become increasingly attractive as has biomass energy production, particularly in some co-generation applications. Finally, there has been a rapid development of practical hydrogen-based fuel cells, which may well be used in combination with these other sources to achieve greater efficiency and to deal with the intermittent nature of the wind and solar source.

The availability of these new technologies suggests some other metrics that might usefully be applied in setting goals for providing energy to Minnesotans. For example, one might take as a measure of progress the extent to which these new technologies are used to meet the new demand for electricity between now and 2020, or the extent to which they are used to replace installed capacity that is phased out during that period. Judging success in terms of the expectation that all or a large fraction of new and replacement capacity should come from more benign new technologies would represent a significantly more aggressive posture than that now being planned.

Electrical Energy System Organization and Structure

The recognition that the electrical power system is divided into generation, transmission, distribution, and user components or sectors is useful from several points of view. Functionally, it makes it considerably more clear how the system is put together and how the parts of the system interact. That makes it easier to identify where there are opportunities for, as well as barriers to, improvements and therefore it is an essential element in developing planning strategies. In addition, by relating this functional structure to the business and regulatory organizational structures, it is possible to see the points of control in the system and, therefore, how planning strategies can be effected.

Perhaps the most important features of the entire system, from a technical point of view, are that, for all practical purposes, the transfer of electrical current is instantaneous regardless of the distance from point of generation to point of use (although the electrons "generated" at one end are not the same ones as those "used" at the other end) and that electrical energy cannot be stored anywhere in the system. Therefore, at any moment in time, somewhere in the network, electricity must be generated at a total rate equal to the total rate at which it is being used in all other parts of the system. Moreover, the network transmission lines must be adequate not only to connect all of the points of generation to all of the points of use, but to allow electric current to flow at an adequate rate so that it can be gathered at exactly the right rate from all points of generation and delivered at exactly the right rate to all points of use at every instant in time. Clearly, for that to happen, many of the lines must have extremely high capacities.

The terms "generation" and "use" are fairly clear in their meaning. "Generation" refers to the production of electrical energy from other forms of energy (wind, solar, coal, natural gas, etc.). "Use" refers to the processes by which electrical energy drives equipment, and provides heat and light, itself being reconverted to other forms of energy at the same time. At both ends of the system, there are inefficiencies;

[7]Minnesota already ranks fourth in the nation in installed wind power capacity (behind California, Texas, and Iowa) and estimates are that it has the potential for significant increases in the use of that source of power.

only a fraction of the energy in one form is converted into the desired new form, with the rest "lost", usually to heat. One important aspect of technological improvement is to reduce those inefficiencies.

The distinction between "transmission" and "distribution" is a bit more arbitrary. Both refer to the network of connections between generators and users. The transmission lines are those parts of the network that are capable of moving very large amounts of power; that is, very large current loads at very high voltages. Because line losses (the conversion of electrical energy to heat as it is being transmitted) diminish as voltage goes up, the high voltage transmission lines are capable of moving electricity over very large distances with minimal electric power loss. On the other hand, like a fire hose, it is difficult to take a "small drink" out of them. Transmission lines usually operate at voltages equal to or exceeding 115 kilovolt (kV).

The distribution lines carry the electricity to end users. Current flow and voltage are lower in these lines, suiting them better for the last stage in transmission to users. They carry less power, but less power is needed at any one final location; their losses are higher, but they are not required to move power over long distances, so that the absolute magnitude of the losses are manageable.

Two aspects of the system are of crucial importance in creating flexibility for new approaches to electric energy generation. First, the ability to integrate a new generating station into the electric power system is dependent on the existence of transmission lines of adequate capacity and appropriate location to collect and deliver the electric energy. For example, at the moment, the potential for generating energy from wind in the southwest region of Minnesota far exceeds the capacity of the transmission lines in that area to carry the energy through the network.

Second, many new ideas for energy generation improvement involve distributed energy generation; that is, users who generate more electrical energy than they consume, at least some of the time. However, for this electricity to be made available to the network, it is necessary for the system to allow energy to be fed *back* through the distribution system. The challenge here is to maintain the required balance in the system (total generation equaling total use at every instant) when variable inputs come from users rather than traditional generating stations and, indeed, are less subject to programming than are traditional stations.

Thus, facilitation and control of the movement of electricity through the power network are the key factors in providing flexibility for encouraging and adopting new schemes of energy generation. In other words, there are strong reasons for focusing on the technology, the organization, and the regulation of the transmission system and the linkages between the distribution system and users to realize the potential of new schemes for generating electricity.

The other side of the coin is that higher capacity and a denser network of transmission lines increase the region across and throughout which electricity can be transmitted with acceptable losses. This leads to more highly integrated and broader electric power regions, in which states and localities are not really autonomous players. The sites at which electricity is generated for the region span a number of states (and even countries) with separate regulatory authorities; the competing users for that electricity cover that same wide region. No state is an

island either with respect to its pricing of electricity or its regulation. Minnesota, for example, is part of a larger integrated power region, known as the Mid-continent Area Power Pool (MAPP), which includes all or parts of Wisconsin, the Dakotas, Iowa, Nebraska, Manitoba and Saskatchewan.

Although there is no formal governmental organization at the MAPP level, there is a council made up of electric power industry companies which is organized under the aegis of the North American Electric Reliability Council (NERC), a non-governmental industry organization (see **Figure 9** for a map of the various regions that comprise NERC). Government involvement at the national level comes through the Federal Energy Regulatory Commission (FERC), which is broken down into four regions, with Minnesota part of the Midwest Region. Still another regional breakdown is shown in **Figure 10**, in which North America's transmission system is divided into three even larger regions, with Minnesota (and MAPP) part of the Eastern Interconnection. The interconnection regions are areas that could be affected by a serious power outage within the regional boundary.

Figure 9: NERC Regions

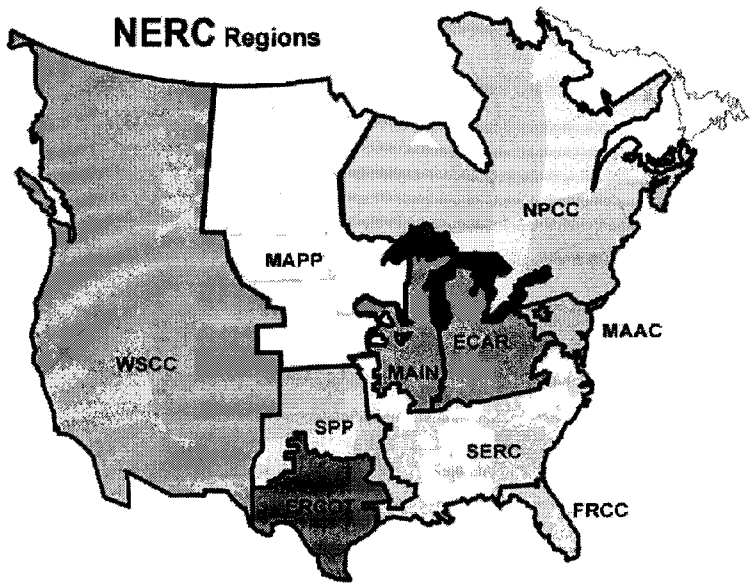
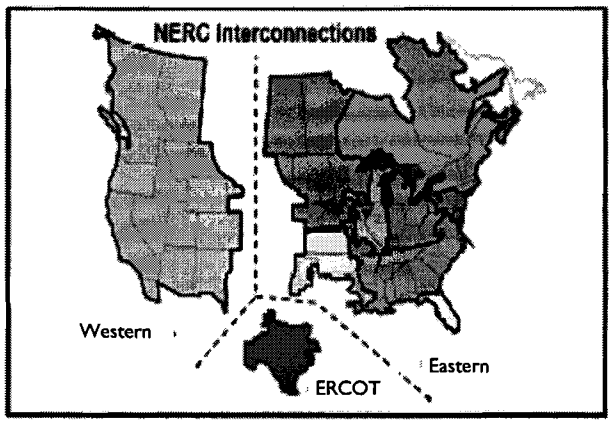


Figure 10: NERC Interconnections, North American Electricity Transmission Systems Source: NERC



The North American electricity transmission system consist of three interconnected systems: the Eastern Interconnection, the Western Interconnection, and most of Texas. Within these interconnections, more than 140 control areas manage electricity operations for local areas and coordinate reliability through 10 regional councils. Source: NERC 2001

Thus, although it is clear that the electric power system is inherently regional for reasons related to the nature of the technologies that it employs, and the non-governmental and governmental organizational entities that operate and regulate the system also are regional in nature, each of

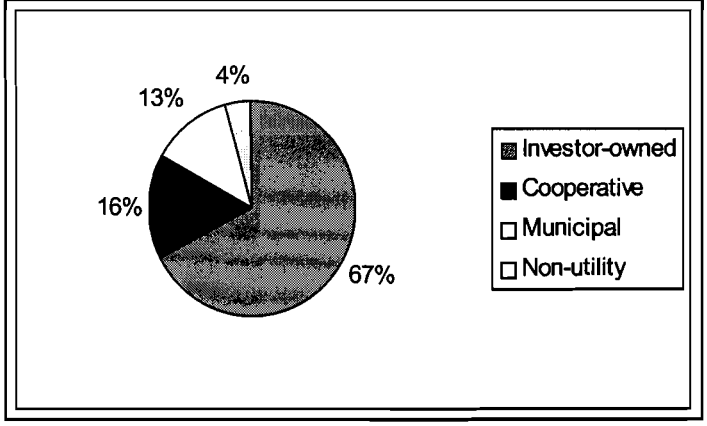
these regions is defined differently. That makes it quite difficult to plan methodically, particularly if one wants to bring about significant changes in the system. Moreover, new technologies and improved technologies in generation, transmission, and distribution, change the shape and extent of the natural, or technically defined, region, creating an even greater mismatch between the technical system and the organizational structures that control and operate it. Any long range plan to achieve a set of comprehensive goals for the electric power system would have to confront and alter this situation.

Looked at from a business point of view, the electric power system includes distinctly different kinds of organizations: investor-owned utilities (IOUs), user cooperatives, and municipal power companies. The fraction of power supplied by each is shown in **Figure 11**. The investor-owned utilities are public corporations, operated within the usual framework of a utility—that is, granted monopoly rights in exchange for accepting a regulated price structure and undertaking a set of obligations to provide service as defined by appropriate legislation and government regulatory bodies—for the benefit of its shareholders. The user cooperatives are owned and operated by and for the benefit of its users or "consumers" (or by groups of cooperatives that themselves "work for" their users), with less government regulation on the assumption that the users themselves, in their roles as owners, will represent their interests. The municipal power companies are owned and operated by municipalities as a service to their communities.

To greater or lesser extents, each of these kinds of power companies owns generating, transmission, and distribution systems. Each also purchases power as needed and leases transmission lines where necessary. The larger IOUs and cooperatives have greater variety in the kinds of power stations they own, and greater flexibility in changing that mix because the total power they provide is considerably larger than the output of a single plant, even a base plant. The smaller municipals have less innate flexibility because they often obtain their power from a single plant but they may be in a better position to undertake small pilot scale experiments with new technologies.

Because each of these power providers has a different set of stakeholders, there are differences between them in operating cultures, in the ways that decisions are made, and in how priorities are set. The IOUs operate within the most closely regulated environment, negotiating rates that then become a constraint within which profitability must be achieved for shareholders. They are obligated by law to carry out certain programs, for example, with respect to energy conservation, and, of course, they meet the requirements of various government entities with respect to reserve capacity, siting, environmental discharges, and other matters. Thus, for them the obvious

Figure 11: Minnesota Electric Consumption by Type of Utility/Company



stakeholders are the utility regulatory agencies and their shareholders. They attempt to meet their obligations to those groups by maintaining maximum control on all other aspects of their operation, so that other kinds of partnerships and pilot programs that might diminish that control—distributed and co-generation projects, for example—are generally not encouraged.

The cooperatives, inherently more responsive to their customer/owners, may have more incentive to experiment or to adopt goals in addition to a reliable supply of low cost energy, but only if some or all of those owners press in that direction. Particularly in the cooperatives that are themselves aggregates of other cooperatives, there appear to be unique opportunities to experiment because both the "producers" of electricity and the "consumers" are organizations with technical expertise which can work together on sophisticated pilot programs.

Although some of the municipals are rather large and own their own generating plants, many are small, more limited in the power they generate and, therefore, more dependent on purchases of power from other companies. They may provide particularly fertile ground for a broad range of pilot projects involving distributed generation and co-generation using a number of alternative fuels in relatively small generating plants. In a number of cases, this may be an economical alternative to purchasing electricity, and it may also help these municipalities to cope with growing energy demand without the need to install more capital-intensive central plants. Since local governments, in these cases, own the electrical power system and may also be one among the most significant users, or customers, of the system, in principle it would appear that a number of flexible and imaginative experiments and pilot projects for funding efficiencies and stimulating conservation practices could be undertaken in these communities.

Energy Regulation

Federal Regulation

For more than one hundred years, electric power has been provided in most parts of the United States by a single vertically integrated electric company, which owns and operates the generating plants, the transmission lines and distribution system. This "natural monopoly," based on a single supplier within designated geographic areas, was widely considered the best means to capture economies of scale and offer reliable, low cost power. The lone provider, however, was a monopolist with the market power to set its own price, unless subject to government controls. As a result, many state utility commissions, like Minnesota's Public Utility Commission (PUC), were assigned the duty to regulate electric utilities. In effect, the utilities operated as state-controlled monopolies. Under this regulatory compact, utilities were ensured a level of stability in their earnings, while the rate paying consumers were afforded universal, nondiscriminatory service and protection from monopolistic pricing.

The regulatory framework for the electric power industry is based on three federal laws enacted in the 1930s: the Public Utilities Holding Company Act (PUHCA), the Federal Power Act and the Rural Electrification Act. By the 1920s, six electric companies controlled 60 percent of the nation's electric power production. Rates were high, service was poor and rural areas were mostly neglected. In response, Congress passed PUHCA to regulate electric power companies, especially to prohibit extortionist prices, require reasonable service and con-

trol corporate abuses. The Federal Power Act created a system where retail electric rates were regulated by state governments and wholesale electric transactions between utilities were regulated by a new federal independent regulatory commission originally called the Federal Power Commission, and now known as the Federal Energy Regulatory Commission (FERC). Under the Rural Electrification Act, the development of cooperative electric associations was encouraged to provide electricity to rural areas.

From the 1930s until the 1970s, the utility regulation established during the New Deal prevailed. During this period, the increasing efficiencies of large-scale electric power generation lead to the construction of ever-larger power plants, as the per-kilowatt cost of electricity decreased. But in the 1970s, high inflation and the oil crises raised fuel prices and interest rates to high levels. About the same time, greater concern arose about cumulative environmental impacts of air emissions from large power plants. Under the Clean Air Act, utilities building new large-scale electric power plants were required to install costly pollution control equipment. As a result, electricity prices went up, demand fell and utilities faced excess capacity.

By the late 1970s, the premises underlying the regulation of the electric utility industry were under serious reexamination for the first time in nearly 50 years. There was a growing interest in energy conservation and efficiency, as well as the development of renewable energy sources. There also was an increasing support to restructure the power generation portion of the electricity industry, as a means to achieve lower production costs, diversify production sources and better consumer service. For the most part, it was then widely recognized that transmission and distribution systems must remain a regulated, natural monopoly because it was not sensible to duplicate the massive infrastructure required to deliver electricity from the production facility to the consumer. However, in terms of power generation, many began to seriously consider whether electricity could be competitively produced.

Congress took a leading role in promoting reform. In 1978, Congress passed the Public Utility Regulatory Policies Act (PURPA) to encourage the development of renewable energy technologies and co-generation. PURPA required electric utilities to purchase power from small-scale production facilities at a rate equal to the cost that would be avoided by not constructing additional electric power plants. These new entities, known as "independent power producers" were capable of producing electric power, but were not conventional electric utilities.

Congress went even further in 1992 when it passed the Energy Power Act. The legislation required FERC to open the electric transmission system to wholesale competition. In Order 888 (April 1996), FERC required open, nondiscriminatory access to the nation's electric transmission grid for wholesale transactions on a "first come, first served" basis. In effect, the transmission system was converted into a common carrier or "super highway." These developments were especially significant for independent power producers who now could either contract with utilities to provide part of the generation resources needed to serve retail customers or sell their power in the increasingly market-based wholesale electricity market.

On July 31, 2002, FERC announced another initiative—a proposed rule called the 'Standard Market Design" - to

restructure electric power markets. FERC characterized its proposal as an "aggressive step," that reflects the Commission's determination that it "is no longer in the public interest" to maintain the *status quo*. Instead, the Commission declared it is necessary to institute "sharp changes" in the manner in which it regulates the industry.

In the propsed rule, FERC presented a comprehensive restructuing proposal. One of the major elements called for the establishment of FERC-regulated Independent Transmission Providers (ITPs) to operate the transmission grid. The ITPs would be involved in long-term resource planning and establish requirements for each load-serving entity to enter into long-term commitments to lock its pro rata share of the resources required to ensure long-term adequacy of supply. Under the FERC proposal, a comprehensive system of bid caps and must offer requirements would also be established at which specific generators are allowed to sell power in the day-ahead and the real time markets.

FERC has four primary goals with its proposed rule:

- Drive down prices in the wholesale market and minimize the risk of future, California-type debacles;

- Eliminate discrimination in the use of the transmission grid by providing equal access to all power producers;

- Establish clear "Rules for the Road" for reserving transmission and managing congestion that (a) fully conforms to the physical realities of how the grid operates; (b) allow the grid operator to manage congestion efficiently; and (c) eliminate (or at least reduce drastically) the need to curtail power flows that have been properly scheduled under the Commission's rules; and

- Eliminate obstacles to interconnections and overcome transmission constraints by accelerating additions to the transmission grid.

The comment period on FERC's proposed Standard Market Design runs until January 10, 2003. Sweeping chnages will be made in the structure of the electic power industry, and FERC will continue to play an increasing role in the regulation of electric power in Minnesoat and throughout the country.

State Regulation

Minnesota's electric power industry is organized and regulated today based on federal laws enacted during the 1930s New Deal. The state is divided into service territories assigned to investor owned, municipal and cooperative electric utilities. (Minn. Stat. 216B.40.) Each electric utility has the exclusive right to provide electric service to the customers in its assigned service area.

There are five investor-owned utilities ("IOUs") in Minnesota: Xcel Energy, Minnesota Power, Otter Tail Power, Alliant Energy and Northwestern Wisconsin. The IOUs are regulated by the PUC regarding the rates they charge and the services they provide. They currently serve 58 percent of utility customers and provide 66 percent of Minnesota's electrical power.

There are 46 cooperative electrical associations ("co-ops") in Minnesota. The coops are regulated by their members under state laws governing the organization and operation of cooperatives. They currently serve 28 percent of utility customers and provide 17 percent of Minnesota's electrical power.

There are 126 municipal utilities ("munis") in Minnesota. The munis are operated and owned by municipal governments. They currently serve 14 percent of utility customers and provide 13 percent of Minnesota's electrical power.

Like other states with relatively low electricity prices, Minnesota has not restructured its electric power industry. The level of production by independent power producers is low in comparison to other states.

Over the past 25 years, Minnesota has enacted a variety of laws and government programs to provide for comprehensive energy planning, to promote conservation and efficiency, to encourage the development of renewable energy, to protect the environment and to ensure reliable, reasonably priced and sufficient energy supplies.

Under the Minnesota Utility Resource Planning Act (Minn. Stat. 216B.2422), enacted in 1993 and revised in 1994 and 1997, electric utilities must file resource plans with the PUC every two years. These resource plans provide the utilities' estimate of future electrical demand based on 5, 10 and 15 year planning horizons. The PUC relies on these forecasts to determine whether future energy supplies are likely to be sufficient and reliable. The resource plans submitted by the IOUs must be approved by the PUC. The resource plans submitted by the coops and munis are used by the PUC for information purpose, but are not subject to PUC review.

Under the Conservation Improvement Program ("CIP") (Minn. Stat. 216B.241), electric utilities, including coops and munis, must spend 1.5 percent of their gross operating revenues on efforts to conserve energy in their service areas. The Department of Commerce must approve the CIP plans for the IOUs.

The siting and permitting of new power plants and transmission lines is shared by two agencies. The Minnesota Public Utilities Commission (PUC) is responsible for authorizing a Certificate of Need (CON) for a proposed transmission project. Once a CON is approved, the Environmental Quality Board (EQB) determines the routing for the project.

During the 2001 legislative session, changes were made affecting the electricity regulatory structure in Minnesota. Article 3 of the bill requires the PUC to adopt generic standards for interconnection for distributed generation resources. It defined distributed generation as generators producing 10 MW or less that use natural gas or a cleaner fuel source. The legislation also requires the municipal utilities and electric cooperatives to adopt similar standards. The PUC was given the authority to order IOUs to provide adequate preventive maintenance to ensure proper infrastructure is available to maintain electric reliability.

Article 6 requires the adoption by the PUC, munis and coops standards for safety, reliablity and service quality in relation to the length of service disruptions and service response time.

Article 7 addresses the issue of transmission planning. The PUC is required to maintain a list of certified high voltage transmission line projects. The utilities are required to identify deficiencies on the transmission system and alternative means of addressing the deficiencies on an annual basis. The PUC can then certify any transmission project proposed by a utility and amend it to the certified projects list.

The 2001 electricity legislation also

amended the Power Plant Siting Act (PPSA) of 1973 to help streamline the approval process. This was accomplished in two ways. First, the amended section aligns the thresholds of the PUC's CoN process with the routing and siting thresholds of the EQB. This is entended to decrease the controversy in the siting process by focusing the discussion on the siting location and removing any discussion of need from the EQB's process.

Second, prior to 2001, certain smaller proposals would be presented to the EQB for a determination as to whether the projects should be cited under the PPSA or whether it was exempt from state citing. If the project was exempted, it was sent to local authorities for route siting. Under the new rules, smaller proposals allow the applicant or the local government has the option of presenting the plan to the EQB. If the EQB does hear the proposal, the decision will be rendered within six months. The change allows for only one proceeding which results in a final decision.

Energy Market Trends

Although FERC is moving rapidly to restructure the wholesale electric power market,, there is still considerable debate about the best structure for the electrical power industry. Afew years ago, it seemed only a matter of time before the electricity sector was deregulated and open to full competition. Minnesota, with its relatively low energy prices, had adopted a "wait and see" approach. But lead by states with the higher electricity prices, deregulation appeared inevitable. The brownouts and exorbitant electricity prices experienced in California from June 2000 until June 2001, however, have caused a serious reexamination of the benefits and viability of electric industry restructuring.

The events in California must be placed in prospective, both in terms of the historic efforts to restructure the electric power industry and the particular circumstances giving rise to the California crisis. Over the past two decades, while Congress and FERC were promoting competition in power generation, many state regulatory agencies established complementary polices. These state policies were based to a large degree on existing "power pools." For a long time, utilities have bought and sold "economy power" from each other on a competitive wholesale market, rather than generating the power with their own facilities. This practice became more prevalent after Congress passed PURPA in 1978 and encouraged the production of electrical power by independent power producers. In many parts of the country, average electrical prices declined significantly between 1980 and the mid-90s due in large part to the increasing competitiveness in power production. Many states aimed to further promote competition and the development of "power pools" by deregulation of their electrical power industries.

Restructuring promised a more efficient electrical power industry—more production, lower consumer costs and greater technological innovation. To achieve these efficiencies, proponents of restructuring claimed it was necessary to unleash market competition by dismantling command-and-control regulations. In California, New York, New England and the Pennsylvania-New Jersey-Maryland area, power-sector reforms were introduced based on four main components:

- Divestiture of many utility-owned generating plants to new owners, to reduce the historical concentration of the generation sector in order to promote competition and encourage private investors

to risk capital and build new plants in anticipation of future market-based profits;

- New opportunities for consumers to choose their electricity provider, and the entry of new retail service providers offering energy supply services to consumers;

- An "open access" transmission system operated by an independent system operator (ISO) or Regional Transmission Organization (RTO) providing a nondiscriminatory environment for competition among power generating companies and retail service providers; and

- A competitive wholesale "spot" market operated by the ISO.

In California, deregulation legislation was enacted in September 1996 and became effective on January 1, 1998, with implementing regulations promulgated by the California Public Utilities Commission (CPUC) and FERC.

To create an "open market," investor-owned utilities were required to sell at least half of their fossil fuel generation. In the deregulated market, the role of the IOUs was limited primarily to distribution of electricity, and California's fossil fuel generation was sold mostly to out-of-state companies like Mirant, Duke, AES, Southern, Dynegy and Destec.

New rules also applied to selling electricity. A wholesale power pool market, the California Power Exchange (PX), and the California Independent System Operator (ISO), were created. The PX provided the marketplace for buying and selling electricity, and ISO was responsible for the reliability of the transmission grid. All power generators were required to sell their power to the PX. The PX set the price through an auction process, where all generators and power marketers bid their electricity into the PX and the PX sold the same electricity at the "clearing price" the following day. The rate paid for the electricity was based on the highest bid rate, even for suppliers who were prepared to sell power for less.

In a critical decision, the CPUC refused to allow IOUs to enter into long-term contracts to purchase electricity. This left the IOUs without common protections to reduce their exposure to price volatility. In addition, the retail rates charged by the IOUs were frozen at 10 percent below those in effect in June 1996. This meant the risk of high wholesale costs would be borne by the IOUs, who were not allowed to pass the higher "market" costs on to their customers.

In this regulatory environment, the California electricity crisis began in high load times in May and June 2000, when demand exceeded the supply bid into the PX. The wholesale cost of electricity began to skyrocket. The average price that PG&E paid for each megawatt hour of electricity in June 1999 was $25.80, but the average price rose to $132.40 by June 2000. By December 2000, the monthly average cost per megawatt hour was $308.74. In his state of the state address on January 8, 2001, Governor Gray Davis declared electricity deregulation a "colossal and dangerous failure." The financial impacts for the IOUs were devastating and the state's largest utility PG&E was pushed into bankruptcy. In the end, the State was forced to enter into the energy procurement and distribution business, as the Department of Water Resources was given the right to purchase power on behalf of sources other than the PX.

The electricity crisis in California was brought on by a combination of bad

weather, off-target economic projections and poor regulatory design. California is interconnected with a much larger western power grid that includes fast-growing states like Arizona, Nevada, Oregon, Washington and Colorado. In the mid-90s, there was a power surplus in the western grid. But these conditions changed quickly and unexpectedly, so that by 2000 market conditions had grown tight. In addition, in 2000, below normal precipitation in the Northwest had reduced hydroelectric generation, which further tightened the supply-demand balance as the summer peak demand period approached.

When the crisis arrived, there was an immediate need for more generation. This led to a demand for more gas-fired generation which, in view of environmental requirements, is the primary source in peak demand periods. The use of this high-cost fuel pushed electricity prices even higher. To make matters worse, many sellers were alleged with exploiting market conditions to raise prices and profits.

The lessons of the California crisis are not yet fully appreciated or understood. For now, it seems clear that California failed to establish a program that allowed markets to operate while protecting the public interest. California adopted a truncated form of electricity deregulation. The wholesale markets were opened to full competition, but price and delivery constraints were left on electricity service at the retail level. Since customer rates were frozen, end-use customers had no incentive to respond to the higher wholesale prices by decreasing demand. IOUs were caught in the middle. They were not allowed to enter into long-term contracts, which would have reduced price volatility when the supply-demand balance tightened.

The move to restructure the electricity industry has slowed, but it remains likely that all states, including Minnesota, will eventually be compelled to deregulate to work within the markets created by federal law and policy. The need for well-informed policies is obvious. Long-term contracts have been a mainstay in the power industry and should be allowed during deregulation without significant limitations. Excessive reliance on spot markets is misplaced and can be disastrous. Long-term contracts reduce price volatility, but they also offer vital security to power developers who must commit significant capital over long periods of time to build and operate generation facilities. To avoid supply crisis, adequate reserves must be maintained, at least until it can be proven that markets will provide sufficient capacity additions on time. If we move to a more market-based system, customers cannot be insulated from price increases. Rate freezes are counterproductive and should be avoided whenever possible. We need to find better ways, perhaps including price metering, to allow customers to respond in more price responsive ways. We need to learn from the experiences in California and other states. Perhaps most importantly, we must realize deregulation is not a panacea, and does not necessarily involve a choice to rely entirely on markets completely unchecked by regulation.

III. Setting and Meeting Long-Term Goals

As stated in the introduction to this report, the Energy Committee believes that Minnesota should aim to meet its electrical energy demand requirements in the year 2040 with a resource supply and technology mix that is flexible, reliable and affordable and that preserves our natural environment and protects public health. In many ways, we believe that these are not independent aims, but interrelated ones. Flexibility, for example, is necessary to assure that electrical energy supply will be reliable and affordable even with shifts in the availability and price of various primary fuels and in the structure of the energy market. Furthermore, in judging the affordability of electric power for a society, the costs associated with environmental remediation and medical care need to be considered even if they are not included explicitly in the electrical pricing structure. Finally, as new scientific knowledge about the health and environmental effects of power plant emissions becomes available, the state needs the flexibility to shift the mix of technologies accordingly.

With a mix of large, small, centralized and dispersed options for supplying electrical energy, the state can be part of the process of testing and proving the feasibility of new technologies; it can lead rather than follow. This is not merely a question of local pride. Minnesota's social cohesion and stability, level of education, and community involvement—the elements of "social capital"—make it an ideal setting for thoughtful systemic change, as it has been in the past with respect to education, health care, metropolitan government, and some aspects of environmental preservation. Its mix of urban and rural settings, of multinational corporations and small businesses, makes it an ideal test bed. Moreover, leadership in developing technologies that serve this very important sector of the world's economy, can have important economic benefits for the state. Therefore, the state should be encouraging technical experiments and pilot projects, as well as creative institutional arrangements to facilitate those projects.

It should also be investing in research, as many other states are doing, to take advantage of its particular strengths and to stimulate the use of energy sources which could be especially helpful to the State's economy, such as biomass. The University's new initiatives in biocatalysis offer an opportunity to pursue a line of research with great potential for developing non-polluting sources of electrical energy and even for developing new approaches to carbon sequestration.

To take these aims of flexibility, reliability, affordability, and environmental and health protection beyond the very general, to make them useful, tangible, and measurable, we believe it is necessary to set specific long-term goals. The goals should be aggressive, but not arbitrary which, in our view, means that they should be related to: estimates of a reasonable rate of turnover of present installed capacity; credible published assessments of the potential of technologies proven at least at a pilot scale; and best estimates of the reductions in greenhouse gas emissions necessary to contain global warming. They should involve the expectation that a somewhat increased electricity pricing structure may be necessary and would be justified to the extent that it results in avoided costs associated with environmental damage (or remediation), or associated with the protection of human health.

With these considerations in mind,

the Energy Committee proposes the following goals for the year 2040:

- ***Carbon Emission Permits.*** *Companies selling electrical energy on the retail market should be operating under a carbon emission permit system. The system should be designed to limit the aggregate release of carbon dioxide from fossil fuels in the primary production of electricity. Allowable emission levels should be set to deal meaningfully with the global warming problem with the assumption that each region will bear a "fair share" responsibility for achieving national goals for reduced CO_2 emissions from non-renewable resources.*

Some states, including California, New Hampshire and North Carolina have already begun to treat CO_2 as a polluting gas subject to emission controls. The Energy Committee believes that this is a sensible and necessary step. It was the consensus of the Energy Committee that, by 2040, any realistic goal for reducing CO_2 emissions would require that traditional coal-fired base generating stations be phased out. To the extent that coal continues to be used as a primary fuel, it would be in high efficiency gasified coal plants and/or co-generation facilities with carbon sequestration technologies used to further reduce emissions. A substantial fraction of the Energy Committee believed that the State should go further and that CO_2 emissions from all fossil fuel burning should actually be eliminated by 2040, either by switching to non-fossil fuels or by employing carbon sequestration technologies. In this latter scenario, conversion to natural gas—a fossil fuel, albeit one with lower carbon content—would represent only an intermediate step.

- ***Other Pollutant Permits.*** *Emissions of other pollutants, including SO_2, NO_x, volatile organic compounds, mercury compounds, and particulates, should be regulated under a permit system that establishes allowable emission levels based upon considerations of public health and the cost of environmental remediation, as well as the cost of reducing emissions.*

The Clean Air Act of 1990 established limits on the emissions of a number of pollutants after more than a decade of studies of the damaging effects of those pollutants on the environment. The Act also introduced an emission permit trading system that encouraged economic efficiency by allowing companies or sites that could reduce emissions most cost-effectively to reduce emissions below their allowable levels and sell the unused portion of their emission allowance to others. The Act has been successful in reducing emissions and the trading system has provided a useful stimulus to lowering the costs associated with that reduction by encouraging technological innovation.

The shortcomings in the Act were the large number of "grandfathered" power plants that are still not subject to the emission limits and the somewhat arbitrary allowable emission levels established for those plants that did come under the Act. That is, the allowable levels, while clearly well below the prevailing rates of emissions at the time, were not determined by any goals with respect to ambient levels of the pollutants or any estimates of the avoided costs of environmental remediation or health care.

By 2040, all "grandfathered" plants should have long been retired and all new plants will be included in the aggregate emissions standards. Permit trading should still allow plant to plant variations, subject to minimum standards to protect those living in the vicinity of the generators. The larger question, however, is how to set the permis-

sible emissions levels. The levels presently allowed appear to represent an implicit qualitative balance between the desirability of reducing emissions and the cost of doing so. The Energy Committee believes that, by 2040, a more rational approach should be in place that explicitly weighs the added costs of environmental remediation and health care against the costs of reducing emissions—that is, Minnesota should, by that time, have taken major steps toward full cost accounting in the electrical energy field.

2040 represents only a point in time, and a somewhat arbitrary one at that. The system of setting emission standards should be a dynamic one. It would need to be updated regularly to reflect new information on the consequences and social costs of emissions as well as the diminishing cost of emission controls that will accompany the technological improvements that are most likely to continue to occur. This system would be an important part of a seamless structure for planning and regulating energy production and environmental protection.

- ***Efficiency Benchmark.*** *Minnesota's integrated electrical energy system from primary energy sources to final use should be at least as efficient as that presently projected by the federal Department of Energy laboratories as achievable with presently proven technologies.*

The Energy Committee believes that goals for efficiency should be set not in terms of incremental changes from the status quo, but in terms of efficiencies judged by objective technical studies to be achievable. At the same time, the Energy Committee is aware of the long lead times necessary to actually introduce new technologies. Therefore, as a practical, but aggressive goal, it appears reasonable to expect that the electrical energy system will implement technical and behavioral improvements in generation, and in industrial, residential, and commercial end uses that achieve the levels of energy efficiency deemed possible with presently proven, though not generally installed technologies.

The work of the federal government's Department of Energy's (DOE) Interlaboratory Working Group on Energy-Efficient and Clean Energy Technologies is particularly relevant in this regard. In their 2000 report, the Group concludes that, *even by 2020*, it should be possible to reduce U.S. primary energy use for electricity by approximately 24 percent below present projections and to reduce carbon emissions by some 46 percent below present projections using presently proven technologies and the economic incentives provided by a tradeable carbon permit program. This does not take into account the additional savings possible with co-generation strategies. The Energy Committee recognizes, as stated earlier, that implementation of the DOE report's $50/ton carbon allowance strategy could result in a retail electricity pricing increase. From the numbers contained in the report, that increase would appear to be in the range of about eight percent. However, the federal laboratory report also concludes that because of the improved efficiencies in the use of electricity, rather than raising the total cost of energy to consumers, it may actually reduce it by as much as 18 percent below the level presently anticipated for 2020. Moreover, the decreased costs of environmental remediation and health care likely to result from reduced pollution, would further offset any electricity pricing increase.

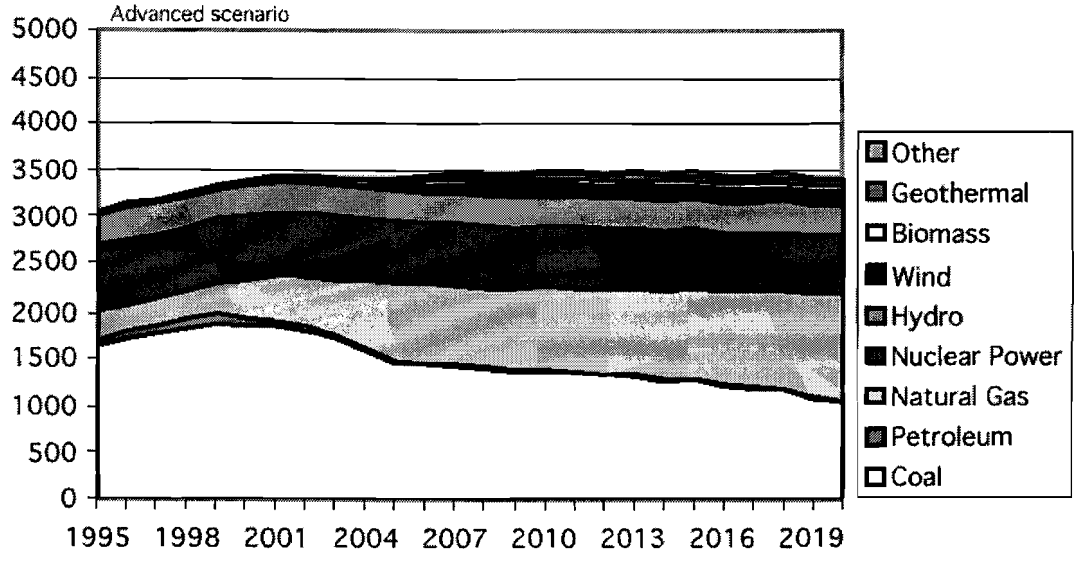
These DOE projections are aggregated across the country and they underestimate specific opportunities available in Minnesota, such as wind power. **Table 2** shows the DOE's projections of the possible mix of

Table 2: Mix of Fuel Sources Under Different Permitting Scenarios

			2010			2020		
	1990	**1997**	**BAU**	**Mod.**	**Adv.**	**Bau**	**Mod.**	**ADV**
Coal Steam	300	305	307	303	262	320	305	225
Other Fossil Steam	144	139	81	76	56	77	56	33
Combined Cycle	8	16	126	107	122	199	134	149
Combustion Turbine/Diesel	46	78	149	142	135	184	145	133
Nuclear Power	100	99	78	78	87	72	64	83
Renewable	82	88	93	103	136	98	111	145
Hydro	75	78	79	79	79	79	79	79
Wind	2	2	2	3	4	3	3	5
Biomass	2	2	2	3	4	3	3	5
Geothermal	3	3	4	5	7	7	9	9
Other	1	4	5	5	5	5	5	5
Other	18	20	22	22	22	22	22	22
Total	**698**	**744**	**855**	**831**	**819**	**971**	**837**	**789**

Note: BAU=Business-as-Usual; Mod.=Moderate scenario; Adv.=Advanced scenario

Figure 12: Advanced Scenario Total Generation by Fuel (TWh) (no cogeneration)



primary energy sources and technologies that could be in place by 2020 under various scenarios. In the most aggressive scenario, installed wind power capacity would be more than ten times what it would be under a business-as-usual pattern, but still only 6 percent of generating capacity. Most observers believe that the wind resource in Minnesota offers much greater potential if we are able to overcome the bottleneck of the present transmission system.

Interestingly, the DOE projections (**Figure 12**) show that it should be possible, by about 2010, to halt the increase in electrical energy consumption across the country and to begin an actual decrease. If the trend lines were to continue until 2040, one could envision an electrical energy generation system with almost no dependence on coal and one that uses measurably less energy.

It is beyond the scope of this report to try to predict precisely what levels of efficiency are achievable by 2040, or what precise mix of primary fuels can or should be in place. However, the Energy Committee does believe that goals can and should be established based on an extrapolation of the approaches and methods used by the DOE's Interlaboratory Working Group.

- ***Flexible Transmission.*** *The transmission and distribution systems serving Minnesota should have the capacity and the flexibility to allow the state to take maximum advantage of renewable resources such as wind, solar, and biomass energy, distributed energy capabilities, and co-generation installations.*

Many experts who appeared before the Energy Committee testified that transmission capacity was the most serious problem facing the state in terms of electricity reliability. For this reason, the Energy Committee believes transmission is one of the primary energy issues that state leaders must address quickly in a manner which will promote the development of renewable energy sources.

In order to achieve the other goals that the Energy Committee is recommending, Minnesota will need transmission and distribution systems that are not, in themselves, bottlenecks that limit the ability to test and introduce new technologies or to vary the mix of primary fuel resources. In the view of the Energy Committee, the goal for 2040 should be a reconceptualized and restructured system. The present system, in which utilities build, own and operate the transmission lines, and siting is a negotiated decision with participation by only some of the stakeholders (utilities, FERC, local zoning authorities, but not independent producers, users with co-generation options, etc.) is sub-optimal. Moreover, the distribution system, which is presently designed primarily as a uni-directional delivery system, provides few stimuli and many barriers to distributed generation and co-generation schemes.

One possible approach would be to view the transmission and distribution conduits as social infrastructure, much as the highway system is today. A combination of federal, regional, state and local agencies could be responsible for building and interconnecting the conduits, in much the same way as these entities now work to build infrastructure to encourage planned economic development and quality of life. This would represent a clear shift from a utility model, which is built on the argument that the electric power generating system has the characteristics of a natural monopoly. However, the trend toward introducing competition in generation and encouraging co-generation and distributed generation schemes, suggests that the overall power generation and distribution system no longer fits a natural mo-

nopoly model in all of its parts and that applying a utility model to one part of the system creates unavoidable conflicts of interest or, at least, skewing of interests. This approach also would be consistent with FERC's efforts to restructure the electric power industry.

The specific elements of the new system—operating responsibility, method of funding, coordination of planning at various levels—are beyond the scope of this study and, indeed, its development may be a groundbreaking effort nationally. However, the goal is clear: to have a transmission and distribution system that provides greater flexibility in the overall electrical energy system. This would create opportunities for the State to encourage a range of partnerships with the electricity user community—residential, commercial, and industrial—to promote more efficient energy use, and would allow the State to take a strong role nationally in promoting pilot demonstrations that could lead to business opportunities.

- ***No Expanded Nuclear Role.*** *In the mix of primary energy sources in 2040, the State should neither plan for nor expect an increase in the role of nuclear energy. At the same time, it appears that nuclear fuel will and should continue to provide a significant fraction of the State's electricity.*

The Energy Committee believes it is unlikely that new nuclear power plants will be built in the State in the next 50 years. The growing availability of non-polluting energy sources, which do not raise the kinds of concerns about waste disposal or the potential for terrorism associated with nuclear plants, will make nuclear energy relatively less desirable, so that there will be a decreasing impetus to build new plants.

At the same time, it appears to the Energy Committee to be impractical to plan for the elimination of nuclear power. With coal presently relied on to such a great extent in Minnesota (as noted earlier, about 75 percent of electrical energy comes from coal), and the urgency of dealing with emissions from those plants, the Energy Committee believes that the highest priority should be to phase out traditional coal plants as quickly as possible and that will require retaining nuclear generating capacity if the State's energy needs are to be met. It seems likely, therefore, that the emphasis with respect to nuclear power will be to deal with the on-site and off-site waste disposal problems (the latter obviously not within the purview of the State), to continue to improve security and operational reliability, and to take the actions necessary to relicense the existing plants.

IV. Encouraging Technical and Institutional Experiments and Pilot Projects

This report has emphasized the interconnected themes of setting ambitious goals for changes in the electrical energy system, providing a long enough time frame to achieve those goals, and putting strategies in place now for keeping us on course to meet the goals. The strategies take on great importance precisely because of the very long time line to achieve significant change in the system and, in consequence, the long term effects of decisions and actions taken now.

For example, **Table 3** provides information on the approximately 800 MW of new electric generation projects now in planning as we work toward meeting the expected 2,000 MW additional need in 2010. Clearly, there are within these plans a number of promising signs, with a significant use of renewable energy sources and some expansion of natural gas. However, the large baseload coal plant, comprising some 20 percent of the new capacity, must raise at least some concern, since this plant is very likely to still be in operation in 2040. Furthermore, natural gas, although it clearly represents a significant improvement over coal in terms of CO_2, as well as other pollutant emissions, is not be the optimal long term solution because of supply problems, competition with other natural gas users, and the fact that natural gas is a fossil fuel, albeit one with a lower carbon content.

These observations, coupled with those earlier in the report concerning the very modest progress we have made in

Table 3: New Electric Generation Projects in Progress[8]

Project	Location	Type	Year	Size	Fuel
Under Construction (139 MW)					
Black Dog	Dakota County	Intermediate	2002	114 MW	Gas
District Heating	St. Paul	Baseload		25 MW	Waste Wood
Approved Purchase Power Agreement (PPA) (100 MW)					
EPS/Beck		Baseload		50 MW	Whole Trees
FibroMinn	Benson	Baseload		50 MW	Turkey Litter
Won All-Source Bid, PPA Pending (250 MW)					
Navitas/NEA		Intermediate Peaking		50 MW 250 MW	Wind
Other (268 MW)					
Bid Selection in Process by Xcel Energy		Intermediate		80 MW	Wind
LTV Power Plant	Taconite Harbor	Baseload		188 MW	Coal

[8]Minnesota Energy Planning Report 2001, Minnesota Department of Commerce, p. 45.

achieving energy efficiencies over the past decade and the modest goals set for the next decade, suggest the need for altered strategies that reflect long term targets and will lead to significant and measurable movement toward those targets in the next few decades. These strategies must encourage the introduction and scale-up of proven technologies that are more efficient and less polluting, the adoption of best practices in conservation, and continued work on new technologies of sufficient promise to warrant pilot scale and demonstration projects.

To achieve these technical advances, we will also need institutional changes that allow for better planning, that match the regulatory decision-making structure to the actual way the technologies develop and the market operates, and that coordinate planning and regulation across the various levels of government as well as across the various agencies at each level.

In the following sections, we call attention to some specific issues—opportunities to be exploited, challenges to be confronted—that hold the key to creating the electrical energy supply system we envision for the future.

Distributed Generation

A more aggressive approach to the use of distributed generation systems would be valuable from several points of view. First, it would provide users already concerned about efficiency and environmental protection with the opportunity to make use of technologies that deal with those concerns even if the aggregate demand for the technologies is not sufficient to warrant the installation of a large, central generating station. Second, a significant amount of distributed generation would ease the pressure on long distance transmission lines, which have been identified repeatedly as a system bottleneck. Third, it would create more diversity in power sources, which has the advantage of reducing dependence on a single fuel with its attendant economic vulnerability.

Finally, and perhaps most importantly, it would provide opportunities for pilot plant and demonstration projects to introduce and begin the scale-up of improved technologies and new approaches to electrical energy generation. Small-scale windmills, new materials for solar power generation, improved micro-turbines, new approaches to bio-mass conversion, among other possibilities, must all be tested for reliability, efficiency, and durability under different operating conditions and at different scales, with minimum risk to the overall reliability of the electric power system. In this respect, the strategy of facilitating distributed generation can also offer Minnesota an economic opportunity: taking a leading role in developing and marketing new energy generation technologies.

The barrier to more widespread use of distributed energy generation is associated with the practicalities of integrating distributed generation sites into the power network; that is, allowing for power to flow in both directions at the point of connection of the user with the distribution network. There are no serious technical limitations to this and, in fact, there are already a number of examples of where this is being done. The issues that do arise relate to metering equipment, pricing structure, and, most importantly, the technical standards that must be met by a generator to connect into the network. Those concerned with operating the network are anxious to ensure that network stability is not compromised by the distributed connections, which is certainly reasonable. It appears to the Energy Committee that their approach to dealing with

this concern is merely to set very high standards for connection and to leave to the generators the burden of meeting them.

The strategy would be appropriate if protecting the network were the singular and overriding interest. However, given the desirability of facilitating distributed generation, the Energy Committee believes that making it possible to connect these generators while protecting network stability should be viewed as a joint technical challenge in the immediate future. This suggests a need for greater effort to explore ways in which network controls can be modified to accommodate inputs that may not meet the same voltage, frequency, and reliability standards as a central generating station. The question is whether computerized controls or other technical approaches can be developed for the larger system that can compensate for the limitations of the smaller system. If this approach were successful, reliability might actually be improved because the system would be even less dependent on a single generating plant or fuel source than it is today.

Co-Generation

Co-generation, the use of a single primary energy source for multiple purposes, one of which is the generation of electricity, is attractive primarily because of the opportunities it offers to use fuel more efficiently. Essentially, what is otherwise "waste" energy from one process—running machinery, heating a building, or generating electricity—is used in a second, or companion, process. This efficiency means lower energy costs as well as lower pollutant emissions per unit of production. There are many variations on this theme. For example, the hot effluent gases from steam generators in electric power plants can be used to heat buildings; or steam used to heat buildings can be redirected, when not needed, to run steam turbines. Cooling water from chemical reactors can be used to run "low-head" turbines for electricity production.

Co-generation is an option open both to those who are primarily users of electricity and to those who are primarily generators of electricity. Increasing the opportunities and ease with which distributed generation sources can be accommodated will encourage more experiments with co-generation. The Energy Committee believes that co-generation initiatives by users, particularly large industrial users, could be encouraged in these next years by designing conservation programs in which government deals more directly with the large users rather than depending entirely upon the electric utilities to design and implement the programs.

A variation on co-generation, generally referred to as combined-cycle generation, describes systems in which the same primary fuel is used in two different ways to generate electricity. For example, the burning of coal is ordinarily used to generate steam that runs steam turbines to produce electricity. However, the hot gases exiting from the steam generator still contain enough energy to run gas turbines that generate additional electricity. In a combined-cycle plant, electricity is generated in both ways, improving efficiency markedly and reducing the emissions of CO_2 and other pollutants per unit of electrical energy generated. In moving toward the goal of eliminating all conventional coal-fired power plants by 2040, the Energy Committee believes that no new coal plants should be constructed that do not take advantage of combined-cycle generation or other technologies that are capable of similar improvements in efficiency and reductions of pollutants.

Still another variation on co- and combined cycle generation may hold the key to a breakthrough in the use of intermittent energy sources such as wind and sunlight. One of the limitations in the use of these otherwise nearly ideal, non-polluting sources is that they are available only when the wind blows or the sun shines. In a system in which generation and use must be matched at every moment in time, that means that the energy may be available when none is needed—and thereby go to waste—or it may not be available when it is needed.

New developments in fuel cell technology may provide the key to overcoming this difficulty, thereby markedly increasing the usefulness of wind and solar energy systems. Fuel cells are battery-like systems that couple the oxidation of hydrogen to the production of electricity. Hydrogen itself can be produced by the electrolysis of water—that is, using electricity to separate water into its constituents, hydrogen and oxygen. Therefore, the development of fuel cells introduces the possibility of "storing" electrical energy in the form of hydrogen. When the electricity produced by wind turbines or solar panels is not needed for immediate consumption, it can be redirected to electrolyze water. The hydrogen thus produced can be stored and subsequently used to generate electricity in a fuel cell cycle

The Energy Committee believes that Minnesota, with its major wind resource, should move aggressively and immediately to promote this kind of co-generation facility, funding programs to experiment with electrolysis units on wind farms to generate hydrogen when the wind generated electrical power is not needed on the grid, and using the hydrogen to run fuel cells to add electrical power to the grid when the wind source is insufficient to meet demand.

New Technologies

The last example in the previous section points out the important role that state government can play in developing technologies that have already been proven at laboratory scale. Fuel cells are a new technology, but not a future technology. They are a technology of the present in need of the investment that will lead to their use in pilot scale projects, generating the data and the experience to move us along the technology learning curve that leads to improved, cheaper and more reliable performance. Indeed, it is likely that experience with fuel cells in stationary applications, such as the generation of electricity, will provide useful data in extending them to widespread use in transportation.

There are other technologies at a similar state of development, although perhaps not with the enormous potential of fuel cells. These include new approaches to biomass conversion for energy use, new materials for construction, new equipment designs, new chemical processes for capturing and sequestering CO_2, each serving to improve the efficiency of energy use, or decrease dependence on fossil fuels, or minimize the environmental damage associated with electrical energy production and use. Many of these are, to some extent, public goods, which the market cannot effectively value or reward, so that their development is not sufficiently promoted by private investment.

The Energy Committee believes that the State has an important role to play in promoting these new developments and that at least as much funding should be directed to this effort—in research, development, and pilot projects—as is now reserved for direct energy conservation programs. In fact, at present, the State investment in research and development in the energy area is pres-

ently negligible. This has relegated Minnesota to a rather passive role in energy technology, despite some of its comparative advantages in non-fossil fuel energy sources (for example, wind, solar, and biomass), and its research capacity both in its University and in the private sector. Indeed, the concentration of large corporations with significant technical resources as well as interest in energy savings suggests that there are real opportunities for promoting public-private partnerships that could move Minnesota to a position of leadership in a number of energy-related technologies (see below).

Regional Consortia

The changes in federal energy regulatory law—particularly the efforts to introduce competition into the wholesale electricity markets—have important implications for Minnesota's energy policy. The efforts by Congress and FERC to reorganize the electric system are now well-advanced. Under Order 888, FERC provided competitive suppliers access to utility power lines. Under Order 2000, FERC pushed utilities to surrender control of transmission lines to independent regional organizations. On July 31, 2002, FERC went even further when it released for public comment its "Standard Market Design," a blueprint for reorganizing the electric industry to allow for competitive generation markets while establishing sufficient regulatory controls to avoid another California crisis.

In the new electricity era, independent transmission providers will play a pivotal role. These regional transmission operators will aim to tap the cheapest source of electricity and move energy in a nondiscriminatory way. It may be some time before the major regulatory structures in this restructured electric industry are established. But it seems clear the relevant electricity markets will be regional and tied closely to the transmission network. In fact, if FERC's proposed Standard Market Design is adopted, FERC-regulated Independent Transmission Providers will be established and have responsibility for transmission planning and long-term regional resource planning.

For Minnesota to be a forward-looking energy state, it must adapt to the new realities in the electric industry. Minnesota cannot stand alone, but must work in new, significant and meaningful ways with FERC and other states. The Energy Committee strongly believes Minnesota should be a leader in organizing regional consortia and working cooperatively with regional transmission operators to update the transmission system and to engage in resource planning to develop reliable, efficient and environmentally-sound new sources of electric production. Minnesota should support the further development of independent transmission providers, including their expanded role in the monitoring, planning and regulating the production and transmission of electricity. At the same time, regional consortia, such as an alliance with North Dakota and South Dakota, can provide an effective means to develop wind power and pursue other opportunities with our neighbor states.

Integration of State Regulatory Structures

Minnesota has long recognized the need for effective state energy policies. For 25 years, State policies have addressed the need for low-cost, clean energy technologies. Just last year, the State Legislature passed the Minnesota Energy Security and Reliability Act, a comprehensive law which requires, among other things, that the Department of Commerce and the newly-established Reliability Administrator set state

energy goals and prepare a state energy plan.

In spite of these efforts, the conservation gains have been modest and the state continues to obtain 75 percent of its electricity from coal. From the Energy Committee's viewpoint, the state currently lacks the strong leadership required to implement our energy policy. The existing regulatory agencies who have a major impact on the electric industry—the Public Utilities Commission ("PUC"), the Pollution Control Agency and the Environmental Quality Board—are not currently in a position to effectively shape and implement state energy policy. The PUC plays the most significant role, but its organizational mission emphasizes the protection of ratepayers and gives too little attention to environmental impacts. The PCA and EQB focus on facility permitting and environmental review, and are not closely tied to achievement of the production and transmission goals set forth in the state energy policies.

The Energy Committee believes it will be essential for Minnesota to develop new regulatory structures for energy policy. The PUC, as currently configured and organized, is obsolete for purposes of energy policy. The PUC was organized to regulate utilities and to protect ratepayers. In recent years, it has been called upon to address more environmental concerns and to facilitate energy resource planning. But these efforts are not enough. To achieve our energy goals, the Energy Committee believes it will be necessary to establish an officer or agency who will champion energy policy, work with regional consortia and advocate for the state's long-term energy interests.

Public-Private Partnerships

Up until now, most of the State's efforts to promote the development of alternative fuel sources or improvements in conservation practices, have depended on programs or funding mechanisms established by the State and carried out by the electric utilities or other organizations involved in the generation, transmission, and distribution of electrical energy. This has certainly led to some improvements over time, and will probably continue to do so, but the Energy Committee believes that there is much to be gained by extending these public-private partnerships to users of electricity as well.

Users, particularly large, institutional users, bring several great strengths to such partnerships. First, as users, they have a strong incentive to reduce their expenses related to the purchase of electricity. Second, many such institutions use energy in several forms as part of their operations. They therefore have the potential to modify industrial processes, interchanging the forms of energy used, in order to minimize total energy use or to ameliorate environmental emissions. Given this kind of incentive and flexibility, they are also excellent partners to work with in the development of cogeneration schemes.

Third, large, institutional users are subject to—and therefore sensitive to—environmental regulations and concerns. In the past several years, a good deal of attention has been directed toward restructuring environmental regulations to be outcome, rather than process oriented, providing the flexibility for trades between types of emissions which result in a reduction in aggregate emissions. The connection of energy use to environmental emissions, which the Energy Committee believes is of major importance, can be promoted in a practical way in the operations of these large institutions. Moreover, the optimization—either in terms of reduced energy use or reduced environmental emissions (or both)—can only be im-

proved if the entire system from generation to use can be integrated, so that appropriate choices and tradeoffs can be made all along the chain.

Fourth, and finally, institutional users have already demonstrated annual energy savings that are significantly larger than the results obtained or projected for the electrical power supply system. There is an obvious public interest both in encouraging those efforts with direct financial support (when appropriate) and in learning from and possibly extrapolating those conservation steps to broader use. As shown in data presented earlier in this report, industry, which includes most of the large institutions, is the largest user of electricity in the State and, therefore, offer the most potential for effecting significant improvements.

Although the emphasis in this discussion has been on partnerships with private institutional users, the Energy Committee is mindful of the fact that public institutions at various levels of government are also major users of electricity. They, too, should be partners in the effort to introduce new technologies and new conservation measures, and they, too, should be eligible for support under programs intended to improve our patterns of electricity use.

V. Conclusions and Recommendations

There are, we believe, several important themes that run through this report.

First, despite some modest steps, neither the State nor the electric power industry has been sufficiently aggressive in moving toward an electricity supply system that provides an adequate and reliable supply of electric power without cumulative and unacceptable damage to the local and global environment. The improvements that have been made thus far and that are planned for the next decade — in a diverse mix of primary fuel sources, in reduced carbon and other emissions, in higher efficiency and in conservation measures— fall far short of what is currently possible technically, what is justifiable in a practical sense if the full economic costs of environmental damage are considered, and what is necessary to avoid currently predicted long term global environmental deterioration. Despite the State's recognition for the past 25 years that we need to change our primary fuel source dependence, about 3/4 of our electrical energy continues to come from coal, with its serious environmental shortcomings, and much of the rest comes from nuclear power; less than 10 percent comes from all other sources.

Second, the almost exclusive emphasis in the past on keeping electrical energy prices as low as possible and divorced from serious consideration of environmental concerns, consistent with a reliable supply, is likely to have to be modified in the future and, indeed, should be. Reliability is, and should remain, an important consideration. However, low price as an almost overriding criterion will have to be modified because of the restructuring of the electric industry as a result of both federal and state policies that increasingly allowed market forces to come into play and have reduced a state's ability to maintain a price structure significantly different from that of the surrounding region. The ease with which electricity can be moved over longer and longer distances, and the fact that much of the electricity used in the State is generated (and purchased from) outside the nominal State electrical power generating system, means that the price of electricity will increasingly be determined by regional competitive market considerations and will be less subject to State control.

Furthermore, the Energy Committee believes that the traditional focus on keeping energy prices as low as possible may actually be costing citizens more when the consequent health care and environmental cleanup costs are considered. For example, it was noted earlier in this report that the DOE's federal energy laboratories had produced analyses showing that very significant reductions in pollution and improvements in electrical energy efficiencies could be achieved with retail price increases of less than 10 percent. By limiting the introduction of these available technologies that would slow or even eliminate environmental deterioration, the electrical energy sector forces other costs on society that the citizenry must bear. In the view of the Energy Committee, these costs must be considered when assessing the cost/benefit of new electrical energy technologies.

These latter considerations, in the view of the Energy Committee, justify more stringent regulations by state and federal government to limit emissions from power plants, even though they result in some increased pricing structure to consumers for electricity. Therefore, in the future, the State and its agencies will have to shift the

primary emphasis from keeping electrical energy prices at the lowest possible level to ensuring cost-effectiveness while meeting broader environmental and public health goals and providing a safety net to protect those who would be severely burdened by price increases. The Citizens League has supported conceptually similar safety nets, for example property taxes.

Third, the State's regulatory system is not well suited to deal with the environmental challenges and market restructuring discussed above. The different levels of regulation applied to investor-owned utilities, cooperatives, municipals and independents seriously impair the State's ability to implement new ideas or goals. Treating energy and environmental regulation as fundamentally separate functions leads the agencies responsible for each to give different weight to each, rather than balancing the needs. For the Public Utilities Commission, low cost, reliable electrical energy is the primary goal. Environmental considerations are not ignored, but are clearly secondary. For the EQB, PCA and local planning boards, environmental protection or local considerations are dominant and these agencies have little responsibility for the problems confronting officials charged with assuring a reliable electrical energy supply. The Energy Committee believes that the Governor and the State Legislature must move to achieve a much better integration of these functions.

Fourth, the very notion of State regulation ignores the reality that the electrical power system is regional in nature. The governmental regulatory structures leave a significant gap between state and federal systems—in contrast to the suppliers and distributors themselves, who have long been part of regional consortia. Current actions by FERC suggest that the federal government will, itself, be pushing regions to fill this gap, but there is no evidence that significant state-level initiatives are being undertaken to protect the state's interests. The Energy Committee believes that Minnesota should be actively engaging with its neighboring states in developing regional level planning and regulatory structures and jointly developing a clear vision of the our energy future.

Fifth, the State has not been a leader in the development and implementation of new technologies or new practices that could improve the efficiency of electricity generation, conserve the use of electricity, or minimize the environmental damage associated with it. Given the technical capacity of the State and the economic potential of new technologies in a nation and world increasingly concerned with energy security and environmental protection, this appears to the Energy Committee to be a lost opportunity. We believe that the State should be much more aggressive in promoting and funding pilot programs as well as research and development to speed the introduction of appropriate new technologies and practices. Moreover, the Energy Committee believes that these new programs should reach beyond the producers and distributors of electric power to the user community, particularly industrial users who have the motivation to reduce energy costs and to broaden the range of options available in meeting environmental protection goals, who have the technical capacity to be partners in new developments, and who, in many cases, have already established a record of being able to improve energy efficiency at a rate far greater than the electric power system as a whole.

We believe that the promise of return on investments in research, development and pilot programs warrants additional

State investment. However, even before increased resources are devoted to this need, the Energy Committee believes that the mandated conservation set aside now being spent by the utilities on conservation programs should immediately be turned to these broader research and development purposes, engaging a much wider range of players. To do so effectively is likely to require that the funds be administered by an agency of State government. One likely candidate, at least in the short run, would be the Department of Commerce which already has organizational entities that have been involved in energy and environmental planning as well as economic development, and should be able to move quickly to undertake these new responsibilities. Placing responsibility there would also emphasize that these are issues that reach beyond the electricity producers and distributors to society at large.

Sixth, *the Energy Committee believes there is an urgent need to act now.* In this report, goals for the year 2040 have been discussed, not because we propose that the State can afford to wait until 2040 to make the necessary changes, but because the significant changes proposed will take a great deal of time to complete. The other side of that coin is that if these changes are not undertaken immediately and aggressively, there is no possibility that the goals will be achieved. Benchmarks have been proposed at various points in this report for the year 2020 to emphasize that we must be well on our way by that time. However, the next decade will see significant changes in or additions to the electricity supply system that will affect at least 20 percent of the system. It is absolutely vital that the goals proposed in this report be reflected in how those changes and additions are made.

Throughout the meetings that have led to this report, the transmission system has been identified over and over as one of the key limiting elements in moving aggressively toward change and also one of the most difficult challenges for regulators because of the many levels of government involved in planning and siting these lines. For example, the potential wind power from the Buffalo Ridge area of the State is not being fully utilized because of limited transmission capacity. Otherwise attractive generating sites and projects are sometimes impractical because the transmission lines are not adequate.

Although it reached no consensus on the matter, the Energy Committee pointed out the need for the planning and operation of the transmission system to be made more responsive to the goals of improving the mix of primary fuels, reducing dependence on coal, facilitating a range of options for cogeneration and distributed generation, and encouraging experiments with new technologies. For example, it was suggested that the transmission system might be more responsive if it were organized as part of the region's social and economic infrastructure— planned and operated more like the highway system than the telephone system. Although the Energy Committee did not explicitly endorse this particular suggestion, it did come to the conclusion that this is a large enough and important enough issue that it should be addressed immediately by state and regional authorities in order to remove this bottleneck to electric power system progress

Many of these proposals will require significant changes to state government organization and policy, a challenge to the new governor and new legislature. Perhaps chief among these challenges is the integration of responsibility for energy and the environment. In the view of the Energy Committee, the absence of a single State officer, charged

with and empowered to deal with both electric energy and environmental goals, is in large part responsible for the slow pace of progress in meeting electric energy goals that the State has long endorsed. It is urgent that this situation be corrected. The Energy Committee has not proposed a precise organizational structure, but we believe that energy and environment must be subsumed in the same administrative unit—a Commissioner-level department within the executive branch. We believe it is not adequate to deal with the challenge merely by coordinating the work of several departments because such approaches tend to be slow and inefficient. They treat coordination as the last step in a process driven primarily by the separate interests of the agencies involved. A properly organized department would consider energy and environment at every stage of its planning and regulatory activities. This clearly presents a practical challenge in breaking up the overall task into encompassible pieces, but there appear to be a number of reasonable approaches—for example, separating responsibilities for different primary energy sources.

Whatever organizational structure is ultimately chosen, it will also be important that the new department or agency have both the power and the flexibility to work with other regional governmental units and with FERC. These other organizations are, themselves, just developing, which only increases the need for flexibility and for sufficient stature to be able to make commitments on the part of the State administration.

The Energy Committee believes that these are issues that demand serious and early attention by the Governor, the Legislature, other levels of government, and the people of Minnesota. For too long, systemic inertia has kept us from achieving our own goals and the very long time scale of change in the environment has kept us from accurately assessing how serious a problem that is. Government and societies usually do not respond effectively to problems that develop over a long period of time. It is sometimes remarked that "the urgent displaces the important." Our fear is that the "important" will become the "urgent" when it is too late to avoid the worst consequences. Our hope is that we will heed early warnings and act now.

APPENDIX A — GLOSSARY OF TERMS

Bottleneck Facility: A point on the system, such as a transmission line, through which all electricity must pass to get to its intended buyers. If there is limited capacity at this point, some priorities must be developed to decide whose power gets through. It also must be decided if the owner of the bottleneck may, or must, build additional facilities to relieve the constraint.

Bulk Power Supply: Often this term is used interchangeably with wholesale power supply. In broader terms, it refers to the aggregate of electric generating plants, transmission lines, and related-equipment. The term may refer to those facilities within one electric utility, or within a group of utilities in which the transmission lines are interconnected.

CIP: Conservation Improvement Program

CO: Carbon Monoxide

CO_2: Carbon Dioxide

Cogeneration: (Also combined Heat and Power) Production of electricity from steam, heat, or other forms of energy produced as a by-product of another process.

Combined Cycle: An electric generating technology in which electricity and process steam is produced from otherwise lost waste heat exiting from one or more combustion turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for use by a steam turbine in the production of electricity. This process increases the efficiency of the electric generating unit.

Co-op: This is the commonly used term for a rural electric cooperative. Rural electric cooperatives generate and purchase wholesale power, arrange for the transmission of that power, and then distribute the power to serve the demand of rural customers. Co-ops typically become involved in ancillary services such as energy conservation, load management and other demand- side management programs in order to serve their customers at least cost.

Cooperative electric association or utility: Utility owned and operated by its members.

Demand: The rate at which electric energy is delivered to or by a system or part of a system, generally expressed in kilowatts (kW), megawatts (MW), or gigawatts (GW), at a given instant or averaged over any designated interval of time. Demand should not be confused with Load or Energy.

Deregulation: The elimination or restructuring of regulation from a previously regulated industry or sector of an industry.

Distributed Energy Resources: (Also called distributed power, distributed energy, distributed generation.) Both electric demand reduction (energy conservation, load management, etc.) and supply generated at or near where the power is used. A distributed generation system involves amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or displacing the need to build additional (or upgrade) local distribution lines.

Distributed Generation: A distributed generation system involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or displacing the need to build additional (or upgrade) local distribution lines.

Distribution: The delivery of electricity to the retail customer's home or business through low voltage distribution lines.

Divestiture: The stripping off of one utility function from the others by selling (spinning-off) or in some other way changing the ownership of the assets related to that function. Most commonly associated with spinning-off generation assets so they are no longer owned by the shareholders that own the transmission and distribution assets. (See also "Disaggregation.")

DSM (Demand-Side Management): Planning, implementation, and evaluation of utility-sponsored programs to influence the amount or timing of customers' energy use.

Economic Efficiency: A term that refers to the optimal production and consumption of goods and services. This generally occurs when prices of products and services reflect their marginal costs. Economic efficiency gains can be achieved through cost reduction, but it is better to think of the concept as actions that promote an increase in overall net value (which includes, but is not limited to, cost reductions).

Economies of Scale: Economies of scale exist where the industry exhibits decreasing average long-run costs with increases in size.

Electric Energy: The generation or use of electric power by a device over a period of time, expressed in kilowatt-hours (kWh), megawatt-hours (MWh), or gigawatt-hours (GWh).

Electric System Losses: Total electric energy losses in the electric system. Losses are primarily due to electric resistance within transmission system lines and transformers.

Electric Utility: A corporation, person, agency, authority, or other legal entity that owns or operates facilities for the generation, transmission, distribution, or ale of electric energy or natural gas primarily for use by the public and is defined as a utility under the statutes and rules by which it is regulated.

Energy Conservation: Using less energy, either by greater energy efficiency or by decreasing the types of applications requiring electricity or natural gas to operate.

Energy Efficiency: Using less energy/electricity to perform the same function. Programs designed to use electricity more efficiently -- doing the same with less. For the purpose of this paper, energy efficiency is distinguished from DSM programs in that the latter are utility-sponsored and -financed, while the former is a broader term not limited to any particular sponsor or funding source. "Energy conservation" is a term which has also been used but it has the connotation of doing without in order to save energy rather than using less energy to do the same thing and so is not used as much today. Many people use these terms interchangeably.

EPA: The Environmental Protection Agency. A federal agency charged with protecting the environment.

Federal Energy Regulatory Commission (FERC): The Federal Energy Regulatory Commission regulates the price, terms and conditions of power sold in interstate commerce and regulates the price, terms and conditions of all transmission services. FERC is the federal counterpart to state utility regulatory commissions.

GWh: Gigawatt-hour; the unit of energy equal to that expended in one hour at a rate of one billion watts. One GWh equals 1,000 megawatt-hours.

Greenhouse gases: Greenhouse gases are water vapor, carbon dioxide, tropospheric ozone, nitrous oxide, methane, and chlorofluorocarbons (CFCs).

Grid: A system of interconnected power lines and generators that is managed so that the generators are dispatched as needed to meet the requirements of the customers connected to the grid at various points. Gridco is sometimes used to identify an independent company responsible for the operation of the grid.

Investor Owned Utility (IOU): Common term for a privately owned (shareholder owned) gas or electric utility regulated by the Minnesota Public Utilities Commission (referred to in statutes as a "public utility").

IPP: Independent Power Producer. An private entity that operates a generation facility and sells power to electric utilities for resale to retail customers.

Independent System Operator (ISO): A neutral and independent organization with no financial interest in generating facilities that administers the operation and use of the transmission system. ISOs exercise final authority over the dispatch of generation to preserve reliability and facilitate efficiency, ensure non-discriminatory access, administer transmission tariffs, ensure the availability of ancillary services, and provide information about the status of the transmission system and available transmission capacity. Under some proposals, an ISO may make some transmission investment decisions.

Interconnected System: A system consisting of two or more individual electric systems that have connecting tie lines and whose operations are synchronized.

Kilowatt (kW): This is a measure of demand for power. The rate at which electricity is used during a defined period (usually metered over 15-minute intervals). Utility customers generally are billed on a monthly basis; therefore, the kW demand for a given month would be the 15- minute period in which the most power is consumed. Customers may be charged a fee (demand charge) based on the peak amount of electricity used during the billing cycle. (Residential customers are generally not levied a demand charge.)

Kilowatt-hour (kWh): This is a measure of consumption. It is the amount of electricity that is used over some period of time, typically a one-month period for billing purposes. Customers are charged a

rate per kWh of electricity used.

Marginal Cost: In the utility context, the cost to the utility of providing the next (marginal) kilowatt-hour of electricity, irrespective of sunk costs.

Minnesota Public Utilities Commission (PUC): The state agency with regulatory jurisdiction over certain Minnesota Utilities.

MISO: Midwest Independent System Operator

MAPP: Mid-Continent Area Power Pool.

Megawatt (MW): A megawatt equals 1,000 kV

Megawatt Hour (MWh): The unit of energy equal to that expended in one hour at a rate of one million watts.

Monopoly: The only seller with control over market sales.

Municipal Utility: A provider of utility services owned and operated by a municipal government.

Natural Monopoly: A situation where one firm can produce a given level of output at a lower total cost than can any combination of multiple firms. Natural monopolies occur in industries which exhibit decreasing average long-run costs due to size (economies of scale). According to economic theory, a public monopoly governed by regulation is justified when an industry exhibits natural monopoly characteristics.

NERC: The North American Electric Reliability Council is the coordinating arm of the nine member regional reliability councils. (See also Reliability Councils).

NOx: Nitrogen Oxides

Obligation to Serve: The obligation of a utility to provide nondiscriminatory electric service to any customer who seeks that service, and is willing to pay the rates set for that service. By law, utilities have an obligation to serve in return for exclusive service territories.

Peak Load or Peak Demand: The electric load that corresponds to a maximum level of electric demand in a specified time period.

Power Pool: An entity established to coordinate short-term operations to maintain system stability and achieve least-cost dispatch. The dispatch provides backup supplies, short-term excess sales, reactive power support, and spinning reserve. Historically, some of these services were provided on an unpriced basis as part of the members' utility franchise obligations. Coordinating short-term operations includes the aggregation and firming of power from various generators, arranging exchanges between generators, and establishing (or enforcing) the rules of conduct for wholesale transactions. The pool may own, manage and/or operate the transmission lines ("wires") or be an independent entity that manages the transactions between entities. Often, the power pool is not meant to provide transmission access and pricing, or settlement mechanisms if differences between contracted volumes among buyers and sellers exist.

Public Utility: A utility operated by a non-profit governmental or quasi-governmental entity. Public utilities include municipal utilities, cooperatives, and power marketing authorities.

Publicly Owned Utilities (POU): Municipal utilities (utilities owned by branches of local government) and/or co-ops (utilities owned cooperatively by customers).

PURPA: The Public Utility Regulatory Policy Act of 1978. Among other things, this federal legislation requires utilities to buy electric power from private "qualifying facilities," at an avoided cost rate. This avoided cost rate is equivalent to what it would have otherwise cost the utility to generate or purchase that power themselves. Utilities must further provide customers who choose to self-generate a reasonably priced back-up supply of electricity.

PV: Photovoltaic

Real-Time Pricing: The instantaneous pricing of electricity based on the cost of the electricity available for use at the time the electricity is demanded by the customer.

Regional Reliability Councils (RRC): Regional reliability councils were organized after the 1965 northeast blackout to coordinate reliability practices and avoid or minimize future outages. They are voluntary organizations of transmission owning utilities and in some cases power cooperatives, power marketers, and nonutility generators. Membership rules vary from region to region. They are coordinated through the North American Electric Reliability Council (NERC). There are ten major regional councils plus the Alaska Systems Coordinating Council.

Regional Transmission Organization (RTO): A regional transmission organization is designed to operate the grid and its wholesale power market over a broad region and with independence from commercial interests. An RTO would also have a role in planning and investing in the grid, through how it would conduct these activities remains unsolved. An RTO would also coordinate with other RTOs.

Reliability: Electric system reliability has two components – adequacy and security. Adequacy is the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system facilities.

Reliability Councils: Regional reliability councils were organized after the 1965 northeast blackout to coordinate reliability practices and avoid or minimize future outages. They are voluntary organizations of transmission-woning utilities and in some cases power cooperatives, power marketers, and non-utility generators. Membership rules vary from region to region. They are coordinated through the North American Electric Reliability Council (NERC). There are nine major regional councils plus the Alaska Systems Coordinating Council.

Renewable Resources: Renewable energy resources are naturally replenishable, but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Some (such as geothermal and biomass) may be stock-limited in that stocks are depleted by use, but on a time scale of decades, or perhaps centuries, they can probably be replenished. Renewable energy resources include: biomass, hydro, geothermal, solar and wind. In the future they could also include the use of ocean thermal, wave, and tidal action technologies. Utility renewable resource applications include bulk electricity generation, on-site electricity generation, distributed electricity generation, non-grid-connected generation, and demand-reduction (energy efficiency) technologies.

Research and Development (R&D): Research is the discovery of fundamental new knowledge. Development is the application of new knowledge to develop a potential new service or product. Basic power sector R&D is most commonly funded and conducted through the Department of Energy (DOE), its associated government laboratories, university laboratories, the Electric Power Research Institute (EPRI), and private sector companies.

Reserve Margin: Capacity over and above anticipated peak loads, maintained for the purpose of providing operational flexibility and for preserving system reliability. Reserve margins cover for planned and unplanned outages of generation and/or transmission facilities.

Restructuring: The reconfiguration of the vertically integrated electric utility. Restructuring usually refers to separation of the various utility functions into individually operated and owned entities.

Retail Competition: a system under which more than one electric provider can sell to retail customers, and retail customers are allowed to buy from more than one provider. (See also Direct Access)

Spot Markets: Any of a number of venues in which purchases and sales, as of electricity, are made by a large number of buyers and sellers, with new transactions being made continuously or at very frequent intervals. Typically, the phrase refers to a market in which the prices, amounts, duration and firmness of the purchases and sales is publicly known, at least shortly after the transaction is completed, if not simultaneously.

Tariff: A document, approved by the responsible regulatory agency, listing the terms and conditions, including a schedule of prices, under which utility services will be provided.

Time-of-Use (TOU) Rates: The pricing of delivered electricity based on the estimated cost of electricity during a particular time block. Time-of-use rates are usually divided into three or four time blocks per twenty-four hour period (on-peak, mid-peak, off-peak and sometimes super off-peak) and by seasons of the year (summer and winter). Real time pricing differs from TOU rates in that it is based on actual (as opposed to forecasted) prices that may fluctuate many times a day and are weather sensitive, rather than varying with a fixed schedule.

Transmitting Utility (Transco): This is a regulated entity which owns, and may construct and maintain, wires used to transmit wholesale power. It may or may not handle the power dispatch and coordination functions. It is regulated to provide non-discriminatory connections, comparable service and cost recovery. According to EPAct, any electric utility, qualifying cogeneration facility, qualifying small power

production facility, or Federal power marketing agency which owns or operates electric power transmission facilities which are used for the sale of electric energy at wholesale. (See also "Generation Dispatch & Control" and "Power Pool.")

Unbundling: Disaggregating electric utility service into its basic components and offering each component separately for sale with separate rates for each component. For example, generation, transmission and distribution could be unbundled and offered as discrete services with separate payment for each.

Universal Service: Electric service sufficient for basic needs (an evolving bundle of basic services) available to virtually all members of the population regardless of income.

Utility: A regulated entity which exhibits the characteristics of a natural monopoly. For the purposes of electric industry restructuring, "utility" refers to the regulated, vertically-integrated electric company. "Transmission utility" refers to the regulated owner/operator of the transmission system only. "Distribution utility" refers to the regulated owner/operator of the distribution system which serves retail customers.

Vertical Integration: An arrangement whereby the same company owns all the different aspects of making, selling, and delivering a product or service. In the electric industry, it refers to the historically common arrangement whereby a utility would own its own generating plants, transmission system, and distribution lines to provide all aspects of electric service.

Wholesale Competition: A system whereby a distributor of power would have the option to buy its power from a variety of power producers, and the power producers would be able to compete to sell their power to a variety of distribution companies.

Wholesale Power Market: The purchase and sale of electricity from generators to resellers (who sell to retail customers) along with the ancillary services needed to maintain reliability and power quality at the transmission level.

APPENDIX B — REPORT RECOMMENDATIONS

I. Setting and Meeting Long-Term Goals

Carbon Emission Permits. Companies selling electrical energy on the retail market should be operating under a carbon emission permit system. The system should be designed to limit the aggregate release of carbon dioxide from fossil fuels in the primary production of electricity. Allowable emission levels should be set to deal meaningfully with the global warming problem with the assumption that each region will bear a "fair share" responsibility for achieving national goals for reduced CO_2 emissions from non-renewable resources.

Other Pollutant Permits. Emissions of other pollutants, including SO_2, NO_x, volatile organic compounds, mercury compounds, and particulates, should be regulated under a permit system that establishes allowable emission levels based upon considerations of public health and the cost of environmental remediation, as well as the cost of reducing emissions.

Efficiency Benchmark. Minnesota's integrated electrical energy system from primary energy sources to final use should be at least as efficient as that presently projected by the federal Department of Energy laboratories as achievable with presently proven technologies.

Flexible Transmission. The transmission and distribution systems serving Minnesota should have the capacity and the flexibility to allow the state to take maximum advantage of renewable resources such as wind, solar, and biomass energy, distributed energy capabilities, and cogeneration installations

No Expanded Nuclear Role. In the mix of primary energy sources in 2040, the State should neither plan for nor expect an increase in the role of nuclear energy. At the same time, it appears that nuclear fuel will and should continue to provide a significant fraction of the State's electricity.

II. Encouraging Technical and Institutional Experiments and Pilot Projects

Distributed Generation

A more aggressive approach to the use of distributed generation systems would be valuable from several points of view. First, it would provide users already concerned about efficiency and environmental protection with the opportunity to make use of technologies that deal with those concerns even if the aggregate demand for the technologies is not sufficient to warrant the installation of a large, central generating station. Second, a significant amount of distributed generation would ease the pressure on long distance transmission lines, which have been identified repeatedly as a system bottleneck. Third, it would create more diversity in power sources, which has the advantage of reducing dependence on a single fuel with its attendant economic vulnerability.

Finally, and perhaps most importantly, it would provide opportunities for pilot plant and demonstration projects to introduce and begin the scale-up of improved technologies and new approaches to electrical energy generation. Small-scale windmills, new materials for solar power generation, improved micro-turbines, new approaches to bio-mass conversion, among other possibilities, must all be tested for reliability, efficiency, and durability under different operating conditions and at different scales, with minimum risk to the overall reliability of the electric power system. In this respect, the strategy of facilitating distributed generation can also offer Minnesota an economic opportunity: taking a leading role in developing and marketing new energy generation technologies.

The barrier to more widespread use of distributed energy generation is associated with the practicalities of integrating distributed generation sites into the power network; that is, allowing for power to flow in both directions at the point of connection of the user with the distribution network. There are no serious technical limitations to this and, in fact, there are already a number of examples of where this is being done. The issues that do arise relate to metering equipment, pricing structure, and, most importantly, the technical standards that must be met by a generator to connect into the network. Those concerned with operating the network are anxious to ensure that network stability is not compromised by the distributed connections, which is certainly reasonable. It appears to the Energy Committee that their approach to dealing with this concern is merely to set very high standards for connection and to leave to the generators the burden of meeting them.

The strategy would be appropriate if protecting the network were the singular and overriding interest. However, given the desirability of facilitating distributed generation, the Energy Committee believes that making it possible to connect these generators while protecting network stability should be viewed as a joint technical challenge in the immediate future. This suggests a need for greater effort to explore ways in which network controls can be modified to accommodate inputs that may not meet the same voltage, frequency, and reliability standards as a central generating station. The question is whether computerized controls or other technical approaches can be developed for the larger system that can compensate for the limitations of the smaller system. If this approach were successful, reliability might actually be improved because the system would be even less dependent on a single generating plant or fuel source than it is today.

Co-Generation

Co-generation, the use of a single primary energy source for multiple purposes, one of which is the generation of electricity, is attractive primarily because of the opportunities it offers to use fuel more efficiently. Essentially, what is otherwise "waste" energy from one process—running machinery, heating a building, or generating electricity—is used in a second, or companion, process. This efficiency means lower energy costs as well as lower pollutant emissions per unit of production. There are many variations on this theme. For example, the hot effluent gases from steam generators in electric power plants can be used to heat buildings; or steam used to heat buildings can be redirected, when not needed, to run steam turbines. Cooling water from chemical reactors can be used to run "low-head" turbines for electricity production.

Co-generation is an option open both to those who are primarily users of electricity and to those who are primarily generators of electricity. Increasing the opportunities and ease with which distributed generation sources can be accommodated will encourage more experiments with co-generation. The Energy Committee believes that co-generation initiatives by users, particularly large industrial users, could be encouraged in these next years by designing conservation programs in which government deals more directly with the large users rather than depending entirely upon the electric utilities to design and implement the programs.

A variation on co-generation, generally referred to as combined-cycle generation, describes systems in which the same primary fuel is used in two different ways to generate electricity. For example, the burning of coal is ordinarily used to generate steam that runs steam turbines to produce electricity. However, the hot gases exiting from the steam generator still contain enough energy to run gas turbines that generate additional electricity. In a combined-cycle plant, electricity is generated in both ways, improving efficiency markedly and reducing the emissions of CO_2 and other pollutants per unit of electrical energy generated. In moving toward the goal of eliminating all conventional coal-fired power plants by 2040, the Energy Committee believes that no new coal plants should be constructed that do not take advantage of combined-cycle generation or other technologies that are capable of similar improvements in efficiency and reductions of pollutants.

Still another variation on co- and combined cycle generation may hold the key to a breakthrough in the use of intermittent energy sources such as wind and sunlight. One of the limitations in the use of these otherwise nearly ideal, non-polluting sources is that they are available only when the wind blows or the sun shines. In a system in which generation and use must be matched at every moment in time, that means that the energy may be available when none is needed—and thereby go to waste—or it may not be available when it is needed.

New developments in fuel cell technology may provide the key to overcoming this difficulty, thereby markedly increasing the usefulness of wind and solar energy systems. Fuel cells are battery-like systems that couple the oxidation of hydrogen to the production of electricity. Hydrogen itself can be produced by the electrolysis of water—that is, using electricity to separate water into its constituents, hydrogen and oxygen. Therefore, the development of fuel cells introduces the possibility of "storing" electrical energy in the form of hydrogen. When the electricity produced by wind turbines or solar panels is not needed for immediate consumption, it can be redirected to electrolyze water. The hydrogen thus produced can be stored and subsequently used to generate electricity in a fuel cell cycle

The Energy Committee believes that Minnesota, with its major wind resource, should move aggressively and immediately to promote this kind of co-generation facility, funding programs to experiment with electrolysis units on wind farms to generate hydrogen when the wind generated electrical power is not needed on the grid, and using the hydrogen to run fuel cells to add electrical power to the grid when the wind source is insufficient to meet demand.

New Technologies

The last example in the previous section points out the important role that state

government can play in developing technologies that have already been proven at laboratory scale. Fuel cells are a new technology, but not a future technology. They are a technology of the present in need of the investment that will lead to their use in pilot scale projects, generating the data and the experience to move us along the technology learning curve that leads to improved, cheaper and more reliable performance. Indeed, it is likely that experience with fuel cells in stationary applications, such as the generation of electricity, will provide useful data in extending them to widespread use in transportation.

There are other technologies at a similar state of development, although perhaps not with the enormous potential of fuel cells. These include new approaches to biomass conversion for energy use, new materials for construction, new equipment designs, new chemical processes for capturing and sequestering CO_2, each serving to improve the efficiency of energy use, or decrease dependence on fossil fuels, or minimize the environmental damage associated with electrical energy production and use. Many of these are, to some extent, public goods, which the market cannot effectively value or reward, so that their development is not sufficiently promoted by private investment.

The Energy Committee believes that the State has an important role to play in promoting these new developments and that at least as much funding should be directed to this effort—in research, development, and pilot projects—as is now reserved for direct energy conservation programs. In fact, at present, the State investment in research and development in the energy area is presently negligible. This has relegated Minnesota to a rather passive role in energy technology, despite some of its comparative advantages in non-fossil fuel energy sources (for example, wind, solar, and biomass), and its research capacity both in its University and in the private sector. Indeed, the concentration of large corporations with significant technical resources as well as interest in energy savings suggests that there are real opportunities for promoting public-private partnerships that could move Minnesota to a position of leadership in a number of energy-related technologies (see below).

Regional Consortia

The changes in federal energy regulatory law—particularly the efforts to introduce competition into the wholesale electricity markets—have important implications for Minnesota's energy policy. The efforts by Congress and FERC to reorganize the electric system are now well-advanced. Under Order 888, FERC provided competitive suppliers access to utility power lines. Under Order 2000, FERC pushed utilities to surrender control of transmission lines to independent regional organizations. On July 31, 2002, FERC went even further when it released for public comment its "Standard Market Design," a blueprint for reorganizing the electric industry to allow for competitive generation markets while establishing sufficient regulatory controls to avoid another California crisis.

In the new electricity era, independent transmission providers will play a pivotal role. These regional transmission operators will aim to tap the cheapest source of electricity and move energy in a nondiscriminatory way. It may be some time before the major regulatory structures in this restructured electric industry are established. But it seems clear the relevant electricity markets will be regional and tied closely to the transmission network. In fact, if

FERC's proposed Standard Market Design is adopted, FERC-regulated Independent Transmission Providers will be established and have responsibility for transmission planning and long-term regional resource planning.

For Minnesota to be a forward-looking energy state, it must adapt to the new realities in the electric industry. Minnesota cannot stand alone, but must work in new, significant and meaningful ways with FERC and other states. The Energy Committee strongly believes Minnesota should be a leader in organizing regional consortia and working cooperatively with regional transmission operators to update the transmission system and to engage in resource planning to develop reliable, efficient and environmentally-sound new sources of electric production. Minnesota should support the further development of independent transmission providers, including their expanded role in the monitoring, planning and regulating the production and transmission of electricity. At the same time, regional consortia, such as an alliance with North Dakota and South Dakota, can provide an effective means to develop wind power and pursue other opportunities with our neighbor states.

Integration of State Regulatory Structures

Minnesota has long recognized the need for effective state energy policies. For 25 years, State policies have addressed the need for low-cost, clean energy technologies. Just last year, the State Legislature passed the Minnesota Energy Security and Reliability Act, a comprehensive law which requires, among other things, that the Department of Commerce and the newly-established Reliability Administrator set state energy goals and prepare a state energy plan.

In spite of these efforts, the conservation gains have been modest and the state continues to obtain 75 percent of its electricity from coal. From the Energy Committee's viewpoint, the state currently lacks the strong leadership required to implement our energy policy. The existing regulatory agencies who have a major impact on the electric industry—the Public Utilities Commission ("PUC"), the Pollution Control Agency and the Environmental Quality Board—are not currently in a position to effectively shape and implement state energy policy. The PUC plays the most significant role, but its organizational mission emphasizes the protection of ratepayers and gives too little attention to environmental impacts. The PCA and EQB focus on facility permitting and environmental review, and are not closely tied to achievement of the production and transmission goals set forth in the state energy policies.

The Energy Committee believes it will be essential for Minnesota to develop new regulatory structures for energy policy. The PUC, as currently configured and organized, is obsolete for purposes of energy policy. The PUC was organized to regulate utilities and to protect ratepayers. In recent years, it has been called upon to address more environmental concerns and to facilitate energy resource planning. But these efforts are not enough. To achieve our energy goals, the Energy Committee believes it will be necessary to establish an officer or agency who will champion energy policy, work with regional consortia and advocate for the state's long-term energy interests.

Public-Private Partnerships

Up until now, most of the State's efforts to promote the development of alternative fuel sources or improvements in conservation practices, have depended on programs or funding mechanisms established by the State and carried out by the electric utilities or other organizations involved in the generation, transmission, and distribution of electrical energy. This has certainly led to some improvements over time, and will probably continue to do so, but the Energy Committee believes that there is much to be gained by extending these public-private partnerships to users of electricity as well.

Users, particularly large, institutional users, bring several great strengths to such partnerships. First, as users, they have a strong incentive to reduce their expenses related to the purchase of electricity. Second, many such institutions use energy in several forms as part of their operations. They therefore have the potential to modify industrial processes, interchanging the forms of energy used, in order to minimize total energy use or to ameliorate environmental emissions. Given this kind of incentive and flexibility, they are also excellent partners to work with in the development of co-generation schemes.

Third, large, institutional users are subject to—and therefore sensitive to—environmental regulations and concerns. In the past several years, a good deal of attention has been directed toward restructuring environmental regulations to be outcome, rather than process oriented, providing the flexibility for trades between types of emissions which result in a reduction in aggregate emissions. The connection of energy use to environmental emissions, which the Energy Committee believes is of major importance, can be promoted in a practical way in the operations of these large institutions. Moreover, the optimization—either in terms of reduced energy use or reduced environmental emissions (or both)—can only be improved if the entire system from generation to use can be integrated, so that appropriate choices and tradeoffs can be made all along the chain.

Fourth, and finally, institutional users have already demonstrated annual energy savings that are significantly larger than the results obtained or projected for the electrical power supply system. There is an obvious public interest both in encouraging those efforts with direct financial support (when appropriate) and in learning from and possibly extrapolating those conservation steps to broader use. As shown in data presented earlier in this report, industry, which includes most of the large institutions, is the largest user of electricity in the State and, therefore, offer the most potential for effecting significant improvements.

Although the emphasis in this discussion has been on partnerships with private institutional users, the Energy Committee is mindful of the fact that public institutions at various levels of government are also major users of electricity. They, too, should be partners in the effort to introduce new technologies and new conservation measures, and they, too, should be eligible for support under programs intended to improve our patterns of electricity use.

III. Conclusions and Recommendations

First, despite some modest steps, neither the State nor the electric power industry has been sufficiently aggressive in moving toward an electricity supply system that provides an adequate and reliable supply of electric power without cumulative and unacceptable damage to the local and global environment. The improvements that have been made thus far and that are planned for the next decade —in a diverse mix of primary fuel sources, in reduced carbon and other emissions, in higher efficiency and in conservation measures— fall far short of what is currently possible technically, what is justifiable in a practical sense if the full economic costs of environmental damage are considered, and what is necessary to avoid currently predicted long term global environmental deterioration. Despite the State's recognition for the past 25 years that we need to change our primary fuel source dependence, about 3/4 of our electrical energy continues to come from coal, with its serious environmental shortcomings, and much of the rest comes from nuclear power; less than 10 percent comes from all other sources.

Second, the almost exclusive emphasis in the past on keeping electrical energy prices as low as possible and divorced from serious consideration of environmental concerns, consistent with a reliable supply, is likely to have to be modified in the future and, indeed, should be. Reliability is, and should remain, an important consideration. However, low price as an almost overriding criterion will have to be modified because of the restructuring of the electric industry as a result of both federal and state policies that increasingly allowed market forces to come into play and have reduced a state's ability to maintain a price structure significantly different from that of the surrounding region. The ease with which electricity can be moved over longer and longer distances, and the fact that much of the electricity used in the State is generated (and purchased from) outside the nominal State electrical power generating system, means that the price of electricity will increasingly be determined by regional competitive market considerations and will be less subject to State control.

Furthermore, the Energy Committee believes that the traditional focus on keeping energy prices as low as possible may actually be costing citizens more when the consequent health care and environmental cleanup costs are considered. For example, it was noted earlier in this report that the DOE's federal energy laboratories had produced analyses showing that very significant reductions in pollution and improvements in electrical energy efficiencies could be achieved with retail price increases of less than 10 percent. By limiting the introduction of these available technologies that would slow or even eliminate environmental deterioration, the electrical energy sector forces other costs on society that the citizenry must bear. In the view of the Energy Committee, these costs must be considered when assessing the cost/benefit of new electrical energy technologies.

These latter considerations, in the view of the Energy Committee, justify more stringent regulations by state and federal government to limit emissions from power plants, even though they result in some increased pricing structure to consumers for electricity. Therefore, in the future, the State and its agencies will have to shift the primary emphasis from keeping electrical energy prices at the lowest possible level to ensuring cost-effectiveness

while meeting broader environmental and public health goals and providing a safety net to protect those who would be severely burdened by price increases. The Citizens League has supported conceptually similar safety nets, for example property taxes.

Third, the State's regulatory system is not well suited to deal with the environmental challenges and market restructuring discussed above. The different levels of regulation applied to investor-owned utilities, cooperatives, municipals and independents seriously impair the State's ability to implement new ideas or goals. Treating energy and environmental regulation as fundamentally separate functions leads the agencies responsible for each to give different weight to each, rather than balancing the needs. For the Public Utilities Commission, low cost, reliable electrical energy is the primary goal. Environmental considerations are not ignored, but are clearly secondary. For the EQB, PCA and local planning boards, environmental protection or local considerations are dominant and these agencies have little responsibility for the problems confronting officials charged with assuring a reliable electrical energy supply. The Energy Committee believes that the Governor and the State Legislature must move to achieve a much better integration of these functions.

Fourth, the very notion of State regulation ignores the reality that the electrical power system is regional in nature. The governmental regulatory structures leave a significant gap between state and federal systems—in contrast to the suppliers and distributors themselves, who have long been part of regional consortia. Current actions by FERC suggest that the federal government will, itself, be pushing regions to fill this gap, but there is no evidence that significant state-level initiatives are being undertaken to protect the state's interests. The Energy Committee believes that Minnesota should be actively engaging with its neighboring states in developing regional level planning and regulatory structures and jointly developing a clear vision of the our energy future.

Fifth, the State has not been a leader in the development and implementation of new technologies or new practices that could improve the efficiency of electricity generation, conserve the use of electricity, or minimize the environmental damage associated with it. Given the technical capacity of the State and the economic potential of new technologies in a nation and world increasingly concerned with energy security and environmental protection, this appears to the Energy Committee to be a lost opportunity. We believe that the State should be much more aggressive in promoting and funding pilot programs as well as research and development to speed the introduction of appropriate new technologies and practices. Moreover, the Energy Committee believes that these new programs should reach beyond the producers and distributors of electric power to the user community, particularly industrial users who have the motivation to reduce energy costs and to broaden the range of options available in meeting environmental protection goals, who have the technical capacity to be partners in new developments, and who, in many cases, have already established a record of being able to improve energy efficiency at a rate far greater than the electric power system as a whole.

We believe that the promise of return on investments in research, development and pilot programs warrants additional State investment. However, even before increased resources are devoted to this need, the Energy Committee believes that the mandated conser-

vation set aside now being spent by the utilities on conservation programs should immediately be turned to these broader research and development purposes, engaging a much wider range of players. To do so effectively is likely to require that the funds be administered by an agency of State government. One likely candidate, at least in the short run, would be the Department of Commerce which already has organizational entities that have been involved in energy and environmental planning as well as economic development, and should be able to move quickly to undertake these new responsibilities. Placing responsibility there would also emphasize that these are issues that reach beyond the electricity producers and distributors to society at large.

Sixth, *the Energy Committee believes there is an urgent need to act now.* In this report, goals for the year 2040 have been discussed, not because we propose that the State can afford to wait until 2040 to make the necessary changes, but because the significant changes proposed will take a great deal of time to complete. The other side of that coin is that if these changes are not undertaken immediately and aggressively, there is no possibility that the goals will be achieved. Benchmarks have been proposed at various points in this report for the year 2020 to emphasize that we must be well on our way by that time. However, the next decade will see significant changes in or additions to the electricity supply system that will affect at least 20 percent of the system. It is absolutely vital that the goals proposed in this report be reflected in how those changes and additions are made.

Throughout the meetings that have led to this report, the transmission system has been identified over and over as one of the key limiting elements in moving aggressively toward change and also one of the most difficult challenges for regulators because of the many levels of government involved in planning and siting these lines. For example, the potential wind power from the Buffalo Ridge area of the State is not being fully utilized because of limited transmission capacity. Otherwise attractive generating sites and projects are sometimes impractical because the transmission lines are not adequate.

Although it reached no consensus on the matter, the Energy Committee pointed out the need for the planning and operation of the transmission system to be made more responsive to the goals of improving the mix of primary fuels, reducing dependence on coal, facilitating a range of options for co-generation and distributed generation, and encouraging experiments with new technologies. For example, it was suggested that the transmission system might be more responsive if it were organized as part of the region's social and economic infrastructure— planned and operated more like the highway system than the telephone system. Although the Energy Committee did not explicitly endorse this particular suggestion, it did come to the conclusion that this is a large enough and important enough issue that it should be addressed immediately by state and regional authorities in order to remove this bottleneck to electric power system progress

Many of these proposals will require significant changes to state government organization and policy, a challenge to the new governor and new legislature. Perhaps chief among these challenges is the integration of responsibility for energy and the environment. In the view of the Energy Committee, the absence of a single State officer, charged with and empowered to deal with both electric energy and environmental goals, is in large part responsible for

the slow pace of progress in meeting electric energy goals that the State has long endorsed. It is urgent that this situation be corrected. The Energy Committee has not proposed a precise organizational structure, but we believe that energy and environment must be subsumed in the same administrative unit—a Commissioner-level department within the executive branch. We believe it is not adequate to deal with the challenge merely by coordinating the work of several departments because such approaches tend to be slow and inefficient. They treat coordination as the last step in a process driven primarily by the separate interests of the agencies involved. A properly organized department would consider energy and environment at every stage of its planning and regulatory activities. This clearly presents a practical challenge in breaking up the overall task into encompassible pieces, but there appear to be a number of reasonable approaches—for example, separating responsibilities for different primary energy sources.

Whatever organizational structure is ultimately chosen, it will also be important that the new department or agency have both the power and the flexibility to work with other regional governmental units and with FERC. These other organizations are, themselves, just developing, which only increases the need for flexibility and for sufficient stature to be able to make commitments on the part of the State administration.

The Energy Committee believes that these are issues that demand serious and early attention by the Governor, the Legislature, other levels of government, and the people of Minnesota. For too long, systemic inertia has kept us from achieving our own goals and the very long time scale of change in the environment has kept us from accurately assessing how serious a problem that is. Government and societies usually do not respond effectively to problems that develop over a long period of time. It is sometimes remarked that "the urgent displaces the important." Our fear is that the "important" will become the "urgent" when it is too late to avoid the worst consequences. Our hope is that we will heed early warnings and act now.

THE WORK OF THE CITIZENS LEAGUE STUDY COMMITTEE

Charge to the Study Committee

The Citizens League Board of Directors approved the following charge to the committee on electricity reliability for the state of Minnesota:

> With the marketplace for energy increasingly crossing state and national borders, what is the state's role in terms of supply, conservation, and market restructuring? What policies should Minnesota adopt in those areas where there is a significant state role?
>
> In preparing for Minnesota's future energy needs, how should we balance affordability, reliability and environmental soundness?

Committee Membership

The *Citizens League Study Committee on Electricity Reliability in Minnesota* was co-chaired by Andrew Brown and Kenneth Keller. A total of 34 individuals took an active part in the committee. The committee met 23 times between July 17, 2001 and August 12, 2002. The Citizens League Board of Directors approved the report on November 22, 2002. In addition to the chairs, the members of the committee were:

David Alden
Alan Anderson
Al Giesen
Lynn Gitelis
Sharon Hansen
Michael Hohmann
Lincoln Hudson
Charles Jorgensen
Jim Jorgenson
Phyllis Kahn
Shef Lang
Charles LaVine
Todd Lefko
Dee Long
Robert McCrea
Bob Minton
Patrick O'Leary
Deb Osgood
Bharat Parekh
James Payne
Douglas Reeder
Ken Reine
Jack Rossmann
Jim Schneider
Alan Shilepsky
Erika Sitz
G. Richard Slade
Russell Susag
Orlan Thorbeck
Albert Trostel
Hugh Tyndall
Robert White

Meetings and Resource Testimony. Resource testimony was provided to the members of the Committee by the following people:

Prof. Dean Abramson—University of Minnesota, Humphrey Institute
Jim Alders—Xcel Energy
Keith Butcher—Center for Energy and Environment
Steve Corneli—Minnesota Attorney Generals Office
Max DeLong—Xcel Energy
John Derus—Metro Counties Energy Task Force
David Detton—Dorsey & Whitney, LLP
Kim Erickson—Xcel Energy
Bill Grant—Isaak Walton League
Peter Grills—O'Neill, Grills & O'Neill, PLLP
J. Drake Hamilton—ME3
Martha Hewett—Center for Energy and Environment
Michele Beck Jensen—Great River Energy
Ken Keller—University of Minnesota, Humphrey Institute
Sen. Steve Kelley—Minnesota Senate
Rick Lancaster—Great River Energy
Dee Long—ME3
Dr. David Morris—Institute for Local Self Reliance
Jim Muffat—3M
Michael Noble—ME3
Greg Oxley—Minnesota Municipality Utilities Association
Mike Pignato—Dorsey & Whitney, LLP
Judy Poferl—Xcel Energy
Anders Rydaker—District Energy St. Paul
Matt Schuerger—Isaak Walton League
Steve Schultz—3M
Ann Seha—Minnesota Department of Commerce
Linda Taylor—Minnesota Department of Commerce
Prof. Jim Vincent—University of St. Thomas
Rep. Ken Wolf—Minnesota House of Representatives

Staffing. Scott McMahon staffed this committee with assistance from Lyle Wray. Trudy Koroschetz and Gayle Ruther provided administrative support.

Acknowledgements: Thanks to the University of Minnesota, Carlson School of Management and the Humphrey Institute for providing meeting space to the committee.

A special thanks to Marsha Riebe at the Humphrey Institute and Bob Cupit from the Minnesota Department of Commerce for their support to the committee.

WHAT IS THE CITIZENS LEAGUE

The Citizens League promotes the public interest in Minnesota by involving citizens in identifying and framing critical public policy choices, forging recommendations and advocating their adoption.

The Citizens League has been an active and effective public affairs research and education organization in the Twin Cities metropolitan area for 50 years.

Volunteer research committees of League members study policy issues in depth and develop informational reports that propose specific workable solutions to public issues. Recommendations in these reports often become law. Over the years, League reports have been a reliable source of information for governmental officials, community leaders, and citizens concerned with public policy issues of our area.

The League depends upon the support of individual members and contributions from businesses, foundations, and other organizations throughout the metropolitan area.

RECENT CITIZENS LEAGUE REPORTS

These reports are the product of the League's unique program of citizen-based research. To order copies, use the form in this report. Earlier reports are available on request, call the CL office at 612-338-0791.

A Failing Grade for School Completion: Increasing School Completion in Mpls & St. Paul	8-01
Meeting Every Child's Mental Health Needs: A Public Priority	1-01
Mental Health in the Workplace: An Issue for one in five employees	1-01
Assessing Minnesota's Property Tax: Improving Affordability	8-00
From Jobs for Workers, to Workers for Jobs	11-99
Seniors with Disabilities: Getting Ready for the Aging Boom	9-99
What's on the Public Agenda?	5-99
A New Wrinkle on Aging: Baby Steps to 2030	12-98
Help Wanted: More Opportunities than People	11-98
A Competitive Place in the Quality Race: Putting the Univ. of MN in the Top Five	1-98
It Takes a Region to Build Livable Neighborhoods	2-97
Straight "A"s for Minnesota's Schools	2-97
Compete Globally, Thrive Locally: What the Public Sector Should do.....	9-96
Building a Legacy of Better Value: Choose Reform, Not Declining Quality	8-15-95
Effective Transit: Invest in access to jobs and services	1-95
The Case for a Regional Housing Policy in the Twin Cities Metropolitan Area	5-94
Minnesota's Budget Problem: A Crisis of Quality, Cost and Fairness	7-13-93
Results for Citizens, Options for Officials	6-16-92
Reform the Electoral Process, Restore the Public Trust	5-28-92
The Party Caucus: An Inquiry	4-5-91
New Regional Approaches to Library Services: Long Overdue	2-25-91
Large Trucks: A Small Piece of A Larger Problem	1-24-91
Remaking the Minnesota Miracle: Facing New Fiscal Realities	10-8-90
Because That's Where the Money Is: Why the Public Sector Lobbies	6-28-90
Does the System Maltreat Children?	4-3-90
Wiring Minnesota: New State Goals for Telecommunications	11-16-89
Losing Lakes: Enjoyment of a Unique Metropolitan Resource is Threatened	11-8-89
Access, Not More Mandates: A New Focus for Minnesota Health Policy	9-21-89
Community: A Resource for the '90s	7-25-89
The Metropolitan Council: Strengthening Its Leadership Role	3-23-89
Building Tomorrow by Helping Today's Kids	12-16-88
Chartered Schools = Choices for Educators + Quality for All Students	11-17-88
Cut Tax Exemptions, Boost Equity and Accountability	10-20-88
Stopping AIDS: An Individual Responsibility	5-09-88
The Public's Courts: Making the Governor's Nominating Process Statutory	1-28-88
Make the Present Airport Better-Make A New Airport Possible	12-17-87
Cooperatively-Managed Schools: Teachers as Partners	8-05-87
The New Weigh to Recycle	5-22-87
First Class Property Tax System	4-27-87
Start Right with "Right Start": A Health Plan for Minnesota's Uninsured	2-24-87
New Destinations for Transit	10-28-86
Commitment to Focus: More of Both	8-27-86
State Civil Service: People Make the Difference	6-12-86
It's Only a Game: A Lottery in Minnesota	2-11-86
Adaptability--The New Mission for Vocational Education	1-08-86
A Strategy for the Waterbelt	11-22-85
Power to the Process: Making Minnesota's Legislature Work Better	9-19-85
Accountability for the Development Dollar	6-20-85
Building on Strength: A Competitive Minnesota Economic Strategy	11-28-84
A Larger Vision for Small Scale Agriculture	9-25-84
The Metro Council: Narrowing the Agenda and Raising the Stakes	6-07-84
The Region's Infrastructure: The Problem Isn't What You Think It Is	5-30-84
Meeting the Crisis in Institutional Care: Toward Better Choices, Financing and Results	4-24-84
A Farewell to Welfare	2-07-84
Homegrown Services: The Neighborhood Opportunity	11-03-83
Use Road Revenue for the Roads That Are Used	3-02-83
Workers' Compensation Reform: Get the Employees Back on the Job	12-15-82

RECENT CITIZENS LEAGUE STATEMENTS

These statements update the League's positions on key issues. No charge for a copy of League statements.

Securing Minnesota's Economic Future	5-2000
Statement on the Proposed Education Diversity Rule	11-24-97
Letter to the Board of Regents at the University of Minnesota: re: General College	4-10-96
Regional Challenges and Regional Governance	4-8-93
Health-Care Access for All Minnesotans	2-20-92
Testing Health-Care Workers for the AIDS Virus	12-11-91
Light Rail Transit: The Regional Transit Board's Proposal to the 1991 Minnesota Legislature	1-24-91
Letter to Legislature from Community Information Committee re: Financing at the University of Minnesota	4-07-89
Statement on Changing the Fiscal Disparities Law	1-15-88
Statement to the Governor & Legislature on Transportation Financing in 1988	1-04-88
Statement to Legislative Commission re: Road Financing	10-12-87
Statement to University of Minnesota Regents re: Commitment to Focus	7-7-87
Statement to Governor and Legislature on Innovation and Cost Control	4-8-87
Selection of a New State Commissioner of Transportation	10-30-86
Letter to Regional Transit Board re: Metro Mobility Price Competition Ideas	6-12-86
Testimony to Legislature on Bloomington Stadium Site Bill	2-20-86
Letter to Regional Transit Board re: Policy Committee's Study of Metro Mobility	12-6-85
Statement to House Tax Subcommittee on Fiscal Disparities	10-31-85
Statement to Legislature on Preserving Metropolitan Tax-Base Sharing	9-6-85
Statement to Legislature & Metro Council on Bloomington Development Proposal	8-15-85
Statement to Metropolitan Council on Organized Collection of Solid Waste	4-24-85
Statement to Metropolitan Council on Long-Term Care	3-8-85
Statement on Transit Alternatives	1-23-85
Statement on Solid Waste Disposal	1-21-85
Statement to Tax Study Commission	8-22-84
Statement on Light Rail Transit	4-6-84
Statement to Legislative Study Committee on Metropolitan Transit	12-15-83
Statement to Governor's Tax Study Commission	11-22-83
Statement to Minnesota's Highway Study Commission	9-29-83
Statement on the Metropolitan Council's Proposed Interim Economic Policies	8-29-83
Statement to Minneapolis. Charter Commission: Proposal to have Mayor as non-voting member of Council	8-11-83
Statement to Metropolitan Council & Richard P. Braun, Commissioner of Transportation on Preferential Treatment in I-35W Expansion	7-21-83
Statement to Members, Steering Committee on Southwest-University Avenue Corridor Study	7-19-83
Statement to Commission on the Future of Post-Secondary Education in Minnesota	6-22-83
Statement to the Metropolitan Health Board	6-20-83
Appeal to the Legislature and the Governor	4-26-83
Citizens League Opposes Unfunded Shifts to Balance Budget	12-1-82
Longer-Term Spending Issues Which the Governor and Legislature Should Face in 1982	1-18-82
Statement Concerning Alternatives to Solid Waste Flow Control	1-12-82
Amicus Curiae Brief in Fiscal Disparities Case, *filed*	12-17-81
Statement to the Minnesota State Legislature Regarding the Reconstruction Project	12-14-81
Letter to the Joint Legislative Commission on Metropolitan Governance	11-13-81
Statement to Metropolitan Health Board on Phase IV Report	11-4-81
Statement to Metropolitan Council on I-35E	9-24-81
Statement to Minneapolis Charter Commission	7-6-81

CITIZENS LEAGUE CORPORATE AND BUSINESS MEMBERSHIP CONTRIBUTIONS:

Gold Members ($20,000-$24,999)

Wells Fargo Minnesota
General Mills Foundation

Silver Members ($10,000-$19,999)

The St. Paul Companies Inc. Foundation
St. Jude Medical Foundation
Star Tribune
U.S. Bancorp Foundation

Bronze Members ($5,000-$9,999)

Aid Association for Lutherans/Lutheran Brotherhood
American Express Financial Advisors
Cargill Foundation
Medtronic Foundation
Target Corporation

Partners ($1,000-$4,999)

The Dorsey & Whitney Foundation
Andersen Corporation
Faegre & Benson Foundation
3M Foundation
ING Foundation
Minnesota Association of Realtors
Minnesota Mutual Foundation
Preferred One*
Prudential Financial
Tennant Foundation
Best and Flanagan LLP*
Creative Carton*
Fredrickson & Byron
Hubbard Broadcasting Inc.
Qwest
RBC Dain Rauscher Foundation
Workers' Compensation Reinsurance Association

Sponsors ($500-$999)

KPMG
G & K Services
Academic Health Center Communications
AmeriPride Services Inc.
BORSON Construction*
Cincinnatus, Inc.
Culligan Water Conditioning Company
Gray Plant Mooty Foundation
H.B. Fuller Company
Northeast Bank*
Port Authority of the City of St. Paul
Smith Parker
Springsted, Inc.
U-Care Minnesota*
Wells Fargo Financial

* New Corporate Donors

CommunityAction

GENERAL MILLS

Tennant Foundation

CITIZENS LEAGUE PUBLICATIONS

PRICE LIST

Use the coupon below to order any reports or statements and copies of:

Minnesota Homestead Property Tax Review 2001
(December 2001 issue of the *Minnesota Journal*) $2.00
and available online at **www.citizensleague.net**

2002 Public Affairs Directory	**Members**	**Non-members**
1 copy	$15.00	$20.00
2 - 10 copies, *each*	$12.00	$16.00
11 copies or more, *each*	$9.00	$12.00

Postage and Handling: **$1.50 1st copy; $1.00 each additional copy**

STUDY COMMITTEE REPORTS	**Free**	$10.00

==========

CITIZENS LEAGUE PUBLICATIONS

ORDER COUPON

Quantity	**Publication**	**Cost**
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
	Subtotal:	$_____
	Postage & Handling: (**PAD** only)	$_____
	Total:	$_____

Ship to: Name _____

Address _____

City, St, Zip _____

Phone _____

Form of payment: Check enclosed:_____
Credit card: Visa____Master Card____Discover____Am. Exp.____

Account #_____Exp. Date_____
Signature_____

I am interested in receiving Citizens League membership information:____

Mail to: Citizens League, 708 So. Third St, Ste 500, Minneapolis, MN 55415 or Fax: 612-337-5919