

BEFORE THE MINNESOTA
OFFICE OF ADMINISTRATIVE HEARINGS
600 North Robert Street
P.O. Box 64620
St. Paul, MN 55164-0620

FOR THE PUBLIC UTILITIES COMMISSION
121 Seventh Place East Suite 350
St. Paul, Minnesota 55101-2147

**In the Matter of the Application of Great
River Energy, Northern States Power
Company (d/b/a Xcel Energy) and others
for Certificates of Need for the Cap X 345-
kV Transmission Projects.**

**OAH Docket No.15-2500-19350-2
PUC Docket No. CN-06-1115**

DIRECT TESTIMONY OF ARNE C. KILDEGAARD

On Behalf of

INTERVENORS

CITIZENS ENERGY TASK FORCE

May 23, 2008

Exhibit _____

1 INTRODUCTION

2 **Q. Please state your name and address.**

3 A. My name is Arne C. Kildegaard and my address until June 25, 2008, is: Børnehøjen
4 59, Himmelev, 4000 Roskilde, Denmark. From June 25th forward, my home address is
5 23161 469th Ave., Morris, MN 56267.

6
7 **Q. What is your primary work and what is your business address?**

8 A. My primary work is as an Associate Professor of Economics and Management at the
9 University of Minnesota in Morris, Minnesota 56267. Currently, I am a visiting
10 researcher in the Energy Systems Analysis division of Risø National Laboratory/Danish
11 Technological University (DTU) during my 2007-2008 academic year sabbatical from
12 the University of Minnesota.

13
14 **Q. Who are you representing in this proceeding?**

15 A. In this proceeding, I am offering my testimony on behalf of Citizens Energy Task
16 Force, a grass roots organization of community members concerned about the impacts of
17 the proposed CapX 2020 transmission expansion and the choices in energy generation,
18 conservation, economic and environmental costs that the proposal reflects. I am not
19 receiving any fees for providing expert testimony. I consider providing testimony as an
20 appropriate form of civic engagement for a professor employed in the State of Minnesota
21 higher education system, and my only interest is to assist the state in making
22 economically reasonable and efficient choices in selection of energy projects.

23
24 **Q. Please briefly state your qualifications to render an expert opinion in this
25 matter.**

26 A. I received a B.A. from Gustavus Adolphus College in St. Peter, Minnesota in June
27 1981, a Masters degree from the University of Chicago in 1987 and a Ph.D. in Economics
28 from the University of Texas at Austin in 1994. I have taught economics in research
29 university settings in the United States, Mexico and Denmark for more than fifteen years.

1 I began teaching as an Associate Professor of Economics and Management at the
2 University of Minnesota in Morris, Minnesota in 2001 and was awarded tenure in May
3 2004. My teaching specialties are environmental and natural resource economics, as well
4 as international economics. In addition to my current sabbatical in Denmark, I have been
5 an invited lecturer in Denmark and Mexico, an Advisory Board Member for the North
6 American Economics and Finance Association and the Faculty Director for the
7 University of Minnesota, Morris, Center for Small Towns. I've received more than a
8 dozen grants for study and research, including research on the economics of community
9 wind projects, development of biomass, economic impediments to renewable energy
10 technology and adapting to change in rural communities.

11
12 I have authored or co-authored approximately 15 publications in peer-reviewed journals
13 and served as a peer-reviewer for international professional journals in the field,
14 including *Energy Journal* and *Energy Policy*. I have also presented approximately 20
15 papers at international professional conferences, including papers published in conference
16 proceedings. Much of my published work pertains to the economic analysis of renewable
17 and non-renewable energy and policy options. I am familiar with the principles of
18 economic rationality in policy making and the way in which these principles are
19 specifically applied to energy alternatives and choices. My published work includes
20 analysis of Minnesota laws and policies from an economic perspective and comparisons
21 between the local economic effects of wind depending on ownership structures. My
22 curriculum vitae is provided as Kildegaard Attachment 1.

23
24 **Q. Are you familiar with the CapX 2020 high voltage transmission line proposal?**

25 A. In order to determine whether it would be appropriate for me to testify in this matter, I
26 reviewed the CapX 2020 Application for Certificate of Need and Attachments and other
27 materials pertaining to this proposal.

28
29 **Q. What documents and materials have you reviewed in connection with this**
30 **matter?**

1 A. In addition to the CapX 2020 Application and Attachments, I have reviewed various
2 Information Requests of parties, Responses of Applicants and other documents available
3 through the efilng system and other Internet sites. I have also reviewed the
4 Environmental Report prepared by the Department of Commerce in this matter and
5 various parts of the record in the Big Stone transmission case, including the
6 Administrative Law Judges' Supplemental Findings of Fact, Conclusions of Law and
7 Recommendation dated May 9, 2008, attached hereto as Kildegaard Attachment 2.

8
9 **Q. What else have you done to become familiar with the CapX 2020 proposal and to**
10 **develop your expert opinions regarding this matter.**

11 A. I was first contacted regarding the CapX 2020 transmission project by Bev Topp, one
12 of the community members involved with Citizens Energy Task Force. I also discussed
13 these projects informally with colleagues and reviewed some of the literature pertaining
14 to the real costs of non-renewable energy generation and the feasibility of generation near
15 load as an alternative to the proposed CapX 2020 expansion. It is customary in my work
16 to consult with colleagues and to review the published literature to develop and verify
17 expert opinions. Specific articles which I reviewed in the course of developing my
18 opinion are referenced in Kildegaard Attachment 3.

19
20 **SUMMARY**

21 **Q. Please summarize your testimony.**

22 A. Based on the information I've reviewed in this record, I am recommending that the
23 Public Utilities Commission determine that the burden of proof has not been met to
24 justify issuing a certificate of need for any of the CapX 2020 high voltage power lines.
25 Although there are unique issues for each of the proposed CapX 2020 projects, this
26 recommendation applies to the proposed Twin-Cities LaCrosse, Wisconsin 345 kV
27 Project, the proposed Twin Cities- Fargo, North Dakota 345 kV Project and the proposed
28 Twin Cities – Brookings, South Dakota 345 kV Project. Where my testimony refers to
29 the "CapX 2020 transmission expansion projects" it is meant to refer to all of the
30 proposed CapX 2020 projects in this Application.

1 In my opinion, the Applicants’ attempt to separate the consideration of transmission from
2 generation does not meet the test of economic rationality. The information provided by
3 the Applicants does not comply with pertinent statutes pertaining to conservation and
4 renewable energy and does not permit either regulators or citizens to evaluate the true
5 costs or benefits of the proposals.

6
7 Although the information provided by Applicants is deficient, my experience suggests
8 that there are credible alternatives to the CapX 2020 high voltage transmission line
9 expansion that were apparently not evaluated by the Applicants that could reduce costs,
10 regulatory risks and environmental harms, while providing greater socioeconomic
11 benefits than the proposed CapX 2020 projects.

12
13 My testimony explains the deficiencies in the justification for the CapX 2020 projects
14 and explains some specific considerations that should be used by state officials and
15 regulators in determining what would be an economically reasonable choice to meet
16 energy demand.

17
18 **DISCUSSION**

19 **Q. Have Applicants provided an economic analysis of the full range of potential**
20 **costs and benefits of the CapX 2020 project?**

21 A. No. The Applicants have not provided an integrated cost analysis of transmission and
22 generation expansion. Because they have not provided reasonable estimates for their
23 implicit generation scenario, it is impossible to make a thorough comparison with
24 alternatives, such as generation-near-load or remote wind power combined with
25 compressed air storage.

26
27 **Q. Is the CapX 2020 proposal “generation neutral”?**

28 A. Applicants are on the record at several places in the official proceedings as arguing
29 that the proposed transmission plan is “generation neutral.” (See for example, Applicants’
30 Request for Exemption, February 5, 2007, p. 5 and Applicants’ Reply to Comments on
31 Incompleteness, October 8, 2008, p. 10-11). Applicants have argued that this neutrality

1 exempts them from pertinent statutory requirements regarding the proposal and
2 permitting of generation resources.

3
4 Applicants' argument that the proposed CapX 2020 transmission is "generation neutral"
5 (because it cannot distinguish a "green" from a "brown" electron) is correct in an
6 engineering sense, but it is incorrect in an economic sense: generation and transmission
7 cannot be separated without sacrificing economic rationality.

8
9 **Q: Why is it economically irrational to separate generation from transmission?**

10 A. The presence or absence of conveniently located transmission affects the economic
11 viability of current and future generation assets, not unlike the way in which a highway
12 from a center city affects real estate values in the suburbs along the new route. Once the
13 network has been laid down (and the costs "sunk"), certain forms of generation in certain
14 locations and at certain scales will be economically advantaged relative to others.

15
16 Once in place, the transmission network largely determines (economically) the form and
17 location of future generation expansion. From the perspective of rationally minimizing
18 the cost of providing power, the time to consider the costs of expanding the system is
19 before the transmission network is laid in place.

20
21 Different forms of generation have different costs that are highly geographically specific.
22 For example: a coal-fired plant must be located either near the mine mouth or near an
23 appropriate rail link; a compressed air storage facility must be located above an
24 appropriate geological formation, with an appropriate wind resource at the surface; a
25 natural gas-fired generator must be located near a natural gas pipeline; etc..

26
27 To lay out a transmission network without regard to the underlying economics (including
28 environmental and regulatory costs and risks) of different generation sources is to "pick
29 winners" in a way that will not minimize costs for ratepayers.

1 **Q. How could an economic analysis be done with respect to the CapX 2020 project,**
2 **where Applicants have not asserted that any particular energy generation facilities**
3 **are contemplated?**

4 A. In both Appendix A-1 of the Application and in the discovery phase of these
5 proceedings, Applicants have released a fairly detailed description of their energy
6 generation assumptions (although not of the associated costs). The Applicants Response
7 to NAWO/ILSR Information Request No. 12, which reflects these energy generation
8 assumptions, is attached as Kildegaard Attachment 4a and 4b. The energy generation
9 assumptions for the CapX 2020 transmission expansion projects include substantial base
10 load coal generation and peaking natural gas generation as well as wind energy
11 installations, primarily in locations remote from load.

12
13 The starting place for this analysis should be to evaluate the costs of the energy
14 generation alternatives in the assumptions for the CapX 2020 modeling, including the
15 three scenarios developed in the CapX 2020 study referenced in Application A-1 and the
16 Applicants Response to NAWO/ILSR Information Request 12, described previously.

17
18 If Applicants believe that the predicted energy generation expansion scenarios have
19 changed substantially since these assumptions were developed, it should be incumbent
20 upon them to describe the changes predicted and to explain why the modeling process
21 itself should not be repeated with new assumptions.

22
23 **Q. Is it significant that the scenarios for energy generation assumed in the**
24 **Applicants' CapX 2020 model have a substantial proportion of base load coal**
25 **generation?**

26 A. Yes. To the extent that the strategy for meeting demand in the CapX 2020 vision relies
27 on fossil-fuel generation, building the infrastructure for that future commits ratepayers to
28 shouldering significant regulatory risks.

29
30 There is substantial research evidence that failure to internalize environmental costs from
31 coal-fired plants masks the costs of such generation, and consequently exposes ratepayers

1 to regulatory risk. Dewees (2008), for example, in a study of the ECAR region (roughly
2 speaking: Indiana, Ohio, and Michigan) demonstrates that environmental costs from coal-
3 fired plants for criteria pollutants, if internalized in an economically rational way, would
4 roughly double the wholesale price of power. There is an unmistakable trend in federal
5 regulation over the last three decades towards internalizing such external costs.

6
7 The likelihood of carbon regulation in the near future poses further price risk to
8 electricity consumers dependent on carbon-intensive technologies. The PUC has
9 established a range of values for regulatory risk (\$4-\$30 per ton of carbon dioxide
10 equivalent, for all greenhouse gases) and ordered utilities to apply these estimates in all
11 proceedings to acquire new sources of generation for Minnesota customers, starting in
12 2012.

13
14 Regulatory risks of this nature expose Minnesota ratepayers to substantial future costs.
15 For purposes of comparison, these costs should be analyzed and articulated by the
16 Applicants, but there is no evidence of this in the CapX 2020 proceeding records.

17
18 **Q. Based on your training and experience do you have an opinion as to the economic**
19 **reasonableness of the CapX 2020 proposal?**

20 A. On the basis of my training and general understanding of power system economics,
21 my best judgment is that, if all costs are included, the CapX 2020 alternative may be
22 more costly than alternatives including generation near load with a greater proportion of
23 renewable energy. The absence of full cost accounting in the Application prevents
24 confirmation of this judgment.

25
26 **Q. How would you suggest that the question of meeting demand for reliability and**
27 **load growth be approached?**

28 A. From an economic perspective, electric service reliability is not a binary variable.
29 Reliability is subject to sharply increasing marginal costs, suggesting that there may be
30 strategies which are more cost-effective than providing an absolute security of supply,
31 particularly to address peak spikes in demand.

1
2 There are many ways to approach matters of reliability and load growth, including i)
3 conservation (“negawatts”); ii) generation near load with local grid re-enforcement; iii)
4 voluntary curtailment at a price; and iv) expanded transmission with expanded generation
5 at remote sites. To determine how best to provide adequate reliability and service load
6 growth, each of these strategies should be analyzed in terms of efficacy and cost. This
7 Application is heavily weighted in favor of (iv) and does not seriously consider the other
8 alternatives for addressing reliability and load growth. Furthermore, as discussed above,
9 the full costs of (iv) are not articulated in the Application.

10
11 **Q. Do you have an opinion as to the availability of a reasonable alternative or**
12 **alternatives to the CapX 2020 transmission proposal?**

13 A. As I understand Minnesota’s statutory scheme, cost-effective demand side
14 management must be considered as an alternative if it can displace all or a part of demand
15 for a large energy facility. Despite the disappointing history of utility-sponsored energy
16 conservation, there are various strategies for cost-effective conservation that could play a
17 significant role in reducing the demand reflected in the CapX 2020 Application.

18
19 **Q. Please explain how conservation could effectively play a role in reducing the**
20 **demand reflected in the CapX 2020 Application.**

21 A. It is recognized in much of the literature that utility-sponsored energy conservation has
22 generally not been cost-effective. Many feared that these programs, limited as they were,
23 would be orphaned by the introduction of competition into electricity markets.

24
25 But competition in energy markets has also brought about the use of many innovative
26 market-oriented incentive schemes (for example: trading in green certificates; trading in
27 emissions permits; trading in sensitive lands development rights), and these kinds of
28 incentive systems can also be applied to develop cost-effective conservation programs.
29 Recent experience with “white certificates” for energy conservation has resulted in
30 significant conservation in Italy and Australia, and these instruments are being widely
31 adopted elsewhere. Minnesota has recently passed a mandate for conservation, and a

1 system of tradable white certificates would be a logical next step in achieving the State's
2 targets in this area.

3
4 The potential savings through energy conservation should be analyzed and compared to
5 costs of additional generation and transmission. Specific strategies to maximize cost-
6 effective conservation, such as a certificate program, should be compared to the full costs
7 of the CapX 2020 system before billions of dollars are invested in new generation and a
8 bulk power transmission system to meet projected demand.

9
10 **Q. In addition to maximizing cost-effective conservation, do you have an opinion as**
11 **to the availability of a reasonable alternative or alternatives to the CapX 2020**
12 **transmission proposal?**

13 A. Generation-near-load may be a reasonable alternative to high voltage transmission line
14 expansion, particularly for the Twin Cities – LaCrosse and Twin Cities – Fargo projects,
15 which are asserted in the Application to be needed for community service reliability.

16
17 **Q. Does the Application appropriately analyze the alternative of generation near**
18 **load?**

19 A. No. The dismissive consideration which this alternative is afforded in the Application
20 (Chapter 7.3) is superficial, mathematically flawed and incorrectly framed.

21
22 To achieve the same reliability as transmission in the brief calculation on p. 7-14,
23 Applicants argue correctly that redundant capacity would be necessary (since generating
24 unit availability does not match transmission availability), however they calculate the
25 amount incorrectly. Given the probabilities assumed, the targeted reliability of 99 percent
26 would be met with *three* additional generating plants, rather than the *four* claimed.

27 Therefore, estimated costs as reported are 33 percent too high.

28
29 More importantly, Applicant's analysis in Chapter 7.3 is poorly framed and compares
30 unlike measures. The Application compares the *reliability* of the proposed CapX 2020
31 transmission lines to the *cost and reliability* of generation-near-load.

1
2 A valid comparison would include all of the costs of each approach to achieve a given
3 level of reliability. The cost of the capacity to meet community service needs would have
4 to include not just the allocated cost of the CapX 2020 transmission expansion but also
5 the costs of the generation capacity (including environmental costs and regulatory risks),
6 the costs of line losses along the transmission system, variable costs of fuel inputs, as
7 well as other operation and maintenance expenses.

8
9 **Q. In evaluating the alternatives and costs to provide community service reliability,**
10 **are there any other factors that might influence the comparison?**

11 A. The comparison would become sharply more favorable to generation-near-load if the
12 utility identified customers whose load could be curtailed at a cost below the cost of
13 peaking power.

14
15 **Q. How could voluntary curtailment provide a reasonable alternative for any of the**
16 **needs asserted in the CapX 2020 Application?**

17 A. The CapX 2020 high voltage transmission lines are proposed as a way to provide
18 guaranteed continuous service to all customers at winter and summer peak demands in
19 the event of multiple adverse contingencies related to transmission and generation that
20 could overload the transmission system.

21
22 This is not likely to be the most reasonable or cost-effective way to address voltage
23 fluctuations, since electricity generation is subject to sharply increasing marginal costs
24 during key peak hours of the year. It is certainly cheaper to contract with selected
25 customers for voluntary load curtailment during these few peak hours, rather than to pay
26 the extreme costs associated with guaranteed continuous service.

27
28 The “value of [involuntarily] lost load” (VOLL) is a standard industry measure, and is
29 sometimes used as an input for determining the optimal rates of reliability. I can find no
30 reference to such a calculation anywhere in the Application or supplementary filings.

31

1 Voluntary curtailment appears to be one of the strategies to manage demand employed by
2 Xcel Energy as part of its “SmartGrid” pilot project in Boulder, Colorado, but it is
3 certainly not unique to any single project or location.
4

5 **Q. Would voluntary curtailment would meet all the needs for community service**
6 **reliability described in this Application?**

7 A. It is highly unlikely that a level of voluntary curtailment sufficient to meet *all* the
8 needs of communities like Rochester and Alexandria would be feasible and cost-
9 effective. But this strategy, along with conservation and energy efficiency would reduce
10 the size of new generation facilities needed and improve the economics of generation
11 close to load.
12

13 **Q. What type of energy facility should be considered as an alternative for generation**
14 **near load?**

15 A. Once cost-effective conservation and load management have been maximized,
16 renewable energy alternatives should be prioritized to evaluate cost-effective generation
17 near load. Base load wind energy combined with natural gas back-up is an economically
18 viable technology under a wide range of fuel price, carbon price, and pollution price
19 scenarios. Compressed air storage is a reasonable alternative to firm up wind generation
20 availability and is being deployed in Iowa as well as in Europe
21

22 **Q. Is the Environmental Report sufficient to demonstrate that the alternatives to**
23 **the CapX 2020 proposal that you describe are not reasonable, cost-effective**
24 **alternatives to the CapX 2020 transmission expansion?**

25 A. No. The Environmental Report commits many of the same errors as does the
26 Application and fails to demonstrate that conservation, load management and generation-
27 close-to-load separately or in combination are not reasonable, cost-effective alternatives
28 to the CapX 2020 transmission expansion.
29

30 **Q. Please explain your concerns about the analysis in the Environmental Report?**

1 A. Although the Environmental Report prepared by the Department of Commerce
2 provides more information about the potential alternative of generation-close-to-load than
3 the Application, the Environmental Report repeats the Applicant’s conceptual error: the
4 transmission and generation costs of the “alternative” are compared with the transmission
5 costs alone of the proposed project.

6
7 The following quote is illustrative: “In addition, the generation alternative may not
8 provide comparable local load serving and reliability benefits that the CapX
9 Transmission Project seeks to provide by building generation facilities in the
10 communities. Natural gas fired generation would have significantly higher long term fuel
11 and operation costs than transmission lines due to the high cost of fuel, fixed and variable
12 costs of natural gas-fired generation facilities. Transmission lines have very low
13 operation and maintenance costs in comparison” (p.90, DOC Environmental Report).”

14
15 The problem with such a comparison is that transmission systems do not power
16 themselves. They are reliant, ultimately, on generation – all sources of which are
17 intermittent to some degree.

18
19 Likewise, the Environmental Report estimates the air quality impacts of a natural gas
20 “alternative” generation-near-load scenario (p.88), and the air quality impacts of the
21 proposed Cap-X transmission project (p. 35), but, remarkably, does not consider the air
22 quality impacts of the generation that would be transmitted along the proposed CapX
23 2020 transmission lines, which is modeled to include large quantities of both coal and
24 natural gas. Emissions are overwhelmingly associated with the generation rather than the
25 transmission of power, so this comparison is fundamentally flawed.

26
27 **Q. Does the Environmental Report analyze conservation and load management as**
28 **an alternative to meet all or part of the energy demand through 2020?**

29 A. Conservation receives three brief paragraphs of attention in the Environmental Report
30 (p. 90), most of which are devoted to a discussion of Minnesota statutes. The
31 Environmental Report concludes, unfavorably, that stand-alone conservation is not a

1 substitute for the Cap-x Group 1 transmission project. In my opinion, there is no evidence
2 in the record that the contribution conservation might make to limiting load growth or
3 bolstering local reliability of supply has been duly appraised.

4
5 **Q. Have you reviewed the proposal for the Twin Cities –Brookings, South Dakota**
6 **high voltage transmission line to evaluate whether it provides a cost-effective**
7 **alternative to increase generation outlet capacity for renewable generation?**

8 A. Yes.

9
10 **Q. And have you reached any conclusions as to whether the Twin Cities-Brookings**
11 **project is a reasonable project to increase generation outlet capacity for renewable**
12 **generation on the Buffalo Ridge?**

13 A. The Application is insufficient to establish the reasonableness of the Twin Cities-
14 Brookings project. Although the Application states that generation outlet capacity for
15 renewable generation is the primary driver for the Twin Cities- Brookings project, it does
16 not contain the information needed to permit an analysis of whether or not the Twin
17 Cities- Brookings project is a reasonable alternative to increase generation outlet capacity
18 for renewable energy.

19
20 No comparisons are made including the costs and benefits of various distributions of
21 wind energy and non-renewable energy that would be transmitted by the Brookings line
22 and the costs of transmission (including construction, maintenance and electric line
23 losses) needed to maximize generation outlet capacity from that resource. Since, as
24 explained before, the sunk costs of transmission influence the nature and location of
25 future generation sources, this analysis is necessary to determine the reasonableness of
26 the Brookings line.

27
28 **Q. Is there information in the record that raises questions about the reasonableness**
29 **of the Twin Cities –Brookings project as a strategy to increase renewable generation**
30 **outlet capacity?**

1 A. Yes. The Applicants have stated that the 345 kV Twin Cities—Brookings line would
2 provide 700 MW of incremental outlet capacity for wind generation from the Buffalo
3 Ridge at a cost of \$600 to \$665 million dollars. The substantial cost to provide a
4 relatively modest increase in renewable generation outlet capacity suggests that
5 additional alternatives must be tested and comparisons made if the purpose of the line is
6 to provide renewable generation outlet capacity.

7
8 Information in the Application and discovery documents pertaining to the generation
9 types and locations used to model the CapX 2020 projects also raises questions about the
10 reasonableness of the Twin Cities - Brookings transmission expansion as a cost-effective
11 way to support renewable generation. Although there is substantial wind in the CapX
12 2020 model (2,275 MW in each of the generation scenarios) the model also included
13 substantial fossil-fuel generation (1,800 MW to 2,850 MW of coal and 1,250 MW to
14 2,450 MW of natural gas, depending on the scenario), including 600 MW from the Big
15 Stone coal plant, which would depend on the Brookings line for transmission. While the
16 modeling may not predict actual generation, without further information substantiating
17 that the Brookings transmission line will be actually used to transmit wind energy, it is
18 not reasonable to assume that this project is a cost-effective response to the Applicants’
19 legitimate purpose of increasing outlet support for renewable generation.

20
21 **Q. What kind of information would substantiate that the Brookings transmission**
22 **line will be used to transmit wind energy?**

23 A. There may be several ways to do this. In certifying prior high voltage transmission in
24 Southwest Minnesota, the Public Utilities Commission required coordination of in-
25 service time with power purchase agreements for wind in the Buffalo Ridge area. This
26 type of condition would reduce the likelihood that the CapX 2020 transmission expansion
27 would be used to transmit coal generation, with substantial environmental and regulatory
28 risk costs not justified in this record.

1 **Q. In addition to your question whether the Brookings transmission line will serve**
2 **wind energy, do you have other concerns about the costs and benefits of this**
3 **transmission configuration?**

4 A. Yes. As I explained before, transmission infrastructure expansion will create capital
5 advantages and losses for certain geographically specific generation resources. It will
6 permanently change the economic efficiency of a generator located near the transmission
7 corridor relative to a generator located remotely from the transmission corridor. Once a
8 transmission grid is in place, the associated costs are “sunk”, which privileges certain
9 forms and locations for generation expansion. Even where wind energy is concerned, the
10 architecture of a 345 kV transmission line grid may tip the balance in favor of larger
11 concentrations of corporate wind, due to both the sunk costs for transmission and the
12 costs of interconnection.

13
14 **Q. How would you propose to optimize renewable generation outlet capacity?**

15 A. To minimize costs and maximize benefits of supporting renewable energy, the
16 topology of the grid and the expansion of generation must be simultaneously designed. A
17 distribution of renewable generation closer to load that uses the transmission system more
18 efficiently could be more cost-effective than the proposed CapX 2020 projects. In
19 addition, a transmission grid pattern to support a greater proportion of community based
20 energy development could provide greater economic benefits from the investment in
21 transmission.

22
23 **Q. Is there any differential economic impact of community wind ownership as**
24 **compared to corporate wind ownership structures?**

25 A. There is a growing economic literature on the differential economic impacts of
26 corporate as compared to community based ownership structures. Although the precise
27 multiplier that reflects the difference in local economic impact from community wind
28 varies from study to study, there is a clear consensus that community wind ownership
29 provides greater local economic benefits than corporate wind ownership.

30 Goldberg, Sinclair, and Milligan (2004) reported the results of an input-output analysis
31 using the Job and Economic Development Impact (JEDI) model conducted by the

1 National Renewable Energy Laboratory (NREL) of the local economic impacts of
2 various wind projects on 11 counties in California, Colorado, Iowa, Minnesota, and
3 Texas. The study found a great deal of variation in local spending results, based on state
4 incentives, location, and ownership structures, but community wind structures generally
5 had the greatest local economic impact, by a wide margin.

6
7 Costanti (2004) conducted an NREL and Great Northern Power Development L.P.
8 (GNPD) sponsored JEDI analysis on the local economic impact of 6 wind project sizes
9 ranging from 5 MW to 300 MW capacities on six Montana counties. The study found that
10 the amount of local impact depended on the size, phase, ownership structure, and the
11 degree of intra-regional economic linkages. Job creation was found to be significantly
12 higher when projects were locally funded and spending effects on the local economy
13 were also found to be very significantly higher. Across project sizes and counties, a 100
14 percent community-owned project generated approximately \$135,000 in additional
15 annual local spending per MW installed during the operational phase, while a corporate-
16 wind project generated approximately \$20,000.

17
18 **Q. Have you conducted any analysis of the economic impact of wind generation**
19 **under various ownership models?**

20 A. Yes. As part of a research grant funded by the Initiative for Renewable Energy and the
21 Environment (University of Minnesota), we conducted an input/output analysis on
22 county-level data from Big Stone County, Minnesota to determine the incremental impact
23 that a locally-owned 10 MW wind project would have on the local economy. We utilized
24 a specific input-output model called IMPLAN (for IMpact Analysis for PLANning) to
25 develop the estimates of economic impact. We relied on data from local wind developers
26 and from the National Renewable Energy Laboratory's JEDI model for cost estimates and
27 some questions of methodology.

28
29 **Q. What were your findings?**

30 A. Our empirical research confirmed what we found in our literature review. Community
31 owned projects have greater positive economic impact on local economies. Our simplest

1 scenario analysis for a 10.5 MW project suggested that community wind has 5 times the
2 economic impact on local value added, and 3.4 times the impact on local job creation,
3 relative to a project developed by an outside ownership group. These numbers should
4 probably be considered an upper bound on the differential impacts, since most projects in
5 practice will involve an outside-the-region equity partner, or at the very least a discounted
6 sale of the production tax credit.

7
8 Our study, provided in Kildegaard Attachment 5 has not been subject to formal peer
9 review, although it has been circulated informally and presented at a regional conference.

10
11 **Q. What implications does this research on the economic benefits of community
12 wind projects have on the analysis of renewable generation outlet capacity?**

13 A. The differential local economic benefit of community wind is one additional variable
14 that ought to be considered in designing transmission to provide generation outlet
15 capacity for renewable energy. Transmission should be designed to maximize the benefits
16 of renewable energy, including making efficient use of existing transmission, minimizing
17 line losses and supporting wind that has the greatest local economic benefit as well as
18 creating efficiencies from using high quality wind regimes.

19
20 **CONCLUSION**

21 **Q. Could you summarize your opinions for the Public Utilities Commission?**

22 A. Overall, it is my opinion that the Applicants have failed to demonstrate that their
23 demand for electricity, whether framed in terms of regional system demand or
24 community reliability, cannot be met more cost effectively through energy conservation
25 and load management. The Applicants have not otherwise justified their need for the
26 CapX 2020 transmission expansion.

27
28 Applicants have failed to demonstrate that they have explored the possibility of obtaining
29 power from renewable energy sources, rather than the substantially non-renewable
30 energy sources assumed in their modeling, and they have provided no comprehensive

1 analysis of costs that would demonstrate that the CapX 2020 projects as a whole or
2 individually are less expensive than their alternatives.

3
4 It is not economically rational to de-couple generation from transmission considerations,
5 as this Application has done. To do so would certainly result in a power system that is
6 more expensive than necessary, as well as one that indirectly determines the generation
7 choices in the future. The generation future supported by the CapX 2020 projects is likely
8 to include more remote generation, less renewable energy and less local economic benefit
9 than would be optimal if all costs and benefits of the proposal were compared to
10 alternatives.

11
12 **Q. What is your recommendation to the Commission?**

13 A. I recommend that the Commission reject the certificate of need Application for the
14 CapX 2020 power lines. A renewed application must transparently compare
15 comprehensive costs of the proposal and include a robust comparison with alternatives.
16 Costs must include the cost of transmission, new generation capacity, operation and
17 maintenance (including fuel costs), and line losses. Alternatives to achieve targeted levels
18 of reliability of service requiring thorough cost and benefits analysis should at a
19 minimum include incentive-based conservation strategies, demand management and
20 generation closer to load modeled to maximize renewable generation and to support
21 community ownership.

22
23 **Q. Does this conclude your testimony?**

24 A. Yes.