

## 2.0 Gap Analysis

### 2.1 Introduction

The Renewable Energy Act passed by the Minnesota Legislature in 2007 significantly increases the amount of energy that must be produced from renewable power sources. In order to evaluate transmission requirements necessary to support the Renewable Energy Standard milestones, it is first necessary to estimate the amount of renewable based generation that will be required to achieve the standard.

In the subsections that follow, the utilities present estimates of the energy sales that will be needed to meet statutory milestones for the target years 2010, 2012, 2016, 2020 and 2025. These estimates are then compared with the existing RES eligible energy production to determine the gap between what is presently generated and what will be required to meet the milestones in future years.

Using the figures estimated for the amount of renewable energy that will be required to meet the various milestones, the utilities then estimated the amount of generation from eligible renewable energy sources that may be required to achieve the requisite amount of energy sales. While a number of different types of sources are eligible under the statute for purposes of obtaining energy from renewable energy sources, including solar, certain hydro, and biomass, in addition to wind, the utilities assumed that most of the renewable energy would come from wind. They then calculated the number of megawatts of generation that would be required based on three different capacity factors for the wind generators. Finally, another round of estimates was calculated taking into account Minnesota's policy to achieve a certain amount of energy conservation.

The new standards apply to public utilities providing electric service, generation and transmission cooperative electric associations, municipal power agencies and power districts. Fifteen separate companies and organizations who are required to meet the RES are participating in the preparation of this report.

### 2.2 Minnesota Renewable Energy Standard Milestones

The Minnesota Legislature amended Minn. Stat. § 216B.1691, Renewable Energy Objectives during the 2007 legislative session thereby transforming the "objectives" into "standards" (*see* Minnesota Laws 2007, Chapter 3). The statute, as amended, requires Minnesota utilities to supply a certain percentage of their retail electric sales from renewable based energy generation for various target years. The renewable sales requirement escalates from a good-faith effort by utilities to provide 7% of their retail sales from renewable sources in 2010, to a mandate that utilities provide 25% of their retail sales from renewable generation sources by 2025. Xcel Energy, by virtue of owning nuclear generation, is subject to an accelerated implementation schedule.

The following table illustrates the Minnesota Renewable Energy milestones.

**Table 1.0 Renewable Energy Standards  
Percent of Annual Retail Minnesota  
Sales to be Met with Renewable Generation**

<b>Year</b>	<b>Utility Requirement</b>	<b>Xcel Energy</b>
2010	7%*	15%
2012	12%	18%
2016	17%	25%
2020	20%	30% - 25% must be wind
2025	25%	30% - 25% must be wind

\*NOTE: Good Faith Energy Objective

### **2.3 Utility Sales Forecasts**

The sales forecast data in Table 1.1 represents each utility's forecast of the number of megawatt hours of retail sales that will be sold in Minnesota for each of the target years. These data represent retail sales to customers.

**Table 1.1 Minnesota Retail Sales Forecast Total MWh**

Utility	2010 MWh	2012 MWh	2016 MWh	2020 MWh	2025 MWh
Xcel Energy	33,841,660	34,710,291	36,291,842	38,041,751	40,170,509
Minnkota Power Cooperative	1,973,328	2,059,025	2,240,176	2,426,605	2,359,200
Missouri River Energy Services	1,179,400	1,267,408	1,630,169	1,966,761	2,138,696
Great River Energy	12,871,342	13,609,300	15,223,111	17,188,395	20,190,440
Minnesota Power	9,369,871	9,760,626	10,092,373	10,292,209	10,479,217
Dairyland Power Cooperative	903,642	941,858	1,002,647	1,062,675	1,136,760
Otter Tail Power	2,396,000	2,489,000	2,668,000	2,860,000	3,080,000
Southern Minnesota Municipal Power Agency*	3,246,800	3,413,366	3,739,311	4,013,060	4,321,968
Minnesota Municipal Power Agency	1,534,628	1,630,625	1,818,864	2,013,685	2,262,788
Central Minnesota Municipal Power Agency	502,514	515,766	539,811	560,670	585,400
Alliant Energy	896,714	924,641	986,411	1,053,195	1,143,140
Heartland Power District	983,885	1,008,030	803,410	588,514	685,538
Basin Electric**	1,236,443	1,462,622	1,917,295	2,406,506	3,015,797
<b>Totals:</b>	<b>70,936,227</b>	<b>73,792,558</b>	<b>77,953,420</b>	<b>83,474,026</b>	<b>81,090,236</b>

**NOTE:** Forecast values are actual sales not production at the generator.

\* Southern Minnesota Municipal Power Agency sales forecast numbers are Net Inlet to Member System (“IMS”) values. Net IMS does not include transmission line losses, WAPA served load, Rochester load above 216 MW, load served by local hydro units, or other minor member load adjustments.

\*\* Basin Electric numbers in this table and subsequent tables include figures for not only Basin Electric, but L&O Power Cooperative and East River Electric Power Cooperative as well, although L&O and East River will report separately to the state regarding actual RES compliance.

## 2.4 Renewable Retail Sales Requirements

Table 1.2 presents the number of megawatt hours of retail sales that is projected to come from renewable generation sources for each utility. These figures are the product of total sales from Table 1.1, multiplied by the percentage requirements of the RES statute. For example, Central Minnesota Municipal Power Agency forecasts total Minnesota sales for 2020 to be 560,670 MWh, consequently 112,134 MWh must come from a renewable based source (total sales 560,670 MWh from Table 1.1 x 0.20% RES for 2020 = 112,134 MWh).

**Table 1.2 Minnesota Electric Sales in  
MWh Required from Renewable Generation**

<b>Utility</b>	<b>2010 MWh</b>	<b>2012 MWh</b>	<b>2016 MWh</b>	<b>2020 MWh</b>	<b>2025 MWh</b>
Xcel Energy	5,076,249	6,247,852	9,072,960	11,412,525	12,051,152
Minnkota Power Cooperative	138,133	247,083	380,830	485,321	589,800
Missouri River Energy Services	82,558	152,089	277,128	393,352	534,674
Great River Energy	900,994	1,633,116	2,587,929	3,437,679	5,047,610
Minnesota Power	655,890	1,171,275	1,715,703	2,058,441	2,619,804
Dairyland Power Cooperative	63,255	113,023	170,450	212,535	284,190
Otter Tail Power	167,720	298,680	453,560	572,000	770,000
Southern Minnesota Municipal Power Agency	227,276	409,604	635,683	802,612	1,080,492
Minnesota Municipal Power Agency	107,424	195,675	309,207	402,737	565,697
Central Minnesota Municipal Power Agency	35,176	61,892	91,768	112,134	146,350
Alliant Energy	62,770	110,957	167,690	210,639	285,785
Heartland Power District	68,872	120,963	136,580	117,703	171,384
Basin Electric	86,551	175,515	325,940	481,301	753,949
<b>Totals</b>	<b>7,672,878</b>	<b>10,937,724</b>	<b>16,295,123</b>	<b>20,698,979</b>	<b>22,281,083</b>

## 2.5 Existing Renewable Generation

Existing renewable generation data was used to determine how many additional megawatts of generation each utility will need in order to comply with the standard. Table 1.3 shows how many megawatt hours of qualifying renewable energy each utility purchased or produced during 2006. These numbers were provided by each utility and include units that qualify based on 2007 requirements.

**Table 1.3 Renewable Energy Generation in 2006**

<b>Utility</b>	<b>Qualifying Renewable Generation December 31, 2006 (MWh)</b>
Xcel Energy	3,325,755
Minnkota Power Cooperative	5,487
Missouri River Energy Services	13,981
Great River Energy	553,467
Minnesota Power	786,000
Dairyland Power Cooperative	14,971
Ottertail Power	44,961
Southern Minnesota Municipal Power Agency	34,087
Minnesota Municipal Power Agency	1,796
Central Minnesota Municipal Power Agency	16,024
Alliant Energy	29,105
Heartland Power District	0
Basin Electric	498,165
<b>Totals</b>	<b>5,055,799</b>

## 2.6 Megawatts of Renewable Generation Required

Tables 1.4 through 1.6 show approximately how many megawatts of wind generated energy each utility will need to acquire by each of the target years in order to comply with the Renewable Energy milestones. These projections are based on the assumption that all new generation would come from wind turbines. These wind projections are intended to be illustrative only since some utilities will no doubt choose to acquire a mix of renewable generation sources from a combination of wind, hydro, biomass, and perhaps other qualifying types.

Three separate projections were made based on capacity factors of 30%, 35% and 40%, respectively. Each utility's existing renewable generation production and purchases in 2006 were assumed to be representative of existing resources and was subtracted from the utility's renewable sales forecast data. Estimates were also reduced by additions made in 2007.

**Table 1.4 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 30% Capacity Factor**

<b>Utility</b>	<b>Renewable Generation December 31, 2006 MWh</b>	<b>MW 2007 Plant capacity additions</b>	<b>MW Needed 2010 (7%)*</b>	<b>MW Needed 2012 (12%)*</b>	<b>MW Needed 2016 (17%)*</b>	<b>MW Needed 2020 (20%)*</b>	<b>MW Needed 2025 (25%)*</b>
Xcel Energy	3,325,755	420	240	900	1,770	2,660	2,900
Minnkota Power Cooperative	5,487	0	50	90	140	180	220
Missouri River Energy Services	13,981	0	30	50	100	140	200
Great River Energy	553,467	100	30	310	670	1000	1,610
Minnesota Power	786,000	100	0	50	250	380	600
Dairyland Power Cooperative	14,971		20	40	60	70	100
Otter Tail Power	44,961	1	50	100	150	200	270
Southern Minnesota Municipal Power Agency	34,087		70	140	230	290	400
Minnesota Municipal Power Agency	1,796		40	70	120	150	210
Central Minnesota Municipal Power Agency	16,024		10	50	30	40	50
Alliant Energy	29,105	17	0	10	40	50	80
Heartland Power District	0	0	30	50	50	50	60
Basin Electric**	498,165	0	0	0	0	0	100
<b>Total MW Needed</b>	<b>NA</b>		<b>570</b>	<b>1,830</b>	<b>3,610</b>	<b>5,210</b>	<b>6,800</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-of which 25% must be from wind energy).

\*\* Basin Electric numbers in this table and subsequent tables include figures for not only Basin Electric, but L&O Power Cooperative and East River Electric Power Cooperative, although L&O and East River will report separately to the state regarding actual RES compliance.

**Table 1.5 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 35% Capacity Factor**

Utility	Renewable Generation December 31, 2006 MWh	MW 2007 Plant capacity additions	MW Needed 2010 (7%)*	MW Needed 2012 (12%)*	MW Needed 2016 (17%)*	MW Needed 2020 (20%)*	MW Needed 2025 (25%)*
Xcel Energy	3,325,755	420	150	530	1,450	2,220	2,430
Minnkota Power Cooperative	5,487	0	40	80	120	160	190
Missouri River Energy Services	13,981	0	20	40	90	120	170
Great River Energy	553,467	100	10	250	560	840	1,370
Minnesota Power	786,833	100	0	30	200	320	500
Dairyland Power Cooperative	14,971		20	30	50	60	90
Otter Tail Power	44,961	1	20	60	110	150	220
Southern Minnesota Municipal Power Agency	34,087		60	120	200	250	340
Minnesota Municipal Power Agency	1,796		30	60	100	130	180
Central Minnesota Municipal Power Agency	16,024		10	10	20	30	40
Alliant Energy	29,105	17	0	10	30	40	70
Heartland Power District	0	0	20	40	50	40	60
Basin Electric	498,165	0	0	0	0	0	80
<b>Total MW Needed</b>	<b>NA</b>		<b>380</b>	<b>1,260</b>	<b>2,980</b>	<b>4,360</b>	<b>5,740</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).

**Table 1.6 MW Wind Generation Estimates  
To Comply With 2007 Renewable Energy Standards  
Assuming 40% Capacity Factor**

Utility	Renewable Generation December 31, 2006 MWh	MW 2007 Plant capacity additions	MW Needed 2010 (7%)*	MW Needed 2012 (12%)*	MW Needed 2016 (17%)*	MW Needed 2020 (20%)*	MW Needed 2025 (25%)*
Xcel Energy	3,325,755	420	80	410	1,420	1,890	2,070
Minnkota Power Cooperative	5,487	0	40	70	110	140	170
Missouri River Energy Services	13,981	0	20	40	70	110	150
Great River Energy	553,467	100	0	210	480	720	1,180
Minnesota Power	786,000	100	0	10	170	260	420
Dairyland Power Cooperative	14,971		10	30	40	60	80
Otter Tail Power	44,961	1	20	50	100	130	190
Southern Minnesota Municipal Power Agency	34,087		50	110	170	220	300
Minnesota Municipal Power Agency	1,796		30	50	90	110	160
Central Minnesota Municipal Power Agency	16,024		5	10	20	30	40
Alliant Energy	29,105	17	0	10	20	30	60
Heartland Power District	0	0	20	30	40	30	50
Basin Electric	498,165	0	0	0	0	0	70
<b>Total MW Needed</b>	<b>NA</b>		<b>270</b>	<b>1,030</b>	<b>2,730</b>	<b>3,730</b>	<b>4,940</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).



## 2.7 Demand Side Management

In addition to the Renewable Energy Act establishing new renewable milestones, the Minnesota Legislature also in 2007 established some conservation goals. Minnesota Laws 2007, chapter 136, art. 2, § 4. The goal is to achieve annual energy savings equal to 1.5% of annual retail energy sales of electricity through conservation and other measures.

The utilities determined that it was also necessary to estimate the amount of retail sales that must come from renewables if certain conservation goals were achieved. The tables below show the results of calculations when the amount of retail sales forecasted for upcoming years are reduced by either 1% annually or 1.5% annually.

**Table 1.7 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 30% Capacity Factor and 1% DSM**

Utility	Renewable Generation December 31, 2006 MWh	MW Needed 2010 (7%)*	MW Needed 2012 (12%)*	MW Needed 2016 (17%)*	MW Needed 2020 (20%)*	MW Needed 2025 (25%)*
Xcel Energy	3,325,755	230	670	1,730	2,610	2,850
Minnkota Power Cooperative	5,487	50	90	140	180	220
Missouri River Energy Services	13,981	30	50	100	140	200
Great River Energy	553,467	30	300	660	980	1,590
Minnesota Power	786,000	0	40	250	380	590
Dairyland Power Cooperative	14,971	20	40	60	70	100
Otter Tail Power	44,961	40	90	150	200	270
Southern Minnesota Municipal Power Agency	34,087	70	140	230	290	390
Minnesota Municipal Power Agency	1,796	40	70	120	150	210
Central Minnesota Municipal Power Agency	16,024	10	20	30	40	50
Alliant Energy	29,105	0	20	30	50	80
Heartland Power District	0	30	50	50	40	70
Basin Electric	498,165	0	0	0	0	100
<b>Total MW Needed</b>	<b>NA</b>	<b>550</b>	<b>1,580</b>	<b>3,50</b>	<b>5,130</b>	<b>6,720</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).

**Table 1.8 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 35% Capacity Factor and 1% DSM**

<b>Utility</b>	<b>Renewable Generation December 31, 2006 MWh</b>	<b>MW Needed 2010 (7%)*</b>	<b>MW Needed 2012 (12%)*</b>	<b>MW Needed 2016 (17%)*</b>	<b>MW Needed 2020 (20%)*</b>	<b>MW Needed 2025 (25%)*</b>
Xcel Energy	3,325,755	130	510	1,420	1,980	2,370
Minnkota Power Cooperative	5,487	40	80	120	150	190
Missouri River Energy Services	13,981	20	40	80	120	170
Great River Energy	553,467	10	350	550	830	1,350
Minnesota Power	786,000	0	20	200	310	490
Dairyland Power Cooperative	14,971	20	30	50	60	90
Otter Tail Power	44,961	40	80	130	170	230
Southern Minnesota Municipal Power Agency	34,087	60	120	190	250	340
Minnesota Municipal Power Agency	1,796	30	60	100	130	180
Central Minnesota Municipal Power Agency	16,024	10	10	20	30	40
Alliant Energy	29,105	0	10	30	40	70
Heartland Power District	0	20	40	40	40	60
Basin Electric	498,165	0	0	0	0	80
<b>Total MW Needed</b>	<b>NA</b>	<b>380</b>	<b>1,350</b>	<b>2,930</b>	<b>4,110</b>	<b>5,660</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).

**Table 1.9 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 40% Capacity Factor and 1% DSM**

<b>Utility</b>	<b>Renewable Generation December 31, 2006 MWh</b>	<b>MW Needed 2010 (7%)*</b>	<b>MW Needed 2012 (12%)*</b>	<b>MW Needed 2016 (17%)*</b>	<b>MW Needed 2020 (20%)*</b>	<b>MW Needed 2025 (25%)*</b>
Xcel Energy	3,325,755	60	400	1,200	1,850	2,040
Minnkota Power Cooperative	5,487	40	70	110	140	160
Missouri River Energy Services	13,981	20	40	70	110	150
Great River Energy	553,467	0	200	470	710	1,170
Minnesota Power	786,000	0	10	160	260	420
Dairyland Power Cooperative	14,971	10	30	40	60	80
Otter Tail Power	44,961	30	70	110	150	200
Southern Minnesota Municipal Power Agency	34,087	50	110	170	220	300
Minnesota Municipal Power Agency	1,796	30	50	90	110	160
Central Minnesota Municipal Power Agency	16,024	5	10	20	30	40
Alliant Energy	29,105	0	10	20	30	50
Heartland Power District	0	20	30	40	30	50
Basin Electric	498,165	0	0	0	0	70
<b>Total MW Needed</b>	<b>NA</b>	<b>260</b>	<b>1,030</b>	<b>2,500</b>	<b>3,700</b>	<b>4,890</b>

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).

**Table 1.10 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 30% Capacity Factor and 1.5% DSM**

Utility	Renewable Generation December 31, 2006 MWh	MW Needed 2010 (7%)*	MW Needed 2012 (12%)*	MW Needed 2016 (17%)*	MW Needed 2020 (20%)*	MW Needed 2025 (25%)*
Xcel Energy	3,325,755	220	660	1,710	2,590	2,830
Minnkota Power Cooperative	5,487	50	90	140	180	220
Missouri River Energy Services	13,981	30	50	100	140	200
Great River Energy	553,467	30	300	660	980	1,580
Minnesota Power	786,000	0	40	250	370	580
Dairyland Power Cooperative	14,971	20	40	60	70	100
Otter Tail Power	44,961	40	90	150	200	270
Southern Minnesota Municipal Power Agency	34,087	70	140	220	290	390
Minnesota Municipal Power Agency	1,796	40	70	110	150	210
Central Minnesota Municipal Power Agency	16,024	10	20	30	40	50
Alliant Energy	29,105	0	10	30	50	80
Heartland Power District	0	30	40	50	40	60
Basin Electric	498,165	0	0	0	0	100
<b>Total MW Needed</b>	NA	530	1,550	3,500	5,100	6,670

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-- of which 25% must be from wind energy).

**Table 1.11 MW Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 35% Capacity Factor and 1.5% DSM**

<b>Utility</b>	<b>Renewable Generation December 31, 2006 MWh</b>	<b>MW Needed 2010 (7%)*</b>	<b>MW Needed 2012 (12%)*</b>	<b>MW Needed 2016 (17%)*</b>	<b>MW Needed 2020 (20%)*</b>	<b>MW Needed 2025 (25%)*</b>
Xcel Energy	3,325,755	140	500	1,410	2,160	2,370
Minnkota Power Cooperative	5,487	40	80	120	150	190
Missouri River Energy Services	13,981	20	40	80	120	170
Great River Energy	553,467	10	240	550	820	1,340
Minnesota Power	786,000	0	20	200	310	490
Dairyland Power Cooperative	14,971	10	30	50	60	90
Otter Tail Power	44,961	40	80	130	170	230
Southern Minnesota Municipal Power Agency	34,087	60	120	190	250	340
Minnesota Municipal Power Agency	1,796	30	60	100	130	180
Central Minnesota Municipal Power Agency	16,024	5	10	20	30	40
Alliant Energy	29,105	0	10	30	40	60
Heartland Power District	0	20	40	40	40	60
Basin Electric	498,165	0	0	0	0	80
<b>Total MW Needed</b>	NA	380	1,230	2,920	4,260	5,640

\*Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-of which 25% must be from wind energy).

**Table 1.12 W Wind Generation Estimates  
To Comply With Renewable Energy Standards  
Assuming 40% Capacity Factor and 1.5% DSM**

Utility	Renewable Generation December 31, 2006 MWh	MW Needed 2010 (7%)*	MW Needed 2012 (12%)*	MW Needed 2016 (17%)*	MW Needed 2020 (20%)*	MW Needed 2025 (25%)*
Xcel Energy	3,325,755	60	390	1,180	1,840	2,020
Minnkota Power Cooperative	5,487	40	70	100	130	160
Missouri River Energy Services	13,981	20	40	70	110	150
Great River Energy	553,467	0	200	470	710	1,160
Minnesota Power	786,000	0	10	160	250	410
Dairyland Power Cooperative	14,971	10	30	40	50	80
Otter Tail Power	44,961	30	70	110	150	200
Southern Minnesota Municipal Power Agency	34,087	50	100	170	220	290
Minnesota Municipal Power Agency	1,796	30	50	90	110	160
Central Minnesota Municipal Power Agency	16,024	5	10	20	30	40
Alliant Energy	29,105	0	10	20	30	50
Heartland Power District	0	20	30	40	30	50
Basin Electric	498,165	0	0	0	0	70
<b>Total MW Needed</b>	NA	260	1,010	2,470	3,690	4,840

\* Targets for Xcel Energy are 2010 (15%), 2012 (18%), 2016 (25%), 2020 & 2025 (30%-of which 25% must be from wind energy)

## 2.8 2007 RES Objective

As discussed in Part I of this document (the Biennial Transmission Projects Report) in Section 8, those utilities that participated in the Biennial Report and are subject to the RES, are in compliance with 2007 Renewable Energy Objectives. In addition, those utilities subject to the

RES who are not obligated to participate in the Biennial Report are also in compliance with the objective for 2007.

## 2.9 2010 Milestone

Projects are underway to meet most if not all of the generation needed for the 2010 milestone, and significant transmission additions are not needed to support those efforts. The table below summarizes the projects that are underway.

Utility	Approximate Capacity Needed 2010	Project
Xcel Energy	100-150	100 MW Grand Meadows ~ 80 MW CBED projects under contract
Minnkota Power Cooperative	40	100 MW Langdon
Missouri River Energy Services	20	20 MW Odin 18.7 MW Marshall
Great River Energy	0- 10	With the addition of Prairie Star Wind Farm, GRE has sufficient resources to meet its RES obligations through 2011
Minnesota Power	0	
Dairyland Power Cooperative	10-20	
Otter Tail Power	20	60 MW Langdon ND under construction
Southern Minnesota Municipal Power Agency	50	36 MW wind PPA 30 MW CBED in negotiation
Minnesota Municipal Power Agency	30	50 MW rfp
Central Minnesota Municipal Power Agency	5-10	
Alliant Energy	0	
Heartland		50 MW Wessington Springs
Basin Electric Power Cooperative		

In several cases transmission requirements have been analyzed and additions are underway, such as with the Otter Tail's Langdon project in North Dakota.

Another example is Xcel Energy's Grand Meadows proposal in southeastern Minnesota. Grand Meadows, a 100 MW wind farm, is pending before the Commission in Need and Site permit proceedings. PUC Docket No. WS-07-839. Also, Tracking Number 2007-SE-N2 in the Biennial Report. The project is expected to be under construction in 2008. Xcel Energy anticipates that it will be able to connect Grand Meadows to the system and transmit energy with

a MISO approved special protection operating guide while transmission network upgrades are being developed. Xcel Energy also anticipates little chance of curtailment associated with the plan.

In other cases, transmission improvements have been identified but are not yet finalized. Utilities anticipate they will be able to arrange connection to the system and delivery of energy to the system utilizing a special protection operating guide. It is anticipated that other projects will connect and deliver energy without the need for special protection schemes. In some cases, these energy only delivery arrangements will change to more firm network service arrangements as transmission additions are made.

### **2.10 2012 RES Milestone**

There appear to be roughly 1000 to 1800 MW of generation additions above and beyond projects under development that will be necessary to meet the 2012 milestones, depending on the capacity factors and conservation that are realized. (Compare figures in Table 1.12 with figures in Table 1.4.) Transmission requirements will depend on the location of the generation. The utilities anticipate that if transmission is necessary, requirements can be met with 115 kV additions. The Biennial Report (Part I of this document) describes projects transmission planners are currently working on to provide additional increments of system capacity by 2012.

### **2.11 2016 RES Milestone**

By 2016 the utilities could require between 2500 and 3600 MW of additional renewable generation to meet the milestone. The transmission requirements for this amount of wind are unknown at the present time, and will depend on where the wind development occurs and the available capacity on the system existing at that time.

### **2.12 2020 RES Milestone**

By 2020 the utilities could require between 3700 and 5200 MW of additional renewable generation to meet the milestone.

### **2.13 2025 RES Milestone**

By the year 2025, Minnesota electric utilities could be required to generate or acquire approximately over 20,000,000 MWh of power from renewable energy sources. *See* Table 1.2. In order to provide that much power and comply with the standard, and assuming wind turbines will be the primary technology chosen, something on the order of 4,800 to 6,800 MW of additional wind generation will be required. It is likely not all utilities will choose to generate or procure all of their needed generation from wind sources but the estimate gives some indication of the magnitude of generation additions that will need to be accommodated on the transmission system.



## 2.14 Summary

The numbers provided in this document are intended to provide a snapshot of the approximate number of megawatts of renewable generation that was on line at the end of 2006 and the number of megawatts of wind generation (or mixed renewable generation) that will be needed by 2025 to achieve the RES. These numbers are subject to change as subsequent forecasts are made.

For the most part plans to meet the 2010 milestone are well underway and it does not appear that significant new transmission will be necessary to support them. It is expected that the 2012 milestone can be achieved with relatively modest upgrades to the 115 kV system.

In 2016, however, it becomes more difficult to achieve the standard. Not only are significant additions of renewable resources going to be required, but new transmission is also going to be necessary. Compliance becomes even more difficult from both a generation standpoint and a transmission standpoint in 2020 and 2025.

In the remainder of this Report, the utilities describe the studies that are underway to comply with the upcoming RES milestones and present several conceptual plans for constructing high voltage transmission lines to accommodate the kind of growth in renewable generation that will be necessary to meet the upcoming RES milestones. The Report also describes some of the barriers that will be encountered in developing the kind of infrastructure that is anticipated.