Using a Dispersed Strategy in Your Region

By

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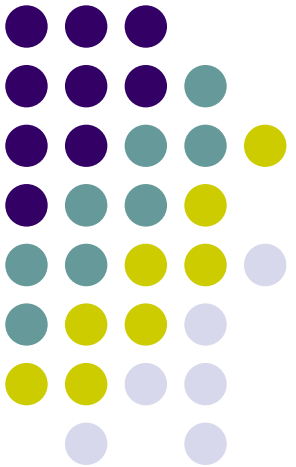
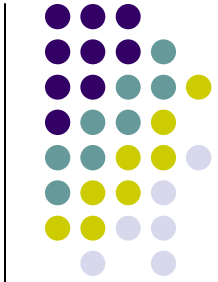
Matrix Energy Solutions



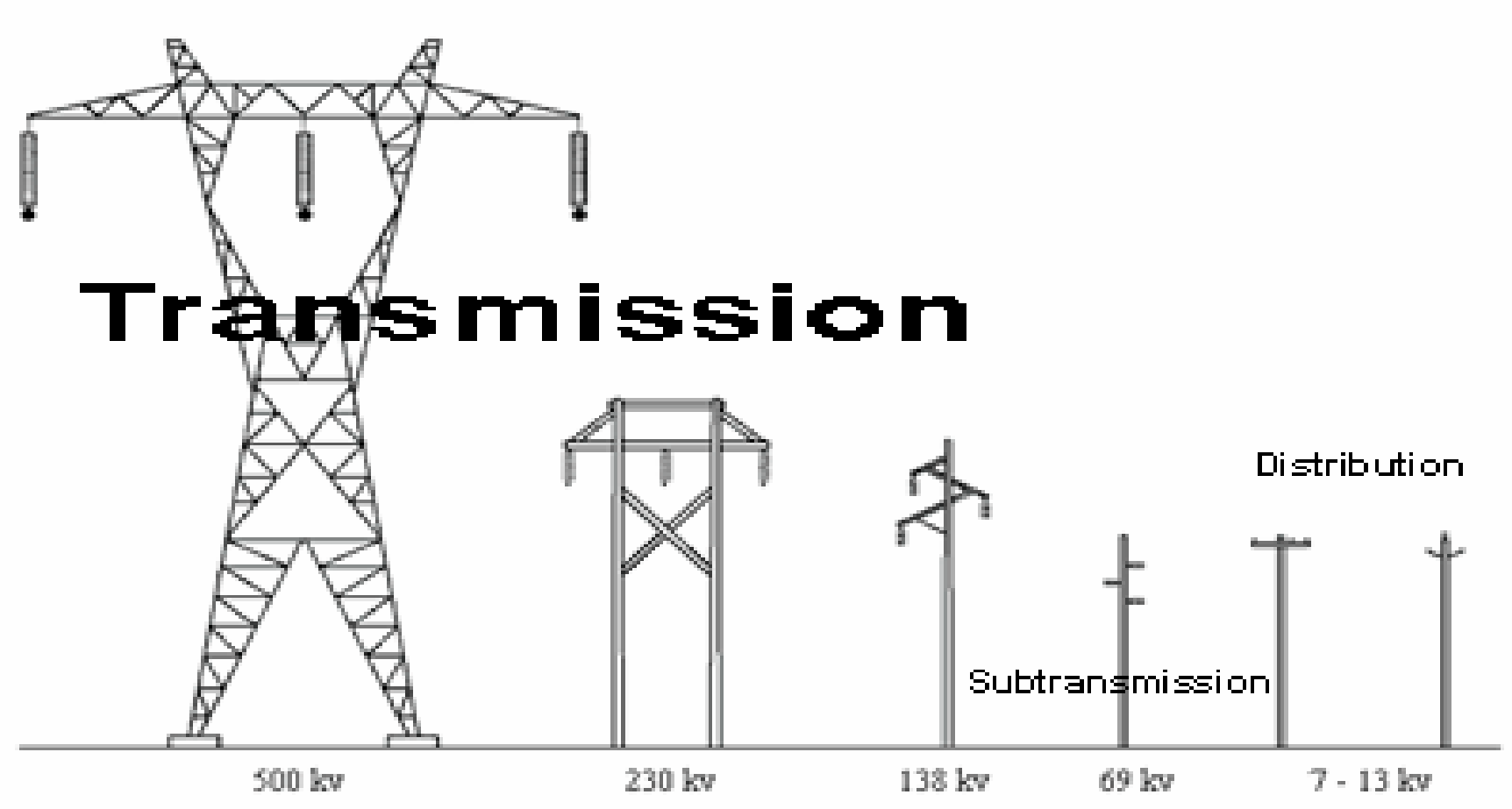
What We Will Cover



- Definitions
- CBED Study,What did we learn?
- Using Transmission Maps & Tables
- Conservation & Renewables, Co-Development Strategies

Transmission Planning Zones

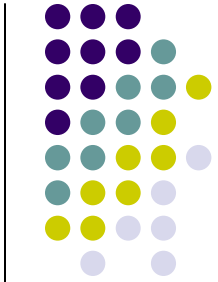
TRANSMISSION & DISTRIBUTION LINES



TRANSMISSION LINE CHARACTERISTICS

- Functions as a network to connect generation to load and support wholesale power transfers. (See FERC Seven Factor test).
- Interstate power transfer capability.
- 115 kV and above Federally regulated (FERC).
- Lines below 115 kV can be “dual use” “sub transmission” facilities that serve retail load and the wholesale power market.

DISTRIBUTION LINE CHARACTERISTICS



- Voltages are < 100kV, typically at or below 34.5 kV.
- Functions primarily to serve retail customer load.
- Traditionally, power flows into the line but not out.
- State regulated system.

SUBSTATIONS

- Changes voltage levels and provides switching functions.
- Can be the point of transfer from transmission to distribution system.
- Transformers define power flow capability.
- Can be “on ramps” to feed power into the high voltage system.

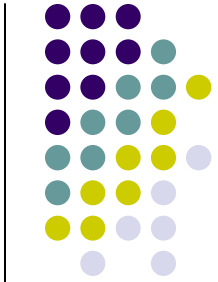
DISTRIBUTED GENERATION

- Generation sited at or near load, “behind the meter.”
- Typically connected to the distribution system.
- Differing ownership structures possible.
- May or may not feed excess power to grid.
- State definition now limits to 10 MW max.

DISTRIBUTED RESOURCES

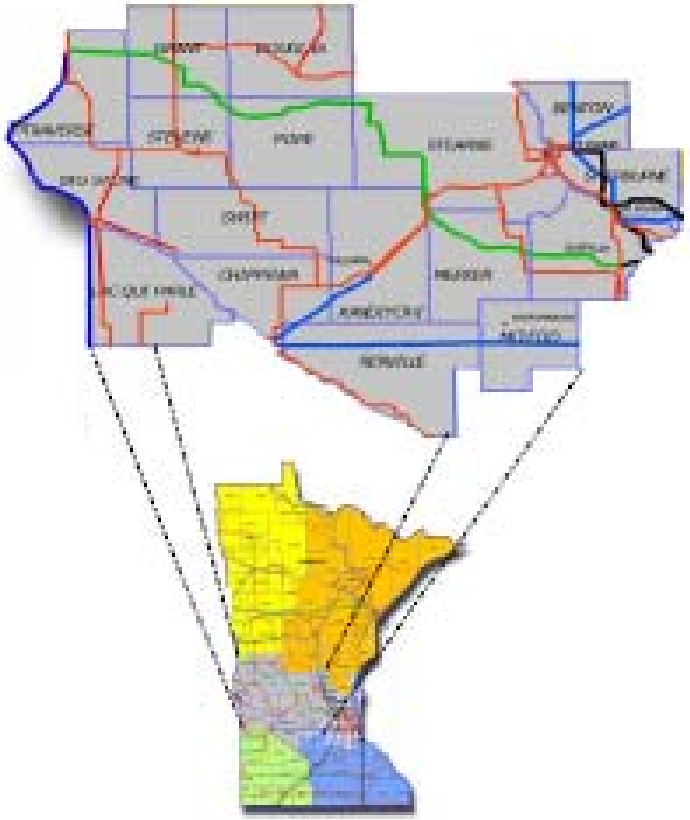
- Includes distributed generation and “demand side” strategies such as conservation, efficiency, and load management.

DISPERSED GENERATION

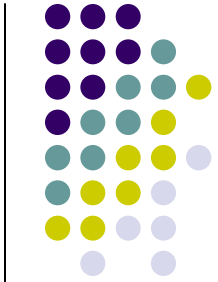


- “Stand alone” generators not at existing retail customer sites.
- 100 % of output injected into the grid.
- No size limits, current DOC study looking at 10-40 MW sizes.
- Can be connected to either distribution or transmission lines.

WEST CENTRAL CBED STUDY
WHAT DID WE LEARN?

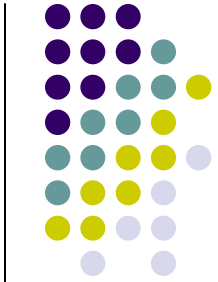


WHAT THEY DID



- Modeled Dispersed Generation at all Substations that connect at the high voltage side to 115 kV system in 2009.
- Created 57 new generator locations ranging in size from 1 MW to 370 MW.
- Approximately 3500 MW total.

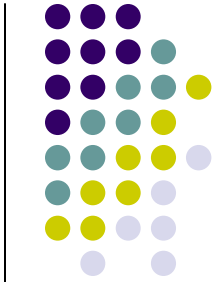
WHAT THEY DID



- Focused on analyzing thermal line loading and voltage levels for 800 MW and 1400 MW of Dispersed Generation at 21 locations.
- Used CBED Energy to reduce Minnesota gas peaking plants output.
- Analyzed transmission system constraints and established costs for mitigation.

STUDY RESULTS

- Could develop 800 MW of Dispersed Generation for $49 Million of constraint mitigation.
- Could develop 1400 MW of Dispersed generation for $ 97 Million in constraint mitigation.
- No major new power lines were needed.



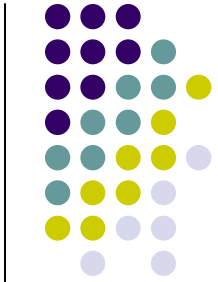
DISPERSED GENERATION, A NEW PARADIGM FOR RESOURCE DEVELOPMENT?

- In the West Central Zone CBED Study 1400 MW out of a possible 3500 MW was modeled without adding new major power lines.
- In the Southwest Zone, historically about 400 MW of wind out of 1182 MW theoretically possible was developed before new major power lines were needed.
- Does this rule of thumb hold true for the entire state?

STATEWIDE INJECTION POTENTIAL

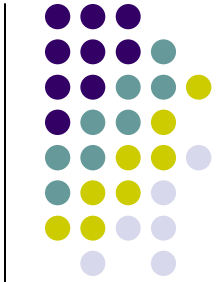
WEST CENTRAL ZONE	3585 MW
SOUTHWEST ZONE	1182 MW
SOUTHEAST ZONE	4000 MW
NORTHWEST ZONE	2602 MW
NORTHEAST ZONE	2383 MW
STATEWIDE TOTAL	**13752 MW**

A NEW PARADIGM FOR RESOURCE DEVELOPMENT?



- If the same sort of ratio between developed generation MW and the theoretical injection limit holds for all the sub regions, a total of about 5300 MW could be developed statewide without building major new transmission lines.
- Only further study will tell the tale.

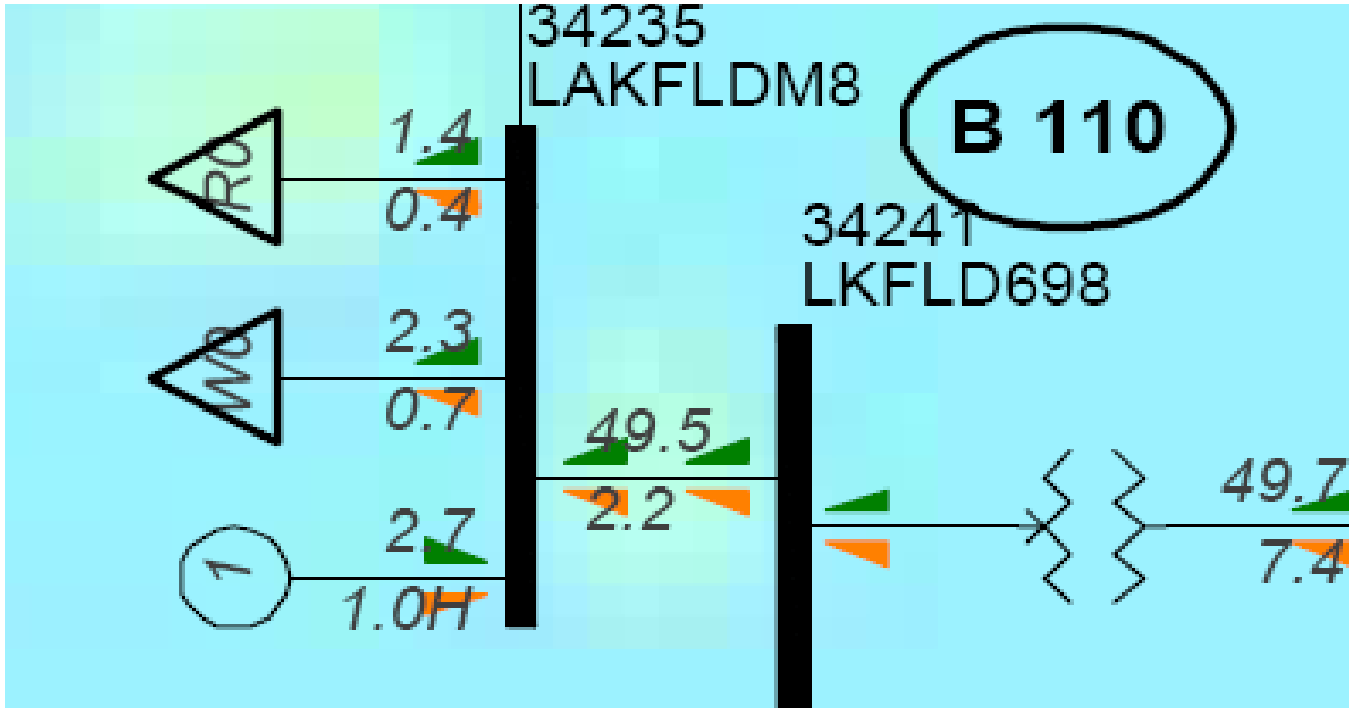
NEW TOOLS DEVELOPED FROM THE STUDY



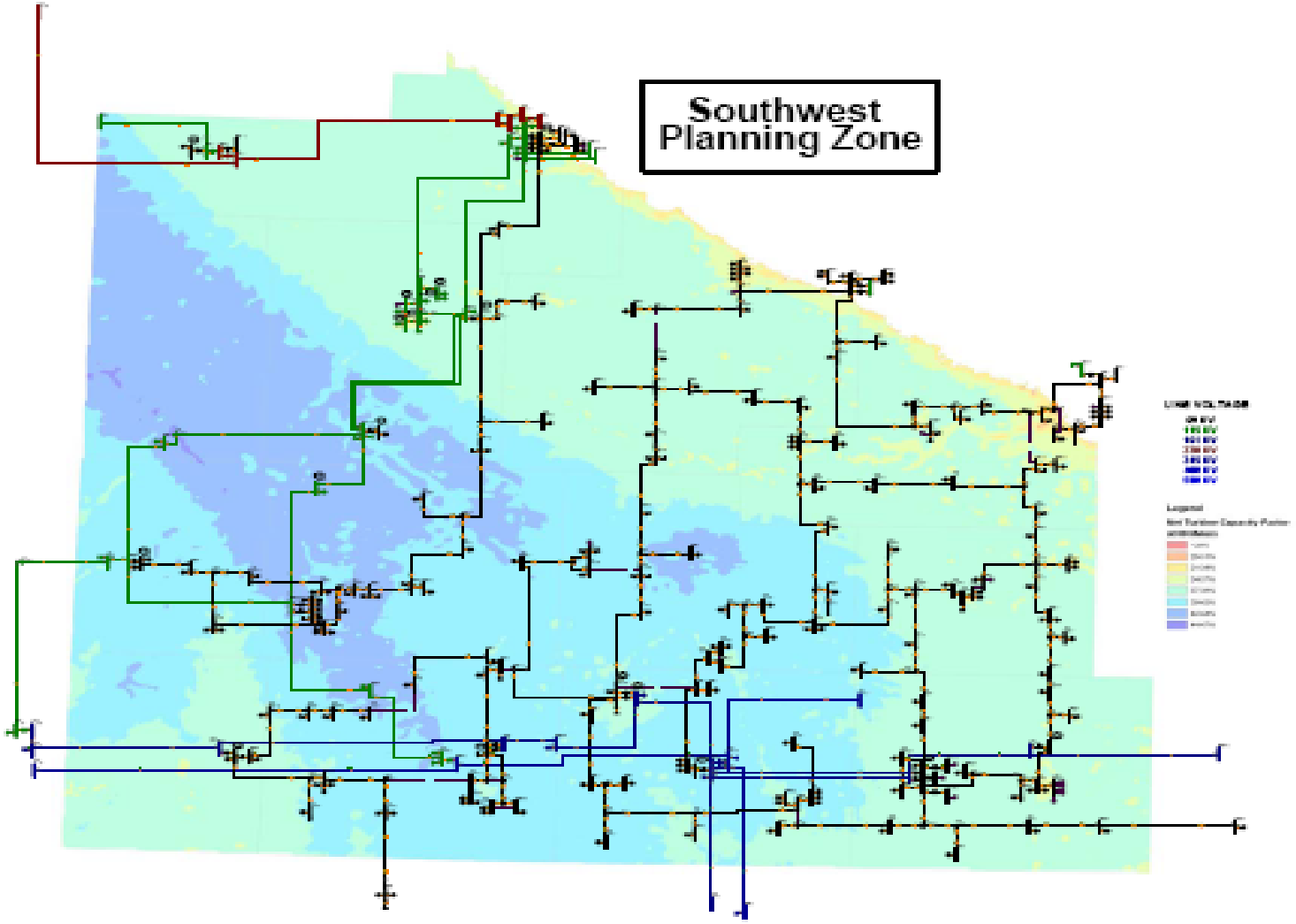
- Methodology for calculating theoretical injection capacity limit for a substation
- Maps showing wind resource, substation locations, and transmission lines for all five rural transmission planning zones.
- Data tables of substation injection potentials for all five rural transmission planning zones.

THEORETICAL INJECTION POTENTIAL

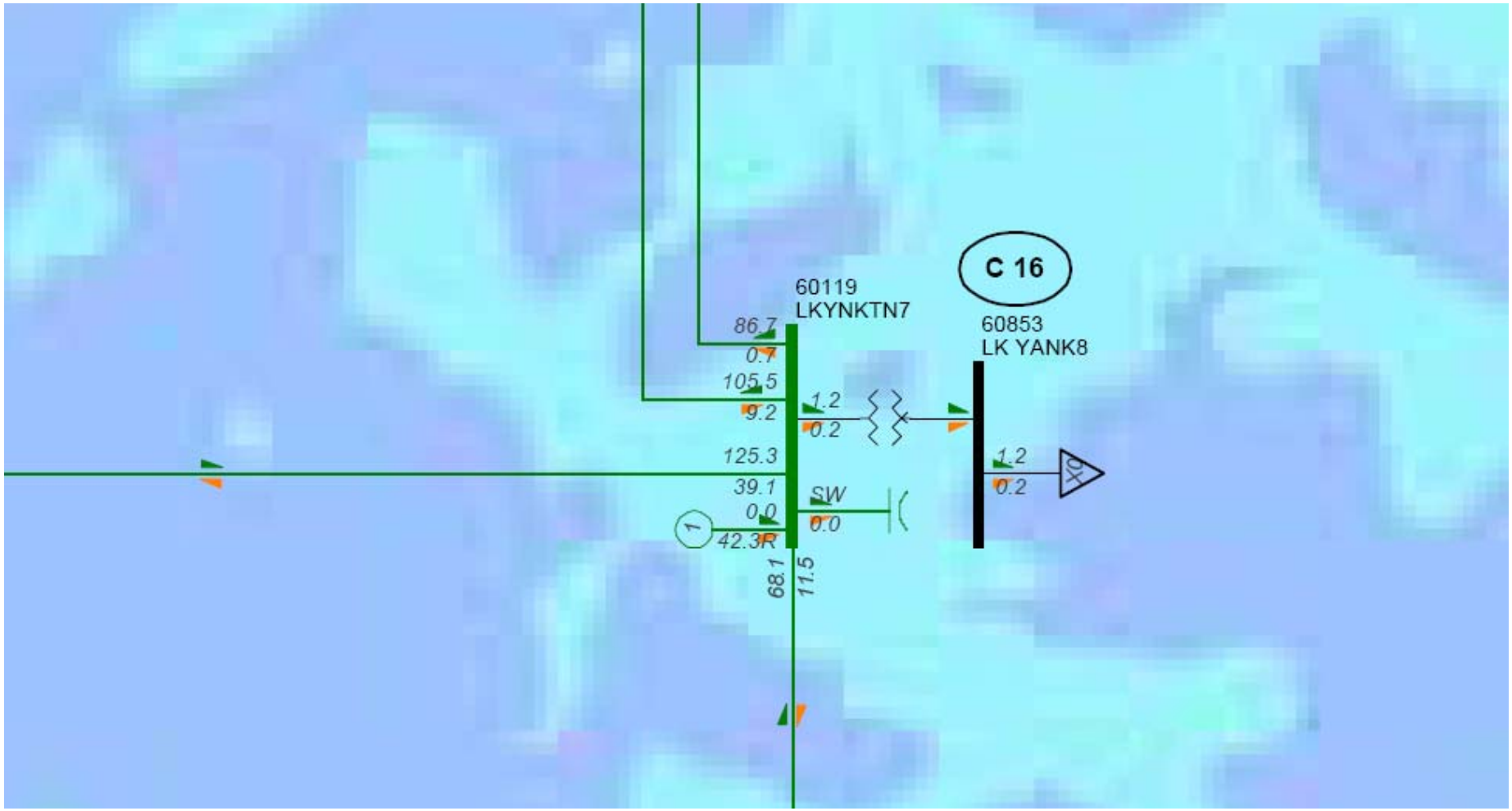
Injection MW = (Peak Load x 70%)+Transformer MVA



Sub Region Transmission & Wind Maps



SOUTHWEST MAP DETAIL



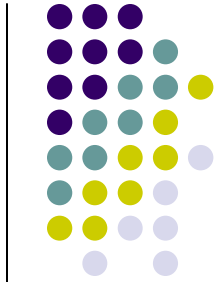
SUBSTATION DATA TABLES

Southeast Planning Zone
Available Generation Capacity

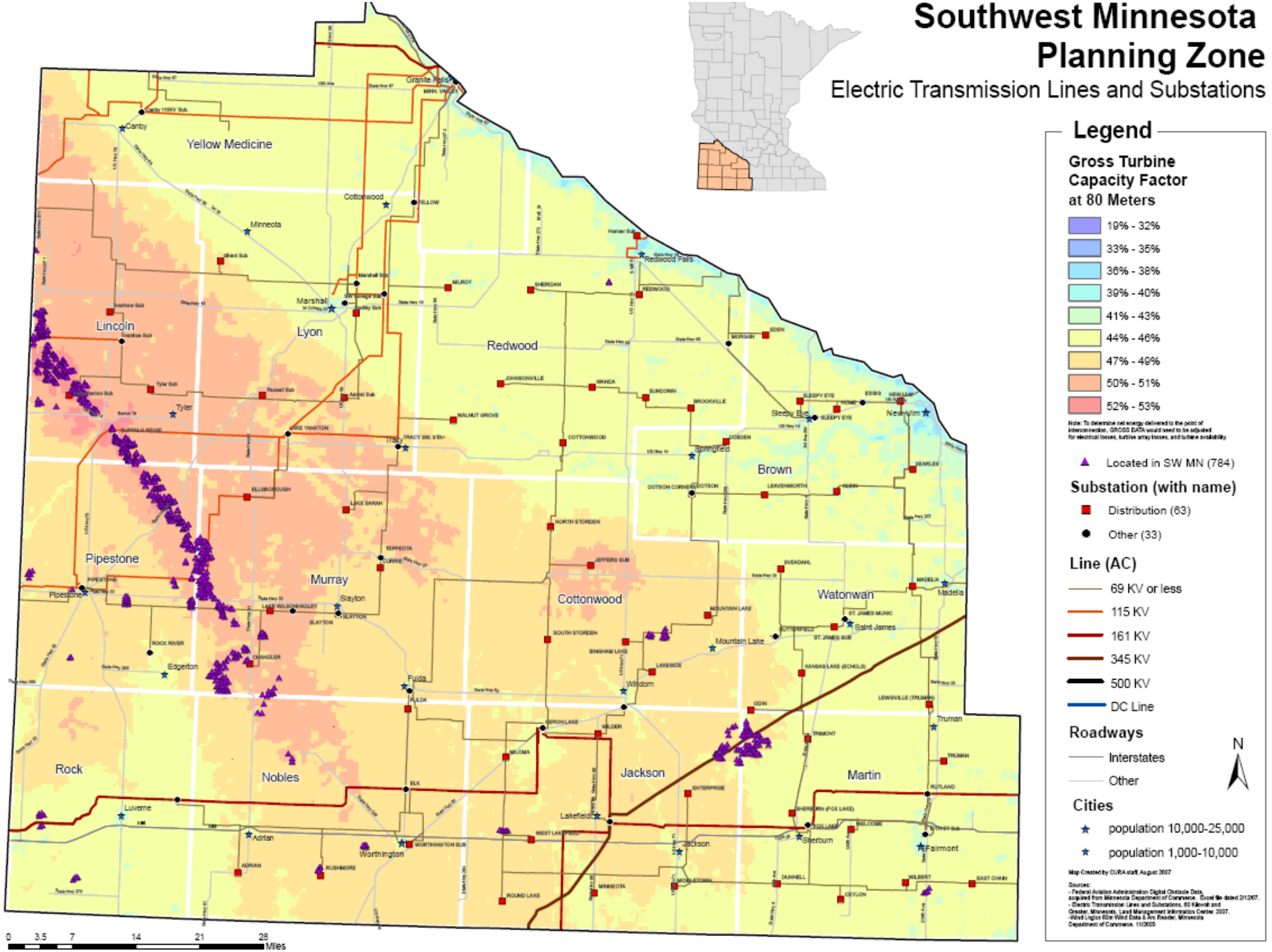
Available Generation Capacity at indicated bus.
Each load is listed for only one source bus.
All information

A	729	MVA load on bus + MVA rating of transformer (not in model: 70% of load if unknown)
B	3271	MVA transformer loading * 70% + MVA rating of transformer (subsystem in model)
C	0	MVA transformer loading * 70% + MVA rating of transformer (subsystem not in model)
total:	4000	

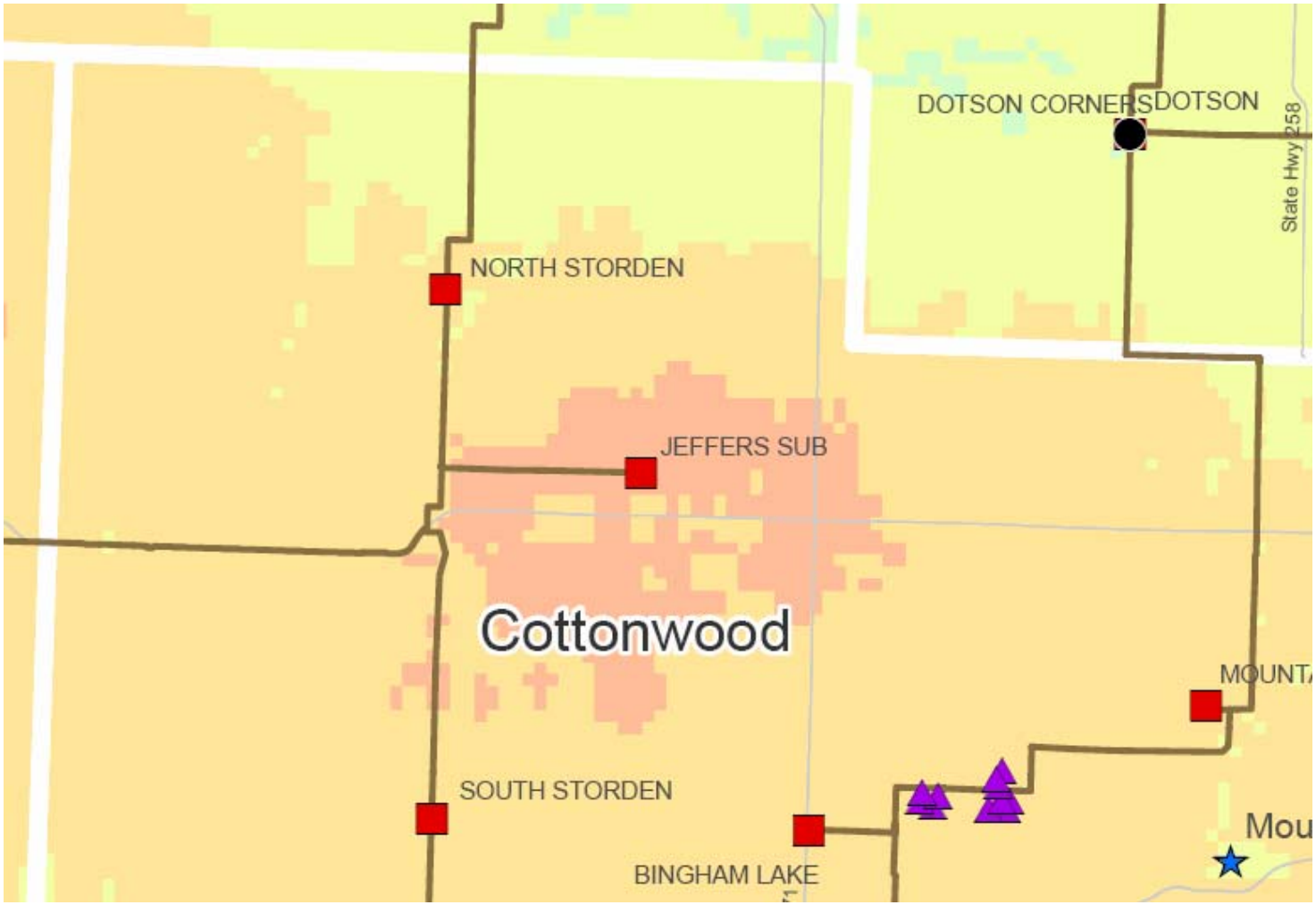
					load on bus (type A) (type A)					OR	transformer loading (type B or C)				
Bus#	Bus Name	type	AGC	Load	MW	MVAr	MVA	rating	total		MVA	* 0.7	rating	total	notes
34306	'ADAMS 8'	B	107	34306 'ADAMS 8'	4	0	4	3	7		47	33	75	107	
				68911 'VNDMYD8 '	1	0	2	1	3		0	0	0	0	
				68910 'LITTLE C'	2	0	2	1	3		0	0	0	0	
				69078 'ROSE CRE'	3	0	3	2	5		0	0	0	0	
				34312 'STWRTVL8'	6	0	6	4	10		0	0	0	0	
				34315 'CHATFLD8'	3	1	3	2	5		0	0	0	0	
				34314 'SPRVALL8'	5	1	5	3	8		0	0	0	0	
				61940 'SPRING V'	5	1	5	4	9		0	0	0	0	
				68936 'LONDON '	2	0	2	1	3		0	0	0	0	
				68924 'CARPENTE'	2	1	2	2	4		0	0	0	0	
				69122 'TAOPI '	2	0	2	2	4		0	0	0	0	
						total:	35	25	60						



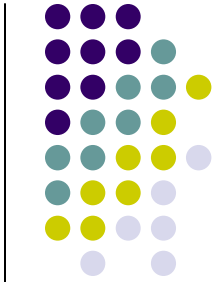
USING NEW MAPS & TABLES


Southwest Minnesota Planning Zone
Electric Transmission Lines and Substations
Legend
Gross Turbine Capacity Factor at 80 Meters
19% - 32%
33% - 35%
36% - 38%
39% - 40%
41% - 43%
44% - 46%
47% - 49%
50% - 51%
52% - 53%
Note: To determine net energy delivered to the point of interconnection, GROSS DATA would need to be adjusted for electrical losses, turbine array losses, and turbine availability.
Located in SW MN (784)
Substation (with name)
Distribution (63)
Other (33)
Line (AC)
69 KV or less
115 KV
161 KV
345 KV
500 KV
DC Line
Roadways
Interstates
Other
Cities
population 10,000-25,000
population 1,000-10,000
Map Created by OURA staff, August 2007
Sources:
- Federal Aviation Administration Digital Obstacle Data, acquired from Minnesota Department of Commerce. Excel file dated 2/12/07.
- Electric Transmission Lines and Substations, 60 Kilovolt and Greater, Minnesota, Land Management Information Center, 2007.
-Wind Logics 60m Wind Data & Arc Reader, Minnesota Department of Commerce, 11/2005
N
Granite Falls
Canby
Yellow Medicine
Cottonwood
Minneota
Marshall
Lincoln
Lyon
Redwood
Redwood Falls
Tyler
Pipestone
Murray
Slayton
Edgerton
Fulda
Rock
Nobles
Luverne
Adrian
Worthington
Cottonwood
Watonwan
Madelia
Saint James
Mountain Lake
Windom
Jackson
Lakefield
Brown
Springfield
New Ulm
Sleepy Eye
Martin
Truman
Fairmont
Jackson
Silverburn
0 3.5 7 14 21 28 Miles

LIKELY SPOT?

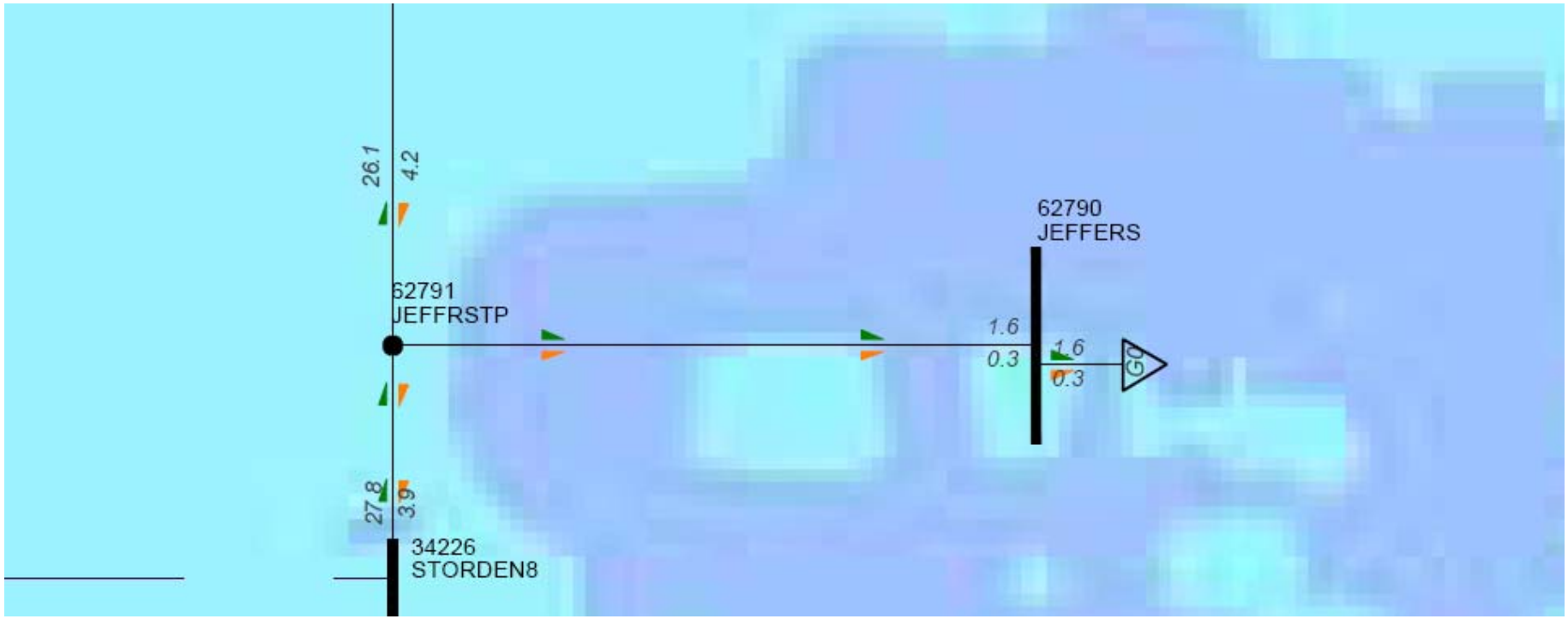

DOTSON CORNERS
DOTSON
State Hwy 258
NORTH STORDEN
JEFFERS SUB
Cottonwood
SOUTH STORDEN
BINGHAM LAKE

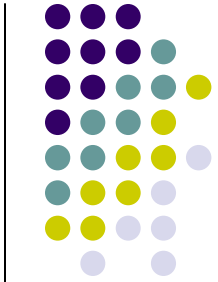
LOOK UP THEORETICAL INJECTION



34225 'HERONLK8'	B	150												
			34225 'HERONLK8'	2	0	2	1	4		54	38	112	150
			62355 'MILOMA '	1	0	1	1	2		0	0	0	0
			62370 'W LAKFLD'	2	0	2	1	3		0	0	0	0
			62369 'ROUND LK'	3	1	3	2	6		0	0	0	0
			62357 'MINNEOTA'	1	0	1	1	2		0	0	0	0
			34221 'DOVRAY 8'	0	0	0	0	1		0	0	0	0
			34222 'WESTBKM8'	2	1	2	1	4		0	0	0	0
			34224 'WESTBRK8'	2	1	2	1	4		0	0	0	0
			62801 'S STORDN'	2	0	2	1	3		0	0	0	0
			34226 'STORDEN8'	1	0	1	1	2		0	0	0	0
			62790 'JEFFERS '	2	0	2	1	3		0	0	0	0

LOOK UP LINE LOADING





CONSERVATION & RENEWABLES

“A PENNY SAVED IS A PENNY EARNED”

DYNAMIC DUALITY

TURNING OFF A LIGHT

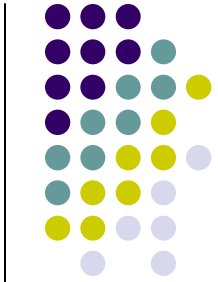
OR

SUPPLYING THE ENERGY FOR THE LIGHT LOCALLY

LOOKS THE SAME

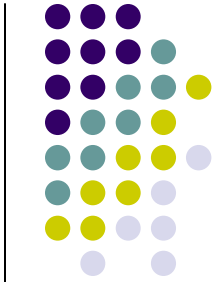
TO A SUBSTATION TRANSFORMER OR A TRANSMISSION LINE

Timing and Aggregation



- Community involvement in supply and demand side resources can add economic value through aggregation and active control of the timing of the use of those resources.
- When organized at the substation level the value added can extend to the utility company, in terms of ability to manage loads on the substation.
- Microgrids with Internet communications create new possibilities for dispersed community projects.

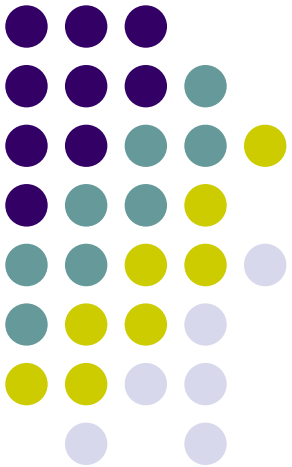
SYSTEM WIDE BENEFITS



- Active control of locally aggregated resources enables them to be used for transmission constraint management.
- Active control allows for the capture of maximum economic value in the electricity market place.
- Active control enables system reliability value such as peak demand management.

MATRIX ENERGY SOLUTIONS

ENABLING COMMUNITIES TO SUSTAINABLE ENERGY



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