SPP Southwest Power Pool

**Helping our members work together to keep the lights on...**

**today & in the future**

SPP Southwest Power Pool

# Priority Projects Phase II Technical Conference

**February 10, 2010**

SOUTHWEST POWER POOL

## Agenda

- **Introduction and Recommendation**

  Bruce Rew, Vice President of Engineering

- **Study Overview, Results, and Assumptions**

  Katherine Prewitt, Manager, Engineering Administration

- **KEMA Analysis**

  Jeff Palermo, Executive Consultant

- **Qualitative Benefits**

- **Recap and Next Steps**

  Bruce Rew, Vice President of Engineering



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## Introduction

- **Staff presented initial Priority Projects effort to BOD, RSC, and MOPC in October 2009**
- **Instructed to perform further analysis on 6 of the 10 projects to determine if they:**
  - **Better integrate SPP's west and east regions**
  - **Benefit SPP Generation Interconnection and Aggregate Study processes**
  - **Address known congestion**
- **Studied in two groups with 765 kV vs. 345 kV options**
- **Phase II guided by SPC - to be presented to stakeholders and BOD for review in April 2010**

## Engineering and Construction costs

- **Group 1 - $1.26 billion**
  - **Spearville – Comanche – Medicine Lodge – Wichita constructed at 765 kV**
  - **Comanche – Woodward District EHV constructed at 765 kV**
- **Group 2 - $1.11 billion**
  - **Spearville – Comanche – Medicine Lodge – Wichita constructed at double-circuit 345 kV**
  - **Comanche – Woodward District EHV constructed at double-circuit 345 kV**





## Phase II Projects Studied

- **Spearville – Comanche – Medicine Lodge – Wichita (765 kV operated at 345 kV & double Circuit 345 kV)**
- **Comanche – Woodward District EHV (765 kV operated at 345 kV & double Circuit 345 kV)**
- **Hitchland – Woodward District EHV (double-circuit 345 kV)**
- **Valiant – NW Texarkana (345 kV)**
- **Cooper – Maryville – Sibley (345 kV)**
- **Riverside – Tulsa Reactor (138 kV)**

## Recommendation

- **Based on SPPT, SPC, and ESWG guidance, staff recommends approval of Group 2, as they:**
  - **Improve west to east connections**
  - **Improve Generation Interconnection and Aggregate Study processes**
  - **Relieve known congestion**
- **Quantitative and Qualitative net benefits have a B/C ratio of 1.4**





## Quantitative Benefits

- **Study quantified NPV benefits of $1.5 billion over 40 years**
- **B/C Ratio of 0.74**

| Total | $$ | B/C Ratio |
|---|---|---|
| APC | $819 M | 0.41 |
| Losses | $ 26 M | 0.01 |
| Wind Revenue* | $266 M | 0.13 |
| Fuel Diversity | $399 M | 0.20 |
| Reliability | $ -20 M | (0.01) |
| *(Adjusted down) | $1.5 B | 0.74 |

## Qualitative Benefits

- **Brattle Group economic analysis showed over $6.5 billion in total benefit (attachments 5 and 6)**
- **Staff conservatively used only 20% of $6.5 billion for B/C ratio**
- **Qualitative 20% B/C ratio of 0.66 with $1.3 billion in benefits**



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## Qualitative Benefits

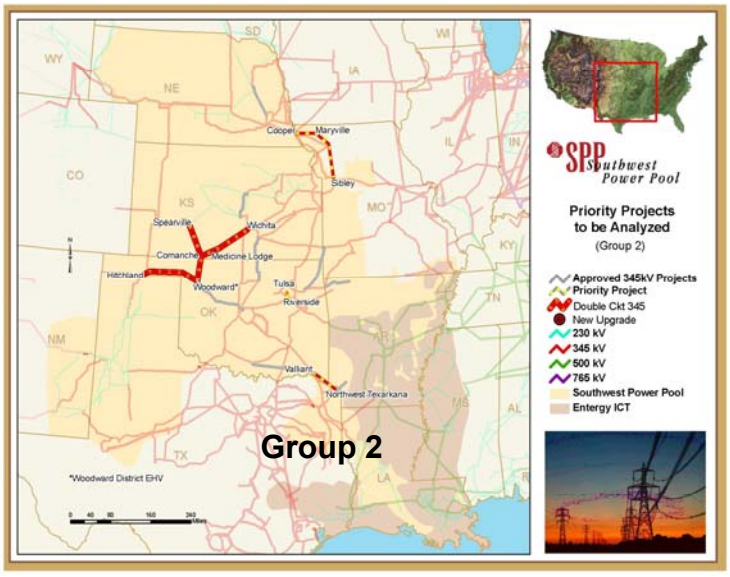
| Total (B/C at 20% of $$) | $$ | B/C Ratio |
|---|---|---|
| Taxes (table 28): | $ 34 M | 0.00 |
| Econ. Trans (table 27) | $1,000 M | 0.10 |
| Wind Earning (table 5a) | $ 560 M | 0.06 |
| Econ Operating (table 5a) | $1,900 M | 0.19 |
| Wind Earning Construct (table 5a) | $ 766 M | 0.08 |
| Econ Construction (table 5a) | $2,300 M | 0.23 |
| Total | $6,500 B | 0.66 |

## Total Group 2 Benefits

- **B/C ratio of 1.4 when quantitative and qualitative benefits are combined**
- **Benefits would be higher if studying more wind**
  - **Plan to study 11 GW prior to April**
- **"No regrets" projects needed for SPP transmission system's current and future needs**







# Priority Projects Phase II Study Overview





## Evolutionary vs. Revolutionary

- **This effort is a marathon, not a sprint**
  - **SPPT report in April 2009**
  - **Stakeholder involvement**
  - **SPC and BOD guidance**
- **At the end of the day, have we met the charge of the BOD, SPPT, and SPC?**

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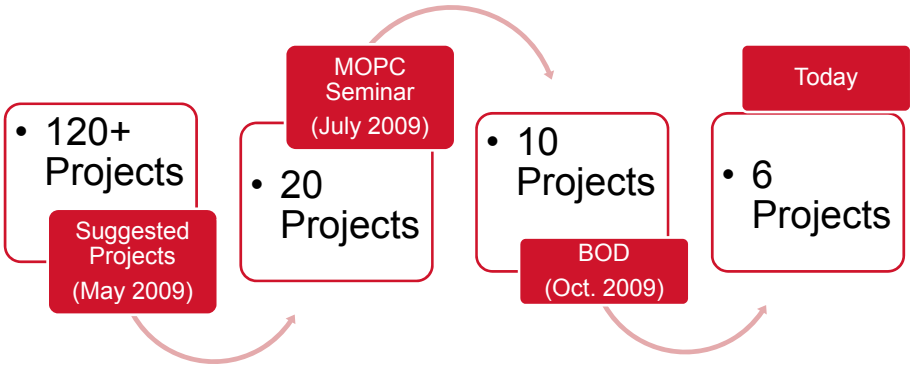
## How did we get here?



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## Review of Phase I

- **Studied 10 projects**
- **Graduated wind levels from existing up to 14 GW**
  - **No additional wind in base case**
- **Stakeholder concerns over modeling**
  - **Changing two variables**

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## Phase II Stakeholder Involvement

- **Input and output data review process**
  - **Approval from all Transmission Owners (January 14)**
- **ESWG provided feedback on benefit metrics and wind injection**
- **TWG reviewed and endorsed reliability report with comment**
- **CAWG survey and wind revenue allocation**



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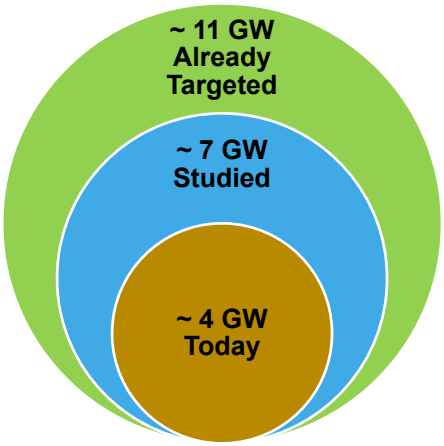
## CAWG Survey

- **November 10, 2009 survey sent to state CAWG representatives and RSC members**
- **Questions dealt with:**
  - **Renewable energy**
  - **Energy efficiency programs**
  - **Energy conservation programs**

## CAWG Survey








## Wind Integration Task Force

- **WITF completed report at end of 2009**
- **Purpose was to determine operational and reliability impacts of 10%, 20%, and 40% wind penetration levels for SPP**
- **Determined SPP could reliably integrate up to 20% wind**
- **Recommended major transmission reinforcements needed starting as low as 10% wind - especially west to east**

## SPC Direction

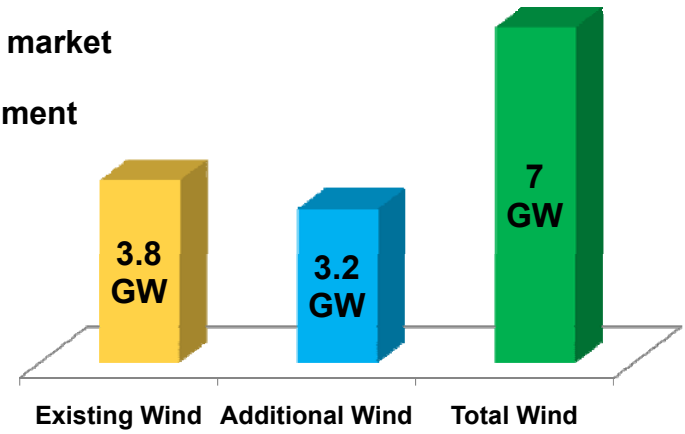
- **Study 7 GW of Wind**
  - **Base and change case**
  - **$8 wind**
- **Study projects as a group**
  - **Group 1 - $1.26 billion E&C**
    - **765 kV construction operated at 345 kV**
  - **Group 2 - $1.11 billion E&C**
    - **Double-circuit 345 kV alternative to 765 kV construction**

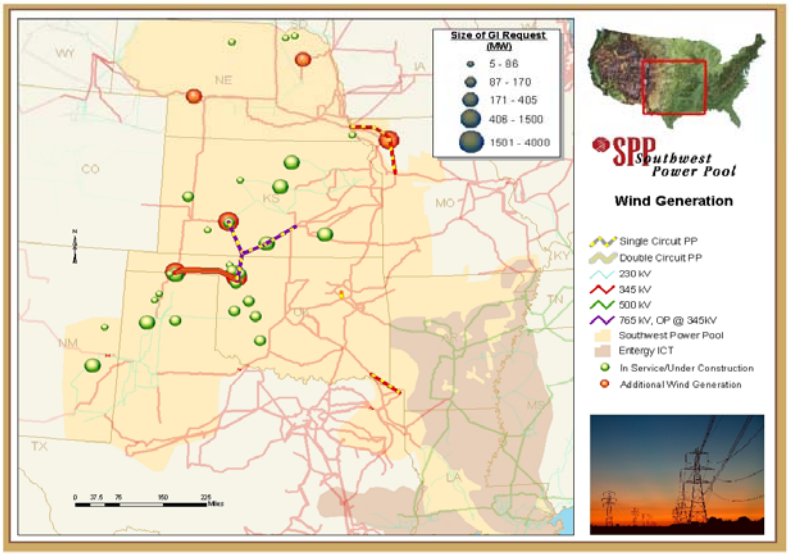




## Other Assumptions

- **Consolidated Balancing Authority**
- **Day Ahead market**
- **Wind placement**










## Study Process

- **Identify constraints for economic model**
  - **PAT**
  - **Added over 100 constraints**
- **Update inputs and outputs based on stakeholder review**
- **Run PROMOD on models**
- **Process results and calculate benefits**

# Quantitative Assessment





## Adjusted Production Cost (APC)

- **PROMOD 8,760 hourly model**
- **7 GW Wind in base and change case**
- **Consolidated Balancing Authority**
- **APC = ∆ PC + ∆ Purchases - ∆ Sales**

## Reliability

- Same process used in STEP Reliability Assessment
- Used 2008 STEP models
- Determined impact of Priority Projects on reliability
  - Deferring/advancing projects
  - New reliability projects
  - New 3rd party reliability impacts
- Endorsed with comment by TWG on January 5
  - SPS and EDE voted no, NPPD and KCPL abstained





## Impact on Losses

- Energy vs. capacity components
- Developed by BATTF
- Capacity component determined through powerflow analysis
  - Less generation needed (initial capital investment)
  - Reduced fixed O&M
- Limited to 20 years of benefits due to estimated life span of a CT

## Increased Revenue for Wind

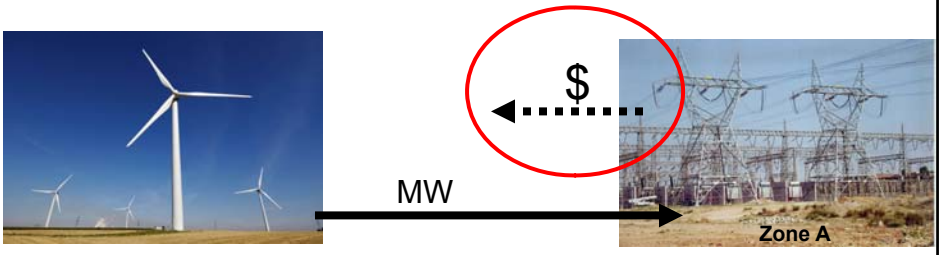
- **Developed by Mike Proctor**
- **Not captured in existing APC formula, but uses outputs from APC model**
- **As transmission is added, wind capacity factors go up**
- **Increased energy output results in increased revenue for the footprint**
- **Designated vs. undesignated**
- **ESWG gave endorsement February 2**
- **Initial wind revenue calculations were reduced by $8/MWh from $443 million to $266 million**





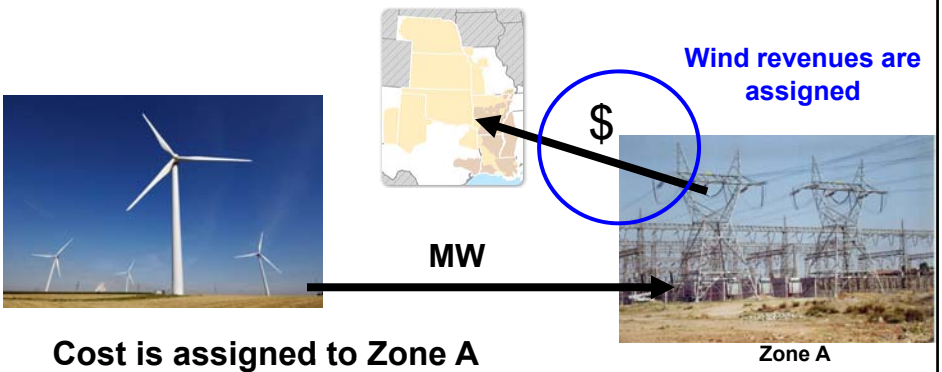
## Where did it go?

**Dollars leave Zone A but are not allocated as a revenue**




- **Cost is assigned to Zone A**
  - **MW x Load LMP**
- **The revenues ($) are not assigned!**

# Capturing the revenues




**Cost is assigned to Zone A**

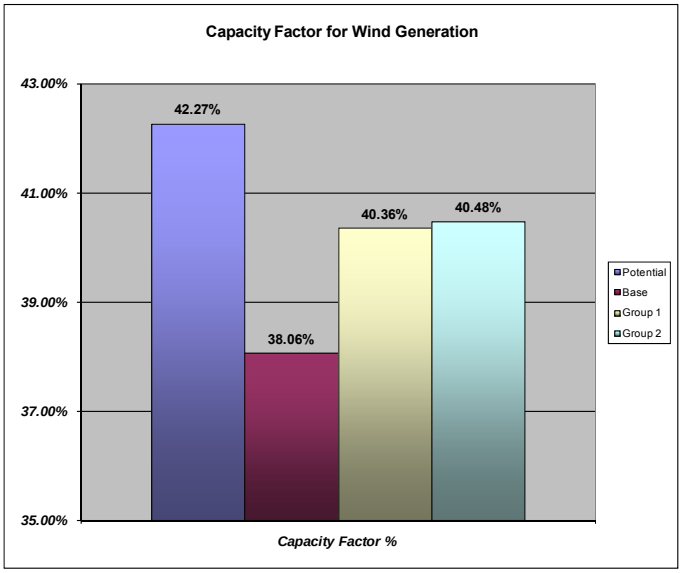
- **MW x Load LMP**

**Revenue is captured**

- **MW x Gen LMP**







## Carbon Impact

- **BATTF developed method for approximating benefits based on reduction in carbon output**
- **Same wind is modeled in base and change case**
- **Not appropriate to use for this phase of Priority Projects**
- **No carbon benefits are considered in Priority Projects Phase II analysis**





## Quantitative Regional Results

| Study Group | APC (Years 1-40) | Reliability (Years 1-40) | Losses (Years 1-40) | Wind Benefit | Fuel Diversity Benefit | Total Benefit (w/ Wind) | Total Cost (Years 1-40) | Net Benefit | B/C (w/ Wind) |
|---|---|---|---|---|---|---|---|---|---|
| Group 1 | $786,001,884 | ($20,175,666) | $26,627,100 | $236,837,269 | $361,073,329 | $1,390,363,916 | $2,246,851,575 | ($856,487,658) | 0.62 |
| Group 2 | $819,705,924 | ($20,175,666) | $26,888,067 | $266,368,253 | $399,916,159 | $1,492,702,737 | $2,012,293,729 | ($519,590,993) | 0.74 |

- **40 year present values**
- **Total benefit is sum of APC, Reliability, Losses, Wind, and Fuel Diversity**
- **Total cost is PV of ATRR for Priority Projects**
- **Net Benefit is Total Benefit – Total Cost**

## Fuel Diversity Benefit



## Natural gas supply elasticity

- Recent studies of regional natural gas prices
  - Lawrence Berkley labs—0.9 to 2.0—1.2 median
  - Rand Corp—0.97
  - KEMA used 1.2—so 1.0% Δ use = 1.2% Δ price
- SPP gas for electricity is 22.5% of region
  (EIA 2007 data for KS, LA, NE, OK)
- So 1.0% change in SPP gas use
  will cause a 0.27% change in price

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# Supply elasticity for SPP priority projects

| | Gas percent change | | Resulting price change | |
|---|---|---|---|---|
| | Group 1 | Group 2 | Group 1 | Group 2 |
| 2009 | 5.0% | 5.1% | 1.3% | 1.4% |
| 2014 | 5.0% | 5.4% | 1.3% | 1.5% |
| 2019 | 4.1% | 4.3% | 1.1% | 1.2% |

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# Supply Diversity Expected Savings

| | 2009 | 2014 | 2019 |
|---|---|---|---|
| Group 1 | $13.3M | $22.5M | $29.7M |
| Group 2 | $14.4M | $26.0M | $32.4M |

- Assumption are for 7GW of wind only
- Numbers are conservative
- Net Present Value of Group 2 expected savings is $399.9M

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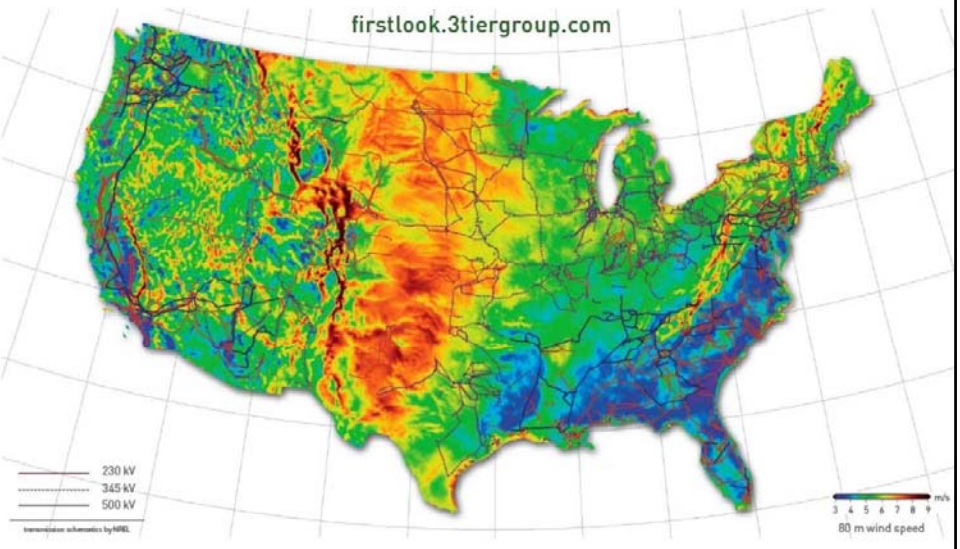
# Qualitative Assessment

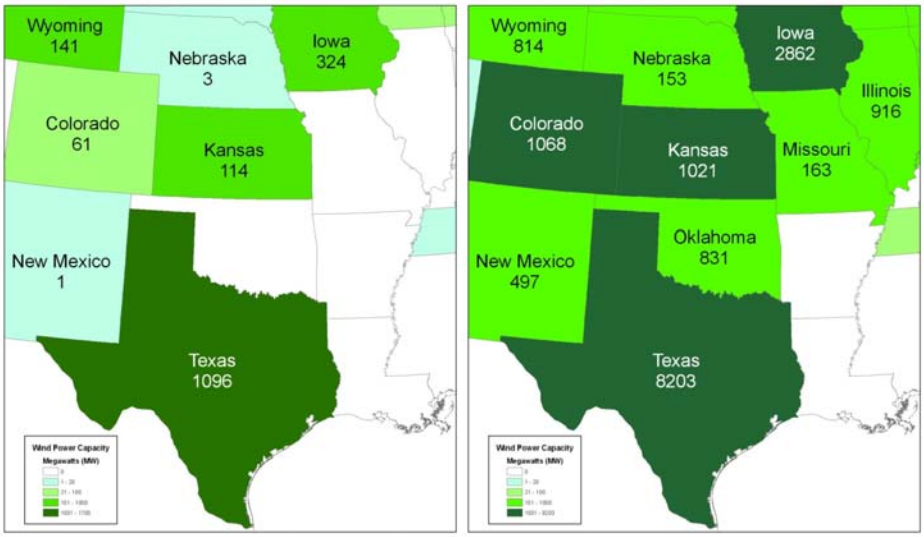


## Annual Average 80m wind speed

3TIER



## Wind In Service: 2001 2009

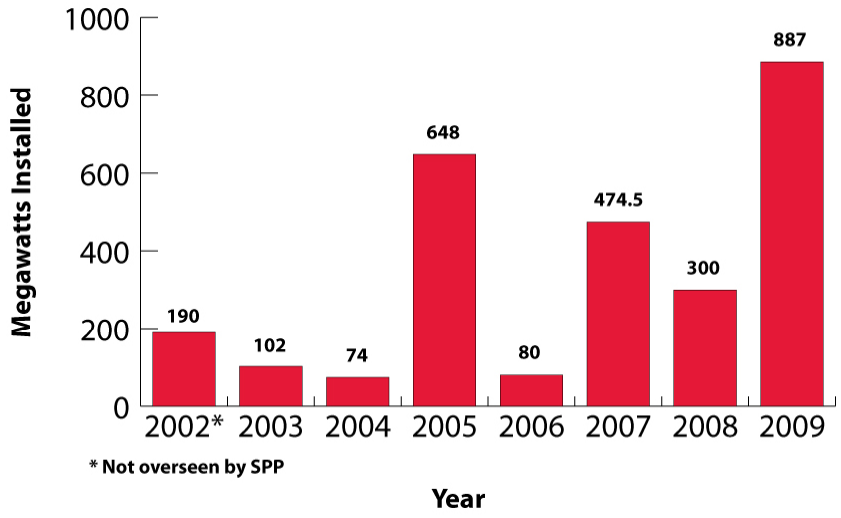



Source: NREL



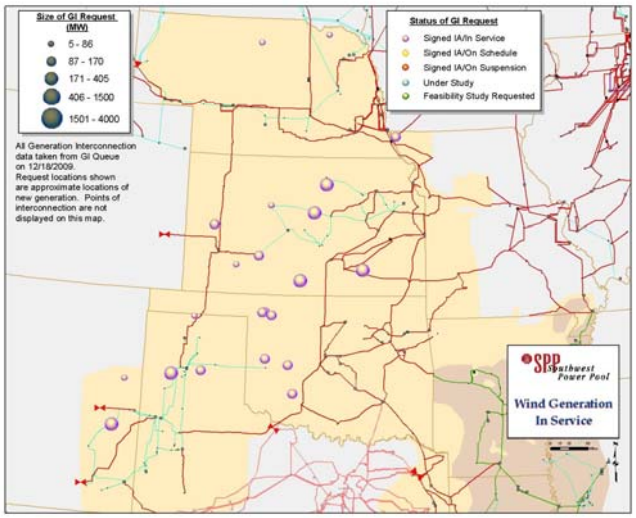


## Wind Installed by Year (2002-2009)




Source: SPP

# Wind in Service Today

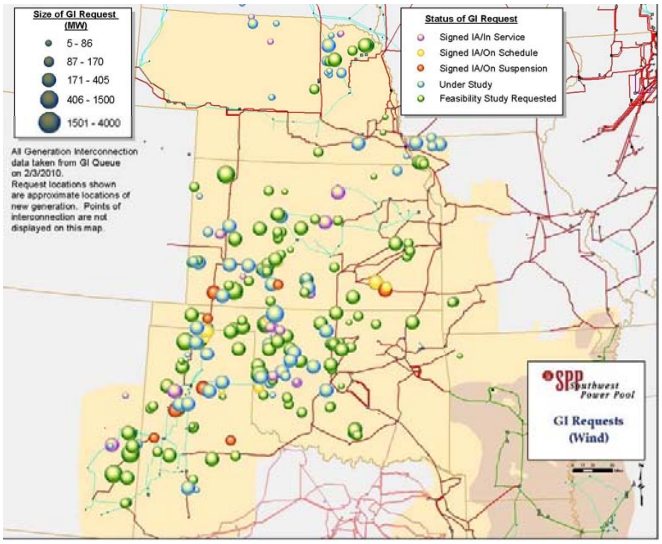



Source: SPP



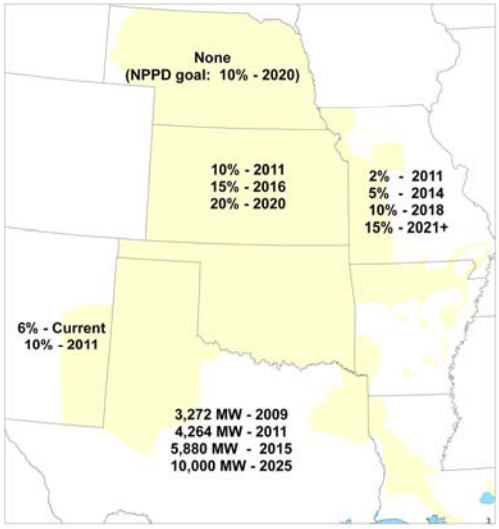


# Wind in Generation Interconnection Queue




Source: SPP

## Renewable Energy Standards By State



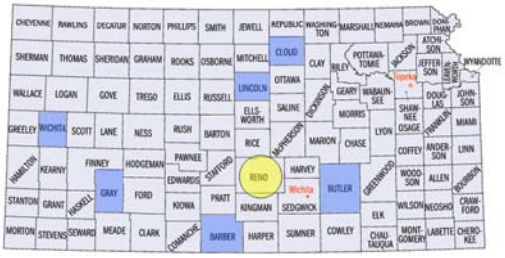

Source: SPP





## Wind Status in Kansas

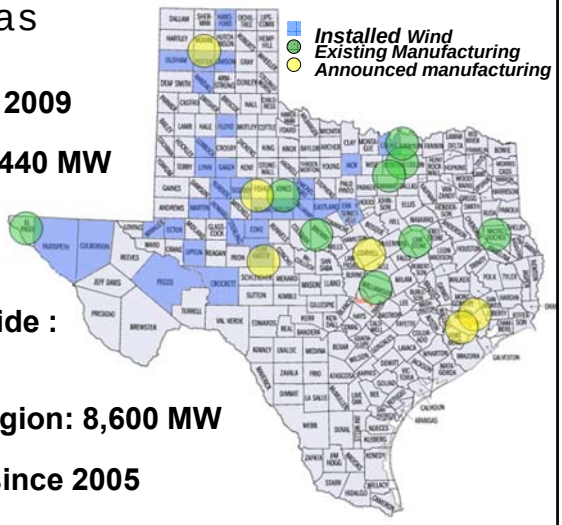
- **Installed: 1,014 MW through 3Q 2009**
- **3.85% wind generation in 2008**
- **10th in wind installation nationally**
- **2009 - Siemens announced first American nacelle assembly plant**




Source: AWEA

## Wind Status in Texas

- **Installed statewide: 8,796 MW through 3Q 2009**
- **Installed SPP region: 440 MW**
- **3.5% wind generation in 2008**
- **Wind in queue statewide : >59,000 MW**
- **Wind in queue SPP region: 8,600 MW**
- **#1 for wind installed since 2005**
- **Districts 19,17, and 5 represent #1, #2, and #4 Congressional districts with most wind power in U.S.**



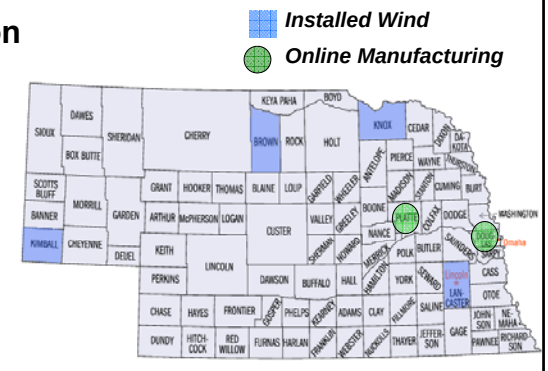

Source: AWEA, SPP





## Wind Status in Nebraska

- **Wind Installed: 153 MW through 3Q 2009**
- **0.67% wind generation in 2008**
- **Wind in queue: 3,726 MW**
- **Ranks 6th for wind potential**




Source: AWEA

## Wind Status in New Mexico

Installed Wind


- **Installed statewide: 597 MW through 3Q 2009**
- **Installed SPP region: 180 MW**
- **4.4% wind generation in 2008**
- **Wind in queue statewide: >14,000 MW**
- **Wind in queue SPP region: 2,700 MW**
- **Ranks 5th for highest penetration of wind power**

Source: AWEA, SPP





## Wind Status in Missouri

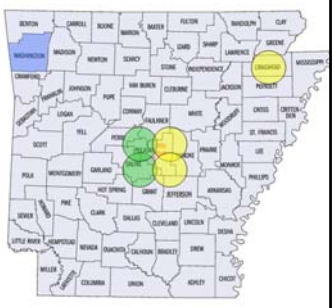
Installed Wind

- **Installed: 309 MW**
- **2009 - doubled wind installations**
- **Major Player: Wind Capital Group**
  - **Closed financing on 150 MW Lost Creek project - raised $240 million in debt facilities for construction and operation**
  - **Believed to be largest investment by private sector in Missouri in 2009**
  - **Transformers going into the project's turbines built by United Auto Worker employees in Jefferson City**

Source: AWEA

# Arkansas Becoming Manufacturing Hub

- **LM Glasfiber**
  - Employs 300 workers @ $12-$15/hour
  - Invested $95 million in Little Rock
- **Mitsubishi Power Systems**
  - Announced October 2009
  - $100 million plant will bring 400 jobs in 2011
- **Nordex**
  - Sept 2009 - Broke ground on $100 million plant
  - Expected to employ 700 by 2014
- **Emergya Wind Technologies/Polymarin**
  - Plans to invest $16 M and create 830 jobs @ $15/hour



*Installed Wind*
*Existing Manufacturing*
*Announced manufacturing*

Sources: NREL, AR Economic Dev. Commission, Nordex, *Arkansas Business*

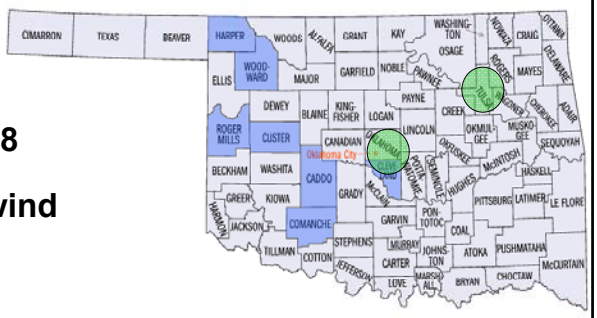




# Wind Status in Oklahoma

- **865 MW installed through 3Q 2009**
- **3% wind generation in 2008**
- **Ranks 12th total wind installation**

*Installed Wind*
*Online Manufacturing*




Source: AWEA, NREL

## Oklahoma Weatherford Wind Energy Center

- **$300,000 in annual lease payments to landowners**
- **$17 million in property taxes over 20 years**
- **147 MW**
- **150 workers during construction peak; 6 full-time O&M positions**


Source: NREL





## Oklahoma CPV – OU Spirit project

- **Annual allocations from addition of 2.3 MW Siemens turbines**
  - **$1,057,000 in new tax dollars for two school districts**
  - **CareerTech allocation from county revenue will increase by $227,000**
  - **County general funds will increase by $190,000 –will assist with building new jail**
  - **EMS services will receive $57,000 increase**
  - **County Heal services will receive $20,000 increase**


Source: Woodward County Assessor

## Oklahoma, Wind, and Economic Development

- **Economic benefit of 1,000 MW = $1.25 billion**
  - **5,530 construction jobs, 215 permanent jobs**
- **Average wages in component manufacturing industry = $40,709 - 15% higher than average state wage**
- **Strong correlation between Western OK counties that have lost population in recent decades with counties that have significant wind resources**
- **In many cases, land suited for wind development has lower per-acre returns for agricultural use**
- **Sooner Survey of 600 registered voters:**
  - **72% of Oklahomans willing to pay more for wind-generated electricity**
  - **91% approve of further development of wind farms**

Source: NREL; Cole, Hargrave Snodgrass, and Associates; Oklahoma Department of Commerce





## Component Manufacturing-Oklahoma, Kansas

- **Bergey WindPower (Oklahoma)**
  - **Employs 42, manufactures one turbine per day**
- **DMI Industries (Oklahoma)**
  - **Employs 215**
- **Siemens (Kansas)**
  - **Broke ground September 2009**
  - **Will invest $50 million in new facility**
  - **Expected to employ 400 workers by 2012 @ >$16/hour**
  - **Planned annual output = 650 nacelles**

Sources: NREL, *Wichita Eagle*

## Component Manufacturing in Nebraska

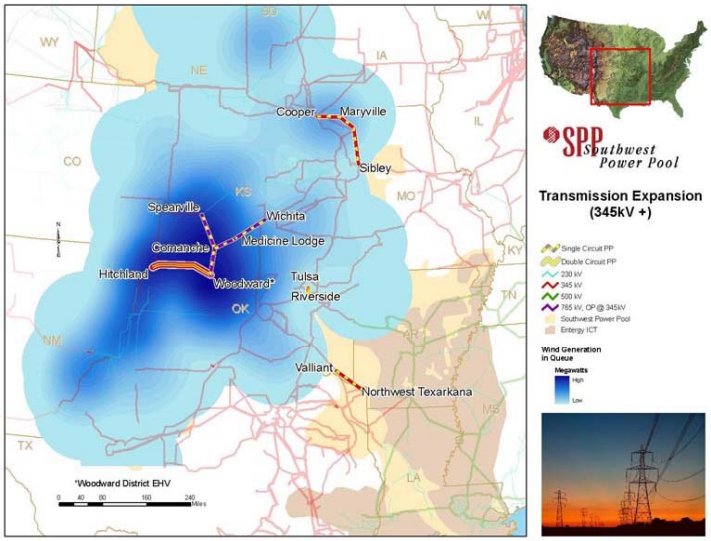
- **Katana Summit- Nebraska**
  - **300+ employees**
  - **Produces 200 towers per year**
- **Northstar Wind Towers – Nebraska**
  - **Building $24 million facility for modular towers**
  - **Expects to employ 80-100 people**
- **NREL Report for Nebraska Energy Office**
  - **4,700 temporary and permanent jobs would be created over the next 20 years if wind farms generating 1,000 megawatts were built**

Sources: NREL, Katana Summit, Northstar Wind Towers





## Wind and Priority Projects





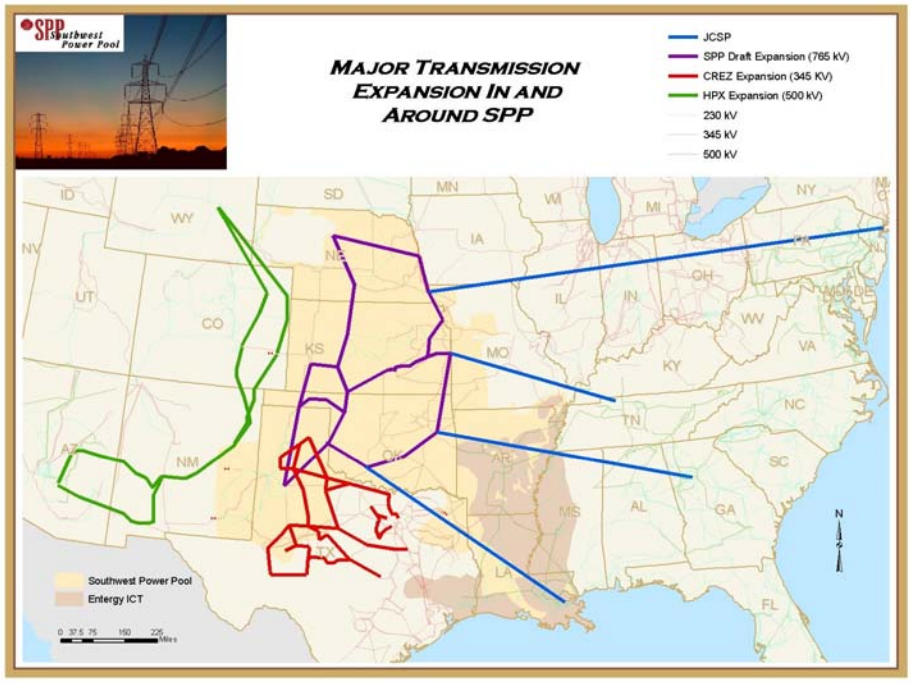

SPP Southwest Power Pool

Transmission Expansion (345kV +)

Single Circuit PP
Double Circuit PP
230 kV
345 kV
500 kV
765 kV, OP @ 345kV
Southwest Power Pool
Entergy ICT

Wind Generation in Queue

Megawatts
High
Low






## Priority Projects Economic Development Benefits

- **<u>Direct Jobs</u>: Construct or operate facility**
- **<u>Indirect Jobs</u>: Provide services or materials to enable construction or operation**
- **<u>Induced Jobs</u>: Provide food, housing, day care, to direct and indirect employees**

Source: Brattle Group analysis for SPP, included in *SPP Priority Projects Report* Attachment 4

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## Brattle Analysis included in report

- **Brattle used Jobs and Economic Development Impact (JEDI) Wind Model**
- **JEDI model uses the Input-Output model IMPLAN to perform estimations**
- **JEDI developed for DOE and IMPLAN developed by University of Minnesota**
- **Attachment 5 presents economic impact of wind development in the SPP footprint**
- **Attachment 6 presents economic impact from transmission investments**

Source: Brattle Group analysis for SPP, included in *SPP Priority Projects Report* Attachment 5 & 6



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## Priority Projects Economic Development Benefits

- **Investment of additional 4 GW wind projects in 2010 (Attachment 5, Table 5a):**
  - **Earnings during construction: ~ $766 million**
  - **Earnings during Operation: ~ $561 million**
  - **Earnings output during construction period: ~ $2.4 billion**
  - **Earnings output during operation period: ~ $1.9 billion**
- **Transmission Economic Impact for Group 2 projects (Attachment 6)**
  - **Economic Activity (table 27): ~ $998 million**
  - **State and local tax impact (table 28): ~ $34 million**

## Qualitative Benefits

- **Net assessment of economic benefits are a net present value of $6.5 billion**
- **Brattle confident in economic impact values representing the transmission and wind benefits**
- **SPP staff recommends using a conservative qualitative benefit measurement equal to 20% of calculated, equivalent to $1.3 billion**
- **SPP qualitative benefits will be substantial for transmission projects recommended**





## Recap and Next Steps

## Recommendation

- **SPP staff recommends Group 2 Priority Projects for construction:**
  - **Spearville – Comanche – Medicine Lodge – Wichita (double circuit 345 kV)**
  - **Comanche – Woodward District EHV (double circuit 345 kV)**
  - **Hitchland – Woodward District EHV (double circuit 345 kV)**
  - **Valiant – NW Texarkana (345 kV)**
  - **Cooper – Maryville – Sibley (345 kV)**
  - **Riverside – Tulsa Reactor (138 kV)**



## Recap

- **Projects consistent with SPPT's benefit metrics**
- **Estimated engineering and construction costs = $1.11 B**
- **Quantitative and qualitative benefits net B/C ratio = 1.4**
- **"No regrets" projects**

## Evaluation

- **Evaluation of these projects will continue in ITP process**
- **ITP January 2011 includes scenarios:**
  - **Base**
  - **Carbon mandate, including renewables**
  - **Demand response and energy efficiency**
- **Review these projects to be consistent with 20-Year ITP Assessment**





## Next Steps

- **Prior to the April series of meetings, incremental analysis to:**
  - **Include STEP Appendix B projects approved in January 2010**
  - **Evaluate 11 GW wind needed to meet state renewable projects**
  - **Working with ESWG (possibly Brattle) assign qualitative benefits contained in this report to individual zones and states**