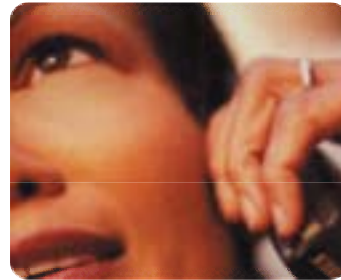


BUILDING A WORLD OF DIFFERENCE®



BLACK & VEATCH



KWEA & KsAWWA
Joint Annual Conference
August 31 – September 3, 2009



Energy Management Strategies for Water and Wastewater Systems

Fred Ellermeier
Director of Engineering Services
Black & Veatch Corporation

Energy Management Strategies for Water Utilities

- Drivers
- Energy Management Strategies
- Optimization Methods
- Renewable Energy
- Resources

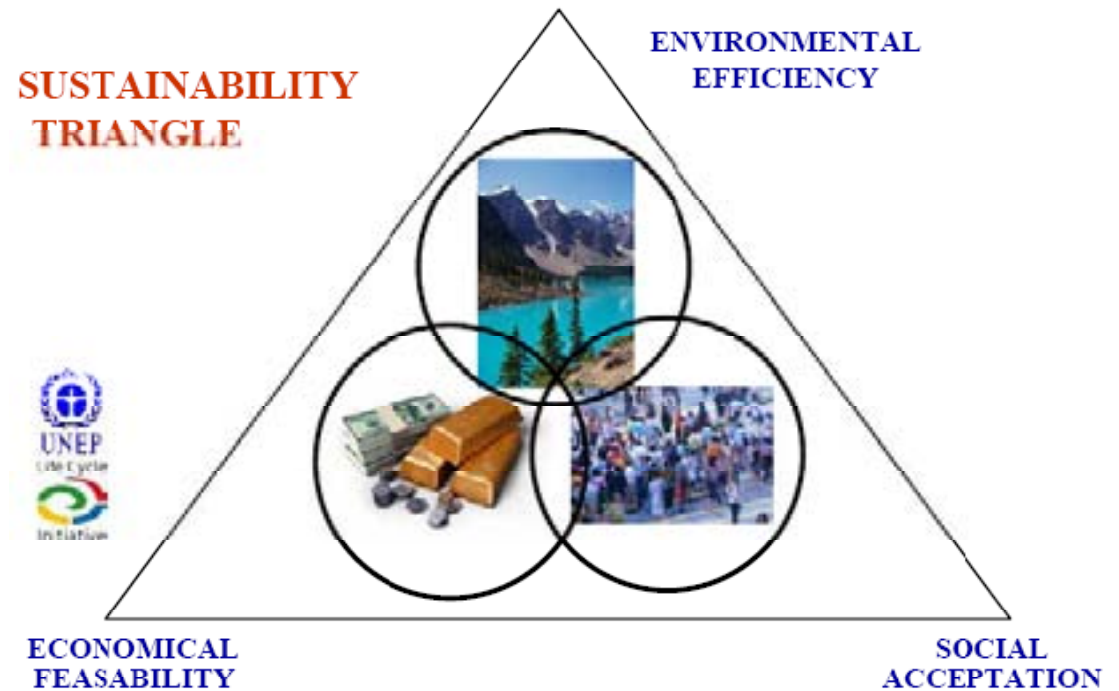


Energy Consumption in the Water/Wastewater Industry

“Some 4% of the nation’s electricity use goes towards moving (80%) and treating water/wastewater. Approximately 80% of municipal water processing and distribution costs are for electricity...”

Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment - The Next Half Century, Electric Power Research Institute (EPRI), 2002:

Drivers for Energy Management



Source: UNEP

- Economic Drivers
 - Reduction in Operating Costs
 - Available Funding Resources
 - Regulatory Requirements that Increase Operating Costs
 - Offsetting High Energy Treatment Processes

Potential Additional Water Treatment Energy Use of Emerging Treatment Processes (EPRI/GEP, 2004)

- UV: 70-100 kW-hr/MG
- Ozone: 170 kW-hr/MG
- Membranes
 - microfiltration: 100 kW-hr/MG
 - ultrafiltration: 1,000 kW-hr/MG
 - nanofiltration: 1,800 kW-hr/MG

Drivers for Energy Management

- Social Drivers
 - Community Impact
 - Industry Leadership
- Environmental Drivers
 - Carbon Footprint Reduction
 - Energy Use Reduction
 - Sustainability of Energy Resources



Water and wastewater facilities are energy intensive, accounting for up to 35 percent of municipal energy usage.*

**Consortium For Energy Efficiency (CEE)*

Energy Management Strategies

- Energy Optimization – Reduction in utility energy demand that results from energy efficiency improvements and implementation of renewable energy sources.
- Cost Optimization – Reduction in energy costs achieved through changes in operations that reduce operating costs
- Shifting operations to off-peak hours
 - Doesn't save energy, but reduces peak demand on the utility grid.

Energy Master Planning

- Energy Audits
- Automated Control Strategies
- Equipment Replacement
- Energy Recovery
- Energy Portfolio



Energy Audit

- Walk-through and analysis of “low hanging fruit” for energy optimization
- Develop Energy Conservation Measures (ECMs) and determine payback cycles
- Implementation
 - Prioritized implementation projects
 - Targeted improvements integral to process improvements
 - Performance Contracting Approach – Financed improvements with savings payback and performance guarantees

Energy Audits Water Treatment Facilities

- Plant Operational Audits
 - Motors and Drive Systems
 - Pump Efficiency
 - Process and Control Optimization
 - Electrical Equipment Efficiency
- Facility Structure Audits
 - Building Envelope
 - HVAC
 - Lighting Systems

Energy Optimization – Example

- Pumping Systems – Highest Energy Consumer in Water Treatment & Distribution Systems
- Consider the Complete System
 - Pump
 - Motor
 - Drive System
- Wire-to-Water Efficiency = Complete Efficiency of the Pump, Motor, and Drive Combination



Pumping Systems

- Pump selection - *Improving Pumping System Performance: A Sourcebook for Industry, U.S. Department of Energy's Industrial Technologies Program (ITP) and the Hydraulic Institute (HI):*
<http://www1.eere.energy.gov/industry/bestpractices/pdfs/pump.pdf>
- Motor efficiency
 - Inventory and consider replacement of aging motors with low efficiency



www.nema.org/gov/energy/efficiency/premium



Motor Decisions Matter

<http://www.motorsmatter.org/>

Pumping Systems

- Evaluate complete adjustable speed drive system
- Affinity laws for centrifugal loads
 - Volume of flow is directly proportional to speed
 - Pressure (or head) is proportional to the square of the speed
 - Input power is proportional to the cube of the speed
 - Actual losses in head and efficiency can reduce the power savings, conservatively estimate power proportional to the square of the speed

Pumping Systems

- Operating at 70% volume requires only 49% of the power needed to run the system at 100% volume
- Opportunity for significant energy savings at relatively high operating speeds
- Utilize field instrumentation and control strategies to optimize efficiency

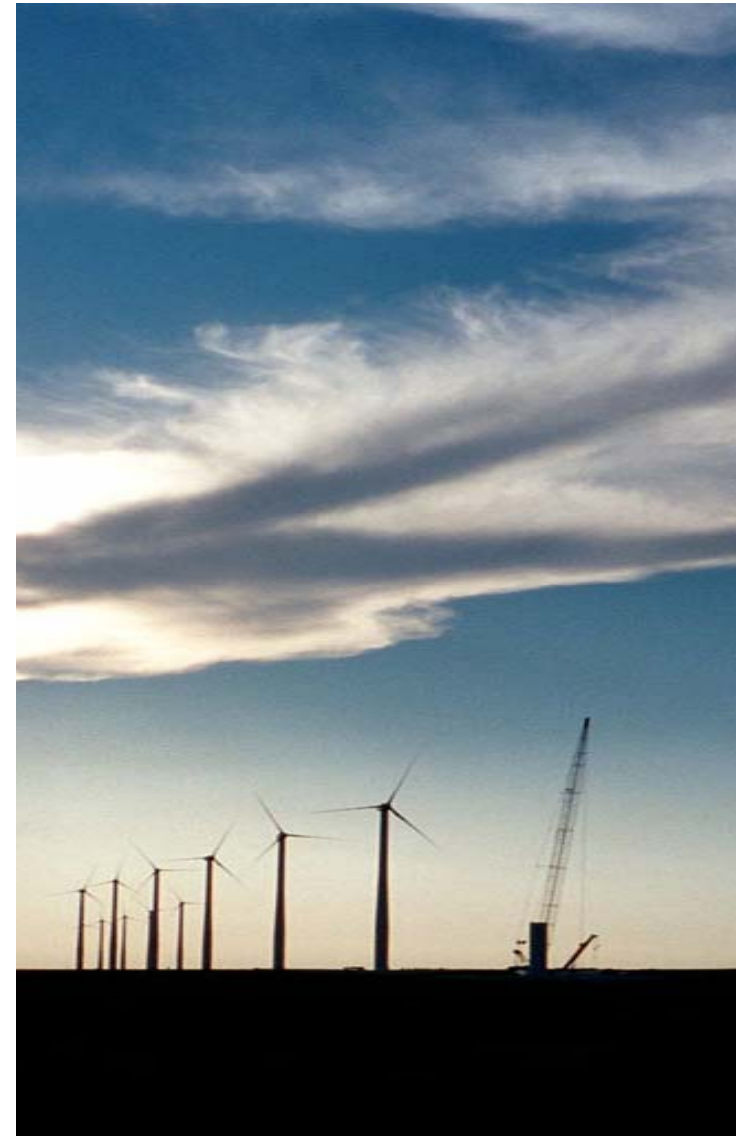
Cost Optimization – Example

- Distribution Optimization – Software Solutions to Manage:
 - Pumping Systems
 - Distribution Storage
 - Monitoring Systems
 - Utility Rate
- Backup / Peak shaving generators



Energy Portfolio Planning – Renewables

- Biomass
 - Anaerobic Digestion
 - Landfill Gas
- Solar
 - Photovoltaic
 - Thermal
- Wind
 - Turbines
- Water
 - Hydroelectric Dams
 - In-Line Hydro Generators



Renewable Energy Costs

	Capacity Factor	Capital Cost, US\$/kW	Levelized Cost of Generation, US\$/megawatt-hour
Solid Biomass	70 to 90	3,000 to 5,000	70 to 150
Cofired Biomass	70 to 90	300 to 500	0 to 20
Landfill Gas	70 to 90	1,200 to 2,000	50 to 80
Solar Thermal	26 to 29	3,600 to 4,200	140 to 180
Solar Photovoltaic	25 to 30	6,500 to 7,500	200 to 280
Hydroelectric	40 to 60	2,500 to 4,000	60 to 140
Wind	25 to 40	1,900 to 2,400	60 to 130
Geothermal	70 to 90	3,000 to 5,000	50 to 110

Notes:

Source: Black & Veatch estimates for typical projects based in the United States.
 Levelized Cost includes currently applicable incentives, subsidies, etc.

Renewable Energy Options for Water and Wastewater Systems, by Mark Kleveter and Keene Matsuda of Black & Veatch, *APWA Reporter*, February 2009

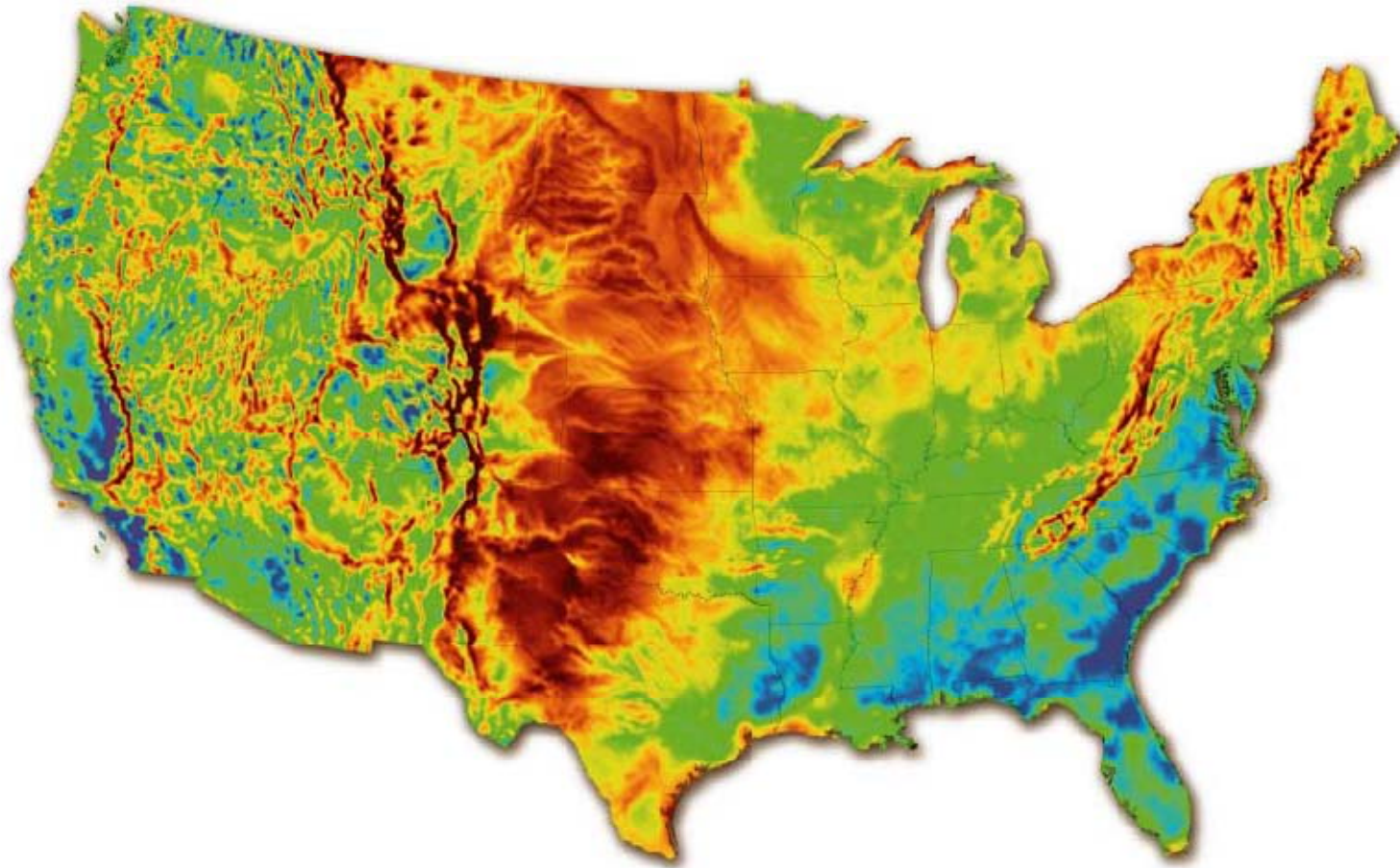
Renewables – Pros and Cons

	Pros	Cons	Initial Cost	Subsidies
Wind	-Inexpensive	-Resource -Permits	\$\$	\$\$
Solar PV	-Minimal maintenance -Modular Easy to site	-Expensive	\$\$\$\$	\$\$
Biomass	-Leverages digester gas	-O&M	\$\$	\$
Hydro	-Capacity	-Limited opportunities	\$\$	\$

Renewable Energy Focus – Wind Power



NATIONAL WIND RESOURCE



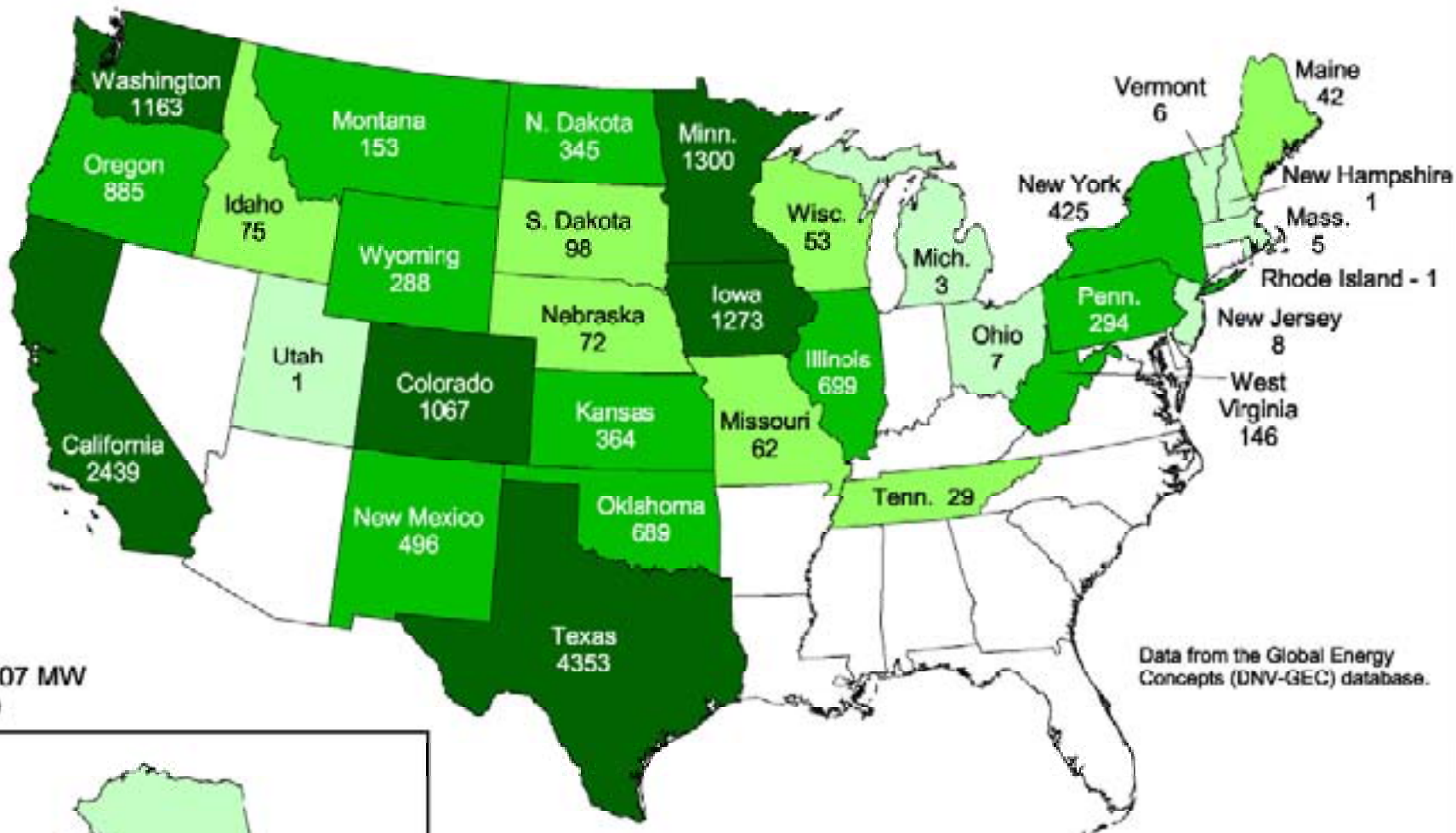
© Copyright 2008 3TIER, Inc.

5km Wind Map at 80m

Wind speed

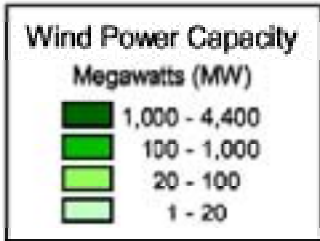


2007 Year End Wind Power Capacity (MW)



Total: 16,907 MW
(As of 12/31/07)

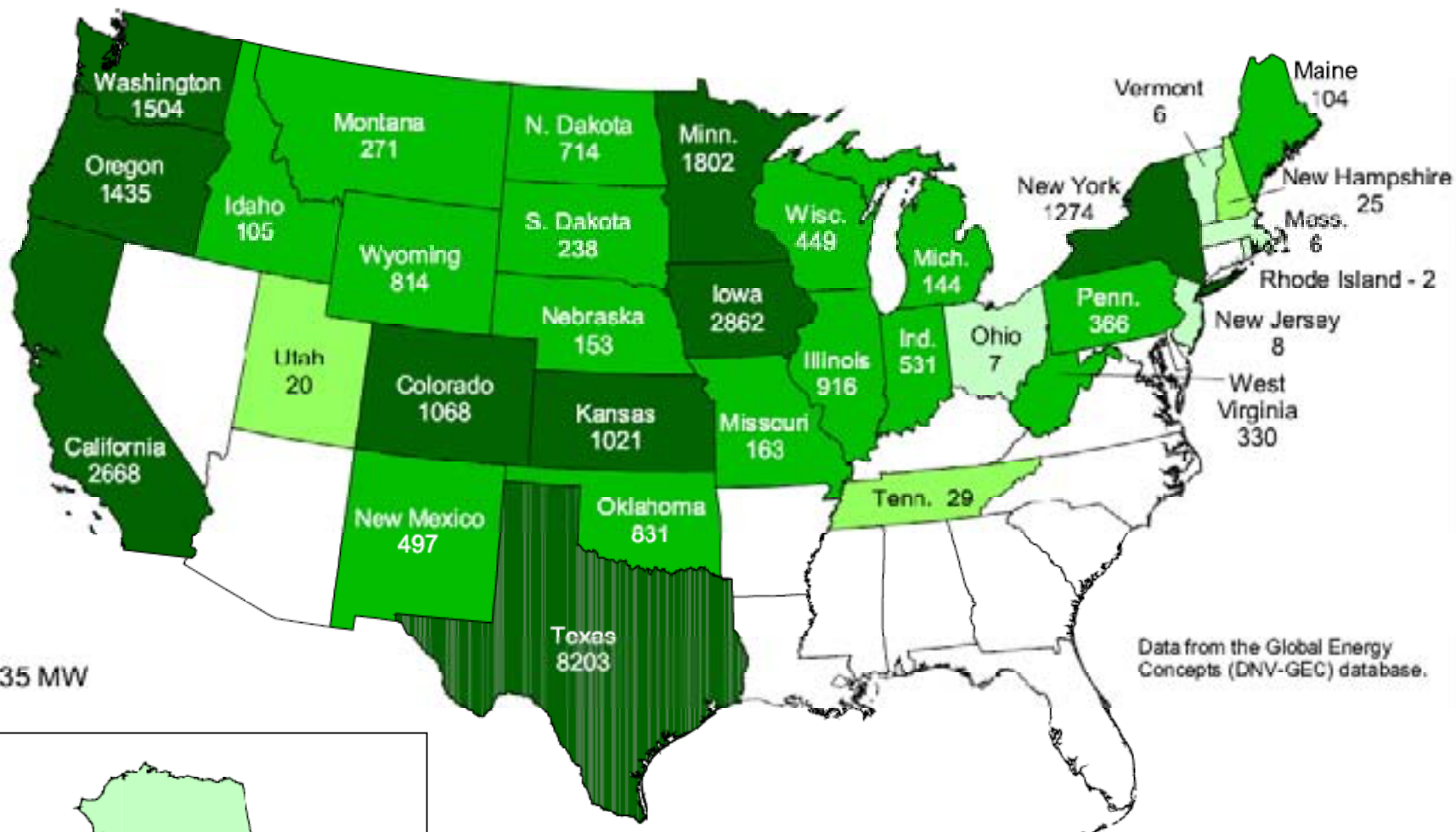
Data from the Global Energy Concepts (DNV-GEC) database.



U.S. Department of Energy
National Renewable Energy Laboratory



United States - Current Installed Wind Power Capacity (MW)

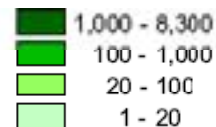


Total: 28,635 MW
(As of 4/30/09)

Data from the Global Energy Concepts (DNV-GEC) database.



Wind Power Capacity Megawatts (MW)



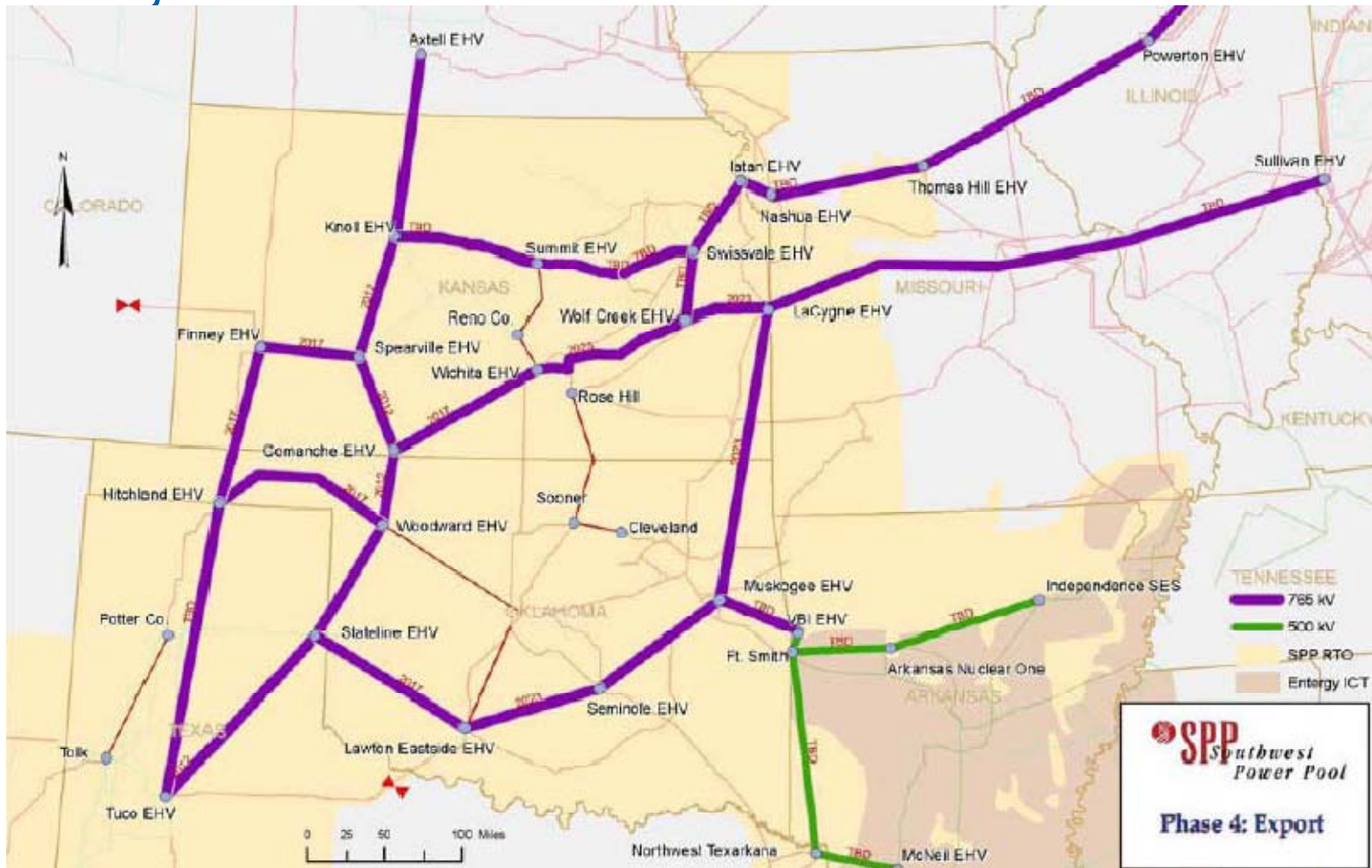
U.S. Department of Energy
National Renewable Energy Laboratory



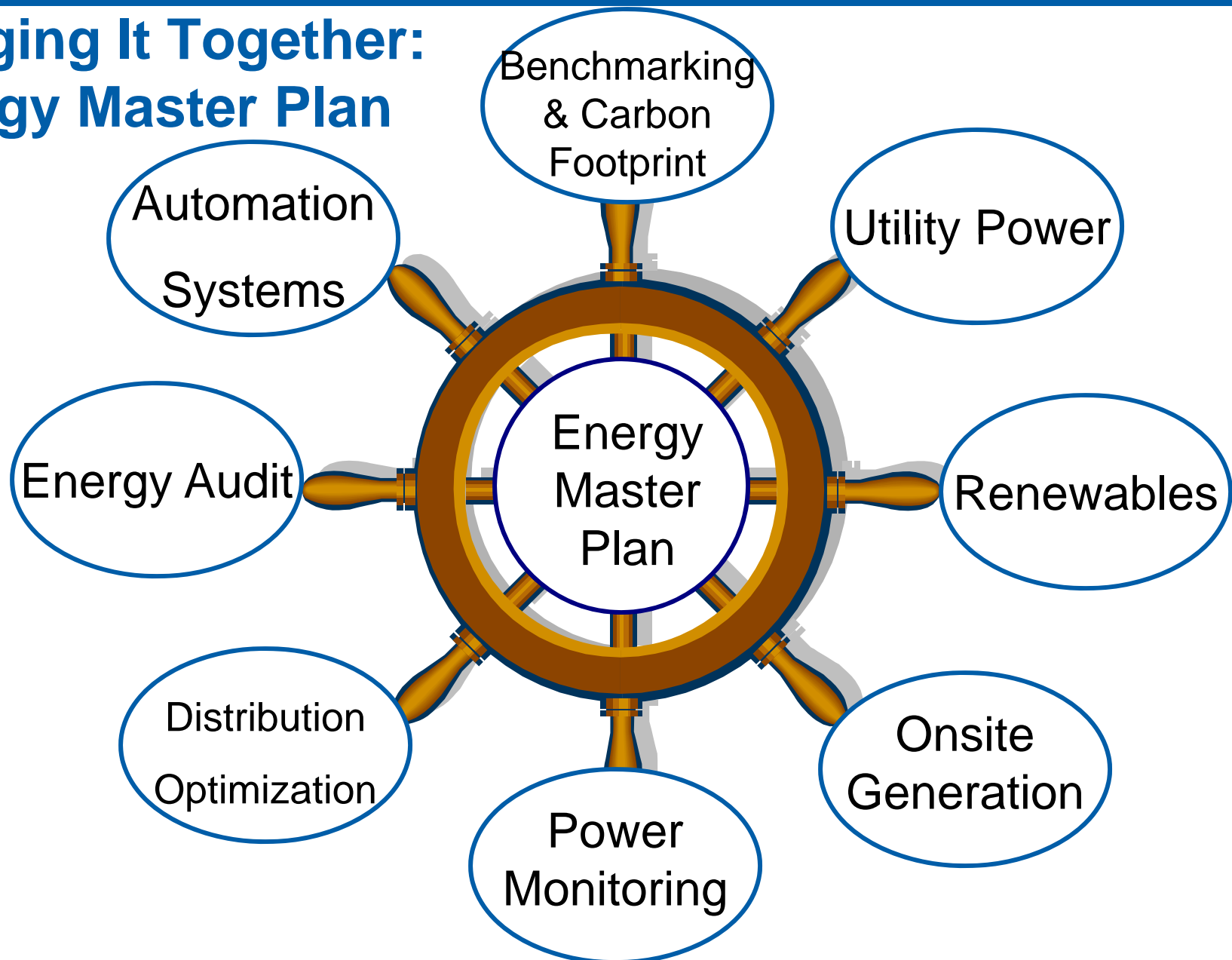
19-MAY-2009 1.1.23

Name	Location	Power Capacity (MW)	Units	Turbine Mfr.	Developer	Owner	Power Purchaser	Year Online
Elk River Wind Farm	Butler	150	100	GE Energy	PPM Energy	PPM Energy	Empire District Electric Co.	2005
Smoky Hills II	Lincoln County	148.5	99	GE Energy	TradeWind Energy	Enel North America		2008
Gray County Wind Farm	Gray County	112.2	170	Vestas	FPL Energy	FPL Energy	Aquila	2001
Meridian Way		105	35	Vestas	Horizon Wind Energy	Horizon Wind Energy	Westar Energy/Empire District Electric	2008
Smoky Hills Wind Farm	Lincoln County	100.8	56	Vestas	TradeWind Energy	Enel North America	Sunflower Electric/Midwest Energy/BPU	2008
Spearville Wind Energy Facility	near Dodge City	100.5	67	GE Energy	enXco	Kansas City Power & Light	Kansas City Power & Light	2006
Flat Ridge Wind Farm		100	40	Clipper	BP Alternative Energy/Westar Energy	BP Alternative Energy	Westar Energy	2009
Central Plains		99	33	Vestas	Westar Energy	Westar Energy	Westar Energy	2009
Meridian Way II		96	32	Vestas	Horizon Wind Energy	Horizon Wind Energy	Westar Energy/Empire District Electric	2008
St. Mary's		1.5	2	Enron		Western Resources	Western Resources	1999

SOUTHWEST POWER POOL ELECTRIC HIGH VOLTAGE (EHV) TRANSMISSION PLAN, PHASE 4



Bringing It Together: Energy Master Plan



Resources

US Department of Energy

www.eere.energy.gov

Consortium for Energy Efficiency

www.motorsmatter.org www.cee1.org

EPA / Energy Star

www.epa.gov/waterinfrastructure/bettermanagement_energy.html

www.energystar.gov

NEMA

www.nema.org/gov/energy/efficiency/premium

DSIRE – Renewable & Efficiency Incentive Database

www.dsireusa.org

Questions?

Fred Ellermeier

Director of Engineering

Black & Veatch Corporation

(913) 458-3885

Ellermeierfj@bv.com