Establishing an In-House Wind Maintenance Program:

A Case Study of Los Angeles Department of Water and Power

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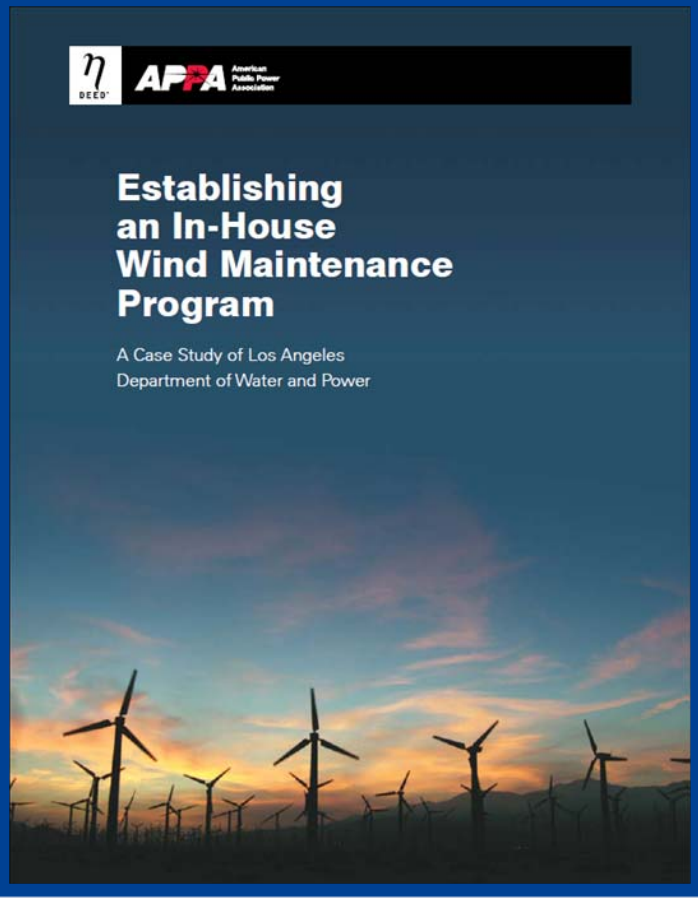
October 21, 2009

APPA American Public Power Association

The Case Study

- Find it at www.APPAnet.org and search for the title
- Published summer 2008
- Funding provided by:
  - DOE Wind Powering America
  - Western Area Power Administration
  - APPA Demonstration of Energy-Efficient Developments



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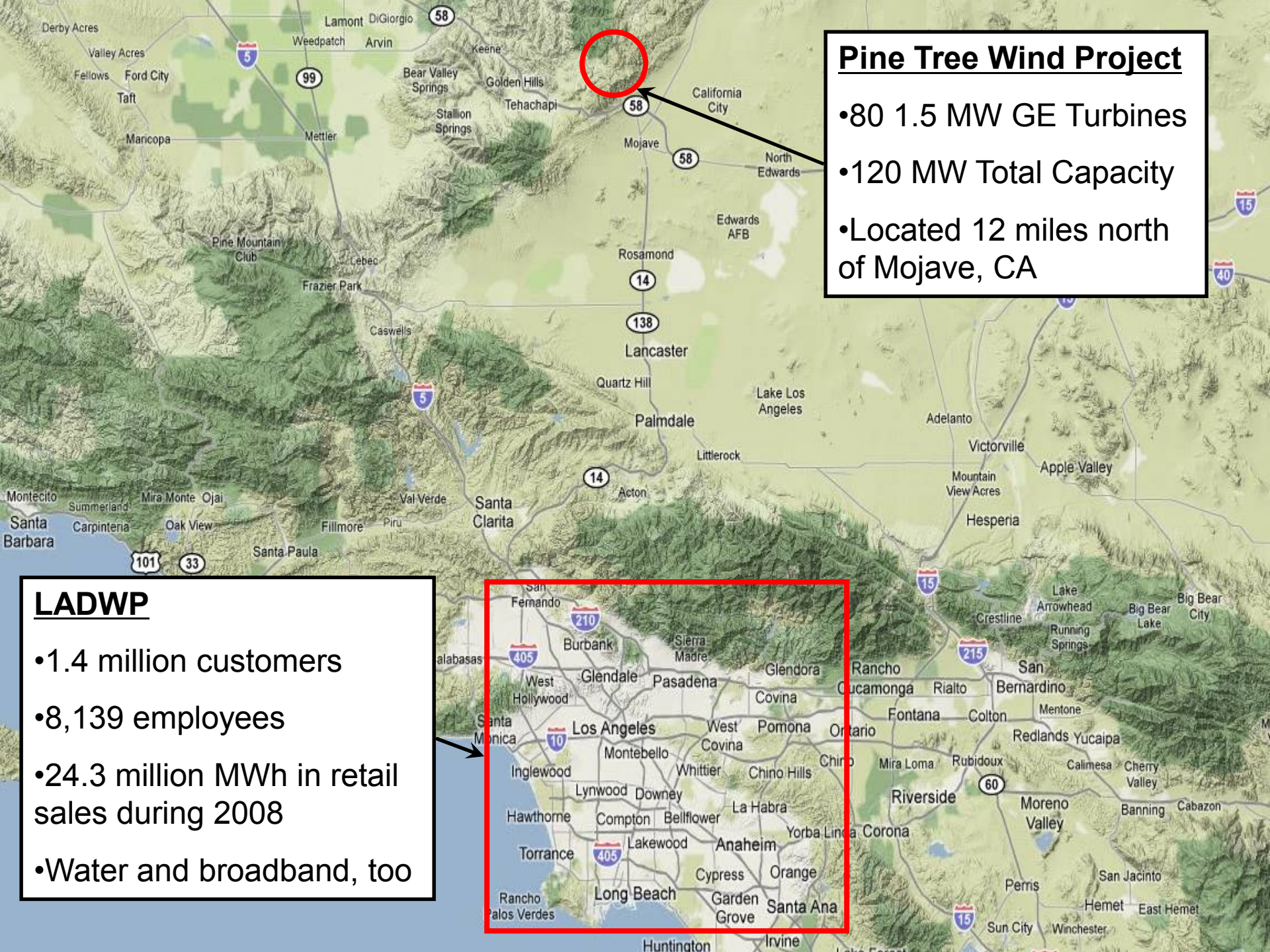
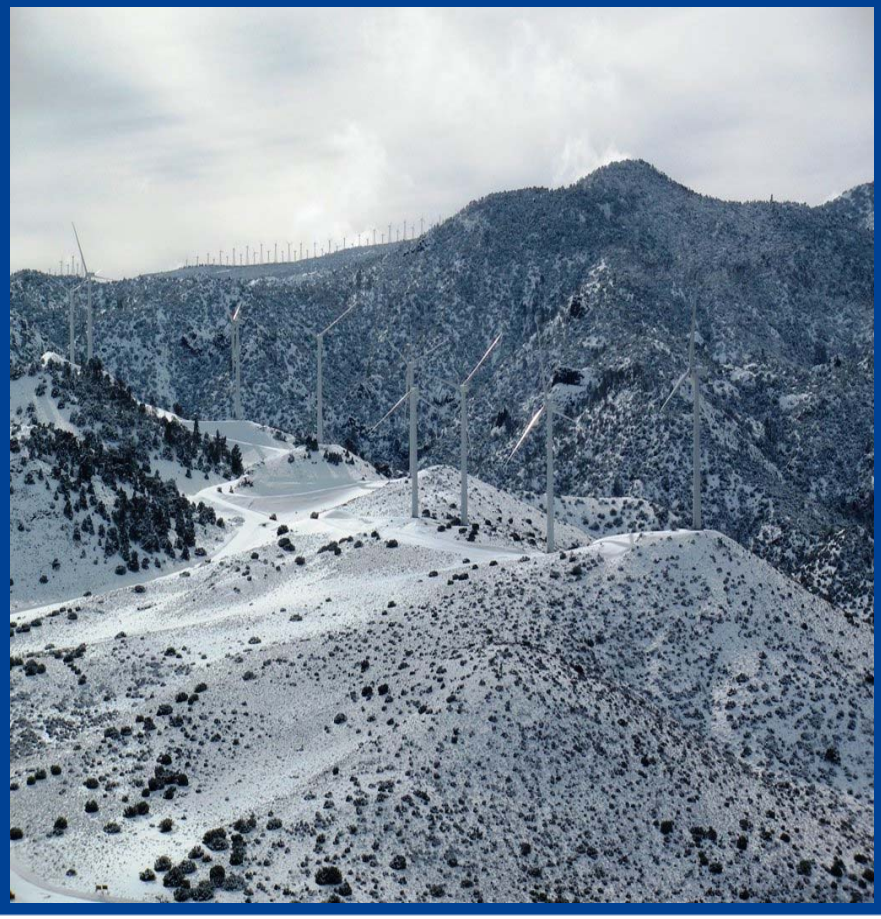

Pine Tree Wind Project
•80 1.5 MW GE Turbines
•120 MW Total Capacity
•Located 12 miles north of Mojave, CA
LADWP
•1.4 million customers
•8,139 employees
•24.3 million MWh in retail sales during 2008
•Water and broadband, too
Derby Acres
Valley Acres
Fellows
Ford City
Taft
Maricopa
Lamont
DiGiorgio
Weedpatch
Arvin
Mettler
Keene
Bear Valley Springs
Golden Hills
Tehachapi
Stallion Springs
California City
Mojave
North Edwards
Edwards AFB
Rosamond
Pine Mountain Club
Lebec
Frazier Park
Caswells
Lancaster
Quartz Hill
Palmdale
Lake Los Angeles
Littlerock
Acton
Adelanto
Victorville
Apple Valley
Mountain View Acres
Hesperia
Montecito
Summerland
Mira Monte
Ojai
Santa Barbara
Carpinteria
Oak View
Fillmore
Piru
Val Verde
Santa Clarita
Santa Paula
San Fernando
Burbank
Sierra Madre
Glendale
Pasadena
West Hollywood
Glendora
Covina
Rancho Cucamonga
Rialto
San Bernardino
Fontana
Colton
Mentone
Redlands
Yucaipa
Los Angeles
West Covina
Pomona
Ontario
Montebello
Inglewood
Whittier
Chino Hills
Chino
Mira Loma
Rubidoux
Calimesa
Cherry Valley
Lynwood
Downey
La Habra
Riverside
Moreno Valley
Banning
Cabazon
Hawthorne
Compton
Bellflower
Yorba Linda
Corona
Torrance
Lakewood
Anaheim
Cypress
Orange
Long Beach
Garden Grove
Santa Ana
Rancho Palos Verdes
Perris
San Jacinto
Hemet
East Hemet
Sun City
Winchester
Huntington
Irvine
Lake Arrowhead
Crestline
Running Springs
Big Bear Lake
Big Bear City

In-House Maintenance

- LADWP decides to develop in-house maintenance program
- Key drivers:
  - Warranty decision
  - IBEW Union
- Asks DOE for help

Key Program Elements

1. Establishing a maintenance schedule
2. Grouping maintenance tasks
3. Addressing special needs of older wind turbines
4. Incorporating predictive maintenance
5. Cleaning wind turbines
6. Preparing for unscheduled maintenance
7. Implementing quality control maintenance
8. Incorporating a rescue plan



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Safety and Training

- Safety is a priority
- Determine the acceptable risks
- Training is essential
- Establish a training log

Some common causes of injuries:

- Distractions
- Unsecured equipment
- Electric shock
- Tool misuse
- Loose footing
- Dropped items
- Not following safety procedures

Staff, Equipment, and Parts

- NPPD → 1:6 tech-to-turbine ratio
- EnXco → 8 to 12 techs for a farm
- Cranes are expensive
- Recommended equipment
  - Electric and hydraulic torque tools
  - Laser generator alignment tool
  - Tower lifts
- Keep a stock of manufacturer-recommended spare parts along with commonly-used parts

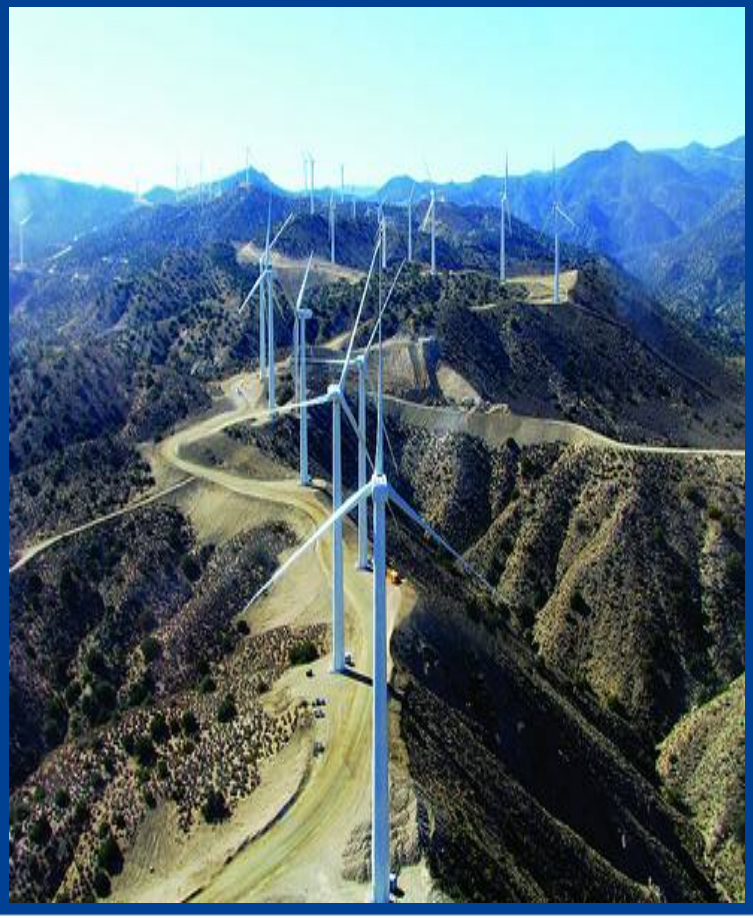
Reliability

- Reliability is the probability a product can perform its intended functions under stated conditions for a given period of time.
- Common reliability equations:
  - MTBF = Operational Time/Failures
  - MTTR = Repair Time/Failures
  - Availability = MTBF / (MTBF + MTTR)

Budgeting

- Rules of thumb:
  - 1% of annual budget
  - $1 million per MW
- NWCC Project Cost Estimates:

Unscheduled Maintenance	16%
Preventative Maintenance	4%
Major Overhaul	1%
Capital and Other Operations Costs	79%
Total Cost	**100%**



More Resources

- American Public Power Association (APPA)
- American Wind Energy Association (AWEA)
- Edison Electric Institute (EEI)
- Electric Power Research Institute (EPRI)
- National Wind Coordinating Collaborative (NWCC)
- National Wind Technology Center (NWTC)
- Utility Wind Integration Group (UWIG)
- Wind Powering America

Find the full case study at:

http://www.appanet.org/files/PDFs/LADWPInHouseWindMaintenanceProg10-15-08FINAL.pdf

or

Go to www.APPAnet.org and search for:

“Establishing an In-House Wind Maintenance Program”