

Cost-Effectiveness of Undergrounding Power Lines

Presented by
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Introduction

- Hi-Line Engineering is a consulting firm specializing in the design distribution systems
- We design 300 miles of line each year
- Teach over 30 training classes on proper design of overhead and underground distribution lines
- Provide expert testimony regarding public contact with distribution lines
- General consulting for planning the expansion of power systems

Training for North American Wood Pole Council

- Wood Pole Structure Design Seminar
 - Nashville April 3-5
 - Nashville Sept 25-27
- Focus on distribution line design
 - Conductor characteristics
 - Pole strengths
 - Calculation of wind loading
 - Pole-Top assemblies
 - Guying and Anchoring
 - Calculation of loading

Desire for Underground Utilities



- The Public wants underground utilities
 - Desire the college campus look
- Most new subdivisions are fed underground
 - Reported 9 out 10
 - Many communities require underground utilities before approving subdivision
 - Developers want underground utilities and even advertise underground utilities.

Commercial Developments

- Developer's desire underground service
 - Aesthetics
- Utility's also like underground to commercial developments
 - Less expensive
 - Padmounts verse two-pole platform mounted
 - Vehicle damage is reduced
 - Clearance limitations

Undergrounding Trends

- One Alabama Cooperative Experience
 - 55% of new services are underground in 2000
 - 75% of new services are underground in 2006
- Streetscape projects
 - Urban beautification
- Comprehensive Plan for Undergrounding
 - San Antonio, Tx
 - Colorado Springs, Co
 - Williamsburg, Va
 - Tocomo, Wa

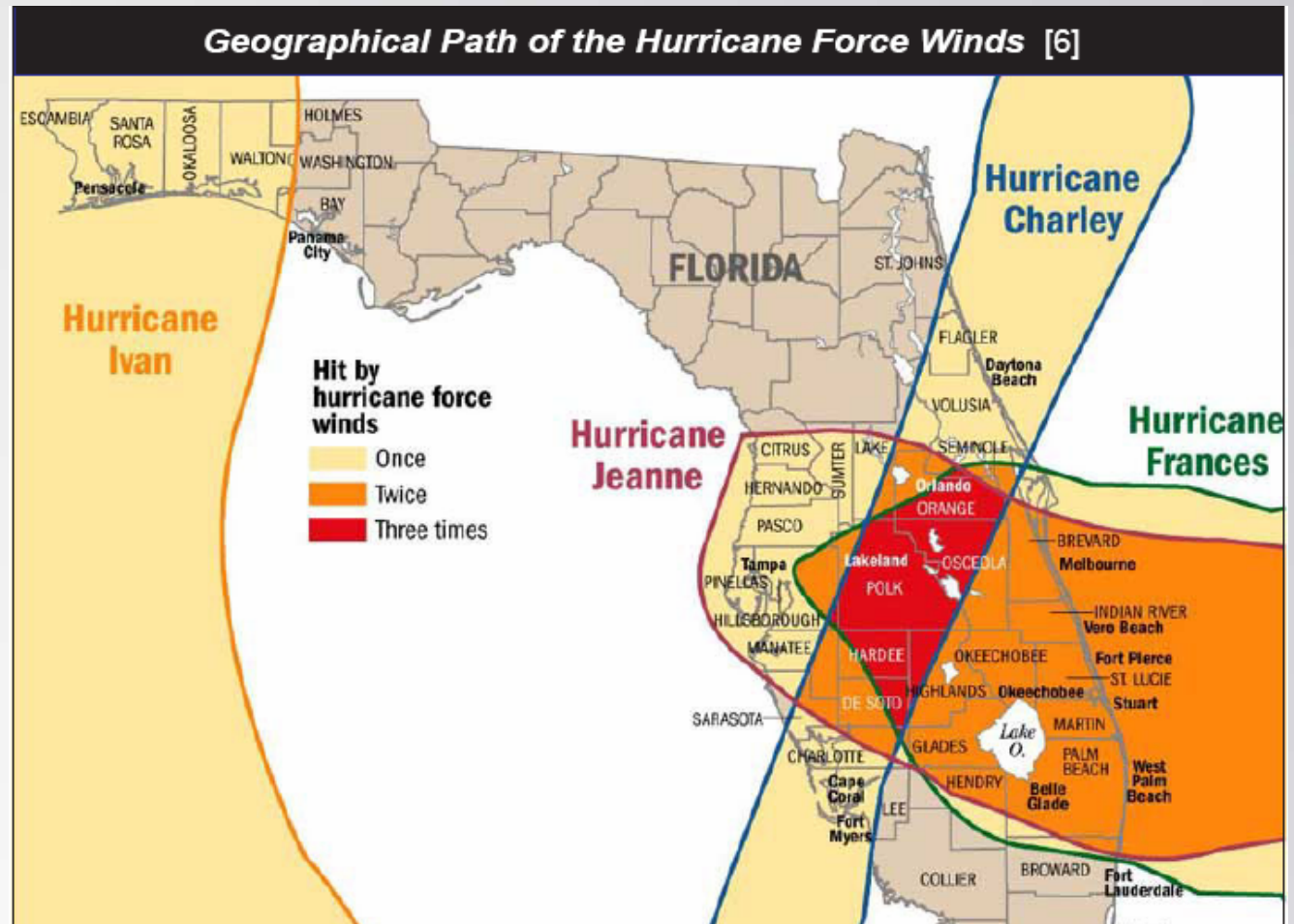


Desire for Underground

- Communities want underground
- Willingness to pay for underground
 - Cost in Aide
 - 0-\$1000s/lot
- Selling point for new homes
- Can it be justified?
 - Not affected by storms
 - No right-of-way maintenance
 - Considered safer



After severe storms, the public/governmental agencies want to replace overhead line with underground lines



Recent Studies
Florida
Virginia
North Carolina
Maryland

Cost Effectiveness of Undergrounding

Cost per Mile of Overhead Systems

- \$15,000 for 1-phase
- \$80,000 for 3-phase
- \$250,000 for extra large 3-ph
- Service \$1,500 to \$2,500
- 25 kVA Transformer
\$1,000

Cost per Mile of Underground Systems

- \$25,000 for 1-phase
- \$160,000 for 3-phase
- \$1,500,000 for extra large 3-ph
- Service \$2,000 to \$5,000
- 25kVA Padmount Transformer
\$2,000

Cost Effectiveness of Undergrounding

- High initial cost of underground offset by
 - Reduction in tree trimming costs
 - (largest cost outside of power costs)
 - Reduction in vehicle accidents
 - (17% of highway deaths involve poles)
 - Reduction restoration costs
 - Reduction in line losses
 - Larger conductors
- All the states that have recently studied and analyzed the cost compared to the savings have the same conclusion
 - Undergrounding CAN NOT be justified based on economics



Virginia 2005 Study

Economic Benefit	Annualized Benefits	Annualized Cost
Underground Power Lines		\$10,000,000,000
O&M Savings	Negligible	
Tree trimming savings	\$50,000,000	
"100-Yr" Post Storm rebuild	\$40,000,000	
Avoided Sales Lost	\$14,000,000	
Avoided Vehicle Accidents	\$150,000,000	
Avoided Outages	\$3,670,000,000	
Total	\$3,924,000,000	\$10,000,000,000

Cost is based on initial investment of \$93,900,000,000

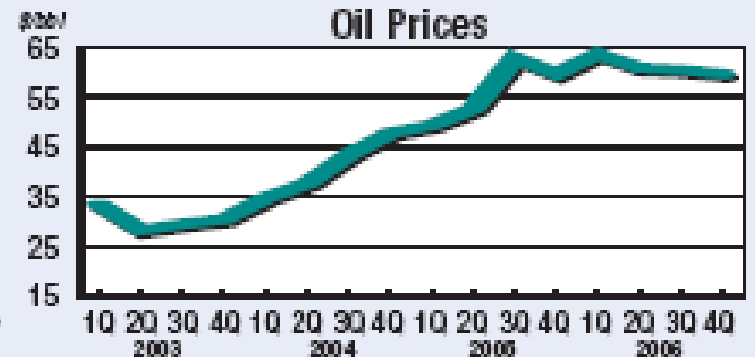
Service Life and Reliability

- Service Life
 - Overhead lines 30-50 years
 - 30 years for poles, 50 years for conductor
 - Underground lines 30 years
 - 30 years for cable, could be less for padmounted equipment
- Reliability
 - Underground reliability fades after 25 years
 - Fewer outages but longer outages
 - North Carolina study reported
 - 92 minutes for overhead outages
 - 145 minutes for underground outages

Trending Differences Costs

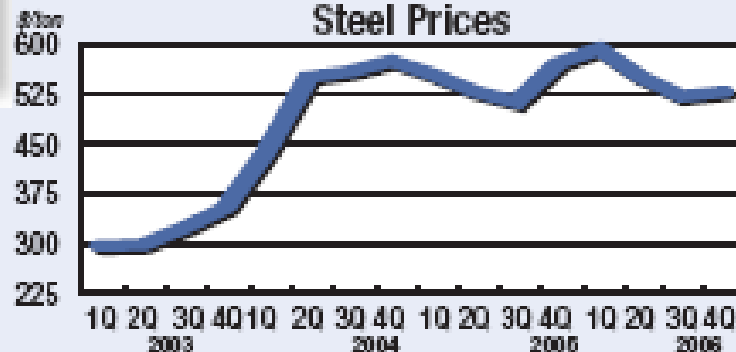
- Labor is about the same
- Overhead material costs will track wood pole prices
- Underground material costs track oil and metal prices
 - Conduit and cable insulation, padmounted cabinets

High oil prices are expected to remain near \$60 per barrel throughout 2006.



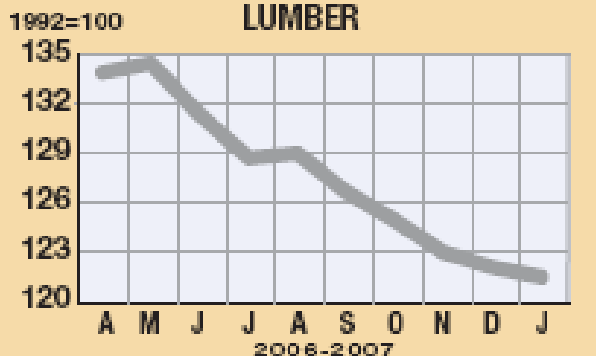
SOURCE: GLOBAL INSIGHTS, AVERAGE PRICE OF WEST TEXAS INTERMEDIATE CRUDE, 2006 FIRST-QUARTER ESTIMATE AND FORECAST

Steel Prices



SOURCE: GLOBAL INSIGHTS

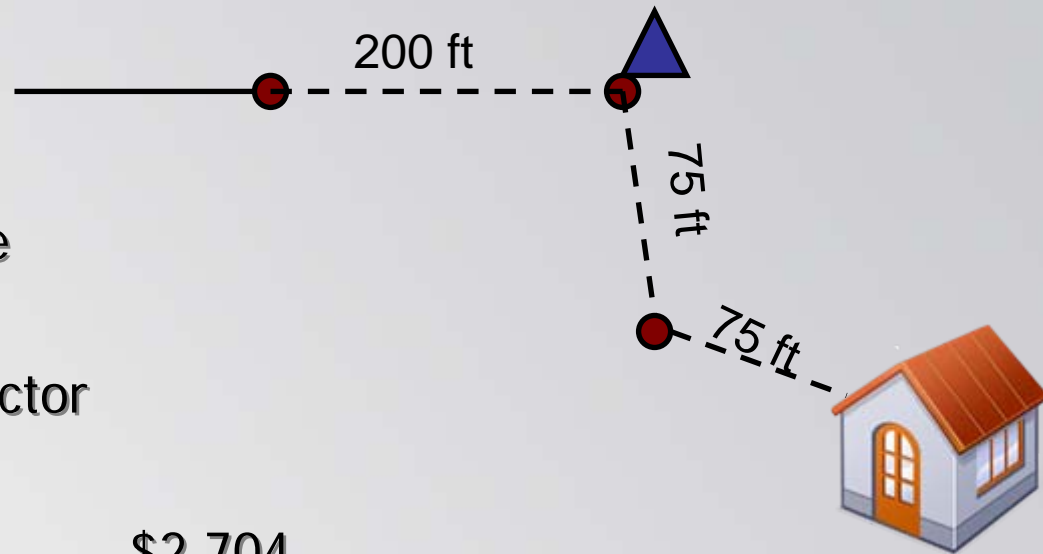
Structural steel prices are holding near peak levels set in 2004.



PRICES HAVE FALLEN FROM LAST MAY'S PEAK AND ARE 12% BELOW A YEAR AGO.

Case Study

- Single family home
 - 2,400 square feet
- 200 feet of 7,200 volt line
- Transformer
- 150 feet of service conductor



Overhead	\$2,704
Underground	\$4,763
Hybrid	\$3,325

Overhead 7200 volt

Underground Service

(cost of conduit & trench = \$706)

Undergrounding the Last Span

- The service drop to the house is vulnerable outages
 - Falling trees
 - Trees not trimming as aggressively on service drops
- When a tree falls on service drop
 - Pulls the weather head off the house
 - The weather head is owned by the customer
 - He/She must make repairs before restoration of power
- Undergrounding the last span will reduce outage times
 - Encouraged by some communities and utilities

Conclusions

- Underground power is not cost-effective
 - According to four state commissions
- Studies shows benefits
 - Reduced tree trimming
 - Reduced restoration cost from severe storms
 - Not enough benefits to justify cost
- Public believes there is a value
 - Willing to pay for additional costs
 - Reason is aesthetics
 - As long undergrounding costs remains a small percentage of the home cost
 - Home buyers will continue to demand underground