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

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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 comminutes require underground utilities before approving subdivision
  - Developers want underground utilities and even advertise underground utilities.

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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

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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
  - Tocoma, 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

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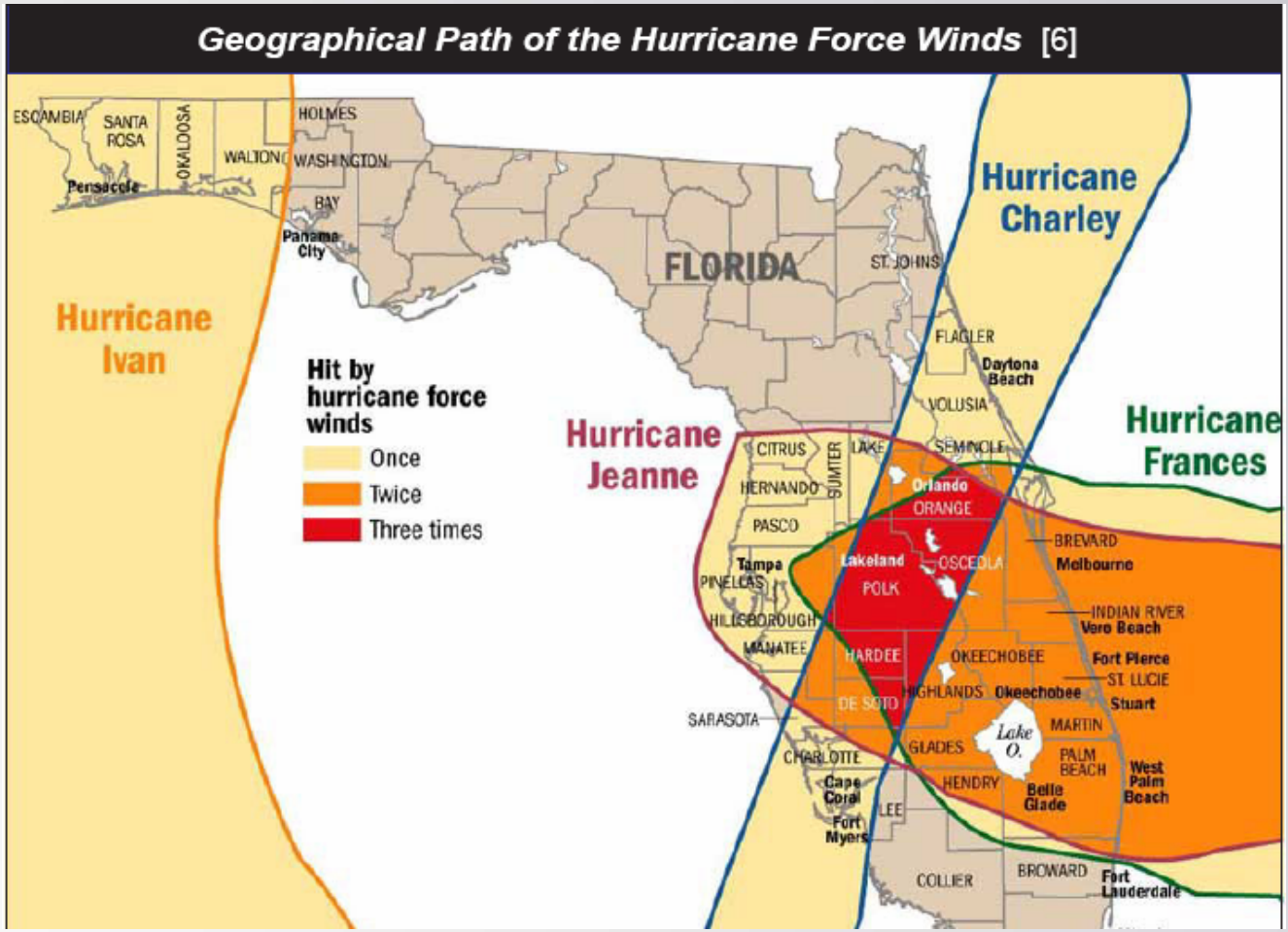
After severe storms, the public/governmental agencies want to replace overhead line with underground lines

Recent Studies

- Florida
- Virginia
- North Carolina
- Maryland



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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

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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

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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

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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

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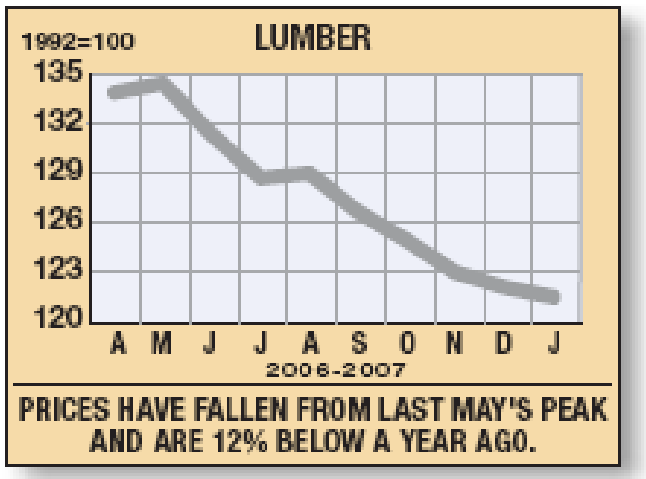
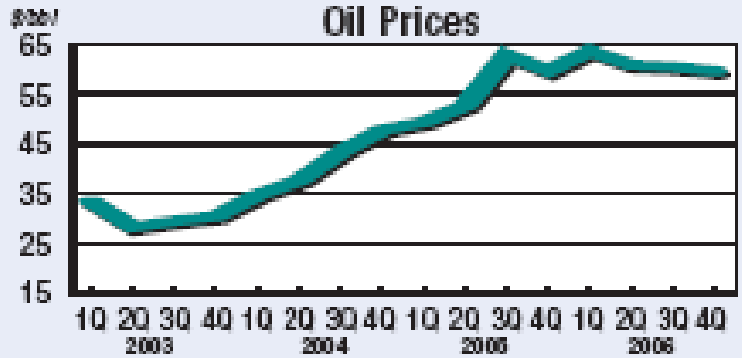
Trending Differences Costs

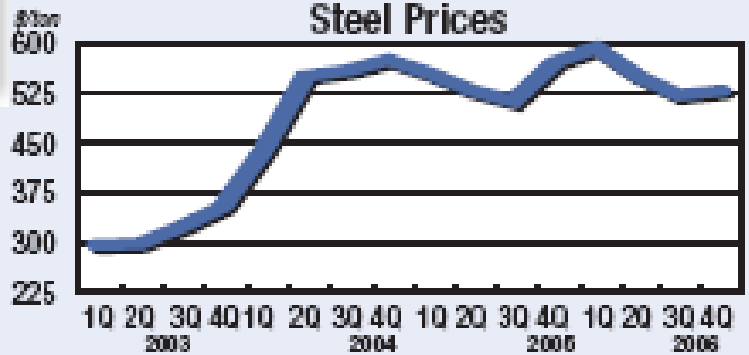
- Labor is about the same
- Overhead material costs will track wood pole prices
- Underground material costs track oil and metal prices
  - Conduit and cable insulation, padmounted cabinets



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.



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

SOURCE: GLOBAL INSIGHTS.

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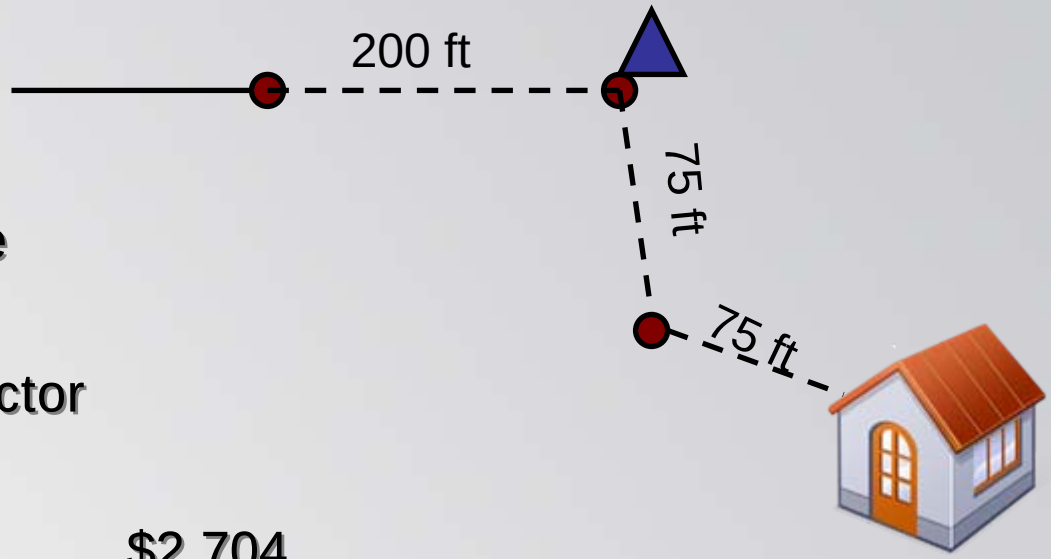
Case Study

- 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)

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Undergrouding 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

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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

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