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
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.
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
  - 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
Recent Studies
Florida
Virginia
North Carolina
Maryland

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

<table>
<thead>
<tr>
<th>Economic Benefit</th>
<th>Annualized Benefits</th>
<th>Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground Power Lines</td>
<td>$10,000,000,000</td>
<td>$10,000,000,000</td>
</tr>
<tr>
<td>O&amp;M Savings</td>
<td>Negligible</td>
<td></td>
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<tr>
<td>Tree trimming savings</td>
<td>$50,000,000</td>
<td></td>
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<tr>
<td>&quot;100-Yr&quot; Post Storm rebuild</td>
<td>$40,000,000</td>
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<tr>
<td>Avoided Sales Lost</td>
<td>$14,000,000</td>
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<tr>
<td>Avoided Vehicle Accidents</td>
<td>$150,000,000</td>
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<tr>
<td>Avoided Outages</td>
<td>$3,670,000,000</td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$3,924,000,000</strong></td>
<td><strong>$10,000,000,000</strong></td>
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</tbody>
</table>

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.

Steel prices are holding near peak levels set in 2004.
Case Study

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

<table>
<thead>
<tr>
<th>Method</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead</td>
<td>$2,704</td>
</tr>
<tr>
<td>Underground</td>
<td>$4,763</td>
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<tr>
<td>Hybrid</td>
<td>$3,325</td>
</tr>
</tbody>
</table>
| Overhead 7200 volt Underground Service | (cost of conduit & trench = $706)
Undergrouding the Last Span

- The service drop to the house is vulnerable to 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
- Undergrouding 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