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Out of Sight, Out of Mind?

A study on the costs and benefits of undergrounding overhead power lines

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Report Outline

- *How much does undergrounding improve electric reliability?*
- *Other benefits of undergrounding.*
- *The costs of undergrounding.*
- *Benefit/cost summary.*
- *Paying for undergrounding.*

Executive Summary

It is an unpleasant fact of modern day life – big storms such as hurricanes and ice storms cause major power outages. Sometimes these outages in heavily damaged areas can last for days or even weeks. In the post mortem that follows a major storm related power outage, there is almost always a public clamoring for burying overhead power lines. For many, it seems only intuitive that placing electric wires underground should protect them from severe storms.

This report provides a summary overview of previously completed studies [in the US and abroad] and examines historical performance data for underground and overhead lines to evaluate the benefits and costs of placing more of our existing overhead electric distribution infrastructure underground.

The report finds that burying overhead power lines has a huge price tag, costing about 10 times what it costs to install overhead power lines. When compared to overhead power systems, underground power systems tend to have fewer power outages, but the duration of these outages tends to be much longer. Underground power systems are also not immune from outages during storms. The bottom line – reliability benefits associated with burying existing overhead power lines are uncertain and in most instances do not appear to be to be sufficient to justify the high price tag that undergrounding carries.

There are however, other substantial benefits for burying existing overhead power lines, the most significant of which is improved aesthetics. Many communities and individuals want their power lines removed from sight. While the benefits derived from these kinds of undergrounding initiatives are difficult to quantify, they are real and they are substantial. Because these projects cannot be justified based on standard economic criteria, community and government decision makers often struggle to determine who should pay and who should benefit from undergrounding initiatives based on aesthetics.

The report concludes with summaries of innovative programs that communities and local governments have adopted to help pay for burying their overhead power lines.

Introduction

In the last decade, the US East Coast and Midwest regions have experienced several catastrophic “100 year storms.” These storms have left widespread electric power outages that have lasted for several days (Figure 1).

Given the critical role that electricity plays in our modern lifestyle, even a momentary power outage is an inconvenience. A days-long power outage presents a major hardship and can be catastrophic in terms of its health and safety consequences, and the economic losses it creates.

Why then, don’t we bury more of our power lines so they will be protected from storms?

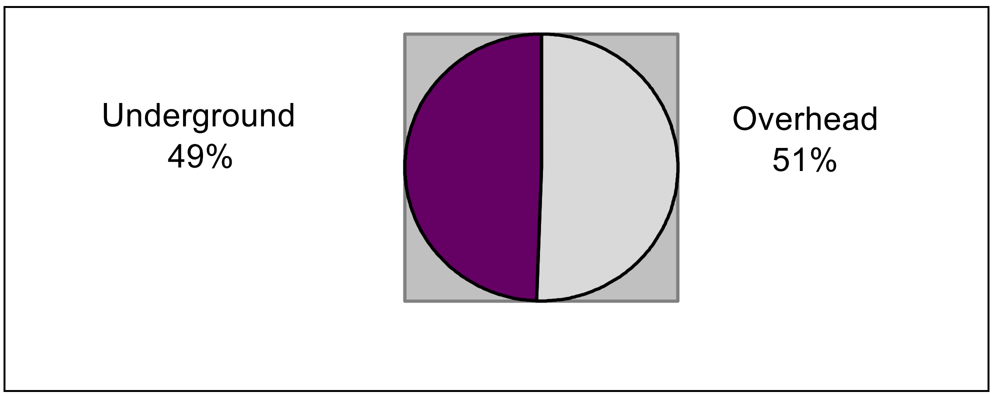
Figure 1: Electric Outages Caused by Severe Storms

Storm Event	Utility	Date	Customers Impacted	Outage Duration (Days)
Ice Storm	Kentucky Utilities	2003	146,000	8
Ice Storm	Duke	2002	1,375,000	9
	Carolina Power	2002	561,000	8
Ice Storm	KCPL	2002	305,000	10
Snowstorm	Carolina Power	2000	173,000	5
Hurricane Floyd	Virginia Power	1999	800,000	5
	Carolina Power	1999	537,000	6
	BGE	1999	490,000	5
Ice Storm	Pepco	1999	213,000	5
	BGE	1999	350,000	5
Ice Storm	Central Maine Power	1998	250,000	21
Ice Storm	Virginia Power	1998	401,000	10
Hurricane Fran	Virginia Power	1996	415,000	6
	Duke	1996	450,000	9
Ice Storm	Duke	1996	650,000	8
	Carolina Power	1996	61,000	4
	Carolina Power	1996	790,000	10

Source: Press Accounts of Storms

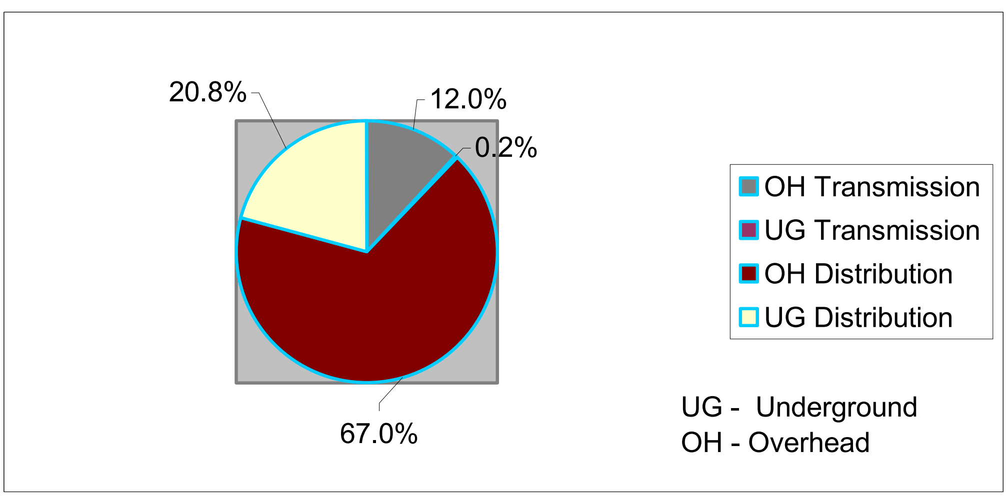
The fact is we already are placing significant numbers of power lines underground. Over the past 10 years, approximately half of the capital expenditures by US investor-owned utilities for ***new*** transmission and distribution wires have been for underground wires (Figure 2). Almost 80% of the nation's electric grid, however, has been built with overhead power lines (Figure 3). Would electric reliability be improved if more of these existing overhead lines were placed underground as well?

Figure 2: Capital Expenditures for New Power Lines (1993 – 2002 Average)



Source: FERC Form 1 Data 1993-2002

Figure 3: Miles of Overhead & Underground Line 2001 U.S. Total



Source: EEI Statistics

This report examines the major issues associated with undergrounding existing overhead power lines. It summarizes reliability comparisons between underground and overhead power lines and presents data on the benefits and costs of undergrounding. The report also presents summary information on programs that have been developed to fund undergrounding initiatives.

What the report finds is that burying existing overhead power lines does not completely protect consumers from storm-related power outages. However, underground power lines do result in fewer overall power outages, but the duration of power outages on underground systems tends to be longer than for overhead lines.

Also, undergrounding is expensive, costing up to $1 million/mile or almost 10 times the cost of a new overhead power line. This means that most undergrounding projects cannot be economically justified and must cite intangible, unquantifiable benefits such as improved community or neighborhood aesthetics for their justification. Determining who pays and who benefits from undergrounding projects can be difficult and often requires the establishment of separate government sponsored programs for funding.

I. How Much Does Undergrounding Improve Electric Reliability?

Many consumers assume that burying electric power lines will protect them from power outages caused by storms, and significantly improve overall power reliability. This is not necessarily the case.

Underground power systems are not immune from storm related outages. Figure 4 shows the equipment failures Baltimore Gas & Electric suffered on its underground system during Hurricane Isabel.

Figure 4: BGE Underground Failures Hurricane Isabel

Underground Equipment Item	Number of Failures
1000 kVA Network Transformers	3
Network Protectors	5
Switchgear Fuses	26
4kV D&W Fuses	17
Pad-mounted Switchgear	5
Pad-mounted Transformers	12
Primary Ductlilne Failures	8
Secondary Ductline Failures	10
Sections of Cable Renewed	14
Underground Cable Faults	100+

Source: Baltimore Gas & Electric Co.
"Major Storm Report: Hurricane Isabel" Attachment 5

Measuring Electric Reliability

Accurately measuring electric reliability is difficult. Most measures of electric reliability focus on two metrics:

- The **frequency** with which a customer sustains a power outage, i.e. the number of power outages/year, and
- The **duration** of power outages, i.e. the number of minutes/year a customer is without power.

For most utilities, it is extremely difficult to track the number of outages that occur on their systems and determine the number of customers impacted by these power outages. Utility switching actions, for example, can result in momentary outages that last only a fraction of a second.

For storm-related outages, the utility often relies on customers to provide notification that they are without power. If the customer does not report the outage, the utility may be unaware of it.

In spite of these difficulties, utilities worldwide collect data on both the frequency and duration of power outages. Increasingly, this data is used to measure utility performance against reliability standards, and utilities are rewarded and penalized based on how the data indicates they are performing.

Comparing the reliability of overhead power lines to underground power lines is even more difficult. Most utility outage-reporting systems do not separately track overhead and underground systems.

Another problem in trying to evaluate underground lines is that most underground circuits have at least some component above the ground. Installing monitoring equipment to distinguish between outages on the overhead and underground components of the same circuit is prohibitively expensive.

Comparing Overhead Reliability to Underground Reliability

Comparative reliability data indicate that the frequency of outages on underground systems can be substantially less than for overhead systems. However, when the duration of outages is compared, underground systems lose much of their advantage.

Figure 5 shows the frequency of power outages for overhead and underground electric systems around the world. The data show that the frequency of power outages on underground systems is only about one-third of that of overhead systems.

Figure 5: Yearly Power Interruptions per 100 km of Circuit

Utility	Voltage	Overhead	Underground
Integral Energy	HV	30.3	2.8
Integral Energy	LV	7.4	7.7
Energy Australia	HV	13.0	4.0
Citipower	HV	4.0	1.0
Mercury Energy	HV	30.5	7.1
Survey of Australian Utilities	HV & LV	23.6	5.6
France	LV	12.3	7.6
Finland	LV	8.0	4.0
Average		**16.1**	**5.0**

Note: km = kilometer, HV = high voltage, LV = low voltage

Source: "The Putting Cables Underground Working Group Report"
http://www.dcita.gov.au/cables/econ/econ_9a.htm

Figure 6 compares the duration of power outages for overhead and underground systems for UK utilities. This data shows that in 1996 and 1997, underground circuits were actually ***less*** reliable than overhead circuits. Over the 10-year period, however, the duration of outages for underground was about half of what it was for overhead.

Figure 6: Thousands of Customer Minutes Lost per 100 km of Circuit: UK Utilities

	1996/97		10 Year Average	
Utility	**Overhead**	**Underground**	**Overhead**	**Underground**
Eastern	2.5	4.5	7.5	3.5
East Midland	3.5	5.0	7.5	4.0
Manweb	3.5	3.5	5.0	4.5
Midlands	6.5	5.0		1.0
Northern	1.8	3.0	4.8	4.0
NORWEB	2.8	3.5	3.5	3.0
SEEBOARD	6.5	6.0	20.0	5.5
Southern	3.0	3.0	7.0	3.5
SWALEC	3.8	6.5		
Southern Western	2.0	4.0	5.5	5.5
Yorkshire	4.5	4.0	2.8	3.5
Scottish	3.5	2.5	2.0	2.0
Average	**3.7**	**4.2**	**6.6**	**3.6**

"The Putting Cables Underground Working Group Report"
http://www.dcita.gov.au/cables/econ/econ_9a.htm

Figure 7 presents data from a 2000 report issued by the Maryland Public Service Commission. Maryland utilities were asked to select "comparable" overhead and underground feeders and provide comparative reliability data for an historical period.

Based on the data summarized in Figure 7, the Maryland commission concluded in its final report that the impact of undergrounding on reliability was "unclear."[1]

Figure 7: Maryland Overhead vs. Underground Feeder Reliability Comparison[1]

	Overhead	Avg	Underground	Avg
Allegheny Power				
1996 SAIFI	0.11		0.28	
1997 SAIFI	1.73	0.6	0.91	0.8
1998 SAIFI	0.04		1.29	
1996 SAIDI	25.16		49.49	
1997 SAIDI	124.96	51.6	569.88	236.8
1998 SAIDI	4.59		91.07	
BGE				
1997 SAIFI	3.43		0.58	
1998 SAIFI	0.45	2.6	1.72	1.2
1999 SAIFI	3.84		1.39	
1997 SAIDI	65.00		178.00	
1998 SAIDI	242.00	152.7	94.00	130.0
1999 SAIDI	151.00		118.00	
Conectiv				
1997 SAIFI	1.84		1.25	
1998 SAIFI	0.29	0.8	1.47	1.0
1999 SAIFI	0.34		0.21	
1997 SAIDI	129.04		11.80	
1998 SAIDI	23.48	65.6	129.61	53.3
1999 SAIDI	44.30		18.59	
Pepco				
1997 SAIFI	2.59		0.22	
1998 SAIFI	2.47	2.1	0.93	0.7
1999 SAIFI	1.31		1.07	
1997 SAIDI	4.55		2.21	
1998 SAIDI	0.78	3.2	0.71	2.1
1999 SAIDI	4.39		3.29	

[1] Excludes major storms

Source: "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission & Distribution Plant" Februrary 14, 2000.

Note:

SAIFI = Total Number of Customers Interrupted/Total Customers

SAIDI = Sum of All Customer Interruption Minutes/Total Customers

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[1] "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission and Distribution Plant," prepared by the Selective Undergrounding Working Group; February 14, 2000; page 2

Figure 8 summarizes five years of underground and overhead reliability comparisons for North Carolina's investor-owned electric utilities – Duke Energy, Progress Energy Carolinas and Dominion North Carolina Power. The data indicate that the frequency of outages on underground systems was 50% less than for overhead systems, but the average duration of an underground outage was 58% longer than for an overhead outage.

In other words, for the North Carolina utilities, an underground system suffers only about half the number of outages of an overhead system, but those outages take almost 1.6 times longer to repair.

Based on this data, Duke Power has concluded, "underground distribution lines will improve the potential for reduced outage interruption during normal weather, and limit the extent of damage to the electrical distribution system from severe weather-related storms. However, once an interruption has occurred, underground outages normally take significantly longer to repair than a similar overhead outage."[2]

Figure 8: North Carolina Reliability Comparison of Overhead & Underground Feeders 1998-2002

Reliability Category	Overhead	Underground
System interruption rate per mile	0.6	0.3
Tap line interruption rate per mile	0.4	0.2
Average outage duration (minutes)	92.0	145.0
Service conductor interruptions per 1000 customers	9.7	9.6

Source: "The Feasibility of Placing Electric Distribution Facilities Underground"
North Carolina Utilities Commission, November 2003

Discussion

The following summary points, taken from reports produced by utilities and conversations with industry experts, provide additional information on the reliability characteristics of overhead and underground power lines.

- Overhead lines tend to have more power outages primarily due to trees coming in contact with overhead lines.[3]

[2] "North Carolina Public Utility Commission Study Undergrounding Reliability Discussion" Duke Power," Duke Power

[3] Duke Power

- It is relatively easy to locate a fault on an overhead line and repair it. A single line worker, for example, can locate and repair a fuse. This results in shorter duration outages.[4]
- Underground lines require specialized equipment and crews to locate a fault, a separate crew with heavy equipment to dig up a line, and a specialized crew to repair the fault. This greatly increases the cost and the time to repair a fault on an underground system.[5]
- In urban areas, underground lines are four times more costly to maintain than overhead facilities.[6]
- Underground lines have a higher failure rate initially due to dig-ins and installation problems. After three or four years, however, failures become virtually non-existent.[7]
- As underground cables approach their end of life, failure rates increase significantly and these failures are extremely difficult to locate and repair. Maryland utilities report that their underground cables are becoming unreliable after 15 to 20 years and reaching their end of life after 25 to 35 years.[8]

It is unlikely that 100% of the circuit from the substation to the customer can be placed entirely underground.

This leaves the circuit vulnerable to the same types of events that affect other overhead lines, e.g. high winds and ice storms.

- Pepco found that customers served by 40-year-old overhead lines had better reliability than customers served by 20-year-old underground lines.[9]
- Two Maryland utilities, Choptank and Conectiv, have replaced underground distribution systems with overhead systems to improve reliability.[10]
- Water and moisture infiltration can cause significant failures in underground systems when they are flooded, as often happens in hurricanes.[11]
- Due to cost or technical considerations, it is unlikely that 100% of the circuit from the substation to the customer can be placed entirely underground. This leaves the circuit vulnerable to the same types of events that impact other overhead lines, e.g. high winds and ice storms.

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[4] North Carolina Utilities Commission

[5] North Carolina Utilities Commission

[6] "The Feasibility of Placing Electric Distribution Facilities Underground," North Carolina Utilities Commission, November 2003

[7] Duke Power

[8] "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission and Distribution Plant," prepared by The Selective Undergrounding Working Group; February 14, 2000; page 9

[9] "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission and Distribution Plant," prepared by The Selective Undergrounding Working Group; February 14, 2000; page 2, page 9

[10] "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission and Distribution Plant," prepared by the Selective Undergrounding Working Group; February 14, 2000; page 9

[11] Duke Power

II. Other Benefits of Undergrounding

One of the most commonly cited benefits of undergrounding is the removal of unsightly poles and wires. Local communities and neighborhoods routinely spend millions to place their existing overhead power lines underground.

Similarly, when given the option, builders of new residential communities will often pay a premium of several thousand dollars/home to place the utilities underground. These "aesthetic" benefits are virtually impossible to quantify but are, in many instances, the primary justification for projects to place existing power lines underground.

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Underground lines do have other benefits. In 1998, Australia completed a major benefit/cost analysis of undergrounding all existing power lines in urban and suburban areas throughout the country.[12] The study cost more than $1.5 million Australian ($1.05 million US at current rates), and represents what may be the most comprehensive undertaking to date to quantify the benefits and costs related to undergrounding.

In addition to the value of improved aesthetics (which the Australian study did not attempt to quantify except as it affected property values) the study identified the following potential benefits related to undergrounding that it attempted to quantify:

- Reduced motor-vehicle accidents caused by collisions with poles
- Reduced losses caused by electricity outages
- Reduced network maintenance costs.
- Reduced tree-pruning costs
- Increased property values
- Reduced transmission losses due to the use of larger conductors
- Reduced greenhouse-gas emissions (lower transmission losses)
- Reduced electrocutions
- Reduced brushfire risks, and
- Indirect effects on the economy such as employment.

Of this list, only four items were deemed significant in the study's benefit/cost calculus. Figure 9 summarizes the values the Australian study calculated for each of these benefits. They included:

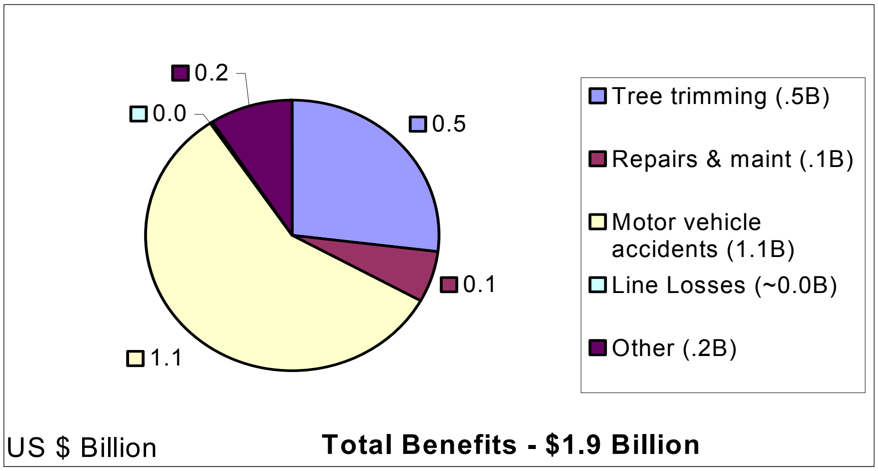
- Motor-vehicle accidents
- Maintenance costs
- Tree-trimming costs, and
- Line Losses.

The Australian list of benefits does not include improved reliability as a significant benefit of undergrounding. It identifies the reduction in losses from motor vehicle accidents as the largest benefit from undergrounding – something utilities have no control over (Figure 9).

[12] "The Putting Cables Underground Working Group Report" (http://www.dcita.gov.au/cables/report_x.htm#intro)

The US has never conducted a national undergrounding study comparable to the one conducted by Australia. Undergrounding studies in the US have been regional in nature, and have focused on the costs rather than the benefits of undergrounding.

Figure 9: 20 Year Underground Benefit Projection Australian Underground Study



Source: The Putting Cables Underground Working Group Report (http://www.dcita.gov.au/cables/report/chap_4.htm)

III. The Costs of Undergrounding

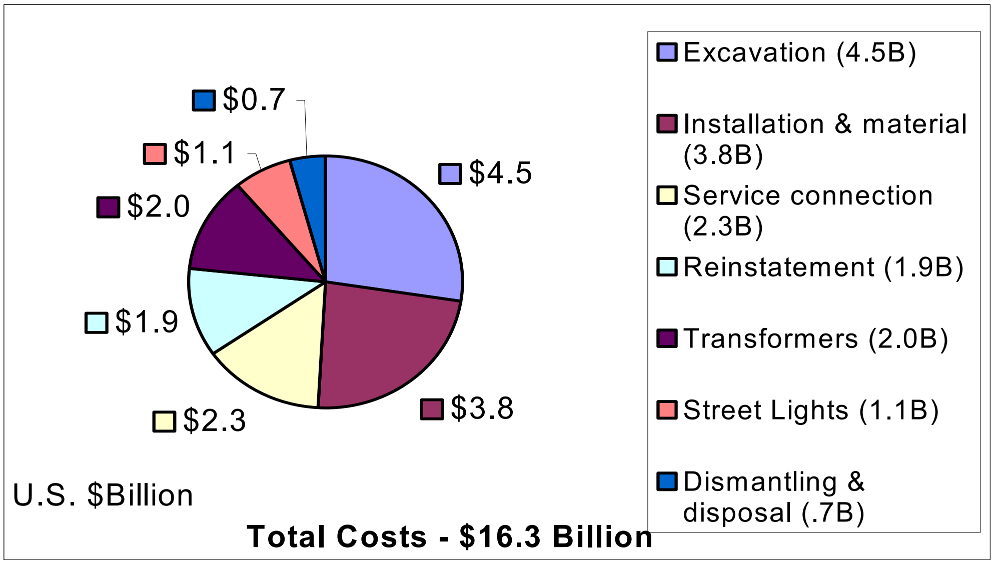
The Australian study performed an extensive analysis of underground costs, and developed a national costing model to estimate costs for undergrounding existing overhead power lines in urban and suburban areas. The results of that model are summarized on page 13 in Figures 10 and 10a.

In the U.S., the North Carolina Utilities Commission recently estimated it would take its three investor-owned utilities 25 years to underground all of their existing overhead distribution systems at a cost of approximately $41 billion. This six-fold increase in the existing book value of the utilities' current distribution assets would require a 125% rate increase.[13]

In other words, consumers would have to pay more than twice as much for electricity to enjoy the "benefits" of underground lines.

[13] "The Feasibility of Placing Electric Distribution Facilities Underground," North Carolina Utilities Commission, November 2003

Figure 10: Underground Cost Projection Australian Underground Study



Source: The Putting Cables Underground Working Group Report (http://www.dcita.gov.au/cables/report/report_x.htm#Intro)

Figure 10a: Underground Cost Summary Australian Underground Study

Total Cost (US $Billion)	$/Customer	$/Mile
$ 16.3	$ 3,856	$ 360,207

Source: The Putting Cables Underground Working Group Report (http://www.dcita.gov.au/cables/report/report_x.htm#Intro)

Underground cost data for other U.S. utilities is summarized in Figure 11, which indicates that the cost of placing overhead power lines underground is five to 10 times the cost of new overhead power lines.

Figure 11: Utility Underground Costs

	Average Cost/ Mile
Allegheny Power[1]	$ 764,655
BGE[1]	$ 952,066
Pepco[1]	$ 1,826,415
Conectiv[1]	$ 728,190
Va Power[2]	$ 950,000
California[3]	$ 500,000
FPL[4]	$ 840,000
Georgia Power[5]	$ 950,400
Puget Sount Energy[7]	$ 1,100,000
Average Overhead Line [6]	***$ 120,000***

Sources:
[1] Maryland Selective Undergrounding Working Group
[2] Dare County North Carolina Underground Study
[3] "Utility Undergrounding Programs", Scientech, May 2001, page 2
[4] "Utility Undergrounding Programs", Scientech, May 2001, page 3
[5] "Utility Undergrounding Programs", Scientech, May 2001, page 4
[6] "Utility Undergrounding Programs", Scientech, May 2001, page 4
[7] Puget Sound Energy

Figure 12 puts the U.S. underground cost data in perspective. It illustrates that, at a cost of $1 million/mile, a new underground system would require an investment of more than ten times what the typical U.S. investor owned utility currently has invested in distribution plant.

Figure 12: Investment Statistics
IOU Distribution Plant

Investment Category	Existing Plant	New Underground
$/Customer[1]	$ 2,199	$29,854
$/Mile	$ 73,666	$1 Million

[1] Assumes U.S. average of 33.5 customers/mile of IOU distribution line
Source: NRECA Statistical Comparison
http://www.nreca.org/nreca/About_Us/Our_Members/Statistics/Statistics

Other factors also can result in substantial additional customer costs for undergrounding projects. These include:

- Electric undergrounding strands other utilities, e.g. cable and telephone companies, which must assume 100% of pole costs if electric lines are underground. These additional non-electric costs will likely be passed on to cable and telephone consumers.

- Customers may incur substantial additional costs to connect homes to newly installed underground service, possibly as much as $2,000 if the household electric service must be upgraded to conform to current electric codes.

Both the Australian and US studies on undergrounding have identified significant issues related to who assumes the burden for underground costs. If utilities were told they must underground a significant portion of their overhead power lines, who would pay for it and who would get their power lines placed underground first?

If the costs of undergrounding are fully allocated, only the wealthy may be able to afford it. On the other hand, if undergrounding is financed or socialized through a broad-base tax or electricity rates, people may end up paying for undergrounding projects that do not get to their neighborhoods for a decade or more (or after they have already moved).

Some innovative approaches being used to fund undergrounding projects are discussed in the final section of this report.

IV. Benefit/Cost Summary

Based on the projected benefits and costs for undergrounding much of its existing urban and suburban power lines, the Australian study calculated that the benefits would offset only about 11% of total costs (Figure 13).

Figure 13: Projected 20 Year Costs and Benefits
Australia Underground Study

Quantifiable Costs (US $Billion)		Quantifiable Benefits (US $ Billion)	
Excavation	$ 4.5	Motor vehicle accidents	$ 1.1
Installation & material	$ 3.8	Tree trimming	$ 0.5
Service connection	$ 2.3	Other	$ 0.2
Transformers	$ 2.0	Repairs & maint	$ 0.1
Reinstatement	$ 1.9	Line Losses	~0.0
Street Lights	$ 1.1		
Dismantling & disposal	$ 0.7		
Total	**$ 16.3**	**Total**	**$ 1.9**

Source: The Putting Cables Underground Working Group Report (http://www.dcita.gov.au/cables/report/report_x.htm#Intro)

For the US, no comparable benefit cost analysis exists. However, based on the high costs of undergrounding projected in Figure 11, it appears that placing existing overhead lines underground is difficult to justify economically. Today, most undergrounding costs appear to be justified by aesthetic and public-policy considerations.

V. Paying For Undergrounding

In-spite of its high cost and lack of economic justification, undergrounding is very popular across the country. In nine out of 10 new subdivisions, contractors bury power lines.[14] In addition, dozens of cities have developed comprehensive plans to bury or relocate utility lines to improve aesthetics, including:[15]

- San Antonio, Texas
- Colorado Springs, Colorado
- New Castle, Delaware
- Saratoga Springs, New York
- Williamsburg, Virginia
- Tacoma, Washington
- Frederick, Maryland.

For new residential construction, utilities vary on how they charge for the cost of providing underground services. A sample of these policies is provided in Figure 14.

Figure 14: Sample Residential Undergrounding Requirements

Utility	State	Requirement
SDG&E, PGE & SCE	CA	Customer/Developer pays for trenching & backfilling. Utility pays remaining costs.
Atlantic City Electric	NJ	Customer/Developer pays $802.74 + $4.35 per front foot for each home. Utility pays remaining costs.
Cobb Electric Membership Corp.	GA	Customer/developer pays $260 per customer. Utility pays remaining costs.
Green Mountain Power	VT	Customer/Developer pays for trenching & backfilling. Utility pays remaining costs.
Nantucket Electric Co.	MA	The utility pays up to $837.85. The customer pays the remaining costs.
Consolidated Edison	NY	The utility charges the customer the diferential in charges for equivalent overhead construction
Mississippi Power	MS	Developer pays the cost differential above what it would cost to install overhead lines

Source: "Utility Undergrounding Programs", Scientech, May, 2001

When it comes to converting existing overhead lines to underground, a variety of programs are being utilized. They include special assessment areas, undergrounding districts, and state and local government initiatives. Details are provided below.

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14 "Utility Undergrounding Programs," Scientech; May 2001; page 6

15 "Utility Undergrounding Programs," Scientech; May 2001; page 6

Special Assessment Areas

Several communities are establishing "special assessment areas," where subscribers pay extra on their monthly bill to fund the underground project. These areas are typically created through a petition of the majority of the property owners in an area.

Commonwealth Electric in Massachusetts has used special assessments since 1970 to fund burial efforts in historic communities such as Nantucket. One drawback to special assessments is that the total revenue collected is often minimal, requiring utilities to extend the schedule for undergrounding over an extended period of time.[16]

Undergrounding Districts

Another approach employed in California and Oregon is the establishment of "underground districts."

In California, the public utility commission collects a percentage of revenue from wire-based utilities for a special undergrounding fund. To receive these funds, a community must form an undergrounding district, approved by at least 70% of the property owners in that district. The property owners also must agree to pay the $500 to $2,000 it costs to connect their homes to a new underground system.[17]

Hawaii

Hawaii Electric has a program where it pays for up to one-third of the cost to place existing neighborhood electric distribution lines underground. Hawaii Electric will undertake the conversion as part of a community or government-initiated underground project, subject to public utility commission approval. The program does not include transmission lines.[18]

Hawaii Electric has a program where it pays for up to one-third of the cost to place existing neighborhood electric distribution lines underground.

South Carolina Electric and Gas

SCE&G has established a special undergrounding program, approved by the South Carolina Public Service Commission. Under the program, if the local municipality agrees to contribute a matching amount, SCE&G contributes .5% of the gross receipts it is obligated to pay to the municipality. This money goes into a special underground fund.[19]

Dare County North Carolina

In 1999 the North Carolina legislature passed a law allowing Dare County on North Carolina's Outer Banks to form a special utility district for the purpose of funding the conversion of existing overhead power lines to underground.

[16] "Utility Undergrounding Programs," Scientech; May 2001; page 5

[17] "Utility Undergrounding Programs," Scientech; May 2001; page 5

[18] "Utility Undergrounding Programs," Scientech; May 2001; page 36

[19] "Utility Undergrounding Programs," Scientech; May 2001; page 38 and phone conversation with SCE&G

Under the legislation, once the utility district is created, the county's electric supplier, Dominion Virginia Power, is required to collect a maximum of $1/month from residential customers in the county and a maximum of $5/month from all other customers. These funds are placed in a special undergrounding fund, managed by Dominion Virginia Power, to be used on a pay-as-you-go basis to convert the county's existing overhead power lines to underground.

As of 2003, Dare County has not yet elected to form the special utility district. One of the reasons is that two communities in the county, Duck and Southern Shores, have objected to the special assessment. Both of these communities already have underground electric systems they paid for through development fees or special property-tax assessments. Residents in these communities believe it is unfair for them to pay for undergrounding the electric system for other county residents.

In communities in Dare County, N.C., residents who have already paid for underground systems through development fees or tax assessments object to a monthly assessment to fund underground conversion throughout the remainder of the county.

Several other counties in North Carolina and the Tidewater area of Southeast Virginia are studying the 1999 North Carolina legislation with the thought that they may seek similar legislation for their areas.

VI. Conclusion

Placing existing power lines underground is expensive, costing approximately $1 million/mile. This is almost 10 times the cost of a new overhead power line.

While communities and individuals continue to push for undergrounding—particularly after extended power outages caused by major storms—the reliability benefits that would result are uncertain, and there appears to be little economic justification for paying the required premiums.

"If a 10 percent return is imputed to the great amounts of capital freed up by building overhead instead of underground line, the earnings alone will pay for substantial ongoing overhead maintenance."

--***Maryland Public Service Commission***

Indeed, in its study of the undergrounding issue, the Maryland Public Service Commission concluded, "If a 10 percent return is imputed to the great amounts of capital freed up by building overhead instead of underground line, the earnings alone will pay for substantial ongoing overhead maintenance," implying that utilities could have more resources available to them to perform maintenance and improve reliability on overhead lines if they invested less in new underground facilities. [20]

For the foreseeable future, however, it appears that the undergrounding of existing overhead power lines will continue, justified primarily by aesthetic considerations—not reliability or

[20] "Report to the Public Service Commission of Maryland on the Selective Undergrounding of Electric Transmission and Distribution Plant," prepared by The Selective Undergrounding Working Group; February 14, 2000; page 3

economic benefits. Many consumers simply want their power lines placed underground, regardless of the costs. The challenge for decision makers, is determining who will pay for these projects and who will benefit.

There are several undergrounding programs around the country that are working through these equity issues and coming up with what appear to be viable compromises. Once a public-policy decision is reached to pursue an undergrounding project, it is worthwhile for the leaders involved to evaluate these programs in more detail to determine what is working, and what is not.

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