EXTEND DATES OF USEC PRIVATIZATION ACT

BACKGROUND: Section 3112(b)(2) of the USEC Privatization Act requires the Department of Energy to sell uranium hexafluoride into what is now an already oversupplied market due in major part to overty aggressive transfers of government stockpiles.

DESCRIPTION: A simple date extension will avoid exacerbating the governmentally fostered market damage. This extension will assist domestic producers to the front end of the nuclear fuel cycle.

RECOMMENDATION: Amend USEC Privatization Act, Section 3112(b)(2) to read:

"(2) ~~Within 7 years of the date of enactment of this Act, t~~The Secretary ~~shall~~ may sell, and receive payment for, the uranium hexafluoride transferred to the Secretary pursuant to paragraph (1). Such uranium hexafluoride ~~shall~~ may be sold –

(A) ~~at any time for use in the United States~~

(~~B~~A) at any time for end use outside the United States;

(~~C~~B) in 1995 and 1996 to the Russian Executive Agent at the purchase price for use in matched sales pursuant to the Suspension Agreement; or,

(~~D~~C) in calendar ~~2001~~ 2008 for consumption by end users in the United States no prior to January 1, ~~2002~~ 2009, in volumes not to exceed 3,000,000 pounds U308 equivalent per year."

DOMESTIC URANIUM RESEARCH AND DEVELOPMENT

PRINCIPLE: Support for the domestic uranium industry is essential for both energy and national security reasons. A federal research program to support advanced exploration, mining and milling technologies is required to assure the long term viability of the domestic industry.

BACKGROUND: The domestic uranium mining and conversion service industries have been unintentionally adversely affected due to the privatization process in actions taken by the Department of Energy and the U.S. Enrichment Corporation in the management of government uranium inventories. Due to current excess inventories, including material available from the U.S.-Russia agreement on the conversion of weapons grade highly enriched uranium (HEU), worldwide production of uranium and conversion has declined to less than half of annual consumption, and domestic production of uranium is currently less than 10% of annual U.S. requirements. The utilization of existing inventories has greatly benefitted the U.S. government by avoiding the need for cash payments in the hundreds of millions of dollars from the Treasury to the USEC, and has benefitted consumers of nuclear power, due to the reduction in the market price of uranium fuel feedstock material. The United States Enrichment Corporation Privatization Act stated the public interest in mitigating adverse impacts to the domestic mining.

DESCRIPTION: Funds should be allocated for cooperative agreements to mitigate the impact of government inventory sales and transfers that have devastated the domestic uranium industry. These cooperative agreements can be used to mitigate the cost of compliance with environmental safety and health laws and regulations for certain domestic uranium production facilities. The proposed cooperative agreements will ensure full environmental compliance where costs would normally be defrayed through production revenues. The cooperative agreements can also assure the preservation of domestic reserves by assisting in land and lease costs and promoting the exploration for new domestic reserves. Finally the cooperative agreements can be made with existing producers to enhance mining and milling technology and remediation activities to promote a strong competitive domestic uranium industry.

RECOMMENDATION: Legislation on Domestic Uranium Research and Development should be enacted addressing the following.

Section 1. The Secretary of the Department of Energy is authorized to enter into multi-year cooperative agreements with domestic uranium producers to:

(a) ensure compliance with all applicable federal, state and local requirements for the protection of environment, safety and health;
(b) assure the preservation of existing uranium reserves and leases;
(c) promote uranium mining and milling techniques and innovations;
(d) promote exploration techniques and activities to increase the domestic natural uranium reserve.

Section 2.

(a) there is authorized to be appropriated $_____________ to carry out this part. The aggregate amount in the preceding sentence shall be increased annually, based upon an inflation index to be determined by the Secretary;

(b) Funds described in subsection (a) of this section shall be provided from the USEC Privatization Expense Fund established by Section 3104(e) of the Privatization Act;

Section 3. Domestic uranium producers shall mean individuals, companies, partnerships, joint ventures and other business entities that owned, controlled, operated and/or managed a uranium recovery facility (including conventional mills, in-situ leaching operations, heap leaching operations or any other type of uranium recovery facility) that possessed an operating Nuclear Regulatory Commission (NRC) or agreement state license on or after July 28, 1998 and are capable of future operation..

URANIUM PRODUCT TAX CREDIT

PRINCIPLE: Support modification of the federal tax laws to provide a credit for the purchase of domestic uranium products.

BACKGROUND: The United States uranium recovery industry has long been recognized as vital to United States energy independence and essential to United States national security, the domestic uranium industry has been found to be "not viable" by the Secretary of Energy under provisions of the Atomic Energy Act of 1954, as amended. Transfers and sale of government uranium inventories including those related to the United States/Russian HEU Agreement and the privatization of the United States Enrichment Corporation have had material adverse impacts on the United States uranium industry to the extent that the current spot market price of uranium is at an historical all time low. The unfettered introduction of government inventories has caused domestic uranium producers to either cease or curtail production;

DESCRIPTION: At such time as the price of natural uranium recovers to approach a reasonable cost of production, the United States uranium industry can be competitive with foreign producers due to advances in technology. Providing assistance to the domestic uranium industry is essential to mitigate the impacts on a private industry from government disarmament policies and government transfers of excess uranium reserves as well as to assure an adequate long-term supply of domestic uranium for the Nation's nuclear power program to preclude an undue threat from foreign supply disruptions or price controls.

RECOMMENDATION: To amend the Internal Revenue Code of 1986 to allow a credit for the purchase of uranium products within the United States, and for other purposes.

SECTION 1. SHORT TITLE.

This Act may be cited as the "United States Uranium Employment and Production Incentive Tax Credit Act".

SECTION 2. FINDINGS AND PURPOSE.

(a) FINDINGS.—The Congress finds that—

(1) although the United States uranium industry has long been recognized as vital to United States energy independence and essential to United States national security, the domestic uranium industry has been found to be "not viable" by the Secretary of Energy under provisions of the Atomic Energy Act of 1954, as amended;

(2) transfers and sale of government uranium inventories including those related to the United States/Russian HEU Agreement and the privatization of the United States Enrichment Corporation have had material adverse impacts on the United States uranium industry to the extent that the current spot market price of uranium is at an historical all time low;

(A) the unfettered introduction of government inventories has caused domestic uranium producers to either cease or curtail production;

(B) at such time as the price of natural uranium recovers to approach a reasonable cost of production, the United States uranium industry can be competitive with foreign producers due to advances in technology; and

(C) at the present time approximately 23 percent of United States electricity is produced from uranium fueled power plants and this number is expected to increase;

(3) the United States has historically been the leading uranium producing nation and holds extensive proven reserves of natural uranium that offer the potential for secure sources of future supply; and

(4) providing assistance to the domestic uranium industry is essential to—

(A) mitigate the impacts on a private industry from government disarmament policies and government transfers of excess uranium reserves;

(B) preclude an undue threat from foreign supply disruptions that could hinder the Nation's common defense and security; and

(C) assure an adequate long-term supply of domestic uranium for the Nation's nuclear power program to preclude an undue threat from foreign supply disruptions or price controls.

(b) PURPOSE.—It is the purpose of this Act to—

(1) ensure an adequate long-term supply of domestic uranium for the Nation's nuclear electric power program and for the Nation's common defense and security; and

(2) provide assistance to the domestic uranium industry by creating a domestic utility purchase incentive to ensure the continued existence of the domestic uranium industry and this industry's infrastructure.

SECTION. 3. CREDIT FOR PURCHASE OR URANIUM PRODUCED WITHIN THE UNITED STATES.

(a) IN GENERAL.—Subpart B of part IV of sub-chapter A of chapter 1 of the Internal Revenue Code of 1986 (relating to foreign tax credit, etc.) is amended by adding at the end thereof the following new section:

SECTION 30. CREDIT FOR PURCHASE OF URANIUM MINED OR PRODUCED AS A BY-PRODUCT WITHIN UNITED STATES.

"(a) ALLOWANCE OF CREDIT.—There shall be allowed as a credit against the tax imposed by this chapter for the taxable year an amount equal to the product of $7 multiplied by the number of pounds of qualified uranium purchased by and delivered to the tax payer during such taxable year for use by a domestic utility.

"(b) LIMITATIONS AND ADJUSTMENTS.—

"(1) CREDIT ALLOWED ONLY ONCE.—If a credit was allowed under subsection (a) with respect to qualified uranium, no credit shall be allowed under subsection (a) with respect to any subsequent purchase of such uranium.

"(2) APPLICATION WITH OTHER CREDITS.—The credit allowed by subsection (a) for any taxable year shall not exceed the excess (if any) of—

"(A) the regular tax for the taxable year reduced by the sum of the credits allowable under subpart A and sections 27, 28, and 29, over

"(B) the tentative minimum tax for the taxable year.

"(3) INFLATION ADJUSTMENT.—The $7 amount in subsection (a) shall be adjusted by multiplying such amount by the inflation adjustment factor for the calendar year in which the purchase occurs.

"(c) QUALIFIED URANIUM.—For purposes of this section, the term 'qualified uranium' means uranium ore the seller or producer of which certifies, in such manner as the Secretary may prescribe, as having been mined or produced as a by-product in the United States (within the meaning of section 638(1)) on or after January 1, 2000.

"(d) DEFINITIONS AND SPECIAL RULES.—For purposes of this section—

"(1) SALES BETWEEN RELATED PERSONS.—No credit shall be allowed under subsection (a) for any sale between related persons (as defined in section 29(d)(8)).

"(2) INFLATION ADJUSTMENT FACTOR.—The term 'inflation adjustment factor' has the meaning given such term by section 29(d)(2)(B), except that '2001' shall be substituted for '1979'.

"(e) APPLICATION OF SECTION.—This section shall apply to purchase after December 31, 2000, and before January 1, 2006, except that any purchase after December 31, 2000, pursuant to a contract entered into before January 1, 2001, shall be treated as a purchase on or before December 31, 2000."

(b) CONFORMING AMENDMENT.—The table sections for subpart B or part IV of subchapter A of chapter 1 of such Code is amended by adding at the end thereof the following:

(c) EFFECTIVE DATE.—The amendments made by this section shall apply to purchases after December 31, 2000, in taxable years ending after such date.

Document No. 243

EDISON ELECTRIC INSTITUTE

Catalogue of Investor-Owned Electric Utilities

40th Edition | Published 2

TABLE OF CONTENTS

FOREWORD

...the names, addresses, and telephone numbers of investor-owned electric utilities, ...d transmission companies, arranged by state according to place of operation and ...ffice. In addition, 1999 data on average number of ultimate customers, total sales to ...and revenue from sales to ultimate customers are presented by company within each ..., megawatthour sales, and revenues data used in this publication was taken from the ...rgy, Energy Information Administration's Form No. 861.

...been updated for mergers, acquisitions and name changes through October 20, 2000. The ...-owned electric utility companies currently operating in the United States includes:

- Electric utility operating companies which serve ultimate customers (includes 127 electric-only and 56 combination companies).
- Wholesale only operating companies.
- Transmission only companies.
- Companies which lease plants (non-operating).

- Total investor-owned electric utility companies.

...panies operating in more than one state, reference is made - "See ___________" for state where ...ipal office is located and the complete address is given. Ultimate customers, sales, and revenues ...wn in the state(s) in which the utility serves, i.e.;

...NOIS (IL)

...lliant Energy/Interstate Power Company	Customers:	11,081
See IA	Sales (MWh):	349,252
	Revenues ($000):	16,668

...OWA (IA)

Alliant Energy/Interstate Power Company	Customers:	115,714
1000 Main Street, P.O. Box 769	Sales (MWh):	4,205,350
Dubuque, IA 52004-0769	Revenues ($000):	195,559
(319) 582-5421		

Also serves in IL and MN

Company Totals:	Customers:	166,780
	Sales:	5,311,928
	Revenues:	261,799

MINNESOTA (MN)

Alliant Energy/Interstate Power Company	Customers:	39,985
See IA	Sales (MWh):	757,326
	Revenues ($000):	49,572

The abbreviations in parentheses following a company name refer to the holding company, if applicable. Non-operating and operating investor-owned electric utility holding companies and systems along with their abbreviations are listed on pages 1-5. The list includes only those electric utility holding companies that have at least one wholly-owned electric utility subsidiary. The indentation of a company's name indicates that it has a subsidiary relationship to the company listed above. A company followed by a "J" and a number in parentheses denotes that the company is jointly-owned. Jointly-owned companies and their owners are listed on page 6.

Also included are listings of electric-only investor-owned utilities and combination companies. A combination company is defined as a company which renders more than one type of utility service, such as electric and gas. If more than 95 percent of such a company's utility plant is devoted to one type of service, or more than 95 percent of its operating revenue is derived from one type of service, it is not classified as a combination company.

Due to the increasing number of states with deregulated retail electricity markets, we have added a table on page 52 that shows state aggregated MWh sales, revenues from electricity sales and the number of ultimate customers served by non-traditional energy service providers.

A list of power marketing affiliates of investor-owned electric utilities, updated through June 15, 2000 can be found on page 57. The source of the information is EEI Online, Power Marketing Database.

We have also compiled information on completed industry mergers and acquisitions from September 1999 through October 2000. This listing shows the companies involved in mergers and acquisitions and effective dates, as well as post-merger company structures. Information on pending mergers and acquisitions can be accessed via EEI Online.

Visit EEI's home page at www.eei.org for links to the Internet home pages of many of the companies in this publication. An online publications catalogue is also available to access information about other EEI products and services.

SELECTED 1999 STATISTICS OF THE TOTAL UNITED STATES INVESTOR-OWNED ELECTRIC UTILITY INDUSTRY

Installed Generating Capacity (p)	486,272 MW
Generation	2,444,435 GWh
Energy Sales to Ultimate Customers*	2,390,697 GWh
Average Number of Ultimate Customers*	92,389,604
Revenues from Sales to Ultimate Customers*	$163,496,703,000
Average Revenue per kWh Sold	6.84¢
Average Annual kWh Use per Customer	25,876 kWh
Average Annual Revenue per Customer	$1,769.64

* Only includes traditional regulated service provided to ultimate customers. Please see page 52 for state aggregated data for those states that offer retail electric choice.
p Preliminary.
kWh = kilowatthour
MW = megawatt = one thousand kilowatts.
GWh = gigawatthour = one million kilowatthours.

INVESTOR-OWNED ELECTRIC UTILITY HOLDING COMPANIES AND SYSTEMS

AES Corporation (AES)
1001 North 19th Street
Arlington, VA 22209
(703) 522-1315
Central Illinois Light Company

Alaska Energy and Resources Company (AER)
5601 Tonsgard Court
Juneau, AK 99801-7201
(907) 780-2222
Alaska Electric Light and Power Company
Haines Light and Power Company, Inc.

Allegheny Energy, Inc. (AYE) *
10435 Downsville Pike
Hagerstown, MD 21740-1766
(301) 790-3400
Monongahela Power Company
Potomac Edison Company, The
West Penn Power Company
Note: All subsidiaries operate under the name Allegheny Power. Their legal names are listed above.

ALLETE (ALE)
30 West Superior Street
Duluth, MN 55802-2093
(216) 722-2641
Minnesota Power
Superior Water, Light and Power Company

Alliant Energy Corporation (LNT) *
222 West Washington Avenue
Madison, WI 53701-0192
(608) 252-3311
Alliant Energy/IES Utilities Inc.
Alliant Energy/Interstate Power Company
Alliant Energy/Wisconsin Power and Light Company
South Beloit Water, Gas and Electric Company

Ameren Corp. (AEE) *
One Ameren Plaza
1901 Chouteau Avenue
St. Louis, MO 63103-3003
(314) 621-3222
AmerenCIPS
AmerenUE

American Electric Power Company, Inc. (AEP) *
1 Riverside Plaza
Columbus, OH 43215-2373
(614) 223-1000
AEP Generating Company
Appalachian Power Company
Central Power & Light Company
Columbus Southern Power Company
Indiana Michigan Power Company
Kentucky Power Company
Kingsport Power Company
Ohio Power Company
Public Service Company of Oklahoma
Southwestern Electric Power Company
West Texas Utilities Company
Wheeling Power Company
Note: All subsidiaries operate under the name American Electric Power. Their legal names are listed above.

American States Water Company (AWR)
630 East Foothill Boulevard
San Dimas, CA 91773-1212
(909) 394-3600
Southern California Water Company

Central Vermont Public Service Corporation (CV)
77 Grove Street
Rutland, VT 05701-0608
(802) 773-2711
Connecticut Valley Electric Company, Inc.

CH Energy Group, Inc. (CNH)
284 South Avenue
Poughkeepsie, NY 12601-4823
(914) 452-2000
Central Hudson Gas & Electric Corporation

Cinergy Corp. (CIN) *
139 East Fourth Street
Cincinnati, OH 45202-4003
(513) 287-2644
Cincinnati Gas & Electric Company, The
Miami Power Corporation
Union Light, Heat & Power Company
West Harrison Gas & Electric Company
PSI Energy, Inc.

* Subject to the full regulatory scope of the Public Utility Holding Company Act of 1935 (PUHCA).

INVESTOR-OWNED ELECTRIC UTILITY HOLDING COMPANIES AND SYSTEMS, Cont'd.

Cleco Corporation (CNL)
2030 Donahue Ferry Road
Pineville, LA 71360-5226
(318) 484-7400
Cleco Utility Group, Inc.

CMS Energy Corporation (CMS)
Fairlane Plaza South
330 Town Center Drive
Dearborn, MI 48126
(313) 436-9261
Consumers Energy

Conectiv (CIV) *
800 King Street
Wilmington, DE 19899
(302) 429-3114
Atlantic City Electric Company
Deepwater Operating Company
Delmarva Power & Light Company

Consolidated Edison, Inc. (ED)
4 Irving Place
New York, NY 10003-3502
(212) 460-4600
Consolidated Edison Company of New York, Inc.
Orange and Rockland Utilities, Inc.
Pike County Light & Power Company
Rockland Electric Company

Constellation Energy Group, Inc. (CEG)
250 West Pratt Street
Baltimore, MD 21201
(410) 234-5685
Baltimore Gas and Electric Company

CP&L Energy, Inc.
411 Fayetteville Street Mall
Raleigh, NC 27601-1748
(919) 546-6111
Carolina Power & Light Company

Dominion Resources, Inc. (DRI)*
120 Tredegar Street
Richmond, VA 23219
(804) 819-2000
Dominion Virginia Power
Dominion North Carolina Power

DPL Inc. (DPL)
Courthouse Plaza, SW
Dayton, OH 45402
(937) 224-6000
Dayton Power and Light Company, The

DQE (DQE)
Cherrington Corp. Center
500 Cherrington Pkwy
Coraopolis, PA 15108-3184
(412) 262-4700
Duquesne Light Company

DTE Energy Company (DTE)
2000 Second Avenue
Detroit, MI 48226-1279
(313) 235-8000
Detroit Edison Company, The

Duke Energy Corporation (DUK)
422 South Church Street
Charlotte, NC 28201-1006
(704) 594-6200
Duke Power
Nantahala Power & Light Company

Dynegy (DYN)
1000 Louisiana
Houston, TX 77002
(713) 507-6400
Illinois Power Company

Edison International (EIX)
2244 Walnut Grove Avenue
Rosemead, CA 91770-0800
(626) 302-2222
Southern California Edison Company

Energy East Corporation (EAS) *
1 Commerce Plaza
Albany, NY 12260
(518) 434-3014
Central Maine Power Company
New York State Electric & Gas Corporation

Enron Corp. (ENE)
1400 Smith Street
Houston, TX 77002
(713) 853-6161
Portland General Electric Company

* Subject to the full regulatory scope of the Public Utility Holding Company Act of 1935 (PUHCA).

INVESTOR-OWNED ELECTRIC UTILITY HOLDING COMPANIES AND SYSTEMS, Cont'd.

Entergy Corporation (EC) *
639 Loyola Avenue
New Orleans, LA 70113-1704
(504) 529-5262
- Entergy Arkansas, Inc.
- Entergy Gulf States, Inc.
- Entergy Louisiana, Inc.
- Entergy Mississippi, Inc.
- Entergy New Orleans, Inc.
- System Energy Resources, Inc.

Exelon Corporation (EXE) *
One First National Plaza
10 South Dearborn Street
Chicago, IL 60690-3005
(312) 394-7399
- Commonwealth Edison Company
- Commonwealth Edison Company of Indiana
- PECO Energy Power Company
  - Susquehanna Power Company, The
- Susquehanna Electric Company, The

FirstEnergy Corp. (FE)
76 South Main
Akron, OH 44308-1890
(800) 736-3402
- Cleveland Electric Illuminating Company, The
- Ohio Edison Company
  - Pennsylvania Power Company
- Toledo Edison Company, The

Florida Progress Corporation (FPC)
One Progress Plaza
St. Petersburg, FL 33701
(727) 824-6400
- Florida Power Corporation

FPL Group, Inc. (FPL)
700 Universe Boulevard
Juno Beach, FL 33408-2683
(561) 694-4000
- Florida Power & Light Company

GPU, Inc. (GPU) *
300 Madison Avenue
Morristown, NJ 07962-1911
(973) 455-8200
- Jersey Central Power & Light Company
- Metropolitan Edison Company
  - York Haven Power Company
- Pennsylvania Electric Company

Note: GPU, Inc. operates under the name GPU. All subsidiaries operate under the name GPU Energy. Their legal names are listed above.

Hawaiian Electric Industries, Inc. (HEI)
900 Richards Street
Honolulu, HI 96813
(808) 543-5662
- Hawaiian Electric Company, Inc.
  - Hawaii Electric Light Company, Inc.
  - Maui Electric Company, Ltd.

IDACORP, Inc. (IDA)
1221 West Idaho Street
Boise, ID 83702-5627
(208) 388-2200
- Idaho Power Company

IPALCO Enterprises, Inc. (IPL)
25 Monument Circle
Indianapolis, IN 46206-1595
(317) 261-8261
- Indianapolis Power & Light Company

KeySpan Corporation (KSE)
One MetroTech Center
Brooklyn, NY 11201-3851
(718) 403-2000
- KeySpan Generation LLC
- KeySpan-Ravenswood, Inc.

LG&E Energy Corporation (LGE)
220 West Main Street
Louisville, KY 40232
(502) 627-2000
- Kentucky Utilities Company
- Louisville Gas and Electric Company

MidAmerican Energy Holdings Company (MEC)
666 Grand Avenue
Des Moines, IA 50309
(515) 242-4300
- MidAmerican Energy Company

National Grid Group plc (NGG) *
National Grid House, Kirby Corner Road
Coventry CV4 8JY, England
011-44-1203-423616
- National Grid USA *
  - Granite State Electric Company
  - Massachusetts Electric Company
  - Montaup Electric Company
  - Nantucket Electric Company
  - Narragansett Electric Company, The
  - New England Electric Transmission Corporation
  - New England Hydro-Transmission Corporation
  - New England Hydro-Transmission Electric Co.
  - New England Power Company

* Subject to the full regulatory scope of the Public Utility Holding Company Act of 1935 (PUHCA).

INVESTOR-OWNED ELECTRIC UTILITY HOLDING COMPANIES AND SYSTEMS, Cont'd.

Niagara Mohawk Holdings Inc. (NMK)
300 Erie Boulevard West
Syracuse, NY 13202-4201
(315) 474-1511
Niagara Mohawk Power Corp.

NiSource, Inc. (NI)
801 East 86th Avenue
Merrillville, IN 46410
(219) 853-5200
Northern Indiana Public Service Company

Northeast Utilities (NU) *
174 Brush Hill Avenue
West Springfield, MA 01090-0010
(413) 785-5871
Connecticut Light and Power Company, The
Holyoke Water Power Company
Holyoke Power and Electric Company
Public Service Company of New Hampshire
Western Massachusetts Electric Company

NSTAR (NST)
800 Boylston Street
Boston, MA 02199-8003
(617) 424-2000
Boston Edison Company
Cambridge Electric Light Company
Canal Electric Company
Commonwealth Electric Company

OGE Energy Corp. (OGE)
321 North Harvey Avenue
Oklahoma City, OK 73102
(405) 553-3000
OG&E Electric Services

PG&E Corporation (PCG)
1 Market, Spear Tower
Suite 2400
San Francisco, CA 94105
(415) 267-7000
Pacific Gas & Electric Company

Pinnacle West Capital Corporation (PNW)
400 East Van Buren Street
Phoenix, AZ 85072
(602) 379-2616
Arizona Public Service Company

PPL Corporation (PPL)
Two North Ninth Street
Allentown, PA 18101-1179
(610) 774-5151
PPL Utilities

Public Service Enterprise Group, Inc. (PSEG)
80 Park Plaza
Newark, NJ 07102-4106
(973) 430-7000
Public Service Electric and Gas Company

Reliant Energy, Inc. (REI)
1111 Louisiana
Houston, TX 77002-5231
(713) 207-3000
Reliant Energy HL&P

RGS Energy Group Inc. (RGS)
89 East Avenue
Rochester, NY 14649-0001
(716) 771-4444
Rochester Gas and Electric Corporation

SCANA Corporation (SCG)
1426 Main Street
Columbia, SC 29201
(803) 217-9000
South Carolina Electric & Gas Company
South Carolina Generating Company, Inc.

ScottishPower Group (SPI) *
1 Atlantic Quay
Glasgow G2 8SP, Scotland
011-44-141-2488200
PacifiCorp

Sempra Energy (SRE)
101 Ash Street
San Diego, CA 92101-3906
(619) 696-2000
San Diego Gas & Electric Company

Sierra Pacific Resources (SPR)
6100 Neil Road
Reno, NV 89511-1132
(775) 834-4011
Nevada Power Company
Sierra Pacific Power Company

Southern Company, The (SO) *
270 Peachtree Street, NW
Atlanta, GA 30303
(404) 506-6526
Alabama Power Company
Georgia Power Company
Gulf Power Company
Mississippi Power Company
Savannah Electric and Power Company
Southern Electric Generating Company

*Subject to the full regulatory scope of the Public Utility Holding Company Act of 1935 (PUHCA).

INVESTOR-OWNED ELECTRIC UTILITY HOLDING COMPANIES AND SYSTEMS, Cont'd.

TECO Energy, Inc. (TE)
702 North Franklin Street
Tampa FL 33602-4418
(813) 228-4111
Tampa Electric Company

TNP Enterprises, Inc. (TNP)
4100 International Plaza Tower Two
Fort Worth, TX 76109-4896
(817) 731-0099
Texas-New Mexico Power Company

Texas Utilities Company (TXU)
dba TXU Corp.
Energy Plaza, 1601 Bryan Street
Dallas, TX 75201-3411
(214) 812-4600
Southwestern Electric Service Company
TXU Electric & Gas

UIL Holdings Corporation (UIL)
157 Church Street
New Haven, CT 06506-0901
(203) 299-2000
United Illuminating Company, The

UGI Corporation (UGI)
460 North Gulph Road
King of Prussia, PA 19406
(610) 337-1000
UGI Utilities, Inc.

UniSource Energy Corporation (UNS)
220 West Sixth Street
Tucson, AZ 85701-1093
(520) 571-4000
Tucson Electric Power Company

UNITIL Corporation (UNT) *
Six Liberty Lane West
Hampton, NH 03842-1720
(603) 772-0775
Concord Electric Company
Exeter & Hampton Electric Company
Fitchburg Gas and Electric Light Company

Vectren, Inc. (VVC)
20 NW Fourth Street
Evansville, IN 47741-0001
(812) 465-5300
Southern Indiana Gas and Electric Company

Western Resources, Inc. (WRI)
818 South Kansas Avenue
Topeka, KS 66612-1217
(785) 575-6300
Kansas Gas and Electric Company

Wisconsin Energy Corporation (WEC)
P.O. Box 2949
Milwaukee, WI 53201-2949
(414) 221-2345
Edison Sault Electric Company
Wisconsin Electric Power Company

WPS Resources Corporation (WPS)
700 North Adams Street
Green Bay, WI 54307
(920) 433-1727
Upper Peninsula Power Company
Wisconsin Public Service Corporation

Xcel Energy Inc. (XEL) *
1225 17th Street
Denver, CO 80202-5533
(303) 571-7511
Cheyenne Light, Fuel and Power Company
Northern States Power Company
Northern States Power Company (WI)
Public Service Company of Colorado
Southwestern Public Service Company

*Subject to the full regulatory scope of the Public Utility Holding Company Act of 1935 (PUHCA).

JOINTLY-OWNED COMPANIES

(J1) Allegheny Generating Company
Jointly-owned by:
- Monongahela Power Company
- Potomac Edison Company, The

(J2) Connecticut Yankee Atomic Power Company
Jointly-owned by:
- Boston Edison Company
- Cambridge Electric Light Company
- Central Maine Power Company
- Central Vermont Public Service Corporation
- Connecticut Light and Power Company, The
- Montaup Electric Company
- New England Power Company
- Public Service Company of New Hampshire
- United Illuminating Company, The
- Western Massachusetts Electric Company

(J3) Electric Energy, Inc.
Jointly-owned by:
- AmerenCIPS
- AmerenUE
- Illinois Power Company
- Kentucky Utilities Company

(J4) Maine Electric Power Company, Inc.
Jointly-owned by:
- Bangor Hydro- Electric Company
- Central Maine Power Company
- Maine Public Service Company

(J5) Maine Yankee Atomic Power Company
Jointly-owned by:
- Bangor Hydro-Electric Company
- Cambridge Electric Light Company
- Central Maine Power Company
- Central Vermont Public Service Corporation
- Connecticut Light and Power Company, The
- Maine Public Service Company
- Montaup Electric Company
- New England Power Company
- Public Service Company of New Hampshire
- Western Massachusetts Electric Company

(J6) Ohio Valley Electric Corporation
Jointly-owned by:
- Allegheny Energy, Inc.
- American Electric Power Company, Inc.
- Cincinnati Gas & Electric Company, The
- Dayton Power and Light Company
- Kentucky Utilities Company
- Louisville Gas and Electric Company
- Ohio Edison Company
- Southern Indiana Gas and Electric Company
- Toledo Edison Company, The

(J7) Safe Harbor Water Power Corporation
Jointly-owned by:
- Baltimore Gas and Electric Company
- PPL Utilities.

(J8) Southern Electric Generating Company
Jointly-owned by:
- Alabama Power Company
- Georgia Power Company

(J9) Vermont Electric Power Company, Inc.
Jointly-owned by:
- Central Vermont Public Service Corporation
- Citizens Utilities Company
- Green Mountain Power Corporation

(J10) Vermont Yankee Nuclear Power Corporation
Jointly-owned by:
- Cambridge Electric Light Company
- Central Maine Power Company
- Central Vermont Public Service Corporation
- Connecticut Light and Power Company, The
- Maine Public Service Company
- Montaup Electric Company
- New England Power Company
- Public Service Company of New Hampshire
- Western Massachusetts Electric Company

(J11) Wisconsin River Power Company
Jointly-owned by:
- Alliant Energy/Wisconsin Power & Light Co.
- Consolidated Paper, Inc.
- Wisconsin Public Service Corporation

(J12) Wolf Creek Nuclear Operating Corporation
Jointly-owned by:
- Kansas City Power & Light Company
- Kansas Electric Power Cooperative, Inc.
- Western Resources, Inc.

(J13) Yankee Atomic Electric Company
Jointly-owned by:
- Boston Edison Company
- Cambridge Electric Light Company
- Central Maine Power Company
- Central Vermont Public Service Corporation
- Commonwealth Electric Company
- Connecticut Light and Power Company, The
- Montaup Electric Company
- New England Power Company
- Public Service Company of New Hampshire
- Western Massachusetts Electric Company

INVESTOR-OWNED ELECTRIC UTILITY COMPANIES OPERATING IN THE UNITED STATES

ALABAMA (AL)

Alabama Power Company (SO) 600 North 18th Street Birmingham, AL 35203-0001 (205) 257-1000	Customers: Sales (MWh): Revenues ($000):	1,303,541 50,157,204 2,811,117
Southern Electric Generating Company (SO) (J8) 600 North 18th Street Birmingham, AL 35203-2200 (205) 257-1000		Wholesale Only

Alabama Totals	**1999**
Total Ultimate Customers:	**1,303,541**
Total Sales to Ultimate Customers (MWh):	**50,157,204**
Total Revenues from Sales to Ultimate Customers ($000):	**2,811,117**

ALASKA (AK)

Alaska Electric Light and Power Company (AER) 5601 Tonsgard Court Juneau, AK 99801-7201 (907) 780-2222	Customers: Sales (MWh): Revenues ($000):	14,443 298,983 24,934
Alaska Power and Telephone Company, Inc. See WA	Customers: Sales (MWh): Revenues ($000):	5,269 58,910 7,067
Bethel Utilities Corporation, Inc. 3380 C Street, Suite 210 Anchorage, AK 99503 (907) 562-2500	Customers: Sales (MWh): Revenues ($000):	2,279 36,472 7,136
McGrath Light and Power Company P.O. Box 52 McGrath, AK 99627 (907) 524-3009	Customers: Sales (MWh): Revenues ($000):	235 2,861 1,126
Pelican Utility Company P.O. Box 110 Pelican, AK 99832 (907) 735-2204	Customers: Sales (MWh): Revenues ($000):	201 2,103 296

Alaska Totals	**1999**
Total Ultimate Customers:	**22,427**
Total Sales to Ultimate Customers (MWh):	**399,329**
Total Revenues from Sales to Ultimate Customers ($000):	**40,559**

ARIZONA (AZ)

Arizona Public Service Company (PNW) 400 North 5th Street Phoenix, AZ 85004 (602) 250-1000	Customers: Sales (MWh): Revenues ($000):	806,569 20,961,836 1,716,236
Citizens Utilities Company See CT	Customers: Sales (MWh): Revenues ($000):	65,694 1,116,563 97,911
Tucson Electric Power Company (UNS) 220 West Sixth Street Tucson, AZ 85701-1093 (520) 571-4000	Customers: Sales (MWh): Revenues ($000):	329,778 7,789,068 629,901

Arizona Totals	**1999**
Total Ultimate Customers:	**1,202,041**
Total Sales to Ultimate Customers (MWh):	**29,867,467**
Total Revenues from Sales to Ultimate Customers ($000):	**2,444,048**

ARKANSAS (AR)

Empire District Electric Company, The See MO	Customers: Sales (MWh): Revenues ($000):	3,667 125,573 6,034
Entergy Arkansas, Inc. (EC) 425 West Capitol Avenue Little Rock, AR 72201-3439 (501) 377-4000 Also serves in TN Company Totals: Customers: 637,244 Sales: 18,663,671 Revenues: 1,172,352	Customers: Sales (MWh): Revenues ($000):	637,202 18,663,431 1,172,328
OG&E Electric Services (OGE) See OK	Customers: Sales (MWh): Revenues ($000):	59,517 2,421,657 99,820
* Southwestern Electric Power Company (AEP) *(Operates as AEP-Southwestern Electric Power)* See LA	Customers: Sales (MWh): Revenues ($000):	98,439 3,547,222 170,840

Arkansas Totals	**1999**
Total Ultimate Customers:	**798,825**
Total Sales to Ultimate Customers (MWh):	**24,757,883**
Total Revenues from Sales to Ultimate Customers ($000):	**1,449,022**

*Effective June 15, 2000, Central and SouthWest Corporation and its subsidiaries, Central Power & Light Co., Public Service Company of Oklahoma, Southwestern Electric Power Co. and West Texas Utilities Co., merged with American Electric Power, Inc. and its nine investor-owned electric utility subsidiaries. The former Central and SouthWest subsidiaries are wholly-owned subsidiaries of American Electric Power, Inc.

CALIFORNIA (CA)

Pacific Gas and Electric Company (PCG) 77 Beale Street San Francisco, CA 94177 (415) 973-7000	Customers: Sales (MWh): Revenues ($000):	4,535,909 70,186,749 6,785,994
* PacifiCorp (SPI) *(Operates as Pacific Power)* See OR	Customers: Sales (MWh): Revenues ($000):	41,473 778,531 53,324
San Diego Gas & Electric Company (SRE) 101 Ash Street San Diego, CA 92101-3017 (619) 696-2000	Customers: Sales (MWh): Revenues ($000):	1,184,844 14,718,306 1,415,141
Sierra Pacific Power Company (SPR) See NV	Customers: Sales (MWh): Revenues ($000):	43,877 506,280 38,826
Southern California Edison Company (EIX) 2244 Walnut Grove Avenue Rosemead, CA 91770-3714 (626) 302-1212	Customers: Sales (MWh): Revenues ($000):	4,213,562 67,206,530 6,692,164
Southern California Water Company (AWR) 630 East Foothill Boulevard San Dimas, CA 91773 (909) 394-3600	Customers: Sales (MWh): Revenues ($000):	20,988 127,135 13,275

California Totals	1999
Total Ultimate Customers:	10,040,653
Total Sales to Ultimate Customers (MWh):	153,523,531
Total Revenues from Sales to Ultimate Customers ($000):	14,998,724

COLORADO (CO)

** Public Service Company of Colorado (XEL) 1225 17th Street Denver, CO 80202-5533 (303) 571-7511	Customers: Sales (MWh): Revenues ($000):	1,194,847 23,337,607 1,375,599
UtiliCorp United Inc. See MO	Customers: Sales (MWh): Revenues ($000):	80,155 1,517,589 87,424

* Effective November 30, 1999, PacifiCorp was acquired by and became a wholly-owned subsidiary of ScottishPower Group.

** New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Co., Public Service Company of Colorado and Southwestern Public Service Co. merged with Northern States Power Co. (MN) and its subsidiary, Northern States Power Co. (WI), under a new holding company, Xcel Energy Inc.

COLORADO (CO) (cont'd)

Colorado Totals	1999
Total Ultimate Customers:	1,275,002
Total Sales to Ultimate Customers (MWh):	24,855,196
Total Revenues from Sales to Ultimate Customers ($000):	1,463,023

CONNECTICUT (CT)

Citizens Utilities Company
Three High Ridge Park, P.O. Box 3801
Stamford, CT 06905
(203) 329-8800
Serves in AZ, HI and VT
Company Totals: Customers: 116,055
Sales: 1,803,847
Revenues: 199,947

Customers: -0-
Sales (MWh): -0-
Revenues ($000): -0-

Connecticut Light and Power Company, The (NU)
107 Selden Street
Berlin, CT 06037-1616
(860) 665-5000

Customers: 1,120,816
Sales (MWh): 22,315,405
Revenues ($000): 2,190,813

Connecticut Yankee Atomic Power Company (J2)
107 Selden Street
Berlin, CT 06037-1616
(860) 665-5000

Wholesale Only (Nuclear)

United Illuminating Company, The (UIL)
157 Church Street
New Haven, CT 06506-0901
(203) 499-2000

Customers: 315,674
Sales (MWh): 5,652,050
Revenues ($000): 639,596

Connecticut Totals	1999
Total Ultimate Customers:	1,436,490
Total Sales to Ultimate Customers (MWh):	27,967,455
Total Revenues from Sales to Ultimate Customers ($000):	2,830,409

DELAWARE (DE)

Delmarva Power & Light Company (CIV)
(Operates as Conectiv Power Delivery)
800 King Street
Wilmington, DE 19899-0231
(800) 266-3284
Also serves in MD and VA
Company Totals: Customers: 459,830
Sales: 12,363,783
Revenues: 894,277

Customers: 264,269
Sales (MWh): 8,242,796
Revenues ($000): 571,874

DELAWARE (DE) (cont'd)

Delaware Totals	1999
Total Ultimate Customers:	264,269
Total Sales to Ultimate Customers (MWh):	8,242,796
Total Revenues from Sales to Ultimate Customers ($000):	571,874

DISTRICT OF COLUMBIA (DC)

Potomac Electric Power Company
(Operates as Pepco)
1900 Pennsylvania Avenue, N.W.
Washington, DC 20068-0001
(202) 833-7500
Also serves in MD
Company Totals: Customers: 696,243
Sales: 24,209,242
Revenues: 1,788,040

Customers: 219,923
Sales (MWh): 10,417,813
Revenues ($000): 776,523

District of Columbia Totals	1999
Total Ultimate Customers:	219,923
Total Sales to Ultimate Customers (MWh):	10,417,813
Total Revenues from Sales to Ultimate Customers ($000):	776,523

FLORIDA (FL)

Florida Power Corporation (FPC)
One Progress Plaza
St. Petersburg, FL 33701
(727) 820-5151

Customers: 1,371,188
Sales (MWh): 33,441,029
Revenues ($000): 2,361,848

Florida Power & Light Company (FPL)
9250 West Flagler Street
Miami, FL 33174-3414
(305) 552-3552

Customers: 3,756,012
Sales (MWh): 84,450,082
Revenues ($000): 5,830,116

Florida Public Utilities Company
401 S. Dixie
West Palm Beach, FL 33401
(561) 832-2461

Customers: 24,640
Sales (MWh): 719,070
Revenues ($000): 38,377

Gulf Power Company (SO)
One Energy Place
Pensacola, FL 32520-0102
(850) 444-6111

Customers: 360,111
Sales (MWh): 9,559,183
Revenues ($000): 512,760

Tampa Electric Company (TE)
702 North Franklin Street
Tampa, FL 33602-4418
(813) 228-4111

Customers: 543,661
Sales (MWh): 15,804,958
Revenues ($000): 1,100,103

FLORIDA (FL) (cont'd)

Florida Totals	**1999**
Total Ultimate Customers:	**6,055,612**
Total Sales to Ultimate Customers (MWh):	**143,974,322**
Total Revenues from Sales to Ultimate Customers ($000):	**9,843,204**

GEORGIA (GA)

Georgia Power Company (SO) 241 Ralph McGill Blvd., NE Atlanta, GA 30308-3374 (404) 506-6526	Customers: Sales (MWh): Revenues ($000):	1,854,311 70,972,000 4,129,088
Savannah Electric and Power Company (SO) 600 East Bay Street Savannah, GA 31401-1286 (912) 644-7171	Customers: Sales (MWh): Revenues ($000):	127,844 3,712,902 238,804

Georgia Totals	**1999**
Total Ultimate Customers:	**1,982,155**
Total Sales to Ultimate Customers (MWh):	**74,684,902**
Total Revenues from Sales to Ultimate Customers ($000):	**4,367,892**

HAWAII (HI)

Citizens Utilities Company See CT	Customers: Sales (MWh): Revenues ($000):	30,031 396,112 77,798
Hawaii Electric Light Company, Inc. (HEI) 1200 Kilauea Avenue Hilo, HI 96720-4206 (808) 935-1171	Customers: Sales (MWh): Revenues ($000):	61,795 922,352 158,962
Hawaiian Electric Company, Inc. (HEI) 900 Richards Street Honolulu, HI 96813-2919 (808) 543-7771	Customers: Sales (MWh): Revenues ($000):	273,968 6,997,936 729,557
Maui Electric Company, Ltd. (HEI) 210 West Kamehameha Avenue Kahului, HI 96732 (808) 871-8461	Customers: Sales (MWh): Revenues ($000):	55,787 1,064,739 156,808

Hawaii Totals	**1999**
Total Ultimate Customers:	**421,581**
Total Sales to Ultimate Customers (MWh):	**9,381,139**
Total Revenues from Sales to Ultimate Customers ($000):	**1,123,125**

IDAHO (ID)

Avista Corp.
See WA

Customers:	102,050
Sales (MWh):	3,159,378
Revenues ($000):	139,841

Idaho Power Company (IDA)
1221 West Idaho Street
Boise, ID 83702-5610
(208) 388-2200
Also serves in NV and OR

Company Totals:	Customers:	378,402
	Sales:	13,765,885
	Revenues:	516,151

Customers:	360,021
Sales (MWh):	13,077,842
Revenues ($000):	489,568

PacifiCorp (SPI)
(Operates as Utah Power)
See OR

Customers:	54,326
Sales (MWh):	3,038,426
Revenues ($000):	117,802

Idaho Totals	1999
Total Ultimate Customers:	516,397
Total Sales to Ultimate Customers (MWh):	19,275,646
Total Revenues from Sales to Ultimate Customers ($000):	747,211

ILLINOIS (IL)

Alliant Energy/Interstate Power Company (LNT)
See IA

Customers:	11,081
Sales (MWh):	349,252
Revenues ($000):	16,668

AmerenCIPS (AEE)
607 East Adams Street
Springfield, IL 62739-0001
(217) 523-3600

Customers:	319,339
Sales (MWh):	8,538,572
Revenues ($000):	544,132

AmerenUE (AEE)
See MO

Customers:	62,359
Sales (MWh):	3,621,194
Revenues ($000):	144,152

* Central Illinois Light Company (AES)
300 Liberty Street
Peoria, IL 61602-1404
(309) 672-5271

Customers:	198,091
Sales (MWh):	5,910,714
Revenues ($000):	347,075

** Commonwealth Edison Company (EXE)
One First National Plaza
10 South Dearborn Street
Chicago, IL 60690
(312) 394-4321

Customers:	3,475,519
Sales (MWh):	83,500,597
Revenues ($000):	6,175,861

* Effective October 18, 1999, CILCORP, Inc. and its subsidiary, Central Illinois Light Co. merged with AES Corporation. Central Illinois Light Co. is a wholly-owned subsidiary of AES Corporation.

** Effective October 20, 2000, Unicom Corp. and its subsidiaries, Commonwealth Edison Co. and Commonwealth Edison Company of Indiana merged with PECO Energy Co. and its subsidiaries, PECO Energy Power Co., Susquehanna Electric Co. and Susquehanna Power Co., under a new holding company, Exelon Corp.

ILLINOIS (IL) (cont'd)

Company		
Commonwealth Edison Company of Indiana (EXE) One First National Plaza Chicago, IL 60603 (312) 394-4321		Wholesale Only
Electric Energy, Inc. (J3) 2100 Portland Road Joppa, IL 62953-9999 (618) 543-7531 Serves in KY Company Totals: Customers: 1 Sales: 7,013,929 Revenues: 136,875	Customers: Sales (MWh): Revenues ($000):	-0- -0- -0-
* Illinois Power Company (DYN) 500 South 27th Street Decatur, IL 62521-2200 (217) 424-6600	Customers: Sales (MWh): Revenues ($000):	485,879 18,215,452 1,138,822
MidAmerican Energy Company (MEC) See IA	Customers: Sales (MWh): Revenues ($000):	83,956 1,662,889 105,794
Mt. Carmel Public Utility Company 316 Market Street Mt. Carmel, IL 62863-1519 (618) 262-5151	Customers: Sales (MWh): Revenues ($000):	5,629 139,582 9,474
North Counties Hydro-Electric Company 1030 Ridge Avenue Evanston, IL 62205		Wholesale Only
South Beloit Water, Gas and Electric Company (LNT) See WI	Customers: Sales (MWh): Revenues ($000):	7,650 210,734 10,527

Illinois Totals	**1999**
Total Ultimate Customers:	**4,649,503**
Total Sales to Ultimate Customers (MWh):	**122,148,986**
Total Revenues from Sales to Ultimate Customers ($000):	**8,492,505**

INDIANA (IN)

Company		
Indiana Michigan Power Company (AEP) *(operates as American Electric Power)* One Summit Square Fort Wayne, IN 46801-0060 (800) 311-4634 Also serves in MI Company Totals: Customers: 556,970 Sales: 18,339,892 Revenues: 1,039,934	Customers: Sales (MWh): Revenues ($000):	437,050 15,460,123 861,152

* Effective February 2, 2000, Illinova Corp. and its subsidiary, Illinois Power Co., merged with Dynegy Inc. Illinois Power Co. is a wholly-owned subsidiary of Dynegy Inc.

INDIANA (IN) (cont'd)

Indianapolis Power & Light Company (IPL) One Monument Circle Indianapolis, IN 46204-2936 (317) 261-8261	Customers: Sales (MWh): Revenues ($000):	430,052 13,848,628 748,570
Northern Indiana Public Service Company (NI) 5265 Hohman Avenue Hammond, IN 46320-1775 (219) 853-5200	Customers: Sales (MWh): Revenues ($000):	423,114 15,627,599 1,000,390
PSI Energy, Inc. (CIN) 1000 East Main Street Plainfield, IN 46168-1765 (317) 839-9611	Customers: Sales (MWh): Revenues ($000):	696,330 26,080,752 1,251,012
* Southern Indiana Gas and Electric Company (VVC) 20 NW Fourth Street Evansville, IN 47741-0001 (812) 465-5300	Customers: Sales (MWh): Revenues ($000):	125,185 5,110,945 242,317
West Harrison Gas & Electric Company (CIN) See OH	Customers: Sales (MWh): Revenues ($000):	384 7,242 560

Indiana Totals	**1999**
Total Ultimate Customers:	**2,112,115**
Total Sales to Ultimate Customers (MWh):	**76,135,289**
Total Revenues from Sales to Ultimate Customers ($000):	**4,104,001**

IOWA (IA)

Alliant Energy/IES Utilities Inc. (LNT) Alliant Tower, 200 First Street, SE Cedar Rapids, IA 52401-1409 (319) 398-4411	Customers: Sales (MWh): Revenues ($000):	342,636 10,454,840 593,690
Alliant Energy/Interstate Power Company (LNT) 1000 Main Street, P.O. Box 769 Dubuque, IA 52004-0769 (319) 582-5421 Also serves in IL and MN Company Totals: Customers: 166,780 Sales: 5,311,928 Revenues: 261,799	Customers: Sales (MWh): Revenues ($000):	115,714 4,205,350 195,559
Amana Society Service Company 708 49th Avenue Amana, IA 52203 (319) 622-3052	Customers: Sales (MWh): Revenues ($000):	847 92,302 4,423

* Effective March 31, 2000, SIGCORP, Inc. and its subsidiary, Southern Indiana Gas & Electric Company, merged with Indiana Energy and formed a new holding company, Vectren Corp.

IOWA (IA) (cont'd)

MidAmerican Energy Company (MEC)
666 Grand Avenue
Des Moines, IA 50309
(515) 242-4300
Also serves in IL and SD
Company Totals: Customers: 658,165
Sales: 16,007,300
Revenues: 1,024,652

Customers: 570,863
Sales (MWh): 14,226,720
Revenues ($000): 912,007

Iowa Totals	**1999**
Total Ultimate Customers:	**1,830,060**
Total Sales to Ultimate Customers (MWh):	**28,979,212**
Total Revenues from Sales to Ultimate Customers ($000):	**1,705,679**

KANSAS (KS)

Company		
Empire District Electric Company, The See MO	Customers: Sales (MWh): Revenues ($000):	10,231 218,935 12,403
Kansas City Power & Light Company See MO	Customers: Sales (MWh): Revenues ($000):	198,814 4,934,348 331,804
Kansas Gas and Electric Company (WRI) 201 North Market Street Wichita, KS 67201 (316) 383-8600	Customers: Sales (MWh): Revenues ($000):	286,714 8,607,403 558,734
* Southwestern Public Service Company (XEL) See TX	Customers: Sales (MWh): Revenues ($000):	1,493 22,332 1,356
UtiliCorp United Inc. See MO	Customers: Sales (MWh): Revenues ($000):	64,287 1,751,355 106,764
Western Resources, Inc. (WRI) 818 South Kansas Avenue Topeka, KS 66601-0889 (785) 575-6300	Customers: Sales (MWh): Revenues ($000):	340,989 8,996,335 466,374

* New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Co., Public Service Company of Colorado and Southwestern Public Service Co., merged with Northern States Power Co. (MN) and its subsidiary, Northern States Power Co. (WI), under a new holding company, Xcel Energy Inc.

KANSAS (KS) (cont'd)

Wolf Creek Nuclear Operating Corporation (J12) P.O. Box 411 Burlington, KS 66839-0411 (316) 364-8831	Wholesale Only (Nuclear)

Kansas Totals	**1999**
Total Ultimate Customers:	**902,528**
Total Sales to Ultimate Customers (MWh):	**24,530,708**
Total Revenues from Sales to Ultimate Customers ($000):	**1,477,435**

KENTUCKY (KY)

Company		
Berea College Utilities C.P.O. Box 2337 Berea, KY 40404 (606) 986-3451	Customers: Sales (MWh): Revenues ($000):	4,485 126,861 5,725
Electric Energy, Inc. (J3) See IL	Customers: Sales (MWh): Revenues ($000):	1 7,013,929 136,875
* Kentucky Power Company (AEP) *(operates as American Electric Power)* P.O. Box 1428 Ashland, KY 41105-1428 (800) 572-1113	Customers: Sales (MWh): Revenues ($000):	170,130 6,491,087 266,855
Kentucky Utilities Company (LGE) One Quality Street Lexington, KY 40507-1462 (606) 255-2100 Also serves in TN and VA Company Totals: Customers: 481,039 Sales: 16,307,546 Revenues: 638,959	Customers: Sales (MWh): Revenues ($000):	451,802 15,481,497 599,446
Louisville Gas and Electric Company (LGE) 220 W. Main Street Louisville, KY 40202-1395 (502) 627-2000	Customers: Sales (MWh): Revenues ($000):	365,149 11,203,916 559,791
Union Light, Heat & Power Company (CIN) 107 Brent Spence Square Covington, KY 41011-1433 (513) 381-2000	Customers: Sales (MWh): Revenues ($000):	121,514 3,711,708 204,559

* Effective June 15, 2000, Central and SouthWest Corporation and its subsidiaries, Central Power & Light Co., Public Service Company of Oklahoma, Southwestern Electric Power Co. and West Texas Utilities Co., merged with American Electric Power, Inc. and its nine investor-owned electric utility subsidiaries. The former Central and SouthWest subsidiaries are wholly-owned subsidiaries of American Electric Power, Inc.

KENTUCKY (KY) (cont'd)

Kentucky Totals	**1999**
Total Ultimate Customers:	**1,113,081**
Total Sales to Ultimate Customers (MWh):	**44,028,998**
Total Revenues from Sales to Ultimate Customers ($000):	**1,773,251**

LOUISIANA (LA)

Cleco Utility Group, Inc. (CNL) 2030 Donahue Ferry Road Pineville, LA 71360-5226 (318) 484-7400	Customers: Sales (MWh): Revenues ($000):	250,135 8,099,438 468,169
Entergy Gulf States, Inc. (EC) See TX	Customers: Sales (MWh): Revenues ($000):	337,944 19,515,257 1,020,542
Entergy Louisiana, Inc. (EC) 639 Loyola Avenue New Orleans, LA 70113-1704 (504) 576-4000	Customers: Sales (MWh): Revenues ($000):	634,997 29,095,658 1,686,442
Entergy New Orleans, Inc. (EC) 1600 Perdido Street Building 505 New Orleans, LA 70113-1704 (504) 670-3600	Customers: Sales (MWh): Revenues ($000):	189,477 5,896,732 393,928
* Southwestern Electric Power Company (AEP) *(Operates as AEP-Southwestern Electric Power)* 428 Travis Street Shreveport, LA 71101-3164 (318) 673-3000 Also serves in AR and TX Company Totals: Customers: 421,908 Sales: 16,049,294 Revenues: 776,476	Customers: Sales (MWh): Revenues ($000):	163,383 5,013,193 262,532

Louisiana Totals	**1999**
Total Ultimate Customers:	**1,575,936**
Total Sales to Ultimate Customers (MWh):	**67,620,278**
Total Revenues from Sales to Ultimate Customers ($000):	**3,831,613**

MAINE (ME)

Bangor Hydro-Electric Company 33 State Street Bangor, ME 04401 (207) 945-5621	Customers: Sales (MWh): Revenues ($000):	122,773 1,766,395 184,267

* See footnote for Kentucky Power Company on previous page.

MAINE (MN) (cont'd)

* Central Maine Power Company (NEG) 83 Edison Drive Augusta, ME 04336-0001 (207) 623-3521	Customers: Sales (MWh): Revenues ($000):	536,643 9,144,308 892,792
Maine Electric Power Company, Inc. (J4) 83 Edison Drive Augusta, ME 04336 (207) 623-3521		Transmission Only
Maine Public Service Company 209 State Street Presque Isle, ME 04769-2655 (207) 768-5811	Customers: Sales (MWh): Revenues ($000):	35,606 511,361 53,015
Maine Yankee Atomic Power Company (J5) 321 Old Ferry Road Wiscasset, ME 04578-0408 (207) 882-6321		Wholesale Only (Nuclear)

Maine Totals	**1999**
Total Ultimate Customers:	**695,022**
Total Sales to Ultimate Customers (MWh):	**11,422,064**
Total Revenues from Sales to Ultimate Customers ($000):	**1,130,074**

MARYLAND (MD)

Allegheny Generating Company (J1) 10435 Downsville Pike Hagerstown, MD 21740-1966 (301) 790-3400		Wholesale Only
Baltimore Gas and Electric Company (CEG) 39 West Lexington Street Baltimore, MD 21201 (410) 234-5000	Customers: Sales (MWh): Revenues ($000):	1,126,035 29,264,078 2,118,845
Delmarva Power & Light Company (CIV) (Operates as Conectiv Power Delivery) See DE	Customers: Sales (MWh): Revenues ($000):	175,541 3,772,336 294,092
Potomac Edison Company, The (AYE) *(operates as Allegheny Power)* 10435 Downsville Pike Hagerstown, MD 21740-1766 (301) 790-3400 Also serves in VA and WV Company Totals: Customers: 394,515 Sales: 12,835,897 Revenues: 715,280	Customers: Sales (MWh): Revenues ($000):	208,875 8,256,426 434,075

* Effective September 1, 2000, CMP Group, Inc. and its subsidiary, Central Maine Power Co., merged with Energy East Corp. and its subsidiary, New York State Electric & Gas Corp. Central Maine Power Co. is a wholly-owned subsidiary of Energy East Corp.

MARYLAND (MD) (cont'd)

Potomac Electric Power Company *(Operates as Pepco)* See DC	Customers: Sales (MWh): Revenues ($000):	476,320 13,791,429 1,011,517

Maryland Totals **1999**

Total Ultimate Customers:	**1,986,771**
Total Sales to Ultimate Customers (MWh):	**55,084,269**
Total Revenues from Sales to Ultimate Customers ($000):	**3,858,529**

MASSACHUSETTS (MA)

Boston Edison Company (NST) 800 Boylston Street Boston, MA 02199-8003 (617) 424-2000	Customers: Sales (MWh): Revenues ($000):	676,915 12,864,155 1,338,479
Cambridge Electric Light Company (NST) 46 Blackstone Street Cambridge, MA 02139-3710 (617) 225-4808	Customers: Sales (MWh): Revenues ($000):	45,749 1,377,503 104,801
Canal Electric Company (NST) Nine Freezer Road Sandwich, MA 02563 (508) 833-8522		Wholesale Only
Commonwealth Electric Company (NST) 2421 Cranberry Highway Wareham, MA 02571-1091 (508) 291-0950	Customers: Sales (MWh): Revenues ($000):	325,389 3,665,492 391,027
* Eastern Edison Company (NGG) 750 West Center Street West Bridgewater, MA 02379 (508) 559-2000	Customers: Sales (MWh): Revenues ($000):	195,760 2,827,205 243,928
Fitchburg Gas and Electric Light Company (UNT) 285 John Fitch Highway Fitchburg, MA 01420 (888) 301-7700	Customers: Sales (MWh): Revenues ($000):	25,879 502,612 52,118
Holyoke Power and Electric Company (NU) One Canal Street Holyoke, MA 01040-5883 (413) 536-5520		Wholesale Only
Holyoke Water Power Company (NU) One Canal Street Holyoke, MA 01040-5883 (413) 536-5520	Customers: Sales (MWh): Revenues ($000):	32 95,883 5,897

* Effective April 19, 2000, National Grid USA and its subsidiaries, Granite State Electric Co., Massachusetts Electric Co., Narragansett Electric Co., and Nantucket Electric Co., merged with Eastern Utilities Associates and its subsidiaries, Blackstone Valley Electric Co., Eastern Edison Co., Newport Electric Corp. Under terms of the merger, Eastern Edison Co. is part of Massachusetts Electric Co. while Blackstone Valley Electric Co. and Newport Electric Corp. are part of Narragansett Electric Co.

MASSACHUSETTS (MA) (cont'd)

* Massachusetts Electric Company (NGG) 25 Research Drive Westborough, MA 01582-0001 (508) 389-2000	Customers: Sales (MWh): Revenues ($000):	981,469 15,657,428 1,259,428
Montaup Electric Company (NGG) 1606 Riverside Avenue Somerset, MA 02726 (508) 559-2000		Wholesale Only
** Nantucket Electric Company (NGG) Two Fairgrounds Road Nantucket, MA 02554 (508) 325-8000	Customers: Sales (MWh): Revenues ($000):	10,298 109,409 12,949
** New England Hydro-Transmission Electric Company, Inc. (NGG) 25 Research Drive Westborough, MA 01582 (508) 389-2000		Transmission Only
** New England Power Company (NGG) 25 Research Drive Westborough, MA 01582-0001 (508) 389-2000 Also has wholesale operations in NH	Customers: Sales (MWh): Revenues ($000):	-0- -0- -0-
Western Massachusetts Electric Company (NU) 174 Brush Hill Avenue West Springfield, MA 01090 (413) 785-5871	Customers: Sales (MWh): Revenues ($000):	197,996 3,885,392 358,434
Yankee Atomic Electric Company (J13) 19 Midstate Drive Auburn, MA 01501-1858 (978) 779-9822		Wholesale Only (Nuclear)

Massachusetts Totals	1999
Total Ultimate Customers:	2,459,487
Total Sales to Ultimate Customers (MWh):	40,985,079
Total Revenues from Sales to Ultimate Customers ($000):	3,767,061

MICHIGAN (MI)

Alpena Power Company 310 North Second Avenue Alpena, MI 49707-2883 (517) 356-2293	Customers: Sales (MWh): Revenues ($000):	16,538 310,181 19,904

* See footnote for Eastern Edison Company on previous page.

** Effective March 22, 2000, New England Electric System (NEES) and its subsidiaries, Granite State Electric Co., Massachusetts Electric Co., Montaup Electric Co., Nantucket Electric Co., Narragansett Electric Co., New England Power Co., New England Electric Transmission Corp., New England Hydro-Transmission Corp., and New England Hydro-Transmission Electric Co., merged with National Grid Group plc. Under terms of the merger, the former NEES subsidiaries will be part of National Grid USA, a subsidiary of National Grid Group plc.

MICHIGAN (MI) (cont'd)

Consumers Energy (CMS) 212 West Michigan Avenue Jackson, MI 49201-2276 (517) 788-0550	Customers: Sales (MWh): Revenues ($000):	1,651,437 35,754,796 2,498,266
Detroit Edison Company, The (DTE) 2000 Second Avenue Detroit, MI 48226-1279 (313) 235-8000	Customers: Sales (MWh): Revenues ($000):	2,078,607 49,822,240 3,791,116
Edison Sault Electric Company (WEC) 725 East Portage Avenue Sault Ste. Marie, MI 49783-2439 (906) 632-2221	Customers: Sales (MWh): Revenues ($000):	21,469 646,408 33,505
Indiana Michigan Power Company (AEP) *(operates as American Electric Power)* See IN	Customers: Sales (MWh): Revenues ($000):	119,920 2,879,769 178,782
Mid-State Service Company 924 Grandville S.W. Grand Rapids, MI 49093 (616) 454-1481		Wholesale Only
* Northern States Power Company - WI (XEL) See WI	Customers: Sales (MWh): Revenues ($000):	9,270 137,989 8,896
Upper Peninsula Power Company (WPS) 600 Lakeshore Drive Houghton, MI 49931 (906) 487-5000	Customers: Sales (MWh): Revenues ($000):	62,709 738,872 56,032
Wisconsin Electric Power Company (WEC) See WI	Customers: Sales (MWh): Revenues ($000):	25,467 2,923,501 104,691
Wisconsin Public Service Corporation (WPS) See WI	Customers: Sales (MWh): Revenues ($000):	8,694 315,341 12,839
Wolverine Power Corporation Box 147 Edenville, MI 48620 (517) 689-3161		Wholesale Only

Michigan Totals	1999
Total Ultimate Customers:	3,994,111
Total Sales to Ultimate Customers (MWh):	93,529,097
Total Revenues from Sales to Ultimate Customers ($000):	6,704,031

* New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Company, Public Service Company of Colorado and Southwestern Public Service Company merged with Northern States Power Company (MN) and its subsidiary, Northern States Power Company (WI) under a new holding company, Xcel Energy Inc.

MINNESOTA (MN)

Alliant Energy/Interstate Power Company (LNT) See IA	Customers: Sales (MWh): Revenues ($000):	39,985 757,326 49,572
Minnesota Power (ALE) 30 West Superior Street Duluth, MN 55802-2093 (218) 722-2641	Customers: Sales (MWh): Revenues ($000):	126,195 8,429,549 354,497
* Northern States Power Company (XEL) 414 Nicollet Mall Minneapolis, MN 55401-1993 (612) 330-5500 Also serves in ND and SD Company Totals: Customers: 1,281,491 Sales: 31,645,688 Revenues: 1,922,997	Customers: Sales (MWh): Revenues ($000):	1,128,693 28,291,721 1,730,560
Northwestern Wisconsin Electric Company See WI	Customers: Sales (MWh): Revenues ($000):	97 503 44
Otter Tail Power Company 215 Cascade Street Fergus Falls, MN 56537-2897 (218) 739-8200 Also serves in ND and SD Company Totals: Customers: 125,952 Sales: 3,393,860 Revenues: 183,478	Customers: Sales (MWh): Revenues ($000):	57,590 1,754,138 93,264

Minnesota Totals	1999
Total Ultimate Customers:	1,352,560
Total Sales to Ultimate Customers (MWh):	39,233,237
Total Revenues from Sales to Ultimate Customers ($000):	2,227,937

MISSISSIPPI (MS)

Entergy Mississippi, Inc. (EC) 308 East Pearl Street Jackson, MS 39201-2670 (601) 969-2684	Customers: Sales (MWh): Revenues ($000):	392,876 12,517,845 737,120
Mississippi Power Company (SO) 2992 West Beach Boulevard Gulfport, MS 39501-1952 (228) 864-1211	Customers: Sales (MWh): Revenues ($000):	189,558 9,543,133 469,434
System Energy Resources, Inc. (EC) 1340 Echelon Parkway Jackson, MS 39213 (601) 368-5000		Wholesale Only (Nuclear)

* See footnote for Northern States Power Co. (WI) on previous page.

MISSISSIPPI (MS) (cont'd)

Mississippi Totals	1999
Total Ultimate Customers:	582,434
Total Sales to Ultimate Customers (MWh):	22,060,978
Total Revenues from Sales to Ultimate Customers ($000):	1,206,554

MISSOURI (MO)

AmerenUE (AEE)
1901 Chouteau Avenue
St. Louis, MO 63103-3003
(314) 621-3222
Also serves in IL
Company Totals: Customers: 1,164,127
Sales: 33,565,723
Revenues: 2,036,863

Customers: 1,101,768
Sales (MWh): 29,944,529
Revenues ($000): 1,892,711

Empire District Electric Company, The
602 Joplin Street
Joplin, MO 64801
(417) 625-5100
Also serves in AR, KS and OK
Company Totals: Customers: 145,846
Sales: 3,859,166
Revenues: 219,512

Customers: 126,496
Sales (MWh): 3,397,896
Revenues ($000): 194,029

Kansas City Power & Light Company
1201 Walnut
Kansas City, MO 64106-2124
(816) 556-2200
Also serves in KS
Company Totals: Customers: 457,207
Sales: 13,342,151
Revenues: 838,641

Customers: 258,393
Sales (MWh): 8,407,803
Revenues ($000): 506,837

St. Joseph Light & Power Company
520 Francis Street
St. Joseph, MO 64502
(816) 233-8888

Customers: 62,495
Sales (MWh): 1,667,937
Revenues ($000): 87,028

UtiliCorp United Inc.
20 West Ninth Street
Kansas City, MO 64105-1711
(816) 421-6600
Also serves in CO and KS
Company Totals: Customers: 374,683
Sales: 8,121,358
Revenues: 505,765

Customers: 202,042
Sales (MWh): 4,456,267
Revenues ($000): 284,691

Missouri Totals	1999
Total Ultimate Customers:	1,751,194
Total Sales to Ultimate Customers (MWh):	47,874,432
Total Revenues from Sales to Ultimate Customers ($000):	2,965,296

MONTANA (MT)

Avista Corp. See WA	Customers: Sales (MWh): Revenues ($000):	17 295 16
Black Hills Corporation See SD	Customers: Sales (MWh): Revenues ($000):	39 12,929 618
MDU Resources Group, Inc. See ND	Customers: Sales (MWh): Revenues ($000):	23,524 498,495 28,432
Montana Power Company, The 40 East Broadway Butte, MT 59701-9394 (406) 497-3000 Also serves in WY Company Totals: Customers: 284,197 Sales: 5,326,478 Revenues: 332,304	Customers: Sales (MWh): Revenues ($000):	283,759 5,300,855 329,512
* PacifiCorp (SPI) See OR	Customers: Sales (MWh): Revenues ($000):	-0- -0- -0-

Montana Totals	1999
Total Ultimate Customers:	307,339
Total Sales to Ultimate Customers (MWh):	5,812,574
Total Revenues from Sales to Ultimate Customers ($000):	358,578

NEBRASKA (NE)

No Investor-Owned Companies

NEVADA (NV)

Idaho Power Company (IDA) See ID	Customers: Sales (MWh): Revenues ($000):	1,248 50,126 1,749
Nevada Power Company (SPR) 6226 West Sahara Avenue Las Vegas, NV 89146 (702) 367-5000	Customers: Sales (MWh): Revenues ($000):	566,675 15,337,607 935,381
Panaca Power and Light Company P.O. Box 222 Panaca, NV 89042-0222 (702) 728-4422	Customers: Sales (MWh): Revenues ($000):	365 6,064 377

* No longer provides electric service in Montana

NEVADA (NV) (cont'd)

Sierra Pacific Power Company (SPR)
6100 Neil Road
Reno, NV 89511-1132
(775) 834-4011
Also serves in CA

Customers:	254,627
Sales (MWh):	7,926,186
Revenues ($000):	509,681

Company Totals:		
	Customers:	298,504
	Sales:	8,432,466
	Revenues:	548,507

Nevada Totals	1999
Total Ultimate Customers:	822,915
Total Sales to Ultimate Customers (MWh):	23,319,983
Total Revenues from Sales to Ultimate Customers ($000):	1,447,188

NEW HAMPSHIRE (NH)

Concord Electric Company (UNT)
One McGuire Street
Concord, NH 03301
(603) 224-2311

Customers:	27,358
Sales (MWh):	516,685
Revenues ($000):	45,428

Connecticut Valley Electric Company, Inc. (CV)
104 Pleasant Street
Claremont, NH 03743-2608
(800) 649-2877

Customers:	10,457
Sales (MWh):	167,643
Revenues ($000):	19,817

Exeter & Hampton Electric Company (UNT)
Six Liberty Lane West
Hampton, NH 03842
(603) 772-5916

Customers:	40,256
Sales (MWh):	558,048
Revenues ($000):	50,095

* Granite State Electric Company (NGG)
407 Miracle Mile
Lebanon, NH 03766-2637
(603) 443-4200

Customers:	37,031
Sales (MWh):	754,128
Revenues ($000):	59,802

** New England Power Company (NGG)
See MA

Wholesale Only

** New England Electric Transmission Corporation (NGG)
25 Research Drive
Westborough, MA 01582
(508) 389-2000

Transmission Only

* Effective April 19, 2000, National Grid USA and its subsidiaries, Granite State Electric Co., Massachusetts Electric Co., Narragansett Electric Co., and Nantucket Electric Co., merged with Eastern Utilities Associates and its subsidiaries, Blackstone Valley Electric Co., Eastern Edison Co., Newport Electric Corp. Under terms of the merger, Eastern Edison Co. is part of Massachusetts Electric Co. while Blackstone Valley Electric Co. and Newport Electric Corp. are part of Narragansett Electric Co.

** Effective March 22, 2000, New England Electric System (NEES) and its subsidiaries, Granite State Electric Co., Massachusetts Electric Co., Nantucket Electric Co., Narragansett Electric Co., New England Power Co., New England Electric Transmission Corp., New England Hydro-Transmission Corp., and New England Hydro-Transmission Electric Co., merged with National Grid Group plc. Under terms of the merger, the former NEES subsidiaries are part of National Grid USA, a subsidiary of National Grid Group plc.

NEW HAMPSHIRE (NH) (cont'd)

* New England Hydro-Transmission Corporation (NGG) 25 Research Drive Westborough, MA 01582 (508) 389-2000	Transmission Only	
Public Service Company of New Hampshire (NU) 1000 Elm Street Manchester, NH 03105 (603) 669-4000	Customers: Sales (MWh): Revenues ($000):	427,661 6,957,064 853,654

New Hampshire Totals	1999
Total Ultimate Customers:	542,763
Total Sales to Ultimate Customers (MWh):	8,953,568
Total Revenues from Sales to Ultimate Customers ($000):	1,028,796

NEW JERSEY (NJ)

Atlantic City Electric Company (CIV) (Operates as Conectiv Power Delivery) 6801 Black Horse Pike Egg Harbor Township, NJ 08234-4130 (800) 266-3284	Customers: Sales (MWh): Revenues ($000):	491,035 8,831,691 936,227
Deepwater Operating Company (CIV) 373 North Broadway Pennsville, NJ 08070 (800) 266-3284	Wholesale Only	
Jersey Central Power & Light Company (GPU) *(operates as GPU Energy)* 2800 Pottsville Pike Reading, PA 19605 (610) 929-3601	Customers: Sales (MWh): Revenues ($000):	989,126 18,951,186 2,010,735
Public Service Electric and Gas Company (PSEG) 80 Park Plaza Newark, NJ 07102-4106 (973) 430-7000	Customers: Sales (MWh): Revenues ($000):	1,991,609 40,289,444 3,873,893
Rockland Electric Company (ED) 82 East Allendale Road, Suite 8 Saddle River, NJ 07458 (201) 327-6900	Customers: Sales (MWh): Revenues ($000):	68,504 1,432,604 139,148

New Jersey Totals	1999
Total Ultimate Customers:	3,540,274
Total Sales to Ultimate Customers (MWh):	69,504,925
Total Revenues from Sales to Ultimate Customers ($000):	6,960,003

* Please see footnote for New England Power Co. on previous page.

NEW MEXICO (NM)

El Paso Electric Company See TX	Customers: Sales (MWh): Revenues ($000):	68,903 1,163,289 97,971
Public Service Company of New Mexico 414 Silver SW Albuquerque, NM 87102-2824 (505) 241-2700	Customers: Sales (MWh): Revenues ($000):	361,384 6,803,583 522,523
Southwestern Public Service Company (XEL) See TX	Customers: Sales (MWh): Revenues ($000):	102,982 3,033,224 131,965
Texas-New Mexico Power Company (TNP) See TX	Customers: Sales (MWh): Revenues ($000):	45,804 1,662,651 83,942

New Mexico Totals	1999
Total Ultimate Customers:	579,073
Total Sales to Ultimate Customers (MWh):	12,662,747
Total Revenues from Sales to Ultimate Customers ($000):	836,401

NEW YORK (NY)

Central Hudson Gas & Electric Corporation (CNH) 284 South Avenue Poughkeepsie, NY 12601-4823 (914) 452-2000	Customers: Sales (MWh): Revenues ($000):	270,847 4,562,393 387,836
Consolidated Edison Company of New York, Inc. (ED) 4 Irving Place New York, NY 10003-3502 (212) 460-4600	Customers: Sales (MWh): Revenues ($000):	3,054,693 32,630,506 4,500,992
Fishers Island Electric Corporation, The P.O. Box Drawer E Fishers Island, NY 06390 (516) 788-7543	Customers: Sales (MWh): Revenues ($000):	728 4,860 1,133
KeySpan Corporation (KSE) One MetroTech Center Brooklyn, NY 11201-3851 (718) 403-2000		Wholesale Only
Long Sault, Inc. P.O. Box 150 Massena, NY 13662		Transmission Only
* New York State Electric & Gas Corporation (NEG) 4500 Vestal Parkway East Binghamton, NY 13902 (607) 729-2551	Customers: Sales (MWh): Revenues ($000):	813,137 13,192,379 1,492,881

* Effective September 1, 2000, CMP Group, Inc. and its subsidiary, Central Maine Power Co. merged with Energy East Corp. and its subsidiary, New York State Electric & Gas Corp. Central Maine Power Co. is a wholly-owned subsidiary of Energy East Corp.

NEW YORK (NY) (cont'd)

Niagara Mohawk Power Corporation (NMK) 300 Erie Boulevard West Syracuse, NY 13202-4201 (315) 474-1511	Customers: Sales (MWh): Revenues ($000):	1,579,090 33,756,106 3,043,028
Orange and Rockland Utilities, Inc. (ED) One Blue Hill Plaza Pearl River, NY 10965-3199 (914) 352-6000	Customers: Sales (MWh): Revenues ($000):	202,947 3,509,266 332,249
Pennsylvania Electric Company (GPU) *(operates as GPU Energy)* See PA	Customers: Sales (MWh): Revenues ($000):	3,724 100,173 6,249
Rochester Gas and Electric Corporation (RGS) 89 East Avenue Rochester, NY 14649-0001 (716) 546-2700	Customers: Sales (MWh): Revenues ($000):	344,375 6,296,112 608,628

New York Totals	**1999**
Total Ultimate Customers:	**6,269,541**
Total Sales to Ultimate Customers (MWh):	**94,851,795**
Total Revenues from Sales to Ultimate Customers ($000):	**10,372,996**

NORTH CAROLINA (NC)

Carolina Power & Light Company (CPL) 411 Fayetteville Street Raleigh, NC 27601-1748 (919) 546-6111 Also serves in SC Company Totals: Customers: 1,199,456 Sales: 40,217,290 Revenues: 2,519,348	Customers: Sales (MWh): Revenues ($000):	1,036,839 33,310,362 2,106,227
* Duke Power (DUK) 422 South Church Street Charlotte, NC 28242-0001 (704) 594-0887 Also serves in SC Company Totals: Customers: 2,022,835 Sales: 74,109,763 Revenues: 4,093,115	Customers: Sales (MWh): Revenues ($000):	1,547,843 52,008,959 3,012,019
Nantahala Power & Light Company (DUK) 301 NPL Loop Franklin, NC 28734 (828) 369-4500	Customers: Sales (MWh): Revenues ($000):	NA NA NA
Virginia Electric and Power Company (DRI) *(Operates as Dominion North Carolina Power)* See VA	Customers: Sales (MWh): Revenues ($000):	106,410 3,175,734 206,880

* Includes data for Nantahala Power & Light Co., a subsidiary of Duke Power.

NORTH CAROLINA (NC) (cont'd)

North Carolina Totals	**1999**
Total Ultimate Customers:	**2,691,092**
Total Sales to Ultimate Customers (MWh):	**88,495,055**
Total Revenues from Sales to Ultimate Customers ($000):	**5,325,126**

NORTH DAKOTA (ND)

MDU Resources Group, Inc.
918 East Divide Avenue
Bismarck, ND 58501
(701) 222-7900
Also serves in MT, SD, and WY
Company Totals: Customers: 114,653
Sales: 2,075,446
Revenues: 130,932

Customers: 69,381
Sales (MWh): 1,231,510
Revenues ($000): 78,284

* Northern States Power Company (XEL)
See MN

Customers: 84,982
Sales (MWh): 1,901,262
Revenues ($000): 103,268

Otter Tail Power Company
See MN

Customers: 56,770
Sales (MWh): 1,381,934
Revenues ($000): 75,851

North Dakota Totals	**1999**
Total Ultimate Customers:	**211,133**
Total Sales to Ultimate Customers (MWh):	**4,514,706**
Total Revenues from Sales to Ultimate Customers ($000):	**257,403**

OHIO (OH)

AEP Generating Company (AEP)
1 Riverside Plaza
Columbus, OH 43215-2355
(614) 223-1000

Wholesale Only

Cincinnati Gas & Electric Company, The (CIN)
139 East Fourth Street
Cincinnati, OH 45202-4003
(513) 421-9500

Customers: 632,452
Sales (MWh): 20,070,826
Revenues ($000): 1,259,683

Cleveland Electric Illuminating Company, The (FE)
4140 Rockside Road
Independence, OH 44131
(216) 861-9000

Customers: 742,357
Sales (MWh): 20,021,621
Revenues ($000): 1,743,148

* New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Co., Public Service Company of Colorado and Southwestern Public Service Co., merged with Northern States Power Co. and its subsidiary, Northern States Power Co. (WI), under a new holding company, Xcel Energy Inc.

OHIO (OH) (cont'd)

Columbus Southern Power Company (AEP) *(operates as American Electric Power)* 700 Morrison Road Gahana, OH 43230 (614) 223-1000	Customers: Sales (MWh): Revenues ($000):	645,491 16,435,078 1,062,454
Dayton Power and Light Company, The (DPL) Courthouse Plaza, SW Dayton, OH 45402 (937) 224-6000	Customers: Sales (MWh): Revenues ($000):	492,061 14,315,947 964,329
Indiana-Kentucky Electric Corporation P.O. Box 468 Piketon, OH 45661-0468 (740) 289-7200		Wholesale Only
Miami Power Corporation (CIN) P.O. Box 128 North Bend, OH 45052 (513) 421-9500		Transmission Only
Monongahela Power Company (AYE) *(operates as Allegheny Power)* See WV	Customers: Sales (MWh): Revenues ($000):	28,592 1,653,971 63,562
Ohio Edison Company (FE) 76 South Main Street Akron, OH 44308-1890 (330) 384-5100	Customers: Sales (MWh): Revenues ($000):	982,772 24,946,704 2,093,478
Ohio Power Company (AEP) *(operates as American Electric Power)* 301 Cleveland Avenue SW Canton, OH 44702 (800) 277-2177	Customers: Sales (MWh): Revenues ($000):	685,577 31,982,889 1,393,498
Ohio Valley Electric Corporation (J6) P.O. Box 468 Piketon, OH 45661-0468 (740) 289-7200	Customers: Sales (MWh): Revenues ($000):	1 9,805,889 197,877
Toledo Edison Company, The (FE) 300 Madison Avenue Toledo, OH 43652-0001 (419) 249-5000	Customers: Sales (MWh): Revenues ($000):	300,275 9,866,345 762,405
West Harrison Gas & Electric Company (CIN) 139 East Fourth Street Cincinnati, OH 45202-4003 (513) 421-9500 Serves in IN Company Totals: Customers: 384 Sales: 7,242 Revenues: 560	Customers: Sales (MWh): Revenues ($000):	-0- -0- -0-

Ohio Totals	1999
Total Ultimate Customers:	4,509,578
Total Sales to Ultimate Customers (MWh):	149,099,270
Total Revenues from Sales to Ultimate Customers ($000):	9,540,434

1295

DOE002-1305

OKLAHOMA (OK)

Empire District Electric Company, The See MO	Customers: Sales (MWh): Revenues ($000):	5,452 116,762 7,046
OG&E Electric Services (OGE) 321 North Harvey Avenue Oklahoma City, OK 73102 (405) 553-3000 Also serves in AR Company Totals: Customers: 697,939 Sales: 21,916,854 Revenues: 1,191,079	Customers: Sales (MWh): Revenues ($000):	638,422 19,495,197 1,091,259
Public Service Company of Oklahoma (AEP) *(Operates as AEP-Public Service Company of Oklahoma)* 212 East 6th Street Tulsa, OK 74119-1212 (918) 599-2000	Customers: Sales (MWh): Revenues ($000):	490,855 15,615,999 691,685
Southwestern Public Service Company (XEL) See TX	Customers: Sales (MWh): Revenues ($000):	9,172 257,665 12,652

Oklahoma Totals	1999
Total Ultimate Customers:	1,143,901
Total Sales to Ultimate Customers (MWh):	35,485,623
Total Revenues from Sales to Ultimate Customers ($000):	1,802,642

OREGON (OR)

Idaho Power Company (IDA) See ID	Customers: Sales (MWh): Revenues ($000):	17,133 637,917 24,834
* PacifiCorp (SPI) *(Operates as Pacific Power)* 700 N.E. Multnomah, Suite 1600 Portland, OR 97232-4116 (503) 813-5000 Also serves in CA, ID, UT, WA and WY Company Totals: Customers: 1,449,207 Sales: 46,605,155 Revenues: 2,172,555	Customers: Sales (MWh): Revenues ($000):	486,185 13,693,677 719,847
Portland General Electric Company (ENE) 121 S.W. Salmon Street Portland, OR 97204-2977 (503) 464-8000	Customers: Sales (MWh): Revenues ($000):	714,130 19,258,992 973,326

* Effective November 30, 1999, PacifiCorp was acquired by and is a wholly-owned subsidiary of ScottishPower Group.

OREGON (OR) (cont'd)

Oregon Totals	**1999**
Total Ultimate Customers:	**1,217,448**
Total Sales to Ultimate Customers (MWh):	**33,590,586**
Total Revenues from Sales to Ultimate Customers ($000):	**1,718,007**

PENNSYLVANIA (PA)

Citizens' Electric Company
1775 Industrial Blvd.
Lewisburg, PA 17837
(717) 524-2231

Customers: 6,459
Sales (MWh): 154,521
Revenues ($000): 8,689

Duquesne Light Company (DQE)
411 Seventh Avenue
Pittsburgh, PA 15219-1905
(412) 393-6000

Customers: 468,494
Sales (MWh): 8,925,000
Revenues ($000): 782,274

Metropolitan Edison Company (GPU)
(operates as GPU Energy)
P.O. Box 16001
Reading, PA 19640-0001
(610) 929-3601

Customers: 460,014
Sales (MWh): 6,832,063
Revenues ($000): 573,978

* PECO Energy Company (EXE)
2301 Market Street
Philadelphia, PA 19103-1338
(215) 841-4000

Customers: 1,256,756
Sales (MWh): 23,593,639
Revenues ($000): 2,066,833

* PECO Energy Power Company (EXE)
2301 Market Street
Philadelphia, PA 19103-1338
(215) 841-4000

Leases Plant

Pennsylvania Electric Company (GPU)
(operates as GPU Energy)
2800 Pottsville Pike
Reading, PA 19605-2459
(610) 929-3601
Also serves in NY
Company Totals: Customers: 552,063
Sales: 8,190,632
Revenues: 612,166

Customers: 548,339
Sales (MWh): 8,090,459
Revenues ($000): 605,917

Pennsylvania Power Company (FE)
1 East Washington Street
New Castle, PA 16101-3814
(724) 652-5531

Customers: 139,142
Sales (MWh): 3,306,062
Revenues ($000): 240,158

Pike County Light & Power Company (ED)
219 1/2 Broad Street
Milford, PA 18337
(570) 296-6434

Customers: 4,199
Sales (MWh): 59,687
Revenues ($000): 5,508

* Effective October 20, 2000, Unicom Corp. and its subsidiaries, Commonwealth Edison Co. and Commonwealth Edison Company of Indiana, merged with PECO Energy Co. and its subsidiaries, PECO Energy Power Co., Susquehanna Electric Co. and Susquehanna Power Co., under a new holding company, Exelon Corp.

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PENNSYLVANIA (PA) (cont'd)

* PPL Utilities (PPL) Two North Ninth Street Allentown, PA 18101-1179 (610) 774-5151	Customers: Sales (MWh): Revenues ($000):	1,214,301 23,397,070 1,761,778
Safe Harbor Water Power Corporation (J7) One Powerhouse Road Conestoga, PA 17516-9651 (717) 872-5441		Wholesale Only
** Susquehanna Electric Company, The (EXE) 2301 Market Street Philadelphia, PA 19101 (215) 841-4000		Wholesale Only
** Susquehanna Power Company, The (EXE) 2301 Market Street Philadelphia, PA 19101 (215) 841-4000		Leases Plant
UGI Utilities, Inc. (UGI) 100 Kachel Boulevard, Suite 400 Reading, PA 19607 (610) 796-3400	Customers: Sales (MWh): Revenues ($000):	58,472 852,790 70,381
Wellsboro Electric Company 33 Austin Street Wellsboro, PA 16901 (570) 724-3516	Customers: Sales (MWh): Revenues ($000):	5,628 109,154 6,516
West Penn Power Company (AYE) *(operates as Allegheny Power)* 800 Cabin Hill Drive Greensburg, PA 15601-1689 (724) 837-3000	Customers: Sales (MWh): Revenues ($000):	662,551 17,281,530 931,763
York Haven Power Company (GPU) *(operates as GPU Energy)* 501 Parkway Boulevard York, PA 17403 (717) 848-7161		Wholesale Only

Pennsylvania Totals	1999
Total Ultimate Customers:	4,824,355
Total Sales to Ultimate Customers (MWh):	92,601,975
Total Revenues from Sales to Ultimate Customers ($000):	7,053,795

* Formerly PP&L, Inc.

** Please see footnote for PECO Energy Company on previous page.

RHODE ISLAND (RI)

* Blackstone Valley Electric Company (NGG) 642 George Washington Highway Lincoln, RI 02865 (508) 559-2000	Customers: Sales (MWh): Revenues ($000):	92,069 1,340,817 120,728
Block Island Power Company P.O. Box 518 Block Island, RI 02807 (401) 466-5851	Customers: Sales (MWh): Revenues ($000):	1,514 8,975 2,344
* Narragansett Electric Company, The (NGG) 280 Melrose Street Providence, RI 02907 (401) 784-7000	Customers: Sales (MWh): Revenues ($000):	335,202 4,692,777 413,925
* Newport Electric Corporation (NGG) 12 Turner Road Middletown, RI 02840-0011 (508) 559-2000	Customers: Sales (MWh): Revenues ($000):	34,966 570,679 59,336

Rhode Island Totals	**1999**
Total Ultimate Customers:	**463,751**
Total Sales to Ultimate Customers (MWh):	**6,613,248**
Total Revenues from Sales to Ultimate Customers ($000):	**596,333**

SOUTH CAROLINA (SC)

Carolina Power & Light Company See NC	Customers: Sales (MWh): Revenues ($000):	162,617 6,906,928 413,121
Duke Power (DUK) See NC	Customers: Sales (MWh): Revenues ($000):	474,992 22,100,804 1,081,096
Lockhart Power Company P.O. Box 10 Lockhart, SC 29364 (864) 545-2211	Customers: Sales (MWh): Revenues ($000):	6,102 224,327 11,770

* Effective April 19, 2000, National Grid USA and its subsidiaries, Granite State Electric Co., Massachusetts Electric Co., Narragansett Electric Co., and Nantucket Electric Co., merged with Eastern Utilities Associates and its subsidiaries, Blackstone Valley Electric Co., Eastern Edison Co., Newport Electric Corp. Under terms of the merger, Eastern Edison Co. is part of Massachusetts Electric Co. while Blackstone Valley Electric Co. and Newport Electric Corp. are part of Narragansett Electric Co.

SOUTH CAROLINA (SC) (cont'd)

* South Carolina Electric & Gas Company (SCG) 1426 Main Street Columbia, SC 29201 (803) 799-9000	Customers: Sales (MWh): Revenues ($000):	522,302 18,878,812 1,124,176
* South Carolina Generating Company, Inc. (SCG) 1426 Main Street Columbia, SC 29201 (803 799-9000		Wholesale Only

South Carolina Totals	1999
Total Ultimate Customers:	1,166,013
Total Sales to Ultimate Customers (MWh):	48,110,871
Total Revenues from Sales to Ultimate Customers ($000):	2,630,163

SOUTH DAKOTA (SD)

Black Hills Corporation 625 Ninth Street Rapid City, SD 57701-2693 (605) 721-1700 Also serves in MT and WY Company Totals: Customers: 57,456 Sales: 1,501,808 Revenues: 102,204	Customers: Sales (MWh): Revenues ($000):	55,030 1,362,869 94,026
MDU Resources Group, Inc. See ND	Customers: Sales (MWh): Revenues ($000):	8,808 123,534 9,958
MidAmerican Energy Company (MEC) See IA	Customers: Sales (MWh): Revenues ($000):	3,346 117,691 6,851
Northern States Power Company - MN (XEL) See MN	Customers: Sales (MWh): Revenues ($000):	67,816 1,452,705 89,169
Northwestern Corporation 125 South Dakota Avenue Sioux Falls, SD 57104-6403 (605) 978-2908	Customers: Sales (MWh): Revenues ($000):	56,844 1,111,728 76,434
Otter Tail Power Company See MN	Customers: Sales (MWh): Revenues ($000):	11,592 257,788 14,363

* SCANA Corporation and its subsidiary, South Carolina Electric & Gas Company, merged with Public Service Company of North Carolina, Inc. Public Service Company of North Carolina, Inc. operates as a wholly-owned subsidiary of SCANA Corporation.

SOUTH DAKOTA (SD) (cont'd)

South Dakota Totals	1999
Total Ultimate Customers:	203,436
Total Sales to Ultimate Customers (MWh):	4,426,315
Total Revenues from Sales to Ultimate Customers ($000):	290,801

TENNESSEE (TN)

Entergy Arkansas, Inc. (EC)
See AR

Customers: 42
Sales (MWh): 240
Revenues ($000): 24

Kentucky Utilities Company (LGE)
See KY

Customers: 5
Sales (MWh): 101
Revenues ($000): 2

Kingsport Power Company (AEP)
(operates as American Electric Power)
420 River Port Road
Kingsport, TN 37660
(800) 967-4237

Customers: 44,208
Sales (MWh): 1,804,152
Revenues ($000): 79,404

Tennessee Totals	1999
Total Ultimate Customers:	44,255
Total Sales to Ultimate Customers (MWh):	1,804,493
Total Revenues from Sales to Ultimate Customers ($000):	79,430

TEXAS (TX)

* Central Power and Light Company (AEP)
(Operates as AEP-Central Power and Light Company)
539 North Carancahua Street
Corpus Christi, TX 78401-0001
(512) 361-5300

Customers: 661,105
Sales (MWh): 21,303,608
Revenues ($000): 1,306,971

El Paso Electric Company
123 West Mills Street
El Paso, TX 79901-1341
(915) 543-5711
Also serves in NM
Company Totals: Customers: 294,811
Sales: 5,866,168
Revenues: 486,193

Customers: 225,908
Sales (MWh): 4,702,879
Revenues ($000): 388,222

* Effective June 15, 2000, Central and SouthWest Corporation and its subsidiaries, Central Power & Light Co., Public Service Company of Oklahoma, Southwestern Electric Power Co. And West Texas Utilities Co., merged with American Electric Power, Inc. and its nine investor-owned electric utility subsidiaries. The former Central and SouthWest subsidiaries are wholly-owned subsidiaries of American Electric Power, Inc.

TEXAS (TX) (cont'd)

Entergy Gulf States, Inc. (EC) 350 Pine Street Beaumont, TX 77701-2437 (409) 981-2000 Also serves in LA Company Totals: Customers: 664,043 Sales: 34,347,913 Revenues: 1,788,538	Customers: Sales (MWh): Revenues ($000):	326,099 14,832,656 767,996
Reliant Energy HL&P (REL) 1111 Louisiana Houston, TX 77002-5231 (713) 207-1111	Customers: Sales (MWh): Revenues ($000):	1,645,552 69,374,552 4,247,269
Southwestern Electric Power Company (AEP) See LA	Customers: Sales (MWh): Revenues ($000):	160,086 7,488,879 343,104
Southwestern Electric Service Company (TXU) 1601 Bryan Street Dallas, TX 75201 (214) 812-4600	Customers: Sales (MWh): Revenues ($000):	42,542 1,058,507 54,829
* Southwestern Public Service Company (XEL) 6th and Tyler Amarillo, TX 79170 (806) 378-2121 Also serves in KS, NM and OK Company Totals: Customers: 382,520 Sales: 9,248,086 Revenues: 600,729	Customers: Sales (MWh): Revenues ($000):	268,873 11,121,731 454,756
Texas-New Mexico Power Company (TNP) 4100 International Plaza Fort Worth, TX 76109-4896 (817) 731-0099 Also serves in NM Company Totals: Customers: 231,432 Sales: 9,248,086 Revenues: 535,664	Customers: Sales (MWh): Revenues ($000):	185,628 7,585,435 451,722
TXU Electric & Gas (TXU) 1601 Bryan Street Dallas, TX 75201-3411 (214) 812-4600	Customers: Sales (MWh): Revenues ($000):	2,537,010 95,927,336 5,851,857
** West Texas Utilities Company (AEP) 301 Cypress Street Abilene, TX 79601-5820 (915) 674-7000	Customers: Sales (MWh): Revenues ($000):	189,004 4,837,210 300,148

* New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Co., Public Service Company of Colorado and Southwestern Public Service Co., merged with Northern States Power Co. and its subsidiary, Northern States Power Co. (WI), under a new holding company, Xcel Energy Inc.

** See footnote for Central Power & Light Co. on previous page.

TEXAS (TX) (cont'd)

Texas Totals	**1999**
Total Ultimate Customers:	**6,241,807**
Total Sales to Ultimate Customers (MWh):	**238,232,793**
Total Revenues from Sales to Ultimate Customers ($000):	**14,166,874**

UTAH (UT)

PacifiCorp (SPI) *(Operates as Utah Power)* See OR	Customers: Sales (MWh): Revenues ($000):	630,968 17,846,211 826,839

Utah Totals	**1999**
Total Ultimate Customers:	**630,968**
Total Sales to Ultimate Customers (MWh):	**17,846,211**
Total Revenues from Sales to Ultimate Customers ($000):	**826,839**

VERMONT (VT)

Central Vermont Public Service Corporation (CV) 77 Grove Street Rutland, VT 05701-3403 (800) 649-2877	Customers: Sales (MWh): Revenues ($000):	141,103 2,172,798 251,540
Citizens Utilities Company See CT	Customers: Sales (MWh): Revenues ($000):	20,330 291,172 24,238
Green Mountain Power Corporation 163 Acorn Lane Colchester, VT 05446-6611 (802) 864-5731	Customers: Sales (MWh): Revenues ($000):	83,989 1,901,783 179,641
New England Power Company (NGG) See MA	Customers: Sales (MWh): Revenues ($000):	1 4,509 324
Rochester Electric Light & Power Company P.O. Box 6 Rochester, VT 05767 (802) 767-4291	Customers: Sales (MWh): Revenues ($000):	801 6,109 737
Vermont Electric Power Company, Inc. (J9) Pinnacle Ridge Avenue Rutland, VT 05701 (802) 773-9161		Transmission Only
Vermont Electric Transmission Company, Inc. Pinnacle Ridge Avenue Rutland, VT 05701 (802) 773-9161		Transmission Only

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VERMONT (VT) (cont'd)

Vermont Yankee Nuclear Power Corporation (J10)
185 Old Ferry Road
Brattleboro, VT 05302
(802) 257-5271

Wholesale Only (Nuclear)

Vermont Totals	1999
Total Ultimate Customers:	246,224
Total Sales to Ultimate Customers (MWh):	4,376,371
Total Revenues from Sales to Ultimate Customers ($000):	456,480

VIRGINIA (VA)

Appalachian Power Company (AEP)
(operates as American Electric Power)
40 Franklin Road SW
Roanoke, VA 24011
(800) 956-4237
Also serves in WV
Company Totals: Customers: 892,748
Sales: 27,933,324
Revenues: 1,292,237

Customers: 470,151
Sales (MWh): 14,874,789
Revenues ($000): 681,402

Delmarva Power & Light Company (CIV)
(Operates as Conectiv Power Delivery)
See DE

Customers: 20,020
Sales (MWh): 348,651
Revenues ($000): 28,311

Kentucky Utilities Company (LGE)
See KY

Customers: 29,232
Sales (MWh): 825,948
Revenues ($000): 39,511

Potomac Edison Company, The (AYE)
(operates as Allegheny Power)
See MD

Customers: 82,486
Sales (MWh): 2,257,350
Revenues ($000): 134,598

Virginia Electric and Power Company (DRI)
(Operates as Dominion Virginia Power)
7th & Cary Streets
Richmond, VA 23219-0001
(804) 771-3000
Also serves in NC
Company Totals: Customers: 2,047,938
Sales: 65,826,104
Revenues: 3,989,073

Customers: 1,941,528
Sales (MWh): 62,650,370
Revenues ($000): 3,782,193

Virginia Totals	1999
Total Ultimate Customers:	2,543,417
Total Sales to Ultimate Customers (MWh):	80,957,108
Total Revenues from Sales to Ultimate Customers ($000):	4,666,015

WASHINGTON (WA)

Alaska Power and Telephone Company, Inc.
191 Otto Street
Port Townsend, WA 98368-0922
(360) 385-1733
Serves in AK
Company Totals: Customers: 5,269; Sales: 58,910; Revenues: 7,067

Customers: -0-
Sales (MWh): -0-
Revenues ($000): -0-

Avista Corp.
1411 East Mission Avenue
Spokane, WA 99220
(509) 489-0500
Also serves in ID and MT
Company Totals: Customers: 306,527; Sales: 8,156,926; Revenues: 384,546

Customers: 204,460
Sales (MWh): 4,997,253
Revenues ($000): 244,689

PacifiCorp (SPI)
(Operates as Pacific Power)
See OR

Customers: 117,004
Sales (MWh): 3,997,992
Revenues ($000): 181,538

Puget Sound Energy, Inc.
411-108th Avenue, NE, 15th Floor
Bellevue, WA 98004-5515
(425) 454-6363

Customers: 899,902
Sales (MWh): 21,292,035
Revenues ($000): 1,269,286

Washington Totals	1999
Total Ultimate Customers:	1,221,366
Total Sales to Ultimate Customers (MWh):	30,287,280
Total Revenues from Sales to Ultimate Customers ($000):	1,695,513

WEST VIRGINIA (WV)

Appalachian Power Company (AEP)
(operates as American Electric Power)
See VA

Customers: 422,597
Sales (MWh): 13,058,535
Revenues ($000): 610,835

Black Diamond Power Company
P.O. Box 2109
Charleston, WV 25328
(304) 342-2721

Customers: 1,752
Sales (MWh): 18,058
Revenues ($000): 1,061

Elk Power Company
P.O. Box 2109
Charleston, WV 25328
(304) 342-2721

Customers: 1,756
Sales (MWh): 18,857
Revenues ($000): 1,250

Elkhorn Public Service Company
P.O. Box 2109
Charleston, WV 25328
(304) 342-2721

Customers: 206
Sales (MWh): 2,373
Revenues ($000): 151

WEST VIRGINIA (WV) (cont'd)

Kimball Light and Water Company P.O. Box 2109 Charleston, WV 25328 (304) 342-2721	Customers: Sales (MWh): Revenues ($000):	443 4,894 298
Monongahela Power Company (AYE) *(operates as Allegheny Power)* 1310 Fairmont Avenue Fairmont, WV 26555-1392 (304) 366-3000 Also serves in OH Company Totals: Customers: 357,198 Sales: 10,794,563 Revenues: 561,175	Customers: Sales (MWh): Revenues ($000):	328,606 9,140,592 497,613
Potomac Edison Company, The (AYE) *(operates as Allegheny Power)* See MD	Customers: Sales (MWh): Revenues ($000):	103,154 2,322,121 146,607
Union Power Company P.O. Box 2109 Charleston, WV 25328 (304) 342-2721	Customers: Sales (MWh): Revenues ($000):	1,337 16,437 990
United Light & Power Company P.O. Box 2109 Charleston, WV 25328 (304) 342-2721	Customers: Sales (MWh): Revenues ($000):	1,169 16,011 1,027
* UtiliCorp United Inc. *(Operates as West Virginia Power)* See MO	Customers: Sales (MWh): Revenues ($000):	28,199 396,147 26,886
War Light & Power Company P.O. Box 2109 Charleston, WV 25328 (304) 342-2721	Customers: Sales (MWh): Revenues ($000):	1,027 13,116 815
Wheeling Power Company (AEP) *(operates as American Electric Power)* 51 16th Street Wheeling, WV 26003 (800) 852-6942	Customers: Sales (MWh): Revenues ($000):	41,546 1,798,846 83,899

West Virginia Totals	**1999**
Total Ultimate Customers:	**931,792**
Total Sales to Ultimate Customers (MWh):	**26,805,987**
Total Revenues from Sales to Ultimate Customers ($000):	**1,371,432**

* Effective January 4, 2000, Allegheny Power, a subsidiary of Allegheny Energy, Inc. purchased West Virginia Power, a division of UtiliCorp United Inc.

WISCONSIN (WI)

Alliant Energy/Wisconsin Power and Light Company (LNT) 222 West Washington Avenue Madison, WI 53703-2719 (608) 252-3311	Customers: Sales (MWh): Revenues ($000):	395,652 9,504,473 494,473
Consolidated Water Power Company P.O. Box 8050 Wisconsin Rapids, WI 54495-8050 (715) 422-2582	Customers: Sales (MWh): Revenues ($000):	1,045 1,376,263 39,038
Dahlberg Light and Power Company P.O. Box 300 Solon Springs, WI 54873 (715) 378-2205	Customers: Sales (MWh): Revenues ($000):	9,653 84,303 6,882
Madison Gas and Electric Company 133 South Blair Street Madison, WI 53703-3471 (608) 252-7000	Customers: Sales (MWh): Revenues ($000):	125,566 2,916,533 179,844
North Central Power Company, Inc. 104 South Pine Street Grantsburg, WI 54840 (715) 463-5371	Customers: Sales (MWh): Revenues ($000):	3,897 28,454 2,260
* Northern States Power Company - WI (XEL) 1414 West Hamilton Avenue Eau Claire, WI 54701 (715) 839-2621 Also serves in MI Company Totals: Customers: 222,138 Sales: 5,433,618 Revenues: 317,648	Customers: Sales (MWh): Revenues ($000):	212,868 5,295,629 308,752
Northwestern Wisconsin Electric Company 104 S. Pine Street, Box 9 Grantsburg, WI 54840 (715) 463-5371 Also Serves in MN Company Totals: Customers: 11,429 Sales: 144,232 Revenues: 10,691	Customers: Sales (MWh): Revenues ($000):	11,332 143,729 10,647
Pioneer Power and Light Company 104 N. Main Street Westfield, WI 53964 (608) 296-2149	Customers: Sales (MWh): Revenues ($000):	1,839 13,971 1,034
South Beloit Water, Gas and Electric Company (LNT) 222 West Washington Avenue Madison, WI 53703-2793 (608) 252-3311 Serves in IL Company Totals: Customers: 7,650 Sales: 210,734 Revenues: 10,527	Customers: Sales (MWh): Revenues ($000):	-0- -0- -0-

* New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Company, Public Service Company of Colorado and Southwestern Public Service Company, merged with Northern States Power Company (MN) and its subsidiary, Northern States Power Company (WI), under a new holding company, Xcel Energy Inc.

WISCONSIN (WI) (cont'd)

Superior Water, Light and Power Company (ALE) 2915 Hill Avenue Superior, WI 54880-1524 (715) 394-2200	Customers: Sales (MWh): Revenues ($000):	14,104 532,336 23,171
Westfield Electric Company 204 N. Main Street Westfield, WI 53964 (608) 296-2149	Customers: Sales (MWh): Revenues ($000):	697 12,487 813
Wisconsin Electric Power Company (WEC) 231 West Michigan Street Milwaukee, WI 53203 (414) 221-2345 Also serves in MI Company Totals: Customers: 995,876 Sales: 26,877,397 Revenues: 1,550,536	Customers: Sales (MWh): Revenues ($000):	970,409 23,953,896 1,445,845
Wisconsin Public Service Corporation (WPS) 700 North Adams Street Green Bay, WI 54301-5173 (920) 433-4901 Also serves in MI Company Totals: Customers: 384,465 Sales: 9,971,356 Revenues: 466,297	Customers: Sales (MWh): Revenues ($000):	375,771 9,656,015 453,458
Wisconsin River Power Company (J11) P.O. Box 8050 Wisconsin Rapids, WI 54495-8050 (715) 422-3144		Wholesale Only

Wisconsin Totals	1999
Total Ultimate Customers:	2,122,833
Total Sales to Ultimate Customers (MWh):	53,518,089
Total Revenues from Sales to Ultimate Customers ($000):	2,966,217

WYOMING (WY)

Black Hills Corporation See SD	Customers: Sales (MWh): Revenues ($000):	2,387 126,010 7,560
* Cheyenne Light, Fuel and Power Company (XEL) 108 West 18th Street Cheyenne, WY 82001-4521 (307) 638-3361	Customers: Sales (MWh): Revenues ($000):	35,596 864,079 40,725

* Please see footnote for Northern States Power Co. (WI) on previous page.

WYOMING (WY) (cont'd)

MDU Resources Group, Inc. See ND	Customers:	12,940
	Sales (MWh):	221,907
	Revenues ($000):	14,258
Montana Power Company, The See MT	Customers:	438
	Sales (MWh):	25,623
	Revenues ($000):	2,792
PacifiCorp (SPI) See OR	Customers:	119,251
	Sales (MWh):	7,250,318
	Revenues ($000):	273,205

Wyoming Totals	1999
Total Ultimate Customers:	170,612
Total Sales to Ultimate Customers (MWh):	8,487,937
Total Revenues from Sales to Ultimate Customers ($000):	338,540

UNITED STATES TOTALS	1999
TOTAL ULTIMATE CUSTOMERS:	92,389,604
TOTAL SALES TO ULTIMATE CUSTOMERS (MWh):	2,390,696,820
TOTAL REVENUES FROM SALES TO ULTIMATE CUSTOMERS ($000):	163,496,703

1999 AVERAGE NUMBER OF ULTIMATE CUSTOMERS 1/
Ranked in Descending Order by Company

Rank	Company Name	Customers	Rank	Company Name	Customers
1	Pacific Gas & Electric Company	4,535,909	51	Indiana Michigan Power Company	556,970
2	Southern California Edison Company	4,213,562	52	Pennsylvania Electric Company	552,063
3	Florida Power & Light Company	3,756,012	53	Tampa Electric Company	543,661
4	Commonwealth Edison Company	3,475,519	54	Central Maine Power Company	536,643
5	Consolidated Edison Company of New York, Inc.	3,054,693	55	South Carolina Electric & Gas Company	522,302
6	TXU Electric & Gas	2,537,010	56	Dayton Power & Light Company	492,061
7	Detroit Edison Company, The	2,078,607	57	Atlantic City Electric Co./Conectiv	491,035
8	Virginia Electric & Power Company	2,047,938	58	Public Service Company of Oklahoma	490,855
9	Duke Energy Corporation 2/	2,022,835	59	Illinois Power Company	485,879
10	Public Service Electric & Gas Company	1,991,609	60	Kentucky Utilities Company	481,039
11	Georgia Power Company	1,854,311	61	Duquesne Light Company	468,494
12	Consumers Energy	1,651,437	62	Metropolitan Edison Company	460,014
13	Reliant/HL&P	1,645,552	63	Delmarva Power & Light/Conectiv	459,830
14	Niagara Mohawk Power Corporation	1,579,090	64	Kansas City Power & Light Company	457,207
15	PacifiCorp	1,449,207	65	Indianapolis Power & Light Company	430,052
16	Florida Power Corporation	1,371,188	66	Public Service Company of New Hampshire	427,661
17	Alabama Power Company	1,303,541	67	Northern Indiana Public Service Company	423,114
18	Northern States Power Company	1,281,491	68	Southwestern Electric Power Company	421,908
19	PECO Energy Company	1,256,756	69	Alliant Energy/Wisconsin Power & Light Co.	395,652
20	PPL Utilities	1,214,301	70	Potomac Edison Company, The	394,515
21	Carolina Power & Light Company	1,199,456	71	Entergy Mississippi, Inc.	392,876
22	Public Service Company of Colorado	1,194,847	72	Wisconsin Public Service Corporation	384,465
23	San Diego Gas & Electric Company	1,184,844	73	Southwestern Public Service Company	382,520
24	AmerenUE	1,164,127	74	Idaho Power Company	378,402
25	Baltimore Gas & Electric Company	1,126,035	75	Utilicorp United Inc.	374,683
26	Connecticut Light & Power Company, The	1,120,816	76	Louisville Gas & Electric Company	365,149
27	Wisconsin Electric Power Company	995,876	77	Public Service Company of New Mexico	361,384
28	Jersey Central Power & Light Company	989,126	78	Gulf Power Company	360,111
29	Ohio Edison Company	982,772	79	Monongahela Power Company	357,198
30	Massachusetts Electric Company	981,469	80	Rochester Gas & Electric Corporation	344,375
31	Puget Sound Energy	899,902	81	Alliant Energy/IES Utilities Inc.	342,636
32	Appalachian Power Company	892,748	82	Western Resources, Inc.	340,989
33	New York State Electric & Gas Corporation	813,137	83	Narragansett Electric Company, The	335,202
34	Arizona Public Service Company	806,569	84	Tucson Electric Power Company	329,778
35	Cleveland Electric Illuminating Company, The	742,357	85	Commonwealth Electric Company	325,389
36	Portland General Electric Company	714,130	86	AmerenCIPS	319,339
37	OG&E Electric Services	697,939	87	United Illuminating Company, The	315,674
38	PSI Energy, Inc.	696,330	88	Washington Water Power Company	306,527
39	Pepco	696,243	89	Toledo Edison Company, The	300,275
40	Ohio Power Company	685,577	90	Sierra Pacific Power Company	298,504
41	Boston Edison Company	676,915	91	El Paso Electric Company	294,811
42	Entergy Gulf States, Inc.	664,043	92	Kansas Gas & Electric Company	286,714
43	West Penn Power Company	662,551	93	Montana Power Company, The	284,197
44	Central Power & Light Company	661,105	94	Hawaiian Electric Company, Inc.	273,968
45	MidAmerican Energy Company	658,165	95	Central Hudson Gas & Electric Corporation	270,847
46	Columbus Southern Power Company	645,491	96	Cleco Utility Group	250,135
47	Entergy Arkansas, Inc.	637,244	97	Texas-New Mexico Power Company	231,432
48	Entergy Louisiana, Inc.	634,997	98	Northern States Power Company - WI	222,138
49	Cincinnati Gas & Electric Company	632,452	99	Orange & Rockland Utilities, Inc.	202,947
50	Nevada Power Company	566,675	100	Central Illinois Light Company	198,091

See footnotes at end of table.

...omers, cont'd

Rank	Company Name	Customers	Rank	Company Name	Customers
	Western Massachusetts Electric Company	197,996	142	Edison Sault Electric Company	21,469
	Eastern Edison Company	195,760	143	Southern California Water Company	20,988
	Mississippi Power Company	189,558	144	Alpena Power Company	16,538
	Entergy New Orleans, Inc.	189,477	145	Alaska Electric Light & Power Co.	14,443
	West Texas Utilities Company	189,004	146	Superior Water, Light & Power Company	14,104
	Kentucky Power Company	170,130	147	Northwestern Wisconsin Electric Company	11,429
	Alliant Energy/Interstate Power Company	166,780	148	Connecticut Valley Electric Company, Inc.	10,457
	Empire District Electric Company, The	145,846	149	Nantucket Electric Company	10,298
	Central Vermont Public Service Corporation	141,103	150	Dahlberg Light & Power Company	9,653
	Pennsylvania Power Company	139,142	151	South Beloit Water, Gas & Electric Company	7,650
	Savannah Electric & Power Company	127,844	152	Citizens Electric Company	6,459
112	Minnesota Power	126,195	153	Lockhart Power Company	6,102
113	Otter Tail Power Company	125,952	154	Mt. Carmel Public Utility Company	5,629
114	Madison Gas & Electric Company	125,566	155	Wellsboro Electric Company	5,628
115	Southern Indiana Gas & Electric Company	125,185	156	Alaska Power & Telephone Co., Inc.	5,269
116	Bangor Hydro-Electric Company	122,773	157	Berea College Utilities	4,485
117	Union, Light, Heat & Power Company	121,514	158	Pike County Light & Power Company	4,199
118	Citizens Utilities Company	116,055	159	North Central Power Company, Inc.	3,897
119	MDU Resources Group, Inc.	114,653	160	Bethel Utilities Corporation, Inc.	2,279
120	Blackstone Valley Electric Company	92,069	161	Pioneer Power & Light Company	1,839
121	Green Mountain Power Corporation	83,989	162	Elk Power Company	1,756
122	Rockland Electric Company	68,504	163	Black Diamond Power Company	1,752
123	Upper Peninsula Power Company	62,709	164	Block Island Power Company	1,514
124	St. Joseph Light & Power Company	62,495	165	Union Power Company	1,337
125	Hawaii Electric Light Company, Inc.	61,795	166	United Light & Power Company	1,169
126	UGI Utilities, Inc.	58,472	167	Consolidated Water Power Company	1,045
127	Black Hills Corporation	57,456	168	War Light & Power Company	1,027
128	Northwestern Corporation	56,844	169	Amana Society Service Company	847
129	Maui Electric Company, Ltd.	55,787	170	Rochester Electric Light & Power Company	801
130	Cambridge Electric Light Company	45,749	171	Fishers Island Electric Corporation, The	728
131	Kingsport Power Company	44,208	172	Westfield Electric Company	697
132	Southwestern Electric Service Company	42,542	173	Kimball Light & Water Company	443
133	Wheeling Power Company	41,546	174	West Harrison Gas & Electric Company	384
134	Exeter & Hampton Electric Company	40,256	175	Panaca Power & Light Company	365
135	Granite State Electric Company	37,031	176	McGrath Light & Power	235
136	Maine Public Service Company	35,606	177	Elkhorn Public Service Company	206
137	Cheyenne Light, Fuel & Power Company	35,596	178	Pelican Utility Company	201
138	Newport Electric Corporation	34,966	179	Holyoke Water Power Company	32
139	Concord Electric Company	27,358	180	Electric Energy, Inc.	1
140	Fitchburg Gas & Electric Light Company	25,879	181	Ohio Valley Electric Corporation	1
141	Florida Public Utilities Company	24,640	182	New England Power Company	1
				Total United States:	92,389,604

1/ Rankings may not include all customers in states with deregulated markets. Please see page 52 for state aggregated retail data for those states with deregulated markets.

2/ Includes data for Nantahala Power & Light Company, a subsidiary of Duke Power.

1999 SALES TO ULTIMATE CUSTOMERS 1/
Ranked in Descending Order by Company
(Megawatthours)

Rank	Company Name	Sales	Rank	Company Name	Sales
1	TXU Electric & Gas	95,927,336	51	Tampa Electric Company	15,804,958
2	Florida Power & Light Company	84,450,082	52	Massachusetts Electric Company	15,657,428
3	Commonwealth Edison Company	83,500,597	53	Northern Indiana Public Service Company	15,627,599
4	Duke Energy Corporation 2/	74,109,763	54	Public Service Company of Oklahoma	15,615,999
5	Georgia Power Company	70,972,000	55	Nevada Power Company	15,337,607
6	Pacific Gas & Electric Company	70,186,749	56	San Diego Gas & Electric Company	14,718,306
7	Reliant/HL&P	69,374,552	57	Southwestern Public Service Company	14,434,952
8	Southern California Edison Company	67,206,530	58	Dayton Power & Light Company	14,315,947
9	Virginia Electric & Power Company	65,826,104	59	Indianapolis Power & Light Company	13,848,628
10	Alabama Power Company	50,157,204	60	Idaho Power Company	13,765,885
11	Detroit Edison Company, The	49,822,240	61	Kansas City Power & Light Company	13,342,151
12	PacifiCorp	46,605,155	62	New York State Electric & Gas Corporation	13,192,379
13	Public Service Electric & Gas Company	40,289,444	63	Boston Edison Company	12,864,155
14	Carolina Power & Light Company	40,217,290	64	Potomac Edison Company, The	12,835,897
15	Consumers Energy	35,754,796	65	Entergy Mississippi, Inc.	12,517,845
16	Entergy Gulf States, Inc.	34,347,913	66	Delmarva Power & Light/Conectiv	12,363,783
17	Niagara Mohawk Power Corporation	33,756,106	67	Louisville Gas & Electric Company	11,203,916
18	AmerenUE	33,565,723	68	Monongahela Power Company	10,794,563
19	Florida Power Corporation	33,441,029	69	Alliant Energy/IES Utilities Inc.	10,454,840
20	Consolidated Edison Company of New York, Inc.	32,630,506	70	Wisconsin Public Service Corporation	9,971,356
21	Ohio Power Company	31,982,889	71	Toledo Edison Company, The	9,866,345
22	Northern States Power Company	31,645,688	72	Ohio Valley Electric Corporation	9,805,889
23	Baltimore Gas & Electric Company	29,264,078	73	Gulf Power Company	9,559,183
24	Entergy Louisiana, Inc.	29,095,658	74	Mississippi Power Company	9,543,133
25	Appalachian Power Company	27,933,324	75	Alliant Energy/Wisconsin Power & Light Co.	9,504,473
26	Wisconsin Electric Power Company	26,877,397	76	Texas-New Mexico Power Company	9,248,086
27	PSI Energy, Inc.	26,080,752	77	Central Maine Power Company	9,144,308
28	Ohio Edison Company	24,946,704	78	Western Resources, Inc.	8,996,335
29	Pepco	24,209,242	79	Duquesne Light Company	8,925,000
30	PECO Energy Company	23,593,639	80	Atlantic City Electric Co./Conectiv	8,831,691
31	PPL Utilities	23,397,070	81	Kansas Gas & Electric Company	8,607,403
32	Public Service Company of Colorado	23,337,607	82	AmerenCIPS	8,538,572
33	Connecticut Light & Power Company, The	22,315,405	83	Sierra Pacific Power Company	8,432,466
34	OG&E Electric Services	21,916,854	84	Minnesota Power	8,429,549
35	Central Power & Light Company	21,303,608	85	Pennsylvania Electric Company	8,190,632
36	Puget Sound Energy	21,292,035	86	Washington Water Power Company	8,156,926
37	Arizona Public Service Company	20,961,836	87	Utilicorp United Inc.	8,121,358
38	Cincinnati Gas & Electric Company	20,070,826	88	Cleco Utility Group	8,099,438
39	Cleveland Electric Illuminating Company, The	20,021,621	89	Tucson Electric Power Company	7,789,068
40	Portland General Electric Company	19,258,992	90	Electric Energy, Inc.	7,013,929
41	Jersey Central Power & Light Company	18,951,186	91	Hawaiian Electric Company, Inc.	6,997,936
42	South Carolina Electric & Gas Company	18,878,812	92	Public Service Company of New Hampshire	6,957,064
43	Entergy Arkansas, Inc.	18,663,671	93	Metropolitan Edison Company	6,832,063
44	Indiana Michigan Power Company	18,339,892	94	Public Service Company of New Mexico	6,803,583
45	Illinois Power Company	18,215,452	95	Kentucky Power Company	6,491,087
46	West Penn Power Company	17,281,530	96	Rochester Gas & Electric Corporation	6,296,112
47	Columbus Southern Power Company	16,435,078	97	Central Illinois Light Company	5,910,714
48	Kentucky Utilities Company	16,307,546	98	Entergy New Orleans, Inc.	5,896,732
49	Southwestern Electric Power Company	16,049,294	99	El Paso Electric Company	5,866,168
50	MidAmerican Energy Company	16,007,300	100	United Illuminating Company, The	5,652,050

See footnotes at end of table.

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DOE002-1322

1999 Sales, cont'd

Rank	Company Name	Sales	Rank	Company Name	Sales
101	Northern States Power Company - WI	5,433,618	142	Exeter & Hampton Electric Company	558,048
102	Montana Power Company, The	5,326,478	143	Superior Water, Light & Power Company	532,336
103	Alliant Energy/Interstate Power Company	5,311,928	144	Concord Electric Company	516,685
104	Southern Indiana Gas & Electric Company	5,110,945	145	Maine Public Service Company	511,361
105	West Texas Utilities Company	4,837,210	146	Fitchburg Gas & Electric Light Company	502,612
106	Narragansett Electric Company, The	4,692,777	147	Alpena Power Company	310,181
107	Central Hudson Gas & Electric Corporation	4,562,393	148	Alaska Electric Light & Power Co.	298,983
108	Western Massachusetts Electric Company	3,885,392	149	Lockhart Power Company	224,327
109	Empire District Electric Company, The	3,859,166	150	South Beloit Water, Gas & Electric Company	210,734
110	Savannah Electric & Power Company	3,712,902	151	Connecticut Valley Electric Company, Inc.	167,643
111	Union, Light, Heat & Power Company	3,711,708	152	Citizens Electric Company	154,521
112	Commonwealth Electric Company	3,665,492	153	Northwestern Wisconsin Electric Company	144,232
113	Orange & Rockland Utilities, Inc.	3,509,266	154	Mt. Carmel Public Utility Company	139,582
114	Otter Tail Power Company	3,393,860	155	Southern California Water Company	127,135
115	Pennsylvania Power Company	3,306,062	156	Berea College Utilities	126,861
116	Madison Gas & Electric Company	2,916,533	157	Nantucket Electric Company	109,409
117	Eastern Edison Company	2,827,205	158	Wellsboro Electric Company	109,154
118	Central Vermont Public Service Corporation	2,172,798	159	Holyoke Water Power Company	95,883
119	MDU Resources Group, Inc.	2,075,446	160	Amana Society Service Company	92,302
120	Green Mountain Power Corporation	1,901,783	161	Dahlberg Light & Power Company	84,303
121	Kingsport Power Company	1,804,152	162	Pike County Light & Power Company	59,687
122	Citizens Utilities Company	1,803,847	163	Alaska Power & Telephone Co., Inc.	58,910
123	Wheeling Power Company	1,798,846	164	Bethel Utilities Corporation, Inc.	36,472
124	Bangor Hydro-Electric Company	1,766,395	165	North Central Power Company, Inc.	28,454
125	St. Joseph Light & Power Company	1,667,937	166	Elk Power Company	18,857
126	Black Hills Corporation	1,501,808	167	Black Diamond Power Company	18,058
127	Rockland Electric Company	1,432,604	168	Union Power Company	16,437
128	Cambridge Electric Light Company	1,377,503	169	United Light & Power Company	16,011
129	Consolidated Water Power Company	1,376,263	170	Pioneer Power & Light Company	13,971
130	Blackstone Valley Electric Company	1,340,817	171	War Light & Power Company	13,116
131	Northwestern Corporation	1,111,728	172	Westfield Electric Company	12,487
132	Maui Electric Company, Ltd.	1,064,739	173	Block Island Power Company	8,975
133	Southwestern Electric Service Company	1,058,507	174	West Harrison Gas & Electric Company	7,242
134	Hawaii Electric Light Company, Inc.	922,352	175	Rochester Electric Light & Power Company	6,109
135	Cheyenne Light, Fuel & Power Company	864,079	176	Panaca Power & Light Company	6,064
136	UGI Utilities, Inc.	852,790	177	Kimball Light & Water Company	4,894
137	Granite State Electric Company	754,128	178	Fishers Island Electric Corporation, The	4,860
138	Upper Peninsula Power Company	738,872	179	New England Power Company	4,509
139	Florida Public Utilities Company	719,070	180	McGrath Light & Power	2,861
140	Edison Sault Electric Company	646,408	181	Elkhorn Public Service Company	2,373
141	Newport Electric Corporation	570,679	182	Pelican Utility Company	2,103
				Total United States:	2,390,696,820

1/ Rankings may not include all MWh sales in states with deregulated markets. Please see page 52 for state aggregated retail data for those states with deregulated markets.

2/ Includes data for Nantahala Power & Light Company, a subsidiary of Duke Power.

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DOE002-1323

1999 REVENUES FROM SALES TO ULTIMATE CUSTOMERS 1/
Ranked in Descending Order by Company
(Thousands of Dollars)

Rank	Company Name	Revenues	Rank	Company Name	Revenues
1	Pacific Gas & Electric Company	$6,785,994	51	MidAmerican Energy Company	1,024,652
2	Southern California Edison Company	6,692,164	52	Northern Indiana Public Service Company	1,000,390
3	Commonwealth Edison Company	6,175,861	53	Portland General Electric Company	973,326
4	TXU Electric & Gas	5,851,857	54	Dayton Power & Light Company	964,329
5	Florida Power & Light Company	5,830,116	55	Atlantic City Electric Co./Conectiv	936,227
6	Consolidated Edison Company of New York, Inc.	4,500,992	56	Nevada Power Company	935,381
7	Reliant/HL&P	4,247,269	57	West Penn Power Company	931,763
8	Georgia Power Company	4,129,088	58	Delmarva Power & Light/Conectiv	894,277
9	Duke Energy Corporation 2/	4,093,115	59	Central Maine Power Company	892,792
10	Virginia Electric & Power Company	3,989,073	60	Public Service Company of New Hampshire	853,654
11	Public Service Electric & Gas Company	3,873,893	61	Kansas City Power & Light Company	838,641
12	Detroit Edison Company, The	3,791,116	62	Duquesne Light Company	782,274
13	Niagara Mohawk Power Corporation	3,043,028	63	Southwestern Electric Power Company	776,476
14	Alabama Power Company	2,811,117	64	Toledo Edison Company, The	762,405
15	Carolina Power & Light Company	2,519,348	65	Indianapolis Power & Light Company	748,570
16	Consumers Energy	2,498,266	66	Entergy Mississippi, Inc.	737,120
17	Florida Power Corporation	2,361,848	67	Hawaiian Electric Company, Inc.	729,557
18	Connecticut Light & Power Company, The	2,190,813	68	Potomac Edison Company, The	715,280
19	PacifiCorp	2,172,555	69	Public Service Company of Oklahoma	691,685
20	Baltimore Gas & Electric Company	2,118,845	70	United Illuminating Company, The	639,596
21	Ohio Edison Company	2,093,478	71	Kentucky Utilities Company	638,959
22	PECO Energy Company	2,066,833	72	Tucson Electric Power Company	629,901
23	AmerenUE	2,036,863	73	Pennsylvania Electric Company	612,166
24	Jersey Central Power & Light Company	2,010,735	74	Rochester Gas & Electric Corporation	608,628
25	Northern States Power Company	1,922,997	75	Southwestern Public Service Company	600,729
26	Entergy Gulf States, Inc.	1,788,538	76	Alliant Energy/IES Utilities Inc.	593,690
27	Pepco	1,788,040	77	Metropolitan Edison Company	573,978
28	PPL Utilities	1,761,778	78	Monongahela Power Company	561,175
29	Cleveland Electric Illuminating Company, The	1,743,148	79	Louisville Gas & Electric Company	559,791
30	Arizona Public Service Company	1,716,236	80	Kansas Gas & Electric Company	558,734
31	Entergy Louisiana, Inc.	1,686,442	81	Sierra Pacific Power Company	548,507
32	Wisconsin Electric Power Company	1,550,536	82	AmerenCIPS	544,132
33	New York State Electric & Gas Corporation	1,492,881	83	Texas-New Mexico Power Company	535,664
34	San Diego Gas & Electric Company	1,415,141	84	Public Service Company of New Mexico	522,523
35	Ohio Power Company	1,393,498	85	Idaho Power Company	516,151
36	Public Service Company of Colorado	1,375,599	86	Gulf Power Company	512,760
37	Boston Edison Company	1,338,479	87	Utilicorp United Inc.	505,765
38	Central Power & Light Company	1,306,971	88	Alliant Energy/Wisconsin Power & Light Co.	494,473
39	Appalachian Power Company	1,292,237	89	El Paso Electric Company	486,193
40	Puget Sound Energy	1,269,286	90	Mississippi Power Company	469,434
41	Cincinnati Gas & Electric Company	1,259,683	91	Cleco Utility Group	468,169
42	Massachusetts Electric Company	1,259,428	92	Western Resources, Inc.	466,374
43	PSI Energy, Inc.	1,251,012	93	Wisconsin Public Service Corporation	466,297
44	OG&E Electric Services	1,191,079	94	Narragansett Electric Company, The	413,925
45	Entergy Arkansas, Inc.	1,172,352	95	Entergy New Orleans, Inc.	393,928
46	Illinois Power Company	1,138,822	96	Commonwealth Electric Company	391,027
47	South Carolina Electric & Gas Company	1,124,176	97	Central Hudson Gas & Electric Corporation	387,836
48	Tampa Electric Company	1,100,103	98	Washington Water Power Company	384,546
49	Columbus Southern Power Company	1,062,454	99	Western Massachusetts Electric Company	358,434
50	Indiana Michigan Power Company	1,039,934	100	Minnesota Power	354,497

See footnotes at end of table.

1999 Revenues, cont.'d

Rank	Company Name	Revenues	Rank	Company Name	Revenues
101	Central Illinois Light Company	347,075	143	Cheyenne Light, Fuel & Power Company	40,725
102	Montana Power Company, The	332,304	144	Consolidated Water Power Company	39,038
103	Orange & Rockland Utilities, Inc.	332,249	145	Florida Public Utilities Company	38,377
104	Northern States Power Company - WI	317,648	146	Edison Sault Electric Company	33,505
105	West Texas Utilities Company	300,148	147	Alaska Electric Light & Power Co.	24,934
106	Kentucky Power Company	266,855	148	Superior Water, Light & Power Company	23,171
107	Alliant Energy/Interstate Power Company	261,799	149	Alpena Power Company	19,904
108	Central Vermont Public Service Corporation	251,540	150	Connecticut Valley Electric Company, Inc.	19,817
109	Eastern Edison Company	243,928	151	Southern California Water Company	13,275
110	Southern Indiana Gas & Electric Company	242,317	152	Nantucket Electric Company	12,949
111	Pennsylvania Power Company	240,158	153	Lockhart Power Company	11,770
112	Savannah Electric & Power Company	238,804	154	Northwestern Wisconsin Electric Company	10,691
113	Empire District Electric Company, The	219,512	155	South Beloit Water, Gas & Electric Company	10,527
114	Union, Light, Heat & Power Company	204,559	156	Mt. Carmel Public Utility Company	9,474
115	Citizens Utilities Company	199,947	157	Citizens Electric Company	8,689
116	Ohio Valley Electric Corporation	197,877	158	Bethel Utilities Corporation, Inc.	7,136
117	Bangor Hydro-Electric Company	184,267	159	Alaska Power & Telephone Co., Inc.	7,067
118	Otter Tail Power Company	183,478	160	Dahlberg Light & Power Company	6,882
119	Madison Gas & Electric Company	179,844	161	Wellsboro Electric Company	6,516
120	Green Mountain Power Corporation	179,641	162	Holyoke Water Power Company	5,897
121	Hawaii Electric Light Company, Inc.	158,962	163	Berea College Utilities	5,725
122	Maui Electric Company, Ltd.	156,808	164	Pike County Light & Power Company	5,508
123	Rockland Electric Company	139,148	165	Amana Society Service Company	4,423
124	Electric Energy, Inc.	136,875	166	Block Island Power Company	2,344
125	MDU Resources Group, Inc.	130,932	167	North Central Power Company, Inc.	2,260
126	Blackstone Valley Electric Company	120,728	168	Elk Power Company	1,250
127	Cambridge Electric Light Company	104,801	169	Fishers Island Electric Corporation, The	1,133
128	Black Hills Corporation	102,204	170	McGrath Light & Power	1,126
129	St. Joseph Light & Power Company	87,028	171	Black Diamond Power Company	1,061
130	Wheeling Power Company	83,899	172	Pioneer Power & Light Company	1,034
131	Kingsport Power Company	79,404	173	United Light & Power Company	1,027
132	Northwestern Corporation	76,434	174	Union Power Company	990
133	UGI Utilities, Inc.	70,381	175	War Light & Power Company	815
134	Granite State Electric Company	59,802	176	Westfield Electric Company	813
135	Newport Electric Corporation	59,336	177	Rochester Electric Light & Power Company	737
136	Upper Peninsula Power Company	56,032	178	West Harrison Gas & Electric Company	560
137	Southwestern Electric Service Company	54,829	179	Panaca Power & Light Company	377
138	Maine Public Service Company	53,015	180	New England Power Company	324
139	Fitchburg Gas & Electric Light Company	52,118	181	Kimball Light & Water Company	298
140	Exeter & Hampton Electric Company	50,095	182	Pelican Utility Company	296
141	Concord Electric Company	45,428	183	Elkhorn Public Service Company	151
				Total United States:	$163,496,703

1/ Rankings may not include all revenues in states with deregulated markets. Please see page 52 for state aggregated retail data for those states with deregulated markets.

2/ Includes data for Nantahala Power & Light Company, a subsidiary of Duke Power.

Retail Electricity Service to Ultimate Customers by Investor-Owned Electric Utility Affiliates and Other Energy Service Providers in States with Full or Partial Deregulated Electricity Markets

State	Ultimate Customers	MWh Sales to Ultimate Customers	MWh Sales per Customer	Revenues from Sales to Ultimate Customers (000's)
California	141,510	22,849,739	162	$748,661
Delaware	14	58,865	4,205	1,944
Idaho	1	876,000	876,000	13,558
Illinois	1,620	444,690	275	9,929
Massachusetts	673	1,586,664	2,358	57,094
Michigan	18	501,329	27,852	14,048
Missouri	1	69,318	69,318	1,668
Montana	5	1,149,744	229,949	25,902
New Hampshire	4,201	165,209	39	4,848
New Jersey	4,560	121,473	27	4,580
New Mexico	501	43,800	87	1,186
New York	60,494	9,543,250	158	365,274
Ohio	5	168	34	254
Oregon	16	547,341	34,209	9,654
Pennsylvania	487,901	32,859,903	67	1,280,101
Rhode Island	890	495,561	557	16,632
Washington	10	4,874,988	487,499	108,851
Total from states fully or partially deregulated	**702,420**	**76,188,042**	**109**	**2,664,184**

Source: Department of Energy, Energy Information Administration, EIA-861.

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DOE002-1326

ELECTRIC OPERATING COMPANIES SERVING ULTIMATE CUSTOMERS

Alabama Power Company
Alaska Electric Light and Power Company
Alpena Power Company
Amana Society Service Company
AmerenUE
Appalachian Power Company
Arizona Public Service Company
Atlantic City Electric Company/Conectiv
Bangor Hydro-Electric Company
Berea College Utilities
Bethel Utilities Corporation, Inc.
Black Diamond Power Company
Black Hills Corporation
Block Island Power Company
Boston Edison Company
Cambridge Electric Light Company
Carolina Power & Light Company
Central Maine Power Company
Central Power and Light Company
Central Vermont Public Service Corporation
Citizens' Electric Company
Cleco Utility Group, Inc.
Cleveland Electric Illuminating Company, The
Columbus Southern Power Company
Commonwealth Edison Company
Commonwealth Electric Company
Concord Electric Company
Connecticut Light and Power Company, The
Connecticut Valley Electric Company, Inc.
Consolidated Water Power Company
Dahlberg Light and Power Company
Detroit Edison Company, The
Duke Power
Duquesne Light Company
Edison Sault Electric Company
El Paso Electric Company
Electric Energy, Inc.
Elk Power Company
Elkhorn Public Service Company
Empire District Electric Company, The
Entergy Arkansas, Inc.
Entergy Gulf States, Inc.
Entergy Louisiana, Inc.
Entergy Mississippi, Inc.
Exeter & Hampton Electric Company
Fishers Island Electric Corporation, The
Florida Power Corporation
Florida Power & Light Company
Georgia Power Company
Granite State Electric Company
Green Mountain Power Corporation
Gulf Power Company
Hawaii Electric Light Company, Inc.
Hawaiian Electric Company, Inc.
Holyoke Water Power Company
Idaho Power Company
Indiana Michigan Power Company
Indianapolis Power & Light Company
Jersey Central Power & Light
Kansas City Power & Light Company
Kansas Gas and Electric Company
Kentucky Power Company
Kentucky Utilities Company
Kimball Light and Water Company
Kingsport Power Company
Lockhart Power Company
Maine Public Service Company
Massachusetts Electric Company
Maui Electric Company, Ltd.
McGrath Light and Power
Metropolitan Edison Company
Minnesota Power
Mississippi Power Company
Monongahela Power Company
Nantahala Power & Light Company
Nantucket Electric Company
Narragansett Electric Company, The
Nevada Power Company
New England Power Company
Newport Electric Corporation
North Central Power Company, Inc.
Northwestern Wisconsin Electric Company
Ohio Edison Company
Ohio Power Company
Ohio Valley Electric Corporation
OG&E Electric Services
Otter Tail Power Company
PacifiCorp
Panaca Power and Light Company
Pelican Utility Company
Pennsylvania Electric Company
Pennsylvania Power Company
Pioneer Power and Light Company
Portland General Electric Company
Potomac Edison Company, The
Potomac Electric Power Company
PPL Utilities
PSI Energy, Inc.
Public Service Company of New Hampshire
Public Service Company of Oklahoma
Reliant Energy HL&P
Rochester Electric Light & Power Company
Rockland Electric Company
Savannah Electric and Power Company
Southern California Edison Company
Southern California Water Company
Southwestern Electric Power Company
Southwestern Electric Service Company
Southwestern Public Service Company
Tampa Electric Company
Texas-New Mexico Power Company
Toledo Edison Company The
Tucson Electric Power Company
Union Power Company
United Illuminating Company, The
United Light & Power Company
Upper Peninsula Power Company
Virginia Electric and Power Company
War Light & Power Company
Wellsboro Electric Company

ELECTRIC COMPANIES, cont'd

West Harrison Gas & Electric Company
West Penn Power Company
West Texas Utilities Company
Western Massachusetts Electric Company
Westfield Electric Company
Wheeling Power Company

COMBINATION OPERATING COMPANIES SERVING ULTIMATE CUSTOMERS

Company Name	Type of Service
Alaska Power and Telephone Company, Inc.	Electric, Telephone
Alliant Energy/IES Utilities Inc.	Electric, Gas, Steam
Alliant Energy/Interstate Power Company	Electric, Gas
Alliant Energy/Wisconsin Power & Light Company	Electric, Gas
AmerenCIPS	Electric, Gas
Avista Corp.	Electric, Gas
Baltimore Gas and Electric Company	Electric, Gas
Central Hudson Gas & Electric Corporation	Electric, Gas
Central Illinois Light Company	Electric, Gas
Cheyenne Light, Fuel and Power Company	Electric, Gas
Cincinnati Gas & Electric Company, The	Electric, Gas
Citizens Utilities Company	Electric, Gas
Consolidated Edison Company of New York, Inc.	Electric, Steam
Consumers Energy	Electric, Gas
Dayton Power and Light Company, The	Electric, Gas, Steam
Delmarva Power & Light Company/Conectiv	Electric, Gas, Steam
Entergy New Orleans, Inc.	Electric, Gas
Fitchburg Gas and Electric Company	Electric, Gas
Florida Public Utilities Company	Electric, Gas, Water
Illinois Power Company	Electric, Gas
KeySpan Corporation	Electric, Gas
Louisville Gas and Electric Company	Electric, Gas
Madison Gas and Electric Company	Electric, Gas
MDU Resources Group, Inc.	Electric, Gas
MidAmerican Energy Company	Electric, Gas
Montana Power Company, The	Electric, Gas
Mt. Carmel Public Utility Company	Electric, Gas
New York State Electric & Gas Corporation	Electric, Gas
Niagara Mohawk Power Corporation	Electric, Gas
Northern Indiana Public Service Company	Electric, Gas
Northern States Power Company	Electric, Gas, Telephone
Northern States Power Company - WI	Electric, Gas
Northwestern Corporation	Electric, Gas
Orange and Rockland Utilities, Inc.	Electric, Gas
Pacific Gas and Electric Company	Electric, Gas, Steam, Water
PECO Energy Company	Electric, Gas
Pike County Light & Power Company	Electric, Gas
Puget Sound Energy	Electric, Gas
Public Service Company of Colorado	Electric, Gas, Steam
Public Service Company of New Mexico	Electric, Gas, Water
Public Service Electric and Gas Company	Electric, Gas
Rochester Gas and Electric Corporation	Electric, Gas
St. Joseph Light & Power Company	Electric, Gas, Steam
San Diego Gas & Electric Company	Electric, Gas, Steam
Sierra Pacific Power Company	Electric, Gas, Water
South Beloit Water, Gas and Electric Company	Electric, Gas, Water
South Carolina Electric & Gas Company	Electric, Gas, Transit
Southern Indiana Gas and Electric Company	Electric, Gas
Superior Water, Light and Power Company	Electric, Gas, Water
TXU Electric & Gas	Electric, Gas
UGI Utilities, Inc.	Electric, Gas
Union Light, Heat & Power Company	Electric, Gas
UtiliCorp United Inc.	Electric, Gas
West Harrison Gas & Electric Company	Electric, Gas
Western Resources, Inc.	Electric, Gas, Steam
Wisconsin Electric Power Company	Electric, Steam
Wisconsin Public Service Corporation	Electric, Gas

POWER MARKETING AFFILIATES OF INVESTOR-OWNED ELECTRIC UTILITIES

Investor-Owned Electric Utility 1/	Power Marketer
AES Corporation	AES Alamitos, LLC AES Creative Resources, LP AES Eastern Energy, LP AES Huntington Beach, LLC AES Londonderry, LLC AES Placerita, Inc. AES Power Inc. AES Redondo Beach, LLC Northern/AES Energy LLC QST Energy Trading Inc.
Allegheny Energy, Inc.	Allegheny Energy Supply Company AYP Energy, Inc.
Alliant Energy Corporation	Alliant Energy Industrial Services, Inc. Cargill-Alliant, LLC
Ameren Corp.	Ameren Energy
American Electric Power Company, Inc.	AEP Power Marketing, Inc. CSW Energy Services, Inc. CSW Power Marketing Inc. Denver City Energy Associates, LP e prime, inc. Front Range Energy Associates, LLC Texas-Ohio Power Marketing, Inc.
Avista Corporation	Avista Energy, Inc. Avista Turbine Power, Inc. Rathdrum Power, LLC Spokane Energy, LLC Vitol Gas and Electric LLC
Bangor Hydro-Electric Company	Bangor Energy Resale, Inc.
Black Hills Corporation	Black Hills Energy Resources, Inc. Enserco Energy Inc. Indeck Colorado, LLC
Carolina Power & Light Company	Monroe Power Company
CH Energy Group, Inc.	Central Hudson Enterprise Corporation CH Resources, Inc.
Cinergy Corp.	CinCap IV, LLC CinCap V, LLC CinCap VI, LLC CinCap VII, LLC CinCap VIII, LLC Cinergy Capital & Trading, Inc. Duke Energy Madison, LLC Duke Energy Vermillion, LLC
Cleco Corporation	CLECO Energy, LLC Cleco Evangeline LLC Cleco Trading & Marketing LLC
CMS Energy Corporation	CMS Distributed Power, LLC CMS Generation Michigan Power, LLC CMS Marketing, Services and Trading Company Genesee Power Station Limited Partnership Grayling Generating Station Limited Partnership Lakewood Cogeneration Limited Partnership

See footnote on page 62.

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Investor-Owned Electric Utility 1/	Power Marketer
CMS Energy Corporation (cont'd)	PanEnergy Lake Charles Generation
Conectiv	Conectiv Energy Supply, Inc.
Consolidated Edison, Inc.	Consolidated Edison Energy Massachusetts, Inc. Consolidated Edison Solutions, Inc. Inventory Management and Distribution Company, Inc.
Constellation Energy Group, Inc.	Astoria Generating Company, LP Calvert Cliffs, Inc. Carr Street Generating Station, LP Constellation Generation, Inc. Constellation Power Source, Inc. Erie Boulevard Hydropower, LP Orion Power MidWest, LLC
Dominion Resources, Inc.	Elwood Energy LLC Elwood Marketing, LLC Kincaid Generation, LLC
DPL Inc.	DPL Energy, Inc.
DQE	Monmouth Energy, Inc.
DTE Energy Company	DTE Edison America, Inc. DTE Energy Marketing, Inc. DTE Energy Trading, Inc. DTE Georgetown, LLC DTE River Rouge No. 1, LLC
Duke Energy Corporation	Bridgeport Energy LLC Casco Bay Energy Company, LLC CinCap VII, LLC Duke Energy Madison, LLC Duke Energy Marketing Corporation Duke Energy Merchants, LLC Duke Energy Morro Bay LLC Duke Energy Moss Landing LLC Duke Energy New Smyrna Beach Power Company Ltd., LLP Duke Energy Oakland LLC Duke Energy South Bay LLC Duke Energy St. Francis LLC Duke Energy St. Lucie, LLC Duke Energy Trading and Marketing, LLC Duke Energy Trenton, LLC Duke Energy Vermillion, LLC DukeSolutions, Inc. Lowell Cogeneration Company Limited Partnership UAE Lowell Power LLC United American Energy Corp.
Dynegy	Illinova Energy Partners, Inc. Illinova Power Marketing, Inc. Tenaska Frontier Partners, Ltd.
Edison International	Brooklyn Navy Yard Cogeneration Partners, LP Edison Mission Marketing & Trading, Inc. Edison Source EME Homer City Generation, LP Harbor Cogeneration Company Midwest Generation, LLC
Energy East Corporation	Carthage Energy, LLC NGE Generation, Inc. NYSEG Solutions, Inc. South Glens Falls Energy, LLC XENERGY Inc.
Enron Corp.	Clinton Energy Management Services, Inc.

Investor-Owned Electric Utility 1/	Power Marketer
Enron Corp. (cont'd)	Des Plaines Green Land Development, LLC EGC 1999 Holding Company, LP Enron Energy Services, Inc. Enron Power Marketing, Inc. Gleason Power I, LLC Green Power Partners I LLC Minnesota Agri-Power, LLC Storm Lake Power Partners II, LLC West Fork Land Development Company, LLC
Entergy Corporation	Entergy Nuclear FitzPatrick, LLC Entergy Nuclear Generation Company Entergy Nuclear Indian Point 3, LLC Entergy Power Marketing Corp.
FirstEnergy Corp.	FirstEnergy Trading Services, Inc.
Florida Power Corporation	Progress Power Marketing Inc.
FPL Group, Inc.	Doswell Limited Partnership FPL Energy AVEC LLC FPL Energy Maine Hydro LLC FPL Energy Mason LLC FPL Energy MH50, LP FPL Energy Power Marketing, Inc. FPL Energy Services, Inc. FPL Energy Wyman IV LLC FPL Energy Wyman LLC Lamar Power Partners, LP
GPU, Inc.	GPU Advanced Resources, Inc. Onondaga Cogeneration Limited Partnership
Kansas City Power & Light Company	Strategic Energy, LLC
KeySpan Energy Corporation	KeySpan-Ravenswood, Inc.
LG&E Energy Corporation	LG&E Capital Corporation LG&E Energy Marketing, Inc. LG&E-Westmoreland Rensselaer Western Kentucky Energy Corp.
Maine Public Service Company	Energy Atlantic, LLC
MidAmerican Energy Holdings Company	Cordova Energy Company LLC InterCoast Power Marketing Company
Montana Power Company	Tenaska Frontier Partners, Ltd. The Montana Power Trading & Marketing Company
National Grid USA	AllEnergy Marketing Company, LLC
Niagara Mohawk Holdings Inc.	Niagara Mohawk Energy Marketing, Inc.
NiSource, Inc.	Bay State GPE, Inc. NESI Power Marketing, Inc.
Northeast Utilities	Northeast Generation Company Select Energy, Inc.
Northwestern Corporation	CornerStone Propane, LP
OGE Energy Corp.	OGE Energy Resources, Inc.
PacifiCorp	PacifiCorp Power Marketing, Inc. PPM One LLC PPM Two LLC PPM Three LLC PPM Four LLC PPM Five LLC PPM Six LLC
PECO Energy Company	AmerGen Energy Company, LLC AmerGen Vermont, LLC Exelon Energy
Pepco	Pepco Services, Inc.

Investor-Owned Electric Utility 1/	Power Marketer
PG&E Corporation	Athens Generating Company, LP La Paloma Generating Company, LLC Lake Road Generating Company, LP Liberty Generating Company, LLC Logan Generating Company Madison Windpower, LLC Mantua Creek Generating Company, LP Millennium Power Partners, LP Okeechobee Generating Company, LLC PG&E Dispersed Generating Company, LLC PG&E Energy Services Corporation PG&E Energy Trading - Power, LP Pittsfield Generating Company, LP USGen New England, Inc.
PPL Corporation	Penobscot Hydro, LLC PP&L Colstrip III, LLC PP&L EnergyPlus Co., LLC PP&L Great Works, LLC PP&L Montana, LLC PPL Brunner Island, LLC PPL Holtwood, LLC PPL Martins Creek, LLC PPL Montour, LLC PPL Susquehanna, LLC
Public Service Enterprise Group, Inc.	PSEG Energy Technologies Inc.
Reliant Energy, Inc.	El Dorado Energy, LLC Reliant Energy Coolwater, LLC Reliant Energy Desert Basin, LLC Reliant Energy Ellwood, LLC Reliant Energy Etiwanda, LLC Reliant Energy Indian River, LLC Reliant Energy Mandalay, LLC Reliant Energy Maryland Holdings LLC Reliant Energy New Jersey Holdings LLC Reliant Energy Ormond Beach, LLC Reliant Energy Osceola, LLC Reliant Energy Pennsylvania Holdings LLC Reliant Energy Services, Inc. Reliant Energy Shelby County, LP Sithe Blossburg LLC Sithe Conemaugh LLC Sithe Forked River LLC Sithe Gilbert LLC Sithe Glen Gardner LLC Sithe Hamilton LLC Sithe Hunterstown LLC Sithe Keystone LLC Sithe Mountain LLC Sithe Orrtanna LLC Sithe Piney LLC Sithe Portland LLC Sithe Sayreville LLC Sithe Seward LLC Sithe Shawnee LLC Sithe Shawville LLC Sithe Titus LLC Sithe Tolna LLC

Investor-Owned Electric Utility 1/	Power Marketer
Reliant Energy, Inc. (cont'd)	Sithe Warren LLC Sithe Wayne LLC Sithe Werner LLC York Haven Power Company
RGS Energy Group Inc.	Energetix, Inc.
SCANA Corporation	SCANA Energy Marketing, Inc.
Sempra Energy	El Dorado Energy, LLC Enova Energy, Inc. MEG Marketing, LLC Sempra Energy Trading Corp.
Southern Company	Mobile Energy Services Company, LLC SEI Wisconsin, LLC Southern Company Energy Marketing LP Southern Energy Bowline, LLC Southern Energy California, LLC Southern Energy Canal, LLC Southern Energy Delta, LLC Southern Energy Kendall, LLC Southern Energy Lovett, LLC Southern Energy New England, LLC Southern Energy NY-GEN, LLC Southern Energy Potrero, LLC Southern Energy Retail Trading and Marketing, Inc. State Line Energy, LLC
TECO Energy, Inc.	Commonwealth Chesapeake Company, LLC Hardee Power Partners Limited TECO EnergySource, Inc.
TXU Corp.	TXU Energy Trading Company
UGI Corporation	UGI Development Company UGI Power Supply, Inc.
UIL Holdings Corporation	Bridgeport Energy LLC
Unicom Corporation	Unicom Energy, Inc. Unicom Power Marketing, Inc.
UNITIL Corporation	Unitil Power Corp. Unitil Resources, Inc.
UtiliCorp United Inc.	Aquila Energy Marketing Corporation MEP Investments, LLC MEP Pleasant Hill, LLC Pleasant Hill Marketing, LLC
Vectren, Inc.	SIGCORP Energy Services, LLC
Wisconsin Energy Corporation	Griffin Energy Marketing, LLC Minergy Neenah, LLC Wisvest-Connecticut, LLC
WPS Resources Corporation	Mid-American Power LLC PDI Canada, Inc. PDI New England, Inc. Sunbury Generation, LLC WPS Energy Services, Inc. WPS Power Development, Inc.
Xcel Energy Inc.	Arthur Kill Power LLC Astoria Power LLC B.L. England Power LLC Cabrillo Power I LLC Cabrillo Power II LLC Cadillac Renewable Energy LLC Conemaugh Power LLC Connecticut Jet Power LLC

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Investor-Owned Electric Utility 1/	Power Marketer
Xcel Energy Inc. (cont'd)	Deepwater Power LLC Denver City Energy Associates, LP Devon Power LLC Dunkirk Power LLC e prime, inc. El Segundo Power, LLC Front Range Energy Associates, LLC Huntley Power LLC Indian River Power LLC Keystone Power LLC Long Beach Generation LLC Louisiana Generating LLC Middletown Power LLC Montville Power LLC Northbrook New York, LLC Norwalk Power LLC NRG Energy Center Paxton, Inc. NRG Power Marketing Inc. Oswego Harbor Power LLC Rocky Road Power, LLC Somerset Power LLC Texas-Ohio Power Marketing, Inc. Vienna Power LLC

1/ Company listed is either the holding company of investor-owned electric utility subisidiaries or when no holding company structure exists, the investor-owned utility operating company is listed.

Source: EEI Power Marketing Database, updated through June 15, 2000. See page ii for more information.

COMPLETED MERGERS AND ACQUISITIONS
MAJOR INVESTOR-OWNED ELECTRIC UTILITIES

August 1999 thru 10/15/00

Merger/Acquisition	Effective Date
Unicom Corp. and its subsidiaries, Commonwealth Edison Co. and Commonwealth Edison Co. of Indiana, merged with PECO Energy Co. and its subsidiaries, PECO Energy Power Co., Susquehanna Electric Co. and Susquehanna Power Co. under a new holding company, Exelon Corp.	10/20/00
CMP Group, Inc. and its subsidiary, Central Maine Power Company, merged with Energy East Corporation and its subsidiary, New York State Electric & Gas Corporation. Central Maine Power Company is a wholly-owned subsidiary of Energy East Corporation.	09/01/00
New Century Energies, Inc. and its subsidiaries, Cheyenne Light, Fuel and Power Company, Public Service Company of Colorado and Southwestern Public Service Company, merged with Northern States Power Company (MN) and its subsidiary, Northern States Power Company (WI), under a new holding company, Xcel Energy Inc.	08/17/00
Central and South West Corporation and its subsidiaries, Central Power & Light, Public Service Company of Oklahoma, Southwestern Electric Power Company and West Texas Utilities Company, merged with American Electric Power, Inc. and its nine investor-owned electric utility subsidiaries. The former Central and South West subsidiaries are wholly-owned subsidiaries of American Electric Power, Inc.	06/15/00
National Grid USA and its subsidiaries, Granite State Electric Company, Massachusetts Electric Company, Narragansett Electric Company, and Nantucket Electric Company, merged with Eastern Utilities Associates and its subsidiaries, Blackstone Valley Electric Company, Eastern Edison Company, and Newport Electric Corporation. Under terms of the merger, Eastern Edison Company is part of Massachusetts Electric Company while Blackstone Valley Electric Company and Newport Electric Corporation are part of Narragansett Electric Company.	04/19/00
SIGCORP, Inc. and its subsidiary, Southern Indiana Gas & Electric Company, merged with Indiana Energy and formed a new holding company, Vectren Corp.*	03/31/00
New England Electric System (NEES) and its subsidiaries, Granite State Electric Company, Massachusetts Electric Company, Narragansett Electric Company, and Nantucket Electric Company, merged with National Grid Group plc (National Grid). NEES has been renamed National Grid USA.	03/22/00
SCANA Corporation and its subsidiary, South Carolina Electric & Gas Company, merged with Public Service Company of North Carolina, Inc. As terms of the agreement, Public Service Company of North Carolina, Inc. will operate as a wholly-owned subsidiary of SCANA Corporation.	02/10/00
Illinova Corp. and its subsidiary, Illinois Power, merged with Dynegy Inc. Illinois Power is a regulated subsidiary of the holding company Dynegy, Inc.	02/01/00
Dominion Resources, Inc. and its subsidiaries, Virginia Power and North Carolina Power, merged with Consolidated Natural Gas Company (CNG). CNG is a direct subsidiary of Dominion Resources, Inc. *	01/28/00
Allegheny Power, a subsidiary of Allegheny Energy, Inc. purchased West Virginia Power, a division of UtiliCorp United Inc.	01/04/00
PacifiCorp was acquired by and became a subsidiary of ScottishPower Group.	11/30/99
CILCORP, Inc. and its subsidiary, Central Illinois Light Company, merged with the AES Corporation. Central Illinois Light Co. is a wholly-owned subsidiary of AES Corp.	10/18/99

* Convergence merger. Whether the companies involved appear in other areas of the Catalogue depends upon the post-merger structure of the company.

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INVESTOR-OWNED ELECTRIC UTILITIES
NO LONGER IN EXISTENCE
1965-October 2000

Company Name	Merged Into/Name Change*	Date
Adams Electric Light Co., Inc.	Niagara Mohawk Power Corp.	08/25/67
Albia Light and Railway Co.	Sheraton Valley Electric Coop.	10/01/89
Allegheny Power System, Inc.	*Allegheny Energy, Inc.*	08/07/97
Alliant Corporation	*Alliant Energy Corp.*	05/19/99
Alliant Utilities/IES Utilities Inc.	*Alliant Energy/IES Utilities Inc.*	05/19/99
Alliant Utilities/Interstate Power Co.	*Alliant Energy/Interstate Power Co.*	05/19/99
Alliant Utilities/Wisconsin Power & Light Co.	*Alliant Energy/Wisconsin Power & Light Co.*	05/19/99
Allied Power and Light Co.	Central Vermont Public Service Corp.	03/91
Arkansas-Missouri Power Co.	Arkansas Power & Light Co.	01/01/81
Arkansas Power & Light Co.	*Entergy Arkansas, Inc.*	1996
Atlantic Energy, Inc.	Conectiv	03/01/98
Austin Light & Power	Sierra Pacific Power Co.	05/03/76
Bay Point Light & Power Co.	Pacific Gas and Electric Co.	12/31/83
BEC Energy	NSTAR	08/25/99
Bells Light & Water Co.	Gibson County EMC	07/01/70
Berea College Electric Utility	*Berea College Utilities*	1990
Blackstone Valley Electric Co.	**Narragansett Electric Co.**	**04/19/00**
Boston Gas Co. (Elec. Operations)	Boston Edison Co.	12/28/72
Bozrah Light and Power Co.	City of Groton, CT	05/05/95
Bridgewater Electric Co.	Central Vermont Public Serv. Corp.	11/01/71
CMP Group, Inc.	**Energy East Corp.**	**09/01/00**
CP National Corp. (AZ)	City of Fredonia	01/01/87
CP National Corp. (CA)	Lassen Municipal Utility District	05/10/88
CP National Corp. (NV)	Nevada Power Co.	01/01/87
CP National Corp. (OR)	Oregon Trail Electric Consumers Coop.	10/01/88
Canton Electric Light & Power Co.	Niagara Mohawk Power Corp.	02/18/69
Cape & Vineyard Electric Co.	New Bedford Gas & Edison Light Co.	01/01/72
Carrabassett Light & Power Co.	Central Maine Power Co.	12/01/81
Casco Bay Light & Power Co.	Central Maine Power Co.	12/01/65
Cedar Point Light & Water Co.	Illinois Power Co.	03/29/85
Centel Corporation (Electric Operations)	UtiliCorp United, Inc.	09/30/91
Central and SouthWest Corp.	**American Electric Power Co., Inc.**	**06/15/00**
Central Illinois Elec. & Gas Co.	Commonwealth Edison Co.	12/66
Central Illinois Public Service Co.	*AmerenCIPS*	12/31/97
Central Kansas Power Co., Inc.	Central Kansas Electric Coop.	05/15/79
Central Louisiana Electric Co.	*Cleco Corporation*	04/24/98
CILCORP Inc.	**AES Corporation**	**10/18/99**
Chesapeake Light & Power Co.	Appalachian Power Co.	12/28/88
Chestertown Elec. Lgt. & Pwr. Co.	Delmarva Power & Light Co.	11/23/76
CIPSCO Inc.	Ameren Corporation	12/31/97
Citizens Light & Power Co.	Arkansas Power & Light Co.	1977
Cleco Corporation	*Cleco Utility Group, Inc.*	1999
Cochran Power & Light Co.	Southwestern Public Service Co.	11/01/82
Commonwealth Energy System	NSTAR	08/25/99
Community Light & Power Co.	Central Vermont Public Svc. Corp.	01/01/69
Conowingo Power Co.	Delmarva Power & Light Co.	06/19/95
Consumers Power Co.	*Consumers Energy*	01/01/97
Cornish & Kezar Falls Lgt. & Pwr. Co.	Maine Power Co.	07/01/65
Crisp Power Co.	Edgecombe-Martin County EMC	02/83
Cross Plains Electric Light Co.	Madison Gas and Electric Co.	07/22/81
Crossett Electric Co.	Middle South Utilities, Inc.	02/66
Dallas Power & Light Co.	TU Electric	01/01/84
Davenport Light & Power Co.	Edgecombe-Martin County EMC	01/01/69
Delmarva Power & Light Co., of MD	Delmarva Power & Light Co.	01/01/80
Delmarva Power & Light Co., of VA	Delmarva Power & Light Co.	01/01/80
Domestic Electric Service Inc.	Carolina Power & Light Co.	05/23/78

* Italics indicate company name change only. Bold denotes company changes that have occurred since September 1999.

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UTILITIES NO LONGER IN EXISTENCE, cont.'d

Company Name	Merged Into/Name Change*	Date
Eastern Edison Co.	**Massachusetts Electric Co.**	**04/19/00**
Eastern Utilities Associates	**National Grid USA**	**04/19/00**
Electric Co. Inc., The	Duke Power Co.	09/21/72
Elkland Electric Co.	Pennsylvania Electric Co.	12/23/87
Ellenville Electric Co.	Central Hudson Gas & Electric Corp.	02/67
Ellicottville Electric Light Co.	Niagara Mohawk Power Corp.	04/21/69
Ely Light & Power Co.	Mt. Wheeler Power Inc.	02/19/70
Enova Corporation	Sempra Energy	07/01/98
ESELCO, Inc.	Wisconsin Energy Corp.	05/31/98
Eureka Light & Power Co.	Mt. Wheeler Power Inc.	07/26/72
Fall River Electric Light Co.	Eastern Edison Co.	07/31/79
Farmers Electric Co.	Iowa Public Service Co.	05/26/67
Fletcher Electric Light Co.	Connecticut Light and Power Co., The	10/27/92
Franconia Paper Corp. Inc.	New Hampshire Electric Coop.	1971
Franklin Electric Light Co.	Citizens Utilities Co.	08/10/93
Franklin Power & Light Co.	Mid Tennessee EMC	03/71
Gideon-Anderson Lumber Co.	Arkansas-Missouri Power Co.	07/24/78
Gildersleeve, J.R. Estate	Appalachian Power Co.	03/01/70
Gilman Electric Light & Power Co.	Central Vermont Public Service Corp.	08/01/68
Graben Light & Power Co.	Oklahoma Gas and Electric Co.	03/13/70
Greenville Electric Lighting Co.	Public Service Co., of New Hampshire	06/15/71
Gulf States Utilities Co.	*Entergy Gulf States, Inc.*	1996
Haines Light & Power Co., Inc.	Alaska Electric Light & Power Co.	12/29/98
Hamden Newburgh Light & Power Co.	Bangor Hydro-Electric Co.	12/66
Hartford Electric Light Co., The	Connecticut Light & Power Co., The	07/01/82
Harvey's Lake Light Co.	UGI Corp.	09/67
Heath Springs Light & Power Co.	Lynches River Electric Coop.	12/31/86
Hershey Electric Co.	Pennsylvania Power & Light Co.	03/01/80
Home Electric Co.	Pennsylvania Electric Co.	06/66
Home Light & Power Co., CO	Public Service Co. of Colorado	11/01/86
Home Light & Power Co., MN	Northern States Power Co.	06/18/86
Horton Power Co.	Arizona Public Service Co.	06/01/65
Houston Industries, Inc.	*Reliant EnergyInc.*	02/08/99
Houston Lighting & Power Co.	*Reliant Energy HL&P*	02/08/99
Huntington Electric Light Co.	Western Massachusetts Electric Co.	07/31/71
IES Utilities Inc.	*Alliant Utilities/IES Utilities Inc.*	04/21/98
Illinova Corporation.	**Dynegy**	**02/01/00**
Indian Valley Light & Power Co.	Pacific Gas & Electric Co.	05/66
International Electric Co.	Vermont Electric Coop.	1970
Interstate Energy Corporation	*Alliant Energy Corporation*	05/28/99
Interstate Power Company	*Alliant Utilities/Interstate Power Co.*	04/21/98
Iowa Electric Light and Power Co.	IES Utilities Inc.	12/31/93
Iowa-Illinois Gas and Electric Co.	MidAmerican Energy Company	07/01/95
Iowa Power and Light Co.	*Iowa Power Inc.*	1990
Iowa Power Inc.	Midwest Power Systems Inc.	07/22/92
Iowa Public Service Co.	Midwest Power Systems Inc.	07/22/92
Iowa Southern Utilities Co.	IES Utilities Inc.	12/31/93
Joanna Community Corp.	Laurens Electric Coop.	08/66
KU Energy Corporation	LG&E Energy Corp.	05/04/98
Kansas Power and Light Co., The	Western Resources, Inc.	03/31/92
Kershaw Power & Light Co.	Duke Power Co.	08/17/70
Kittery Electric Light Co.	Public Service Co. of New Hampshire	10/01/65
Lahaina Light & Power Co., Ltd.	Maui Electric Co., Ltd.	10/13/67
Lake Electric Corp.	Franklin Electric Light Co.	01/01/80
Lake Superior District Power Co.	Northern States Power Co., WI	12/31/86
Laona Public Service Co.	Wisconsin Public Service Corp.	09/21/76
Laurel Hill Electric Co., Inc.	Pee Dee Electric Membership Corp	02/01/85
LaValle Electric Co.	Oakdale Electric Coop	10/01/70

* Italics indicate company name change only. Bold denotes company changes that have occurred since September 1999.

UTILITIES NO LONGER IN EXISTENCE, cont'd

Company Name	Merged Into/Name Change*	Date
Lawrence Park Heat, Light & Power Co., The	Consolidated Edison Co. of NY, Inc.	06/30/86
Lincoln Service Corp.	Utah Power & Light Co.	01/01/81
Lloyd, W.A., Inc.	Rangeley Power Co.	1966
Long Island Lighting Company	MarketSpan Corporation	05/28/98
Louisiana Power & Light Co.	*Entergy Louisiana, Inc.*	1996
Maine Consolidated Power Co.	Maine Power Co.	10/66
Manchester Electric Co.	Massachusetts Electric Co.	07/01/83
Marietta Electric Co.	Monongahela Power Co.	01/66
MarketSpan Corporation	*KeySpan Energy Corporation*	09/10/98
Medicine Bow Electric Co.	Hotsprings County REA, Inc.	
Michigan Power Co.	Indiana Michigan Power Co.	02/29/92
Middle South Utilities Inc.	Entergy Corp.	05/19/89
Midwest Power Systems Inc.	MidAmerican Energy Company	07/01/95
Minnesota Power, Inc.	***ALLETE***	**09/05/00**
Mississippi Power & Light Co.	*Entergy Mississippi, Inc.*	1996
Missouri Edison Co.	Union Electric Co.	12/30/83
Missouri Power & Light Co.	Union Electric Co.	12/30/83
Missouri Public Service Co.	UtiliCorp United Inc.	05/01/85
Missouri Utilities Co.	Union Electric Co.	12/30/83
Molokai Electric Co., Ltd.	Hawaiian Electric Co., Inc.	08/89
Montana Light and Power Co.	The City of Troy, MT	12/04/87
Monterey Utilities Corp., The	Potomac Edison Co., The	05/31/74
Newport Electric Co.	**Narragansett Electric Co.**	**04/19/00**
New Century Energies	**Xcel Energy Inc.**	**08/21/00**
New England Electric System (NEES)	**National Grid USA**	**03/22/00**
New Jersey Power & Light Co.	Jersey Central Power & Light Co.	08/01/73
New Mexico Electric Service Co.	Southwestern Public Service Co.	05/01/83
New Orleans Public Service, Inc.	*Entergy New Orleans, Inc.*	1996
NIPSCO Industries, Inc.	*NiSource Inc.*	03/99
North Carolina Power Co.	***Dominion North Carolina Power***	**08/28/00**
Northern Commercial	Unknown	1980
Northwestern Public Service Co.	*Northwestern Corporation*	05/07/98
Old Dominion Power Co.	Kentucky Utilities Co.	12/01/91
Oklahoma Gas and Electric Co.	*OG&E Electric Services*	1995
Pacific Power & Light Co.	PacifiCorp	01/09/89
Paul Electric Co.	Rural Electric Co.	07/66
Paul Smith's Elec. Light & Pwr. Railroad Co.	Niagara Mohawk Power Corp.	02/66
Peach Lake Utilities Inc.	New York State Electric & Gas Corp.	10/31/80
Pecos Light & Power Co., Inc.	Mora-San Miguel Electric Coop., Inc.	04/01/68
Pemberton Light & Water Co.	Appalachian Power Co.	03/01/74
Pennsylvania Power & Light Company	*PP&L, Inc.*	09/97
Peoples Utilities, Inc.	Louisiana Power & Light Co.	10/66
Perkinsville Service Corp.	Central Vermont Public Service Corp.	05/28/71
Philadelphia Electric Co.	*PECO Energy Co.*	1994
Philadelphia Electric Power Co.	*PECO Energy Power Co.*	1994
Phillips Electric Light & Power Co.	Central Maine Power Co.	10/66
Pinedale Power & Light Co., The	Unknown	1974
Pinehurst Inc.	Carolina Power & Light Co.	1981
Pioche Power & Light Co.	Pioche Public Utilities	07/01/71
Plymouth County Electric Co.	New Bedford Gas & Electric Co.	01/66
Portland General Corporation	Enron Corp.	07/01/97
Potomac Edison Co. of PA, The	Potomac Edison Co., The	05/31/74
Potomac Edison Co. of VA, The	Potomac Edison Co., The	05/31/74
Potomac Edison Co. of WV, The	Potomac Edison Co., The	05/31/74
PP&L Resources, Inc.	***PPL Corporation***	**02/14/00**
PP&L, Inc.	***PPL Utilities***	**02/14/00**
Preston Electric Co.	Monongahela Power Co.	01/01/88
Prudence Island Utilities Corp., Elec. Div.	Newport Electric Corp.	05/15/68
PSI Resources, Inc.	*Cinergy Corp.*	1994
Public Service Co. of Indiana	*PSI Energy, Inc.*	1990
Puget Sound Power & Light Co.	*Puget Sound Energy*	04/21/97

* Italics indicate company name change only. Bold denotes company changes that have occurred since September 1999.

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UTILITIES NO LONGER IN EXISTENCE, cont.'d

Company Name	Merged Into/Name Change*	Date
Rainey River Improvement Co.	Minnesota Power	01/01/81
Rangeley Power Co.	Central Maine Power Co.	06/30/76
Reedy Creek Utilities Co., Inc.	Reedy Creek Improvement District (Municipal)	1990
Rocky Mount Mills	Rocky Mount, NC Municipal	10/15/69
Roger City Power Co.	Consumers Power Co.	09/67
SCEcorp	*Edison International*	1996
Sewell Valley Utilities Co.	Appalachian Power Co.	08/31/72
Sherrard Power System	Iowa-Illinois Gas and Electric Co.	10/01/86
Sherrill-Kenwood Paper & Light Co., The	The City of Sherrill, NY	01/01/77
SIGCORP, Inc.	**Vectren Corporation**	**03/31/00**
Siler Light Plant	Northern Indiana Public Service Co.	10/16/72
South Shore Utility Co.	Combined Locks, WI Municipal	
St. Regis Paper Co.	PUD Goldendale, WA	1977
Stockton Light & Power Co.	Delmarva Power & Light Co	06/06/74
Stonington & Deer Isle Power Co.	Bangor Hydro-Electric Co.	11/23/87
Svilar Light & Power Co., Inc.	Pacific Power & Light Co.	02/86
Tallahassee Utility Co.	Alabama Power Co.	02/68
Texas Electric Service Co.	TU Electric	01/01/84
Texas Hydro Electric Co.	Guadalupe-Blanco River Authority	03/27/64
Texas Power & Light Co.	TU Electric	01/01/84
Texas Power Corp.	Guadalupe-Blanco River Authority	03/27/64
Thrasher, J.J. Power Co.	Sierra Pacific Power Co.	1966
Tigerton Electric Co.	Central Wisconsin Electric Coop.	09/01/71
Tongas Power & Light Co.	British Columbia Hydro	05/31/65
Texas Utilities Company	*TXU Corp.*	05/14/99
TU Electric	*TXU Electric & Gas*	05/14/99
Unicom Corporation	**Exelon Corporation**	**10/20/00**
Union Electric Co.	*AmerenUE*	12/31/97
Upper Peninsula Energy Corporation	WPS Resources Corporation	09/29/98
Utah Power & Light Co.	PacifiCorp	01/09/89
Utilicorp United Inc. (West Virginia Power)	**Allegheny Power**	**01/04/00**
Valley Power Co.	Southern California Edison Co.	06/66
Vinalhaven Light & Power Co.	Fox Island Electric Coop.	11/75
Virginia Electric and Power Co.	**Dominion Virginia Power**	**08/28/00**
WPL Holdings Inc.	Alliant	04/21/98
Wapello Light & Gas Co.	Iowa Southern Utilities Co.	01/01/70
Washington Mills Co.	Duke Power Co.	11/01/67
Washington Water Power Company	*Avista Corp.*	01/01/99
Waterford Electric Light Co.	Pennsylvania Electric Co.	12/31/76
West Dunkirk Electric Line Co.	Stoughton, WI Municipal	10/06/69
Western Colorado Power Co.	Western Colorado Power Energy	05/01/75
West Maryland Power Co.	Monongahela Power Co.	01/66
West Virginia Power Co.	UtiliCorp United Inc.	05/01/85
Windber Electric Corp.	Pennsylvania Electric Co.	12/01/78
Wisconsin Michigan Power Co.	Wisconsin Electric Co.	01/01/78
Wisconsin Power & Light Co.	*Alliant Utilities/Wisconsin Power & Light Co.*	04/21/98
Woodland Water & Electric Co.	Eastern Maine Electric Coop.	12/14/76

* Italics indicate company name change only. Bold denotes company name changes that have occurred since September 1999.

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DOE002-1341

EEI Statistics Publications

Advance Release—2000 Edition Data for the Statistical Yearbook of the Electric Utility Industry/1999

Get your first look at 1999 electric utility industry data with EEI's *Advance Release – 2000 Edition*. This is the initial data collection charting 1999 electric utility operations and financial performance. Previewing year-end results in easy-to-read charts and tables, this release provides the most current data available on:

- Installed capacity by state and prime mover
- Generation by state and prime mover
- Fuel consumption
- Customers, sales, and revenues by state and customer class
- Revenue per kilowatthour by state and customer class
- Revenue and use per customer by state and customer class
- Combined balance sheets and income statements
- Long-term financing
- And more

Use these figures to get a head start on your analysis of 1999. EEI, 2000.

Item# 03-00-11
List Price: $90.00
EEI Member Price: $45.00

Capacity and Generation of Non-Utility Sources of Energy

The data is now available as special data reports. The summary tables containing capacity and generation by state, type of producer, fuel and industry class will be created for immediate delivery. You can also request custom data runs to meet your specific data needs. Order a single table or as many as you need with exactly the data you need...and no data that you don't need! Data are available for calendar years 1985 through 1998.

Give EEI a call and let's discuss your data needs! Call Peggy Suggs at 202-508-5572 or e-mail psuggs@eei.org

Catalogue of Investor-Owned Electric Utilities — 2000 Edition

The *Catalogue* is an essential reference that should be on the shelf of all energy professionals! Expanded and completely updated!

Your one-stop resource for:

- Who are the industry's players?
- Which companies have merged or changed names?
- Which companies are no longer in existence?
- Which companies are jointly owned?

You get complete IOU listings of:

- All operating companies (Organized by state)
- All holding companies and systems
- All jointly-owned and combination companies

Company information includes:

- Current company names, addresses and telephone numbers
- Revenues
- Rankings by sales, revenues, and customers
- Ultimate customers
- Megawatthour sales
- Mergers and acquisitions
- Power marketing affiliates of investor-owned electric utilities

This nuts-and-bolts directory is a basic reference that should be on the office shelf of everyone involved in the energy industry! Available as a print publication or as a PDF file. EEI, 2000.

FREE to EEI Utility Members – EEI Utility Members have FREE access to the *Catalogue* in EEI Member Net's Products and Services section at www.eei.org/member_net. Print copies can be purchased for an additional cost.

Print Format:
Item # 03-00-12
List Price: $95.00
EEI Associate Member Price: $45.00
EEI Utility Member Price: Free electronically in EEI Member Net, print copies are $45.00

PDF File:
Item #03-00-18
List Price: $75.00
EEI Associate Member Price: $25.00
A PDF file will be e-mailed to you within three days of receipt of payment.

Customized Statistical Reports

Customized computer runs for special information needs are available. Using any data element in the *Statistical Yearbook*, or *Capacity and Generation: Non-Utility Sources of Energy*, special reports can be created. Historical data is also available. Contact the EEI Statistics Department at (202) 508-5574.

Historical Statistics of the Electric Utility Industry through 1992

This comprehensive reference traces important operating and financial data as far back as 1902. Data are presented in tables that clearly show information and trends for both the investor-owned electric utilities and the total electric utility industry. Various categories make accessibility easy:

- Generating capacity
- Electric power supply
- Generation
- Fuel
- Energy
- Energy sales
- Customers
- Revenues
- Financial
- Economics
- And more

Tables sorted by state cover statistics from 1960 through 1992. Starting years for each series may vary depending on information availability. Data has been compiled from EEI's statistical questionnaires, the Federal government, and the private sector. Recommended for energy analysts, consultants, investors, students, and anyone interested in the electric utility industry. EEI, 1995.

Item # 11-95-01
List Price: $200.00
EEI Member Price: $100.00

Historical Statistics of the Electric Utility Industry through 1992 (Diskette)

Files are in standard LOTUS 1-2-3® format for easy retrieval and manipulation of tables. All information is identical to and appears in the same order as the book for easy reference. Full or partial installation may be chosen depending on available computer memory.

Diskette
Item # 11-95-03
List Price: $350.00
EEI Member Price: $175.00

Book and Diskette Set
Item #11-95-04
List Price: $395.00
EEI Member Price: $195.00

Rankings of Investor-Owned Electric Utilities—1999 Edition

Who are the major players in today's changing market place? This barometer of the investor-owned electric utility industry provides information on the top 50 utilities in several categories. Includes rankings on a holding-company basis by assets and by electric operating revenues; on an operating company basis by ultimate customer, sales to ultimate customers, and by revenues to ultimate customers. A comparative ranking, showing total revenues, customers, and sales – ranked by revenues – is also provided. Additional rankings include net generation, number of employees, total sales for resale, and fossil fuel receipts (top ten).

Additional holding company rankings include total operating revenues, market capitalization, and total employees. Useful for utilities, public service commissions, governmental agencies, energy consultants, and financial institutions, Rankings helps industry stakeholders with company-to-company comparisons. EEI, 1999.

Item # 71-99-10
List Price: $90.00
EEI Member Price: $45.00

24

performance

raised to the power of El Paso

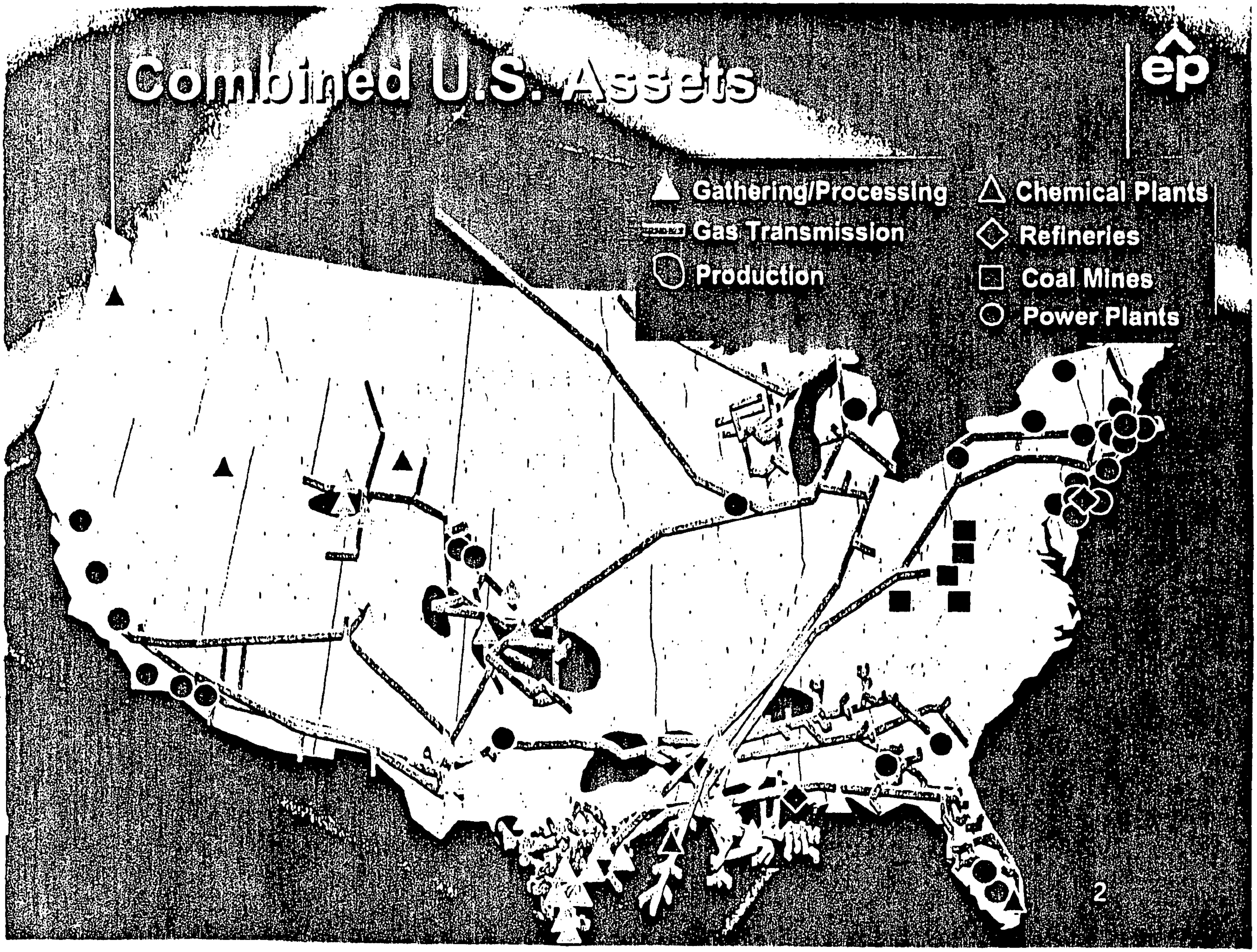
ep

Clark Smith

President

Merchant Energy North America

elpaso Merchant Energy Group

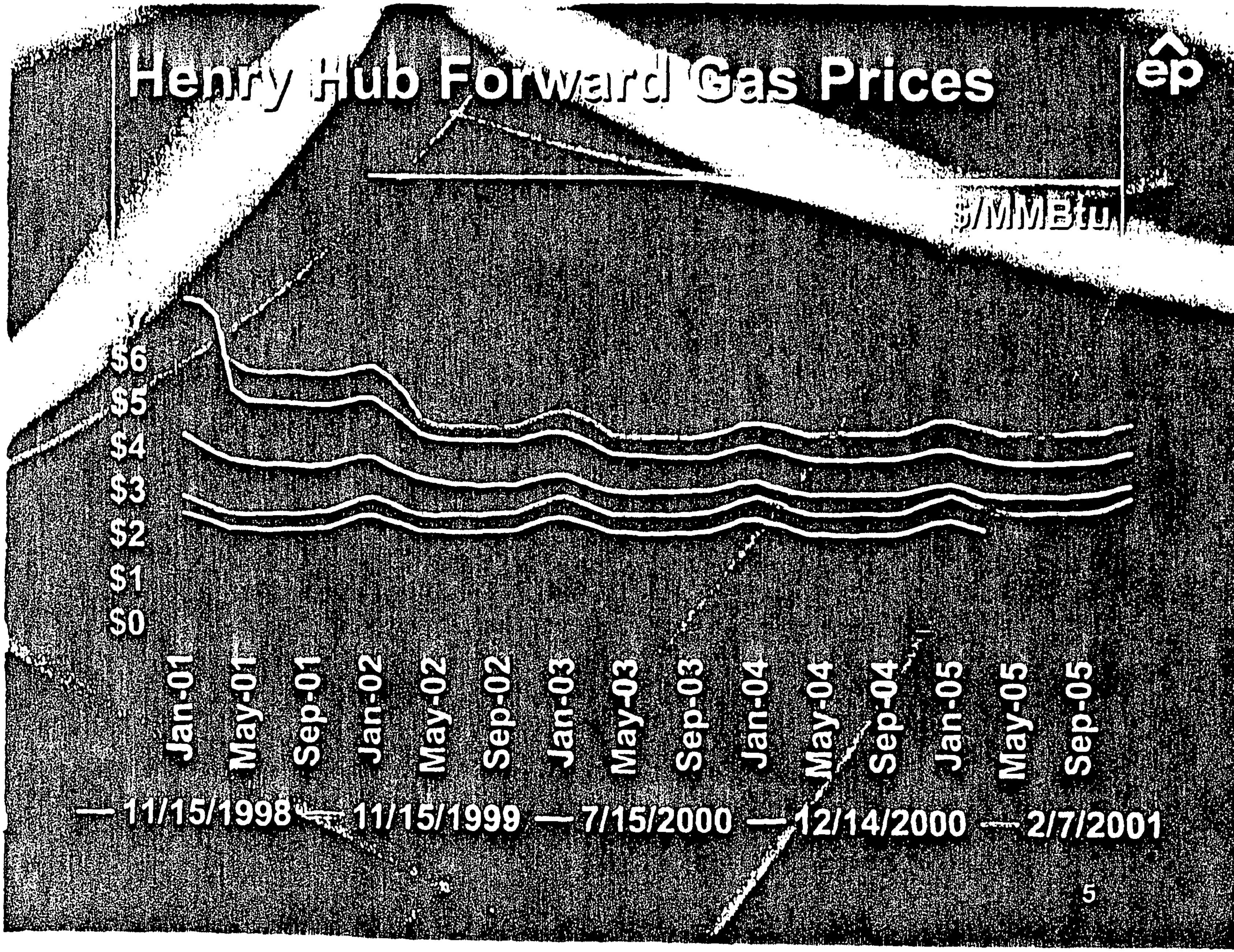

Combined U.S. Assets
ep
Gathering/Processing
Gas Transmission
Production
Chemical Plants
Refineries
Coal Mines
Power Plants
2

El Paso Energy

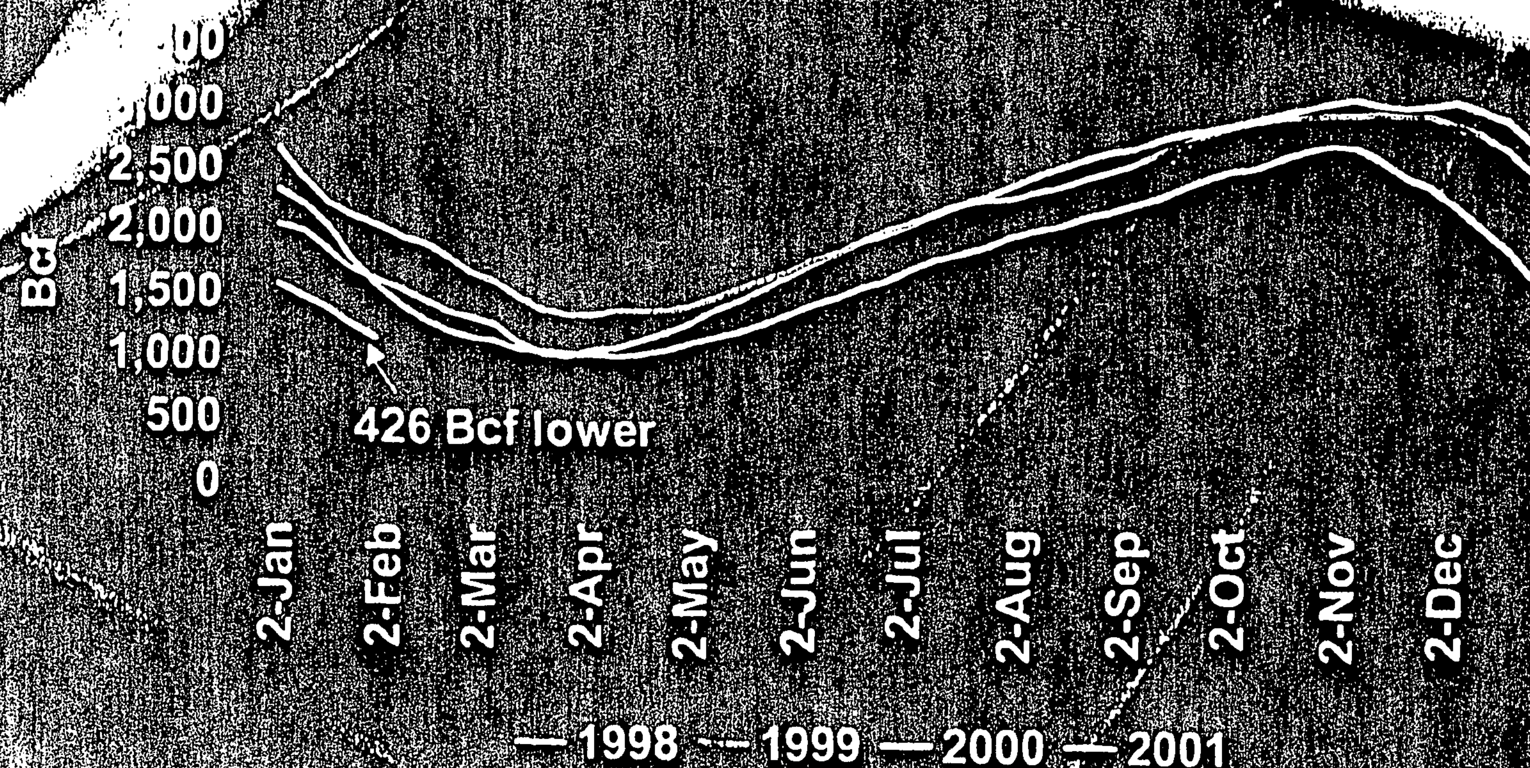
El Paso Energy Corporation

Regulated	Non-Regulated	Telecommunications
El Paso Natural Gas	El Paso Production	El Paso Global Networks
Tennessee Gas Pipeline	El Paso Field Services	
Southern Natural Gas	El Paso Merchant Energy	
Colorado Interstate Gas	El Paso Energy International	
ANR Pipeline		

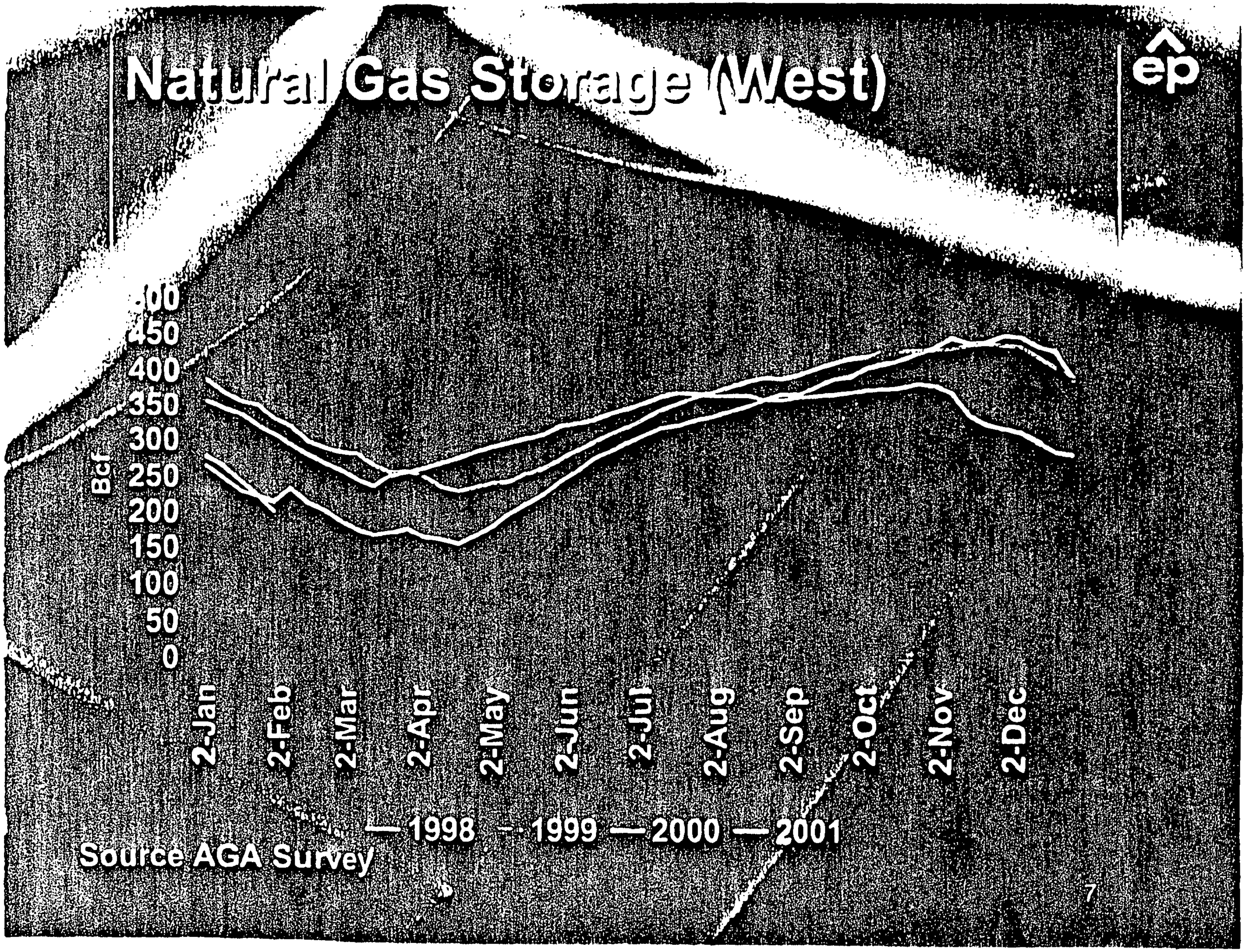
Market Dynamics


Henry Hub Forward Gas Prices
ep
$/MMBtu
$6
$5
$4
$3
$2
$1
$0
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
May-05
Sep-05
11/15/1998
11/15/1999
7/15/2000
12/14/2000
2/7/2001
5

U.S. Natural Gas Storage

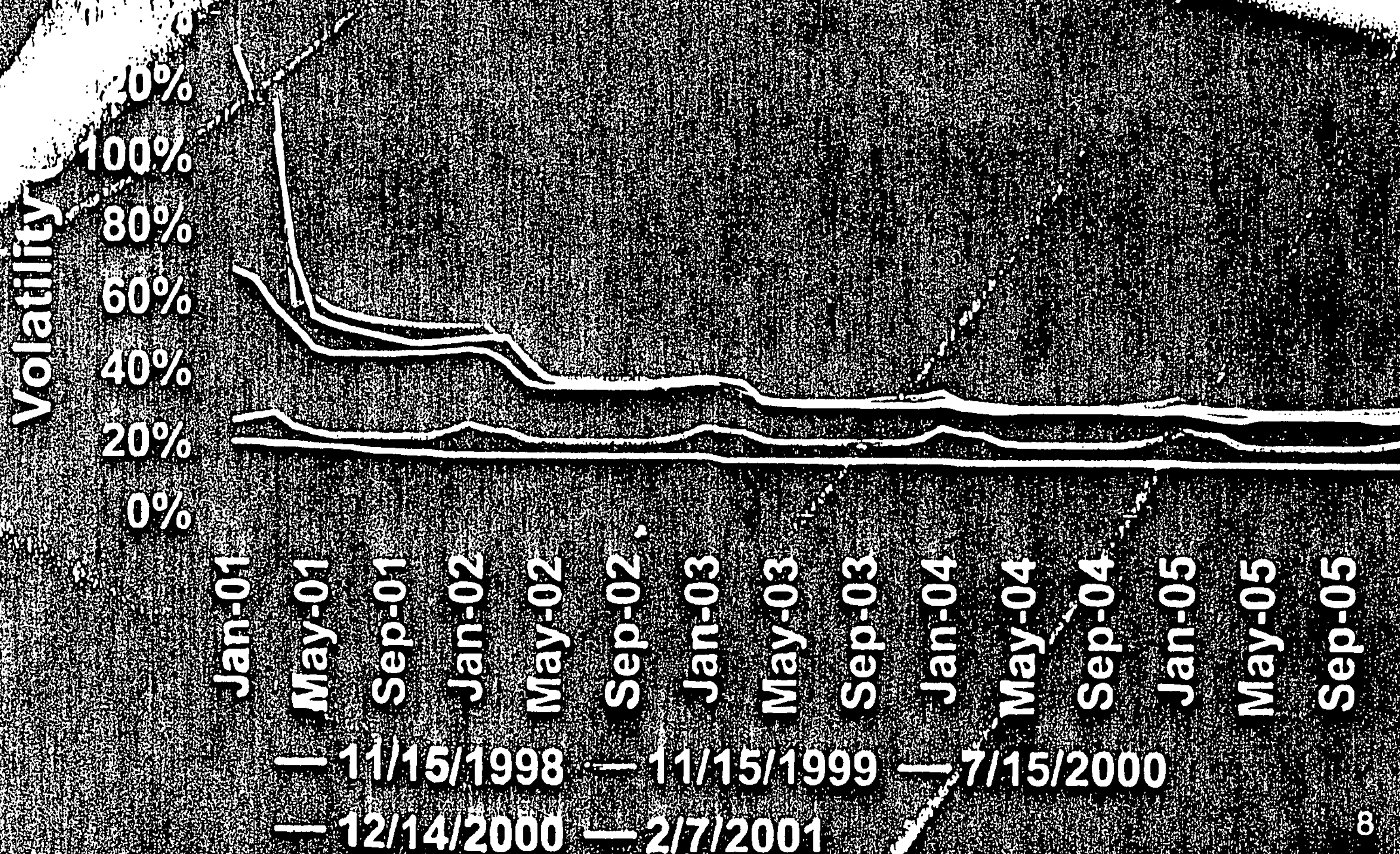


Source: 02/02/01 AGA Survey



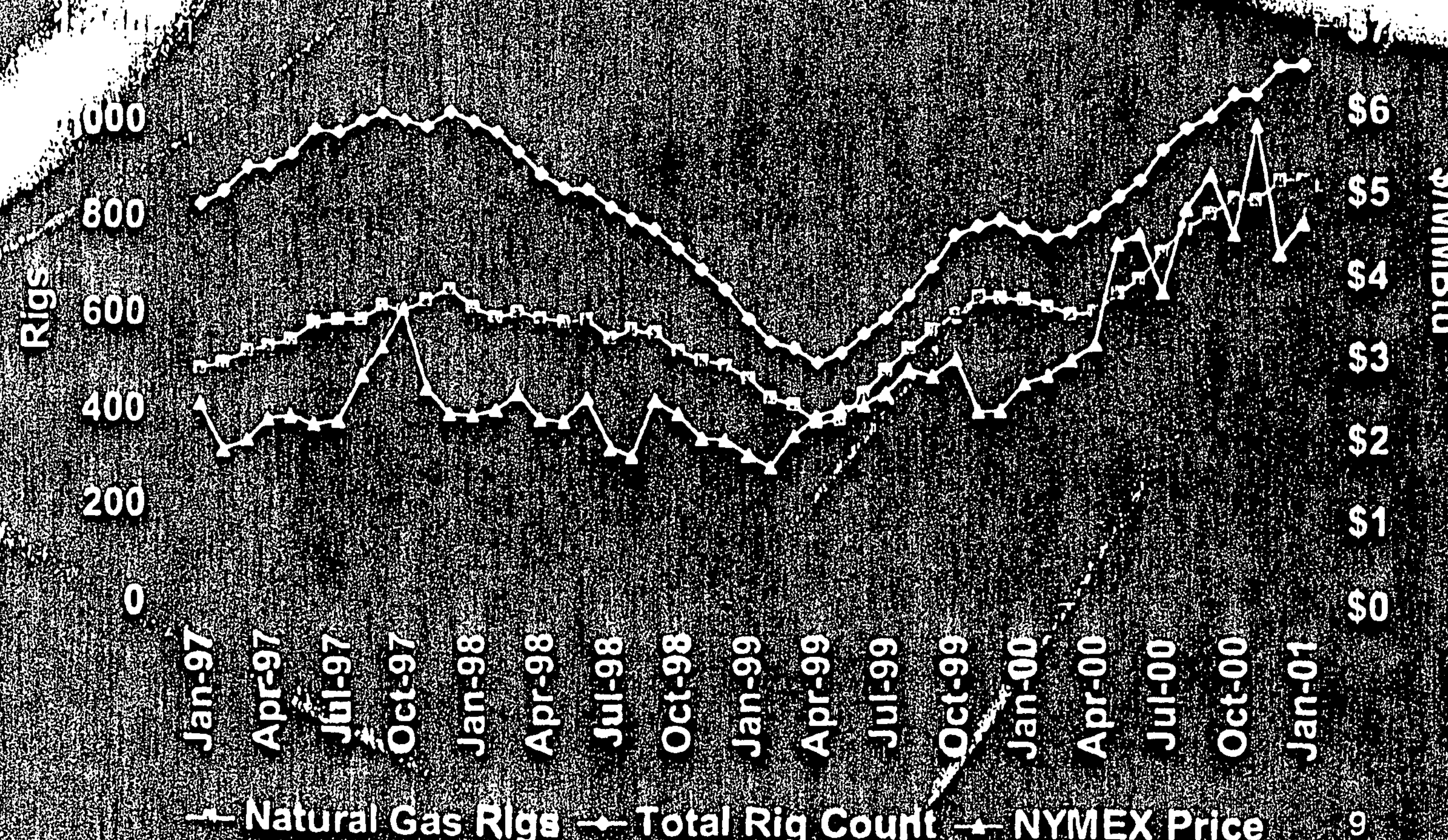
Natural Gas Storage (West)
ep
Bcf
450
400
350
300
250
200
150
100
50
0
2-Jan
2-Feb
2-Mar
2-Apr
2-May
2-Jun
2-Jul
2-Aug
2-Sep
2-Oct
2-Nov
2-Dec
—1998 - -1999 —2000 —2001
Source AGA Survey
7

Implied Volatility Natural Gas Prices

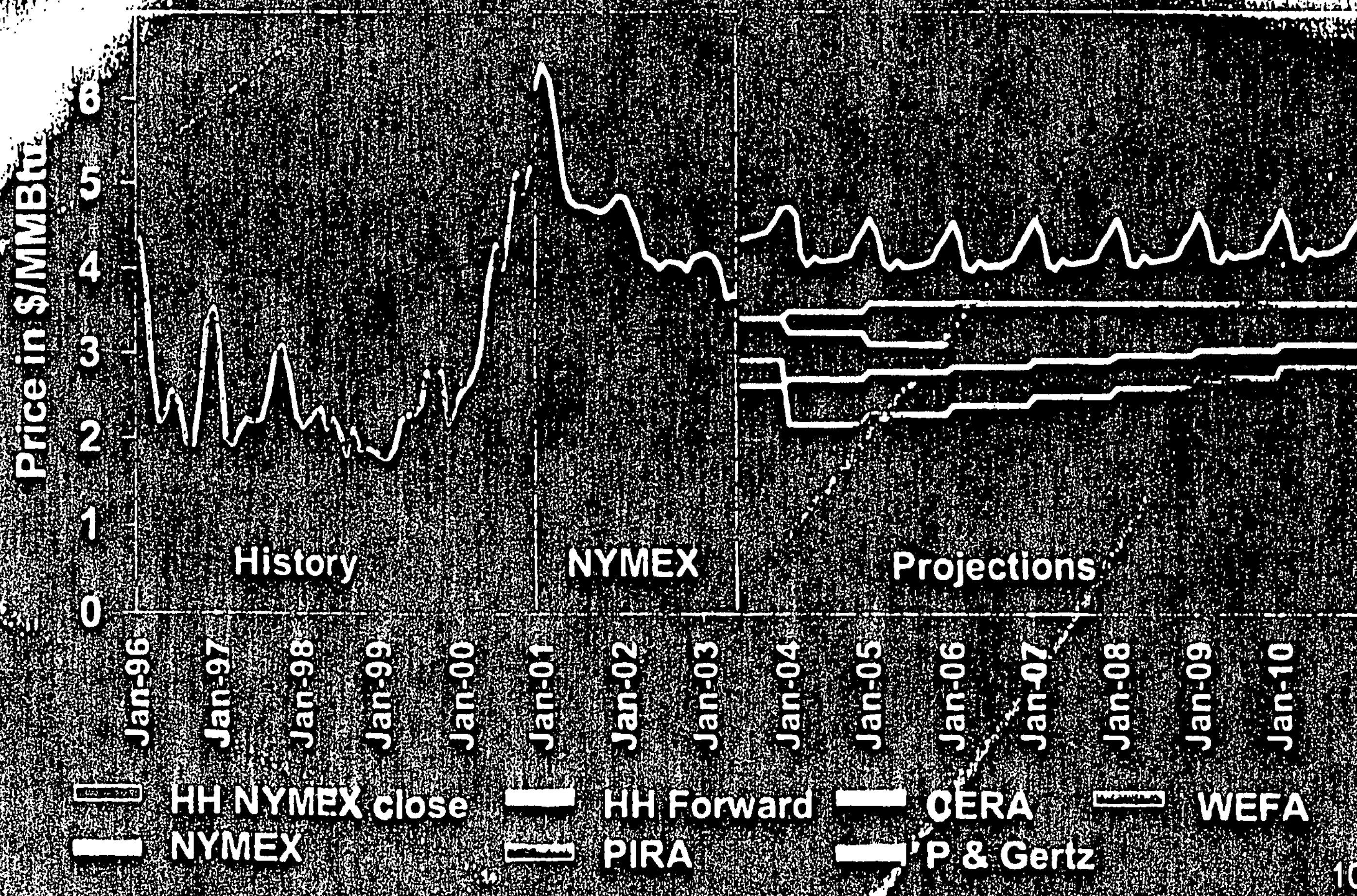


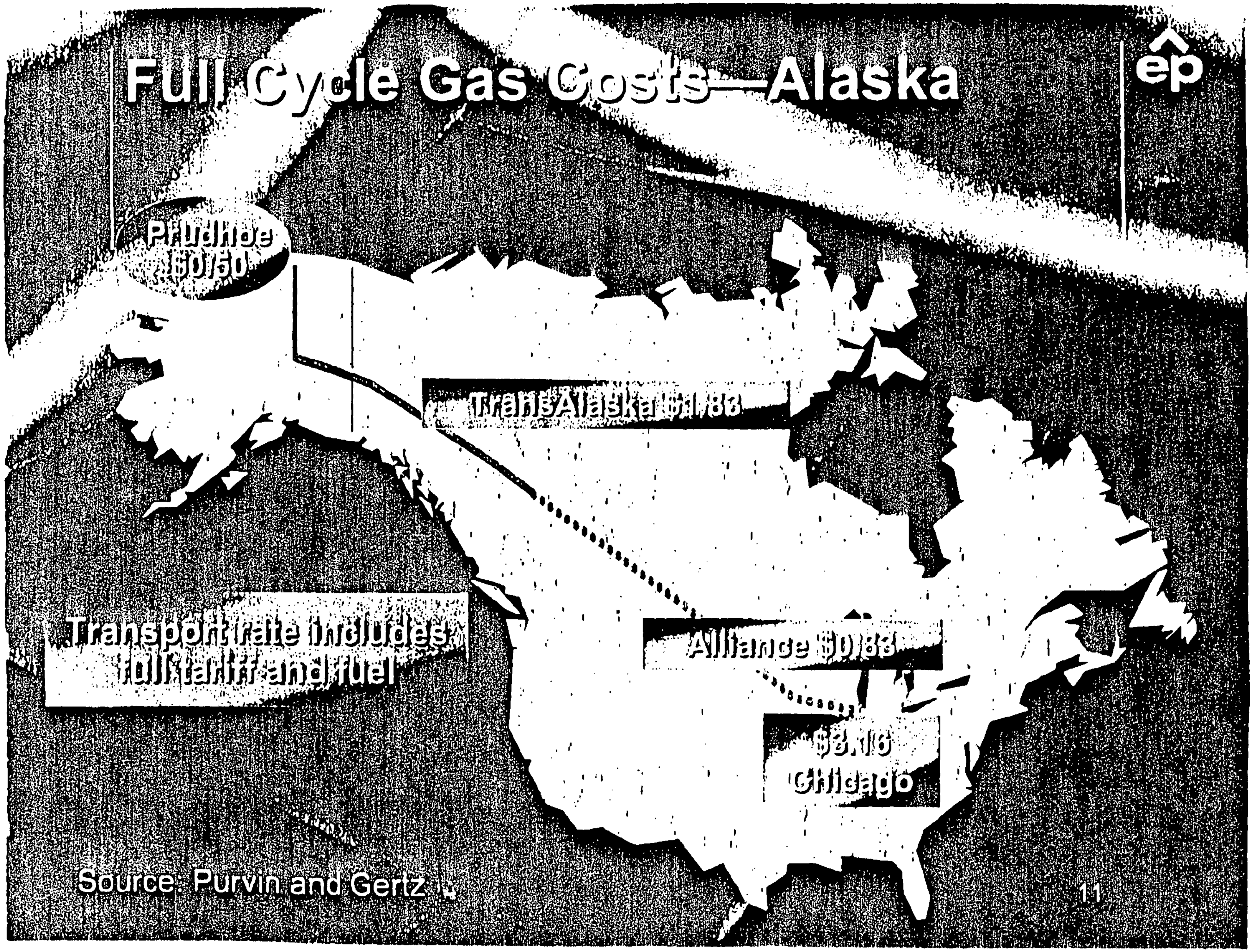
U.S. Rotary Rig Count vs. NYMEX Gas

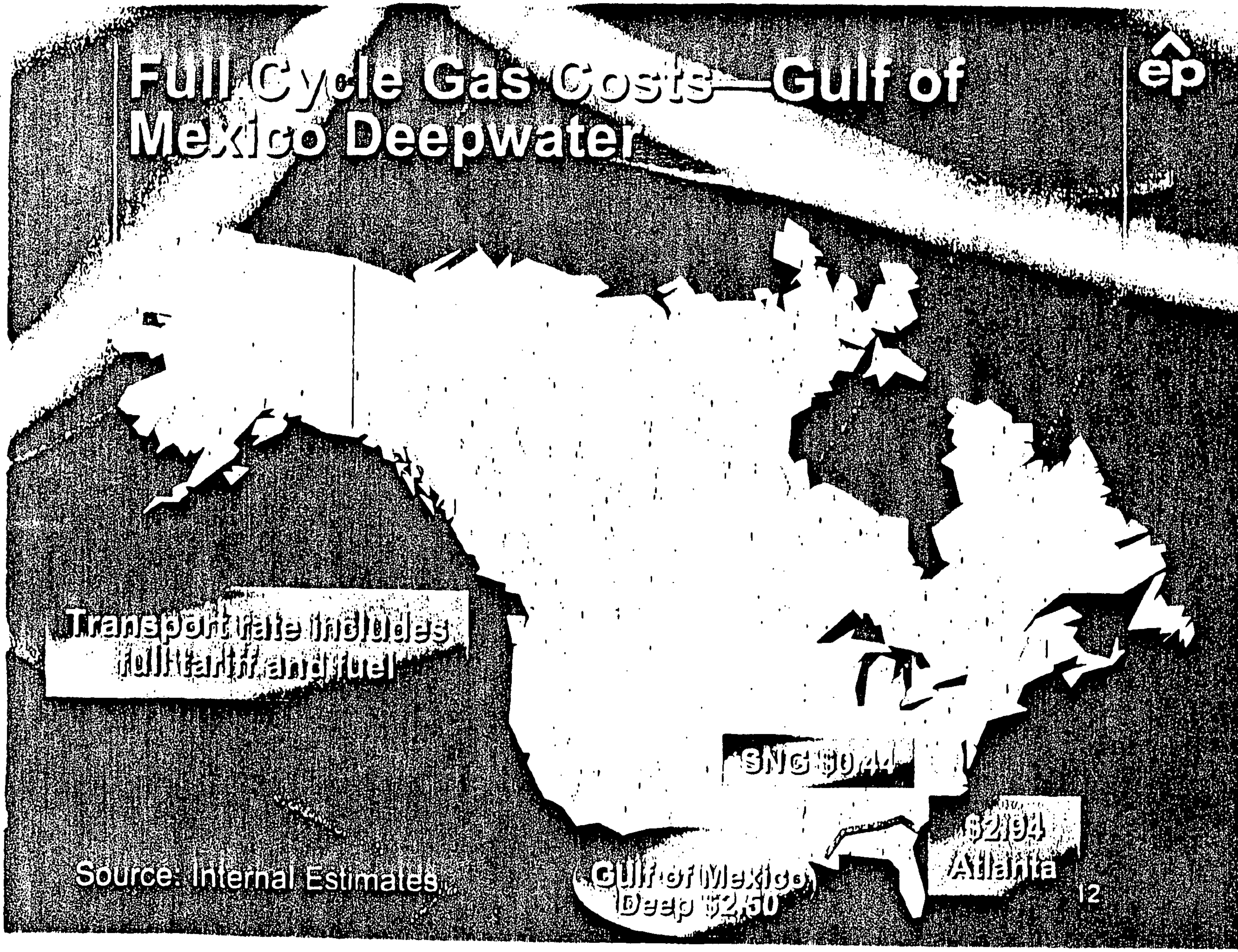
ep

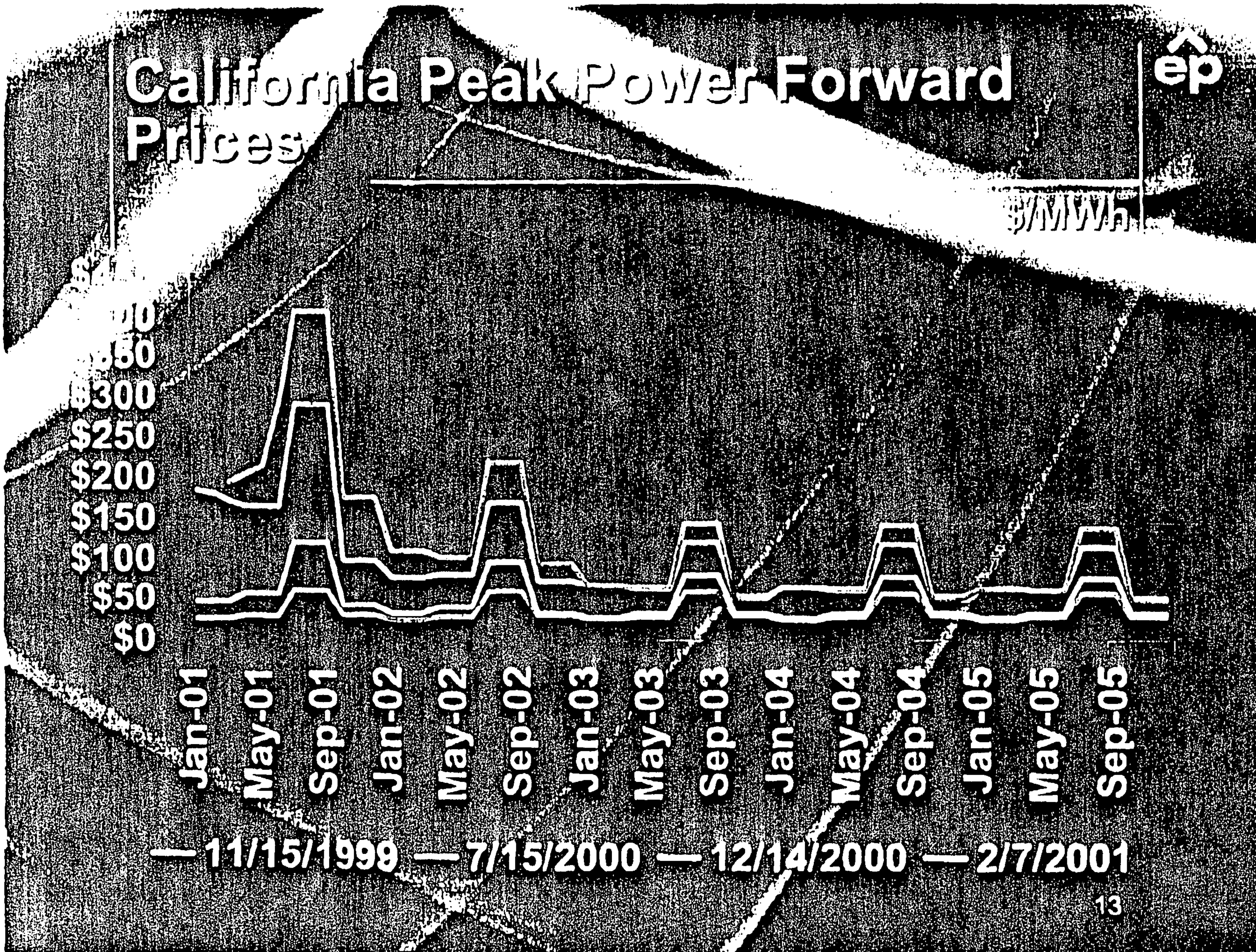


Henry Hub Price Projections




Full Cycle Gas Costs—Alaska
ep
Prudhoe
$0.50
TransAlaska $1.83
Transport rate includes
full tariff and fuel
Alliance $0.83
$3.16
Chicago
Source: Purvin and Gertz
11


Full Cycle Gas Costs—Gulf of Mexico Deepwater
ep
Transport rate includes full tariff and fuel
SNG $0.44
$2.94 Atlanta
Gulf of Mexico Deep $2.50
Source: Internal Estimates
12



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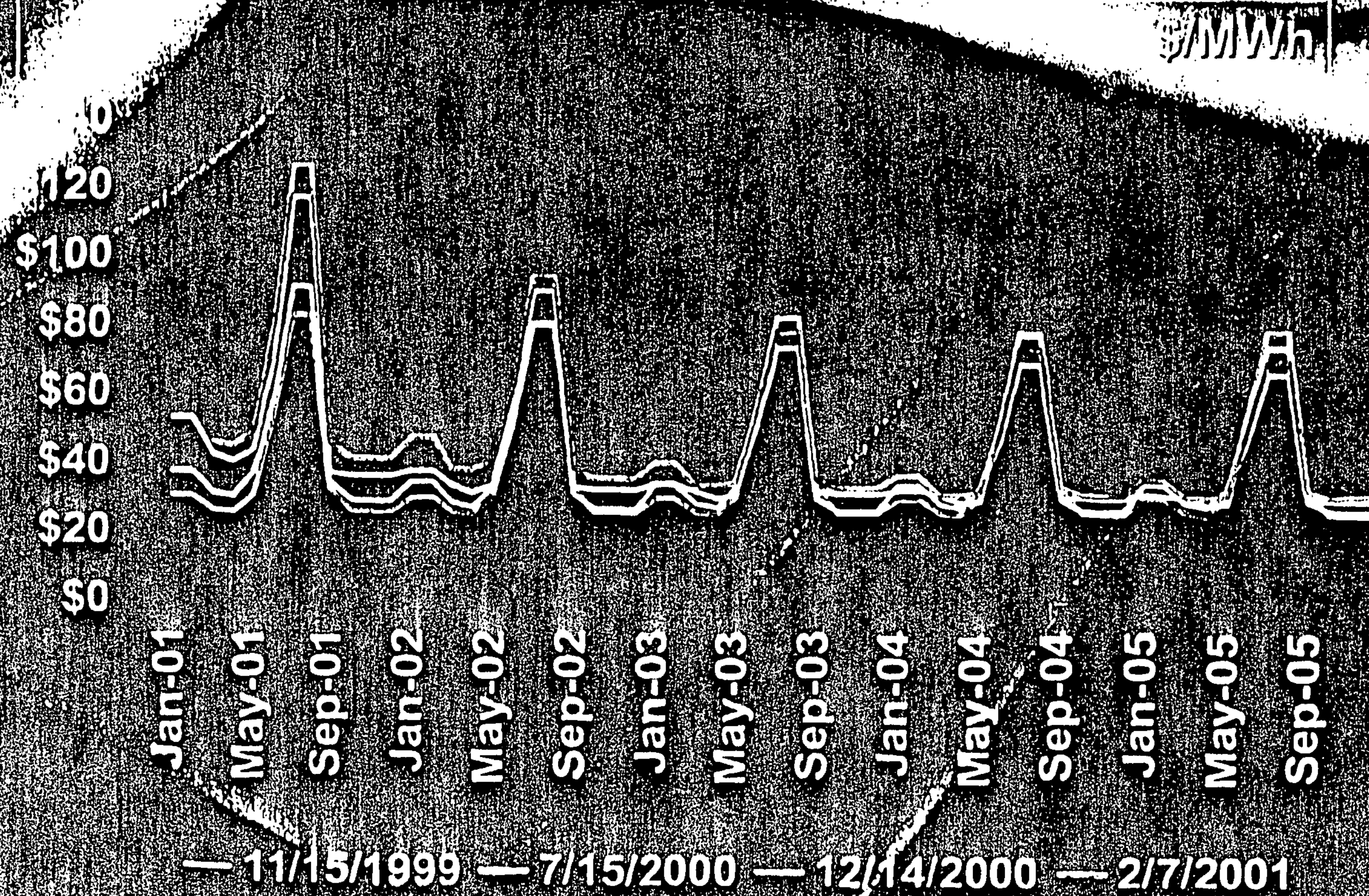
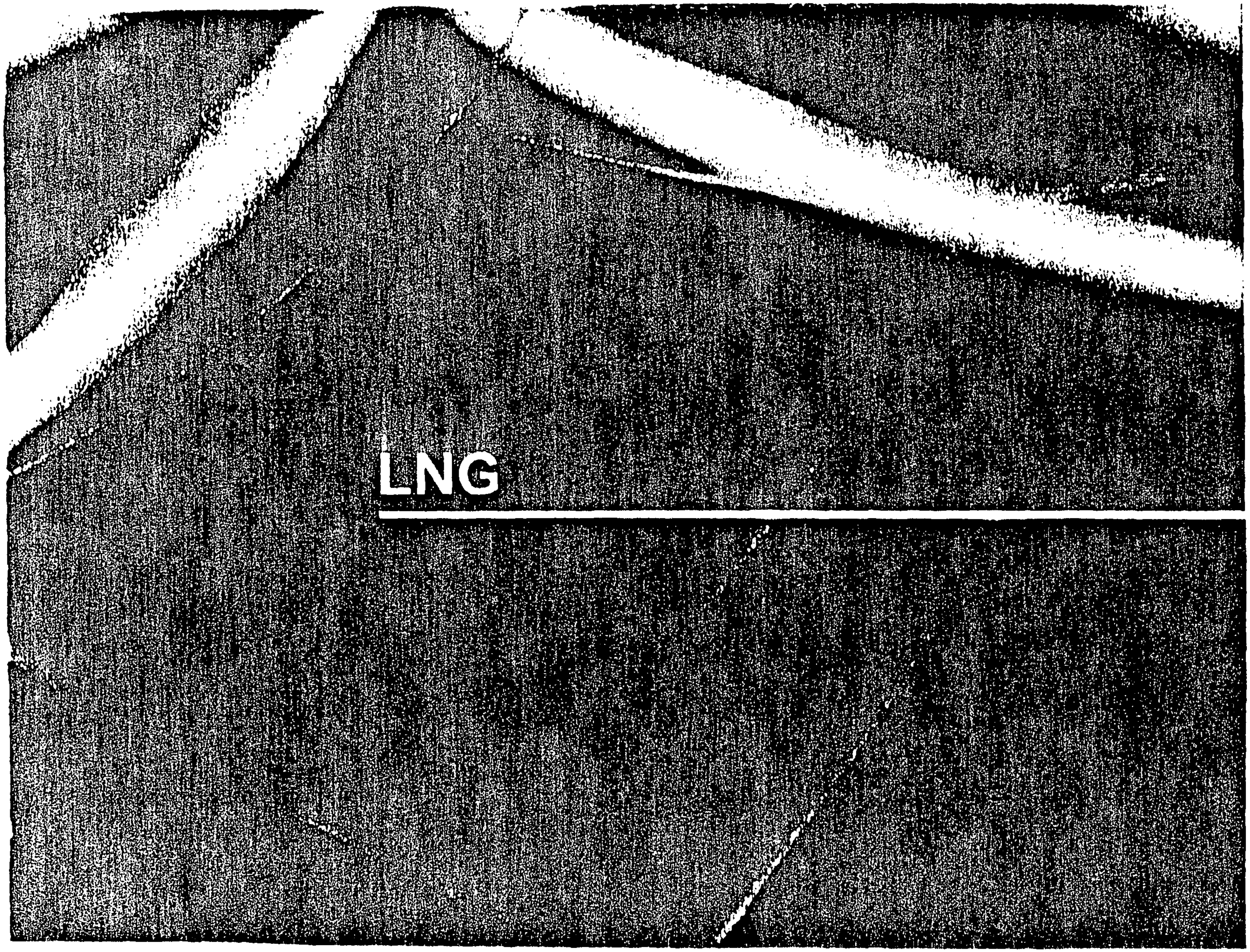
Northeast Peak Power Forward Prices



El Paso Merchant Energy: Physical and Contractual

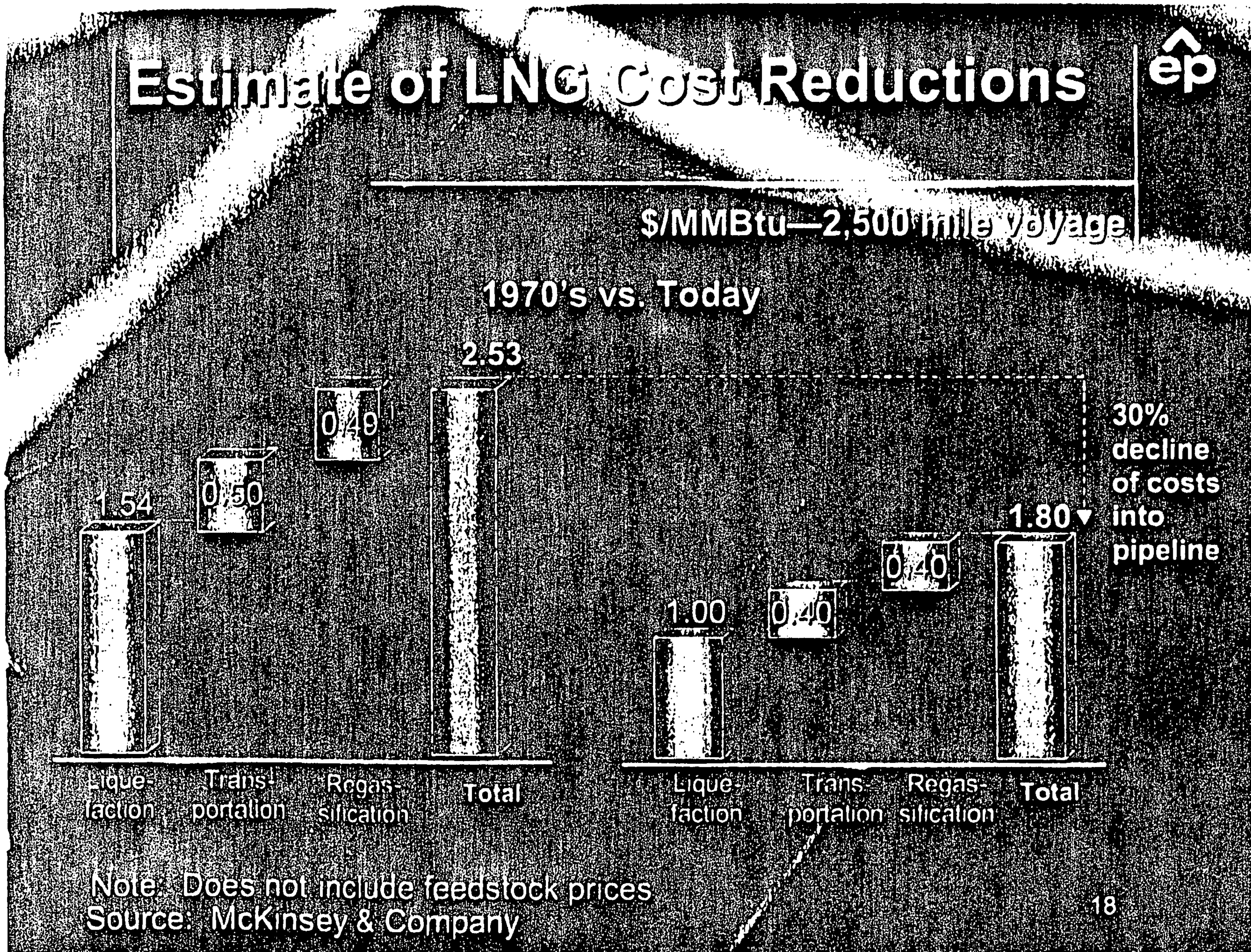
	06/30/98	Post Merger
Pipeline capacity	1.4 Bcf/d	5.0 Bcf/d
Storage capacity	35 Bcf	125 Bcf
Domestic generation (controlled and owned)	340 MW	7,000 MW
Equity gas reserves	–	5 Tcfe
LNG capacity	–	280+ Bcf/yr
Financial assets under management	–	$1.5 billion
Average life of assets	1 year	6+ years
Headcount (professional staff)	166	400


LNG

LNG's Attractiveness in North America

What has changed in the past 30 years?

- Cost of LNG has been reduced significantly
- Marginal costs of domestic production are increasing
- New demand for gas-fired generation is concentrated in North America
- Producers worldwide are willing to assume netback risk to Henry Hub prices



DOE002-1362

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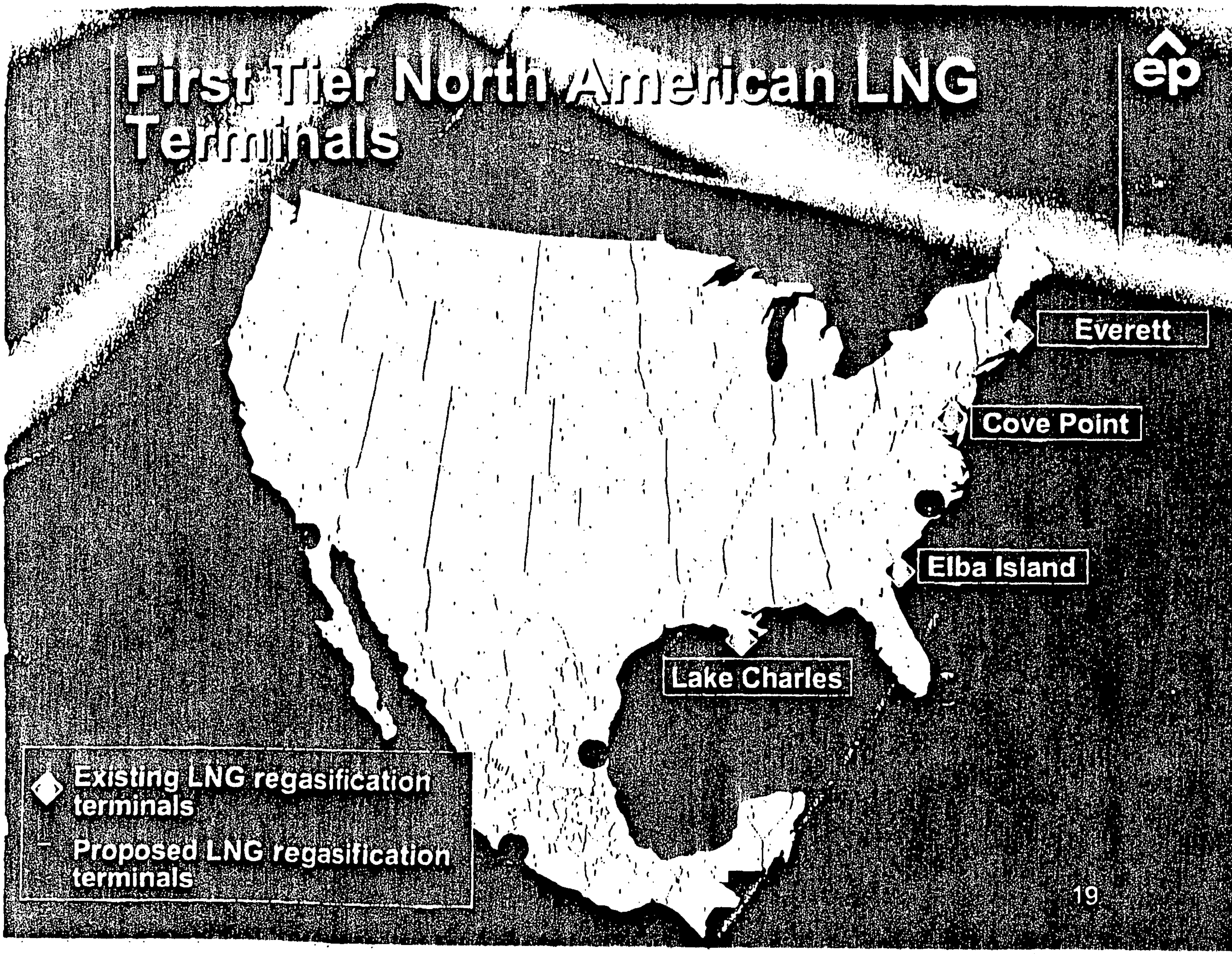
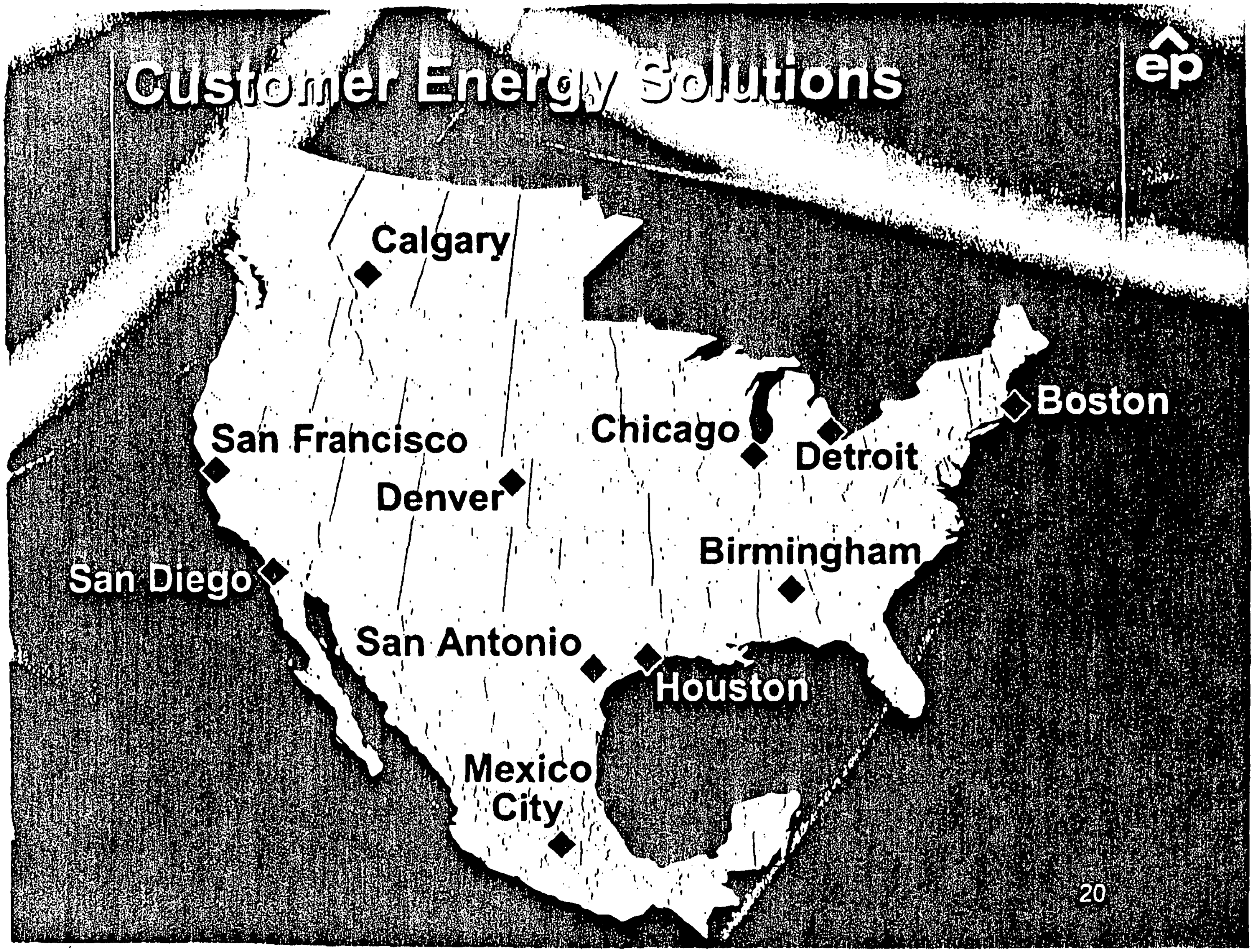

First Tier North American LNG Terminals
ep
Everett
Cove Point
Elba Island
Lake Charles
Existing LNG regasification terminals
Proposed LNG regasification terminals
19


Customer Energy Solutions
ep
Calgary
San Francisco
Denver
Chicago
Detroit
Boston
Birmingham
San Diego
San Antonio
Houston
Mexico City
20

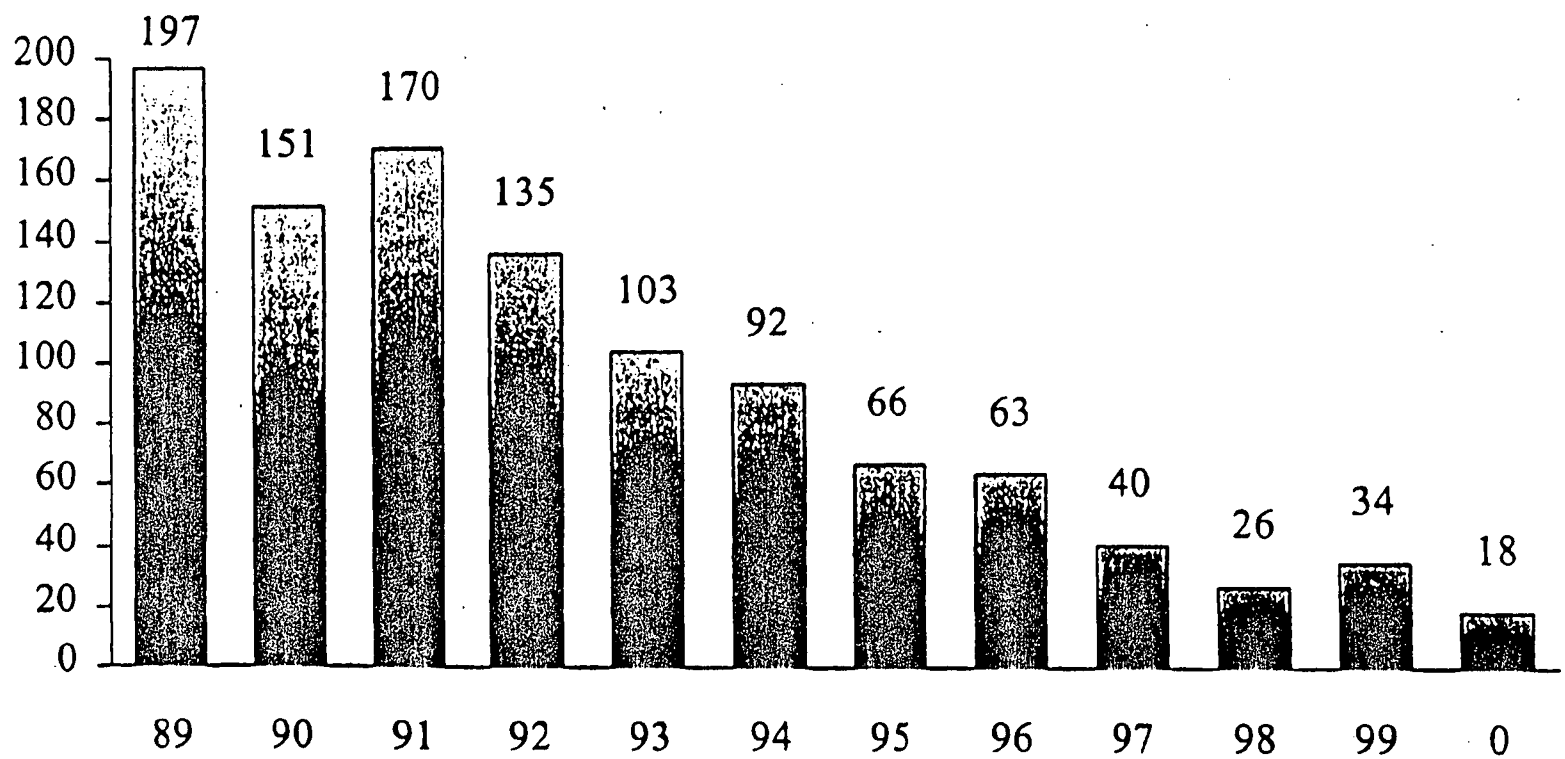
New Power Initiatives

ep

- Clean coal projects
- Greenfield project inventory
- Large restructuring portfolio
- Expansion opportunities
- Transmission projects
- Utility enhancements

Steady Improvement in Safety

(Number of Unusual Events Reported to NRC)



Using Targeted Energy Efficiency Programs to Reduce Peak Electrical Demand and Address Electric System Reliability Problems

Steven Nadel, ACEEE
Fred Gordon, Pacific Energy Associates
Chris Neme, Vermont Energy Investment Corporation

November 2000

AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY
Washington, D.C.

1357

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November 2000

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Report Number: U008

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CONTENTS

EXECUTIVE SUMMARY

In the summers of 1998, 1999, and 2000, electric system reliability problems were regular front-page news. The reliability of the power system, however, should not be viewed as only a short-term, summertime issue. In much of the country, electricity use (particularly peak demand) is expected to grow rapidly, and power supplies will probably be strained for many years to come.

A range of solutions have been proposed to address electric system reliability problems and reduce the likelihood of power outages. These solutions include constructing new power plants, expanding the transmission and distribution system, implementing load control programs, improving energy efficiency, and investing in distributed generation resources (e.g., combined heat and power systems [CHP]). An approach limited to only supply-side solutions would create additional pollution as well as political opposition to siting these new facilities. Energy efficiency, on the other hand, offers a low-cost alternative that reduces the need for additional central station generation and distribution capacity while reducing pollutant emissions and saving consumers and businesses billions of dollars. In this report, we discuss how demand-side efficiency could make a substantial and cost-effective contribution to addressing power reliability problems.

With reliability problems occurring in the short term and likely to persist for awhile, utility companies (or other appropriate program administrators) should design and implement programs that will have a substantial impact on peak demand within the next 1–5 years. In order to achieve this objective, the programs must:

- Save energy at peak hours.
- Have enough impact on dominant loads that massive savings would result;
- Use technologies and practices that are already proven and in the market; and
- Build upon program designs that have been demonstrated to be successful.

Based on these criteria, three areas jump out as having the most potential: efficient heating, ventilating, and air conditioning (HVAC) equipment; proper installation, maintenance, and use of HVAC and other building systems; and commercial sector lighting.

In the following sections we recommend six programs that could cover these end-uses. The six programs are:

1. new and replacement residential cooling systems;
2. residential cooling systems tune-up and repair;
3. commercial and industrial HVAC equipment;
4. commercial building retrocommissioning and maintenance;

5. commercial and industrial lighting retrofit acceleration; and
6. commercial and industrial lighting design enhancement.

Next, we discuss information on these suggested programs, including data on estimated program costs and impacts. Overall we find that each of these programs would likely be cost-effective relative to other peak demand supply or peak demand reduction options, particularly when the value of both energy and peak demand savings are included in the analysis. Further details on each program, including suggestions for program planning, and savings and cost-effectiveness analysis, are provided in Appendix C.

Overall, the six recommended programs could reduce peak electrical demand in 2010 by about 64,000 megawatts (MW). These savings would negate about 40% of the growth in peak demand predicted over the next decade. About 45% of the savings would be due to the new residential air conditioner program. The commercial retrocommissioning program and the commercial lighting upgrade programs would each account for about 15% of the savings, while the other three programs would account for 11% (residential air conditioning repair), 8% (commercial lighting design), and 6% (commercial HVAC equipment).

In order to capture the peak demand savings possible from energy efficiency, we recommend the following actions.

- Policy-makers should consider efficiency programs as an *essential complement* to supply-side programs and load management in efforts to assure system reliability.

- Utility companies (or other appropriate program administrators) should begin developing and implementing major peak reduction programs as soon as possible so that programs would start by the end of 2000, and also should undertake sufficient installations so that they begin to have an impact on the 2001 summer peak.

- State utility commissions should encourage, or even require, utilities or other organizations under their jurisdiction to develop and implement energy efficiency programs targeted at reducing peak demand.

- The U.S. Department of Energy (DOE) should provide technical assistance to states, utilities, and other program sponsors to help them develop and implement energy efficiency and other programs targeting peak demand.

- States should adopt funding mechanisms for energy efficiency and other public benefit fund (PBF) programs. In addition, as part of federal restructuring legislation, the federal government should encourage states to set up and expand PBFs by establishing a national fund to match state PBF expenditures.

- Congress should also consider pending tax credits on high-efficiency residential air conditioners and energy-saving new commercial buildings as a complement to the programs listed here.

THE PROBLEM: GROWING RELIABILITY PROBLEMS

In the summers of 1998, 1999, and 2000, electric system reliability problems were regular front-page news. In 1998 there were power interruptions, brownouts, and requests for voluntary curtailments in Chicago, Colorado, Michigan, and New York (Cowart 1999). In 1999, blackouts occurred in New York City, Chicago, Long Island, New Jersey, the Delmarva Peninsula, and the South-Central States (DOE 2000a). In June 2000, rolling blackouts occurred in California and there were close calls in several other regions (e.g., Pennsylvania/New Jersey and New England) (Howe 2000; Norr 2000; Penn Future 2000). During this past summer, supplies were extremely tight in New England, New York, California, and the Southwest (NERC 2000a); if had not been a cool summer in much of the country, reliability problems could have been much worse.

The summer months are particularly taxing on the electric system. Soaring temperatures lead to increased peak demand as consumers and businesses crank up their air conditioners to stay cool. The greatest demand for air conditioning generally occurs in the mid-afternoon hours, coinciding with the highest demand for other electricity uses such as for lighting businesses and powering factories. High temperatures also negatively impact the performance of electricity generation, transmission, and distribution equipment, reducing the availability of generation and transmission capacity and increasing the likelihood of distribution system failures. As a result, the electricity system is called on to meet the highest demand at the time when its components are most prone to problems.

Electric reliability problems tend to be of two types — regional and local. Regional problems occur throughout a utility service area, or often throughout a regional power pool, when available generating capacity is unable to meet peak demand. For example, on July 23, 1999, Entergy, a major utility serving parts of Louisiana, Texas, Arkansas, and Mississippi, needed 900 MW of additional power to meet customer demand. To make up this shortfall, Entergy had to resort to "rolling blackouts" in which it shut off power to thousands of customers at a time, then after 20–30 minutes, restored power to these customers and shut off power to another group of customers (DOE 2000a). Local problems occur in more geographically limited areas and can be due to a shortage of adequate transmission or distribution capacity to get power into a particular local area (as was the cause of the rolling blackouts in San Francisco on June 14, 2000) or can be due to failure of distribution equipment such as transformers or switches that are most prone to fail when high demand and high temperatures coincide (as was the cause of the 1999 blackouts in Chicago and New York City). The distinction between regional and local problems is far from absolute; some reliability problems are due to a combination of factors and lie in between these two categories. For example, on July 5-8, 1999, a heat wave in the New Jersey/Delaware area caused both a regional shortage of power and localized cable and switchgear problems, leading to the failure of several substations and rotating blackouts in a portion of the region (DOE 2000a).

The reliability of the power system should not be viewed as only a short-term issue. In much of the country, electricity use (particularly peak demand) is expected to grow rapidly, and power supplies will probably be strained for many years to come. For example, the California Independent System Operator expects peak demand to grow about 1,000 MW annually through the end of their forecast period (CEC 1999). Likewise, a March 2000 reliability study on the Northwest power system concluded that "the probability of a generation shortfall reaches approximately 24% by 2003." The study recommended that in order to reduce this probability to 5% (the traditional utility planning target), about 3,000 MW of new resources (generating capacity and voluntary load reductions) will be needed (NPPC 2000). Nationwide, the North American Electric Reliability Council (comprised of most of the power generating and distribution companies in the United States) predicts that peak demand will grow an average of 1.8% annually over the next 9 years. Projected growth in summer peak in the different regions of the country totals 128,000 MW over this period (NERC 2000a).

A range of solutions have been proposed to address electric system reliability problems and reduce the likelihood of power outages, including constructing new power plants, expanding the transmission and distribution system, implementing load control programs, improving energy efficiency, and investing in distributed generation resources (e.g., combined heat and power systems). Building additional generation, transmission, and distribution capacity can be very expensive, particularly when the power is only needed for a limited number of hours each year. For example, a recent analysis found that:

> In Florida, 15% of the capacity in the system is needed less than 1% of the hours in a year. For the sake of analysis assume it is 0.5% of the hours in a year. Therefore, a new combined cycle turbine generator built to run only 43.5 hours a year would need a price of more than $1,260/MWh [$1.26/kWh] during those hours to be profitable (Energy Insight 1998).

Upgrading transmission systems can also be costly. For example, the Long Island Power Authority just completed a $65 million project to build a new transmission line to serve portions of eastern Long Island. The line has a capacity of about 120 MW (i.e., $542/kilowatt [kW]) but with $7 million additional investment, the capacity could be doubled (i.e., a total cost of $300/kW) (Milhous 1999; PII 2000). Moreover, transmission upgrades are often only a short-term solution to reliability problems because with continued growth in peak demand, in many regions peak demand will soon exceed available generation capacity. And heat waves often extend across power pools, meaning that power is not available to transmit from one region to another, even if transmission capacity is available. For example, on July 5-8, 1999, heat waves hit the New England, New York, and Pennsylvania/Jersey/Maryland (PJM) power pools simultaneously, causing brownouts and blackouts across the region. Furthermore, additional power generation imposes costs to the environment and public health — electricity generation is a leading source of the air pollution that contributes to global warming and increases the incidence and severity of asthma and other respiratory and cardiopulmonary diseases. These environmental and health issues, along with concerns about the disappearance of open space and added noise, are driving community opposition to power plants and transmission line construction across the country.

In contrast, energy efficiency offers a low-cost alternative that could reduce the need for additional central station generation and distribution capacity while reducing pollutant emissions and saving consumers and businesses billions of dollars. In the following sections we discuss how demand-side efficiency could make a substantial and cost-effective contribution to addressing power reliability problems. Load control and distributed generation could also help reduce peak demand and are discussed in the sidebar. However, given projected growth in peak demand of more than 100,000 MW, load control and distributed generation would be only part of the solution to reliability problems — additional steps would also be needed.

Load Control, Distributed Generation, and Fuel Switching

Load control, meaning shifting some loads from peak periods to off-peak periods, could make a significant contribution to reducing peak demand. Many utilities (as well as some non-utility organizations) pay customers to participate in programs under which the utility installs radio-controlled switches to turn air conditioners and water heaters off during peak demand periods. Programs also give large customers discount rates for "interruptible loads" that the utility can shut off on short notice. And some experimental programs are allowing customers to participate in regional power bidding pools, but instead of bidding to supply power, customers can bid to interrupt power to their facilities (CAISO 2000). In 1998 (the last year for which complete data are available), load control programs reduced peak demand by 13,640 MW (EIA 1999a). Given the substantial contributions to date of load control programs, it is unclear how much more these programs could save but clearly there is some additional potential.

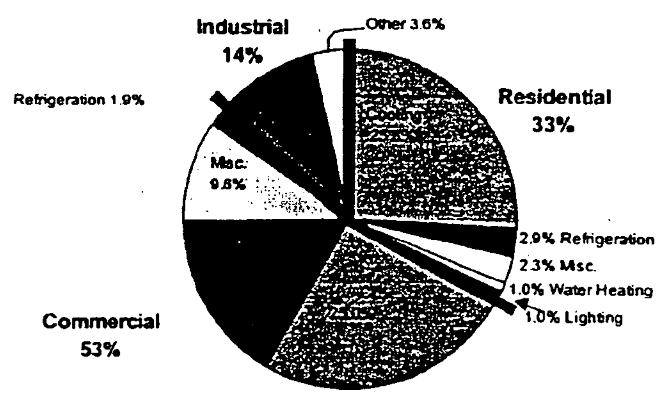
Distributed generation includes renewable generation technologies (e.g., wind and biomass) as well as on-site generation systems. One type of on-site system that is receiving a lot of attention is combined heat and power systems, which produce both electricity and thermal energy, resulting in the capture of up to 80% of the energy contained in the fuel. A major initiative is now underway in the United States to double CHP capacity over the next 10 years. This goal is ambitious and would require about 50,000 MW of new capacity by 2010; given the need for a ramp-up period, perhaps 10,000–20,000 MW of additional capacity could result over the next 5 years (Elliott 2000). To this total, projections indicate that on the order of 3,000 MW of renewable generation capacity is likely to be added over the next 5 years (EIA 1999b).

Another approach for reducing peak demand would be to switch some electric loads to other energy sources such as natural gas. Since air conditioning is a major driver of peak demand, air conditioning is a particularly attractive load for fuel switching. Over the last decade, much progress has been made in developing improved gas cooling equipment including many new chillers and unitary air conditioners, which use a natural gas engine in lieu of an electric motor to drive the compressor. The American Gas Cooling Center estimated that units with a total cooling capacity of 20–30 million tons have been installed, including annual installations of about 0.2 million tons, and current targets are to increase annual additions by 0.5 million tons in 5 years (Occhionero 2000). If we roughly assume that this equipment displaces electric air conditioners and chillers with an average efficiency of 0.8 kW/ton, total peak capacity savings could be on the order of 2,000 MW over the next 5 years if these targets are met.

REDUCING PEAK DEMAND THROUGH ENERGY EFFICIENCY

Since increased peak demand is the heart of reliability problems, efforts designed to reduce peak demand must be an important part of any strategy to improve electric system reliability. The difference in load between a normal day and a peak day is primarily driven by air conditioning, and thus strategies to reduce cooling loads and improve the efficiency of cooling systems must be a central part of any strategy to reduce peak loads. In addition, commercial lighting loads are generally substantial during weekday afternoons when peak demand generally occurs. Key loads on a typical peak demand day are illustrated in Figure 1.

Figure 1. Distribution of Summer Peak Demand by End-Use for New Jersey



Source: XENERGY Inc. 1999.

Economics

Energy efficiency programs directed at reducing peak demand can often be cheaper per kW saved than the cost of alternative power supply and power reduction strategies. For example, a recent Commonwealth Edison pilot project in Chicago commissioned (checked and reset controls and other system components) the cooling systems in 11 large commercial buildings. The work reduced peak demand by about 2 MW, reducing demand at an average cost to the utility of $132/kW saved (Kessler et al. 1999). Assuming an average measure life of 7 years (as discussed in Appendix C), this works out to $24/kW-year (the standard index of the cost of electric generation capacity), substantially less than the typical $47/kW-year capital cost of a new peaking power plant (see Appendix A). Similarly, the incremental cost of a high-efficiency commercial chiller or packaged cooling system relative to standard equipment is on the order of $31-44/kW-year (see Table 1 below). In other cases, efficiency investments may cost a little more per kW-year but would still be cost-effective because power plants have significant operating costs while efficient equipment has lower operating costs than standard-efficiency equipment. For example, while a residential air conditioning tune-up costs nearly $100/kW-year, due to the substantial energy savings, it costs on the order of $0.07 per kilowatt-hour (kWh) saved,[1] significantly less than the cost of summertime power in most regions of the United States. Similarly, advanced lighting design costs more than $100/kW-year, but on an annual basis the energy savings work out to approximately $0.03/kWh, significantly less than the average annual electric rate paid by most commercial customers.[2] Table 1 compares the approximate costs of a variety of peak demand-reduction and power supply strategies.

Table 1. Cost/kW for Different Demand Reduction and Power Supply Strategies

Option	Cost/Peak kW-year
Supply-Side	
Peaking power plant (capital only)	$47
Peaking power (including operating costs)	$55
Transmission upgrade (e.g., S. Fork of Long Island)	$22
Local distribution upgrades	$20–60
Note: In many cases both new power plants *and* transmission/distribution upgrades would be needed — doing one without the other would go only part of the way in addressing some reliability problems.	
Demand-Side	
More efficient chiller	$44
More efficient packaged commercial cooling system	$31
More efficient residential air conditioners	$62
Residential cooling system tune-up	$98
Commissioning of existing commercial buildings	$58
Commercial lighting upgrade	$25
Commercial lighting design	$125
Residential air conditioning load control	$53
Residential water heater load control	$92
Commercial & industrial interruptible rates	$44
Note: Demand-side measures also save energy; when the value of these energy savings is considered, even measures costing $100/kW-year or more would be cost-effective. Details on these calculations are provided in Appendix A.	

In addition to being cost-effective from a direct economic point of view, efficiency investments often produce indirect benefits as well, such as better lighting, more effective cooling, improved worker productivity, and the health care savings and environmental benefits associated with reduced emissions from power plants.

[1] Measure costs, life, and discount rate per Appendix A. Energy savings based on Appendix C and a national average energy use for residential central air conditioners of 2,109 kWh/year (EIA 1999c).

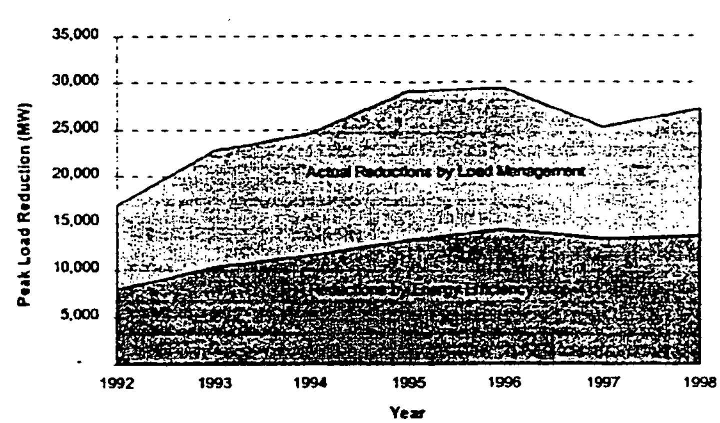
[2] Calculation based on data in Appendix A and further assuming that lights operate an average of 4,000 hours/year.

Historic Experience

Energy efficiency is already contributing substantially to reducing peak demand. Since the 1980s, many utilities have operated energy efficiency and load management programs. Nationwide, these programs have yielded significant peak demand savings. As shown in Figure 2, actual demand savings climbed steadily from 1992 to1995, with 1995 savings of 29,600 MW, which was 4.8% of summer peak demand in that year.[3]

Unfortunately, in the mid-1990s, as electric industry restructuring began, many utilities cut back spending on their energy efficiency and load management programs in order to accelerate depreciation on high-cost assets and to reduce short-term rates. As a result, peak demand savings began to fall in absolute terms (e.g., actual nationwide demand reductions in 1997 were 14% lower than in 1996). Furthermore, available[4] nationwide peak reductions fell even more relative to previous utility power supply plans. For example, available peak reductions in 1998 were 24% lower than plans for 1998 made in 1993 (see Figure 3).[5] Thus, cutbacks in energy efficiency and load management programs have contributed to rising peak demand, and by extension, to our current reliability problems.

Figure 2. Actual Peak Load Reductions from Energy Efficiency and Load Management Programs, 1992-1998



Source: ACEEE analysis of Energy Information Administration reports and Form 861 data.

[3] Calculation based on summer peak demand in 1995 of 620,249 MW (NERC 2000b).

[4] "Available" demand reductions include actual reductions plus load management reductions that are under contract but are not called upon.

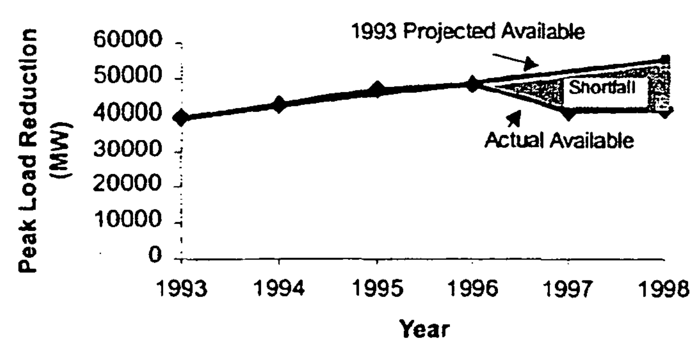
[5] In 1993, utilities projected available peak load reductions in 1998 of 55,163 MW (EIA 1995). In 1998, available peak load reductions were only 41,430 MW (EIA 1999a).

New Opportunities

It is time to reverse these recent trends and reinvigorate energy efficiency programs. Past programs illustrate the magnitude of savings that can be achieved, but significantly greater savings would be possible by focusing on new technologies and services that were not readily available in the mid-1990s. In the sections below we discuss some of the most prominent of these opportunities.

Furthermore, programs targeting peak demand could be be a useful complement to other energy efficiency strategies now being pursued. In several regions of the country, utilities and regional organizations are operating *market transformation* programs that seek to make specific energy-saving goods and services normal practice by addressing market barriers that impede their use. Among the measures being pursued in this manner are proper air conditioner installation and maintenance, building commissioning, and advanced lighting design practices. Programs to promote these measures in the short term in order to reduce peak demand could help to accelerate long-term market transformation. Likewise, these longer-term market transformation efforts could build on the momentum generated by short-term peak reduction programs in order to continue to reduce peak demand in the longer term.

Figure 3. Projected vs. Actual Available Peak Reductions for 1998



Source: ACEEE analysis of Energy Information Administration reports and Form 861 data.

KEY EFFICIENCY PROGRAM OPTIONS

With reliability problems occurring in the short term and likely to persist for awhile, utility companies (or other appropriate program administrators) should design and implement programs that will have a substantial impact on peak demand within the next 1–5 years. In order to achieve this objective, the programs must:

- Save energy at peak hours;
- Have enough impact on dominant loads that massive savings will result;
- Use technologies and practices that are already proven and in the market; and
- Build upon program designs that have been demonstrated to be successful.

Based on these criteria, three areas jump out as having the most potential: efficient HVAC equipment; proper installation, maintenance, and use of HVAC and other building systems; and commercial sector lighting.

Within each of these areas are an array of activities to save energy and reduce peak demand. For most, a complex of actions oriented at vendors, designers, and service providers would be required to achieve the largest possible savings. This brings out an important point. Big savings could be achieved through efficiency in a relatively modest time, but only if the sponsor commits to managing a small family of initiatives, each of which would require some technical and market sophistication. The days where utilities could garner 70% of the available savings through simple lighting rebates are over. As we note in the lighting section, the simplest initiatives may result in the fastest savings, but these would diminish quickly in comparison to what would happen without the program.

These areas of opportunity include systems in the residential, commercial, and industrial sectors. Given large differences in how equipment and services are provided to the residential and commercial/industrial sectors, separate programs should be organized to serve these sectors.

In the following sections we describe six specific recommended programs. Additional details on these suggested programs, including information on estimated program costs and impacts, are provided in Appendix C. The six programs are:

1. new and replacement residential cooling systems;
2. residential cooling systems tune-up and repair;
3. commercial and industrial HVAC equipment;
4. commercial building retrocommissioning and maintenance;
5. commercial and industrial lighting retrofit acceleration; and
6. commercial and industrial lighting design enhancement.

New and Replacement Residential Cooling Systems Program

In most regions of the country, central cooling dominates the residential contribution to peak demands. In New Jersey, for example, residential customers are estimated to represent approximately one-third of system peak demands and central air conditioners are estimated to represent 52% of that contribution (XENERGY Inc. 1999).[6] The operating efficiency of the equipment has a major bearing on the magnitude of that contribution. Operating efficiency is itself a function of two major factors: the nameplate efficiency of the equipment itself and the way it is installed and maintained.

Over 6 million residential-sized central air conditioners and heat pumps are sold annually in the United States. Unfortunately, fewer than 4% of all new units sold in the United States have efficiency ratings of seasonal energy efficiency ratio (SEER) 13 or higher; roughly three-quarters are rated at or near SEER 10, the lowest efficiency rating available on the market (ARI 1998). In addition, numerous studies from around the country suggest that new central air conditioners and heat pumps are oversized by an average of 1 ton of capacity. The same studies also suggest that roughly 70% of all new systems have inadequate airflow, incorrect levels of refrigerant, or both (Neme, Proctor, & Nadel 1999). The savings potential from addressing both of these opportunities — combined energy savings of 40–50% and combined peak demand savings of 25–40% — would be substantial.

We designed our recommendations in Appendix C to address both of these opportunities. We model our recommendation program after similar programs in New Jersey. The program's goal would be to transform the market to one in which quality installations of high-efficiency equipment become common practice. It would accomplish that goal through a combination of interrelated strategies:

- Incentives for the sale or purchase of high-efficiency equipment for which documentation of proper sizing and installation would be provided;
- Training of HVAC technicians on key elements of quality installations;
- Sales training for contractors (i.e., how to sell efficiency);
- Direct marketing to HVAC distributors and contractors through "circuit riders;"
- Promotion of HVAC technician certification; and
- Aggressive consumer marketing/education campaign on key elements and benefits of efficiency.

[6] Note that central air conditioning represents 63% of single family homes' contribution to the New Jersey system peak demand (XENERGY Inc. 1999). Note also that the saturation of central air conditioning is growing, in part because the saturation in new construction is much higher (almost universal) than in existing homes. Thus, the contribution of residential HVAC systems to utility system peaks would also be higher in states with a larger share of single-family homes and a younger housing stock, as well as in states with warmer climates, higher saturations of central cooling, and below average presence of heavy industry.

Residential Cooling Systems Tune-Up and Repair Program

As noted above, central air conditioners and heat pumps dominate the residential contribution to utility peak demand. They are also usually installed incorrectly, with improper refrigerant charging and inadequate airflow over the coil having particularly adverse impacts on equipment-operating efficiency. These problems persist throughout the life of the equipment. In addition, most central air conditioners and heat pumps are connected to ducted distribution systems that are very leaky, with 20% or more of the air flowing through them leaking to or from the outdoors.[7] Treating both charge/airflow and duct leakage problems on a retrofit basis could save an average of 24% of the energy and 14% of the contribution to peak demand made by the average central air conditioner or heat pump (Neme, Proctor, & Nadel 1999). Moreover, such treatments should improve comfort in the home, reduce maintenance costs, and extend equipment life.

Unfortunately, many HVAC technicians have neither the training nor the tools necessary to diagnose and treat refrigerant charge and airflow problems. Moreover, precious few of the technicians who do have the ability to identify and treat these problems routinely do so. The situation is even worse with respect to leaky duct systems. In most of the country, there are at best a handful of specialists capable of effectively treating duct leakage problems.

We designed our recommendations in Appendix C to address the market barriers to realizing the substantial savings possible from improving the operating efficiency of existing central air conditioners and heat pumps. We model the program after a similar program currently being implemented by Proctor Engineering for San Diego Gas and Electric (SDG&E). The program's long-term goal is to transform the market to one in which there are a number of HVAC technicians capable of diagnosing and treating HVAC efficiency problems working for HVAC firms that see sales of such services as a core part of their business. The program would accomplish that goal through a combination of interrelated strategies:

- Modest consumer incentives for both assessment of HVAC systems and treatment of any problems identified;
- Aggressive consumer marketing campaign to promote the hiring of qualified HVAC contractors to assess and treat operating efficiency problems;

[7] *The average leakage rate from 19 different studies from across the country was 270* CFM_{25} *(CFM=cubic* feet per minute) (Neme, Proctor, & Nadel 1999). CFM_{25} is commonly used as a metric for duct leakage because the pressures created when an air handler is "on" typically average about 25 pascals. A typical 3 ton central air conditioner should have an airflow rate of 1,200 CFM. Thus, duct leakage of 270 CFM_{25} represents roughly 22% of system airflow.

- Direct marketing to HVAC contractors (through "circuit riders") to encourage them to participate in the program;

- Providing interested contractors with: (1) easy-to-use software for guiding diagnosis and treatment of key HVAC operating-efficiency problems; and (2) the training on how to use such software;

- A quality control mechanism to ensure both that any remedial work performed on HVAC systems would be done properly and that any contractors submitting fraudulent data would be identified and removed from the program; and

- A mechanism for referring interested customers to qualified HVAC contractors.

Commercial and Industrial HVAC Equipment Program

Commercial and industrial (C&I) heating, ventilating and air conditioning is probably the single largest contributor to summer peak demand. Yet the HVAC systems on the market today vary substantially in energy efficiency. Peak air conditioning demand could be reduced by an average of about 20% if purchasers chose the most efficient models, rather than average performers. In commercial applications, the high-efficiency systems typically save enough in operating costs to pay back in 3 to 5 years.

The goal of this program is to assure the efficient selection and installation of cooling and air distribution systems in the commercial and industrial sectors. There are two primary components — chiller system efficiency and packaged HVAC system efficiency. In each case, "system efficiency" incorporates efficient equipment, and proper specification, design, and installation. Utilities (or other program sponsors) could significantly reduce peak demand simply by assuring selection of efficient systems, but could save much more through influencing design and installation practices.

There are two major ways to capture the savings from high-efficiency cooling equipment: voluntary programs such as the Consortium for Energy Efficiency's (CEE) packaged equipment standards, and mandatory standards. Both approaches are needed to help reduce demand.

While consumers and commercial buildings could save money by choosing efficient systems, many unitary systems are purchased by building contractors who have no concern with operating cost. Here, mandatory standards would provide the best long-term payoff but voluntary programs would help pave the way. Standards for small commercial systems (expected by 2001) will likely increase performance 10–20%. Setting a strong new federal standard for small commercial air conditioning and heat pump systems could eliminate the need for approximately 4,500 MW of peak generating capacity by 2010, and nearly triple that by 2020 (Thorne, Kubo, & Nadel

2000b). Additional savings would be available from larger systems and also from promotion and incentive programs on small commercial equipment.

For packaged equipment, the proposed program focuses on marketing higher-efficiency units not only to achieve direct effects, but to influence federal standard-setting procedures; high near-term penetration would help support a nearer-term and more stringent standard. The program would also help accelerate acceptance and state and local adoption of the chiller efficiency levels in the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE) 90.1-1999 standard.

However, there are savings on chiller efficiency available beyond the ASHRAE standard. Furthermore, savings from system design and installation will largely be influenced by market forces because these elements are difficult to incorporate into standards. For these reasons, and also to help increase the political and market receptivity to standards, the program should offer a system of rebates, vendor and customer marketing, technical assistance, and training designed to build market demand for efficient equipment, and good systems design and installation, while also assuring that contractors will be able to meet this demand.

Program success would require a close working relationship with key vendors as well as customers. Implementors must be encouraged to work with customers and to ascend a ladder of sophistication in HVAC system design, as described below:

- Step 1. Select efficient equipment.
- Step 2. Properly size equipment.
- Step 3. Design efficiency into chiller distribution systems and packaged system ducts.
- Step 4. Reduce heat-producing loads (e.g., lighting and computers) before sizing and designing large systems.
- Step 5. Employ efficient installation and commissioning practices.

While each of these elements adds complexity to the program, the program administrator should add them incrementally as capability is added, and customers should access the program at the level of their own motivation and capability.

Commercial Building Retrocommissioning and Maintenance Program

In most regions of the United States, commercial buildings account for a larger portion of peak demand than any other sector. But very few of the complex cooling, electrical, and distribution systems in these facilities are properly tuned. That's why so many workspaces are either too hot or too cold. Often, the systems were installed improperly; in other cases, they have fallen out of synch as control settings and building uses change. *Retrocommissioning* such buildings — optimizing their energy-using systems — could significantly cut energy use.

Instituting good operations and maintenance procedures could add to the savings, as well as help to ensure that savings are maintained over time.

As noted above, a recent Commonwealth Edison pilot project commissioned 11 large commercial buildings in Chicago, reducing peak demand by about 2 MW. Total annual savings were more than 6 million kWh, and nearly half a million dollars. The average cost to the utility per kW saved was $132 (Kessler et al. 1999). Another study found average energy savings of nearly 20% in 44 building commissioning projects on existing commercial buildings. The majority paid for themselves in less than a year (Gregerson 1997). A 1998 study estimated that by 2010, programs to commission existing buildings could reduce U.S. energy use by about 60 billion kWh (Suozzo and Nadel 1998). In addition to saving energy, these improvements would result in substantial peak demand reductions.

One impediment is the limited number of qualified commissioning engineers. And building owners are often unaware of the services commissioning engineers can provide. Both problems could readily be addressed. For example, Oregon's Portland General Electric is promoting commissioning to building owners and paying half the cost of commissioning services for local buildings, along with part of the costs to implement the recommendations (Peterson and Findlay 1999). In New York State, a pilot program to retrocommission chiller systems and reduce peak demand was started in June 2000 and by August 2000 more than 130 participants had signed up. These retrocommissioning projects were implemented in August and September and a report summarizing the program's results is scheduled for completion in late 2000 (Henderson 2000).

Building on these results, we recommend that utilities and other local program implementers operate programs with the goal of promoting widespread *retrocommissioning* (commissioning of existing buildings) and proper maintenance of large commercial buildings. Key program components should include:

- Local market research, to understand the current state of commissioning knowledge and skills among potential commissioning customers and providers and to explore proposed intervention strategies with these audiences;

- Education for building owners and facility managers to familiarize these decision-makers with the opportunities and benefits of commissioning and to provide information on how to obtain quality services;

- Local demonstration projects and case studies to help promote retrocommissioning locally;

- Establishing a benchmarking system to help building owners assess the performance of their buildings relative to other buildings. Such a system could inspire owners of inefficient buildings to explore strategies to improve building performance;

- Active marketing efforts to encourage building owners and managers to retrocommission their buildings;

- Commissioning service provider training and technical assistance to help local engineers gain the skills and experience to provide commissioning services;

- Maintenance staff training and certification to help staff gain skills to improve systems operation including helping to keep buildings in tune after they have been commissioned; and

- Financial incentives to reduce the cost of commissioning services.

Commercial and Industrial Lighting Retrofit Acceleration Program

Overall, lighting accounts for about 25% of summer peak demand in the commercial sector, the second largest share after air conditioning. Lighting energy use could be cut by 30-50% in buildings that have never improved their lighting systems through use of "first wave" technologies that conservation programs have already popularized in new construction (e.g., T-8 lamps, electronic ballasts, compact fluorescent lamps, and metal halide lighting) as well as more advanced measures (e.g., high-quality fixtures, high-intensity fluorescent lamps, improved lighting controls, and good design) (EPA 1999). A study for the California Energy Commission estimated that savings of roughly 33% are available in new buildings, *beyond* California's stringent building codes, with higher savings (on the order of 48%) available in existing buildings (Heschong-Mahone Group 1997).

Nevertheless, more than half of existing commercial building floor area does not yet use the "first-wave" measures. Efficient lighting designs are used in only a small minority of spaces, and control systems that maximize the use of daylight are even less common.

No comprehensive studies of potential overall peak load reduction from more efficient commercial lighting exist. However, estimates discussed below suggest that savings by 2010 could be more than 10,000 MW.

We designed our recommended program to increase the saturation of efficient lighting among existing commercial and industrial buildings. The program would accelerate and broaden the efforts already underway by customers and a wide array of contractors to replace obsolete lighting systems with the more efficient systems that have become common practice for most new construction. This program would be complemented by a separate but related effort to enhance the quality and efficiency of common practice for lighting design, as described below.

Of these two programs, the retrofit acceleration one would likely provide the most peak savings in the 1-3 year time horizon because the hardware for this program would already be available in volume, installation would be relatively easy, and contractors and customers would already be familiar with the measures. However, much of the savings that this program would provide would occur with or without this program progressively in the next 15 years or so as buildings are remodeled and renovated and as equipment wears out. Many of the measures common in to a lighting retrofit program are also now common practice for renovation and remodeling. This means that perhaps a third of the first-year savings might be achieved with or without the program by year 5.[8] In contrast, the design enhancement program discussed below would likely have modest early savings, but would increase in significance after 3 years.

We designed the retrofit acceleration program after the model of established programs that are highly successful, have evolved over more than a decade, and are relatively easy to implement. Key components would be as follows:

- Customers must be provided with a range of technical assistance suitable to the scope of each project.

- Prescriptive and customized rebates must be provided (only for retrofits, not for new construction or major renovations).

- Higher rebate levels, and an optional separate procurement process, must be included to address the additional market barriers that face small businesses (<100 kW). The small business component would provide a minority of the savings and may require higher expenditures per kWh, but would likely have the greatest impacts after 5 years. This is because smaller businesses are less prone to adopt new technology on their own.

- The program must be promoted directly by the utility or other program administrator, but also must be designed to make use of the efforts of energy service companies and other proactive marketers of efficiency.

Commercial and Industrial Lighting Design Enhancement Program

One review of recently constructed and renovated New Jersey buildings estimated cost-effective lighting savings in individual buildings ranging from 5-35% *beyond* common practice

[8] Long-term savings are likely to be largest in markets where remodeling and replacing light fixtures are less common, such as in small buildings and institutions.

for new construction. The additional savings comes from additional design and equipment improvements (Sardinsky 2000). While these estimates were for energy savings, most of the proposed measures would deliver on-peak savings as well. Even higher savings may be possible with new technologies such as individualized user-controlled addressable light fixtures and design for daylighting.

We designed this program to capture these savings by increasing the quality and efficiency of lighting design in new commercial and industrial construction, renovation, and remodels. This program would provide relatively modest savings in the next 3 years because it would largely influence new and replacement systems, and could only influence the building stock as fast as it grows or equipment turns over. However, the benefits would grow significantly as the proportion of the building stock that is constructed, renovated, or remodeled cumulates over several years. As detailed in Appendix C, in a region with significant growth, its market could be as big as 40% of the building stock within 5 years.

This program would support and be enhanced by efforts to achieve state-level adoption and enforcement of the lighting standards in the new ASHRAE standard 90.1-1999. It also would encourage efficiency beyond that standard. The program design would leverage off of efforts by pioneering utilities to develop specific tools to work with the design community.

The central structure of the program is a series of prescriptive and custom rebates, supported by a program of technical assistance. The rebates are similar to those in the retrofit acceleration program described above except that: (1) they are keyed to improvements beyond current practice and codes; (2) the customized rebate takes a larger role; and (3) rebates are based on a portion of the incremental cost to exceed current practice and codes.

For smaller and contractor-designed buildings, lighting design tends to be simple and standardized; contractors rarely analyze lighting system energy use or light output. For these buildings, as a complement to rebates, the program would provide lighting design guidelines as a tool to both train contractors and to build demand for better lighting among owners, managers, and renters. The guidelines also would create a template for distributors, manufacturers, and other "contractor helpers" to specify efficient, high-quality layouts.

SUMMARY OF SAVINGS POTENTIAL FROM THESE PROGRAMS

Overall, the six programs recommended in this report could reduce peak electrical demand in 2010 by about 64,000 MW. About 45% of the savings would be due to the new residential air conditioner program. The commercial retrocommissioning program and the commercial lighting upgrade programs would each account for about 15% of the savings. The other three programs would account for 11% (residential air conditioning repair), 8% (commercial lighting design), and 6% (commercial HVAC equipment). Savings estimates by program are summarized in Table 2. Additional details on these calculations are provided in Appendix B.

Table 2. Summary of Savings Potential from Peak Reduction Programs

Program	Available Peak Savings in 2010 (MW)
New and replacement residential cooling systems	28,777
Residential cooling system tune-up and repair	6,900
Commercial and industrial HVAC equipment	3,900
Commercial building retrocommissioning and maintenance	11,000
Commercial and industrial lighting retrofit acceleration	9,200
Commercial and industrial lighting design enhancement	4,900
TOTAL	63,900 (includes adjustment to eliminate double-counting between programs)

According to the North American Electric Reliability Council, summer peak electrical demand is projected to grow by about 160,000 MW from 1999–2010.[9] Thus, the energy efficiency ideas discussed here, *if* aggressively pursued, could address approximately 40% of expected demand growth over the decade, contributing substantially to addressing peak demand-related reliability problems. Additional savings could be achieved from load management programs and other energy efficiency programs not discussed here.

In addition to reducing shortages in generating capacity, by reducing demand in districts with overtaxed distribution systems, these peak reduction programs could also reduce the incidence of distribution-related reliability problems (such as happened last year in New York City, Chicago, New Jersey, and Long Island). Furthermore, by decreasing energy use, these programs would have additional benefits such as reduced energy costs for customers and less emissions from power plants. Also, as described in detail in Nadel et al. (1997), energy efficiency investments have positive effects on jobs and the economy.

[9] NERC (2000a) projects growth of 128,000 MW through 2008. We extend this to 2010 using NERC's projected 1.8% annual growth rate.

However, achieving these savings would require actions by many people. The alternative is either continued reliability problems, or the higher costs and greater environmental problems associated with supply-side-only solutions.

RECOMMENDATIONS

In order to capture the peak demand savings possible from energy efficiency, we recommend the following actions:

- Policy-makers should consider efficiency programs as an *essential complement* to supply-side programs and load management in efforts to assure system reliability. Efficiency can be effective, low in cost, and provide economic savings directly to ratepayers.

- Utilities (or other appropriate program administrators) should begin developing and implementing major peak reduction programs as soon as possible so that programs would start by the end of 2000, and also should undertake sufficient installations so that they begin to have an impact on the 2001 summer peak. For example, HVAC distributors typically order equipment for the next cooling season around October — to ensure that these orders contain sufficient high-efficiency equipment, distributors would have to be briefed on program plans before these orders are placed. As these programs "ramp up" over several years, peak demand savings would steadily increase. All too often utilities do not begin summer peak planning until the spring, leaving inadequate time to take demand-side actions.

- State utility commissions should encourage, or even require, utilities or other organizations under their jurisdiction to develop and implement energy efficiency programs targeted at reducing peak demand. In states that have restructured, this responsibility (or at least funding) would generally fall on distribution utilities since they remain regulated monopolies, are the service provider of last resort, and commonly operate other energy efficiency programs. For example, the California Public Service Commission (CPUC) recently ordered utilities in the state to issue a request for proposals to solicit proposals for accelerated programs to reduce demand in the summer of 2001. The CPUC then reviewed the proposals and accepted 15 for implementation, with a total budget of $72 million (CPUC 2000). Likewise, the New York State Public Service Commission recently proposed a set of expanded programs to reduce peak demand in the state (NYDPS 2000). As state commissions consider steps along these lines, they will also need to consider ways to provide utilities with adequate incentives and resources to implement these programs (Moskovitz 2000). Alternatively, other organizations could operate programs such as state governments or Independent System Operators (ISOs). For example, the California legislature recently appropriated funds for the California

Energy Commission to operate some programs (California Legislature 2000) and in New York State, a state "Authority" (a semi-independent state agency) will operate the programs.

- DOE should provide technical assistance to states, utilities, and other program sponsors to help them develop and implement energy efficiency and other programs targeting peak demand. During the early 1990's, DOE provided extensive technical assistance to states and utilities on efficiency and related issues, but due to budget cutbacks these efforts have been scaled back dramatically in recent years. DOE and Congress should increase funding for the DOE Electricity Restructuring Program so that DOE can expand the amount of assistance it can provide.

- States should adopt funding mechanisms for energy efficiency and other public benefit programs. To date, twenty states have established a public benefit fund of some type, supported by a small surcharge on distribution service, to fund programs in the broad public interest including energy efficiency, low income, renewable energy, and public interest research and design. These programs have traditionally been funded through electric rates; a PBF is a competitively neutral mechanism for continuing these programs following restructuring (Nadel & Kushler 2000). States that do not presently have a PBF should enact them; states with minimal PBFs should expand their programs. In addition, as part of federal restructuring legislation, the federal government should encourage states to set up and expand PBFs by establishing a national fund to match state PBF expenditures. Several bills with such a mechanism have been introduced in Congress.[10]

- Congress should also adopt pending tax credits on high-efficiency residential air conditioners and energy-saving new commercial buildings as a complement to the programs proposed in this report. Several bills have been introduced in Congress that call for a 10% tax credit on residential central air conditioners and heat pumps with a SEER of 13.5 or more, and a 20% tax credit on systems with a SEER of 15 or more. The proposed commercial building tax would provide incentives of up to $2.25 per square foot for buildings that realize energy savings of 30-50% relative to current model energy codes.[11]

[10] Bills with a PBF introduced in the 106th Congress include bills drafted by Senator Jeffords (S. 1369), Rep. Pallone (H.R. 2569), Rep. Kucinich (H.R. 2645), and the Clinton Administration (S. 1047 and H.R. 1828).

[11] In the 106th Congress, bills with provisions along these lines include bills drafted by Rep. Matsui (H.R. 2380), Senator Smith (S. 2718), and Senator Roth (S. 3152).

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APPENDIX A: ECONOMIC COMPARISON OF DEMAND-SIDE AND SUPPLY-SIDE OPTIONS FOR ADDRESSING PEAK DEMAND

Measure	Incremental Cost	kW Saved	Life (years)	$/kW-yr	Notes
Supply-Side Options					
Peaking power plant (capital)			30	$47	NWPPC figures from Eckman 2000.
Peaking power plant (capital and operating)				$55	Assumes operation 3% of year, heat rate of 9847 Btu/kWh, and $3/Mbtu for gas.
Transmission upgrade	$72,000,000	240,000	30	$22	Varies widely; example given is for S. Fork on LI as noted in text.
Local distribution upgrades				$20–60	NWPPC figures from Eckman 2000.
Energy Efficiency Options					
High-efficiency chillers	$60	0.1	30	$44	Figures are per ton of capacity from XENERGY Inc. et al. 1996.
High-efficiency commercial package air conditioner	$510	1.71	15	$31	Figures for improving a 7.5-ton unit from 9.1 to 11 EER; from NEEP 1998.
Efficient residential air conditioner	$550	0.83	18	$62	Figures for improving a 3-ton unit from 10 to 13 SEER; from Thorne, Kubo, & Nadel 2000b. Cost from Appendix C.
Residential air conditioner tune-up	$375	0.39	15	$98	Based on figures in Appendix C.
Commercial retrocommissioning	$0.20	0.0006154	7	$58	Figures per sq. ft. and based on data in Suozzo & Nadel 1998 and Appendix C.
Commercial lighting upgrade	$4	0.01404	20	$22	Figures for T8 lamps and electronic ballasts from Suozzo & Nadel 1998 and assuming 78% of lights on at peak (per Appendix C).
Commercial lighting design	$0.40	.0.000312	20	$112	Figures per sq. ft. from Suozzo & Nadel 1998 and assuming 78% of lights on at peak.

Measure	Incremental Cost	kW Saved	Life (years)	$/kW-yr	Notes
Load Management Options					
Residential air conditioner load control	$250 + $26/yr	0.97	15	$53	Fixed costs of ~$200 for switch, installation, and marketing plus $50/point for the central system.
Residential water heater load control	$250 + $26/yr	0.56	15	$92	Same as above.
C&I interruptible rate				$44	Average for 1994 programs from EPRI 1995.

Note: $/kW-year is the value of one kW of generating capacity or its equivalent for a 1-year period. This measure is commonly used in power markets. We calculate this value by assuming the incremental cost is financed with a loan at a 6% real interest rate for a term equal to the measure life, and then dividing the resulting annual loan payments by the kW savings.

APPENDIX B: ESTIMATED PEAK DEMAND SAVINGS FROM PROPOSED PROGRAMS

Program	Basecase Use/Unit	Savings	Savings/ Unit	Eligible Units/ Area	Penetration Rate 2001–10	Peak Savings in 2010
	(KW)	*(%)*	*(kW)*	*(1000 units)*	*(%)*	*(MW)*
New residential air conditioner*	2.75	30%	0.825	63,147	55%	28,700
Residential air conditioner repair**	2.75	14%	0.385	60,172	30%	6,900
Commercial HVAC equipment						
Packaged systems	10.2	18%	1.8	3,150	55%	3,200
Chillers	108.8	15%	16	70	70%	800
	(Watts)	*(%)*	*(Watts)*	*(million sq. ft.)*	*(%)*	*(MW)*
Commercial retrocommissioning	NA	10%	0.77	28,498	50%	11,000
Commercial lighting upgrades	1,404	30%	0.42	43,667	50%	9,200
Commercial lighting design	1,014	20%	0.20	48,750	50%	4,900
TOTAL						64,700

* = Includes mandatory standard effective 2006.
** = ~10% of these savings overlap w/program above.
*** = Includes mandatory standard effective 2007.
**** = Includes building code standard effective 2006.

Key assumptions for the calculations include the following.

New residential air conditioning: basecase use and savings from Appendix C. Number of eligible units based on annual sales of air-source air conditioners and heat pumps less than 65,000 Btu/hour in 1999 (from ARI 2000) times 10 years. Penetration rate assumes 50% average penetration rate for good installation practices over 10 years plus average 25% penetration rate for efficient equipment during the first 5 years due to incentive programs and average 100% penetration rate during the second 5 years due to government standards.

Residential air conditioner repair: basecase use and savings from Appendix C. Number of eligible units based on number of homes in 1997 with central air conditioning or heat pumps (from EIA 1999c) plus a 3% annual growth rate through 2005 (from Neme, Proctor, & Nadel1999). Penetration rate also from Neme, Proctor, & Nadel (1999).

Commercial HVAC equipment: Basecase packaged unit is a 9 ton unit — weighted average in 1998 based on analysis of Census Bureau Current Industrial Report data (Thorne, Kubo, & Nadel 2000b) — with an energy efficiency rating (EER) of 9.2 (modestly above 8.9 minimum standard). Savings assumes 11.2 EER (modestly above CEE Tier 2). Peak savings assumes 85% of units on at time of peak, as discussed in Appendix C. Number of eligible units based on number of units sold in 1998 from *Current Industrial Reports* (BoC 1999) times 10 years. Penetration rate assumes 25% average participation for first 6 years due to incentive programs and 100% participation in final 4 years due to minimum standards.

Basecase chiller is a 200 ton unit with an efficiency of 0.64 kW/ton. Savings based on an efficiency of 0.54 kW/ton. These figures are all authors' estimates. Peak savings assumes 85% of units on at time of peak, as discussed in Appendix C. Number of eligible units based on sales in past decade from *Air Conditioning, Heating and Refrigeration News* (1999). Penetration rate from Appendix C for first 5 years and assumes 100% penetration in final 5 years due to energy code requirements.

Commercial retrocommissioning: 10% savings from Appendix C. kW savings based on average kWh/sq. ft. for commercial buildings above 50,000 sq. ft. (from EIA 1998) times 10% savings divided by 1,950 kWh/kW (from Appendix C). Number of eligible units based on CBECS data from 1995 for buildings over 50,000 sq. ft. (EIA 1998) times an 8-year growth from EIA's *Annual Energy Outlook* (EIA 1999b). Penetration rate is the authors' estimate.

Commercial lighting upgrades: basecase assumes 1.8 W/sq. ft. for buildings that have not yet upgraded their lighting (authors' estimate) times 78% of lights on at peak (from Appendix C). Savings also from Appendix C. Eligible units based on projected commercial building floor area in 2005 (from EIA 1999b) times 0.66, where the latter is the authors' estimate of the proportion of floor area that does not presently use T8 lamps and electronic ballasts (1999 California data indicates a somewhat lower percentage [PG&E 2000b] but California has been aggressively promoting efficient lighting for more than a decade). Penetration rate based on most successful programs, as discussed in Appendix C.

Commercial lighting design: basecase assumes 1.3 W/sq. ft. for new buildings (authors' estimate) times 78% of lights on at peak (from Appendix C). Savings also from Appendix C. Eligible units based on projected annual commercial floor area growth (from EIA 1999b) times 10 years. To this we added 50% of the existing floor area in 2005 (also from EIA 1999b) based on assumption that half of the floor area has its lighting changed each decade (per discussion in Appendix C). Penetration rate based on most successful commercial new construction programs, as discussed in Appendix C.

APPENDIX C: DETAILED PROGRAM DESCRIPTIONS

1. New and Replacement Residential Cooling Systems Program

Overview

This program aims to improve the efficiency of new central air conditioners and heat pumps. It promotes both the sale of high-efficiency equipment and improvements in sizing and installation practices that affect operating efficiency and peak demand. It is modeled on a similar initiative currently being implemented in a coordinated fashion by the three large investor-owned utilities in New Jersey (Public Service Electric and Gas, GPU Energy, and Conectiv Power Delivery). The long-term goal is to transform the market to one in which quality installations of high-efficiency equipment are commonplace. The program employs several key strategies to achieve this goal:

- Incentives for the sale or purchase ofhigh-efficiency equipment for which documentation of proper sizing and installation is provided;
- Training of HVAC technicians on key elements of quality installations;
- Sales training for contractors (i.e., how to sell efficiency);
- Direct marketing to HVAC distributors and contractors through "circuit riders";
- Promotion of HVAC technician certification; and
- Aggressive consumer marketing/education campaign on key elements and benefits of efficiency.

The success of these strategies would be enhanced significantly if they were jointly implemented by utilities with adjoining service territories or if programs were implemented by other state or regional organizations. This would ensure that clear and consistent messages were sent to market actors that serve large geographic areas that often encompass more than one utility service territory (e.g., HVAC distributors). It would also enable more efficient use of program resources by spreading the costs of developing marketing and other program materials across multiple parties.

Target Market

The program targets all residential dwellings for which a new central air conditioner or heat pump is being purchased, including both existing homes and new construction. In the case of new construction, efforts to promote proper installation of high-efficiency equipment could be coupled with efforts to promote improvements in the efficiency of the thermal envelope of the building, providing even greater savings. Utilities and other program sponsors offering such comprehensive new construction programs could offer builders the option of participating in the HVAC equipment installation program or the more comprehensive program (with sufficient incentive offered to encourage as many builders as possible to choose the more comprehensive option).

Efficiency Measures

The program promotes two efficiency tiers for central air conditioners and heat pumps:

Efficiency Level	Minimum SEER	Minimum EER	(heat pumps only) Minimum HSPF
Tier 1	13.0	11.0	8.0
Tier 2	14.0	12.0	8.5

To be eligible for an incentive or any other promotion, a central air conditioner would have to meet both the minimum SEER (a measure of average efficiency over the entire cooling season) and the minimum EER (a measure of efficiency at higher temperatures typical of those experienced during utility peak demand periods in many parts of the country) for a given efficiency tier. The minimum EER requirements would be particularly important to any effort designed to substantially reduce peak demand because efficiency at high temperatures can vary significantly among equipment with the same SEER. In particular, equipment with two-speed or multiple speed operation (common at SEER 15 or above and sometimes found in SEER 14 models) generally does not produce the same savings at peak conditions as at milder temperatures. A heat pump would have to meet the minimum HSPF standard (a measure of average efficiency over the course of the entire heating season) as well as the minimum SEER and EER standards.

In addition (i.e., under either efficiency tier), documentation of proper sizing and installation of qualifying high-efficiency equipment would have to be submitted. This would include submission of Manual J load calculations, documentation of proper refrigerant levels in the system, and documentation that airflow over the coil is within the range recommended by manufacturers (i.e., between 350 and 450 CFM/ton of capacity). Documentation of proper charge and airflow could be provided through a form similar to the one at the end of this program description. An alternative could be using charge and airflow software tools similar to those currently in use in parts of California.

This additional requirement could be implemented either from the start or in the second year of the program. Many HVAC contractors would find the proper sizing and installation requirements to represent a significant departure from how they currently do business. Indeed, many would not know how to meet them. Deferring the requirements to the second year would allow the market to begin reacting to the offer of incentives, making contractors reluctant to stop participating once the proper sizing and installation requirements go into effect. It would also enable the program administrator to "warn" contractors of the new requirements, offer training on key requirements so contractors understand and are ready to meet them, and begin educating consumers on their benefits. Deferments could be particularly helpful in areas where utilities have had relatively little demand-side management activity in the residential HVAC market, where market shares for high-efficiency equipment are low, and where HVAC contractor use of key techniques for proper sizing and installation are low.

Program Strategies

The residential HVAC business is currently a low-bid business, where investment decisions are usually driven by a desire to minimize first cost. As a result, investments in both efficiency and quality — including high-efficiency equipment, proper sizing and installation, and duct repair — are the exception rather than the rule. This reality is itself a function of a variety of ubiquitous and formidable market barriers. These are summarized in Table C-1.

Table C-1. Market Barriers to High-Efficiency Residential HVAC Systems

Market Barrier	Key Issues
Customer Access to Information	• Customers often do not know that a large majority of central air conditioner or heat pump installations are improperly sized and installed. Because systems are complex, most consumers are incapable of knowing whether they got a good installation. • Some customers lack information on the energy savings that would result from installation of an efficient HVAC system. • Customers are usually unaware of the comfort, maintenance, and equipment life costs associated with improper installations.
Customer Inability to Identify Quality Contractors	• Many customers do not have unbiased sources of information. Certification programs for HVAC technicians are very new and the public is unaware that they exist. Very few technicians have taken certification tests. • Certification programs test only "book knowledge." Some good technicians may not pass and some may pass without having good "hands-on" technique.
Lack of Well-Trained Contractors and Technicians	• Many HVAC contractors lack the sales skills necessary to "sell" efficiency. • HVAC technicians often do not have adequate training on key elements of proper sizing and installation. • No training/certification is required to operate an HVAC business.
Lack of Program Consistency	• Different utility program standards or incentives within the same state or region often creates confusion in the market about the definition of efficiency. • Distributors and contractors that serve more than one utility service territory endure hassle of ordering different equipment and/or learning different procedures for customers in each region.
Additional Cost	• Some customers do not have the capital necessary to pay the incremental cost for efficient equipment and efficient/quality installation.
Split Incentives	• In new construction and rental housing, the person making the investment decision (i.e., builder or landlord) will not be paying the energy bills.

To be successful, the program will need to address all of these barriers. Given the diverse nature of the barriers, the program will need to have several different components.

Financial Incentives

The program offers rebates for the purchase and proper sizing and installation of high-efficiency central air conditioners and heat pumps. The incentives need to be large enough to both attract consumer interest and persuade HVAC contractors to "try" proper sizing and installation techniques. Recommended incentive levels are:

Efficiency Tier 1: \$300 to \$400
Efficiency Tier 2: \$500 to \$600

These incentive amounts are consistent with those currently offered by similar programs in New Jersey and Long Island, where utilities are having considerable success in promoting both the sale of high-efficiency equipment and the use of proper sizing and installation techniques. The incentive amounts are designed to cover approximately two-thirds of the incremental equipment cost at Tier 1, with somewhat higher portions of incremental cost being covered at Tier 2. This progressive structure has proven to be effective in steering customers towards the highest equipment efficiency levels. For example, in New Jersey, nearly half of the more than 16,000 rebates processed in 1999 were for central air conditioners with Tier 2 efficiency characteristics.

Over time, as consumers become conditioned to ask and more willing to pay for high-efficiency equipment, HVAC contractors become more accustomed to selling this equipment, and sales volumes for efficient installations grow, it should be possible to reduce incentive levels.[1]

Inspections would be necessary to ensure that program standards for proper sizing and installation are met. However, every effort should be made to also use inspections as an opportunity to further educate contractors and technicians on quality installation procedures and standards.

HVAC Technician Training

The program includes a series of HVAC technician training sessions on key elements of proper equipment installation, including ACCA Manual J-based sizing, proper refrigerant charging, and ensuring proper airflow. Additional training could also be offered on duct design (ACCA Manual D) and duct sealing/repair. Efforts should be made to work with HVAC

[1] For example, between 1992 and 1997 the Potomac Electric Power Company (PEPCO) reduced the rebate it offered for SEER 13 air conditioners in Maryland by nearly 50% (PEPCO 1998). Over the same period of time, the number of Maryland program participants nearly doubled (from 4,712 to 9,114 central air conditioners and heat pumps) (PEPCO 1994, 1998). Moreover, the percent of participants at the SEER 13 level increased from 8% in 1992 to 100% in 1997 (PEPCO 1994, 1998).

distributors, vo-tech programs, ACCA, RSES and other potentially important trade groups in both developing the curricula and providing the training. This would create some critical "buy-in" for the program. Experience in New Jersey suggests that contractors are much more likely to register for training courses if they are promoted and co-sponsored by their distributors.

HVAC technicians (or their firms) would be required to pay fees for the training. However, the program administrator could offer some inducements to complete courses. For example, it could be useful to offer discounts on sizing software and/or other key tools.[2]

Sales Training

As noted above, few HVAC contractors appear to have the sales skills necessary to sell prospective customers on buying high-efficiency equipment or paying for the extra time required to do a job right. The program offers training designed to help interested contractors to improve their sales skills. EPA's ENERGY STAR® program has developed and offers a curriculum and related materials for such sales training. Although the ENERGY STAR standard for central air conditioners and heat pumps (minimum SEER 12, no minimum EER) is lower than the minimum efficiency standard promoted by this program, ENERGY STAR's sales training concepts are applicable to any efficiency standard. Other utilities have developed and are using their own sales training curricula.

Circuit Riders

One of the common attributes of successful HVAC programs has been extensive outreach to and communication with HVAC contractors (Neme, Peters, & Rouleau 1998). Outreach and communication are even more important for the program described here because of the requirements for proper sizing and installation that many contractors would not understand and others would resent. Therefore, the program should employ individuals whose sole job would be to regularly call on HVAC distributors and contractors. Their purpose would be to explain program requirements, recruit technicians for training classes, provide rebate forms and other program materials, encourage contractors to actively participate in the program, and give contractors an outlet for expressing concerns about the program. These circuit riders would be individuals who have extensive HVAC expertise so that they could address technical questions and issues raised by the trade allies with whom they are interacting.

[2] The New Jersey utilities currently offer a free magnehelic gauge to technicians who complete their two-evening course on refrigerant charge and airflow. Magnehelic gauges can be used to measure pressure drops across the coil, which, in turn, can be used to estimate airflow. Surveys of trainees suggested that few had such tools. Offering them to technicians who complete the class ensures that they leave with both the knowledge and the tools necessary to do the job right.

Technician/Contractor Certification

One of the longer-term strategies of the program is to develop and support a mechanism for helping customers identify quality contractors. This certification mechanism should have several components:

- A certification standard that addresses key elements of efficient installations, is administered by an independent 3rd party,[3] and is likely to have credibility with the HVAC industry;[4]
- A means for consumers to easily identify contractors that have met the standard (i.e., a registry of firms that have a pre-requisite number of certified technicians and meet other business requirements);
- Assistance to technicians and contractors interested in getting certified (e.g., sponsorship of and perhaps partial subsidization of training courses and certification tests);
- Quality control procedures to ensure both that contractors do not advertise themselves as certified if they are not and that certified contractors maintain relatively high standards in their work; and
- Marketing (or co-marketing) of certified contractors to consumers.

Development of an effective certification standard will be perhaps the most critical element of this effort. Program operators should work with the North American Technician Excellence (NATE) program — together with other utilities, states, and CEE — to enhance the current NATE tests so that they adequately assesses technicians' understanding of key installation procedures that affect equipment operating efficiency. Program administrators could also want to establish a "hands-on" component (or option) to the current NATE written exam, with technicians required to pass the hands-on test as a condition for being on a program's "preferred contractor" list. Finally, program sponsors would likely want to add business requirements, such

[3] This could be best done by a local nonprofit organization that has ties to the HVAC industry and a strong interest in promoting "best practices." Alternatively, such a nonprofit organization could be created to serve this need. In either case, program administrators should support these organizations financially and otherwise in the early years of program operation, with the hope that they could gradually transition to becoming self-supporting (e.g., through contractor membership dues).

[4] Any certification program must start by certifying individual technicians. However, it will also be important to certify contractor firms for which they work. This could be done, for example, by placing an HVAC contractor firm on a certification registry if at least 50% of their technicians are certified.

as adequate insurance and/or good standing with the Better Business Bureau, to the conditions they establish for being on the certification registry they make available to the public.

Consumer Marketing/Education Campaign

One of the most important factors underlying the "low-bid" nature of the residential HVAC business is that contractors do not feel consumers are demanding or willing to pay for higher-efficiency equipment or work. This, in turn, is related to consumers' lack of knowledge on both what to ask for and why they should ask for it. Therefore, efforts to educate consumers would be essential to the success of this program. The ultimate goal of the marketing/education campaign is to establish the link between energy efficiency and quality (comfort, durability, etc.) in most consumers' minds.

To begin with, the program would develop consumer education materials that summarize the benefits of efficiency (both energy costs savings and non-energy benefits such as improved comfort), explain the key elements of an efficiency system, and provide guidance on how to select a quality contractor. These materials could take several forms, including both written pieces and a brief educational video. They could also include a quality installation specification that customers could ask contractors to incorporate into their bids. These materials would be distributed as widely as possible, both to consumers who would request them and to quality contractors who would be interested in using them to help sell their services.

A variety of different marketing vehicles would be used to both alert consumers to the availability of educational materials and deliver shorter, complementary messages to consumers. The precise nature and mix of those vehicles would depend on a variety of local conditions, including customer demographics and local costs (e.g., of media placements). The options to consider would include direct mail to consumers likely to be in the market for a new central air conditioner (e.g., those living in homes built 10–15 years ago), Yellow Page ads, a dedicated internet Web site, billboards, newspaper ads, and other forms of mass media advertising.

Relationship of Program Strategies to Market Barriers

Table C-2 shows how these program strategies address each of the key market barriers to efficiency investments in the HVAC replacement market.

Relationship to Minimum Efficiency Standards

Residential central air conditioners and heat pumps are covered by minimum-efficiency standards set by DOE. The current standard, which mandates that equipment must have an efficiency rating of at least SEER 10, took effect in 1992. As of this writing, DOE is completing a rulemaking for a new standard that will likely take effect in 2006. The standard will likely be in the range of SEER 12–13 and may include EER requirements. Promotion and incentive programs could encourage purchase of efficient units before the new standard takes effect and could also be used to promote units more efficient than the standard after the new standard takes effect.

Table C-2. Intervention Strategies' Impacts on Market Barriers

Market Barrier	Intervention Strategy
Customer Access to Information	• Develop and distribute educational materials on benefits of efficient equipment/quality installations, how to select both equipment and contractors, and information customers should ask their contractors to provide to document quality work. • Provide both sales and technical training to HVAC contractors interested in providing quality service so that they could help educate consumers.
Customer Inability to Identify Quality Contractors	• Develop and promote technician/contractor certification. • Promote sales training to enable quality contractors to differentiate themselves when meeting with consumers.
Lack of Well-Trained Contractors and Technicians	• Work with trade allies to design and offer high-quality training on sizing and other elements of proper installation that require documentation as part of incentive applications. • Provide sales training to contractors (possibly through ENERGY STAR program). • Circuit riders to encourage contractors to participate in program and help address issues and questions that contractors have, particularly in early years. • Substantial incentives for efficient equipment and quality installations help encourage some contractors to "try" different approach.
Lack of Program Consistency	• Jointly develop efficiency standards, incentive levels, training offerings, marketing plans, and other key program elements with neighboring utilities/sponsors.
Additional cost	• Offer incentives designed to cover a substantial portion of incremental cost. • Education of and marketing to consumers, encouraging them to recognize and consider life-cycle costs of investment decisions.
Split Incentives	• Offer incentives designed to cover a substantial portion of incremental cost.

Key Indicators of Success

A number of different indicators should be used to gauge program success. Key among these are:

- The percent market share of high-efficiency (i.e., minimum SEER 13 and minimum EER 11.0) central air conditioners and heat pumps;
- Reductions in the average over-sizing of new central air conditioners and heat pumps;
- Increases in the percentage of new central air conditioners and heat pumps with both proper refrigerant charge and adequate airflow;
- Increase in consumer awareness of high-efficiency HVAC equipment and services;
- Number of HVAC technicians trained in key elements of equipment installation; and
- The number of certified HVAC technicians and/or contractors.

Costs and Savings Assumptions

Savings

Increasing equipment efficiency and improving sizing and installation practices that affect actual operating efficiency are the two major components of the program that would produce energy and peak demand savings. Together, these two components could reduce central air conditioner energy consumption by 35–45% and peak demand by 25–35%. The two sources of these savings each provide roughly half of the savings.[5] Savings for SEER 13 would generally be at the lower end of this range and savings for SEER 14 towards the upper end of this range. The baseline energy use to which these saving percentages would apply would vary considerably from region to region. The baseline peak demand could also vary. However, it is not likely to vary as much. On average, baseline coincident peak demand is likely to be on the order of 2.75 kW.[6] Thus a 25–35% peak demand savings would translate to approximately 0.7–1.0 kW savings per home.

Costs

The incremental cost of a SEER 13 central air conditioner is estimated to be on the order of $530-610, while a SEER 14 is approximately $640-765 (ECW 1997). There is also an incremental cost associated with the extra time contractors must take to properly size central air conditioners and perform the tasks to ensure that there is proper charge and adequate airflow. However, those costs are more than offset by the cost savings associated with not over-sizing equipment. Therefore, the incremental cost of proper sizing and installation can be considered $0.

[5] Proper sizing, charge, and airflow would save approximately 20–25% of energy use and 10–15% of peak demand, depending on whether the installation would be in an existing home or new construction (Neme, Proctor, & Nadel 1999). Increasing equipment nameplate SEER from 10 to 13 or 14 would produce energy savings of 23–29%. Increasing equipment nameplate EER to 11 or 12 would produce peak demand savings of 16–23% (assuming baseline EER of 9.2). Note that the savings from these two components are not additive (i.e., there are interactive effects).

[6] A 3 ton central air conditioner will draw 3.91 kW if it has an EER of 9.2 [kW = (Btuh/(EER*1000))]. An EER of 9.2 is typical for a SEER of 10.0. A recent study of six different utility service territories suggested that, on average, 15% of units were constantly off during the hour of system peak, 60% of units were cycling (largely due to over-sizing), and 25% of units were running constantly (Petersen & Proctor 1998). If the average duty cycle of the 60% that were cycling was 75%, the average coincidence factor for the entire population would be 70% [(0.60*0.75)+0.25]. A 70% average coincidence factor applied to an average full load draw of 3.91 kW yields an average coincident kW of 2.74.

Non-Energy Benefits

There are substantial non-energy benefits associated with efforts to promote proper sizing and installation. Chief among these are improved comfort in the home, reduced maintenance costs, and longer equipment life.

For example, a properly sized air conditioner will operate for longer periods of time — with fewer "ons" and "offs" — than an oversized unit. That improves humidity control during moderately hot days because it allows the indoor coil to get cold enough to remove moisture from the air. It also reduces stress on the compressor.

Proper airflow and proper charging are also essential to maintaining comfort. Both are necessary to permit proper humidity control. If airflow or refrigerant levels are too low, the capacity of the equipment is reduced since not enough heat transfer can occur between the coils and the air in the duct system. This can compromise the ability of the system to cool a home, particularly on very hot days. Very low airflow or too much refrigerant can lead to icing of the coils, refrigerant floodback, and even compressor failure (Neme, Proctor, & Nadel 1999; Parker et al. 1997).

Measure Life

The savings are expected to last for the life of the new central air conditioner or heat pump. That life was estimated by DOE (2000b) to be 18 years.

Possible Market Penetration Rates

Market penetration rates will likely vary to some degree depending on location. The key market barriers are likely to be more severe in some states than in others. As a result, the baseline market share for high efficiency varies from state to state. This is often at least partly a function of historical utility attempts to influence the market. For states where utilities or other organizations have previously promoted high-efficiency equipment (very few have also promoted proper sizing and installation) but where no substantial efforts currently exist, participation rates can be expected to grow as follows:

Year 1:	15% (assumes no sizing and installation requirements)
Year 2:	15% (assumes sizing and installation requirements begin)
Year 3:	20%
Year 4:	30%
Year 5:	40%

These participation rates are necessarily uncertain projections as the few program administrators that are currently operating similar programs are in only their first or second year of operation. At least one utility was able to achieve a 50% market penetration rate for SEER 13 equipment within 5 years of program operation (Neme, Peters, & Roulcau 1998). However, that was achieved without proper sizing and installation requirements.

Residential Central Air Conditioner and Heat Pump Rebate Program
Airflow & Charging Documentation Form

(Based on New Jersey Utilities rebate form)

A. PROGRAM REQUIREMENTS AND GUIDELINES

1. All applications must include a cooling load calculation worksheet consistent with ACCA Manual J procedures. The installing contractor must size the equipment within 15% or half ton of the calculated cooling load ("Manual J Calculation" or equivalent).
2. For all homes, the installing contractor must measure and document the airflow across the evaporator coil using this form. For residential new construction installations only, the contractor must also verify that the measured airflow across the evaporator coil is within 10% of the manufacturer specifications. A copy of the table or graph used to estimate airflow must be attached to the completed form.
3. The installing contractor must document the proper amount of charge installed (as determined by the manufacturer) by using one of the following charging methods: Weigh In, Superheat, Subcooling, or the Lennox Approach Method. A copy of the table or graph used to determine the proper amount of charge must be attached to the completed form.

B. PROPER SIZING REQUIREMENTS

In order to assure that the equipment installed is properly sized, contractors/installers are required to submit Manual J calculations. The calculations can be either hand-written on Manual J Form J-1 or performed with the use of a computer-based tool that is consistent with Manual J. In either case, copies of both the inputs used in the calculations and the resulting load calculations must be submitted to your utility in order for the customer to be eligible for a rebate. In reviewing the submitted sizing calculations to determine eligibility, your utility will focus particular attention on the following:

1. **Consistency between equipment capacity and sizing calculations.** Installed equipment capacity must be within either 15% or half ton of the calculated Manual J load.
2. **Indoor design temperatures.** Manual J sizing calculations must be performed with an indoor design temperature no lower than 75°F and an indoor relative humidity of either 50% or 55%.
3. **Window Areas.** The utility expects that the vast majority of sizing calculations will be conducted using actual rough window areas between 10% and 18% of floor area, with the average below 15% (In most homes, window areas are approximately 10% to 15% of the floor area. In homes considered more "open" or "stylish", window areas may be as high as 18% of the floor area. Window areas only rarely exceed 20% of floor area).
4. ***Summer infiltration rates.*** *Manual J specifies summer infiltration rates (in Air Changes per Hour) that should be used to calculate design* cooling loads. These infiltration rates are a function of the area of the home that will be cooled (in square feet) and the assumed tightness of the home ("best", "average", or "poor"). Below are the infiltration assumptions required by Manual J, including definitions of the three different building envelope conditions.

Summer Air Changes per Hour (ACH) to be Used in Manual J Calculations of Design Cooling Loads

Envelope Condition	House Area to be Cooled (in Square Feet)			
	Less than 900	901 to 1,500	1,501 to 2,100	Greater than 2,100
Best	0.2	0.2	0.2	0.2
Average	0.5	0.5	0.4	0.4
Poor	0.8	0.7	0.6	0.5

Source: ACCA Manual J Load Calculations for Residential Winter and Summer Air Conditioning, Seventh Edition

Definitions of Envelope Condition:

Best: "Continuous infiltration barrier, all cracks and penetrations sealed, tested leakage of windows and doors less than 0.25 CFM per running foot of crack, vents and exhaust fans dampered, recessed ceiling lights gasketed or taped, no combustion air required or combustion air from outdoors, no duct leakage."

Average: "Plastic vapor barrier, major cracks and penetrations sealed, tested leakage of windows and doors between 0.25 and 0.5 CFM per running foot of crack, electrical fixtures which can penetrate the envelope not taped or gasketed, vents and exhaust fans dampered, combustion air from indoors, intermittent ignition and flue damper, some duct leakage to unconditioned space."

Poor: "No infiltration barrier or plastic vapor barrier, no attempt to seal cracks and penetrations, tested leakage of windows and doors greater than 0.50 CFM per running foot of crack, vents and exhaust fans not dampered, combustion air from indoors, standing pilot, no flue damper, considerable duct leakage to unconditioned space."

C. CHARGING LENNOX SYSTEMS

If you are using the Lennox Approach Method, document your inputs and measurements in the "Option 3: Subcooling" section of this rebate form as shown in the sample below. Be sure that all shaded areas shown in the sample are completed on the actual form.

OPTION 3: SUBCOOLING Notes: Typical for most Thermal Expansion Valve systems when outdoor temperature is greater than 80°F

INPUTS

Refrigerant type: ☐ R-22 ☐ R-410A ☐ Other: ____________ (specify)

Required Subcooling: ________ °F (from nameplate/manufacturer service guide)

Outdoor Dry Bulb Temperature: ________ °F

MEASUREMENTS

Liquid line pressure ____ psig

(F) Saturation temperature for measured pressure ____ °F

(G) Liquid line temperature ____ °F

Measured Subcooling (F minus G) ____ °F

*Measured Subcooling must be within 3°F of the manufacturer specified Subcooling

Note: **Substitute Outdoor Dry Bulb Temperature for item (F) in the calculation**

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DOE003-0054

Residential Central Air Conditioner and Heat Pump Rebate Program
Airflow & Charging Documentation Form

(Based on current New Jersey utilities rebate form)

Customer Name: ______________________ Application #: [| | | | |]

Contractor Name: ______________________ Contractor Phone: (____) ______________

Contractor Mailing Address: ______________________ Contractor Signature: ______________

______________________ Utility: ☐ Utility A ☐ Utility B ☐ Utility C

Quality Installation: Inert gas (Nitrogen) should be used during any brazing/soldering of refrigerant lines on your installation

AIR FLOW

Rated Cooling Capacity (tons): ____________ Target Airflow Volume (CFM): ____________

Total static pressure drop ("W.C." inches of water column) measured across evaporator coil if newly installed: ____________

or external static pressure for fan coil unit: ____________

Total Static Measured With: ☐ Dry Coil (Blower only, fan on cooling speed) ☐ Wet Coil (entire A/C unit operating)

Blower Fan Speed Setting: ☐ Low ☐ Medium/Low ☐ Medium ☐ Medium/High ☐ High

CFM Air Flow Estimated From Total Static Measurement: ______________ Estimated From: ☐ Table ☐ Graph

Note: Copy of table or graph supplied by manufacturer and used to estimate airflow must be attached to this form.

CHARGING OPTIONS

Charging Method Used: ☐ WEIGH IN ☐ SUPERHEAT ☐ SUBCOOLING ☐ LENNOX APPROACH METHOD

NOTE If Lennox Approach Method used, see cover for instructions on completing the charging section

OPTION 1: WEIGH IN [illegible]

Refrigerant type: ☐ R-22 ☐ R-410A ☐ Other: ______________ (specify)

Outdoor unit capacity: ________ pounds ________ ounces

Does this capacity include an allowance for an evaporator? ☐ Yes ☐ No

Does this capacity include an allowance for a line set? ☐ Yes ☐ No

Allowed line set length ________ feet

(A) Suction Line outside diameter ________ inches, Net length* ________ feet x ________ ounces/foot = ________ ounces

(B) Liquid Line outside diameter ________ inches, Net length* ________ feet x ________ ounces/foot = ________ ounces

(C) Driers, Accumulator, and Evaporator Capacities (if not included above) ________ ounces

*Net Length = Measured Length minus (-) Allowed Length | Total charge weighed in (A) + (B) + (C) ________ ounces

Note: A copy of the manufacturer's specifications for weighing in of additional refrigerant must be attached to this form.

OPTION 2: SUPERHEAT [illegible]

INPUTS

Refrigerant type: ☐ R-22 ☐ R-410A ☐ Other: ______________ (specify)

Manufacturer Specified Superheat: ________ °F (from manufacturer service guide or as per manufacturer's specification or cut sheet)

Indoor Wet Bulb Temperature: ________ °F (near system return)

Outdoor Dry Bulb Temperature: ________ °F

MEASUREMENTS

Vapor (suction) pressure	psig
(D) Saturation temperature for measured pressure	°F
(E) Vapor (suction) line temperature near compressor	°F
*Measured Superheat (E minus D)	°F

*Measured Superheat must be within 5°F of the manufacturer specified Superheat

Note: A copy of the documentation of the manufacturer's specified superheat for the installed equipment must be attached to this form.

OPTION 3: SUBCOOLING [illegible]

INPUTS

Refrigerant type: ☐ R-22 ☐ R-410A ☐ Other: ______________ (specify)

Required Subcooling: ________ °F (from nameplate/manufacturer service guide or as per manufacturer's specification or cutsheet)

Outdoor Dry Bulb Temperature: ________ °F

MEASUREMENTS

Liquid line pressure	psig
(F) Saturation temperature for measured pressure	°F
(G) Liquid line temperature	°F
*Measured Subcooling (F minus G)	°F

*Measured Subcooling must be within 3°F of the manufacturer specified Subcooling

Note: A copy of the documentation of the manufacturer's specified subcooling for the installed equipment must be attached to this form.

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2. Residential Cooling Systems Tune-Up and Repair Program

Overview

This program aims to improve the efficiency of *existing* central air conditioners and heat pumps. It promotes the retrofit treatment of common operating problems that adversely affect operating efficiency — particularly improper levels of refrigerant charge, inadequate airflow, and substantial duct leakage — by specially trained and equipped HVAC technicians. The program is modeled on a similar initiative currently being implemented by San Diego Gas and Electric with substantial assistance from the Proctor Engineering Group. This program's long-term goal is to transform the market to one in which there are a substantial number of HVAC technicians capable of diagnosing and treating HVAC efficiency problems working for HVAC firms that see sales of such services as a core part of their business. To achieve this goal, the program employs several key strategies:

- Modest consumer incentives for both assessments of HVAC systems and treatment of any problems identified;
- Aggressive marketing campaign to encourage consumers to ask qualified HVAC contractors to assess and treat potential operating efficiency problems;
- Direct marketing to HVAC contractors (through "circuit riders") to encourage them to participate in the program;
- Providing interested contractors with both easy-to-use software for guiding treatment of key HVAC operating efficiency problems and the training on how to use it;
- A quality control mechanism to ensure that any remedial work performed on HVAC systems was done properly and that any contractors submitting fraudulent data were identified and removed from the program; and
- A mechanism for referring interested customers to qualified HVAC contractors.

Target Market

The program targets all residential dwellings that currently have operating central air conditioners or heat pumps.

Efficiency Measures

The program promotes diagnosis and treatment of HVAC operating problems that adversely affect operating efficiency. It has two specific treatment "modules":

- Correction of refrigerant charge and/or airflow problems; and
- Duct sealing and repair.

Program Strategies

Numerous studies from around the country have demonstrated that most existing central air conditioners and heat pumps suffer from a variety of conditions that combine to significantly reduce their operating efficiency, degrade comfort in the home, and impose strains that could reduce the life of the equipment. For example, roughly 70% of all central air conditioners and heat pumps have inadequate airflow over the coil and/or improper levels of refrigerant. At the same time, the average duct system leaks 20% or more of the air that flows through it to or from the outdoors (Neme, Proctor, & Nadel 1999). These conditions typically persist until there's a catastrophic event (e.g., the break-down of the equipment). They are not treated during maintenance or other service calls due to a variety of ubiquitous and formidable market barriers, which are summarized in Table C-3.

Table C-3. Market Barriers to High-Efficiency Residential HVAC Systems

Market Barrier	Key Issues
Customer Access to Information	• Customers often do not know that a large majority of central air conditioner or heat pump systems are operating with a number of problems. • Some customers lack information on the energy savings that would result from treatment of these problems. • Customers are often unaware of the comfort, maintenance, and equipment life costs associated with improper installations.
Customer Inability to Identify Qualified Contractors	• Customers have no easy way to identify contractors who could effectively diagnose and treat key operating problems. Certification programs for HVAC technicians are very new and the public is unaware that they exist. Very few technicians have taken certification tests. • Certification programs test only "book knowledge." Some good technicians may not pass while some may pass without having good "hands-on" technique.
Lack of Well-Trained Contractors and Technicians	• Few HVAC technicians have adequate training on diagnosis and treatment of key HVAC operating problems, nor do they have an understanding of the benefits of treating them. This is particularly true for duct leakage. • Even if they had the training, many HVAC technicians do not have the tools necessary to accurately diagnose and treat problems.
Split Incentives	• In rental housing, the person making the investment decision (i.e., builder or landlord) will not be paying the energy bills.

To be successful, the program would need to address all of these barriers. Given the diverse nature of the barriers, the program would need to have several different components.

Financial Incentives

The program provides separate consumer incentives for testing the HVAC systems and then treating any problems identified. The incentives in the first year should be as follows:[7]

Charge/Airflow Test:	$ 25
Duct Leakage Test:	$ 75
Charge/Airflow Repair:	$ 50
Duct Sealing/Repair:	$200

These values may be modified in future years based on reactions from the market.

In addition to the customer incentives, the program should offer participating HVAC contractors and their technicians substantial discounts (e.g., 50%) on the purchase of several key tools necessary to diagnose and treat charge, airflow, or duct leakage problems.

Diagnostic Software and Technician Training

The program employs easy-to-use software — in two separate modules — to enable qualified HVAC technicians to provide either charge/airflow correction or duct sealing services.[8] To be eligible to participate in the program, HVAC technicians would have to use this software, receive training in how to use it, and have the diagnostic tools that are necessary to use it correctly.[9] Technicians also would have to work for contractors that have all necessary licenses, adequate insurance, and good standing with the Better Business Bureau.

Technician training would be largely hands-on, with trainees physically performing diagnostic procedures and repairs on several central air conditioners and heat pumps in the

[7] These incentive levels differ in some respect from those currently offered by San Diego Gas and Electric. For example, SDG&E currently offers $75 for a charge and airflow test, irrespective of whether corrective action is taken. This program design recommends making only one-third of that amount available for the charge/airflow test and two-thirds of it available for repair work in an attempt to place the incentive on activity that will produce savings. Similarly, the duct sealing incentive is slightly lower than SDG&E's for testing ($50 vs. $75) but higher for actual repair work ($200 vs. $125).

[8] Examples of software that could be used include Proctor Engineering's "check-me" software and Aeroseal's duct sealing software.

[9] For the charge/airflow module, HVAC technicians must have a digital thermometer, electronic scale, and quality thermocouples. For the duct sealing/repair module, contractors must have a duct blaster and monoxer.

presence (and with the guidance) of an expert trainer. The hands-on approach to training would require very small "class sizes," with only 2 to 3 technicians participating in any given training session. Training for the charge and airflow training session would take two days (including a full day for instruction on how to correct airflow problems). Training for duct diagnostics, sealing, and repair would also take two days. Training would be offered free of charge to HVAC technicians who sign up for the program in the first year. Depending on market reaction, contractors could be asked to pay for a portion of the training in subsequent years.

Quality Control

The software employed by the program would be designed to provide some level of quality control for the user in the field by "flagging" data entries that are unlikely to be accurate and providing recommendations on how to correct problems implied by the data entered. In addition, HVAC technicians would be required to report all pre- and post-treatment diagnostic data to a program contractor intimately familiar with the software. The program contractor would also analyze the data. Such analysis would include assessment of whether any HVAC contractor is submitting fraudulent data (ideally, the software used by the program would be able to help identify patterns of data reporting that suggest "invented" data). If necessary, on-site inspections would also be conducted.

It should be emphasized that these quality control procedures are intended to do much more than catch a few fraudulent contractors or technicians. The procedures' most important function would be to provide nearly instantaneously feedback to technicians in the field on how they are performing and how they could improve their work.[10] Of course, the procedures could also serve as a means of tracking program impacts.

Outreach to Contractors

Circuit riders would be employed to regularly meet with HVAC contractors for the purpose of both recruiting them into the program, and for those already in the program, to obtain feedback on how it is working for them, identify problems being encountered ,and answer questions or address problems. The "circuit rider" function for this program could be integrated with the "circuit rider" function of the HVAC replacement program discussed above.

Consumer Marketing/Education Campaign

One of the most important factors underlying the absence of a market today for charge/airflow and duct repair services is consumers' lack of knowledge of both the likelihood

[10] Results from software could be reported from actual job sites over the phone. This is the way that most of the jobs in the current SDG&D program are recorded and checked (Proctor 2000; Sybert 2000).

that they have such problems and the benefits they would realize from addressing them. This program endeavors to educate consumers on these issues and encourage them to seek out HVAC contractors who could help them diagnose and address key problems.

To begin with, consumer education materials would be developed that summarize the benefits of efficiency (both energy costs savings and non-energy benefits such as improved comfort), explain the key elements of an efficient system, and provide guidance on how to select a quality contractor. These materials could take several forms, including both written pieces and a brief educational video. These materials would be distributed as widely as possible, both to consumers who would request them and to quality contractors who would be interested in using them to help sell their services. They would be closely integrated with any educational materials developed for promotion of quality installations of new equipment under the equipment replacement program discussed above.

A variety of different marketing vehicles would be used to both alert consumers to the availability of educational materials and deliver shorter, complementary messages to consumers. The precise nature and mix of those vehicles would depend on a variety of local conditions, including the customer demographics and local costs (e.g., of media placements). Among the options to be considered would be direct mail to consumers who moved into new homes in the past 8–10 years,[11] Yellow Page ads, a dedicated Internet Web site, billboards, newspaper ads, and other forms of mass media advertising.

Contractor Referrals

To augment the program marketing and educational efforts, the program operator would refer any customer who calls and expresses interest in improving the operating efficiency of an HVAC system to the contractors who have completed program training.

Relationship of Program Strategies to Market Barriers

Table C-4 shows how these program strategies would address each of the key market barriers to efficiency investments in the HVAC replacement market.

[11] There is no evidence that duct leakage, refrigerant levels or airflow over the coil are any better in new homes than in older homes (Neme, Proctor, & Nadel 1999)

Table C-4. Intervention Strategies' Impacts on Market Barriers

Market Barrier	Intervention Strategy
Customer Access to Information	• Develop and distribute educational materials on likelihood of operating efficiency problems, benefits of correcting the problems, and how to find a contractor who has the training and tools to treat the problems. • Provide both sales and technical training to HVAC contractors interested in providing quality service so that they could help educate consumers.
Customer Inability to Identify Qualified Contractors	• Promote sales training to enable quality contractors to differentiate themselves when meeting with consumers. • Provide customer referrals to contractors who have received training through the program.
Lack of Well-Trained or Well-Equipped Contractors and Technicians	• Provide technicians with software that would make it easier to diagnose and treat problems found in the field. • Train contractors in how to use software, as well as in related technical knowledge necessary to understand systems they are treating. • Address problems in the field through instantaneous feedback and technical support. • Employ circuit riders to encourage contractors to participate in program and help address issues and questions that contractors have, particularly in early years. • Offer discounts for purchase of key tools and equipment to encourage contractors to try different approaches. • Offer consumer incentives for efficiency equipment and quality installations to help encourage some contractors to "try" different approach.
Split Incentives	• Offer consumer incentives to significantly reduce building owners' disincentive to consider quality work. • Encourage trained contractors to sell building owners on non-energy benefits — particularly longer equipment life, lower maintenance costs, and fewer tenant comfort complaints — of treating key problems.

Key Indicators of Success

A number of different indicators would be used to gauge program success. Key among these would be:

- The number of HVAC technicians who receive program training to provide charge/airflow diagnosis and repair services;
- The number of HVAC technicians who receive program training to provide duct diagnosis, sealing, and repair services;
- The number of charge/airflow repair jobs that qualified HVAC contractors sell and complete;
- The number of duct sealing/repair jobs that program-qualified HVAC contractors sell and complete; and

- Consumer awareness of the potential operating efficiency problems they may have, the benefits of addressing them, and the availability of program services.

Costs and Savings Assumptions

Savings

Table C-5 summarizes the energy and coincident peak demand savings available from the retrofit HVAC repair services promoted by the program. These savings estimates are based on a review of dozens of studies from across the country (Neme, Proctor, & Nadel 1999).

Table C-5. Energy and Peak Demand Savings from HVAC Tune-Up/Repair

Service	% Energy Savings	% Peak Demand Savings
Charge/Airflow Repair	17%	7%
Duct Sealing/Repair	10%	10%
Combo — Charge/Airflow & Duct Repair	24%	14%

The baseline energy use to which these saving percentages would apply would vary considerably from region to region. The baseline peak demand could also vary. However, it will likely not vary as much. On average, baseline coincident peak demand would likely be on the order of 2.75 kW.[12] Thus a 14% peak demand savings would translate to approximately a little under 0.4 kW.

Costs

The full cost of a service call to repair charge or airflow is estimated to average $100 (Sybert 2000).[13] The full cost of a duct system diagnosis and comprehensive duct sealing and repair is estimated to be approximately $350 (Haskell 1996). The incremental cost of each of these services would be less if they were offered as part of a regular service call (i.e., if the cost of getting to the home were already being incurred). For example, if these services were provided at the time of a normal service call, the incremental cost would be approximately $75 less than the costs noted above, after crediting the cost of a normal service call.

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[12] A 3 ton central air conditioner will draw 3.91 kW if it has an EER of 9.2 [kW = (Btuh/(EER*1000))]. An EER of 9.2 is typical for a SEER of 10.0. A recent study of six different utility service territories suggested that, on average, 15% of units were constantly off during the hour of system peak, 60% of units were cycling (largely due to over-sizing), and 25% of units were running constantly (Petersen & Proctor 1998). If the average duty cycle of the 60% that were cycling was 75%, the average coincidence factor for the entire population would be 70% [(0.60*0.75)+0.25]. A 70% average coincidence factor applied to an average full load draw of 3.91 kW yields an average coincident kW of 2.74.

[13] Some of the HVAC contractors participating in the SDG&E program are offering the service to consumers for the cost of the incentive ($75) that the utility has made available.

Non-Energy Benefits

There are substantial non-energy benefits associated with efforts to promote corrections to air conditioner charge and airflow and also to seal/repair duct systems. Chief among these are improved comfort in the home, reduced maintenance costs, and longer equipment life.

For example, both proper airflow and proper charging are essential to maintaining proper humidity control. If either airflow or refrigerant levels were too low, the capacity of the equipment would be reduced since not enough heat transfer could occur between the coils and the air in the duct system. Duct leakage also reduces effective equipment capacity, particularly if there are leaks in the attic (Rodriguez et al. 1995). Such capacity losses could compromise the ability of the system to cool a home, particularly on very hot days. Very low airflow or too much refrigerant could also lead to icing of the coils, refrigerant floodback, and even compressor failure (Neme, Proctor, & Nadel 1999; Parker et al. 1997).

Measure Life

The savings from charge and airflow corrections could be expected to last for the remaining life of the central air conditioner or heat pump. If the life of a central air conditioner can be estimated as 18 years (see previous program description), on average the remaining life of an existing unit can be estimated as 9 years.

The savings from duct sealing and repair could outlast the existing central air conditioner or heat pump. They can be assumed to last 15 years.

Possible Market Penetration Rates

Market penetration rates would likely vary to some degree depending on location. The key market barriers would likely be more severe in some states than in others. On average, it should be possible to reach the following percentages of existing central air conditioners and heat pumps over a 5-year period:

Table C-6. Penetration Rates for Residential HVAC Tune-Up/Repair

	Charge/Airflow Repair	Duct Sealing/Repair
Year 1	0.30%	0.08%
Year 2	0.75%	0.20%
Year 3	1.50%	0.50%
Year 4	3.00%	1.00%
Year 5	4.00%	1.50%

The estimated participation rates for the early years are consistent with those realized by SDG&E in its first 16 months of operating a software-based program for charge/airflow repair and in its less than 12 months of a duct sealing initiative similar to the one proposed here.[14] The rates for Years 3 through 5 are extrapolations from the first 2 years, as no similar program has progressed beyond its second year of operation.

[14] SDG&E has slightly over 1 million residential customers. Roughly one-third of them have central air conditioners (Downey and Proctor 1999). Therefore, there are approximately 350,000 residential central air conditioners in SDG&E's service territory. SDG&E's goal for the year 2000, its first full year of operation, is 3,000 charge/airflow tests (or roughly 0.85% of the central air conditioner stock). That goal will probably be met. Approximately half of those tested (i.e., a little more than 0.4% of the central air conditioner stock) are expected to receive treatment to correct problems (Proctor 2000). SDG&E also expects to have 500–1,000 duct tests performed in 2000 (Proctor 2000). If half of those result in corrective action, the program will have sealed the ducts of 0.07–0.15% of the central air conditioning systems.

3. Commercial and Industrial HVAC Equipment Program

Overview

The goal of this program is to assure the efficient selection and installation of cooling and air distribution systems in the commercial and industrial sectors. There are two primary components—chiller system efficiency and unitary HVAC system efficiency. In each case, "system efficiency" incorporates efficient equipment and proper specification, design, and installation. Utilities or other program sponsors could significantly reduce peak simply by assuring selection of efficient chillers and unitary systems, but could save much more through influencing overall system design and installation practices.

There are two major ways to capture the savings from high-efficiency cooling equipment: voluntary programs such as the Consortium for Energy Efficiency's unitary equipment standards and rebate programs, and mandatory standards. Both approaches are needed to help reduce demand.

While consumers and commercial buildings could save money by choosing efficient systems, many unitary systems are purchased based on recommendations by building contractors who have no concern with operating cost. Therefore, mandatory standards would provide the most long-term benefits. Standards for small commercial systems expected by 2003 will likely increase performance 10–20%. Setting a strong new federal standard on residential and small commercial air conditioning and heat pump systems could eliminate the need for approximately 26,000 MW of peak generating capacity by 2010, and more than twice that by 2020 (Thorne, Kubo, & Nadel 2000b). Additional savings could be achieved through building code standards on larger systems.

The proposed voluntary program focuses on marketing higher-efficiency units not only to achieve direct effects, but to influence federal standard-setting procedures and state and local codes. High near-term penetration of units that meet the Tier II standard set by CEE (discussed below) could help support a nearer-term and more stringent standard. The program could also help accelerate acceptance and state and local adoption of the chiller efficiency levels in the ASHRAE 90.1-1999 standard (also discussed below).

However, there are savings on chiller efficiency available beyond the ASHRAE standard. Furthermore, savings from system design and installation will largely be influenced by market forces because these elements are difficult to incorporate into standards. For these reasons, the program offers a system of rebates, vendor and customer marketing, technical assistance, and training designed to build market demand for efficient equipment, design, and installation and systems, and also to assure that contractors can meet that demand.

Program success would require a close working relationship with key vendors as well as customers. Implementors should work with customers so they can ascend a ladder of sophistication in HVAC system design, as described below:

- Step 1. Select efficient equipment
- Step 2. Monitor systems and properly size equipment
- Step 3. Design efficiency into chiller distribution systems and unitary ducts.
- Step 4. Reduce heat-producing loads (e.g., lighting, computers) before sizing and designing large systems.
- Step 5. Employ efficient installation and commissioning practices.

While each of these elements adds complexity to the program, the utility or other program implementor could add them incrementally as technical and administrative capability is added, and customers could access the program at the level of their own motivation and capability.

Target Market

The target market consists of unitary HVAC systems (including split, heat pump, etc.) and chiller systems in all commercial and industrial buildings. Common "early adopters" for both chiller systems and unitary HVAC include owner occupants, more forward-looking institutions, and buildings with heavy cooling loads. Early participants in unitary HVAC programs have included hospitals, restaurants, some retail (especially chains), and some industrial facilities. Hospitals, universities, and industrial facilities have been early participants in programs to optimize chiller systems and related loads. In some cases, chiller optimization has actually removed production bottlenecks at industrial facilities.

The relative importance of chillers versus unitary equipment depends on local equipment stock characteristics. Areas with high-rise buildings and older buildings (pre-1990s) tend to have more chillers. Areas with more one- and two-story buildings and more recent buildings tend to have more unitary equipment. While new construction is important, HVAC equipment sales in many areas are dominated by replacement of failed or failing equipment. In most areas, 60% or more of unitary sales volume is replacement equipment. This is especially important because many replacement purchases are not influenced by building codes. Codes may theoretically apply in some cases, but are rarely enforced unless there is a major renovation. The majority of purchased chillers are also replacements.

Chiller installation can have a lead time of 6–24 months, depending on the situation. Therefore, efficiency work with unitary equipment may have more impact during the first 2 program years. However, chiller loads may cumulatively be significant over several years in high-rise cities where chillers are common. Also, chillers provide an opportunity to get large savings from each site.

The chiller optimization approach discussed below could provide significant additional savings, but generally it is only applied to a minority of the replacement chillers in a given year. This is due to the significant time and capital requirements needed.

Efficiency Measures/Incentives

Chillers involved in this program should exceed the minimum peak efficiency thresholds in the recently passed ASHRAE 90.1-1999 standard. Separate minimum thresholds for peak efficiency and integrated part load value (IPLV) are recommended. The former are more appropriate for heavily loaded chillers, and the latter for chillers that operate only partly loaded most of the time. If a chiller is oversized for peak loads (as many are), an IPLV improvement could result in savings during peak. Furthermore, some leading brands perform better on peak, while others perform better at lower load levels. Incentives that reward exceptional efficiency by either criteria would encourage both types of savings and maximize vendor participation. And both would save peak on average. An example of chiller incentives (those for Conectiv Power Delivery — Conectiv) is provided as Table C-7.

Table C-7. Sample Chiller Program Incentive Schedule — Water-Cooled Units, 300+ Tons Cooling Capacity and Larger

KW/ton	Centrifugal		Screw	
	Full Load $/ton	IPLV $/ton	Full Load $/ton	IPLV $/ton
0.64	—	—	$29	—
0.63	—	—	$31	—
0.62	—	—	$33	$29
0.61	—	—	$35	$31
0.60	—	—	$37	$33
0.59	$35	—	$39	$35
0.58	$37	—	$41	$37
0.57	$39	$35	$43	$39
0.56	$41	$37	$45	$41
0.55	$43	$39	$47	$43
0.54	$45	$41	$49	$45
0.53	$47	$43	$51	$47
0.52	$49	$45	$53	$49
0.51	$51	$47	$55	$51
0.50	$53	$49	$57	$53

Conectiv also has incentives for smaller and air cooled chillers. These incentives can be obtained at their Web site (Conectiv 2000c). Utilities in New England and New Jersey plan to update chiller incentives for 2001 to reflect the new ASHRAE standard and current practice. Since significant enhancements are expected, it will be worth checking back at their Web sites for these updates.

A complicated issue for chillers is incentives for variable speed drives (VSDs). Some manufacturers are now offering chillers with built-in VSDs. Like the mechanical improvements that lead to better IPLV performance, VSDs assure better performance at partial loading conditions, which, for oversized chillers, can include peak load. We recommend measuring chiller performance for purposes of chiller rebates without VSDs and providing a separate rebate for VSDs. This would allow manufacturers with units that are most efficient at peak loads to get a rebate for improving peak performance, and then an additional rebate for using VSDs to improve part-load performance.

Recommended minimum thresholds and incentives for unitary HVAC incentives are provided in Table C-8. The efficiency levels were established by CEE for use nationwide. The incentives were set by the Northeast Energy Efficiency Partnership's Cool Choice program and are used by utilities throughout New England and New Jersey.

Table C-8. CEE Eligibility Levels and Cool Choice Incentives for Air-Source Commercial Packaged Air Conditioners

Cooling Capacity	Required Efficiency			NEEP Incentives ($/ton)	
	Federal Standard	CEE Tier 1	CEE Tier 2	CEE Tier 1	CEE Tier 2
<65,000 Btu/hour	10 SEER	12 SEER	13 SEER	$55	$85
65,000–134,999 Btu/hour	8.9 EER	10.3 EER	11 EER	$38	$68
135,000–240,000 Btu/hour	8.5 EER	9.7 EER	10.8 EER	$43	$73
>240,000	None	9.5 EER	10 EER	$43	$73

Separate thresholds and incentives have also been developed for heat pumps, packaged terminal units, and other less-conventional unitary systems. A complete set of unitary HVAC replacement qualifying levels and incentives (along with another example of chiller incentives) can be obtained as an Adobe Acrobat file from National Grid's Web site (National Grid 2000a). National Grid is a participating utility in the Cool Choice program.

As of this writing, the Tier II incentives for air-cooled systems are particularly important. As of this writing, DOE is holding proceedings to determine future efficiency standards for commercial unitary equipment. It appears likely that in a few years, units at least as efficient as Tier I will be required by law. Higher sales of Tier II units through programs might help influence DOE to set the efficiency standards higher. Tier II units are currently available in all sizes from at least two major manufacturers, and will be from a third major manufacturer by the end of 2000.

Economizers generally are not used during peak hours, but they can sometimes minimize peak loads by taking in cool morning air prior to peak. This depends on local peak hours and weather patterns. In areas with appropriate weather patterns, additional incentives should be offered to encourage enthalpy economizers and economizers with more reliable electronic controls. While many HVAC units are currently sold with economizers, enthalpy economizers are less common, some enthalpy economizers use nylon sensors which fail frequently, and dual enthalpy economizers are relatively rare. Enthalpy economizers, which account for both outside air temperature and humidity, offer significant efficiency advantages in humid climates and even in arid climates with heavy dew during early morning hours when economizers take in air. Dual enthalpy economizers optimize outside air based on comparing wet bulb temperature inside and outside the building. Additionally, most single enthalpy economizers can be set to a "minimum outside air" mode that assures contractors that there will not be callbacks, but does not provide much savings. Dual enthalpy economizers do not have this option, so are not as likely to be effectively disabled by contractors who want to avoid callbacks.

A wholesale source (who chooses not to be quoted) suggested that the retail cost of moving from a dry bulb economizer to dual enthalpy with electronic controls should cost less than $300, and to single enthalpy should cost less than $150. Retail sources (which likewise cannot be cited) suggest that incremental costs are on the order of $200 for single enthalpy controls and $400 for fuel enthalpy. It would probably be worthwhile to investigate local prices before setting incentives.

Additionally, some utilities offer incentives for chiller system optimization. These are discussed in the "Chiller Optimization" box below.

Program Strategies

Barriers to efficient HVAC systems are diverse because customers are diverse, and the demands of different elements of this strategy on customers, designers, and contractors vary. Table C-9 presents a basic overview.

Table C-9. Market Barriers to Commercial and Industrial HVAC Efficiency

Market Barrier	Key Issues
Customer Access to Information	Many customers: • Do not know that equipment choices have significant impacts on efficiency and utility costs. • Do not know much about quality installation practices, duct design and materials, economizers, or controls. • Are not aware that well-designed HVAC systems meet user needs better. • Do not have unbiased sources of information. It is difficult for customers to discern which contractors are expert in these areas.
Customer Organizational Barriers	• Most unitary systems are bought from a single contractor without competition or by low bid. Neither situation provides the contractor with high motivation to sell more expensive systems. Efficiency levels are sometimes included by customers in chiller bid specifications, but rarely for unitary systems. • Many customer organizations (small and large) have not assigned responsibility to an individual to pursue efficiency. This hampers decisions and limits expertise. • Most customers do not have the capability to perform quality assurance on duct design, chiller system design, installation, etc. • Many businesses and government entities consider energy efficiency to be a low priority for funding because it is a small part of operating costs. Many financial managers focus on maximizing revenue as a higher priority than cutting costs.
Trade Ally Barriers	• In some regions of the country, high-efficiency packaged equipment is not routinely stocked and is a "special order" item with longer delivery times and higher costs. • Many vendors have limited knowledge of efficient equipment and installation options. Customers are not providing them with the motivation to learn. • Skills to optimize chiller systems involve metering, modeling, and system design. Engineers tend to specialize in a subset of these areas. Because customers have not demanded a synthesis of these skills, nor detailed design for efficiency purposes, very few engineers have the experience to deliver. • Manufacturers' representatives often play a key advisor role in chiller selection. They may bring their own agendas and biases into the fray, based on what equipment their firm most profitably sells.
Design Methods and Values	• Most unitary systems are installed at the time of failure or when systems are performing inadequately. This allows no time for design. Generally the only trade ally consulted is the contractor. • In the absence of metered data, engineers usually add multiple "safety factors" in sizing. This results in oversized systems that could add to peak loads. • In the absence of system modeling, chillers and HVAC distribution components are not optimized.
Product Definition	• There is no nationally accepted definition for a high-efficiency chiller beyond the ASHRAE code (which is not aggressive) • While CEE provides efficiency guidelines for unitary HVAC equipment, these are not promoted in many parts of the country. • There are no well-known labels or third-party-endorsed checklists to help customers ask for quality installation, or for vendors to promote it. • There is no clear market label for a reliable, predictable product. Everything hinges on the reputation of the individual firm.

Market Barrier	Key Issues
Financial Barriers	• Efficiency improvements are often "value engineered" out of construction projects to assure that funds are focussed on more visible equipment and more immediate problems. • In rental buildings on short-term leases where the tenant pays energy bills, neither the landlord nor the tenant has a long-term interest in reducing energy costs. • In large organizations such as state and federal governments and multi-site corporations, the corporate unit that pays for construction often is not the unit that pays energy bills, and the two do not communicate effectively about management of costs. • Failed unitary equipment is often an unplanned and unbudgeted event. • Chillers are major investments. Without outside encouragement, customers will not plan for additional costs associated with chiller optimization.

The following program elements are the core of the HVAC program.

For Chiller Systems

Essential

- Rebates for chillers designed to capture currently available savings, marketed directly to customers and through vendors.

Would Significantly Add to Savings

- Metering and analysis service to help customers "right-size" chillers.
- More sophisticated incentives and technical assistance to help customers optimize chiller systems against loads (see box below).
- Workshops to help customers plan in advance for the cost and effort of optimizing chiller systems, decide when chiller operation and maintenance (O&M) exceeds amortized cost of a new chiller, and manage coolants.
- Commissioning of chiller systems.

Unitary

Essential

- Rebates tied to CEE's unitary HVAC standards, targeted to help encourage stringent federal standards for commercial and industrial unitary equipment.

Would Significantly Add to Savings

- Complimentary rebates for efficient economizers and thermostats.
- Technical assistance and training to enhance duct design.
- Customer and contractor information to encourage efficient installation.
- Commissioning for larger buildings with multiple or large unitary systems.

The key elements are discussed in more detail below.

Chiller Optimization

Chiller optimization is the process of developing the most efficient chiller system that's possible and the best match between chillers, controls, and loads. It is recommended for utilities and other sponsors that have the technical resources to push the HVAC engineering community to higher levels of efficiency in design. National Grid has one of the most highly evolved and successful programs for chiller system optimization — Comprehensive Chiller Track, which serves 6-8 replacement chiller systems per year. This is only a fraction of the chillers addressed through National Grid's programs in a year. Most chiller efficiency projects involve only a rebate for an efficient chiller and sometimes one or two related items (e.g., a motor or variable speed drive). However, optimization projects result in very large savings per site and provide many benefits to customers, including downsizing of chillers, which could directly reduce peak kW.

National Grid pays rebates for efficient chillers (similar to Conectiv's rebates cited above), 90% of the cost of enhancements to peripherals (pumps, fans, motors, ducts, pipes, and controls), and 90% of the full cost of heat-producing loads that are made more efficient prior to the design of the new chiller system (primarily lights), or less if that is sufficient to provide the customer with a 1-year payback based on energy costs. Payments for peripherals and lighting tend to average about 65–70% of the cost of these improvements (Keena 2000). While these payment levels are high, they have proven useful in persuading customers to undertake the expense and effort of improving all components of the chiller system and heat loads at once.

For analysis of chiller optimization, hourly load data must be collected on the old chiller system. This data would then be used to create a calibrated hourly simulation of the building. This simulation would be used to model efficiency improvements to lighting and other heat-producing end-uses, then optimization of the HVAC distribution system, and finally, selection of the most efficient chiller of the correct size.

To provide an example of chiller optimization, Worcester Polytechnic Institute (WPI) in Massachusetts replaced a 290 ton 0.85 kW/ton chiller with a 170 ton 0.62 kW/ton chiller (Gartland and Sartor 1998). The chiller downsizing reduced the cost of the new chiller and was achieved in part due to reduced heat gains from installing more efficient lighting and in part due to the fact that the old chiller was oversized. At the same time, WPI installed new air handling unit controls (to improve system operation), added ASDs to pumps in the system, and installed an outdoor air heat exchanger for wintertime computer room cooling. The total project reduced electricity use in buildings served by the chillers by more than 15% and had a 5.2 year payback to WPI.

To avoid paying for measures that are common practice, the utility or other program sponsor must establish a baseline for chiller system design. This is the set of typical chiller design practices employed locally. Most program sponsors establish these practices through discussions with designers and vendors and review of recently constructed chiller systems.

Pacific Gas and Electric has developed Cool Tools as a streamlined technical approach to optimizing chiller systems. Cool Tools products are software programs, publications, and support services that together provide an objective analytical method for comparing alternative strategies during the design and operation of chilled water systems. The products are public domain and Internet-based (PG&E 2000a). As of mid-2000, over 20 modules (software and/or written materials addressing specific topics) were up and running, and more are in preparation. However, work on actual customer buildings with the tools is just beginning.

Chiller optimization programs work best if there is advance marketing, through workshops, to educate customers not only about the benefits, but about the planning requirements and the types of assistance that program sponsors can provide.

Chiller optimization can be very cost-effective to the utility. A joint filing by New Jersey utilities including a planned chiller optimization program utilized an average program cost of 1.4 cents/kWh saved over the measure life of the project (New Jersey Utilities 2000). This includes the customer share of incentives but does not include the cost of the baseline (inefficient) chiller, and was based on prior experience at other utilities.

Technical Assistance

For unitary systems in new construction and renovation, it may be possible, through utility-funded technical assistance, to encourage quality load calculations to assure proper sizing, designer specification of quality economizers, proper duct design and thermostats, etc.

Technical assistance supporting prescriptive chiller rebates can be relatively simple, but smart customer advice and active assistance can pay. For example, use of load research data or loan of a meter may make it possible to assess loadings on existing chillers prior to purchase of a new system. This load data may lead to "right sizing" a chiller. A properly sized chiller may save peak because it would operate at optimal efficiency on the peak day. Furthermore, it may not continue to "ramp up" loads if weather conditions exceed design conditions.

For replacement of unitary equipment, technical assistance is generally minimal due to the limited timeframe for purchase decisions. It is at least theoretically desirable to require load calculations for unit replacements to assure properly sized replacement units. However, the time frame for replacement and circumstances make this approach difficult. Even if smaller units are appropriate, they sometimes require expensive and time-consuming curb modifications. Furthermore, requirements to properly size equipment may reduce contractor margins. For this reason, at least until programs are well-accepted by vendors, initiatives to assure quality sizing and installation should utilize "carrots," such as technical and promotional support for premium contractor practices, rather than the "stick" of requiring good installation practices to receive equipment rebates.

Marketing

Different parties play more central roles for marketing various aspects of the program, as shown in Table C-10.

Table C-10. Role of Different Parties in Marketing Efficiency C&I HVAC Products and Services

	Contractors	Designers	Large & Multi-Site customers	Other Customers
Efficient unitary equipment sales	Critical marketing channel	Important for new construction	Direct contact is important	Reach through contractors
Unitary duct design (new buildings)	Critical participant	Critical participant	Critical participant	Participant
Unitary installation	Direct contact is important	NA	Direct contact is important	Secondary target market
Chiller efficiency	Critical marketing channel	Important for new construction	Direct contact is important	Reach primarily thru contractors
Chiller right-sizing	Can sometimes influence design	Critical participant	Critical participant	Critical participant
Optimize chiller system, optimize against loads	Secondary participant	Critical participant	Critical participant	Critical participant

Unitary sales are heavily influenced by contractors and vendors. The best marketing approach for vendors would involve consistent rebates and promotion across all program sponsors in a region. For example, Northeast Energy Efficiency Partnerships has contracted for "circuit riders" to visit vendors and provide promotion for their unitary rebate program (NEEP 2000). Additionally, for new buildings, it is important to work with customers, designers, and developers to promote efficient units. Under the NEEP program, utilities mostly work directly with customers to compliment the circuit rider's efforts with contractors. However, it may be more practical in some cases for marketing contractors to work with both parties in tandem. Conectiv Power Delivery of New Jersey, a NEEP program member utility, uses this approach.

Unitary installation would be best influenced by working both with contractors and customers to promote a set of efficient practices. While experience in this area is limited, as of this writing NEEP is experimenting with a set of customer education materials on this topic. These materials will help explain why it is important to hire a contractor who follows quality installation practices and what those practices are. A group of New Jersey utilities is also working to develop contractor training installation practices (Linn 2000). Because there is little understanding of the relationship between installation quality, efficiency, and performance among customers and contractors, program sponsors could need to take a leadership role in working with contractors to demonstrate quality practices and show the benefits.

Unitary HVAC contractors across the country have become leery of utilities because some electric utilities are buying unitary contractors and competing directly for customers. For this reason, utilities would need to assure contractors that they would not use customer data or other intelligence gathered through efficiency programs for their own purposes. However, this situation also creates an opportunity. To survive, unitary HVAC contractors are increasingly receptive to the idea of premium services as a tool to differentiate themselves in the market. A "premium contractor program," endorsed by utilities or other program sponsors as a group, could consist of promoting the use of high-efficiency equipment and high-quality controls and economizers (e.g., programmable thermostats, dual enthalpy economizers), and the adherence to a list of quality installation practices.

Chiller sales are heavily influenced by manufacturers' representatives and distributors. Some highly successful programs market efficient chillers primarily by setting up relationships with these parties. However, larger and more sophisticated customers (some chains, property managers, multi-site office and retail owners, some hospitals, and large institutions) often play a more significant role in product selection and would need to be marketed to as well.

Financial Incentives

These were discussed under "Measures," above.

Financing

Financing is particularly important for chiller optimization projects due to the significant capital cost. The type of financing referral system discussed under the lighting retrofit acceleration program (later in this appendix) is recommended.

Quality Control

For equipment rebates, the utility would need to review the proposed equipment (proposed specifications in advance where possible,[15] installed equipment after the fact) to confirm that it meets program standards. For all equipment, inspections to verify that the specified equipment is installed would be also important. We recommend that efforts to assure proper unitary equipment installation be carefully crafted to not sabotage efforts to enlist vendors. Given the delicate relationships between vendors and utilities discussed above, programs should focus on

[15] Because unitary equipment is often replaced under emergency circumstances, it is important that the program permit rebates without pre-inspection as long as equipment qualifies.

education and marketing for some time before installation quality becomes a program requirement.

Expert engineering review is important to assure that any studies of metered data to help size systems are properly done.

Relationship of Program Strategies to Market Barriers.

These relationships are summarized in Table C-11.

Table C-11. Market Barriers and Strategies for Commercial and Industrial HVAC Efficiency

Market Barrier	Intervention Strategy
Customer Access to Information	• Educational materials and promotion for customers explaining equipment efficiency, system performance, design, project planning, and installation.
Customer Organizational Barriers	• Program sponsors (staff or technical contractors) reduce the burden of recommending strategies and quality control. • Development of model bid specifications for efficient equipment. • Education for customer regarding how to identify quality contractors.
Trade Ally Barriers	• Training on efficiency economics, equipment choices, duct design, and installation practices. • Help for contractors using efficiency to differentiate themselves in the market. • Customer promotions to create the "market pull" to engage contractors. Start with the largest and most motivated customers. • Use of unitary rebate program to encourage stocking. • Use of technical studies and quality control to bring design contractors and energy specialists to the next level of capability.
Design Methods and Values	• Promotion of case studies that show quality design paying off. • Working closely with manufacturers of chillers to influence toward efficient designs. • Use of metered information to improve engineer confidence in appropriately sized systems.
Product Definition	• Promotion of the CEE Tier II unitary HVAC standard. • Development and promotion of the minimum efficiency standards for chillers. • Development of utility-endorsed unitary installation checklists. • Development of specification and/or certification for quality commissioning.
Financial Barriers	• Rebates — prescriptive and custom. • Financing referral service for large projects. • Promotion of successful jobs with bottom-line oriented case studies. • Financial planning as a key element of chiller planning workshops. • Where practical, promotion of equipment downsizing as capital savings. • Promotion of life cycle costing, but don't expect customer tendencies to focus on first cost to change overnight.

Key Indicators of Success

- Sales of efficient chillers and unitary equipment as a proportion of total sales. For unitary equipment, stocking and sales of Tier II unitary systems would be particularly important.

- Contractor and customer awareness of efficiency issues, including efficient design and installation.

- Contractors who market themselves as "premium service" contractors while adhering to utility-approved equipment selection and procedures.

- Proportion of chiller systems being optimized during design.

- Proportion of chiller systems and large unitary systems commissioned.

Cost and Savings Assumptions

Savings

Efficient chillers are available that exceed the baseline peak efficiencies shown for Conectiv's program (Table C-7) by 5–20%, depending on the size, type, and brand. Comprehensive chiller optimization generally results in greater savings, typically resulting in *additional* savings of around 10% or more (Wolpert et al. 1994). CEE Tier I unitary HVAC units reduce energy use by approximately 10% relative to typical non-qualifying units, varying with size. Tier II units save an additional 6–13%, varying with size and manufacturer. Given that efficiency is rated for peak operation, the savings should translate directly into peak savings.

Savings from economizers vary significantly from site to site. Additionally, these measures do not always reduce peak use. Economizers bring air into buildings during cool hours, which in some climates occur in the morning of peak days. This is especially true in moderate, dry summer climates where cool mornings can be followed by peak heat. Economizers that fail in the open mode significantly increase peak load. Experts differ regarding whether such failures are often noticed and corrected, but there is limited information to support any position on this topic. Economizers that fail in the closed mode can also add to peak. If installation of higher-quality economizers results in avoiding failure in a modest share of units, the energy savings would be significant and the peak savings would be significant in many climates.

When comparing savings to cost, it is important to consider the benefit of energy savings as well as peak savings. These depend on hours of use, time of use, and local electric rates.

Cost

For chiller rebates, incentives are paid per kW/ton, so cost/kW can be derived directly from the incentive chart. For example, if a 300 ton chiller were purchased at 0.54 kW/ton instead of 0.60, the cost would be $45/ton for 0.6 kW/ton, or $750/kW. Assuming that the average chiller operates at 85% of capacity during peak (and assuming conservatively that savings are proportional to loading), this would be $882/kW.

For unitary equipment, kW savings at full load can be estimated using the formula:

Peak kW= Btuh/EER/1000
Where:
Btu/hour = tons*12,000

Depending on local conditions, some unitary equipment runs at less than full load during utility peak hours because the equipment is oversized or not in use. A 85% loading factor may be reasonable (as discussed above, 70% is typical in residential but commercial average loading is higher). For example, for a 7.5 ton unit, if local common practice were the federal standard of 8.9 EER, the more efficient equipment would cost $311/peak kW.[16]

Local baseline sales patterns should be considered; many areas probably sell a mix of equipment including some at the CEE Tier I standard and some less efficient. Administrative costs should be added to this figure (perhaps 20%, depending on program design and volume).

Non-Energy Benefits

Well-designed HVAC systems tend to meet user requirements better, because the cooling system is better tailored to building requirements. Chiller optimization can often lead to reduced chiller size and consequent reduced capital costs.

Measure life

According to the *ASHRAE Handbook* (ASHRAE 1999), rooftop air conditioners have a median service life of 15 years and packaged chillers have a median service life of 23 years for centrifugal and absorption units and 20 years for reciprocating units.

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[16] Peak kW = 7.5*12,000/(8.9*1000)*((11-8.9)/11)*.85=1.64 kW. The incentive suggested in Table C-8 is $68/ton, providing a cost of $311/utility peak kW.

Market Penetration

Penetration rates for efficient equipment, as a share of the units sold each year, are estimated in Table C-12. Bear in mind that this is a generalized projection based on market potential and early field results from existing programs. Anecdotal information indicates that baseline penetrations vary significantly by region. "Before-program" penetration rates should be assumed to be static over the forecast period, except for Tier II unitary equipment, where a "without program" projection is provided. The penetration rates shown are *market shares,* including nonparticipants.

For unitary equipment, the net increase in penetration would likely include a significant number of nonparticipants who have been influenced by the program (perhaps half, depending on how the program is marketed.). It is less clear whether nonparticipants would be influenced by chiller rebates. This depends on existing baselines and design practices.

Table C-12. Unitary HVAC, Chiller Efficiency, and Chiller Optimization Penetration Rates

Year	Unitary Tier II*		Chillers	Chiller Optimization
	Without Program	With Program		
Before	15%	15%	5%	0%
1	18%	20%	10%	5%
2	21%	30%	30%	10%
3	24%	40%	50%	15%
4	25%	50%	70%	20%
5	25%	50%	70%	25%

*Assumes significant base year natural market penetration. A 1998 study showed 7% penetration of Tier II equipment in the Massachusetts market in 1998, and availability of Tier II equipment has increased significantly since then (RLW Analytics 1999). Rebate programs help change the market, but many of the influenced customers do not collect the rebate.

These penetrations apply to chiller and unitary equipment *sales*, not to the existing stock. We estimate that, in 5 years, in regions with an even distribution of equipment ages over the measure life and a 4% annual growth rate, sales will equal 44% of the existing stock of chillers and 55% of the existing stock of unitary HVAC equipment.[17]

These proportions will vary locally depending on the predominant age of existing system. For example, if there was a boom in unitary installation 15-20 years ago, there will be a boom in replacement sales about now.

[17] Chiller turnover = 5 years/23 year life = 22%; chiller growth = 1.04(5th power)-1 = 22%, while 22%+22% = 44%. Unitary turnover = 5 years/15 year life = 33%; Unitary growth = 1.04(5th power)-1 = 22%, while 33% +22% = 55%.

4. Commercial Building Retrocommissioning and Maintenance

Overview

The goal of this program is to promote widespread retrocommissioning and proper ongoing maintenance of large commercial buildings. This program also seeks to build a sizable ongoing local market for retrocommissioning services by addressing the major barriers that hinder retrocommissioning today, particularly the limited number of qualified commissioning engineers and the fact that most building owners and managers are unaware of the benefits of commissioning services. Furthermore, the program seeks to maintain the savings from commissioning over time by training and certifying building maintenance staff in good building operations and maintenance procedures. The program combines training and technical assistance for building owners, managers, maintenance staff, tenants, and commissioning providers with local demonstration projects and other promotions as well as financial incentives to reduce the cost of commissioning services. Key program strategies are discussed below and include:

- Education for building owners and facility managers;
- Local demonstration projects and case studies;
- Establishing a benchmarking system to help building owners assess the performance of their buildings relative to other buildings;
- Active marketing to building owners and managers;
- Defining key services so they would be easier to understand and market;
- Commissioning service provider training and technical assistance;
- Maintenance staff training and certification; and
- Financial incentives to reduce the cost of commissioning services.

In addition, the following recommended strategies complement the above-listed activities and would contribute to the success of the program:

- Local market research;
- Tenant education to encourage tenants to talk to their property managers about workspace quality; and
- Cooperation with other commissioning programs around the country on the development of additional commissioning-related procedures and tools.

Target Market

The prime market for this program, at least in its early years, would be large commercial buildings, over approximately 100,000 square feet in size, with an emphasis on owner-occupied buildings and Class A leased space. Owner-occupants should be targeted because they generally care the most about building energy use since they pay the energy bills and not a tenant. They are also generally more interested in making investments in their buildings. Class A offices should be targeted because they have the highest rents and maintaining tenant satisfaction is important for keeping occupancy rates and rents high. Large buildings (as well as multiple smaller buildings on common campuses) should be targeted because these buildings generally have complicated HVAC and control systems that could usually benefit from commissioning. Also, large buildings use large amounts of energy, providing opportunities for large energy and cost savings in a single project. And large buildings often have in-house maintenance staff, providing greater opportunities to maintain the savings over time. Eventually, medium-size buildings (50,000–100,000 square feet and possibly even smaller) could be targeted, but initial efforts should target large buildings.

Efficiency Measures

The prime measure to promote would be retrocommissioning services. Retrocommissioning is an event in the life of an existing building that systematically looks for opportunities to improve and optimize a building's operation and maintenance. Retrocommissioning seeks cost-effective ways to improve functionality of existing equipment and systems, and optimizes how they operate in order to reduce energy waste, extend equipment life, and improve building operation and comfort (Haasl and Sharp 1999).

Retrocommissioning is typically done by a skilled engineer with extensive trouble-shooting and commissioning experience. The commissioning process typically includes four stages — planning, investigation, implementation, and handoff (Haasl and Sharp 1999). The planning stage includes identifying project objectives and systems to be targeted, defining tasks and responsibilities, and preparing a plan that could be used to procure the desired services. The investigation stage includes on-site assessments and testing, including a review of energy use data and maintenance procedures, walk-throughs of the site (during both the day and night), and short-term monitoring of key systems. The investigation phase leads to identification of deficiencies in system operation and maintenance and the development of recommendations to correct these deficiencies. The implementation phase includes implementation of most no- and low-cost recommendations as well as development of a plan for implementing additional improvements over time. Finally, the completed improvements are "handed off" to the owner and their staff, along with information and knowledge gained during the process to help the owner and staff better maintain their building in the future.

In addition, the program promotes training of building maintenance staff on good operations and maintenance procedures. Such training could result in direct energy savings as staff identify and implement improved building management practices (details on many of these procedures can be found in Herzog 1997). Trained personnel are also in a much better position to keep building systems optimized, helping to maintain commissioning savings.

Program Strategies

Several market barriers presently hinder the commissioning of existing commercial buildings. These are summarized in Table C-13.

Table C-13. Barriers to Retrocommissioning

Market Barrier	Key Issues
Customer Access to Information	• Few owners and managers are familiar with commissioning services and their benefits. • The value of commissioning services has not been demonstrated enough to satisfy some owners and managers; some perceive that the claims are too good to be true.
Shortage of Skilled Contractors, Staff, and Tools	• Experienced staff and outside service providers are few in number. • Training for engineers and building staff in commissioning-related activities is often not readily available. • The limited size of the current market for commissioning services makes many potential service providers reluctant to get the training and experience necessary in order to enter the business. • Commissioning-procedures and software tools tend to be custom-developed by each commissioning specialist with the result that many tools are not user friendly and there is much overlap of effort.
Customer Difficulty Identifying Quality Contractors and Staff	• Managers often do not know how to locate experienced staff or outside providers nor can they identify which staff and service providers are well qualified to do commissioning work.
Split Incentives	• In rental spaces, tenants often pay energy bills, reducing the incentive for building managers to properly commission their buildings. • Tenants are unfamiliar with building optimization approaches that could improve the quality of building space as well as reduce operating costs. • Even in owner-occupied spaces, internal accounting practices, such the separation of energy, maintenance, and capital budgets, makes it difficult to obtain funds for new services or to provide direct financial benefits to those who agree to finance these services out of their budget.
Lack of Time and Institutional Inertia	• Lack of time, short-planning horizons, and institutional inertia makes it difficult for owners and managers to consider new approaches.

Program strategies seek to address these barriers in order to:

- Motivate the building owner and their staff to act;
- Make expertise to optimize building operations readily available; and
- Institutionalize the building optimization and maintenance process so that savings continue over time.

The relationship between the different barriers and strategies are summarized in Table C-14. Each of the program strategies are discussed further in the sections below.

Table C-14. Relationship Between Retrocommissioning Barriers and Program Strategies

Market Barrier	Intervention Strategy
Customer Access to Information	• Introductory workshops for owners and managers on commissioning and its benefits • Marketing to owners and managers • Local and owner-specific demonstration projects • Establish benchmarking system to help owners compare their buildings to other buildings
Shortage of Skilled Contractors, Staff, and Tools	• Commissioning service provider training • Technical assistance to local service providers by leading commissioning experts • Training and certification for building maintenance staff • Cooperation with other commissioning programs on the development of improved procedures and tools
Customer Difficulty Identifying Quality Contractors and Staff	• Educational workshops for and marketing to building owners and managers • Certification program for trained and qualified building maintenance staff
Split Incentives	• Financial incentives to reduce the cost of commissioning services • Educational materials for tenants on the benefits of building optimization
Lack of Time and Institutional Inertia	• One-on-one marketing efforts • Financial incentives to reduce the cost of commissioning services

Owner/Manager Education and Marketing

Education for building owners and facility managers is needed to familiarize these decision-makers regarding the opportunities for and the benefits of commissioning, and to provide information on how to obtain quality services. These efforts should generally target the person with budget authority for a building. A potential marketing strategy would be to emphasize how, for many buildings, building operation is a multimillion expense that is largely unmanaged. To support education efforts, standard materials would be useful such as written materials, case studies, and slide presentations (including short, medium, and long versions for different levels of decision-makers). Much of the marketing would need to be done face-to-face with individual decision-makers or through building owner associations and peer groups. One general approach that has been effective is to identify one site or system to optimize, monitor performance before and after optimization, and use the results to help convince decision-makers to optimize other systems or buildings. Utility/government endorsements could also be useful, as could be referrals to qualified contractors. Both the Building Commissioning Association (BCA) and the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) have developed one-day training programs for building owners and managers that could be adapted for use in different regions of the country (Doyle 2000; York 2000).

Local and Owner-Specific Demonstration Projects

While some case studies have been compiled, these cover only a few regions of the country. Local programs should utilize local demonstrations and case studies to help promote optimization in their local areas. In compiling these case studies, in addition to standard information on costs and energy savings, it would be useful to document non-energy benefits of retrocommissioning such as O&M cost savings or changes in worker comfort and productivity. Furthermore, for many building owners, the most relevant demonstration would be one in their own facility, or short of this, a competing firm in the same industry and market. An effective promotion technique would be to work with owners of large or multiple buildings and undertake a pilot project in one of their facilities, so they could see the benefits directly.

Establish Benchmarking System

Building owners want to know how their buildings compare to other buildings. A benchmarking system that is easy to use and adjusts for major climatic and operations differences would be a useful tool for comparing buildings and by extension, motivating owners of subpar buildings to improve their operations. EPA is working on this issue through its ENERGY STARBuildings™ program. As of this writing, ENERGY STAR has developed benchmark tools for offices and schools, is working on a tool for retail buildings, and is developing plans for tools on several other building types. Local program managers should run several local buildings through these tools in order to validate these benchmarks for use in local programs. Another database to tie into this effort would be the Building Owners and Managers Associations's (BOMA) Experience Exchange reports.

Commissioning Service Provider Training

Many HVAC and controls engineers have experience in designing and troubleshooting building systems. However, design experience and systems operation experience are different things. Furthermore, many engineers have limited experience in using observed and metered data together to solve problems. Likewise, engineers may know how to troubleshoot problems, but are unfamiliar with how to set up procedures so that building managers can prevent problems from recurring. Still, with proper training and experience, many of these practitioners could progressively become commissioning service providers. In order to assist this process, the program should sponsor training programs for service providers — including HVAC consulting engineers, control specialists, and others — and then offer them technical assistance for their first retrocommissioning projects using experienced commissioning providers that the program would hire on a retainer basis. These experienced providers would also conduct quality control reviews on initial retrocommissioning projects.

Training programs should be a week long and include hands-on field experience. Training courses of this type have been developed by BCA and ASERTTI. Following completion of the training program, trainees would begin to market their services, but would receive free technical assistance and quality control reviews on their first few commissioning projects in order to help them gain knowledge and experience with practical commissioning procedures and trouble-shooting. Technical assistance would include assistance with preparing the commissioning plan, developing a short-term metering plan, analyzing meter and other data, reviewing draft reports, reviewing draft customer O&M plans, and answering questions. (Note: trainers and technical assistance providers would need to be carefully selected —they must be willing to help new people get started in the field; sometimes this would mean hiring experts from other regions since experts from the local region may be reluctant to train future competitors.)

Maintenance Staff Training and Certification

Building maintenance staff can perform some commissioning work, and they are very important for maintaining commissioning savings. The Northwest Energy Efficiency Council operates a building operator training and certification program with two levels of proficiency. People trained at the highest level are qualified to maintain the high level of building operation that commissioning initiates. The program includes certification in order to help building owners identify skilled staff and to help skilled staff get recognition and possible promotions for gaining these skills (Putnam 2000). The same program is operated in the Northeast by Northeast Energy Efficiency Partnerships. Other operator certification programs are run by BOMA (BOMA 2000) and the Association of Facility Engineers (AFE 2000). Each program operates in a different way, appeals to a different niche among operators, and works with the networks for operators that exist in different regions. Such programs should be available in each region with a retrocommissioning program, and designed to reach operators with a wide range of skills and knowledge.

Financial Incentives

Financial incentives would make it much easier to market commissioning services and substantially increase the number of projects that could be undertaken in the initial years of the program. Based on experience in the Northwest and California, we recommend that incentives cover at least 50% of the cost of commissioning services. On the other hand, the building owner should also pay a portion of the commissioning costs so that they have "buy-in" on the project. In addition, incentives for the implementation of capital measures identified during the commissioning process could increase savings significantly (by *capital measure* we mean measures that have a significant cost to the building owner and that are not paid back with savings in the first year). These incentives, for example, could pay half the cost of capital measures or could be sufficient to buy-down the cost of these capital measures to a particular simple payback period (e.g., 12 months). Dodds, Baxter & Nadel (2000) provided information on incentives offered by many commissioning programs operating in 2000.

In addition to these core program activities, there are several additional activities that could improve the effectiveness of the program, including additional market research, tenant education and marketing, and cooperation with other retrocommissioning programs on procedure and tool development. These additional activities are discussed in the sections below.

Additional Market Research

Some market research on building O&M and commissioning practices has been conducted. For example, reports with market research components include a manual sponsored by DOE on commissioning existing buildings (Haasl and Sharp1999), a study for the Northwest Energy Efficiency Alliance on commissioning practices and needs in the Northwest (SBW 1998), and a research project on O&M practices commissioned by a group of utilities in the Northeast (RLW Analytics 1999). What is still needed is more focused research in other regions to determine current baseline commissioning knowledge and practices, and reactions to various strategies to increase local use of commissioning. Also, there is a need for further market research to explore specific markets for specific approaches, such as focus groups or interviews with engineering firms and specific types of customers to explore their interest in different business and training models for optimization services.

Tenant Education and Marketing

For leased space with "triple net" leases (where tax, insurance, and operating costs — including energy costs — are passed onto tenants), in order to help motivate owners to improve building operations, it would be useful to educate tenants about the range of triple net payments in their local area, and to encourage prospective tenants to consider the sum of rent plus triple net costs when they compare buildings. An example of such a marketing program is the Better Bricks program recently started by the Northwest Energy Efficiency Alliance (NEEA 2000). Simple ways to help tenants identify efficient buildings, such as the new ENERGY STAR Buildings™ program, would also be useful. Creative approaches in which tenants and owners share commissioning costs and benefits should also be explored.

Procedure and Tool Development

Procedures for commissioning existing buildings are still in their infancy. Peter Herzog, a consulting engineer, has developed some procedures and written a book outlining how to develop an in-house team to commission specific end-use processes (Herzog 1997). Many organizations and firms have drafted procedures including Portland Energy Conservation, Inc. for DOE and Texas A&M University.

There are a wide variety of services offered by different service providers, ranging from simple low-lost O&M services to extensive metering, data analysis, and trouble shooting. There is also substantial variation in the systems covered, with some providers focusing on one or several pieces of equipment (e.g., chillers) and others focusing on the whole building. While different service packages may be appropriate for different customers, when all packages are labeled "retrocommissioning" it makes it difficult for potential customers to understand what services they are offered and it also makes it difficult for providers to market their services relative to other providers that are offering differing services. There is a need to better define specific retrocommissioning packages (e.g., "full commissioning," "commissioning-lite," "chiller commissioning," etc.) to match the needs of different customers and the skills of different providers. For each of these service packages, standard tools and procedures could assist new providers in getting started in the field and could also assist current providers in streamlining their operations. Procedures should be flexible enough to service different building types, scales, systems, and design intent.

Local commissioning programs around the country should work together on the development of common definitions and additional procedures and tools that would make training, marketing, and service delivery easier. Development of a library of public domain procedures, with some index to their appropriate application, would be a useful starting point for new providers and would also be very useful for use in government buildings where there is frequently a need for the establishment of formal procedures. Similarly, improved software and hardware should be developed for better diagnosing buildings. In particular, ways to better build diagnostic capabilities into key building equipment (such as energy management systems, chillers, and economizers) should be explored. With such capabilities, it would be easier to monitor and diagnose equipment operations.

Key Indicators of Success

Given the goals of this program, which are to both reduce peak demand and to overcome barriers so that recommissioning and good building O&M grow in the marketplace, indicators of program success should include:

- Steady increases in building owner and manager familiarity and interest in commissioning and good O&M procedures;
- Growth in the number of skilled local commissioning service providers;
- Steady growth in the number of commissioning projects undertaken;
- Good average energy and energy-cost savings (evaluated on a percentage basis so that the depth of commissioning savings can be assessed);
- Proportion of commissioning recipients who implement good operations and maintenance programs;
- Peak energy savings achieved; and

- Good benefit-cost ratios from the customer and societal perspectives.

Cost and Savings Assumptions

Savings

A 1997 review of field data on 44 commissioning projects for existing buildings found that commissioning existing buildings "often result[s] in whole-building energy savings of 5–15% and paybacks of two years or less." Energy cost savings in these projects ranged from 2–49% with a median of 19% (Gregerson 1997). However, given that this program would be a mass production program that works with many different service providers, we would expect average energy savings to be more modest — on the order of 10%.

Little data are available on the peak demand savings of commissioning. However, two programs did collect data on average peak (kW) and energy (kWh) savings, allowing a ratio of energy to peak savings to be calculated. For the Commonwealth Edison program in Chicago, this ratio was 1,950 kWh/kW. For work by Texas A&M on their campus, this ratio was 860 kWh/kW (Dodds, Baxter, & Nadel 2000). In our opinion, the Texas A&M figure is unlikely to be sustained across many projects and the Commonwealth Edison experience is more likely. Based on this thinking, kW savings can be approximated by first estimating kWh savings (based on the 10% estimate discussed above) and then dividing by 1,950.

Cost

The 1997 study on 44 retrocommissioning projects included costs per square foot for all of the projects. Costs ranged from $0.03–0.43 per square foot of building floor area, with a median of $0.17 (Gregerson 1997). More recently, a review of experience with eight retrocommissioning programs found that costs varied from $0.16–0.63 per square foot, with an average of $0.34. However, these latter programs were a bimodal distribution, with four of the programs ranging from $0.16–0.19 per square foot and the other three ranging from 0.52–0.63. These latter programs either used out-of-state service providers or involved very extensive continuous commissioning services. Based on these data points and considerations, we would estimate that commissioning, on average, should cost approximately $0.20 per square foot. All of these figures include costs to implement low-cost commissioning recommendations.

Non-Energy Costs and Benefits

In addition to direct energy savings, there are numerous citations in the literature on how specific commissioning projects have improved occupant comfort (e.g., by eliminating hot and cold spots) and improved equipment reliability and extended equipment life (e.g., because equipment cycles on and off less often). No systematic study has been conducted on how extensive these benefits are on average.

Measure Life

To our knowledge, there are no studies on the lifetime of commissioning energy savings. In practice, the lifetime of savings would vary from project to project, and could range from just a few months (for projects that are not maintained and where building use changes) to in perpetuity (for projects that are very well maintained. A 1998 analysis for the Northwest Energy Efficiency Alliance estimated an average measure life of 7 years (Suozzo et al. 1998).

Possible Market Penetration Rates

As of this writing, commissioning programs are only in the pilot stage. A typical trajectory for commissioning programs might be 4-12 projects in the first year (Dodds, Baxter, & Nadel 2000). However, in New York State, a pilot chiller retrocommissioning program signed up more than 130 participants in just a few months (Henderson 2000). Based on these different experiences, we estimate that a good full-scale program could maybe complete a dozen projects in the first year, perhaps 40 in the second, and on the order of 100 per year thereafter until about 50% of the target market is served. Thereafter, participation rates would slow as the program seeks to serve harder-to-reach customers.

5. Commercial and Industrial Lighting Retrofit Acceleration Program

Overview

The purpose of this program is to increase the saturation of efficient lighting among existing commercial and industrial buildings. The program accelerates and broadens the efforts already underway by customers and a wide array of contractors to replace obsolete lighting systems with the more efficient systems that have become common practice for most new construction. For the proportion of the building stock that replaces lighting periodically to upgrade appearance (i.e., replaces fixtures sometimes during remodeling), a large proportion of the savings from this program would occur with or without the program over the next 15–20 years. Nevertheless, accelerating the large amount of available low-cost savings would produce significant benefits in areas where there is a need for near-term, large-volume savings. This program would be complemented by a separate but related effort to enhance the quality and efficiency of common practice for lighting design, as described below.

The retrofit acceleration program follows the model of highly successful programs that have evolved over more than a decade and are relatively easy to implement. Programs at National Grid and Conectiv Power Delivery were selected as models for various components because the programs are well-known to the authors, the programs have established track records, and further information is readily downloadable on the Web. Key features are described below.

- Customers would be provided with a range of technical assistance suitable to the scope of each project.
- Prescriptive and customized (site-specific) rebates would be provided.
- Higher rebate levels and an optional separate procurement process are proposed to address the particularly hard -to-reach small business customers (<100 KW). The small business component would provides the minority of the savings and could require higher expenditures per kWh, but would likely have the greatest impacts after 5 years. This is because smaller businesses are less prone to adopt new technology on their own.
- The program would be promoted directly by the utility or other program sponsor, but also would be designed to complement the efforts of energy service companies and other proactive marketers of efficiency.

Target Market

The target market is all existing buildings that do not yet have high-efficiency lighting throughout the structure. While this encompasses a wide range of customers, the following groups are prominent:

- Hundreds of thousands of small-scale businesses with modest individual electric bills but huge cumulative potential savings.
- Larger buildings, including many retail buildings, that are leased on a short-term basis and where the tenant pays electric bills. In these situations, the owner has no responsibility for the bills and tenants have no long term interest in capital investments in the buildings, so many owners have been slow to adopt efficient lighting.
- Large institutions and firms with limited capital or internal organizational knowledge, or internal barriers to energy efficiency decision-making and contracting. In particular, many federal and state buildings have not yet been retrofit. In areas where there have not been extensive prior programs, many local government buildings also use obsolete, inefficient lighting. While energy service companies in some of these areas have addressed large institutions, many smaller ones remain largely untouched.
- Many buildings retrofit in the early 1990s with efficient magnetic ballasts and 34 W lamps could experience much higher savings with more aggressive approaches.
- New technologies that are easily retrofit, such as pulse start metal halide lamps for high intensity discharge (HID) applications, create additional opportunities even for buildings that have previously installed efficient hardware.
- In recent years, utilities have informed the authors that even sophisticated high-tech companies are still installing T-12 lamps and electronic ballasts in large new buildings simply because they are paying attention to other issues. The lesson is that retrofit opportunities can be found virtually anywhere.

For purposes of incentives and delivery structure, the market is divided into businesses with loads over 100 kW (including chain stores of smaller buildings) and businesses with loads under 100 kW.

Efficiency Measures

The program includes *any* retrofit lighting efficiency measure that clearly reduces peak load. However, to simplify and accelerate contractor participation, it would useful to pre-calculate

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typical cost and savings, and establish prescriptive incentives for more common measures. For example, National Grid (formerly New England Electric) offers incentives separately for each of the following types of equipment:

- T-8 lamps and electronic ballasts (incentives only available for retrofits);
- A variety of different flourescent fixtures that are highly reflective and use efficient lamps and ballasts —fixtures are differentiated to reflect different costs and efficiencies;
- Compact fluorescent lamps with hard-wired ballasts (screw-in compacts are less permanent and often pay back so quickly that an incentive is not needed);
- Light-emitting diode (LED) exit signs;
- LED red traffic lights (Note: some other program sponsors also provide incentives for green LEDs.);
- Pulse start metal halide retrofit kits;
- New pulse start metal halide fixtures;
- New high pressure sodium fixtures;[18]
- Wall-mounted and remote-mounted occupancy sensors;
- Daylight dimming systems;
- Occupancy-controlled high-low control systems — for fluorescent and HID lighting; and
- Fluorescent de-lamping with reflectors.

Specific prescriptive measures, incentives, minimum performance requirements, and other features are detailed on National Grid's Web site in an Adobe Acrobat downloadable file (National Grid 2000b). In addition, as discussed below, other lighting improvements are eligible for custom incentives.

National Grid's basic approach to prescriptive lighting rebates is to specify minimum watt reductions per fixture and specify quality elements of the installation (such as power factor, total harmonic distortion, and component quality issues such as fixture efficiency). These specifications leave manufacturers and contractors with leeway to design and select a range of products, but avoid situations where shoddy equipment is installed. They also assure that National Grid is paying only for measures that are more efficient than baseline equipment.

National Grid offers an incentive for T-8 lamps and electronic ballasts as one-for-one replacements for T-12 lamps and standard magnetic ballasts. They will also retrofit low-power ballasts (where lighting levels allow) in place of efficient magnetic ballasts (Keena 2000). While these measures reduce load, it is often possible to save much more by reducing the number of lamps and ballasts through use of reflectors or new fixtures. One-for-one swapouts can "lock in" an inefficient fixture layout and thus create lost opportunities for these additional savings. Therefore, it is important, in working with customers and contractors, to encourage the more

[18] National Grid does not pay for HPS retrofit kits.

comprehensive approach wherever feasible. At the same time, it's important to recognize that delamping will not produce adequate light levels in all situations and many customers are not willing to move fixtures.

National Grid complements its prescriptive rebates with a *custom approach*. This is for retrofit measures that do not easily fit into rebate categories. National Grid has a separate worksheet to handle these custom measures. This worksheet also can be viewed as a downloadable Adobe Acrobat file (National Grid 2000b). Among the many strategies eligible for this approach are use of T-5 lamps to replace HID lighting in high-bay industrial settings. Because this involves careful fixture selection to assure proper light distribution, and because there are other alternatives that may be preferable in some situations, National Grid addresses this as a custom measure instead of providing a prescriptive rebate.

Program Strategies

The market infrastructure to retrofit buildings with efficient hardware is in place.[19] The equipment is available in volume and with predictable quality; numerous contractors market, finance, and manage this type of retrofit; customers have seen the equipment; and so on. In fact, this year a consensus was reached between efficiency advocates and lighting equipment manufacturers to recommend equipment standards that would essentially outlaw magnetic fluorescent ballasts for new fixtures by the middle of this decade, and outlaw magnetic ballasts for most replacement applications in 2010. In September 2000, DOE formally adopted these consensus recommendations (Federal Register 2000). However, ballasts and lamps can last for many years, so acceleration of this trend would produce significant savings. Furthermore, many technologies that could be retrofit are not covered by this standard.

Customers who have not yet converted their lighting systems often have a number of firm-specific issues that make it difficult for them to address efficiency. These issues were discussed to some degree in the section on the target market, but are summarized in Table C-15.

The barriers are many, and no single approach could address all these barriers. However, private contractors are achieving some retrofit savings with the most motivated customers. Program sponsors have been able to add significant savings (more savings per building and more customers) by offering programs with incentives; multi-pronged marketing; and streamlined, intensive technical assistance. These tools help by calling attention, reducing paybacks, increasing credibility, taking some of the management burden off the customer, and simply forcing a decision.

[19] Except for cutting-edge technologies such as T-5 lamps and daylighting where only some designers are proficient.

Table C-15. Market Barriers to Commercial and Industrial Lighting Retrofit

Market Barrier	Key Issues
Customer Access to Information	• Many customers do not have the technical familiarity to manage contracts to install efficient lighting or to do the retrofits on their own. • Customers often lack expertise and time to engage in performance contracts. • Early performance problems with reflectors, electronic ballasts, and motion sensors have left some customers gun-shy; they do not know that consistency has improved and don't know how to specify highest-quality products. • Customers usually are less familiar with more recent products such as pulse start metal halide lamps. • Many customers do not know how much light they need, so they are conservative about reducing lighting levels. They also don't know that quality reflectors and fixtures could improve light distribution.
Customer Organizational Barriers	• Customers often lack the time and confidence to perform quality assurance. • Many customer organizations (small and large) have not assigned responsibility to any individual to carry out efficiency measures. This hampers decisions and limits expertise. • In many large organizations such as state and federal government and multi-site corporations, the unit that pays for construction often is not the unit that pays energy bills, and the two do not communicate effectively about management of costs. • Many businesses and government entities consider energy efficiency and lighting improvements to be a low priority for funding because energy costs are a small part of their overall operating costs.
Financial Barriers	• Many government entities have legal or political barriers to borrowing (although leasing is possible in many cases). • Split incentives — properties on short-term leases often leave the owner with no responsibility for electric costs and the tenant with no long-term interest in the property. • Small businesses are often run on a cash-flow basis and lack capital for even quick payback investments.
Scale Issues	• Many hundreds of thousands of customers are too small to attract the attention of contractors or engineering firms. • Performance contractors (that provide off-balance-sheet financing as part of its service) typically target transactions of at least a hundred thousand dollars, and most contractors target larger transactions than this. These criteria exclude all but the largest commercial and industrial customers from performance contracting.

Marketing

The program should be marketed extensively to customers and trade allies. National Grid, for example, works directly with larger customers, but has also set up contracts with a group of trade allies to augment staff in marketing the program to medium-sized customers. Trade ally training sessions for other contractors are also held. Special arrangements have been made to encourage energy service companies to participate in both technical studies and measure installation. In an effort to keep prices down, National Grid has also set up the "Buyers'

Alliance," a form of a buyers' club. National Grid competitively selects specific firms (one per equipment type) to offer low prices on specific equipment types. National Grid then offers (at no profit to itself) the customer the option of using the Buyers' Alliance contractor to supply equipment or working with a contractor of the customer's choice to procure equipment. While the program would be workable without this arrangement, it helps assure a competitive price on smaller equipment installations.

Financial Incentives

National Grid's incentives are detailed on its Web site (National Grid 2000a, 2000b). In general, National Grid pays about 40–50% of the cost of prescriptive efficiency measures. Prescriptive incentive levels for specific items are fine-tuned based on market response through an annual review process. The ***custom*** incentive is set at 50% of equipment cost.

These incentive levels would be sufficient to create large-scale program demand. Areas where less efficiency has already been implemented (ergo there is more pent-up demand) could use lower incentives for a time. However, with significantly lower incentives, there would be the danger that a large proportion of the transactions that would be subsidized through the program would occur without the program. Higher payments would accelerate demand for the program, resulting in a smaller share of "freeriders."

National Grid's custom incentives are paid as a percent of equipment cost. They have chosen to pay a share of cost because the cost/kW or kWh from different measures varies dramatically. Costs used to calculate incentives are based on bids or invoices that are reviewed for reasonableness. Savings for custom measures are determined through a technical study, usually performed by a utility contractor but sometimes provided by an equipment vendor.

Other utilities have chosen to pay a fixed $/kW for custom incentives, or a fixed amount per fixture, to reduce "gaming" of costs by the contractor and to simplify technical review.

Financing

National Grid also helps customers locate financing for their share of the cost of efficiency measures, working with a variety of banks and other lending and leasing firms. These offers complement financing available through many contractors and through the customers' own contacts. National Grid facilitation for financing has proven to be valuable, but is used only in a small minority of transactions. Additionally, National Grid offers customers with loads less than 100 kW the option of financing their share of costs on the utility bill, through National Grid's small C&I program. Other utilities have offered this option and it has proven to be an important complementary lever to increase participation.

Quality Control

The key quality control steps would be review of the proposal and site inspection. Proposal review for prescriptive measures would verify that the specified equipment would save the indicated number of watts compared to prior equipment, would meet program requirements, and would be appropriate for the customer use of the space. Inspections would confirm that the specified equipment was installed properly. Payment would be made after installation. When a contractor would begin work in a program, it would be prudent to inspect all sites. Where contractors have installed equipment in many buildings and have established performance records, post-installations could be on a sample basis.

For *custom* installations, there would be one major difference — a more detailed proposal review to verify the reasonableness of the engineering assumptions behind the savings estimate and the adequacy of the lighting levels. The cost estimate, which drives the custom incentive, would also be reviewed for reasonableness.

Small Building Approach

Smaller businesses (e.g., under 100 kW at all sites) present a special problem. Smaller transactions tend to have higher analysis costs, and due to the lower volume, higher equipment costs. Small business owners have less time to deal with efficiency or with contractors, and the savings/building tend to be smaller. As a consequence, small businesses tend not to respond in large numbers to the type of program described above.

The simplest way to address this problem would be to simply increase incentive levels for smaller business. This would hypothetically encourage contractors to develop special services to bring in smaller customers. However, the use of turnkey contractors has met with limited success at utilities such as Sacramento Municipal Utility District and United Illuminating. Both these utilities decided to increase the degree of utility administration (while still using contractors for audits and installation) to reduce costs and increase program effectiveness.

National Grid addresses small businesses with a special program approach involving bulk purchase of both labor and equipment and direct installation by utility contractors. Its small C&I program is one of the most successful in the country, having treated two to four thousand customers per year for nearly a decade. They have reached about a third of their small customer base. Under National Grid's approach, a handful of firms are competitively selected to provide checklist audits (using an utility-determined standardized format) and install most equipment. Equipment suppliers are selected through a separate competition to provide large volumes of specific types of common measures. The installation contractors use a utility computer system to order the equipment and have it drop shipped to the site for installation. A separate specialist contractor installs case cooler efficiency measures.

National Grid's share of the cost was originally 100%, but over several years has been lowered to 70–80% (varies by state). This has significantly increased the number of customers that refuse to participate, but the program is still able to address thousands of customers per year. To help induce participation, the utility offers to finance the customers' share of costs on the utility bill.

Relationship of Program Strategies to Market Barriers

Table C-16 shows how these program strategies would address each of the key market barriers to efficiency investments in the C&I lighting retrofit market.

Table C-16. Market Barriers and Intervention Strategies for Commercial and Industrial Lighting Retrofit

Market Barrier	Intervention Strategy
Customer Access to Information	• Utility staff and contractor technical assistance • Marketing through contractors • Marketing and technical materials • Technical studies where needed
Customer Organizational Barriers	• Utility/sponsor endorsement sometimes focuses attention • Financial rebate opportunity could focus attention • Utility/sponsor assistance in project implementation • Utility/sponsor quality control and administrative advice to customer
Financial Barriers	• Incentives • Financing facilitation • Alliances with performance contractors and leasing firms to overcome government entity restrictions on financing • Financing to produce positive cash flow, preferably on the electric bill
Scale Issues	• Higher incentives for small customers • Bulk purchase/direct install approach to minimize hassle for small customers

Key Indicators of Success

The primary indicator of success for retrofit lighting programs would be the level of savings and participation. It is important to consider the savings beyond what the private sector would accomplish in the absence of utility programs. While this can never be precisely determined, post-installation interviews with customers often reveal their prior intentions.

A secondary indicator would the comprehensiveness with which buildings would be treated. As previously discussed, delamping with reflectors or fixture change-outs can often save much more than one-for-one lamp and ballast swap-outs. Many of the lighting design approaches discussed in the section on the lighting quality enhancement program could be applied to retrofit situations if the customer and contractor are sufficiently motivated and sophisticated.

Cost and Savings Assumptions

Savings

Precise data on the percent of building peak load that has been saved through this type of program are difficult to obtain, in part because many programs have been evaluated as part of larger integrated programs including other end-uses (because many evaluations focus on energy more than peak) and in part because evaluations tend to focus more on total savings than percent of load saved. However, savings from small C&I retrofit programs are often on the order of 10% of total building (for all electricity uses) energy and peak load. In 1999, Massachusetts Electric's (National Grid's largest subsidiary at that time) small C&I program saved an average of 2.2 kW/customer from lighting measures, and an additional 0.2 kW from other measures (National Grid 2000c).

For larger buildings, the savings from lighting ranges from 10–20% of lighting load, and in many cases even higher, depending on the breadth and depth of the retrofit. EPA's program has commonly found it possible to reduce lighting loads by 30–50% (EPA 1999). In 1999, Massachusetts Electric's Energy Initiative retrofit program saved an average of 4.7 kW/participant with lighting measures.

While evaluation issues are beyond the scope of this report, it is important to recognize that lighting-connected load reductions do not precisely match nameplate ratings (Gordon, Quaid, & Gardner 1995). For example, lamp/ballast interactions must be considered, which will sometime increase and sometimes decrease consumption relative to nameplate ratings. Similarly, not all lights are on (therefore saving energy) during peak periods. For example, New England Electric's (now National Grid) study of lighting measures in new buildings using lighting loggers estimated diversity factors in the range of 77–80% during peak hours (New England Electric 1994). Also, the most common technique for estimating lighting energy savings is to multiply lighting load reductions (in watts) times annual operating hours. Several utilities have conducted studies in which they install meters or light-sensing loggers of some type in a sample of buildings. A recent review of nine of these studies, covering on-site measurements at 367 sites, found average annual operating hours of 4005 (Miller 2000).

In addition, since lighting energy savings reduces the heat produced by lighting systems, savings estimates should include reduced air conditioning load due to less heat produced by lights, and the corresponding increase in heating load for facilities with electric heat. Cooling benefits will be higher and heating benefits lower in warmer climates, and the reverse holds for cooler climates. The particular effects vary by region and building type. A recent set of analyses by Lawrence Berkeley National Laboratory examine these impacts in detail (DOE 2000c provides the most recent estimates by building type at the national level; Sezgen and Huang 1994 provide regional data but their numbers are subject to some shortcomings noted in the 2000 report).

Finally, there is the issue of freeriders, meaning customers who participate in a program but would have installed efficiency measures anyway. Some of the most recent estimates of freerider levels for lighting upgrades are provided by a National Grid 1999 survey of participants in its programs. For lighting retrofit measures, National Grid found that freeriders were 0–2.5% of its small customers and 3–5% of its large customers. The low end of the range signifies participants who are clearly freeriders; the high end of the range includes "partial freeriders," which are customers who claim they would have made the improvements eventually but not necessarily soon (National Grid 2000c). Also, as the new DOE ballast standards kick-in after 2005, these long-term partial freerider levels will increase (i.e., incentives provided in 2001–2004 will merely accelerate adoption of electronic ballasts that would have been sold in the post-2005 period.

Cost

In 1999, Massachusetts Electric's large C&I retrofit program, Energy Initiative, provided the following savings:

	Prescriptive Lighting	Custom Lighting*	Combined
Peak MW	4.1	0.4	4.5
MW years	78	6	84
Annual GWh	16	3	19
Lifetime GWh	306	44	350

*Includes lighting controls.

National Grid does not report cost-effectiveness by end-use. However, the overall cost of program implementation, including non-lighting measures, was $1,013/kW and $65/kW-year (undiscounted — i.e., annual kW x measure life), and 1.3 cents/lifetime kWh (cost/lifetime kWh). The lighting measures were among the more peak-intensive and less expensive, so we can only assume that they cost less per kW (National Grid 2000c).

Lighting savings from Massachusetts Electric's small C&I program in 1999 can be summarized as follows:

	Prescriptive Lighting
Peak MW	2.7
MW years	39
Annual GWh	6
Lifetime GWh	83

The overall cost was $1,134/kW, $78/kW-year, and 3.5 cents/kWh. These figures include non-lighting measures, which are more expensive, and so are probably slightly high. However, this program, and its costs, are dominated by lighting measures. Much of the higher cost/kW (compared to Energy Initiative's program) is due to higher marketing and installation costs due to the small savings at each site. This is balanced by the fact that small buildings tend to have fewer freeriders because customers less frequently upgrade efficiency on their own (National Grid 2000c).

A review of the largest lighting programs in the country found that the majority of programs had total costs below 4.4 cents/kWh saved and utility costs below 3.1 cents/kWh. Four programs had costs of about 2.0 cents/kWh saved or less (Eto, Kito, & Sonnenblick 1995).

Non-Energy Benefits

The program would also replace many lighting fixtures that were providing inadequate light and in some cases reaching the end of their useful life. Quality of lighting could be increased or decreased depending on the quality control regime employed by the program sponsor and the quality of lighting contractors and equipment employed.

Measure Life

Controls aside, the life of most lighting measures depends on the time that the fixtures remain in place. The most thorough study of which we know estimated life for a large sample of in-service fixtures. Even in an area with high building growth, the average life was 21 years (Skumatz 1994).

Control measures may have different lives depending on the durability of the sensors and equipment. National Grid estimates a 10-year average measure life for occupancy sensors.

For ballasts installed without new fixtures, life is best measured in hours of use since annual hours vary significantly from building to building. Generally, the equipment rating for specific equipment is useful. One study found a typical life of 70,000 hours (Gordon et. al 1988).

Market Penetration

This would depend on what has already been done locally. High-volume programs have addressed as much as 5% f the total market per year for a number of years. A few very high-incentive programs may have moved faster for individual years (Edgar, Kushler, &Shultz 1998), particularly those operated by smaller utilities that intensively cultivated community involvement (Holt, Gordon, & Tumidaj 1995).

6. Commercial and Industrial Lighting Design Enhancement Program

Overview

The purpose of this program is to capture savings by using equipment and design practices that are more efficient than standard practice in commercial and industrial new buildings, renovations, and remodels. Lighting loads are the key determinant of commercial building peak. Design enhancements beyond current practice could radically reduce peak lighting load in some facilities if both efficient lighting technologies and daylight harvesting were employed. Simple approaches could save an additional 10%. In the best cases, the majority of lighting load would be eliminated.

The lighting design enhancement program would support and be enhanced by efforts to achieve state-level adoption and enforcement of the lighting standards in the new ASHRAE 90.1-1999 standard. It would also encourage efficiency beyond that standard. In states where the ASHRAE code has not yet been adopted, an effective program could increase the odds of acceptance. In states where the code has been adopted, the program could enhance compliance and assure that compliance results in quality lighting systems. In these states, the program could also lay the groundwork for possible future code upgrades.

The program design capitalizes on efforts of pioneering utilities and regional efficiency organizations to develop specific tools to work with the design community. The central structure of the program is a series of custom and prescriptive incentives, supported by a program of technical assistance. The proposed rebates are similar to those in the retrofit acceleration program described above except that:

1. They are keyed to improvements beyond current practice and codes;
2. The custom rebate takes a larger role; and
3. Rebate levels are based on a portion of the incremental cost to exceed current practice and codes, whereas the retrofit acceleration program bases rebates on a portion of full cost.

A special track is recommended for smaller and contractor-designed buildings. In these buildings, lighting design tends to be simple and standardized. Contractors rarely analyze lighting system energy use or light output. For these buildings, the program proposes lighting design guidelines that would be used both to train contractors and to build demand for better lighting among owners, managers, and renters. The guidelines would also create a template for distributors, manufacturers, and other "contractor helpers" to specify efficient, high-quality layouts. Marketing for the guidelines should be targeted at contractors and designers through their associations and through alliances with manufacturers. Training should be held on the guidelines. A series of demonstrations, funded in part through the incentives discussed above, should be individually evaluated, documented, and published, and used as a tool to help build acceptance of the guidelines.

Target Market

This program is targeted at new construction, renovation, and "hard remodels," which involve changing lighting layouts or fixtures.

The "custom design" track is targeted at large buildings where lighting systems are custom-designed. Key targets would include architects, engineers, and lighting designers, including both consultant designers and design professionals working within property development/management organizations. In-house professionals often exist within chains and owner/manager firms specializing in office and retail rental space. Early adopters have often included high-profile office and institutional spaces.

The "small and simple building design" track focuses on buildings where designs are typically copied from site to site with little or no analysis. These include many industrial spaces, smaller and rental office and retail space, and schools. Schools are something of an anomaly in that they are often designed with the help of an architect, but lighting designs are seldom changed from site to site. Thus, the architects who specialize in this work may pay little attention to the lighting system, and may be responsive to comparative tools and approach as the contractors who do not employ a design professional.

Efficiency Measures

A variety of design approaches should be employed, including:

- Elimination of over-lighting and more efficient provision of lighting through fewer, higher-quality fixtures,[20] fewer lamps, designing lighting to focus on areas of use, and better specification of ballast factor.

- More appropriate lighting fixtures for coves and coffers.

- Alternative approaches for accent lighting.

- Additional applications of compact fluorescent lamps beyond those that are commonplace today.

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[20] These could include T-5, T-8, IR halogen, and many other types of lamps, within fixtures designed to take advantage of the optical properties of each lamp.

- Use of compact fluorescent lamps with electronic ballasts instead of magnetic ballasts.
- More and better use of dimmers, especially daylight-modulated dimmers, occupancy sensors, and timers.
- Task lighting and indirect lighting to reduce required room lighting levels.
- Individual occupant controls over lighting (through addressable fixtures) — a promising new innovation that may significantly reduce energy and peak use.
- Consideration of specialized controls in peak-constrained areas in order to reduce ambient lighting during extreme peak periods. Such controls may prove to be extremely profitable for owners.
- For smaller buildings, especially for remodels, incentives may still be justified for T-8 lamps and electronic ballasts. Current practices vary locally, but these markets appear to be among the last to adopt these technologies.

Many of these measures involve higher-quality fixtures, more diverse fixtures, and more controls than are commonly being used today. The payoff would be a more aesthetically pleasing and functional space as well as lower energy use.

Program Strategies

Design enhancement is new to many program sponsors, but others have been working with the design community for many years. Some sponsors are concerned that they should not "second guess" designers, essentially taking over the task and liability for adequacy of lighting design. Leading utilities have successfully developed design assistance and incentives that empowers designers by providing them with more information, tools, time to design, and the ability to present efficient options to their clients with modest added cost and clear user benefits.

For lighting design improvements, market barriers are summarized in Table C-17.

Table C-17. Market Barriers to Commercial and Industrial Lighting Efficiency through Design Enhancement

Market Barrier	Key Issues
Customer Access to Information	• Most customers are unfamiliar with design approaches to lighting quality and efficiency. • Customers often do not know how much light they need, so they are conservative about reducing lighting levels. They also often do not know that quality reflectors and fixtures could improve light distribution. • Customers sometimes are not familiar with the connection between lighting quality and occupant performance issues such as worker output, retail sales, and student performance. • Many customers do not have unbiased sources of information and lack the time and confidence to perform quality assurance on lighting design. It is particularly difficult for them to know which designers have expertise in designing to specific levels of quality for specific types of applications.
Customer Internal Issues	• In construction projects, lighting is considered a detail. It needs to "work" and then key personnel need to attend to other things. • Many customer organizations (small and large) have not assigned responsibility to an individual to carry out efficiency measures. This hampers decisions and limits expertise.
Product Definition	• "Quality lighting design" is not well-defined for designers, and especially for users. It involves extensive aesthetics and judgement. This makes it harder for customers to identify, desire, purchase, and verify quality designs.
Trade Ally Issues	• Contracting processes are diverse, but generally favor lower bids. Unless quality is a requirement in a bid, quality proposals are risky. • Given limited developer interest and budgets, the conservative approach is to "design it like I did last time." • Smaller buildings are not designed — they are often copied from templates or prior designs. The design process often consists of a counter-top or cell phone discussion with the manufacturer's or distributor's representative. • Contractors may be trained to follow more complex strategies and layouts, but the changes must be presented gradually, within the context of their existing practice. • Even for many larger structures, architects and engineers copy the last design that passed muster, adjusting as necessary for codes or special needs. While skills are higher than among small building contractors, the culture is not oriented towards analysis or efficiency. • Many designers regard efficiency as a "design constraint" more than a design value. They do not regard it as a tool for enhancing their value or winning jobs.
Financial Barriers	• In many organizations, financial managers do not regard efficiency as a source of revenue or major savings; their attention is on maximizing revenue as a higher priority than cutting costs. Energy costs are swamped by other factors in purchasing decisions. • Efficiency improvements are often "value engineered" out of construction projects to assure that funds are focussed on more visible problems, critical code issues, etc. • In large organizations such as state and federal governments and multi-site corporations, the corporate unit that pays for construction often is not the unit that pays energy bills, and the two do not communicate effectively about management of costs. • Many developers provide a "build-out allowance" for lighting for tenants, which restricts investment in quality lighting.
Design Methods and Values	• Some buildings are designed to be as flexible as possible to meet the needs of tenants who may change. Flexibility could lead to generic over-lighting if not carefully thought through.

While awareness should be the first program barrier addressed, the most crucial barrier will be product definition. Lighting design is not a commodity like a ballast. Lighting design is a package of enhancements to selection, placement, and control of a wider variety of equipment than a lighting contractor normally considers. Good lighting design is more complex to ask for or offer, so it is more difficult to establish a market where the buyer understands what is being sold and can verify its legitimacy. Even efficiency-oriented designers don't always agree on the "best" approach to a space. As a consequence, efficiency and quality would be considerations for a select group of elite designers for elite buildings where the clients are looking for ways to distinguish their building.

Detailed discussions with members of the lighting design community have revealed that energy efficiency will never be a high priority for their work (Gordon, Tumidaj, & Coakley 1995). Thus the primary focus of this lighting design enhancement program is on enhancing the market position of "high quality lighting" as a valued, salable, and verifiable commodity.

There have been significant efforts in recent years to address these barriers, ranging from development and promotion of quality/efficient lighting guidelines for contractors, more complex lighting guidelines for high-end designers, lighting demonstration and training facilities, contractor certification, federal branding programs (ENERGY STAR), etc. At the moment, the profusion and lack of coordination of these effort creates an additional barrier to more interested developers, designers, and owners. The proposed program tries to create a "tree" to incorporate all of these appropriate experiments in a way that is coherent to customers and manageable for program sponsors.

Technical Assistance

For buildings where designers are involved, the program should offer both direct technical assistance and reimbursement to contractors for the extra time involved in efficient equipment analysis and design.

For high-end buildings, technical assistance could be provided using the system currently employed with minor variations in several of the more ambitious utility new construction programs (e.g, National Grid, NSTAR, Northeast Utilities, and Conectiv Power Delivery). These programs offer modest compensation to designers for the added cost of considering efficient equipment, and also offer the services of "efficiency expert" contractors to work with designers.

For example, Conectiv Power Delivery of New Jersey (Conectiv) offers up to $2,000 to compensate for analysis of a lighting system that results in a high-quality design, subject to several conditions to assure that the design exercise is effective and necessary. A contractor working for Conectiv will also assist with advice on lighting system design, including:

- Plan review and analysis of energy efficiency options
- Walk-through audit of current facility
- Consultation on selecting and specifying energy efficiency measures
- Basic design assistance (small new construction and/or remodeling)
- Basic measure/system/project analysis and recommendations
- Assistance with incentive applications and program compliance

Some customers rely more on Conectiv Power Delivery's contractor, and others rely more on their own designer, compensated in part by the utility. Conectiv also offers higher incentives for efficient design work involving multiple end-uses. Details are available at Conectiv's Web site (Conectiv 2000b).

For smaller and simpler buildings, there really isn't much of an existing design process to influence. Contractors typically take designs from prior designs or "templates." or work with suggestions provided by the lighting distributor's or manufacturer's salesperson. There is little or no numerical analysis. The Design Lights Consortium (DLC), a group of utilities and other conservation proponents in the northeastern United States, has developed an initiative to directly address this market. Their KnowHow series of lighting design guidelines (DLC 2000) are the centerpiece of this campaign. These guidelines are intended to help create excitement about quality efficient design among contractors and their clients. The guidelines offer "good, better, and best" approaches to lighting design for ordinary commercial spaces. The "good" level is generally not much more efficient than the recently passed ASHRAE lighting standard but assures reasonable lighting quality while meeting the standard. "Better" and "best" standards incorporate progressively higher-quality and more efficient lighting.

The first three guidelines (small office, small retail, and school) are about a year old and have been used in several training classes and several demonstration projects. Three case studies are available (DLC 2000). They have generated significant excitement among both manufacturers and contractors. They are currently being incorporated into code compliance training in Massachusetts. While contractors seem to be using some of the information from training in the guidelines, the extent of their influence is not yet clear. An evaluation is currently being planned. Also, additional guidelines are being developed for industrial lighting and for skylighting in retail and industrial buildings.

The case studies are used to demonstrate how to apply the guidelines, and the case study process is showing some of the complications of marketing high-quality lighting. Because the focus is on quality, the equipment recommended in the guidelines cost more than simple cheap fixtures that could provide efficiency. However, the guidelines assure that the lighting levels meet user needs, and hopefully can create more of a market demand for better lighting for ordinary buildings.

Based on very early feedback, it could prove useful to have additional informational pieces to make the guidelines attractive for purchase and leasing agents (i.e., a shorter "sell" piece") and to help contractors actually lay out conforming lighting systems (i.e., case studies and manufacturer-provided model layouts). However, the guidelines appear to offer the core for a potentially effective approach to "next wave" lighting for smaller buildings. DLC is actively recruiting manufacturers as allies and encouraging them to develop conforming model layouts.

We recommend that sponsors who wish to promote good lighting in small buildings work with the DLC to access their guidelines and help them evolve. In addition, we recommend that sponsors offer training workshops in use of the guidelines, provide custom incentives (as described below) to help get a number of buildings in the field that conform to the guidelines, and develop local case studies. Additionally, the sponsor's technical assistance staff could help contractors through their first few experiences in designing guideline-conforming buildings.

Marketing

The long-range market strategy for this Lighting Quality Enhancement program is to influence the market so that customers are motivated to purchase high-quality efficient lighting for reasons of appearance and functionality, with reduced demand and energy use as a secondary consideration. However, in the short run, many sales could also be made based on energy savings re-enforced by utility incentives. Neither the "quality" nor the "energy savings" approach would work everywhere.

Critical marketing targets would include:

- Designers (mostly architects, engineers, and professional lighting designers for larger and high-end buildings and schools, mostly contractors with limited technical background for smaller and low-priced buildings)
- Developers
- Purchasing, and rental agents within customer organizations
- Personnel who upgrade buildings for rent within property management firms

A keystone to marketing would be demonstrating that quality lighting helps meet developer objectives, such as faster rentals and sales, higher occupancy, higher rents, more satisfied and productive occupants, higher retail sales volume, etc. A national consortium is working to develop information on productivity benefits of efficient lighting (Light Right Consortium 2000). An influential set of studies demonstrating productivity benefits of quality lighting in retail schools (better grades) and retail buildings (better sales) is available (Heschong, Wright, & Okura 2000; Okura, Heschong and Wright 2000).

A more direct approach to showing non-energy benefits would be to conduct "impressions research." This would amount to encouraging personnel who make purchase and rental decisions to tour buildings that meet quality lighting standards and then through other buildings that are similar except that they do not meet those standards. The impressions of real buyers and rental agents (assuming that they prefer quality lighting) would likely make a very direct impression on their peers.

Communications materials should be crafted for contractors, designers, engineers, developers, rental agents, etc. For designers and contractors, professional associations would provide useful allies and leverage points for communication. However, significant one-on-one in-person communication would be necessary to help designers adapt new approaches.

With respect to the lighting guidelines, DLC has developed a detailed marketing plan for 2000. Training, trade ally alliances, trade shows, and direct contact are among the approaches being applied.

The retrofit acceleration program described above might also provide a marketing avenue. Through the custom retrofit incentives proposed for that program, there would be an opportunity to promote advanced lighting designs. However, it is important that very simple approaches should also be available under that program to meet its primary purpose — capture of high-volume, near-term savings.

Financial Incentives

For both the "custom design" and "small and simple building design" tracks, a number of utilities offer cash incentives to help defray the cost of more efficient lighting equipment in new buildings, renovations, and remodels. These incentives typically pay a portion of the incremental cost of more efficient equipment. Traditionally, these incentive strategies have focussed simply on efficiency, and incentives have been structured to sell adequate lighting quality, not superior quality.

Many of the "next wave" lighting strategies require redesign of fixture layouts. Beyond a point, reduction in lighting intensity is possible only with higher-quality components and new layouts to provide more-available and better-distributed light. In some cases, the components would be affordable only if the customer considers the improved "look" of the space to be an asset that helps justify the cost.

For these reasons, one-for-one equipment incentives, while valuable, would be secondary for this program. The centerpiece of the incentive strategy is custom incentives, which would help pay for any measures that the sponsor deems to be acceptable. Since much of the value would come from intangible improvements to the "look" of the space, typical cost-effectiveness screening would not be useful; while the non-energy benefits have been demonstrated in research studies (as discussed below), they would be too difficult to quantify on a site basis. If these benefits weren't considered, many measures that would be appropriate would be eliminated from programs.

Sponsors would have an option of two strategies toward prescriptive incentives. First, some utilities have tried to push as many measures into prescriptive rebates as possible. This is done for two reasons:

- Minimize the delay and expense of a custom calculation for every site.
- More clearly promote classes of efficient product for different types of common practice fixtures.

National Grid clearly falls into this camp. Its prescriptive rebates are downloadable in Adobe Acrobat from their Web site (National Grid 2000a). Rebates are available for a variety of high-quality fixtures, LED exit lights, and controls. Payments are generally established per unit of equipment. Minimum watts per control unit are specified, as are acceptable power factor and harmonic distortion. Incentives are designed to cover the majority but not all of the incremental cost of hardware alternatives.

Other utilities have chosen to rely more on custom incentives. Prescriptive rebates are used only for customers who are unlikely to utilize the more complex custom format (i.e., small buildings and specific industrial opportunities) or for measures where the watt/kW incentive does not work well (i.e, controls).

This approach keeps the program materials relatively simple for the newcomer, and has less tendency to drive designers toward specific solutions. For a small program sponsor, it is resource-intensive to keep a diverse set of prescriptive incentives current.

Conectiv provides an example of this approach. Their incentives and conditions are available from their Web site (Conectiv 2000a). Prescriptive incentives are provided only for:

- T-8 lamps and electronic ballasts in new buildings under 50 connected kW and remodels of facilities under 100 kW ($10)
- Hardwired compact fluorescent lamps in the same classes of smaller buildings ($2.35–$18.25, depending on the size and type)
- Occupancy sensors ($15/fixture, up to cost of sensor)
- Daylight dimming ($15/fixture up to cost of the sensor and controller)

Based on experience working with Conectiv Power Delivery, we recommend a custom incentive that pays $1/watt for reductions in lighting use below established baselines. The intention would be to pay the majority, but not all, of the costs of efficient equipment. It might not pay as large a share of the costs for the highest-quality equipment, but the goal is to sell that equipment based on lighting quality improvements as well as energy savings.

Either the prescriptive or the custom approach would work. We believe that the National Grid approach is superior for sponsors who would be willing to invest the time and expertise in keeping a diverse set of rebates up-to-date and working with contractors to understand the various rebate options. However, the Conectiv system has worked well for it. The system has required that the implementation contractor perform more site-by-site work, but the contractor has developed streamlined procedures for doing this.

To estimate incremental cost for custom measures and establish lists of rebate measures, it would be necessary to establish a design baseline. For states where design is fairly advanced from an energy standpoint or where the ASHRAE 90.1-1999 standard (or similar) has been implemented, the lighting power densities in that standard could provide a baseline. Where building codes have not been upgraded in many years, or are not thoroughly enforced, the baseline could be somewhere between the old ASHRAE code and the new ASHRAE code. For example, after reviewing recent building designs, Conectiv elected to pay incentives for lighting designs with lighting power densities 30% more efficient than the older ASHRAE 90-1989.

Financing

For new construction, we do not believe that direct utility financing is critical. The sort of financial referral service and close coordination with energy service companies described for the retrofit acceleration program (described above) would sometimes be useful, especially for remodel and renovation projects.

Quality Control

Sponsors should provide quality control similar to that for the retrofit acceleration program. They should also track incremental costs of equipment in the market to assess whether incentives continue to be appropriate or need modification.

For the case studies, sponsors should confirm that designs meet the guidelines. Individual sponsors or DLC should review material from manufacturers or others that portends to conform to the guidelines. As of this writing, the DLC is trying to forge alliances with market actors, which should help in this regard.

Relationship of Program Strategies to Market Barriers

These are summarized in Table C-18.

Table C-18. Market Barriers and Intervention Strategies for Commercial and Industrial Lighting Design Enhancement Program

Market Barrier	Intervention Strategy
Customer Access to Information	• Utility staff and contractor technical assistance • Marketing and educational materials for customers to help them understand the benefits • Marketing through contractors • Technical studies where needed
Customer Internal Issues	• Utility/sponsor quality control • Design guidelines for contractor-designed jobs • Prescriptive equipment recommendations • Demonstration of how to build quality specifications into lighting bids and what to expect from contractors
Product Definition	• Establishment of baseline practices • Clear branding (through guidelines) to help customers and developers focus • Training and technical assistance • Design guidelines for contractor-designed jobs • Case studies to show designers that lighting efficiency and quality are compatible
Trade Ally Issues	• Creation of demand for lighting quality so firms want to learn how to provide it • Simplified, guideline-driven approach for smaller buildings; technical assistance for custom jobs • Assistance for smaller contractors in advancing a step at a time.
Financial Barriers	• Incentives for efficient designs • Case studies showing financial benefits, both energy and non-energy. Focus on sales and leasing benefits for developers and property managers. • Direct work with government entities to develop channels for funding efficiency
Design Values	• Case studies of flexible designs that meet needs of rental properties

Key Indicators of Success

The indicators of success for lighting design enhancement programs would include the following:

- Interest in the guidelines among businesses and contractors (an early indicator)
- Increased broad interest in quality design
- Peak and energy savings
- Support by professional groups (another early indicator)
- Attendance at training sessions (a second-stage indicator)
- The square footage of target market that is built/remodeled using lighting guidelines (for the third year and beyond)
- The extent to which contractors and others rely on lighting guidelines (throughout the project)

- The extent of customer satisfaction and demonstrated non-energy benefits from the use of the lighting guidelines in pilot projects (once case studies are in place)
- The extent to which the lighting design community supports and implements incorporating the lighting standards in the new ASHRAE code into local and state codes

In addition to these market indicators, it would be prudent to conduct some evaluation, including use of metered data, for maturing technologies and those where savings would be sensitive to design, installation, and operation (e.g., controls, particularly daylighting).

Cost and Benefits

Savings

Savings would be highly dependent on baseline practices. The previously cited study of baseline lighting practices in New Jersey (Sardinsky 2000) developed rough estimates of potential additional savings by building types as follows:

- Retail: 5–25% (sample of 13)
- Offices: 5–30% (sample of 9)
- Warehouse: 40% (sample of 1)
- Schools: 10–25% (sample of 2)
- Nursing homes: 15–30% (sample of 4)
- Lodging: 10–20% (sample of 1)
- Hospitals: 25–35% (sample of 2)

Significantly, most of these buildings had already incorporated "basic" efficiency measures such as T-8 lamps, electronic ballasts, and compact fluorescent lamps. The variation within building type reflects both building-to-building variation and some uncertainty regarding the estimates. While this analysis addressed energy savings, most of the savings were from measures with proportional energy and peak effects.

Lighting energy savings also produce cooling energy savings, which vary depending on local climate. As discussed above in the discussion on the lighting retrofit acceleration program, these interactions vary by climate and building type and Lawrence Berkeley National Laboratory developed factors to adjust for these interactions by region and building type.

Other Benefits

Customer benefits were introduced under "Marketing," above.

One additional benefit of acceptance of high-quality lighting from a utility perspective is a higher likelihood that lighting market actors would not resist passage or implementation of an advanced lighting code such as one based on the recently passed ASHRAE standard.

From the point of view of contractors, high-quality lighting provides a way to differentiate themselves in the market, and a way to sell higher-priced quality equipment This generally provides higher gross profit. Manufacturers would also benefit by selling high-quality, higher-cost equipment.

Cost

Costs for additional lighting design depend strongly on the approach. The DLC approach (for smaller and simpler buildings) is a market transformation approach, and assumes that the quality of the lighting would help sell higher levels of efficiency. Therefore, the capital cost of conforming to the DLC approach is relatively expensive, but not all the costs are attributable to efficiency. We expect that costs will decrease as standardized approaches evolve for conforming to the guidelines and high-quality equipment costs drop due to volume and competitive pressures. An example is provided by pendant indirect fixtures. One manufacturer decided to create a mid-priced line for these previously "high-end" fixtures. Now several manufacturers offer mid-priced lines at significantly lower cost than those of two years ago (Sardinsky 2000).

For larger, more complex buildings, utilities such as National Grid and Northeast Utilities have been able to pay incentives at a lower cost/kWh than their avoided costs of energy and peak power. Savings and costs for National Grid's Design 2000 program for new construction and equipment replacement are shown below in Table C-19 (National Grid 2000a).

Table C-19. Savings and Costs for National Grid's Design 2000 Program

	Prescriptive Lighting	Custom Lighting*	Combined
Peak MW	1.6	0.2	1.8
MW years	25	3	28
Annual gWh	10	1	11
Lifetime gWh	153	15	168
Cost/kw-year/kW**			$1,605
Cost/lifetime kW**			$96
Cost/lifetime kWh**			$.02
*Includes lighting controls.			
**Includes non-lighting measures			

Because these figures incorporate more expensive measures from non-lighting end-uses, the costs for lighting are likely dramatically overstated. It is also important to bear in mind that historically, the cost for the new technologies in the program (e.g., electronic ballasts) have come down over time as they became commodities. This is likely to occur for the technologies currently being promoted.

There are also costs to running the training, developing the guidelines, etc. as DLC is doing as of this writing. Those costs have run around $900,000 for the Design Lights Consortium as a whole over the past 2 years. This amount was spread among six retail utilities to begin with (currently nine) and one state conservation entity. The amount includes about $200,000 for demonstrations, which provide savings but are more expensive per kWh than ordinary program activity because they are designed as showcases and are also learning sites for the program (Dagher 2000).

Measure Life

See retrofit acceleration program description above.

Possible Market Penetration Rate

While there are huge variations, lighting fixtures are on average replaced every 21 years (Skumatz 1994). In an area with a 4% growth rate, the potential market would be 41% of the lighting equipment stock in place at the end of the 5th year.[21]

Possible rates for penetration into this target stock are shown in Table C-20. The long-term rate is based on participation rates in five of the most successful commercial new construction programs (Nadel, Pye, & Jordan 1994).

Table C-20. Penetration of Lighting Design Enhancement Program

Year 1	1%*
Year 2	10%
Year 3	20%
Year 4	40%
Year 5	50%
*Largely for developing administrative system and relationships, training, and case studies.	

[21] (1.04(fifth power)-1) + (1/21x5)/1.04(fifth power) = 41%.

Coal-Based Electricity Generation: Affordable, Essential, Reliable and Increasingly Clean

March 2001

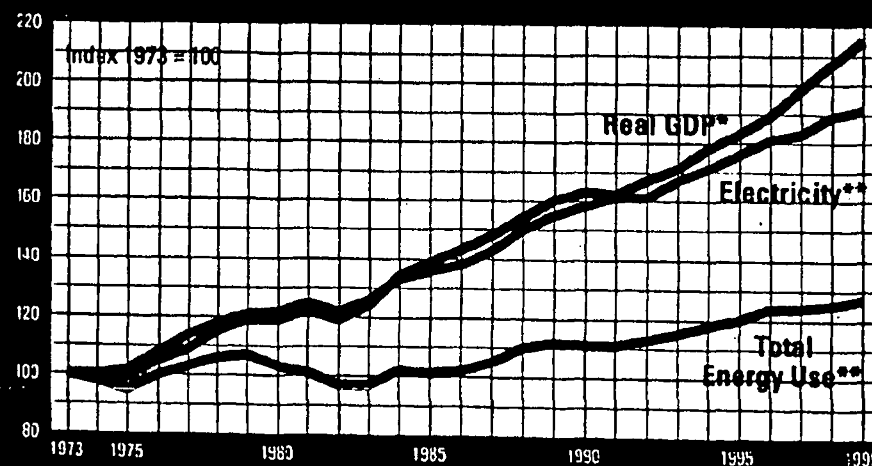
Coal-Based Generators are Critical to Our Nation's Economy

Industry	Annual Revenues	Direct Employment
Shareholder-Owned Utilities*	$164 billion	400,000
Electric Cooperatives*	$ 19 billion	59,200
Public Power Entities*	$ 33 billion	100,000 (est.)
Coal Producers	$ 19 billion	120,000
Railroads	$ 36 billion	265,000
TOTAL	**$271 billion**	**944,200**

*These figures are reflective of the entire electric utility industry, including coal-based generators and others.

Electricity Growth and Economic Growth are Closely Linked

The U.S. economy is highly dependent on affordable and reliable electricity. Since 1970, electricity growth has closely tracked the rise in GDP, while overall energy use has grown more slowly.



*Source: U.S. Dept. of Commerce, Bureau of Economic Analysis **Source: Energy Information Administration

Electricity Demand is Growing

To meet increased demand and to offset retirements of existing power plants, DOE forecasts that 1,310 new power plants will be needed by 2020, with a total of 393,000 megawatts of capacity.

As recent events in California and western markets illustrate, America needs to construct new electricity generation utilizing all of the nation's diverse energy resources, including coal-based electric generating facilities.

Coal is a Reliable Energy Source

Coal is a secure domestic energy source that is not subject to unreliable weather or climate conditions, price volatility or a dependence on foreign suppliers.

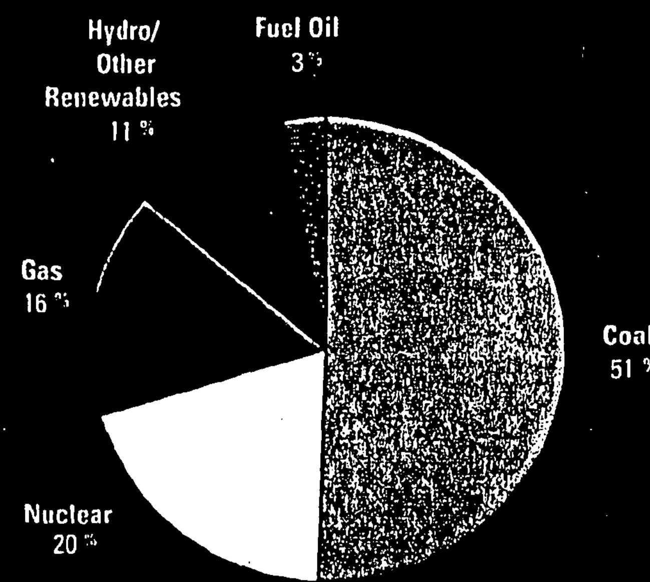
The coal industry also has a fully developed distribution infrastructure, offering predictability and reliability of supply.

Coal-Based Generation is also Increasingly Clean

Since 1970, coal-based electric generation has increased 234% and coal use in power plants has increased 270%, yet emissions from coal-based power plants have steadily declined - and dramatically so for sulfur dioxide (SO_2) emissions.

Coal Supplies over 50% of Our Nation's Electricity Today

A diverse fuel mix protects against contingencies such as fuel unavailability, price volatility and changes in regulatory practices.



Current Generation Mix

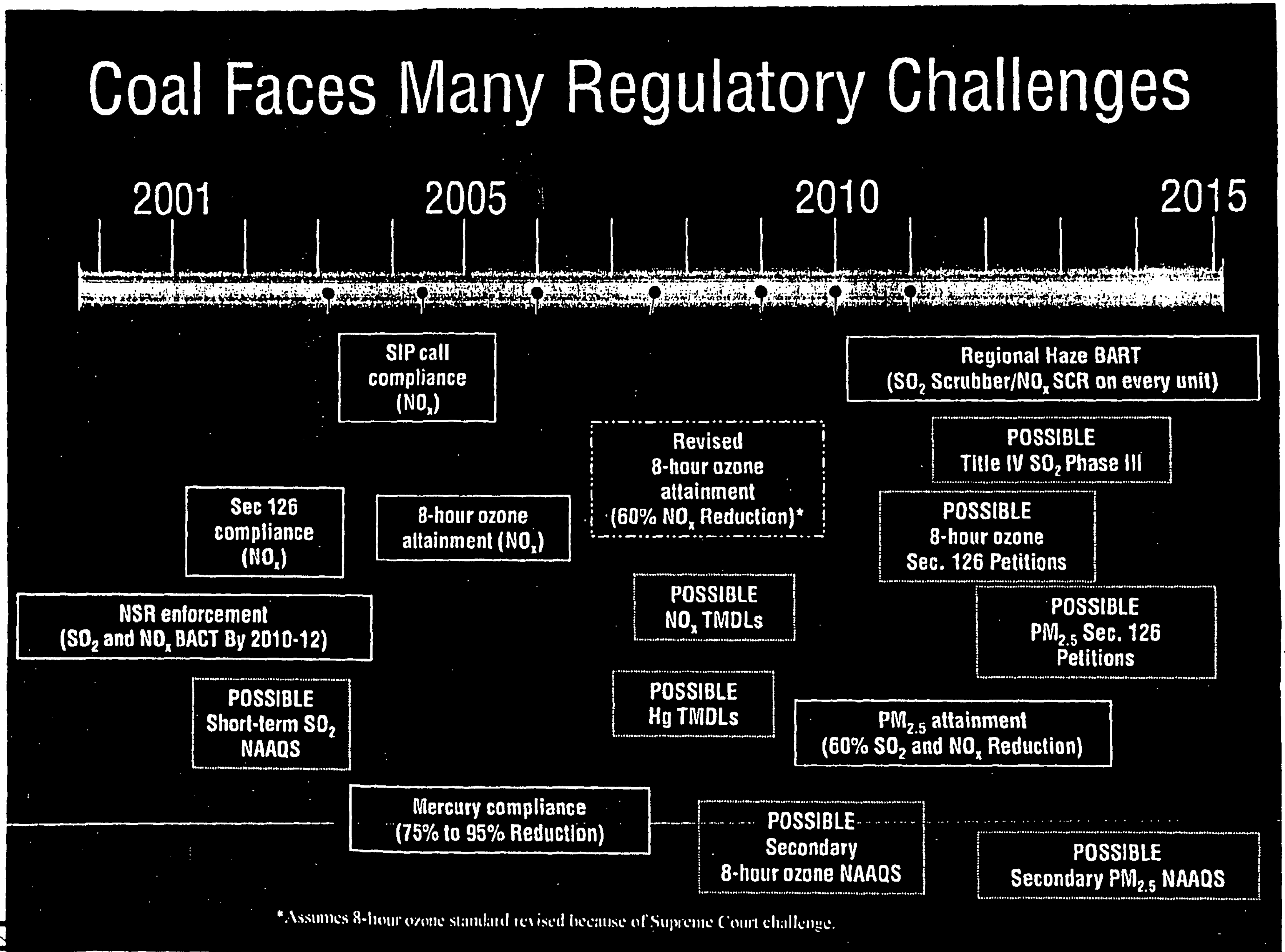
(Numbers exceed 100% due to rounding.)

Source: Form EIA-759 and Form EIA-860B

Coal is Abundant and Affordable

Total U.S. coal resources are estimated to last over 250 years based on current consumption rates.

Coal-based electricity generation is a low-cost energy source. In fact, 23 of the 25 lowest operating-cost electric generation plants in the U.S. today are fueled by coal.


Coal Faces Many Regulatory Challenges
2001
2005
2010
2015
SIP call compliance (NOx)
Regional Haze BART (SO2 Scrubber/NOx SCR on every unit)
POSSIBLE Title IV SO2 Phase III
Revised 8-hour ozone attainment (60% NOx Reduction)*
Sec 126 compliance (NOx)
8-hour ozone attainment (NOx)
POSSIBLE 8-hour ozone Sec. 126 Petitions
NSR enforcement (SO2 and NOx BACT By 2010-12)
POSSIBLE NOx TMDLs
POSSIBLE PM2.5 Sec. 126 Petitions
POSSIBLE Short-term SO2 NAAQS
POSSIBLE Hg TMDLs
PM2.5 attainment (60% SO2 and NOx Reduction)
Mercury compliance (75% to 95% Reduction)
POSSIBLE Secondary 8-hour ozone NAAQS
POSSIBLE Secondary PM2.5 NAAQS
*Assumes 8-hour ozone standard revised because of Supreme Court challenge.

Recommendations

Recognize Coal's Role in a National Energy Policy

To preserve coal-based generation, our National Energy Policy should:

- Maximize the diversity of fuels and technology options available for the generation of electricity;
- Provide appropriate incentives for energy generation, distribution and transportation; and
- Develop and commercialize clean coal technologies and provide adequate funding for coal R&D (S. 60 - National Electricity and Environmental Technology Act).

Recommendations

Adopt Balanced Environmental Policies

Congress and the Administration should adopt balanced environmental policies. Such policies should:

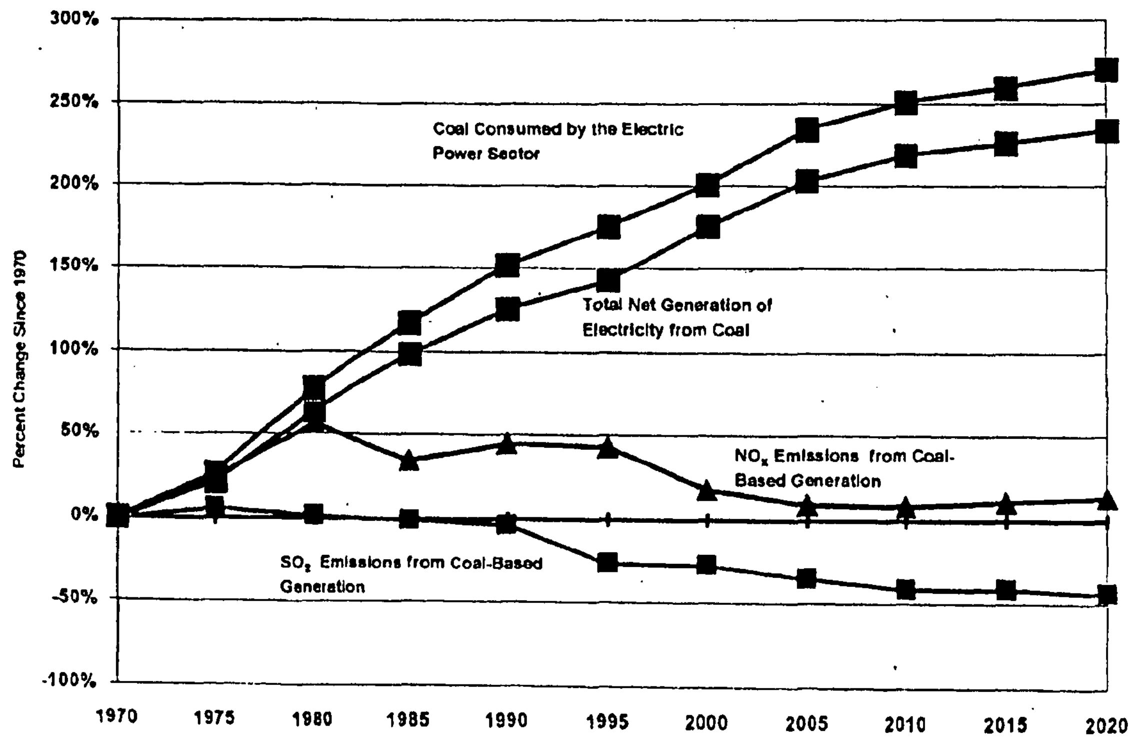
- Rely on sound science and demonstrable public health benefits;
- Consider fuel costs, and security and reliability of electric supplies;
- Establish practical compliance schedules;
- Provide reasonable certainty for investments in environmental controls and new generating facilities; and
- Give states appropriate flexibility in implementing these policies as contemplated by the Clean Air Act.

Adopt Balanced Environmental Policies

Specific policy initiatives should:

- Reform the **New Source Review** program to permit routine maintenance and protect reliability;
- Provide states with more time to implement the **NO_x rules** and harmonize the compliance deadlines;
- Review the science and health justification underlying EPA's potential **mercury rulemaking**;
- Give states greater flexibility in implementing the **regional haze program**; and
- Support programs for voluntary reductions of **greenhouse gas emissions** and technology solutions, and oppose ratification of the Kyoto Protocol or other international treaties that harm the U.S. economy and lack binding commitments from all nations.

Change in Coal-Based Electricity Generation, Coal Consumption, and Emissions since 1970



Source: EPA 1999 and EIA 2000

DOE003-0131

1487

The Outlook for Coal

A number of pending or proposed environmental regulatory initiatives could further restrict coal-based generation and raise our nation's electricity prices.

These regulatory challenges are significant and can be duplicative, contradictory, complex and unnecessarily costly, and create enormous uncertainty.

Despite the importance of coal to our energy security and electricity reliability, federal government funding and support for research and development of clean coal technologies have been inadequate.

The American Public Power Association

Briefing Book

On

Priority Legislative Issues

General Overview

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Tradable Tax Credits for Renewable Energy or Environmentally Sound Energy Technologies—Providing Comparable Incentives to Consumer-owned Electric Utilities

In light of ongoing energy supply shortages and environmental challenges throughout the nation, Congress and the Administration are reviewing legislative options to promote the production of domestic, low-cost, efficient and clean energy supplies. Tax and investment credits made available to investor-owned utilities and privately-owned energy production companies do not create incentives for publicly-owned or rural cooperative electric utilities. Publicly-owned and rural cooperative electric utilities operate on a non-profit basis and therefore do not have federal income tax liability against which to apply credits. In order to provide consumer-owned electric utilities with useful tax incentives comparable to those available to private sector market participants, public power and rural cooperative entities must be permitted to sell the tax credits to private entities that can utilize them. The proceeds from the tax credit sales provide the incentive for consumer-owned utility investment in renewable and clean energy production.

Benefits of Providing Tradable Tax Credits

As the electricity market opens to competition, the market rewards efficient energy production. Because renewable energy sources and environmentally clean, advanced technologies usually are more expensive to operate than traditional alternatives, the federal government needs to provide investment incentives to encourage utilities to build these facilities. The rewards are cleaner and renewable resources, energy security and independence, and energy diversity. Combined, publicly-owned and rural cooperative electric utilities represent almost 3000 entities and 25 percent of the nation's electricity load. To offer incentives that are not usable by this significant segment of the market represents a lost opportunity to employ the existing capacity of players able to deploy their expertise and resources. Without the incentives, consumer-owned utilities may not be able to afford to make these investments. With comparable incentives to investor-owned utilities, Congress and the Administration can expect greater investment from consumer-owned utilities.

Nature of a Tradable Tax Credit Program

A consumer-owned electric utility would build an energy facility and would be authorized to receive a federal tax credit that would be comparable in amount to that made available to its private counterpart. The utility would be permitted under the Internal Revenue Code to sell, transfer, assign or otherwise dispose of the credits directly or indirectly to any taxpayer. For a non-profit entity, neither the credits nor the proceeds derived from their disposition would result in federal taxable income. Taxpayers receiving the credits will not have their alternative minimum income taxes increased as a result of their use. Projects receiving renewable energy production incentive program funds or other federal grants would not be eligible for refundable tax credits.

It is anticipated that consumer-owned utilities will net a smaller amount from the credits than their private counter parts. Investor-owned utilities will be able to use the full amount of the credits assuming they have sufficient tax liability. Consumer-owned utilities will have to offer them at a discount to encourage their purchase by taxpayers and will have to incur transaction costs to effect the disposition.

ELECTRICITY MARKET ISSUES

- Dysfunctional wholesale electricity markets are increasing prices, undermining reliability and threatening some regional economies. Necessary improvements are needed that:
  - Create truly independent Regional Transmission Organizations (RTOs).
  - Allow for federal siting authority to encourage construction of new transmission facilities where needed.
  - Provide the necessary authority and support for rigorous Federal Energy Regulatory Commission (FERC) oversight of the wholesale market to prevent market abuses.
  - Assure FERC approval of market rates for wholesale sales only in markets that can be defined as competitive, requiring only cost-based rates in those that are not.
  - PUHCA should only be repealed if new consumer protections are established in its place.
  - Create a self-regulating reliability organization overseen and backstopped by FERC.

ENVIRONMENTAL ISSUES

- Environmental and energy policy should achieve both environmental quality and energy supply goals by, among other things, ensuring a diversified fuel mix. Initiatives should promote the cleaner use of coal, maintain and where possible increase, supplies of natural gas, nuclear, hydro, wind, biomass, landfill gas, solar and other alternative resources.

- APPA supports an integrated approach to controlling health-based pollutants and **voluntary actions to reduce greenhouse gases**. Since carbon is not a health-based pollutant and no control technology exists to control its emissions, carbon should be managed through flexible and aggressive initiatives such as increasing efficiencies, promoting conservation and pursuing emissions free power generation provided by hydropower and other renewables such as wind, solar and landfill gas to energy projects.

TAX ISSUES

- Existing tax policy is not in balance with the evolving electricity markets. Legislation is needed to address municipal financing concerns and related private use restrictions. The **Electric Power Industry Tax Modernization Act** from the 106th Congress is the proper solution. Similar legislation will soon be reintroduced.

- Tradable tax credits should be provided to publicly-owned utilities and cooperatives as a comparable incentive when tax credits are provided to investor-owned utilities. These credits can then be traded or transferred to any tax paying entity (such as a generation equipment manufacturer) in return for some value.

American Public Power Association

Executive Committee Briefings
Priority Energy, Electricity, Tax and Air Quality Issues
March 20&21, 2001

The American Public Power Association (APPA) is the national service organization representing publicly-owned, community, state and locally-operated not-for-profit electric utilities in every state except Hawaii. There are more than 2000 public power systems providing the electric power needs of about 40 million consumers, or almost 15 percent of all electricity consumers in the U.S. Some of the largest cities with public power systems are Los Angeles, Phoenix, San Antonio, Sacramento, Memphis, Seattle, Jacksonville, Austin, Nashville and Omaha. Public power systems also serve some of the nation's smallest communities. In fact, 75 percent of our members are located in cities with populations of 10,000 people or less. More than 1,200 public power systems serve 3,000 or fewer customers.

ENERGY SUPPLY ISSUES

- APPA supports the development of national energy policy legislation and advocates actions to increase overall production of electricity, enhance the energy and environmental viability of traditional fuels used to generate electricity, promote greater use of alternative sources of electricity, increase energy conservation and provide adequate energy assistance to low-income households.

- In particular, comprehensive energy policy should emphasize a **diversified portfolio of fuels.** This would entail:
  - Aggressive development and use of *alternative energy resources.*
  - Increased investment in *clean coal technologies* to allow continued and clean use of the nation's most abundant energy resource.
  - Reform of the *hydro relicensing* process combined with appropriate classification of hydro as a renewable.
  - Promotion of *landfill gas to energy projects* at existing sites. Landfill gas, which is about 50% methane and 50% carbon dioxide, could be captured and used by deploying existing technologies.

- National energy policy should promote policies to increase domestic supply by providing **incentives on a comparable basis**. For example, where investor owned electric utilities are given tax credits, tradable tax credits should be made available to publicly-owned electric utilities.

American Public Power Association
The National Organization for Community-owned Electric Utilities

The American Public Power Association is the service organization for the nation's more than 2,000 community- and state-owned electric utilities. These public power systems provide for the electric power needs of approximately 40 million Americans.

APPA was created in 1940 as a non-profit, non-partisan organization. Its purpose is to advance the public policy interests of its members and their consumers, and to provide services to ensure adequate, reliable electricity at a reasonable price with proper protection of the environment. It is governed by a 36-member, regionally representative board of directors. About 70 staff members carry out policies and programs.

Association Services

APPA provides a wide variety of services to its members:

- Representation before Congress, federal agencies, and the courts;
- Educational programs and services in technical, management, and policy areas;
- Collection, analysis, and dissemination of information through a variety of periodicals, publications, and the Internet;
- Funding for member energy research and development projects;
- Recognition of utilities and individuals for excellence in management and operations, and commitment to public power;
- Hometown Connections, a subsidiary that provides a portfolio of competitively priced operational and retail products and services for local public power systems and communities.

In addition, APPA serves as a resource for state and local officials, news reporters, other organizations, and the general public on public power and utility service issues.

Public Policy Positions

APPA's policy positions are established through a democratic process with participation of all members. Public policy positions are developed to:

- Ensure reliable electricity service at competitive costs;
- Promote competition in the wholesale electricity marketplace;
- Protect the environment, and the health and safety of electricity consumers;
- Advance the consumer and community interest in energy policy and utility service debates.

The electric utility industry is going through a major restructuring. APPA advocates that a properly structured interstate wholesale electricity marketplace is the key to lowering consumer electricity costs, and that the federal government should play a strong role in ensuring the public interest in the flow of electricity along the interstate transmission system. At the same time, APPA believes federal policy should respect state and local decision-making on many energy policy matters.

APPA Members

Most public power systems are owned by municipalities, with others owned by counties, public utility districts, and states. Regular APPA membership (with voting and committee privileges) is open to public power systems, joint action agencies (state and regional consortia of public power systems), rural electric cooperatives, Canadian municipal/provincial systems; public power systems within U.S. territories and possessions; and state, regional, and local associations in the U.S. and Canada that have purposes similar to APPA.

APPA also encourages and accepts associate memberships from entities and individuals that have an interest in doing business with public power systems, and from cities and towns interested in the possibility of establishing public power systems.

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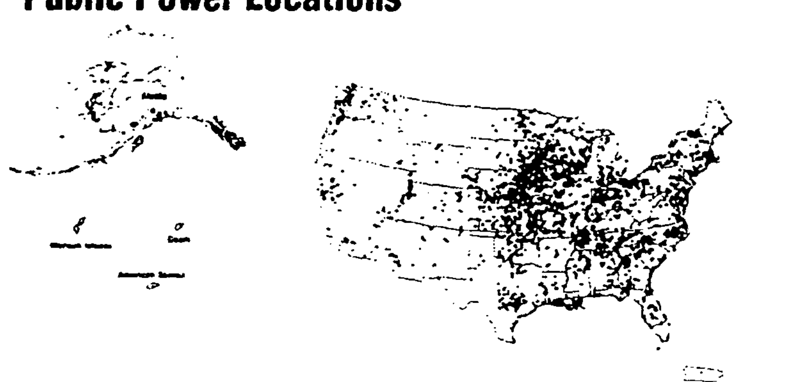
Public Power Facts

Public power utilities represent and serve America's diversity:

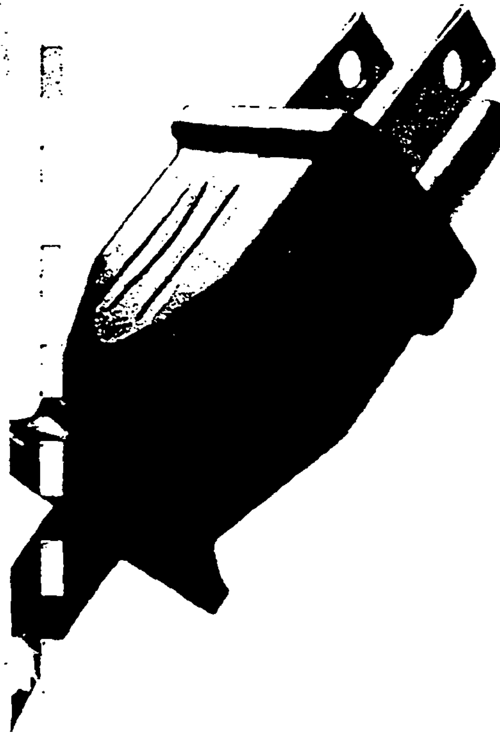
- Approximately one in seven Americans (40 million people) receives electricity from a public power system.
- There are more than 2,000 public power systems in the U.S. They are in every state but Hawaii.
- Some of the largest cities with public power systems are Los Angeles, Phoenix, San Antonio, Sacramento, Memphis, Seattle, Jacksonville, Austin, Nashville, and Omaha.
- Public power systems also serve some of the nation's smallest towns. More than 1,200 public power systems serve 3,000 or fewer customers.
- More than two-thirds of public power systems are distribution-only utilities, purchasing power at wholesale for resale.
- Public power systems are governed democratically through the local government structure. Most — especially the smaller ones — are governed by a city council, while others are governed by an independently elected or appointed board.
- Public power is an American tradition that works. By the end of the year 2005, about 500 public power systems will have celebrated their centennials.
- Public power's not-for-profit, hometown attributes hold down electric rates. According to U.S. Department of Energy statistics, private power company residential customers pay average electricity rates that are about 18% more than those paid by public power customers. Private power commercial customers pay average electricity rates that are about 9% more than those paid by public power customers. Public and private power industrial rates are about the same. Studies show that public power's low rates are due primarily to its not-for-profit status, and operating and managerial efficiencies.

Public Power Locations



There are more than 2,000 public power systems

Public Power:
An American Tradition that Works



More than 2,000 communities across the country have chosen to provide for their own electricity services. They have created public power systems – not-for-profit electric utilities that are owned by the communities and governed democratically. Public power provides for the electric power needs of about 40 million Americans – or almost 15 percent of electricity consumers.

Every public power system is different due to its community's population, geography and climate, natural resources, economic and social resources and challenges, and local government structure and goals. However, all public power systems have in common their purpose: to provide adequate, reliable, not-for-profit electricity at a reasonable price with proper protection of the environment.

Public Power is Hometown Power

Public power systems are operated primarily by municipalities, as well as by counties, public utility districts, or other public bodies. A number of states also operate public power systems.

Public power systems are rooted in the American tradition of local people providing for their basic community needs. Public power systems provide a public service — electricity — at a reasonable price. Most public power systems — especially the smaller ones — are governed by a city council, while others are governed by an independently elected or appointed board. Community ownership and governance provide wide latitude to make local decisions that best suit local needs and values, as well as changing market conditions.

Citizens have a direct voice in utility decisions and policies about electric rates and services, generating fuels, clean air and water, and other issues that affect them through public meetings, the ballot box, and open policy board meetings.

Other Kinds of Electric Utilities

About 240 privately owned electric companies have franchise agreements to serve 74 percent of all consumers in the United States. The private power companies are generally large and an ever increasing number are controlled by holding companies with interests in more than one state or even by overseas investors. While frequently referred to as "public" utilities, and often using the word "public" in their corporate names, these investor-owned companies are not owned by the public. They are owned by stockholders.

About 900 rural electric cooperatives serve the remaining 11 percent of electricity consumers. They are private, member-owned, and primarily non-for profit.

"Customers First" is Public Power's Only Purpose

Public power's first and only purpose is to provide excellent, efficient service to its citizens. Unlike private power companies, public power utilities do not have to serve stockholders as well as customers. Public power systems' measure of success is how much money they can keep within their communities through low rates and contributions to the city budget, not how much can be taken out to send to distant stockholders who are not part of the community.

Hometown Power Holds Down Costs For All Customers

Electricity prices drive local economies. Lower prices help residential customers better manage household budgets. They also allow commercial and industrial customers to grow and thrive, contributing to the overall prosperity of communities and the nation.

Public power has a proven track record of providing customers with lower-cost electric rates than private power companies on a national average. According to information reported to the U.S. Department of Energy:

- Private power company residential customers pay average electricity rates that are about 18% more than those paid by public power customers;
- Private power company commercial customers pay average electricity rates that are about 9% more than those paid by public power customers;
- There are only small differences in average rates paid by industrial customers of public and private power companies

The rate differential is due primarily to public power's not-for-profit status, and efficient management and operations.

Public Power Means Partnership

Public power systems work in partnership with their citizens and communities. Through the public decision making process, they create policies and services that are responsive to and can anticipate citizen needs.

Hometown electric utilities are an integral part of their communities, with skilled managerial and engineering staffs. They are often called upon to find innovative solutions to community needs, working with other city and community institutions. They have become leaders in supplying an array of infrastructure services that are related to the provision of electricity and other essential public needs, such as telecommunications services.

Public power systems also work in partnership with each other through more than 60 joint action agencies. These organizations are consortia of public power systems that own or purchase power supplies, or take part in other activities in which they can obtain economies of scale through their partnership.

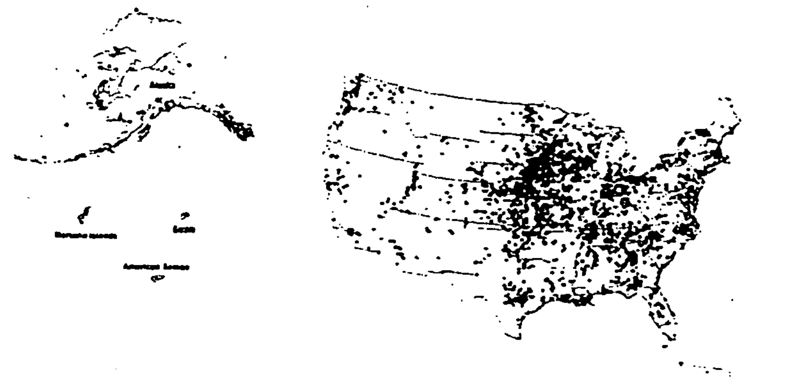
In addition, public power systems can obtain economies of scale through the American Public Power Association's Hometown Connections subsidiary that provides a portfolio of competitively priced operational and retail products and services.

Public Power Boosts Local Economies

Public power's low electric rates are a magnet for community economic development. So is its ability as a local government arm to provide streamlined "one-stop shop" customer services that encourage existing business customers to maintain and expand their operations, and attract new businesses. Strong, stable employers mean strong, stable jobs for local citizens. Low electric rates also hold down consumer costs, stimulating the local economy.

While public power utilities are "not-for-profit" organizations, they make major economic contributions to their communities. Public power systems, on average, return to state and local governments in-lieu-of tax payments and other contributions that are equivalent to state and local taxes paid by private power companies.

Public Power Locations



There are more than 2,000 public power systems

Municipal Bonds Keep the Lights On

As not-for-profit state and local government entities, public power systems have a right to issue tax-exempt bonds for various infrastructure needs. These bonds carry a lower interest rate than taxable bonds, which helps hold down the cost of developing and maintaining a wide range of essential public services.

Public Power Thrives in the New Marketplace

Public power's hometown advantages – low rates, commitment to local communities, not-for-profit operations, public accountability, local decision making, and a customer service ethic — have become readily apparent as the electric utility industry restructures. Public power has remained true to its fundamental obligation to its citizen-customers — the obligation to serve.

Restructuring failures in some parts of the country have enhanced the benefits of hometown power and made it an even more attractive option, both for those consumers it currently serves as well as for many whose private power companies have not kept promises made about competition, service, and rates.

Many communities across the country are now exploring the possibility of taking control of their energy futures by creating municipal utilities.

Public power is an American tradition that works for local communities and consumers across the country. It will continue to work well throughout this new century.

Public Power Facts

- Public power systems provide electricity to about 40 million consumers — about one in seven Americans.
- There are more than 2,000 public power systems in the U.S. They are in every state except Hawaii.
- About two-thirds of public power systems do not generate their own electricity. Instead, they buy it on the wholesale market for distribution to their customers.
- Public power utilities, on average, return to state and local governments in-lieu-of-tax payments and other contributions that are equivalent to state and local taxes paid by private power companies.
- On a national average, private power company residential customers pay about 18% more for electricity than public power customers.

PUBLIC POWER

An American Tradition That Works

- On a national average, private power company commercial customers pay about 9% more for electricity than public power customers, while public and private power industrial rates are about the same.
- The first municipal electric utility was established in 1882. By 1885, four of today's largest public power utilities — in Anaheim, Jacksonville, Tacoma, and Austin — were up and running. By the end of the year 2005, about 500 public power systems will have celebrated their centennials.
- Public power is a pro-competitive and pro-consumer institution that helps to protect all consumers — in public and private power communities — from private company price and efficiency abuses.
- Public power is a big city and a small town phenomenon, although more than 1,200 public power systems serve 3,000 or fewer customers. Some of the larger cities that operate their own electric utilities are Los Angeles, San Antonio, Seattle, Phoenix, Austin, Memphis, Orlando, Omaha, Jacksonville, and Sacramento
- Public power systems are governed democratically through the local government structure. Most — especially the smaller ones — are governed by a city council, while others are governed by an independently elected board.

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National Energy Plan

Resolution: 01-1
Sponsors: Nebraska Public Power District,
Wisconsin Public Power Inc., Sacramento Municipal Utility District,
Gainesville Regional Utilities

In Support of Specific Solutions to the Wholesale Electricity Market Crisis

The failure of electric utility industry restructuring in California has had and continues to have broad and far reaching adverse effects throughout the Western States Coordinating Council region. Electric utilities and their consumers in western states are experiencing unprecedented electricity prices. Utilities, both public and private, are near the financial edge and some are threatened by bankruptcy. The collapse of these utilities would challenge the financial stability of major banks, energy producers and marketers, as well as businesses and industries that provide products and services (and credit for such products and services) to the electric utility industry throughout the region. The magnitude of the problem is sufficient to disrupt the economy of the entire country. If left unchecked, the problems will become more severe. If addressed, the near brush with disaster should provide a sobering message that such problems cannot be allowed to arise in other regions.

There are two critical lessons that must be understood from this. First, electricity is the oxygen of our economy. While lip-service has been paid to this fact in the past, the reality of this proposition is now being driven home with frightening force. The electric utility industry is simply too important to the well-being of the entire nation to permit hasty "experiments" and unquestioning and untested reliance on the ability of "deregulated" retail markets without viable wholesale electric markets to provide reliable and adequate supplies (and sufficient reserves) of electric energy and capacity to all consumers at reasonable rates.

Second, and equally important, electric markets are interstate in nature. What is happening today is not simply a "California" problem. Consumers in Arizona, Utah, Oregon and Washington are directly affected, and there will be ripple effects throughout the economy. Regardless of its origin or cause, the solution requires Federal Congressional and regulatory action.

The problems encountered in the Western electric market, and incipient problems beginning to be seen in other regions, have three distinct characteristics: scarcity in terms of fuels as well as generating capacity; imperfect market structure particularly but not exclusively at the wholesale level; and abuses by various market participants capable of capitalizing on scarcity and imperfect markets. Each of these problems must be addressed.

NOW, THEREFORE, BE IT RESOLVED: That the American Public Power Association calls on the Bush Administration, the 107th Congress, and the Federal Energy Regulatory Commission to develop and implement a cohesive set of policies to address scarcity, wholesale market structure and abuse of the market at the expense of consumers; and

BE IT FURTHER RESOLVED: That the following policies, among others, should be included to deal with problems of scarcity:

- The use of all types and sources of electricity production must be encouraged while maintaining our national commitment to a clean environment.
- Production incentives for both renewable energy as well as environmentally acceptable means of using fossil fuels should be provided, and such incentives must be available to all entities, including not-for-profit publicly owned utilities.

- Regulatory policies, including but not limited to the hydroelectric relicensing process, that reduce the capacity of existing generating facilities without ensuring an appropriate balance of both energy and environmental needs, must be reviewed and modified as necessary.
- Our nation's dormant commitment to efficient use of energy must be renewed, and conservation become an essential component of the solution.

BE IT FURTHER RESOLVED: That properly structured and functioning wholesale electric markets remain the necessary prerequisite to properly functioning retail markets and the following policies, among others, should be included to deal with problems of market structure:

- The existence of an interstate transmission grid, properly sized, free from the influence of market participants, and, as a monopoly enterprise, properly regulated to ensure just and reasonable transmission rates, is the fundamental prerequisite to competitive wholesale markets, and Congress must direct, and FERC must implement, reforms necessary to achieve this result.
- Transmission is an interstate commerce matter within the jurisdiction of Congress. Regionally integrated planning and expansion of the grid is essential to create and maintain a structure that can sustain regional reliability and wholesale competition. Federal eminent domain authority to ensure reliability and competitive wholesale markets must be provided for construction of new transmission facilities, either to properly structured, independent regional transmission organizations, or in their absence to transmission builders pursuant to a FERC issued certificate of public convenience and necessity.
- Wholesale sales at market rates into improperly structured and dysfunctional markets will not produce just and reasonable rates for consumers. Congress must clearly define the fundamental characteristics of workable competitive wholesale markets, and FERC should permit wholesale sales at market rates in regional markets that are consistent with these characteristics and require sales at cost-based rates in those that are not.
- Repeal of the Public Utility Holding Company Act prior to the creation of a new market structure that can sustain effective competition would only make a bad situation worse and should not occur. and,

BE IT FURTHER RESOLVED: That public oversight of the market to ensure the enforcement of appropriate reliability standards, prevent abuses of the market when possible and provide remedies where abuses occur is required to protect the public interest. The following policies, among others, should be adopted.

- A national reliability organization with the authority to establish and enforce reliability standards, assure adequate generating capacity reserves in each relevant wholesale market, and oversee and coordinate maintenance outages, must be created.
- Complete and timely market information on capacity, transactions and prices must be available to regulatory agencies, public officials and all market participants.
- The Federal Energy Regulatory Commission must be directed to monitor the wholesale market, given the resources necessary to do so and the responsibility and the authority to provide remedies and impose penalties as appropriate.

Approved by the APPA Legislative and Resolutions Committee, February 5, 2001.