# TU Electric
## Thermal Cool Storage
### Profile #52

# Executive Summary

TU Electric leads the nation's utilities in the number of customers using thermal cool storage with 205 systems installed to date. The Thermal Cool Storage program was the first nonresidential DSM program offered by the utility, beginning full-scale in 1982. When this program began there were only three utilities in the United States offering incentives for installing thermal storage systems.

A thermal cool storage system provides air conditioning or process cooling for commercial or industrial installations by running chillers at night and in the early morning to produce cold water or ice, then storing and using that element to provide cooling for the structure during the hottest part of the day. These systems shift demand to off-peak hours, reducing peak demand.

TU's Thermal Cool Storage program provides cash incentives to customers that install thermal storage systems. Both new and retrofitted buildings qualify. In 1993 TU offers $250/kW for the first 1,000 kW of shifted demand plus $125/kW for all remaining kW shifted. The actual installation of a thermal cool storage system can take anywhere from a few months to an entire year. These systems provide space and/or process cooling during TU's on-peak periods (noon - 8 p.m., weekdays, June through September). In addition to cash incentives, thermal storage customers may realize additional savings by taking advantage of the Time-of-Day rate option. The utility does not physically control the loads of customers participating in the Thermal Cool Storage program. Each customer is responsible for ensuring that their thermal cool storage system is off during TU's peak demand period.

Through 1992, the Thermal Cool Storage program had cumulative peak demand savings of 70,498 kW. Initial program participation was low during the first several years of the program in terms of the number of projects, with 27 thermal storage projects joining the program from 1982 through 1986. However, in terms of square footage, these buildings were very large on average and accounted for 22,225 kW in peak demand reductions, which is approximately 32% of total program savings. In 1992, 25 buildings joined the program.

TU did not track individual DSM program costs before 1991. In 1991 and 1992, TU spent a total of $6,098,200 on the thermal storage program. In 1992 the utility spent $2,687,000 with $1,745,600 spent on incentives. TU's cost per participant was $107,481 in 1992.

## Thermal Cool Storage

| | |
|---|---|
| Utility: | TU Electric |
| Sector: | Commercial and industrial new construction and retrofits |
| Measures: | Thermal cool storage systems |
| Mechanism: | Cash incentives for permanent installation of thermal storage systems |
| History: | Started in 1982 |

### 1992 Program Data

| | |
|---|---|
| Participants: | 25 |
| Peak demand savings: | 5.1 MW |
| Cost: | $2,687,000 |

### Cumulative Data (1982 - 1992)

| | |
|---|---|
| Participants: | 205 |
| Cumulative demand savings: | 70.5 MW |
| Cost (1991 and 1992 only): | $6,098,200 |

## Conventions

For the entire 1993 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the International Monetary Fund's International Financial Statistics Yearbook: 1991.

*The Results Center* uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

TU Electric (or TU) is an investor-owned, full-service electric utility engaged in the generation, purchase, transmission, distribution, and sale of electricity. The utility is headquartered in Dallas, Texas and is the principal subsidiary of Texas Utilities Company. TU Electric was created on January 1, 1984 following a massive reorganization which brought together the Dallas Power & Light Company (DP&L), Texas Power & Light Company (TP&L), and Texas Electric Service Company (TES).[R#2,7]

TU Electric's service area stretches 600 miles from far west Texas almost to Louisiana, and extends from the Oklahoma border down approximately 250 miles into Central Texas. Electric service is provided to 372 incorporated cities in 88 counties, including the Dallas-Fort Worth area. Major industries in the TU service area include defense, electronics, aerospace, manufacturing, and oil and gas development. The area is also a center for banking, insurance, and ranching and farming. The Dallas-Fort Worth area ranks fourth in the country in terms of its concentration of headquarters of Fortune 500 corporations.

TU Electric has more than 2 million customer accounts which serve more than 5 million people, roughly one-third the population of Texas. In 1992 TU Electric had 1,952,916 residential customers, 210,185 commercial customers, 21,969 industrial customers, 28,204 government and municipal customers, and 243 other utilities as customers.[R#1]

In 1992 10,687 employees worked for TU Electric, which represents a significant reduction from the 1991 total of 15,262 employees. This large worker reduction was due to a voluntary employee separation program that was part of TU's Competitive Action Plan for restructuring the company. TU now serves 30% more customers with 35% fewer employees than it did ten years ago.[R#1]

**1992 TU ELECTRIC STATISTICS**

| | | |
|---|---|---|
| Number of Customers | 2,213,517 | |
| Energy Sales | 80,322 | GWh |
| Energy Sales Revenues | $4.426 | billion |
| Summer Peak Demand | 17,525 | MW |
| Generating Capacity | 23,000 | MW |
| **Average Electric Rates** | | |
| Residential | 6.88 | ¢/kWh |
| Commercial | 5.68 | ¢/kWh |
| Industrial | 3.73 | ¢/kWh |

During 1992, TU completed a 20-year construction program aimed at diversifying fuel sources and building generating capacity. This process was completed with the licensing of Unit 2 of the Comanche Peak nuclear plant in February 1993.[R#1]

In terms of fuel mix, TU Electric has changed from 100% natural gas in the 1970s to a diversified fuel mix in 1992, with a continually declining gas generation forecast for the future. In 1992, lignite coal accounted for 44% of the electricity provided to customers, natural gas 35%, nuclear power 8%, and purchased power 13%. Almost all the purchased power was supplied under contracts with cogenerators who use natural gas. TU Electric's fuel mix projections for the year 2000 are 43% lignite coal, 31.3% gas/oil, 12% nuclear, 6.5% other types of coal, purchases 4%, and other sources 3.2%.[R#2] ☞

# Utility Overview (continued)

Total MWh sales of 80,322,434 in 1992 were down by 2.5 % from 1991 due to milder than normal weather and a weakened economy. In 1992, the Dallas-Fort Worth area had 1,979 heating degree days and 2,410 cooling degree days. On average this area has 2,407 heating degree days and 2,809 cooling degree days. Thus the 1992 winter was warmer than usual and the summer was cooler than usual. Of the total kWh sales, residential customers purchased 27,266,411 MWh (33.95%), commercial customers bought 22,959,464 MWh (28.58%), industrial customers purchased 21,108,894 MWh (26.28%), sales to government and municipal customers totaled 5,032,780 MWh (6.26%), and sales to other utilities totaled 3,954,885 MWh (4.92%).

Average kWh sales per residential customer totaled 13,329 kWh, with air conditioning being a major contributor to this load. Revenues from electric sales totaled $4,426,357,000. TU Electric has a generating capacity of 23,000 MW and peak demand in 1992 was 17,525 MW, occurring on August 10. The 1992 peak demand was up 3.4% over the 1991 peak demand of 16,952 MW. TU Electric projects that demand will increase 2.1% annually from 1993 to 2002.[R#1]

The Electric Reliability Council of Texas (ERCOT) is comprised of 78 member utilities, including TU Electric, which produce approximately 85% of the electric generation in the state. Member utilities provide mutual aid by buying and selling economy power through their interconnected grid and by supporting each other should one become temporarily short on generation.[R#2]

In 1992, as part of the utility's energy efficiency efforts, TU Electric helped Dallas Habitat for Humanity build 22 homes to Energy Action efficiency standards. Habitat volunteers build and sell quality energy-efficient homes to low-income families. TU also continued the Paint the Town program for the fifth year. More than 8,600 current and former employees and their families participated in 112 projects, helping to weatherize and paint the homes of disadvantaged citizens in the service area.

TU Electric was the first utility to join the Utility Photovoltaic Group, an organization formed in 1992 to increase the use of solar photovoltaics. This coalition of 60 electric utilities, three industry trade associations, and EPRI, promotes utility PV applications that are already economically competitive along with use of the technology for new, larger commercial applications.

Early in 1993 TU Electric announced plans to build Energy Park, a demonstration and test facility for renewable energy resources and other new technologies. The Park will include research on solar and wind technologies, alternative fueled vehicles, and fuel cells. ■

TU Electric formally began its DSM efforts in 1981 with an aggressive goal of reducing demand by 1,000 MW by 1985. According to C.C. Benson, TU's former Manager of Information and Statistics, TU's original demand reduction goal was selected with little experience and insufficient scientific data, and in retrospect, was overly ambitious.[R#3,5]

The goal was met in 1990 when TU achieved 1,018 MW of DSM savings from Energy Action programs and an additional 347 MW of interruptible industrial load contracts. In 1992 TU's Energy Action programs produced peak demand savings of 65 MW. Through 1992 these savings totaled 1,134 MW. Energy Action is the umbrella name for TU's conservation and load management (C&LM) programs.[R#3,5,16]

The 1993 10-year System Integrated Resource Plan forecasts that TU's electricity demand will increase 2.1% ☞

**TU ELECTRIC DSM PROGRAMS**

A) Residential
- 1) Cash Incentive Programs
  - New Single Family
  - Volume Builder Program for New Single Family
  - Existing Single Family
  - New Multifamily
  - Existing Multifamily
  - Room Unit Heat Pumps and Air Conditioners
  - Efficient Electric Water Heaters
- 2) Non-Cash Incentive Programs
  - Efficient HVAC
  - Efficient Electric Water Heaters
- 3) Other Programs
  - New Home Inspection
  - Residential Energy Audits
  - In Concert with the Environment
  - Services for Special Needs Customers Pilot

B) Commercial / Industrial
- 1) Cash Incentive Programs
  - Room Unit Heat Pumps and Air Conditioners
  - Efficient Electric Water Heaters
  - On-Peak Efficiency Improvement
    - Heat Pumps & Air Conditioners
    - Chillers
    - Motors
    - Lighting
    - Structure Thermal Integrity Items
  - On-Peak Load Shift
  - **Thermal Cool Storage**
- 2) Non-Cash Incentive Programs
  - Room Unit Heat Pumps & Air Conditioners
  - Efficient Electric Water Heaters
  - On-Peak Efficiency Improvement
  - Thermal Cool Storage
  - On-Peak Load Shift
- 3) Other Programs
  - Commercial Energy Audits
  - Energy Management for Schools
  - Professional Contact for Architects & Engineers
  - Thermal Cool Storage Pilot
  - DSM Consultant's Fee
  - Environmental Improvement Pilot Program
  - Wholesale Power Pilot

| **DSM Overview** | *Annual DSM Expenditure (x1000)* | *Annual Peak Demand Savings (MW)* |
|---|---|---|
| 1980 | $7,439 | 0 |
| 1981 | $11,250 | 20 |
| 1982 | $23,373 | 94 |
| 1983 | $32,763 | 116 |
| 1984 | $45,683 | 199 |
| 1985 | $22,594 | 139 |
| 1986 | $21,787 | 134 |
| 1987 | $18,966 | 98 |
| 1988 | $12,776 | 119 |
| 1989 | $15,345 | 57 |
| 1990 | $15,533 | 43 |
| 1991 | $19,364 | 51 |
| 1992 | $19,983 | 65 |
| Total | $266,857 | 1134 |

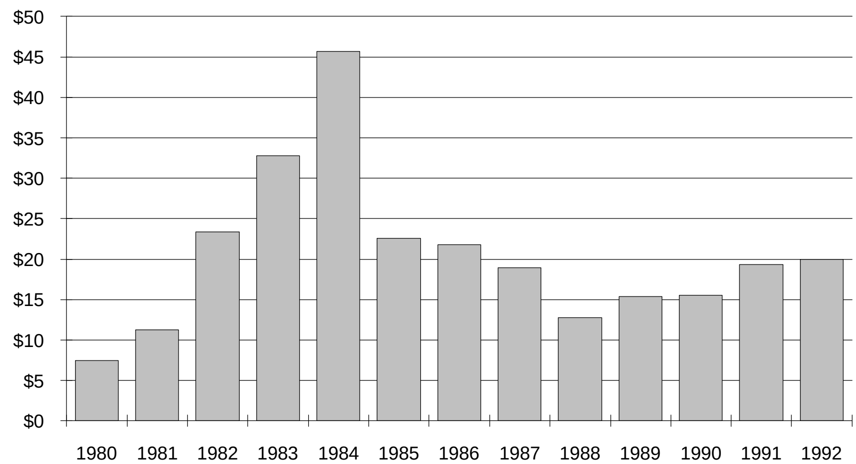
annually from 1993 through 2002. C&LM programs are expected to reduce the increased demand by 1,235 MW or 18% of projected demand increases.[R#1]

TU Electric leads the nation's utilities in the number of customers using thermal cool storage with 205 systems installed to date. TU's Thermal Cool Storage program was the first nonresidential DSM program offered by the utility.

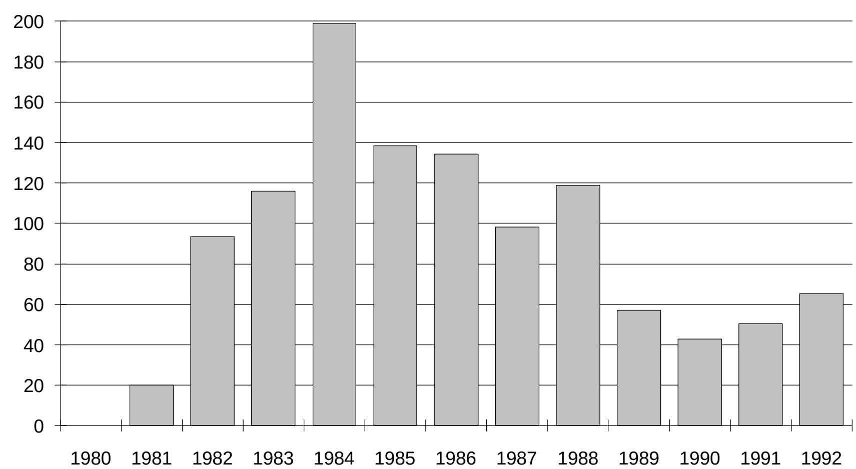
The number of customers using geothermal heat pumps is also increasing. Currently there are 28 nonresidential participants in the geothermal heat pump program and 400 residential participants. Some participants have more than one unit installed.[R#5]

From 1980 through 1992, TU Electric has spent a total of $266,857,000 on DSM activities. In 1992 the utility spent $19,983,000 or 0.45% of 1992 energy sales revenues. DSM expenditures and peak capacity savings were highest in 1984 with expenditures of $45.7 million and peak demand reduction of 199 MW.[R#5] ■

**ANNUAL DSM EXPENDITURE ($1,000,000)**




**ANNUAL PEAK DEMAND SAVINGS (MW)**



TU's Thermal Cool Storage program began full-scale in 1982. At that time there were only three utilities in the United States offering incentives for installing thermal storage systems. Currently there are 53 utilities offering incentives to commercial and industrial customers for thermal storage.[R#14]

Thermal cool storage systems shift demand to off-peak hours reducing TU's peak demand. A thermal cool storage system provides air conditioning or process cooling for commercial or industrial installations by running chillers at night and in the early morning to produce cold water or ice, then storing and using that element to provide cooling for the structure during the hottest part of the day.

TU asserts that thermal cool storage systems, though touted for their load shifting capability also conserve energy at the generation, transmission, distribution and end-use levels. At the generation level, they conserve energy by using electricity at night from baseload plants which generally have a lower heat rate than peaking plants. During nighttime hours, when equipment load is less and ambient temperature has dropped, there are fewer energy losses in transmission and distribution. Nighttime condensing of electric chillers, which operate more effectively when the outdoor temperature is relatively low, may improve chiller efficiency by 5% to 10%. In addition, a properly sized chiller which runs near full load when it is charging or cooling reduces energy consumption approximately 10% annually when compared to a conventional air conditioning system which cycles and operates at part-load. TU's program focuses on peak demand savings and therefore the utility does not track energy savings for its thermal storage program.[R#5]

The Thermal Cool Storage program is part of a group of commercial and industrial cash incentive programs. TU provides cash incentives to customers that install thermal cool storage systems. While the majority of systems installed through the program provide all of the buildings' cooling needs, customers using systems that provide only partial cooling are also eligible.

When the Thermal Cool Storage program began in the early 1980s large office buildings were the most receptive to the program. Developers constructing buildings less than 500,000 square feet were generally not interested in the concept. Before 1986 a typical installation was an office building exceeding 500,000 square feet. By 1986 the construction boom in Dallas was slowing and the number of large construction projects dropped drastically.

During 1987 and 1988 almost twice as many customers installed thermal storage systems as in the previous five years, but the load reduction savings for these two years were approximately half the savings achieved during the previous five years, which indicates a sharp drop in the size of the typical building participating in the program. TU currently encourages the thermal storage concept in most commercial buildings over 50,000 square feet.[R#5,10]

Space cooling and process thermal storage systems have been installed in a wide variety of building types throughout the TU service area including hospitals, hotels, government facilities, churches, schools, food processing plants, and industrial manufacturing facilities. Many of the systems installed have been water systems rather than ice, which is different from most areas of the country.[R#5]

TU Electric does not physically control the loads of customers participating in the Thermal Cool Storage program. Each customer is responsible for ensuring that their thermal cool storage system is off during TU's peak demand period. The types of system controls used by thermal cool storage customers range from simple timers to complex computer systems. Achieving significant savings on the electric bill through reducing peak demand, especially in conjunction with the Time-of-Day rate options provides a very strong incentive for TU thermal storage customers to carefully monitor the operating hours of their thermal cool storage system.[R#5] ■

## THERMAL COOL STORAGE

FUNDAMENTALS:

Thermal cool storage relies on an inexpensive storage medium with a high specific or latent heat (such as water, ice, or eutectic salts) to store cooling produced during off-peak hours for use during peak hours. Refrigeration is provided by conventional chillers or industrial-grade ice-making units which charge the storage tanks during off-peak hours. On-peak cooling is provided by circulating chilled liquid from storage through the building's fan coils or a secondary heat exchanger. The two most common storage designs are chilled water storage and ice storage. Ice storage tanks have much smaller footprints and depths than chilled water tanks of the same cooling capacity.

BACKGROUND:

Cool storage was first used commercially in the 1940s in buildings that only required cooling for limited portions of the day or week such as theaters, churches, and dairies. The goal of these applications was to downsize air conditioning and refrigeration equipment. As the price of air conditioning equipment dropped in the 1950s and 60s and central air conditioning became more popular, the primary incentive for employing cool storage shifted from equipment downsizing to energy cost savings and peak load management.

Thermal cool storage systems can be sized to shift all or part of the building's electrical demand for cooling from peak to off-peak hours. Storage sizing decisions are usually based on economic as opposed to technical factors. Thermal cool storage involves the use of conventional HVAC equipment and a storage tank to shift the period of chiller operation in commercial buildings from peak to off-peak periods. By shifting electricity use to off-peak hours, cool storage benefits both utilities and their customers. Utilities improve load factors and off-peak sales, and customers lower their electric bills.[R#4]

Thermal cool storage helps utilities reduce peak demand and fill load valleys, improving the utilization of baseload generating equipment, reducing reliance on peaking units, and improving load factors. By employing cool storage to stem peak demand growth, utilities can also defer capacity expansion costs.[R#4]

Commercial electric rates typically reflect the utility's cost of generating power which at TU is highest during weekday afternoon peaks. Because conventional air conditioning uses power primarily during peak hours it is a major component of electricity costs. Use of cool storage allows commercial building owners to reduce peak demand and take advantage of the Time-of-Day rate option, thus significantly reducing utility bills.

As space cooling accounts for 30% of commercial sector electricity consumption and 44% of its summer peak demand, it is clear that potential savings from thermal cool storage are very high. High occupancy commercial buildings and other structures with large afternoon cooling "spikes" are the best candidate sites.[R#4]

Cooling systems are typically measured in terms of "ton-hours" which is equal to the number of system tons times the number of hours that the system runs in a typical day. Thus a 3 ton chiller that runs 4 hours a day would require 12 ton-hours of storage. Thermal cool storage systems installed in a retrofit situation typically use the existing chiller. There are additional space requirements with a thermal cool storage system due to the storage tanks. A typical chilled water storage system requires 550 gallons per peak ton shifted, and ice systems typically use 1/4 the storage space of water storage systems. Chilled water storage systems tend to be tall and narrow, while ice systems are usually short and wide. (Note: A "ton" of cooling capacity – 12,000 BTU/h or 3.516 thermal kW – is equivalent to the cooling effect obtained by melting a short ton (2,000 lb of ice in a 24-hour day, without warming the 32°F meltwater): it represents water's latent heat of fusion with no sensible heat added.)

## MARKETING

### MARKETING HISTORY

During the late 1970s the utility recognized the need to address the increasing air conditioning load of commercial buildings. Thermal cool storage was seen as a promising means of flattening commercial air conditioning load shapes. However, initial efforts to interest builders in this technology encountered obstacles, and only a few new buildings included thermal cool storage in their cooling designs. While there were no utility cash incentives in place for thermal cool storage systems, commercial customers received lower electric bills based on their ability to reduce summer peak demand. Cheaper operating and maintenance costs and system efficiencies were the primary reasons for installation of the systems.[R#5]

In 1980 two buildings under construction in Dallas utilized thermal cool storage systems. In addition to these two buildings, two other commercial buildings installed thermal cool storage systems before TU's incentive program was available. Thermal cool storage seemed to be the perfect solution to the utility's load management challenges in this particular sector and the technology has become more widely used throughout TU's service territory due in large part to the company's marketing efforts.[R#5,7]

In 1981 the company realized that offering financial incentives would eliminate many barriers to installation of thermal cool storage systems. These barriers included a high initial system cost, a long payback period, and the large physical size of a thermal cool storage system compared to a standard system. The first thermal cool storage incentive was offered to InterFirst Plaza in Dallas. At the time it was to be the largest (1.8 million square feet) and tallest (72 stories) office building in Dallas. The incentive package included a one-time payment of $150/kW of summer peak demand savings along with a time-of-use demand charge with on-peak hours of noon to 8:00 pm. These incentives became the standard for the Thermal Cool Storage program.[R#5,7]

To increase awareness of the program, presentations were made to architects, engineers, developers, and contractors. During 1982 and 1983, utility representatives made more than 180 presentations to 1,400 people. In 1983, of the commercial square footage with 300 kW demand or more, the thermal cool storage market share of new construction was 18%. By 1984 this figure reached 32%. From 1982-1988 approximately half of the installations were for new buildings, the other half for retrofits. After 1988 approximately 85% of the installations have been for retrofits.[R#5,7]

### MARKETING TODAY

TU Electric focuses on marketing the concept and benefits of thermal cool storage and like most utilities that promote energy-efficient technologies through their DSM programs, TU does not sell any thermal cool storage equipment. For customers who are interested in thermal cool storage, equipment manufacturers present formal proposals that include costs and equipment options. The final decision on choice of equipment is up to the customer.[R#5]

Marketing efforts are geared toward the three predominant parties in the thermal storage decision making process: the developers/owners, engineers, and architects. All three groups must be approached differently because they look at thermal storage from different perspectives. The developer is interested in the cost and payback of the system. The engineer is interested in the technical possibilities and consequences of thermal storage along with equipment options. The architect must be convinced that thermal storage is a worthwhile project enhancement that can be designed into the building.[R#5,8]

TU field representatives market the program to customers and to trade allies (architects, engineers, equipment manufacturers and distributors) who are counted upon to help inform customers of the program. TU field representatives market thermal cool storage by explaining the benefits of thermal cool storage and customer incentives that TU offers.[R#5]

TU also provides customer building audits which include an analysis of various HVAC system types along with system estimated operating costs. TU reps will help the customer determine the payback on a system's cost. Because thermal cool storage is not a widespread technology, TU tries to make several informative contacts with customers to encourage participation.[R#5] ☞

For new construction, effective marketing of thermal cool storage requires that TU initiate discussions as early in the design process of the targeted project as possible. While some potential customers are identified using Dodge data reports which track new residential and non-residential construction on a city-by-city basis, some contacts are initiated by the developers/owners themselves. Many contacts for new construction projects are the result of the company's ongoing relationships with architects and engineers.[R#5]

TU provides interested customers with a folder containing fact sheets and brochures that briefly explain all commercial & industrial cash incentive programs. TU will also arrange for interested customers to make on-site visits to thermal storage installations. Trade allies are informed about the programs through audio/visual presentations as well as program brochures. Periodically, TU sponsors technical training for HVAC dealers, thermal storage system operators, and architects and engineers.[R#5]

## DELIVERY

TU Electric pays cash incentives to qualifying customers to help offset high initial capital expenditures (including associated labor costs) required for the permanent installation of thermal cool storage systems. These systems provide space and/or process cooling during on-peak periods (noon - 8 p.m., weekdays, June through September).

Both new and retrofitted buildings qualify for program incentives. Furthermore, partial storage systems that are expanded to take additional load off-peak receive incentives based on the added kW shifted. In instances where a thermal storage system is intentionally oversized to account for planned future expansion, the customer is eligible for the full cash incentives only upon completion of the expansion.

In 1993, TU Electric's thermal cool storage program offers $250/kW for the first 1,000 kW of shifted demand plus $125/kW for all remaining kW shifted. Incentive payments for 1993 are limited to either the above-mentioned incentive schedule or the customer's capital investment minus one year's estimated electric bill savings, whichever is lower. Qualifying customers must have a payback exceeding one year. Incentive payments are based on shifted demand to off-peak hours. In addition to cash incentives, thermal storage customers may realize additional savings by taking advantage of the Time-of-Day rate option. The Time-of-Day rate option is available to customers who shift electricity use from on-peak hours to off-peak hours.

Currently TU Electric is not planning on providing up-front financing for this program to help customers with high initial system costs. Plans are in the works for other nonresidential and residential programs to include financing mechanisms. It is evident that some potential customers have been discouraged from installing thermal cool storage systems because of their high initial cost. Although TU does not provide equipment loans, some equipment installers do.

Before incentive payments are made, a TU representative verifies the installation of equipment along with the cost of installation. After verification, one half of the incentive payment is made. The remaining incentive payment is made after the end of an entire on-peak (June through September) operating season. The second payment is adjustable, based on the actual kW savings compared to the originally projected kW savings.

Control of the actual operating hours is left up to customers, but customers must follow TU guidelines in order to be eligible for the Time-of-Day rate option.

The actual installation process is rather complex as the building load must be analyzed before thermal cool storage equipment can be sized and installed. It is much easier to analyze building load for new buildings, with the process taking about two weeks. Analyzing load size for existing buildings may take as long as six weeks if no building plans are available and field measurements are required. After load size is determined the equipment manufacturer begins the design process for the thermal cool storage system. Installed systems can either be package or custom, although the large majority are custom. The actual installation of the tanks and complete storage system can take anywhere from a few months to an entire year. The size of the systems installed through the TU program ranges from 20 ton-hours to 25,739 ton-hours, with systems averaging between 3,000 and 4,000 ton-hours.

For customers who participate in the Thermal Cool Storage program, TU also offers a Thermal Storage Pilot program which has been in effect since 1992 and is not retroactive to existing thermal storage installations. This program targets commercial and industrial customers. In 1993 the pilot program offers an additional $50/kW for all kW shifted to customers who agree to operate their thermal storage system on a prearranged schedule on an annual basis. Actual operation of the equipment is determined by the customer's annual internal cooling requirements. During the on-peak months (June through September) the system will be operated in accordance with the Time-of-Day rate option. During the off-peak months (October through May) part or all of the system charging will occur between midnight and 6:00 a.m.

## MEASURES INSTALLED

There are a broad range of thermal cool storage system designs available. There are three basic types of chilled water storage tank systems: thermally stratified, diaphragm, and empty tank. Ice storage systems include ice building systems and ice harvesting systems. Ice building systems come in two types: ice-on-coil and brine systems. Ice harvesting systems also come in two basic types: dynamic ice harvesters and spray slush-ice systems.[R#4]

### SYSTEM DESIGN OPTIONS

**Chilled water storage systems** are basically chilled water air conditioning systems with a storage tank. The main system differences lie in the storage tank types.

Thermally stratified systems rely on the difference in buoyancy between warm and cold water to separate warm water to the top and cold water to the bottom of the storage tank. This system is the simplest and least expensive method of separating warm and chilled water. Because the difference in buoyancy between warm and chilled water is very slight, tank distribution manifolds and laterals must be designed to minimize the turbulence and mixing in the tank.

Diaphragm Systems use a flexible rubberized cloth diaphragm to physically separate warm water and chilled water in the tank. Typically diaphragms divide the tank horizontally, and the diaphragm is usually attached to the tank wall at its midsection and has enough slack to handle a fully chilled or fully warmed tank.

Empty tank systems use multiple tanks to segregate warm and chilled water. By drawing supply water from one tank and routing return water to another, both mixing and heat transfer between warm and chilled water are prevented. Such a system usually consists of three to ten tanks. Successive tanks are emptied as the bank of tanks is charged or discharged. ☞

## CASE STUDY: TEXAS INSTRUMENTS

Texas Instruments (TI), one of TU Electric's major industrial customers, wanted to reduce the operating costs of a 4,200-ton cooling system located at a 1.1 million square foot Electro-Optics manufacturing facility. TU recommended thermal cool storage as the most cost-effective technology. After TU convinced Texas Instruments of the operating efficiency of such a system, TI installed a 24,500 ton-hour naturally stratified cylindrical chilled water storage system. Installation of the system as a retrofit project took 9 1/2 months and was completed in August 1990.

This thermal cool storage system allows TI to reduce its peak demand by 2.9 MW. The system cost Texas Instruments $1.6 million and annual energy bill savings were projected to be $240,000. With the $610,500 incentive paid by TU Electric, TI calculates a simple payback of four years.

"During its first year of operation, the system was 100% reliable, and its performance and savings exceeded our expectations." Don Fiorino, Texas Instruments[R#20]

**Ice Storage systems** come in two basic types: ice building and ice harvesting. Ice building systems form ice directly on coils submerged in water through which a subfreezing fluid is circulated. These system types are either ice-on coil or brine systems.

The ice-on-coil design is an open tank system where ice formation is achieved by submerging the refrigeration unit's evaporation coils or chilled brine coils into the storage tank. During the charging cycle a uniform layer of ice builds up on the exterior surface of the coils. As the ice layer becomes thicker heat removal by the coils decreases and new ice forms more slowly. During the discharge cycle, ice on the outside of the built-up layer adjacent to the tank water melts first as tank water is circulated from storage through the building's fan coils or a secondary heat exchanger.

A brine system is a closed loop system where a circulating glycol/water brine is used for both charging and discharging modular water storage tanks. The charging cycle is similar to an ice-on-coil system. During the space cooling cycle ice on the inside of the built-up layer adjacent to the submerged tubing melts first as unrefrigerated brine is circulated through the tubing to the building's fan coils.

Ice harvesting systems form ice by pumping water or a water/glycol solution through refrigerated tubes or over refrigerated plates. Ice forms on the refrigerated elements and is periodically ejected into a storage tank. There are two types of ice harvesting systems. A dynamic ice harvester uses a water supply and refrigerated plates or tubes suspended above the storage tank for ice generation. A spray slush-ice system is similar, but uses a water/glycol solution and refrigerated tubes to generate an icy slush. In the discharge cycle of both systems, ice cold water or solution from the bottom of the tank is circulated through the building's fan coils or secondary heat exchanger.[R#4]

## STAFFING REQUIREMENTS

The Thermal Cool Storage program is managed by Dallas Frandsen, TU Electric Director of Conservation and Load Management; Price Robertson, Manager of DSM Evaluation and Regulatory Support; and Art Ekholm, Manager of Market Research. Don Simpson, Manager of Program Development, oversees seven Segment Managers and one staff engineer. Janet Freeman is the Market Segment Manager responsible for the Thermal Cool Storage program in addition to several other programs. There are also two corporate Technical Services employees and one Corporate Accounts employee who devote considerable time to the program.[R#5]

TU field employees (Managers, Account Managers and Customer Service Representatives) comprise the bulk of the total estimated 15 FTEs (full time equivalents) devoted to the program. Field employees make the sales calls, market the program, perform the on-site inspections, report the results and issue the incentives. TU also has many trade allies who help market the program. A partial list of allies is often provided to customers which includes 9 architects and engineers and 13 equipment vendors.[R#5] ■

## CASE STUDY: HAGGAR APPAREL MANUFACTURING COMPANY

In 1983 the Haggar Company of Dallas, Texas installed a thermal storage system to cool their 73,000 square foot manufacturing facility. Converting to thermal storage cost Haggar $89,500, and TU Electric paid a cash incentive of $58,100 for a net cost to Haggar of $31,400. Haggar had annual savings of $9,100, creating a simple payback period of 3.5 years.

Four storage tanks, each 20 feet in diameter and 13 feet high hold a total of 112,000 gallons of 40°F water. Nighttime operation of the system is fully automatic with remote control back-up, and no nighttime operator is necessary. Haggar elected to place their tanks above ground. For buildings where space is scarce or at a premium these tanks are usually placed below ground.

Haggar's thermal storage system has reduced their estimated summer peak demand of 483 kW by an estimated 166 kW.[R#15]

## MONITORING

Initial customer incentives are based on calculated kW savings derived from engineering estimates and the EPRI/ EEI micro\AXCESS Building Energy Analysis software which provides an hourly simulation of thermal storage systems. Typically, building owners also have a mechanical design engineer perform an evaluation of the optimal cooling system for the building. The kW savings estimates are used for the initial expected program results.[R#5]

Installation of thermal cool storage systems is confirmed by TU Account Managers before the first half of incentive payments are made. TU representatives field check to see that the equipment is installed, verify completion of installation with the installer, and visit with the customer to ensure that the system is functioning properly. TU does not perform an in-depth technical analysis of the system's function.[R#5]

Most program participants exercise the Time-of-Day rate option. Customers using this rate option have a meter that monitors on-peak energy use. TU does have a few thermal storage customers that are not on the Time-of-Day rate option. Some customers with partial storage systems may benefit from reduced peak demand, but not from the rate option. Currently some school systems do not qualify for this rate option because they are not on a rate with a demand charge, but downsizing chillers and reduced maintenance costs help make these systems cost effective even without the rate. Possible future demand charges for schools will make thermal storage and the Time-of-Day rate option even more attractive for schools.[R#5]

Discussions with customers, review of customer billing histories, and analysis of LODESTAR customer load profiles obtained from recording meters at customers' premises are used to help verify the amount of kW reduction for the final customer payment.[R#5]

TU monitors the program with an in-house developed computer program (LMRS - Load Management Reporting System) that tracks each project including the facility name, location, square footage of building cooled by the thermal storage system, kW reduced, type of system, date of installation, plus many other items. The LMRS program is on a mainframe computer using Application Systems software. Field employees perform the data entry for corporate tracking and reporting. The company plans to review the current tracking program and consider purchasing a more flexible tracking program from an outside source.[R#5]

## EVALUATION

TU Electric is required by the Texas PUC to perform program impact evaluations. These evaluations include four types of cost/benefit analyses (TRC, revenue requirements, rate impact, and participant) for three general system sizes. TU must also file an Integrated Resource Plan each year and an Energy Efficiency Plan every two years with the Commission.

The micro-AXCESS computer model, used to estimate the impact of each program participant on system load, is also used throughout the year to assist in program design and development, and program forecasts. Customer billing histories and analysis of LODESTAR customer load profiles are used to help verify and evaluate program results.[R#5]

The LMRS computer tracking program and marketing reports are used to evaluate company and program performance. Program parameters such as incentive dollars and participation requirements are evaluated at least on an annual basis. Programs are adjusted based on the level of participation and efficiency improvements found in the market place through surveys, discussions with contractors and trade allies, equipment availability, actual equipment inspections, etc.[R#5]

Process evaluations are conducted regularly on each program through meetings between DSM program administrators, field implementation personnel, dealers, builders, architects, contractors, building consultants, building owners, and building operators.

Several marketing reports have been written which evaluate the successes, failures, and lessons learned from the marketing efforts that have been used since the beginning of the program.[R#7,8,10,11] ■

# Program Savings

Through 1992, TU Electric's thermal cool storage program had accumulated peak demand savings of 70,498 kW. Facilities joining the program in 1992 account for 5,100 kW in peak demand savings. Facilities joining the program in 1991 were responsible for 12,278 kW of peak demand savings, the most for any year of the program. The year with the lowest peak demand savings was 1986 with 1,075 kW.

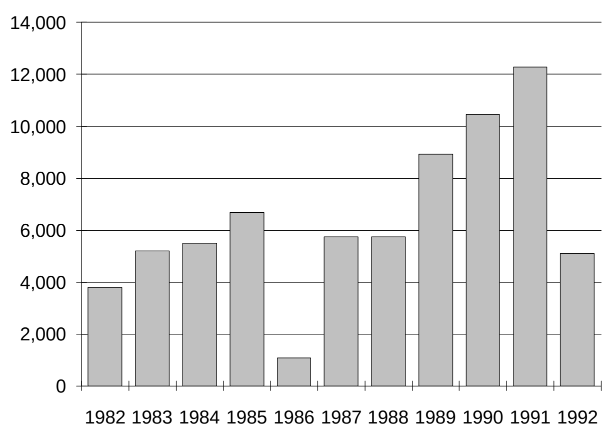
## PARTICIPATION RATES

"Participants" refers to qualifying Energy Action program participants who install full or partial thermal storage systems. Initial program participation was low during the first several years of the program in terms of the number of projects, with 27 thermal storage projects joining the program from 1982 through 1986. However, in terms of square footage, these buildings were very large on average and accounted for 22,255 kW in peak demand reductions, which is approximately 32% of total program savings.

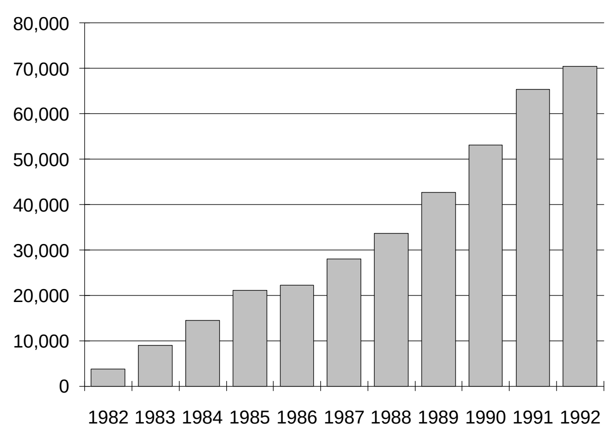
To date there are 205 participants in the program with 25 buildings joining the program in 1992. The year with

| **Savings Overview Table** | *Annual Peak Demand Savings (kW)* | *Cumulative Peak Demand Savings (kW)* |
|---|---|---|
| 1982 | 3,790 | 3,790 |
| 1983 | 5,206 | 8,996 |
| 1984 | 5,496 | 14,492 |
| 1985 | 6,688 | 21,180 |
| 1986 | 1,075 | 22,255 |
| 1987 | 5,735 | 27,990 |
| 1988 | 5,749 | 33,739 |
| 1989 | 8,926 | 42,665 |
| 1990 | 10,455 | 53,120 |
| 1991 | 12,278 | 65,398 |
| 1992 | 5,100 | 70,498 |
| Total | 70,498 | |

**ANNUAL PEAK DEMAND SAVINGS (kW)**




**CUMULATIVE PEAK DEMAND SAVINGS (kW)**



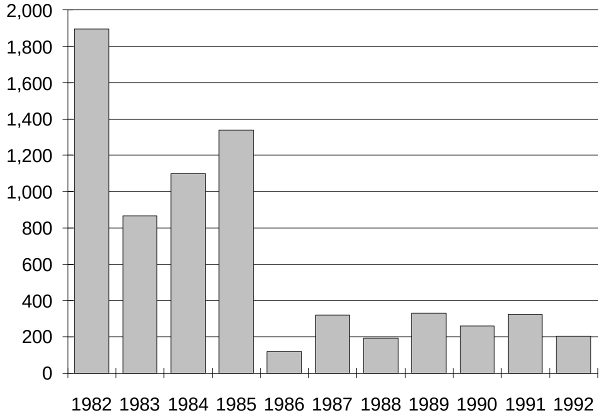

Data Alert: Thermal storage participation is an ongoing process. Peak reduction reporting is done in two parts: the initial kW savings are reported upon equipment installation and the final kW savings are reported after completion of an on-peak season. Because year-end reports state results on a given date, a portion of the annual kW reported for any given year may reflect savings from projects started in prior years and a portion of the kW from new participants in the current report year with the final kW achieved by prior or current year participants reported in subsequent years.[R#5]

| Participation Table | *Participants* | *Annual Peak Demand Savings per Participant (kW)* |
|---|---|---|
| 1982 | 2 | 1,895 |
| 1983 | 6 | 868 |
| 1984 | 5 | 1,099 |
| 1985 | 5 | 1,338 |
| 1986 | 9 | 119 |
| 1987 | 18 | 319 |
| 1988 | 30 | 192 |
| 1989 | 27 | 331 |
| 1990 | 40 | 261 |
| 1991 | 38 | 323 |
| 1992 | 25 | 204 |
| Total | 205 | |

the greatest number of new participants was 1990 with 40 buildings. TU has more thermal cool storage customers than any other utility in the country.

Peak demand reductions per participant have fluctuated greatly over the lifetime of the program. In 1982 peak demand savings per participant were at their highest level with 1,895 kW saved per participant although there were only two participants. Savings per participant were lowest in 1986 at 119 kW. In 1992 peak demand savings per participant totaled 204 kW.

**ANNUAL PEAK DEMAND SAVINGS PER PARTICIPANT (kW)**




## FREE RIDERSHIP

Free ridership is not an issue with this program. Thermal cool storage is not yet a widespread technology. The high initial system costs and TU's relatively low utility demand charges reduce the likelihood of installation in the absence of a utility cash incentive. The cash incentive is usually needed to help achieve an acceptable payback.[R#5]

To date a total of eight Thermal Cool Storage program participants have installed systems without cash incentives, participating in TU Electric's Non-Cash Incentive Thermal Storage program. These consist of four installations prior to the company's incentive package, three TU company facilities, and one process storage installation with a payback less than one year.[R#5]

## MEASURE LIFETIME

TU Electric assigns a 30-year lifetime to thermal cool storage systems.

## PROJECTED SAVINGS & PARTICIPATION

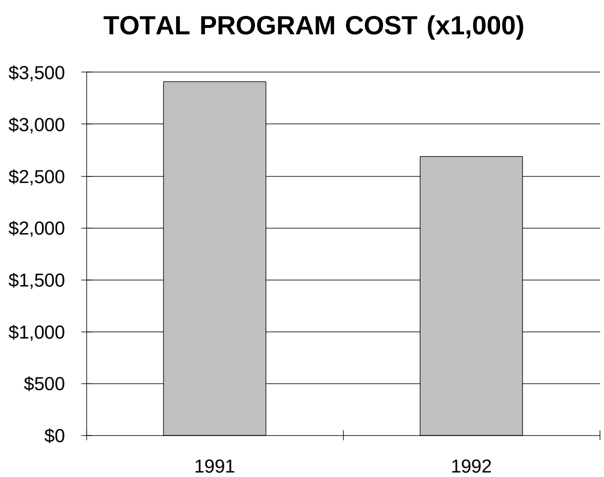
TU Electric has not projected the maximum achievable customer participation. The 1993 ten-year load management forecast predicts an additional 234 participants by the year 2002. The goal for 1993 is 25 participants. In 1992, the 25 new participants exceeded the forecast of 14 participants.[R#5]

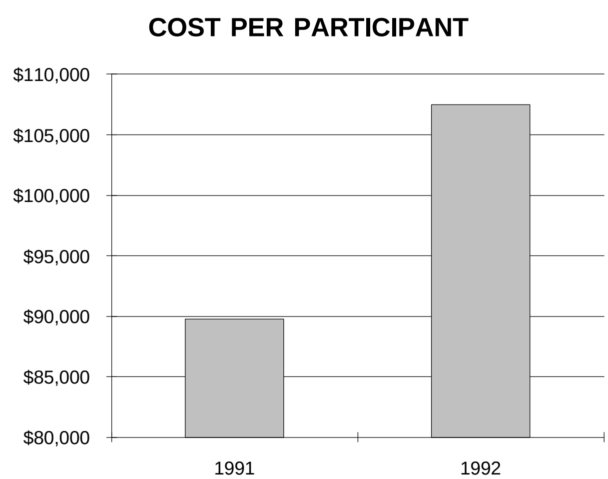
Prior to 1985, DSM savings goals were not broken down by program. The first load forecast was made for the Thermal Cool Storage program in 1985. With a three year savings history of almost 15 MW for only 13 participants, TU Electric's ten-year load management forecast predicted additional thermal storage installations at a rate of approximately 15 MW per year. The mid 1980s was a period of rapid commercial construction and expansion and TU experienced the largest single year increase in the number of electric customers in 1984.[R#5]

The 1993 System Resource Plan forecasts additional thermal storage installations at a rate of about 7 MW per year. In addition to 70.5 MW saved through 1992, an additional 73 MW of savings is forecasted by 2002. The goal for 1993 is to reduce peak demand by 8 MW with thermal cool storage. TU Electric exceeded its 1992 goal of 3.9 MW by achieving 5.1 MW of peak demand savings.[R#5] ■

# Cost of the Program

| Costs Overview Table | Cash Incentives (x1000) | Corporate Labor (x1000) | Overhead (x1000) | Field Labor (x1000) | Total Program Cost (x1000) | Cost per Participant |
|---|---|---|---|---|---|---|
| 1991 | $2,743.1 | $266.3 | $5.8 | $396.0 | $3,411.2 | $89,767.84 |
| 1992 | $1,745.6 | $242.8 | $4.3 | $694.4 | $2,687.0 | $107,481.25 |
| Total | $4,488.7 | $509.0 | $10.1 | $1,090.4 | $6,098.2 | |




Data Alert: Although the Thermal Cool Storage program formally began in 1982, TU did not track specific program costs until 1991. Prior to 1991 the utility tracked its total DSM costs without breaking out costs by specific programs.

In 1991 TU Electric spent $3,411,200 on the Thermal Cool Storage program and in 1992 program expenditures dropped to $2,687,000. Program costs for 1991 and 1992 total $6,098,200.

## COST EFFECTIVENESS

The Results Center calculates that TU spent $278/kW shifted in 1991 and $527/kW shifted in 1992. The average for this two year period was $351/kW. These figures compare favorably to $664/kW which would have been TU Electric's 1992 capital cost (plus O&M costs) to build an off-the-shelf combined cycle combustion turbine (CCCT) including an 18% simple cycle reserve margin. A CCCT is the next plant to be built according to TU Electric's current System Resource Plan.

## COST PER PARTICIPANT

The utility's cost per participant was $89,768 in 1991 and increased to $107,481 in 1992.

## COST COMPONENTS

The majority of program expenses (74%) went towards customer incentives. In 1991 TU spent $2,743,100 on incentives and in 1992 spent $1,745,600 on incentives for a total of $4,488,700. Corporate labor costs for the program totaled $509,000 with $266,300 spent in 1991 and $242,800 spent in 1992. Overhead program costs total $10,100. In 1991 field labor costs were $396,000 and rose to $694,400 in 1992 for a program total of $1,090,400. The increase in field labor costs was due to the reorganization of the utility's accounting procedures, not an increase in salaries or the number of employees.[R#5] ■

## LESSONS LEARNED

TU Electric reports that decisions must often be made quickly on incentive approvals for program participants, and the process must not be too complex. It is critical not to lose potential customers by having a slow decision making process. A standard process is in place at TU in which a technical services representative checks the building's engineering study to determine the kW reduction on which incentives will be based. The program provides standards for incentives and qualifiers for participation.

TU encourages thermal storage systems by being flexible with the Time-of-Day rate option in certain cases. To avoid potential new building start-up problems with chillers operating during on-peak hours, customers can sign up for the Time-of-Day rate option after the building is judged to be operating properly, and any previous on-peak demand is ignored. Occasionally a customer has a technical problem with their system, and they are making an expedient effort to fix the problem. If the utility is notified immediately, TU will evaluate waiving the demand requirements for that time period. TU does not want customers to lose a year of savings because of an unpredictable mechanical problem.[R#5,12]

Thermal cool storage may provide developers with an edge over the competition. In the Dallas area, because there is greater supply than demand within the commercial real estate market and thus a high vacancy rate, there is a great deal of competition for tenants. As a result, thermal storage is thus attractive because it lowers building operating costs, and renters will have lower electric bills.[R#5]

TU has found that developers are willing to consider thermal storage systems even though the initial cost is higher than conventional HVAC systems. This is due to market conditions in the service territory and because electricity rates are at high enough levels to cause developers to look at alternative systems.[R#11]

In terms of influencing project decision-makers, TU has found that engineers (typically mechanical design engineers hired by the building owner, but occasionally facilities managers) are the most influential and supportive of thermal storage technology because of their understanding of equipment performance and energy costs in a given area.[R#11]

Interestingly, the most energy-efficient thermal cool storage system available is not always the system chosen by the customer. Important factors affecting this decision include system sizing requirements, customer space availability, system complexity, and maintenance needs.

The biggest barriers to participation are a lack of awareness of thermal storage technology and lack of awareness that TU offers incentives for thermal storage installations. Proper marketing has been the key to the success of TU's program.[R#10]

In retrospect, TU Electric believes it was lucky to begin the program with a small number of very large projects. This gave the utility lots of implementation experience in a short period of time, not to mention lots of data.

## TRANSFERABILITY

For other utilities interested in starting a similar program, they should bear in mind that greater overall energy savings may be achieved by encouraging program participants to minimize their load through energy efficiency improvements in their building. With the TU program thermal storage systems are sized to the existing building load. While the TU program does shift the cooling load, it does not achieve all possible energy savings.[R#19]

If thermal cool storage customers are encouraged to reduce their total load with more efficient lighting, better thermal integrity of the building shell, and more efficient HVAC equipment, the total load reduction may downsize the thermal storage system to a degree that would cover ☞

the cost of most of the efficiency improvements. Without considering all aspects of energy savings, customers who add energy-efficiency improvements in the future which lower the HVAC load are still left with the embedded cost of the storage system.[R#19]

TU has several recommendations for other utilities implementing a similar program:

Develop and adequately train company employees in both technology and professional sales techniques. Credibility is essential, especially with architects and engineers.

Work closely with trade allies such as equipment manufacturers and building engineers to ensure program success.

Have periodic seminars for architects, consulting engineers, and contractors about thermal storage. TU Electric helps to host periodic architects and engineers conferences where thermal storage is one of the discussion topics.

Have an annual seminar for thermal storage operators where problems, solutions, and successes are discussed. This was done at TU in the early years of the program.

When designing a program, incentives should only be offered to projects having a payback of greater than one year.

Be prepared to adjust $/kW incentives. Throughout the course of the program TU has made several adjustments to their incentives in an attempt to achieve maximum participation. The initial $150/kW was not enough to move the market. In 1984, the incentive was increased to $250/kW for the first 500 kW shifted and $115 for all remaining kW shifted. The incentive was raised in 1987 to $350/kW for the first 200 kW shifted (with a four tier declining $/kW incentive) enabling many smaller customers to participate. After kW demand charges increased in 1991, TU reduced the incentive to $250/kW for the first 500 kW shifted and $125/kW for all remaining kW shifted. To increase the incentive dollars to help offset the high initial costs of very large customers, TU adjusted the incentive in 1993 to $250/kW for the first 1,000 kW shifted with $125/kW for all remaining kW shifted.

A solid computer database is critical. TU's program database allows TU to share program information with other interested utilities as well as provide data to marketing representatives to share with potential customers. Such a database also helps employees in market research and program development determine a future course of action.[R#5] ■

Traditional utility ratemaking, where each and every kilowatt-hour sold provides profit, is a major barrier to utilities' implementation of energy efficiency programs. Several state regulatory commissions and their investor-owned utilities have been pioneers in reforming ratemaking to a) remove the disincentives in utility investment in DSM programs, and b) to provide direct and pronounced incentives so that every marginal dollar spent on DSM provides a more attractive return than the same dollar spent on supply-side resources.

The purpose of this section is to briefly present exciting and innovative incentive ratemaking mechanisms where they're applied. This we trust, will not only provide some understanding to the reader of the context within which the DSM program profiled herein is implemented, but the series of these sections will provide useful snapshots of incentive mechanisms being used and tested across the United States.

### THE TEXAS OVERVIEW

While Texas has had statutory provisions for integrated resource planning and shareholder incentives for superior performance, Texas does not have integrated resource planning in statutes at this point in time. The PUC has the authority to formulate an integrated resource planning rule and is proceeding with developing such a rule. The Texas Public Utility Regulatory Act (PURA) allows the Commission to adjust the rate of return of a utility upward or downward to reward or penalize a utility for its accomplishments, or lack thereof, in the conservation of resources.[R#17,21]

A number of unique factors in Texas have influenced the state's utilities' emphases on demand-side management. First and foremost is the state's capacity situation. Delays in the construction of the Comanche Peak nuclear plant, paired with the economic expansion of the early 1980s, probably prompted TU to invest heavily in energy efficiency in those years. TU Electric's DSM savings achievement decreased steadily after 1985 and have remained steady in the last three years. (HL&P was experiencing similar delays with the South Texas Nuclear Project and this may have motivated its aggressive DSM programs of the early 1980s.)[R#21]

In the early and mid 1980s both TU and HL&P were investing heavily in energy-efficient air conditioning by providing rebates to their customers. In fact, until the Comanche Peak nuclear units came on line in 1990 and 1993, the state's utilities were aggressively purchasing power from qualifying facilities, building peaking turbines, and making substantial DSM investments. From 1986-1989 the recession in Texas curtailed the utilities needs to invest in DSM and TU's investments in DSM fell from a high of approximately $25 million per year to $10-12 million per year.

### INTEGRATED RESOURCE PLANNING IN TEXAS

The framework for electric resource planning in Texas was established by statute in 1980 and amended in 1983. The enabling legislation, the Texas Public Utility Regulatory Act, requires the Commission to develop a statewide forecast of loads and resources every two years. Utilities are required to submit service area forecasts and resource plans every two years. Thus the resource planning process is implemented through a combination of forecasting, resource planning, avoided cost solicitation, energy efficiency planning, and power plant licensing procedures.[R#17]

The Texas Commission has recently been conducting forums on integrated resource planning (IRP), environmental externalities, avoided costs, and transmission access. Unlike other regulatory forums and dockets, these forums have been attended by a number of intervenors anxious to scrap most of the existing DSM efforts which tend to focus on load management, and more aggressively promote energy efficiency in Texas. (In February 1993 the Commission also conducted a public forum on renewable resources.) ☞

IRP legislation was introduced into the State legislature in February 1993 that would have enhanced the Commission's authority and ability to promote energy efficiency. While the Texas legislature has allowed the Commission to adjust utilities' entire rate of return based on five general factors, including quality of service and DSM performance, the proposed legislation would have allowed the Commission to be more responsive to DSM incentives. For instance, currently the utility's rate of return can only be adjusted at the time of a rate case. The legislation would have allowed for monthly adjustments based on actual DSM performance but was dropped in the "eleventh hour." Despite the setback, the Commission plans to move forward with IRP in the absence of the legislation as many other states have done.[R#18]

#### TREATMENT OF DSM EXPENDITURES

State regulations developed in 1984 allow utilities in Texas to expense or capitalize their DSM expenditures. To date most expenditures have been expensed. For instance, in 1990 TU sought recovery of $12.9 million for its DSM efforts. The Commission allowed the utility to expense the entire amount. In the current rate case, TU is asking to recover $18.8 million. In addition, the utility wants to capitalize (ratebase) $4 million.

#### TREATMENT OF LOST REVENUES

Currently the state has no provision either in state statutes or regulations for recovery of lost revenues associated with demand-side management and TU Electric in its current rate case has not asked for this provision. Texas PUC staff notes that a focus on lost revenues opens up "a can of worms." If the company is to be compensated for lost revenues associated with DSM initiatives, shouldn't the Commission try to assess the revenues gained from TU's promotional efforts related to electricity sales? Note that in Texas, declining block residential rates are still the norm, so are bypass prevention rates, economic development rates, and fuel switching via the promotion of heat pumps. In short, the Commission cannot reward the utility for lost revenues without a careful accounting and analysis of gained revenues.[R#18]

A second issue surrounding lost revenues is quite basic for TU. Most of TU's DSM efforts have been focused on load management, not energy conservation. Thus proportionately, there have been few lost revenues associated with the utility's expenditures.

While TU has not requested a lost revenue adjustment, it has proposed a unique ratemaking treatment. In its current rate case TU Electric has requested an operations and maintenance adjustment based on "lost profits" associated with DSM. The company is trying to recover the profits it would have realized as a result of building the combustion turbines it would have needed in the absence of load management programs. What TU is seeking to recover is the profit from the return on equity that it would have had if it had built power plants rather than investing in DSM. Commission response to this proposal is pending and in addition to the $18.8 million being sought for recovery by TU, $3.4 million is related to this "lost profits" provision.[R#17,18,21]

#### SHAREHOLDER INCENTIVES FOR DSM PERFORMANCE

As stated to above, the Public Utility Commission of Texas has the statutory authority to award a higher or lower overall rate of return on invested capital for "the efforts and achievements in the conservation of resources" and "efforts to comply with the statewide energy plan" and three other parameters. This provision has been applied three times by the Commission to adjust utilities' rate of return. One of the three times the Commission adjusted a utility's rate of return upwards. This happened in 1991 when TU was awarded $6.2 million, or 15 basis points ROE, for commendable peak demand reductions. (A basis point is one hundredth of a percent.) Downward adjustments have been made twice in the state, once in 1986 with Houston Lighting and Power and another time in 1988 with El Paso Electric Company. ■

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