# OPPORTUNITIES FOR ENERGY EFFICIENCY IN THE TEXAS INDUSTRIAL SECTOR

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## INTRODUCTION

The 1990s are witnessing renewed interest in energy efficiency in Texas. With declining oil production, the state's traditional role as a net exporter of energy is in jeopardy. Meanwhile, the demand for electricity continues to grow, eroding the surplus generating capacity that Texas enjoyed in the 1980s. Energy efficiency is hailed by many as a cost-effective approach to offset the need to construct additional electricity generating facilities, address some of the state's environmental problems, and maintain a competitive industrial posture in the global marketplace.

Energy efficiency can provide a variety of benefits to industry and society. Reduced spending on energy resources can improve industry's profitability. Additionally, energy-efficient lights and temperature controls often improve work environment quality and enhance productivity. Society benefits as reduced energy use can curb the production of air, land, and water polluting emissions. Consuming less energy may reduce dependence on imported energy. Also, energy efficient industrial processes also tend to be more efficient in other ways, requiring lower quantities of raw materials and producing less waste at the end of the process.

However, efforts to promote energy efficiency in the industrial sector face many obstacles. Industrial firms tend to apply relatively high discount rates and require very short payback periods to investments designed purely to capture energy savings. Budget constraints, lack of information about new technologies, uncertainty about future energy costs, manpower constraints, and high initial costs for detailed "process integration studies" are among the major reasons cited for not implementing energy conservation projects. The investment decision-making process in industrial firms can be very complex and time-consuming, and energy efficiency projects must compete with other opportunities. Recent surveys confirm that management attention is presently focused in areas other than energy efficiency.

Since the 1970s, industry in Texas has done much to reduce its "energy intensity" (energy requirements per unit of output) by adopting more energy efficient technologies and processes.[1] Yet a number of further actions can be taken by the state's industrial energy consumers. The state's policy makers, regulators, and utilities can also play a vital role by taking steps to improve energy pricing, offer more effective demand-side management (DSM) programs, ensure that services and tariffs are available to satisfy industry's emerging energy needs, remove barriers to the development of economical cogeneration projects, promote technology transfer between the state's universities and industries, and encourage education and training on energy issues. Any initiatives to restructure energy markets must recognize the unique needs of industry.

### Impetus For This Study

In Texas, industrial facilities account for nearly 40% of the state's electricity consumption[2] and more than 46% of the non-utility fossil fuel use.[3] The non-utility industrial sector also generates well over 10% of the electrical power used in Texas.[4] Thus, the Texas industrial sector has a vital role to play in the state's pursuit of energy efficiency.

In light of the re-examination of regulatory policies presently taking place in Texas and other states, an assessment of energy efficiency opportunities in the state's industrial sector is particularly timely. Electric utilities, natural gas pipelines, and other energy suppliers have important impacts on energy use in the industrial sector through their pricing practices, marketing or conservation efforts, operations, and resource planning decisions. Changes in tariffs, DSM programs, and regulatory requirements can significantly affect energy requirements, energy prices, usage patterns, industrial production costs, and the need for additional electrical generating capacity. Efforts to promote integrated resource planning, DSM programs, and tariff reform will benefit from this recognition.

**Objectives**

Despite the importance of the industrial sector in Texas' energy market, there was previously little reliable information regarding the potential for industrial energy efficiency improvements. This lack of knowledge has hindered government and utility efforts to encourage industry to capture its full energy efficiency potential. In response to this concern, the Sustainable Energy Development Council of Texas (SEDC) commissioned this study[2] to explore opportunities to promote cost-effective energy efficiency in Texas' industrial sector. The SEDC is a state agency committed to identifying and promoting energy efficiency and renewable energy resources in Texas.

Within the full study, specific energy efficiency measures in key energy-intensive industries are identified and potential energy savings are quantified. Typical economic payback periods for certain types of measures are also estimated. Means of exploiting the potential savings are also addressed. In pursuit of these objectives, the full study also discusses energy usage and waste heat patterns for key industries in Texas, fuel-switching options, cogeneration, and an overview of future manufacturing techniques and energy requirements.

Further, this study complements recent preliminary analyses of energy efficiency opportunities in the residential and commercial sectors to provide a more comprehensive estimate of the state's total potential demand-side resources.[3]

It is hoped that the results of this analysis will contribute to the formulation of effective state energy policies, the design of cost-effective DSM strategies, improved energy tariffs and, ultimately, economic and environmental benefits to Texas, the nation's leading state in energy consumption.

## APPROACH

Estimating the technical, economic, and achievable potential for energy efficiency in the state's industrial sector is particularly challenging because:

- Industrial facilities, processes, and equipment exhibit great diversity.
- Specific industrial processes and equipment data are usually proprietary and difficult to obtain.
- Given the fast pace of technological change, data and savings estimates can quickly become obsolete.

To meet this challenge in the short time frame required, Planergy Inc. led a project team of several consulting firms and individuals, including Linnhoff March, Inc.; Barakat & Chamberlin, Inc.; Philip Schmidt of the University of Texas at Austin; F. T. Sparrow of Purdue University; and Milt Williams of Energy Management Consultants. Neal Elliott of the American Council for an Energy Efficient Economy provided invaluable technical assistance throughout the project.

**Establishing the Baseline**

A profile of present industrial usage patterns was developed from proprietary databases, billing data provided by the state's electric utilities, information filed at the Public Utility Commission of Texas, and other sources. The baseline provides the present energy requirements of various industries and energy end-uses. Baseline energy usage projections were developed from economic-demographic projections. Adjustments were made to the electricity projections to account for the impact of new national efficiency standards for motors and lighting equipment.

To provide accurate and tenable estimates of potential energy and cost savings, the state's energy-intensive manufacturing activities were divided into two categories: *process* operations and *fabrication/assembly* activities. Oil and gas pumping, an electricity-intensive mining industry, was addressed separately. The approach for each of these sections is outlined below.

**Process Operations**

The process industries involve chemical conversion of new materials into products. The industry groups involved in process operations are chemicals; petroleum refining; food and kindred products; pulp and paper; rubber and plastic products; stone, shell, clay, glass, and concrete products; and primary metals. The manufacturing processes themselves are characterized by reactions, separations, and heat transfer, all of which are driven by thermal energy. The use of electrical energy in these industries is primarily for mechanical transport (pumping, conveying, blowing), although some is also used for providing process cooling capability in the form of cooling water circulation and refrigeration. As a consequence, improvements in process energy efficiency tend to save fossil fuel consumption rather than electrical power consumption.

There are three main approaches for improving process energy efficiency: monitoring and targeting (M&T), process integration, and advanced controls. M&T is the easiest to undertake, with typical improvements of 5-10%. The technique relies on an empirical observation that operators focus attention on areas measured by management. Usually, only minimal capital investment is required, and so the paybacks tend to be very short. For this analysis, it has been assumed that the majority of Texas industries have already exploited the energy savings potential using the M&T approach and that very little further savings are possible. It has also been assumed that the total potential savings from Advanced Controls will be small, as the majority of the large petrochemical complexes already have such systems in place. The major remaining scope for energy savings, therefore, lies in the area of process integration.

Process integration involves reducing the inherent energy requirement of the process by a combination of process modifications, increased heat recovery, and optimization of the site utility system. The most powerful method for identifying process integration opportunities is "pinch analysis." Pinch analysis takes its name from a key thermodynamic constraint, or "pinch," that limits heat recovery and energy efficiency, which is characteristic of all thermally driven processes. This technique can simultaneously evaluate heating and cooling energy requirements in conjunction with analyzing the potential benefits of cogeneration or heat pumping.[4]

Linnhoff March, Inc. has conducted over 300 studies at industrial facilities around the world, including Texas. Relevant previous studies were reviewed and their results were extrapolated to estimate the potential energy savings. In this analysis, greater consideration was given to previous studies of facilities with similarities to those in Texas. Consequently, detailed estimates of potential energy savings for facilities with similar product mixes and geographical similarities were given greater weight in the extrapolation process.

The estimates of percentage energy savings developed from a review of previous pinch technology studies were applied to baseline energy use data and baseline product mix and production levels for each industry. The baseline product mix and production level data were derived from a variety of sources, including industry surveys; research and trade publications; and data bases provided by private companies and utilities, in particular the Directory of Natural Gas Consumers developed by Energy Planning, Inc.

**Fabrication and Assembly Activities**

The fabrication and assembly activities transform base or intermediate products into consumer or producer goods. Technology, as opposed to raw materials or energy inputs, is the main source of value-added in these activities. While fossil fuels are used extensively for space heating and water heating, electricity use dominates the fabrication and assembly activities' energy consumption. The main industry groups involved in fabrication and assembly activities are food and kindred products; pulp and paper; chemicals; petroleum refining; rubber and plastic products; stone, shell, clay, glass, and concrete products; primary metals; fabricated metals; machinery and computers; electrical and electronic machinery; and transportation equipment.

In the fabrication and assembly activities, there are several generic energy efficiency measures or technologies which apply broadly across all industry segments and vary little between specific industries. Forty-four generic energy efficiency measures were examined for potential energy savings.

To identify the energy efficiency opportunities tailored to specific industries and applications, energy efficiency profiles were developed for each industry that describe the number of firms in the segment, average firm size, typical operating characteristics, process flows, growth prospects, anticipated structural changes, and technological changes.

Energy savings intensities were developed for each end use and each targeted industry from extensive descriptive data on both generic and site-specific energy efficiency technologies. Due to the complex processes associated with the profiled industries, energy savings intensities blended savings associated with generic measures along with industry-specific opportunities described in the energy-efficiency profiles. Industry-specific opportunities resulting from the energy savings intensities were then reviewed, and both instantaneous and phase-in technical potential estimates were developed.

Achievable potential estimates, based on market penetration rates, were also determined. Since little primary data exists to support Texas-specific market penetration rates, secondary data from national sources were relied upon.

**Oil and Gas Pumping**

The oil and gas extraction group, dominated by oil and gas pumping, is the second leading industrial electricity consumer in Texas. This industry group uses roughly 20,000 GWh of electricity a year. An extensive literature search was conducted to identify electricity conservation measures in oil and gas production.

## RESULTS

This study determined potential savings estimates for energy-intensive industries in Texas. Three types of savings potential were identified:

- Technical potential: the energy savings feasible through existing technology and practices without regard to cost-effectiveness or other impediments.
- Economic potential: the energy savings that can be obtained through cost-effective means, not considering other barriers. Energy efficiency opportunities have been included in the economic potential category if they have a three year or less payback period (if the energy cost savings pay for the investment costs within three years).
- Achievable potential: the energy savings that could be reasonably achieved considering the availability of current technology, cost-effectiveness, market barriers, customer behavior, and any other impediments. The economic health of each industry group is also considered at this level.

Estimates for instantaneous energy savings, which reflect the degree of efficiency that could be achieved if all known energy saving opportunities were implemented at one time, are presented in this paper. Phase-in savings, or efficiency achieved as existing equipment is replaced at the end of its lifetime with the most efficient alternative, are discussed along with instantaneous savings in the full study.

**Process Operations**

As discussed in the approach section, some energy savings can be achieved in process operations through more conventional techniques of improving operations or implementing advanced controls. Yet, the majority of these savings have already been captured in Texas industry. The greatest potential for energy efficiency in the process operations lies in process optimization, studied through pinch analysis. The measures typically considered in pinch analysis include:

- Heat Exchange Network (HEN) Revision: changing process-to-process heat exchange matches; shifting of duty from a more expensive to a less expensive energy source.

- Utility Integration: exhaust gas heat recovery into the utility system; recovering surplus process heat into the steam generation system (e.g., BFW preheat); optimizing arrangement of combined heat and power system (CHP); integration of refrigerant condensers with the process.
- Process Modifications: changing the flow rate or composition of a process stream; changing the pressure or temperature of a process stream.

The end result is a set of practical and mutually consistent measures that typically reduce the existing energy consumption by 17 to 26% at a payback of under three years. Table 1 displays the estimated instantaneous fossil fuel savings potential per industry group.

Table 1. Estimated Fossil Fuel Savings from Instantaneous Implementation of Efficiency Measures

| SIC Code | Industry Group | Base (1993) Consumption (Trillion Btu) | Estimated Potential Savings: Technical % of Base | Technical Trillion Btu | Economic % of Base | Economic Trillion Btu |
|---|---|---|---|---|---|---|
| 20 | Food & Kindred Prods. | 91 | 35% | 32 | 25% | 23 |
| 26 | Pulp & Paper | 71 | 33% | 23 | 23% | 16 |
| 28 | Chemicals | 1,022 | 36% | 368 | 26% | 266 |
| 29 | Petroleum Refining | 781 | 22% | 172 | 17% | 133 |
| 30 | Rubber & Plastics | 14 | 35% | 5 | 25% | 3 |
| 32 | Glass & Concrete | 47 | 32% | 15 | 22% | 10 |
| 33 | Primary Metals | 93 | 32% | 30 | 22% | 21 |
| **TOTAL** | | **2,119 Trillion Btu** | | **645 Trillion Btu** | | **472 Trillion Btu** |

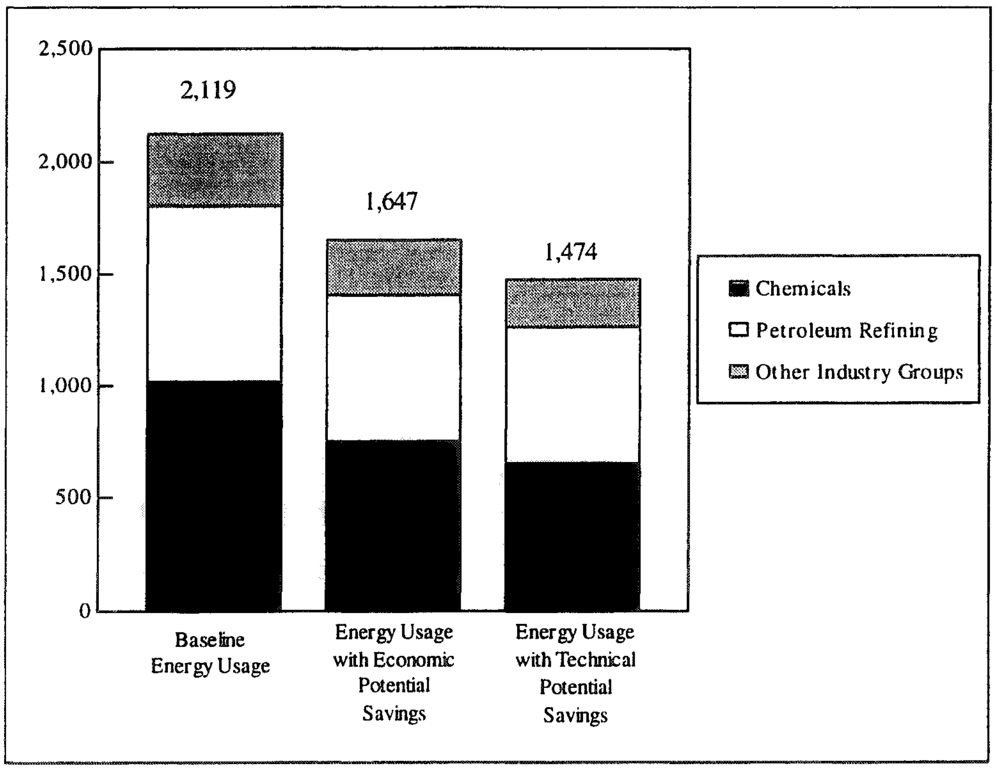
The most promising methods of achieving the above energy savings in each industry group are outlined below:

- Food and Kindred Products:
  - Converting batch operations to continuous processes. In batch processes, streams are cooled down somewhat for storage, then reheated in the next processing step.
  - Replacing steam ejectors with vacuum pumps.
  - Recovering low temperature heat (e.g., from dryer exhaust) to make hot water for storage tank heating and other purposes.
  - Replacing inefficient motors and introducing a heat and power system utilizing a steam turbine.
  - Preheating BFW against evaporator condensing duty.
- Paper:
  - Improved digester blow heat recovery.
  - Mill water preheat against evaporator overhead vapors.
  - White water preheat against dryer exhaust.
  - Optimization of cogeneration scheme.
- Chemicals, Rubber & Plastics (although rubber and plastics are in a separate SIC code, the characteristics of this industry are similar to those of the chemical industry):
  - Heat exchanger network retrofit.
  - Process modifications that increase the opportunity for heat recovery.
  - Bypassing intermediate storage tanks between process units if they have to be heated or cooled.

- Petroleum: Catalytic cracking units -- maximize the steam generation pressure.
  - Hydrocrackers and hydrotreaters -- optimize operating temperature for the main hydrogen separation vessel.
  - Crude units -- revamp the crude oil preheat train to follow the temperature profile of the products being cooled down.

Figure 1 shows that chemicals and petroleum refining, Texas' largest fossil fuel consumers, hold the most potential for energy efficiency savings.

Figure 1. Fossil Fuel Consumption Scenarios in Trillion Btu




Overall, fossil fuel requirements in the process-oriented industries could be reduced between 17 and 26 percent, while maintaining current production levels. As a group, process-oriented industry groups contain the potential to save over 472 trillion Btu per year through cost-effective measures. This could result in potential savings of over $1 billion in annual energy costs. Table 2 provides the estimated total capital investment to achieve the estimated levels of energy efficiency. Table 2 also estimates annual energy cost savings from the instantaneous implementation of energy efficiency measures.

Table 2. Estimated Total Capital Investment and Annual Energy Cost Savings from Fossil Fuel Efficiency Measures

| SIC Code | Industry Group | Estimated Technical Potential | | Estimated Economic Potential | |
|---|---|---|---|---|---|
| | | Total Capital Investment (Million $) | Annual Energy Cost Savings (Million $) | Total Capital Investment (Million $) | Annual Energy Cost Savings (Million $) |
| 20 | Food & Kindred Prods. | $500 | $91 | $173 | $58 |
| 26 | Pulp & Paper | $400 | $62 | $123 | $41 |
| 28 | Chemicals | $4,500 | $894 | $1,989 | $663 |
| 29 | Petroleum Refining | $2,000 | $390 | $995 | $332 |
| 30 | Rubber & Plastics | $50 | $11 | $26 | $9 |
| 32 | Glass & Concrete | $200 | $35 | $77 | $26 |
| 33 | Primary Metals | $350 | $70 | $155 | $51 |
| **TOTAL** | | **$8,000** | **$1,553** | **$3,538** | **$1,180** |

**Fabrication and Assembly Activities**
In fabrication and assembly activities, many of the energy efficiency opportunities are quite specific to a particular industry or manufacturing activity. However, some energy saving options are applicable to all of the fabrication and assembly industry groups: adjustable speed drives; premium efficiency motors; properly sized motors; optimization of fans, pumps, and compressors; compressed air system improvement; energy management systems/process controls; high efficiency lighting

Table 3 displays the instantaneous technical and economic potential energy savings for the fabrication and assembly activities. Higher efficiency standards resulting from the 1992 Energy Policy Act and other regulations will increase the efficiency of motors, other equipment, and lighting available in the marketplace by 1998. Some of the savings reported here may occur naturally through the replacement of burned-out motors with more efficient equipment.

Table 3. Estimated Electricity Savings Instantaneous from Implementation of Energy Efficiency Measures

| SIC Code | Industry Group | Base (1995) Consumption (GWh) | Estimated Potential Savings | | | |
|---|---|---|---|---|---|---|
| | | | Technical | | Economic | |
| | | | % of Base | GWh | % of Base | GWh |
| 20 | Food & Kindred Prod. | 3,240 | 16% | 502 | 8% | 259 |
| 26 | Pulp & Paper | 3,926 | 15% | 603 | 4% | 157 |
| 28 | Chemicals | 52,267 | 14% | 7,275 | 10% | 5,227 |
| 29 | Petroleum Refining | 14,273 | 16% | 2,221 | 8% | 1,142 |
| 30 | Rubber & Plastics | 1,389 | 16% | 220 | 4% | 56 |
| 32 | Glass & Concrete | 2,151 | 16% | 345 | 6% | 129 |
| 33 | Primary Metals | 6,990 | 14% | 970 | 10% | 699 |
| 34 | Fabricated Metals | 1,608 | 13% | 213 | 6% | 96 |
| 35 | Machinery & Computers | 2,001 | 14% | 287 | 8% | 160 |
| 36 | Electronics | 2,819 | 12% | 350 | 10% | 282 |
| 37 | Transportation Equip. | 1,428 | 14% | 201 | 6% | 86 |
| TOTAL | | **92,092 GWh** | | **13,187 GWh** | | **8,293 GWh** |

The most promising methods of achieving the above energy savings in each industry group are outlined below:

- Chemicals:
  - ASDs; high efficiency motors; trimming pump impellers and optimization of fans and compressors
  - Power recovery using turboexpanders in ammonia plants, methanol plants, air separation plants, and nitric acid plants. There is probably the opportunity for 4 to 5 installations in Texas.
  - Hydraulic turbines: As the cost is much less for new installations than for retrofits, the design of hydraulic turbines (and turboexpanders) into new facilities should be a high priority as this industry group recovers from the economic recession and expands capacity.

- Petroleum:
  - Trimming of pump impellers; optimization of fans, blowers, and compressors.
  - Power recovery using turboexpanders: This technology offers the greatest energy efficiency opportunity, but the high capital cost may impede wide-spread adoption.

- Food and kindred products:
  - Energy management systems, high efficiency motors, and compressed air systems.
  - Refrigeration improvements: Energy efficiency technologies present opportunities for significant savings, as much as 30%, in what is the largest electric end use for many food industry segments. Plant personnel are generally well trained and able to maintain energy efficiency savings levels once they understand the applicable technologies.
  - CFC phase-out: The Montreal Protocols require phase-out of freon-based refrigeration systems beginning in 1995. Although freon systems account for only a portion of the refrigeration energy in the Texas food industry, this still presents an opportunity for a more energy efficient design in the reconfigured systems.

- Electronic and other electrical equipment:
  - ASDs, high-efficiency motors, energy-efficient lighting, and compressed air systems.

- Industrial machinery and computer equipment and fabricated metal products (these two industry groups are combined since they have similar opportunities):
  - Compressed air systems
  - Metal coating alternatives: Alternative coatings offer environmental compliance (reduction of VOCs) and reduce ventilation requirements as well as increased efficiency and product quality.
  - Heat treating: Induction and electric furnaces offer improved control as well as efficiency.

- Plastic:
  - Extruder barrel insulation.
  - Improvements in coating technologies: U.S. environmental regulations that restrict the use of solvents have led to an advancement in coating technologies that also has potential to reduce energy use.

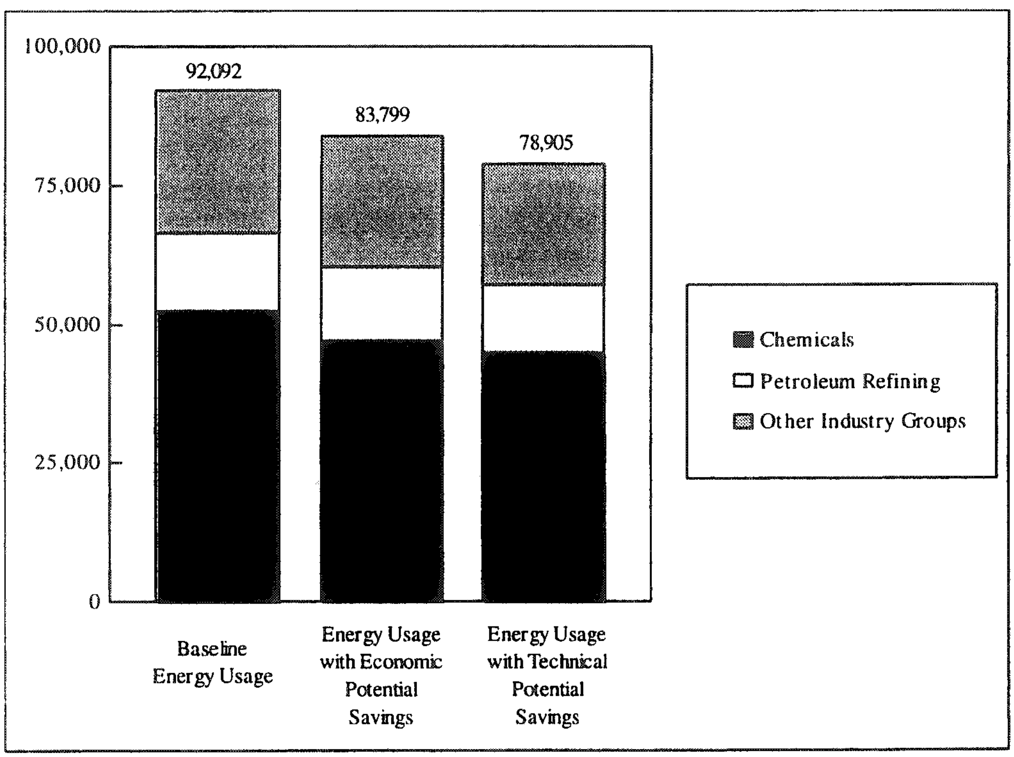
- Primary metals:
  - Energy management/process controls are applicable to steel, iron, and secondary smelting and refining operations.
  - ASDs provide an opportunity in steel and secondary smelting and refining; high efficiency motors have begun to be adopted widely in secondary smelting and refining operations.
  - Electric arc furnaces may produce energy savings in steel mills.

- Automated materials handling: Modern iron foundries are investing in this approach to improve foundry productivity and throughput.

- Concrete and glass:
  - High efficiency motors in glass plants
  - ASDs, particularly for kiln exhaust fans, clinker cooling venting fans, roller mill exhaust fans, and cooling water pumps in cement plants.
  - Variable inlet vane control: Most plants use outlet dampers for flow control on cooling fans, while inlet vane control is more efficient. This is applicable for plants that use ambient air for grate cooling.
  - Finish grinding.
  - High efficiency separators.
  - Automatic tap changing transformers: There are opportunities for power factor improvement in electric melters in most glass plants.
- Paper:
  - Deinking: This technology appears to be an inevitable addition to many newsprint mills.
  - Explosion pulping process: Further proof of the benefits of the Stake process could relieve concerns and permit significant efficiency gains.
  - Effluent treatment: Environmental regulations are tightening the requirements for effluent treatment, which may raise interest in efficiency improvement.

The dominant electricity consumers in the fabrication and assembly activities are the chemicals and petroleum refining industries. As Figure 2 shows, these industries also have the highest potential GWh savings.

Figure 2. Electricity Consumption Scenarios in GWh



As a whole, 8,923 Gwh per year of cost-effective potential electricity savings in the fabrication and assembly activities has been identified. Table 4 displays the estimated capital cost of providing these savings, and that achieving these savings could result in savings of over $471 million in energy costs annually.

Table 4. Estimated Total Capital Investment and Annual Energy Cost Savings of Electricity Efficiency Measures

| SIC Code | Industry Group | Estimated Technical Potential | | Estimated Economic Potential | |
|---|---|---|---|---|---|
| | | Total Capital Investment (Million $) | Annual Energy Cost Savings (Million $) | Total Capital Investment (Million $) | Annual Energy Cost Savings (Million $) |
| 20 | Food & Kindred Prod. | $219 | $29 | $106 | $15 |
| 26 | Pulp & Paper | $84 | $34 | $43 | $9 |
| 28 | Chemicals | $1,337 | $414 | $648 | $297 |
| 29 | Petroleum Refining | $309 | $126 | $150 | $65 |
| 30 | Rubber & Plastics | $46 | $13 | $23 | $3 |
| 32 | Glass & Concrete | $135 | $20 | $69 | $7 |
| 33 | Primary Metals | $363 | $55 | $176 | $40 |
| 34 | Fabricated Metals | $224 | $12 | $114 | $5 |
| 35 | Machinery & Computers | $293 | $16 | $142 | $9 |
| 36 | Electronics | $264 | $20 | $128 | $16 |
| 37 | Transportation Equip. | $100 | $11 | $51 | $5 |
| **TOTAL** | | **$3,374** | **$750** | **$1,650** | **$471** |

## OIL AND GAS PUMPING

The following conservation measures were examined for oil and gas pumping:

- High-efficiency motors
- Ultra-high slip motors
- Adjustable speed drive motors (ASD)
- Pump-off controllers--a device installed on pumps to shut the pumping unit down when fluid entry into the well bore is less than desired. This device allows pumps to operate at optimum levels.
- Smaller pump impellers
- Field checks of motors -- computer programs have been developed which allow checking pump motors installed in the field to ensure they are operating at maximum efficiency.
- Computer prediction of motor size

Greater reliance on pump-off controllers appears to be the most promising of the above measures. Following close behind for high savings opportunities are ultra-high slip motors. Considering all of the above measures, the average technical potential for electricity savings in oil and gas pumping is 1,040 GWh (5.2% of the electricity consumed). With a three year payback period, 900 GWh (4.5% of the electricity consumed) could be conserved, resulting in annual energy cost savings of nearly $50 million.

## LESSONS LEARNED

Besides providing useful estimates of efficiency potential for Texas industry, this study can also provide insight in conducting similar analyses. Below are some of the "lessons learned" while conducting this study.

While data needed to determine baseline energy consumption on a state level is no longer collected by the federal government, reasonable estimates can often be constructed. Assembling baseline data requires the cooperation of utilities and state financial agencies, such as the comptroller's office. The reported data should be cross-checked by "bottom-up" estimates, multiplying production rates by energy intensity data. Baseline determination will likely require at least one-third of a study's analysis time.

In investigating energy efficiency options in the process operations, it is important to take an holistic approach. Analyzing the efficiency of each piece of equipment in isolation will provide far less insight into energy savings opportunities than examining the entire energy-using process.

Certain reactions can be expected of the study's audience. The industrial community may be somewhat defensive that the potential savings suggested by an energy efficiency potential study could actually be achieved in their own plants. Any mention of sensitive policy issues, such as the electric utility industry restructuring, is likely to draw attention.

As with any study, the greatest lesson to learn is determining the means of ensuring that the study's findings have an impact in the targeted arena. As this study has just been released, it's impact on Texas' energy policies and the realization of the state's energy efficiency potential remains to be seen. It is hoped that the results of this study will provide a background for decision-makers needing greater insight into the needs of the industrial community, help guide regulators in their attempts to influence energy consumption of the industrial sector, and provide a source for industry in investigating energy efficiency opportunities.

## REFERENCES

[1] Nationally, industrial energy intensity has been reduced by almost one-third since the 1970s in terms of Btu consumed per industrial output. Industry in Texas appears to have followed this trend. It should be noted that the "value" of energy used by industry per output has remained unchanged since the early 1970s.

[2] Public Utility Commission of Texas, *1994 Statewide Electrical Energy Plan*, February 1995, Table A-4.

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[4] Ibid.

[5] Zarnikau, et al., "Opportunities for Energy Efficiency in the Texas Industrial Sector." The final report is scheduled for printing in June, 1995. Contact Lee Reed, Planergy, Inc. (800/531-5114) or Charlotte Banks, SEDC (512/463-1745) for copies or information regarding the report.

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