April 26, 2001

The Honorable Spencer Abraham
Secretary of Energy
Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Secretary Abraham:

Because of the intense current interest in national energy policy and global climate change policy, I am pleased to tell you about the summary results of the American Chemistry Council's 1999 Energy Efficiency and Greenhouse Gas Emissions Survey and our 1999 Energy Efficiency Awards Program. Both activities are part of the Council's voluntary Energy Efficiency Continuous Improvement Program and Climate Action Program and are directly relevant to national energy policy and global climate change objectives.

The business of chemistry is a major consumer of virtually all types of energy — fuel, power, steam and feedstocks (raw materials) for our processes. Chemistry companies are driven by competition, economics and a strong sense of environmental stewardship to continually improve energy efficiency. The results documented by these Council voluntary programs demonstrate how our members contribute to shared national and industry goals of great importance, specifically improved energy efficiency and strengthened international competitiveness; conservation of energy resources; and, reduction of energy-related and other greenhouse gas emissions.

1. The 1999 Energy Efficiency and Greenhouse Gas Emissions Survey. The survey results indicate that the business of chemistry continues to improve its energy efficiency and CO₂ emissions performance. Summary data from the survey are in Attachment 1 to this letter.

Highlights are as follows:

1998-99 Energy Efficiency & CO₂ Emissions Trends. The sample group of forty-eight Council member companies that responded to the survey in both 1998 and 1999 had, in the aggregate, 1999 sales of approximately $109.2 billion and non-feedstock energy consumption of 2.019 quads.

Energy efficiency performance for this group of companies over this period, measured as Btu per pound of production, improved 1.2%. Carbon dioxide emissions, measured as pounds of CO₂ per pound of production, declined 1.4%. (These CO₂ emissions include emissions from purchased electricity.) Absolute CO₂ emissions for this group of companies, again including emissions from purchased electricity, increased 1.6%, but this increase was much less than the increase in constant dollar value of sales (5.3%) and pounds of production (3.0%).
1992-99 Energy Efficiency & CO₂ Emissions Trends. We track performance from 1992 because in that year our survey began to request data on "pounds of production" which we use as an output metric. Analysis of our survey results indicates energy efficiency (measured as Btu consumed per pound of product produced) improved an average of 3.3% per year since 1992, or a total of 21.1%. CO₂ efficiency (measured as pounds of CO₂ emitted per pound of product produced) improved an average of 3.8% per year since 1992, or a total of 23.7%. (As before, CO₂ emissions include emissions from purchased electricity.)

1990-99 Energy Efficiency & CO₂ Emissions Trends. The Council also tracks energy efficiency and CO₂ emissions performance from 1990, the base year from which emissions reductions are to be measured under the U.N. Framework Convention on Climate Change. In this analysis we use the dollar value of sales, deflated by the BLS Producer Price Index for Industrial Chemicals, as the output measure. Analysis of our survey results indicates energy efficiency (measured as Btu consumed per 1990$ of sales) improved an average of 1.9% per year since 1990, or a total of 15.8%. CO₂ efficiency (measured as tons of CO₂ emitted per million 1990$ of sales) improved an average 2.2% per year, or a total of 18.4%. (Again, CO₂ emissions include emissions from purchased electricity.)

We think this year's survey results show very real energy and CO₂ emissions efficiency progress. However, we must remember that as much as we hope to see such progress continue, past performance does not guarantee the same performance in the future. Many of our members believe that the "low-hanging fruit" has been picked, and that future energy efficiency and greenhouse gas emissions improvements with current technology will be more difficult and more costly than in the past. In addition, general economic conditions drive apparent energy efficiency performance from year to year; specifically, lower capacity utilization typically degrades energy efficiency performance.

II. Results of the 1999 Energy Efficiency Awards Program. Twenty-three projects carried out by ten Council member companies were honored with 1999 Energy Efficiency Awards. Attachment 2 contains short descriptions of each of the winning projects. These winning activities consisted of a variety of innovative measures which were successful in improving energy efficiency and reducing or avoiding related emissions including CO₂ emissions.

III. American Chemistry Council policy recommendations. The Council will continue vigorous implementation of our Energy Efficiency Continuous Improvement Program and our Climate Action Program. We will continue the industry's long-standing tradition of improving energy efficiency and reducing the carbon intensity of our operations, thus demonstrating the effectiveness of voluntary programs in helping to achieve domestic and international energy policy and global climate change goals. We will also continue to research, develop and provide chemistry products that enable other industries and individual consumers to improve their energy efficiency and reduce their emissions.

While the business of chemistry will continue its efforts, government also has a vital role to play. The American Chemistry Council strongly supports a national energy policy that restores balance to U.S. energy markets by promoting high environmental protection.
standards, now and for future generations, and a diverse, flexible energy supply at globally competitive prices. To achieve those goals the Council believes the nation should:

- Use all available and proven energy sources. Over 75 percent of the nation's electricity output comes from oil, coal and nuclear power. The nation cannot turn its back on these and other supply enhancing energy sources. The nation must fully use advanced oil, coal and nuclear technologies and invest in non-traditional and renewable energy sources.
- Balance natural gas markets. Natural gas is fast becoming the nation's fuel of choice. It is in high demand to heat homes, fuel factories, and create electricity. Today, there is simply not enough natural gas to go around. New supplies must be responsibly developed, and new measures are needed to ease demand growth.
- Remove unintended regulatory barriers to safe and reliable energy. Some government policies have severely restricted the production and distribution of energy, especially electricity supplied from cogeneration technology.
- Improve energy distribution channels. Our energy distribution infrastructure is inadequate. New natural gas pipelines are needed and we must pursue a continental natural gas supply and power movement strategy.

The Council believes that U.S. government policy to address the issue of global climate change should focus on the following elements:

- Encouragement of voluntary actions to improve energy efficiency and reduce or avoid greenhouse gas emissions, and appropriate recognition of these actions;
- Targeted research to resolve uncertainties in the science of global climate change;
- Removal of barriers to the deployment of energy efficient and greenhouse-friendly technologies; and,
- Research and development of breakthrough new technologies to dramatically reduce the greenhouse impact of energy-related and other anthropogenic emissions.

I recently wrote you to explain the important benefits that cogeneration brings to the business of chemistry and the nation. I emphasized our concern about possible amendments to the Public Utility Regulatory Policies Act (PURPA) which would remove that statute's vital protections of cogeneration facilities against monopoly abuses, and thus jeopardize our industry's cogeneration contribution to the nation's electricity supply. Let me reiterate our concern at this time.

I hope you find the above information to be of interest. I would welcome the opportunity to meet and discuss it with you. If you or members of your staff should have questions, please call me or call Thomas Parker, Jr. of the Council's Energy Team, at 703-741-5916.

Sincerely,

Frederick L. Webber
President & CEO
The Honorable Spencer Abraham  
April 26, 2001  
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attachments:


cc: The Hon. Joe Kelliher, Senior Advisor to the Secretary, Department of Energy
The Hon. Robert Kuripowicz, Acting Assistant Secretary, Fossil Energy, Department of Energy
The Hon. Abraham Haspel, Acting Assistant Secretary, Energy Efficiency and Renewable Energy, Department of Energy
The Hon. Colin L. Powell, Secretary of State
The Hon. Paula Dobriansky, Under Secretary-designate for Global Affairs, Department of State
The Hon. Alan P. Larson, Under Secretary for Economic, Business and Agricultural Affairs, Department of State
The Hon. Kenneth Brill, Acting Assistant Secretary for Oceans and International Environmental and Scientific Affairs, Department of State
The Hon. Paul H. O’Neill, Secretary of the Treasury
The Hon. Mark Sebel, Acting Assistant Secretary for International Affairs, Department of the Treasury
The Hon. Donald L. Evans, Secretary of Commerce
The Hon. Robert C. Reiley, Director, Office of Metals, Materials and Chemicals, Department of Commerce
The Hon. Christie Whitman, Administrator, Environmental Protection Agency
The Hon. Jeffrey Holmstead, Assistant Administrator-designate for Air and Radiation
The Hon. Andrew Lundquist, Executive Director of the National Energy Policy Development Group, the White House
The Hon. Karen Knutson, Deputy Director of the National Energy Policy Development Group, the White House

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DOE002-0513

Obtained and made public by the Natural Resources Defense Council, March/April 2002
### Summary of Data, 1990-1999

#### 1. 1999: Non-Fuelstock Energy Consumption

<table>
<thead>
<tr>
<th>Total Energy Consumption</th>
<th>Share in Energy Consumption, %</th>
<th>Total CO₂ Emissions*</th>
<th>Share in Total CO₂ Emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Million Btu)</td>
<td>Purchased</td>
<td>Total</td>
<td>(tonnes)</td>
</tr>
<tr>
<td><strong>Purchased Fuel &amp; Electricity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas (675,601,368 MCF)</td>
<td>1,004,814,893</td>
<td>53%</td>
<td>58,239,232</td>
</tr>
<tr>
<td>Electricity (59,346 million kWh)</td>
<td>580,325,883</td>
<td>31%</td>
<td>30,514,200</td>
</tr>
<tr>
<td>Coal (8,140,965 tons)</td>
<td>149,587,289</td>
<td>8%</td>
<td>15,782,372</td>
</tr>
<tr>
<td>Steam (119,202 million lb)</td>
<td>145,632,795</td>
<td>8%</td>
<td>9,524,201</td>
</tr>
<tr>
<td>All Other</td>
<td>914,242,284</td>
<td>4%</td>
<td>1,129,288</td>
</tr>
<tr>
<td><strong>Sub-total, purchased:</strong></td>
<td>1,911,077,877</td>
<td>90%</td>
<td>124,188,690</td>
</tr>
<tr>
<td><strong>Fuel Produced On-Site</strong></td>
<td>600,659,803</td>
<td>24%</td>
<td>33,933,229</td>
</tr>
<tr>
<td><strong>Total Purch. &amp; On-Site</strong></td>
<td>2,511,737,100</td>
<td>100%</td>
<td>158,119,810</td>
</tr>
</tbody>
</table>

#### Averages

<table>
<thead>
<tr>
<th></th>
<th>1999 Dollars</th>
<th>1990 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Energy Consumption</td>
<td>19,421</td>
<td>20,460</td>
</tr>
<tr>
<td>Total CO₂ Emissions*</td>
<td>1,223</td>
<td>1,284</td>
</tr>
</tbody>
</table>

*CO₂ emissions from purchased electricity are imputed from electric utilities' emissions.

### Alternative Calculations for CO₂ emissions including emissions from purchased feedstock electricity

- **Purchased feedstock electricity CO₂ emissions, tons:** 9,490,291
- **Total CO₂ Emissions, tons:** 167,619,119

#### 2. 1999: Feedstock Energy Consumption

<table>
<thead>
<tr>
<th>Feedstock Type</th>
<th>Physical Units</th>
<th>Total Energy (Million Btu)</th>
<th>Shares of CO₂ (Quads)</th>
<th>Feedstocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene</td>
<td>15,223 million lbs</td>
<td>330,338,760</td>
<td>0.330</td>
<td>15%</td>
</tr>
<tr>
<td>Propylene</td>
<td>14,091 million lbs</td>
<td>295,902,825</td>
<td>0.296</td>
<td>14%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>274,527,643 MCF</td>
<td>282,763,472</td>
<td>0.283</td>
<td>13%</td>
</tr>
<tr>
<td>Propene</td>
<td>2,493,768,332 gallons</td>
<td>229,428,587</td>
<td>0.229</td>
<td>11%</td>
</tr>
<tr>
<td>Ethylene</td>
<td>2,793,439,428 gallons</td>
<td>195,400,872</td>
<td>0.195</td>
<td>9%</td>
</tr>
<tr>
<td>Xylenes</td>
<td>1,282,507,766 gallons</td>
<td>174,877,558</td>
<td>0.175</td>
<td>8%</td>
</tr>
<tr>
<td>Naphtha and Raffinates</td>
<td>32,207,103 bbl</td>
<td>181,205,515</td>
<td>0.161</td>
<td>7%</td>
</tr>
<tr>
<td>All Other</td>
<td>n/a</td>
<td>507,355,619</td>
<td>0.507</td>
<td>23%</td>
</tr>
<tr>
<td><strong>Total Feedstocks</strong></td>
<td></td>
<td>2,178,801,208</td>
<td>2.177</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: all emissions data presented in this report are as short tons of carbon dioxide. In other contexts emissions are reported as short tons of carbon or carbon equivalent, or as metric tons of carbon or carbon equivalent. To convert short tons of carbon dioxide to short tons of carbon or carbon equivalent, multiply the short tons of carbon dioxide by 12/4 (or 0.277). To convert short tons to metric tons, multiply short tons by 0.9072. The combined multiplier to convert short tons of carbon dioxide to metric tons of carbon or carbon equivalent is 0.2474.

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1999 EE&GHG Survey Report Tables & Charts 90.99 Summary Data

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DOE002-0514

Obtained and made public by the Natural Resources Defense Council, March/April 2002
Summary of Data, 1990-1999

<table>
<thead>
<tr>
<th>III. 1999: Total Emissions of Greenhouse Gases</th>
<th>Tons CO₂ or CO₂ Equivalent</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ emissions from non-feeback energy, purchased on-site, including purchased electricity</td>
<td>158,119,819</td>
<td>70.2%</td>
</tr>
<tr>
<td>CO₂ emissions from purchased feeback electricity</td>
<td>9,400,291</td>
<td>4.2%</td>
</tr>
<tr>
<td>Emissions of greenhouse gases other than CO₂ produced from combustion of fuels*, expressed as CO₂ equivalent</td>
<td>57,733,016</td>
<td>25.6%</td>
</tr>
<tr>
<td>Total greenhouse gas emissions, CO₂ and CO₂ equivalent</td>
<td>225,343,127</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

* These greenhouse gases are process CO₂, nitrous oxide (N₂O), methane (CH₄), HFCs, PFCs and SF₆.

| III. 1998-99: Comparison of 48 Companies Reporting Dollars of Sales and Pounds of Production in Both Years |
|---------------------------------------------------------------|----------------|
| 1998 | 1999 Units | Change, % |
| Sales (constant 1990) | 98.5 | 103.9 billion $ | 5.2% |
| Pounds of Production | 429,015 | 441,555 million lbs | 3.0% |
| Energy | | |
| Purchased & On-Site Energy | 1,364 | 2,019 quads | 1.7% |
| Ratio to Pounds | 4,025 | 4,588 Btu/lb | -1.2% |
| CO₂ Emissions, Including Purchase Electricity* | 134,490 | 136,779 million tons | 1.6% |
| Ratio to Pounds | 0.6249 | 0.6167 lbCO₂/lb | -1.4% |
| Total GHG Emissions**, as CO₂ Equivalent | 170.4 | 174.9 million tons | 2.7% |
| Ratio to Pounds | 0.794 | 0.792 lbCO₂/lb | -0.3% |

* Non-feeback & feeback electricity
**These greenhouse gases are combustion and process CO₂, nitrous oxide (N₂O), methane (CH₄), HFCs, PFCs and SF₆.

| IV. 1990-96: Cumulative Energy Efficiency and CO₂ Emissions Trends Based on Successive Groups of Two-year Repeat Reporting Companies |
|---------------------------------------------------------------|----------------|
| % Change Since Base Year | Total | Average |
| Energy* efficiency (intensity) trend - Btu/1990$ - 1990 base year | -15.5% | -1.9% |
| Energy* efficiency (intensity) trend - Btu/Lb - 1992 base year | -21.1% | -3.3% |
| CO₂** efficiency (intensity) trend - tons/MM 1990$ - 1990 base year | -18.4% | -2.2% |
| CO₂** efficiency (intensity) trend - lbCO₂/lbProd - 1992 base year | -23.7% | -3.8% |

* Energy consists of non-feeback purchased plus on-site energy.
** In calculating CO₂ emissions, emissions from purchased electricity (non-feeback and feeback) are included, along with emissions from other non-feeback purchased plus on-site energy inputs. Emissions of other greenhouse gases including "process CO₂" are not included.

Note well that all emissions data presented in this report are in short tons of carbon dioxide. In other contexts emissions are reported as short tons of carbon or carbon equivalent, or as metric tons of carbon or carbon equivalent. To convert short tons of carbon dioxide to short tons of carbon or carbon equivalent, multiply the short tons of carbon dioxide by 12/44 (or 0.2727). To convert short tons to metric tons, multiply short tons by 0.9072. The combined multiplier to convert short tons of carbon dioxide to metric tons of carbon or carbon equivalent is 0.2474.
AMERICAN CHEMISTRY COUNCIL
1999 ENERGY EFFICIENCY AWARDS PROGRAM
AWARD WINNERS, WITH SUMMARY DESCRIPTIONS

Number: 1
Company: Texas Petrochemicals LP
Category: Significant Improvement in Manufacturing - Plant Site
Entity: Houston, Texas Plant
Title: TPC Instrumentation Upgrade

Description: To continue its multi-year pursuit of energy reduction, in 1999 Texas Petrochemicals LP implemented a plant instrumentation upgrade project along with several smaller heat recovery projects to increase processing efficiency and to lower overall energy consumption per pound of product. The installation of the instrumentation upgrade utilizing Honeywell distributed controls technology increased production rates. The advanced controls and process modeling then allowed operating the process closer to product specifications, thus decreasing energy usage. Steam heat recovery was increased by replacing a 15 pound steam boiler economizer section with a more efficient 750 pound economizer. In another waste heat recovery boiler installation of steam drum de-misters eliminated sodium carryover and allowed more efficient supplemental firing. Finally, the use of excess condensate flash heat was initiated for preheating two process tower feeds. Actual energy savings realized during 1999 were 508,896 MMBtu. Energy per pound of product decreased 3.3% and CO₂ emissions per pound decreased 5.3%. Larger full year savings were expected for the year 2000.

Number: 2
Company: Celanese
Category: Environmental Impact - Project
Entity: Bay City, Texas Plant
Title: Plant Ethylene Flare Noise and Steam Reduction

Description: Excessive use of 160-psig steam to an ethylene flare caused by a malfunctioning sensor wasted energy and resulted in a pulsating flame and noisy flare. Inadequate steam input, however, would have resulted in excessive smoke, a reportable event to state environmental authorities. Initial observation did not reveal any controller tuning problem. Cause and effect analysis was used to identify and assess factors which might be responsible for the excess steam: a malfunctioning steam flow transmitter, the infrared sensor, and process vent streams not previously accounted for. Further work with instrument maintenance personnel indicated the infrared sensor ("smoke detector") was not programmed properly, giving an incorrect high infrared signal which in turn caused input of excessive steam to reduce that signal. Company personnel worked with the original manufacturer of the device and the sensor was reprogrammed based on a new procedure. The result was to reduce the 160-psig steam usage from 3.6 thousand lb/hr to

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0.6 thousand lb/hr, an annualized savings of 39,322 MM Btu of boiler fuel gas, and to mitigate the excessive noise.

Number: 4  
Company: Celanese  
Category: Significant Improvement in Manufacturing - Operating Unit  
Entity: Operating Unit Within the Clear Lake, Texas Plant  
Title: Use of Excess Process Steam for Heat Recovery

Description: Process-generated steam contained a small amount of organic process material. This steam could not go directly into the plant steam system with this contaminant, so it was treated, resulting in the annual discharge to the environment of approximately 4,000 pounds of the organic material. In another part of the same process, purchased steam was used to reboil a Flasher vessel. A company engineer conducted HTRI calculations to determine whether the Flasher reboiler could operate properly if the process-generated steam were used and condensed in the reboilers, instead of the purchased steam. When the answer was affirmative, the unit decided to implement a low-cost project. New pipelines and jumpers were designed and installed. The process steam was then lined up to the Flasher reboiler, displacing purchased steam. Annualized energy savings are approximately 65,000 MMBtu, or 1.8% per unit of production. The project also has environmental benefits. The reboiler-generated condensate including the organic material is discharged as effluent, which is then remediated through biological treatment.

Number: 8  
Company: Celanese  
Category: Significant Improvement in Manufacturing - Operating Unit  
Entity: Operating Unit Within the Clear Lake, Texas Plant  
Title: Improve Process Control of Large Air Compressor

Description: Company engineers improved the process control for a large air compressor. The new control strategy minimized the differential pressure across the flow control valve downstream of the compressor in order to improve efficiency. In order to open up the flow control valve more, the air discharge pressure of the compressor was reduced by lowering the speed of the compressor. This resulted in saving high pressure steam which powers the compressor. The engineers also trained the operators on how better to operate the equipment. This was an important phase of the project and resulted in a significant change in behavior for the operating unit in managing operation of this compressor. Software changes were made, but no new equipment was required. Annualized energy savings are approximately 22,000 MMBtu, or 1.3% per unit of production.
Number: 9
Company: Celanese
Category: Significant Improvement in Manufacturing - Operating Unit
Entity: Pampa, Texas Plant
Title: Furnace Operations Optimization

Description: Several cabin style radiant-wall furnaces are used to crack a vapor feed stream into an intermediate product stream. The furnaces use natural gas as the primary fuel source and the cracking by-product "off-gas" as a secondary fuel source. Due to increased production demands, several studies for improving furnace capacity, first pass conversion, and carbon efficiency were conducted. First, burner capacity and heat distribution patterns were evaluated. This revealed that certain burner locations were actually counter-productive to cracking and it was found that fouling in the off-gas burner system caused excessive fluctuation in the heat distribution patterns. In addition, the burner fouling was affecting the pressure controlled off-gas collection system. This caused off-gas to be diverted to the unit flare, which results in an appreciable loss of by-product gas BTUs. Burner capacities and firing patterns were optimized and the secondary fuel burner nozzles were redesigned and re-fabricated to reduce fouling. These activities resulted in an increased furnace capacity (~15%), an increased first pass conversion (~3%) and losses of the off-gas to the unit flare was reduced from ~15% to less than 1%. Lastly, an online condenser wash procedure was implemented to reduce downstream pressure drop. This has helped in maintaining a low process operating pressure within the furnace, which favors cracking conversion. Condenser washes have also helped to extend the process run times by over 10%. The annual energy savings of approximately 7.2% per unit of production has exceeded expectations.

Number: 10
Company: PPG Industries, Inc.
Category: Significant Improvement in Manufacturing - Operating Unit
Entity: Lake Charles, Louisiana Plant “C” Chlorine
Title: Tephram® Diaphragms

Description: The “C” Chlorine unit consists of four production circuits, each with 16 bi-polar electrolyzers, each of which in turn contains 12 individual cells, for a total 768 individual cells. Historically these cells used an asbestos diaphragm as the separator between the anode and cathode compartments. Asbestos diaphragms have several shortcomings: problematical long term availability due to environmental concerns; a short life, normally 1 to 1.5 years; and, high operating costs. A company research team created the technology leading to the current “4.2C version” Tephram® Diaphragm more than a decade ago. Several generations of diaphragms were developed and tested before the successful 4.2C version was developed. This diaphragm consists of several non-hazardous, commercially available and proprietary components. Cell renewal crews use equipment essentially identical to that designed for asbestos diaphragms. No modifications to cell structure are required. In addition to using safer materials, the Tephram® diaphragms have demonstrated the following improvements: operating life...
has more than tripled, to more than four years; product purity has improved; and, substantial energy savings were achieved. Annualized energy savings are approximately 4.4%. The company makes this technology available to others on a license basis.

Number: 11
Company: PPG Industries, Inc.
Category: Significant Improvement in Manufacturing - Project
Entity: Lake Charles, Louisiana Plant
Title: Mercury Cell Voltage Reduction Project

Description: A large amount of power is consumed in the generation of chlorine/caustic soda using mercury cell technology, so even small percentage changes in power consumption can yield significant energy savings. Since this plant operates at a nearly constant load (DC current flow) to meet production demands, any reduction in power consumption must come from a reduction in voltage drop across the mercury cells. The primary method used to change the voltage drop across a cell is to change the distance (or gap) of the movable anodes from a fixed cathode. A project was initiated to use Six Sigma methods to reduce power consumption without any capital investment. All components of voltage drop were identified and the variation of each component was studied. The main sources of variation were anode adjustments, brine feed temperature and ambient temperature. The brine temperature control loop was changed, resulting in a higher average brine temperature in the cell during ambient temperature changes, decreasing electrical resistance and lowering voltage during cooler ambient temperatures. Analyzing the variation due to anode adjustment was more difficult. To do this, regression techniques were used to develop a mathematical model to predict voltage drop where all components except anode gap are taken into account. The difference between the voltage thus calculated and the actual voltage would be the contribution due to the anode-cathode gap. A computer program was developed to calculate and report this value in real time. Operators were trained and project implementation begun. Annualized energy savings are approximately 0.85% per unit of production.

Number: 13
Company: Equistar Chemicals, LP
Category: Energy Efficiency Program - Corporate/Business Unit
Entity: Corporate/ Business Unit
Title: Energy Best Practice Team

Description: Equistar Chemicals, LP is a joint venture between Lyondell Chemical Company, Millennium Chemicals Inc. and Occidental Petroleum Corporation, formed in December 1997. The challenge was to identify best practices between the three companies and to implement the best practices throughout Equistar. Projects were limited to those with less than a one-year payback. An Energy Best Practice Team was formed to reduce Equistar's energy costs. The team is lead by an energy manager and supported by a full-time energy engineer. Energy teams led by senior engineers were
formed at fourteen plant sites and meet monthly to discuss opportunities, report progress and discuss action plans. The energy manager, energy engineer and energy team leaders have monthly phone conferences to discuss goals, new projects and team initiatives. Quarterly meetings of site representatives are held to discuss goals, review the most recent projects implemented, and listen to presentations from site energy teams and industry experts. By maintaining a focus on energy cost reduction, low- and no-cost energy projects are continually implemented. Energy best practices have been identified and plants conduct annual self-assessments to the practices. Energy audits have been conducted at each site. Through sharing of these developed best practices with other Equistar sites, energy savings ideas can be multiplied at a faster rate. Of fifty-two projects implemented so far, almost all were procedural changes or required minimal maintenance expense. Annualized energy savings in 1999 were 1,971,000 MMBtu, or 5.4% per unit of production.

Number: 14
Company: Bayer Corporation
Category: Significant Improvement in Manufacturing - Plant Site
Entity: New Martinsville, West Virginia Plant Site
Title: Utilization of Plant Produced Excess Hydrogen

Description: A decision was made to shut down permanently several operating units at this site which produced intermediate products, and to produce these products at an alternate corporate site. One of the units to be shut down used hydrogen as a raw material. The hydrogen was produced on site from the reforming of natural gas, in a reaction which also produced carbon monoxide. The carbon monoxide is a very significant raw material for other production operations at this site and it was essential to continue the supply of carbon monoxide for this purpose. However, no other production units at this site used hydrogen as feedstock. Flaring the hydrogen to the atmosphere was considered unacceptable. Therefore, an alternative productive use for the hydrogen had to be found. Possible alternatives investigated included merchant sales, use in fuel cells for onsite electricity generation, hydrogen-fired cogeneration and co-firing the hydrogen in existing boilers for process and heating steam generation. The decision was to expand existing facilities for burning hydrogen in utility boilers for plant steam supply. A multi-boiler installation was used. The burner, piping, auxiliaries and safety provisions for each boiler were modified in compliance with all corporate, regulatory and insurance requirements. The burner management systems and controls were upgraded to a programmable logic control (PLC). The resultant use of an increased quantity of hydrogen resulted in a corresponding decrease in natural gas used for fuel. Greenhouse gas emissions also decreased. Annualized energy savings are approximately 380,000 MMBtu, or 6.3% of total site energy consumption.
Number: 16
Company: DuPont
Category: Environmental Impact - Operating Unit
Entity: Victoria, Texas Power
Title: Reduction of NOx Emissions and Fuel Gas in the Hydrogen Reformer Furnace

Description: New low-NOx natural gas fired burners, installed in the hydrogen reformer furnace in 1995, were unable to meet permit requirement for NOx emissions. Large, billowy yellow flames were constantly "licking/impinging" on newly replaced process tubes, threatening damage and shortened life. Investigation revealed the burners were sized for a heat load 40% higher than furnace demands, resulting in low fuel tip gas velocity with very poor mixing and burning. In addition, the 19" diameter burners were designed using erroneous firebox vacuum data and a BTU assumption 40% too high, resulting in a 200% over sizing of the burner throat areas. The over sized burner tips and burner throats were the reason the burners could not meet NOx requirements. Smaller burner tips were ordered from the OEM and installed. The 19" burners were fitted with restriction plates conceived by area technical personnel to reduce the cross sectional area at the throats to 13" 14" and 15" in the respective cells. Finally, earlier modifications to the burner air registers, which had the unintended effects of impairing the ability to control oxygen and routinely causing the burner air register push rod mechanisms to jam, were removed and the air registers restored in original condition. Additionally, reformer process tubes were fitted with newly-designed upper tube seals to prevent tramp air from entering the furnace. These various changes resulted in reduction and stabilization of NOx emissions, greatly improved operational control, restored maximum hydrogen capacity (which had been limited to 85%), and improved fuel efficiency. Annualized energy savings are approximately 35,600 MMBtu, or 4.6% per unit of production.

Number: 18
Company: Bayer Corporation
Category: Energy Efficiency Program - Plant Site
Entity: Bushy Park, South Carolina Plant Site
Title: Bushy Park Plant Site Compressed Air

Description: The existing plant site compressed air system consisted of three large centrifugal compressors, three screw-type air compressors, two reciprocating air compressors with associated receivers, dryers, filters, distribution headers and controls. For a number of reasons system was not operating at optimum efficiency. A corrective action team, consisting of plant personnel and with support from engineering, operations and maintenance resources, systematically addressed and resolved numerous problems with the system. a) Cooling water. Impurities were addressed by installing oxygen reduction potential controllers and slipstream filters. Cooling water takeoff was moved to the top of the water supply header and a corrosion inhibitor treatment program begun. b) Air dryer. A purge airflow restriction orifice plate was resized and three-way
lubricated control valves on a heated dryer were upgraded. c) Pressure drops. Unnecessary check valves were removed and an undersized 2” flow meter was bypassed. Air filters are now monitored and changed regularly. d) Air losses. A leak survey of the entire manufacturing site was conducted and remedial action undertaken. Solenoid-operated condensate blow down valves were replaced with compressed air condensate drain traps. e) Large instantaneous increases in air demand. The locating and correcting of leaks enabled provision of the quantity of air needed to respond to instantaneous peak demands. f) Maintenance. A quarterly preventive maintenance program, including oil analysis and vibration analysis, was established. g) Training. Operators were trained to improve the consistency of plant operation. The environmental, energy efficiency and operational benefits of these measures exceeded expectations. Annualized energy savings (electricity for compressed air) are approximately 52,150 MMBtu, or 23%.

Number: 19
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing - Plant Site
Entity: Baton Rouge, Louisiana Complex Cogeneration Project
Title: Major Energy Savings Plus Environmental Improvements Through Expanded and Modernized Cogeneration

Description: The very large refining and petrochemical complex of ExxonMobil in Baton Rouge continues to experience significant growth in its need for electricity. The Complex had an aging cogeneration plant with power boilers which provided nearly 25% of its medium pressure steam supply and about 30% of its electricity through steam turbine generators. Another 15% of the Complex’s electricity needs was purchased from the local utility, which used conventional generation. In addition, the boilers had significant NOx emissions, and reliability of the aging plant infrastructure was a significant concern. This project entailed installation of a new, highly efficient, state-of-the-art gas turbine generator with a large heat recovery steam generator, and slowed/idled the aging, higher emissions boilers. As a result of this project the entire electrical needs for the Complex are met through cogeneration with an additional 70-200+ MW, depending on the season and climate conditions, available for sale to other consumers. With new gas turbine emissions of less than 10 ppm NOx, total plant emissions even with the much higher output are lower than before. In addition, the surplus electricity sold to the local utility or the wholesale market reduces third party fuel use and emissions by trimming less efficient generation at the utility. Fuel efficiency for site steam generation has also been significantly improved and the overall site reliability greatly enhanced through significant replacements and upgrades of the aged infrastructure. Annualized energy savings are approximately 8,355,000 MMBtu, or 19.2% per unit of production.
Number: 20
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing - Plant Site
Entity: Baton Rouge, Louisiana Plastics Plant Site
Title: Reactor Preheat Modifications

Description: The challenge was to increase production capacity and at the same time reduce unit energy consumption on the E-Line Reactor. Rigorous techniques of risk analysis and value engineering on the process flow and reactor designs were used to identify and evaluate project alternatives. As a result, the reactor line was reconfigured to reduce consumption of high-pressure steam to preheat the reactor feed, produced by gas-fired boilers, and a boiler was installed to generate low-pressure steam from process heat. Consumption of high-pressure steam was reduced more than 40% per unit of production, and about 5,000 lb/hr of low-pressure were generated by the boiler using the previously unutilized process heat. Surplus low-pressure steam is now exported from the area for use elsewhere at the site, further reducing demand from natural gas fired boilers. In addition, electricity consumption for the process was reduced by supplying higher pressure ethylene to the compression train, modifying the polymer extruder, and modifying the reactor to increase the conversion of monomer to polymer. A further benefit of these changes was the reduction or elimination of infrastructure capital investment – boiler capacity, power distribution and cooling tower expansion – that otherwise would have been required for the added production volume. Annualized energy savings are approximately 671,000 MMBtu, or 25.6% per unit of production. ExxonMobil is now licensing this technology.

Number: 21
Company: BASF Corporation
Category: Energy Efficiency Program - Corporate/Business Unit
Entity: BASF Corporation
Title: Energy Management Program

Description: In 1993 BASF Corporation’s Executive Committee established an Energy Management Program, in line with the voluntary guidelines in the American Chemistry Council’s Energy Efficiency Continuous Improvement Program, to develop the potential for energy efficiency improvements. An Energy Management Steering Committee, consisting of group vice presidents and manufacturing directors and chaired by a division president, was put in place to foster an awareness of energy savings’ importance and potential and to guide development and implementation of the program. An Energy Management Group was constituted to provide centralized technical support to the sites, monitor performance and report results to the Executive Committee on a regular basis. Noteworthy aspects of the program included the conduct of energy surveys at numerous sites; establishment of a company award program; and, publication of personal and team accomplishments in the corporate newsletter. Each plant focuses on its best energy
savings opportunities based on that plant's business environment, expansion plans, infrastructure requirements, capital availability and operating costs. Many sites
developed quantitative and qualitative mid-term energy goals, and many sites have
already achieved their goals. New facilities are designed with the latest in energy
efficient technology and utilize the latest tools for process optimization and heat
integration. Expanding energy requirements at these sites have been met by high
efficiency cogeneration plants. As a result of these activities, BASF Corporation has
demonstrated continuous improvement in energy efficiency since 1991. Between 1990
and 1999, purchased energy per pound of production has decreased 40%. In absolute
terms, purchased energy use has declined almost 10% even as production has increased
more than 50%. In 1999, annualized energy savings were approximately 5,250,000
MMBtu, or 10% per unit of production.

Number: 22
Company: BASF Corporation
Category: Energy Efficiency Program - Corporate/Business Unit
Entity: BASF Corporation
Title: Motor Management Guideline

Description: An initial survey within BASF Corporation revealed a vast number of
differences in motor management procedures, and no one method that was entirely
correct. Consequently a Motors Team was established in 1998 consisting of
representatives from the largest manufacturing sites, Corporate Engineering, Corporate
Energy Management and one outside consultant. The Motors Team was charged with
developing a Guideline that would apply to all of the company's business units and
manufacturing sites. Given the different levels of engineering staff and guidance at the
various sites, the Motors Team needed to develop a Guideline that addressed technical
issues surrounding motor management while presenting this information in an easily
usable format. The Guideline could then be the basis for site-specific motor management
policies, but was complete enough to adopt "as is". Over a one-year period the Motors
Team addressed a myriad of electric motor issues. Its starting point was the examination
of existing programs such as Motor Master Plus and other "canned" programs available
on the market. When complete, the new BASF Motor Management Guideline was
introduced in a series of roll-out presentations at key regional company facilities. A
tracking procedure was established using an accounting software program (SAP) which is
employed for maintenance management. The estimated potential energy savings through
this program are in the 3-5% range. Annualized energy savings in 1999 were
approximately 50,000 MMBtu. Expected annualized energy savings when the program is
fully implemented are approximately 300-400,000 MMBtu.
Number: 24
Company: Eastman Chemical Company
Category: Significant Improvement in Manufacturing - Project
Entity: Polymer Intermediates Department, Carolina Operations
Title: Reduce Cooling Tower Water Demand

Description: Process cooling in a process in the department is provided by a cooling tower, river water and chilled water. Process improvements had been made to increase production output and the additional demand exceeded the capacity of the cooling tower. This project included alterations to maintain the critical process temperatures and increase the temperature setpoints on components of the process to optimize the cooling tower capacity and optimize process heat. Process instrumentation was used to identify all process conditions. Piping and instrument modifications were made to obtain optimum conditions. These changes lowered the water flow through the tower by 12,500 gallons per minute and improved the efficiency of the cooling tower. Reduced water flow in turn resulted in a substantial reduction in electrical energy demand. These changes deferred the cost of a new cooling tower cell, deferred the cost of modifications to the river water system, and decreased electrical energy costs. Annualized energy savings in 1999 were 54,000 MMBtu, or 39%.

Number: 25
Company: Eastman Chemical Company
Category: Environmental Impact - Project
Entity: Polymer Intermediates Department, Carolina Operations
Title: Reduce River Water Demand in Polymer Intermediates Processes

Description: Much of the process cooling in the polymer intermediates chemical processes is provided by river water. In the past, river water usage in all intermediates process areas normally was much higher than needed for proper operation of the processes. This required more high and low pressure river water to be pumped around the plant and also required running more pumps than needed. Sometimes, when the river level was low, the high river water usage resulted in problems such as process capacity limitations and/or increased costs due to paying for additional water release from the dam upstream of the plant site. Process instrumentation was used to identify all process conditions. Optimum flow and temperature conditions were identified and piping and instrumentation modifications were made to obtain these conditions. River water flow to the process heat exchangers was reduced by manually throttling river water flow, creating river water flow control loops using existing equipment, or increasing the temperature setpoints on some components of the process. Physical changes to plant and equipment consisted of installing one new control valve, repairing several existing control valves, relabeling wiring, transmitters and control valves and updating DCS and drawings. As a
result of this project river water flow was reduced by 7,000 gallons per minute, of which 5,500 gallons per minute was high pressure water. Reduced use of river water pumps resulted in reduced demand for electricity. Annualized energy savings in 1999 were 36,500 MMBtu or 50%.

Number: 27  
Company: Eastman Chemical Company  
Category: Environmental Impact - Operating Unit  
Entity: Utilities Division, Tennessee Operations  
Title: Improvements in Boiler Operating Efficiency and Utilization of Fly Ash

Description: Operations, maintenance and engineering teams at a Tennessee Operations powerhouse combined efforts to improve the operating efficiency of five coal-fired boilers and at the same time increase utilization of the fly ash combustion by-product. Coal pulverizing equipment operation and maintenance practices were improved to optimize the quality of the fuel delivered to the boilers. This enabled operations to reduce the quantity of combustion air, which reduced the quantity of combustion gases and heat emitted from the boiler stacks. (Excess oxygen in stack gases dropped from 5.0% to 3.6%.) In turn, the annual energy demand for coal decreased by about 190,000 MMBtu. At the same time, the improved fuel quality resulted in higher quality fly ash. The average carbon content (unburned coal) of the ash, measured as "loss on ignition", dropped from 5.7% to 5.2%, reflecting a further reduction in coal demand of 2,300 MMBtu per year. Annualized energy savings thus totaled approximately 192,300 MMBtu, or 1%. In addition, environmental benefits were achieved through increased sales of fly ash to the ready-mix concrete market of 10,000 tons per year, with a corresponding decrease in fly ash disposal to the site landfill.

Number: 28  
Company: Eastman Chemical Company  
Category: Environmental Impact - Project  
Entity: Oxo Aldehydes Department, Texas Operations  
Title: Co-Product Feed to Gasifier Reduces Incineration Load

Description: Liquid co-products from three separate plants were formerly incinerated or sold at low value. The challenge was to eliminate this incineration and reduce the requirement for natural gas and other feedstocks to an existing gasification reactor to produce synthesis gas, without jeopardizing safe, continuous operation. To do this the co-product streams from the three locations had to be combined and fed as a single, continuous stream to the reactor. Potential feed streams were identified. Several operating departments collaborated to develop the scope for the co-product collection system. Engineering and operations personnel worked with the gasifier technology licensor to develop a process design package. The gasifier feed injector and feed system were redesigned to conform to stringent safety system guidelines. Co-product storage tanks and pumps were installed for collecting the streams and feeding as a single stream.
A new feed injector was installed and safety controls added to an existing programmable logic control system. Implementation of this project resulted in reduced incineration of co-products and backed out consumption of natural gas and other feed to the gasifier. Annualized energy savings were approximately 244,000 MMBtu, or 13%.

**Number: 29**
**Company:** Eastman Chemical Company
**Category:** Significant Improvement in Manufacturing - Project
**Entity:** Utilities Department, Texas Operations
**Title:** New Controls Upgrade Boilers' Efficiencies

**Description:** Texas Operations has four 600-psig boilers that were originally designed to burn natural gas, but now burn a mixture of natural gas and plant off gas. The composition of the fuel varies frequently and to swing tremendously. When the fuel gas was changed to a mixture of natural gas and plant off gas, the original pneumatic combustion control systems could not handle the fluctuations in heat value without major changes to the control systems. The controls were set up and tuned to provide more combustion air than required in order to maintain an adequate safety margin during "automatic" operation. The boilers could not be run at their optimal efficiency. To address this problem, a redundant calorimeter system was installed to measure the fuel's heat value. A DCS (distributed control system) was installed to optimize the combustion controls. Electronic instrumentation was added to increase the data reliability. The new controls system now predicts the airflow needed for a given fuel flow to account for the fuel's changing heat value. Instead of having preset conditions that don't meet all operating scenarios, the boilers now have controls that respond to them. More control allows operations to run with less airflow, increasing the boilers' efficiencies because heat is transferred to the water instead of to the excess air. Annualized energy savings were approximately 120,000 MMBtu, or 3%.

**Number: 30**
**Company:** Eastman Chemical Company
**Category:** Energy Efficiency Program - Operating Unit
**Entity:** Epolene/Eastoflex Department, Texas Operations
**Title:** Energy Savings through Process Improvement and Simplification

**Description:** Plant personnel recognized that opportunities existed to reduce steam usage through better understanding of metering and reporting, and by closing the gap between actual usage and theoretical requirements. First, the metering system was brought into shape to provide the tools for evaluation and verification of future reductions. Once the direction and magnitude of all steam and condensate flows were known, weekly totalizer readings and a detailed spreadsheet showing the steam breakdown by area provided a structured and disciplined framework that greatly aided efforts. Involved personnel then started a two-fold approach of closing the energy balance around each major steam user and evaluating whether the unit was required for
continued operation. Specific efforts resulting in reductions included 1) elimination of process vessels and heaters that were found to be unneeded; 2) improved understanding of the characteristics of the different steam traps used; 3) an aggressive external leak reduction program, and 4) evaluation of internal steam leak paths (bypasses), which were either eliminated or fitted with flow restricting devices. Annualized energy savings were 114,000 MMBtu, or 48% of steam-related energy usage.

Number: 32
Company: Eastman Chemical Company
Category: Significant Improvement in Manufacturing - Operating Unit
Entity: No.2 Olefin Department, Texas Operations
Title: Modify Eastman PSA Unit Mode of Operation to Recover Off-Gas for Waste-Heat Boilers

Description: A Pressure Swing Adsorption (PSA) unit is used in one of Eastman's hydrocarbon cracking plants to produce high purity hydrogen from a fuel-gas stream containing methane and hydrogen. The PSA unit was originally configured to operate in one of two modes: 1) High Pressure mode for normal hydrogen production with fuel-gas (primarily methane) recovery, and 2) Low Pressure mode for maximum hydrogen production with no fuel-gas recovery. The Low Pressure mode was used when plant hydrogen demand exceeded available supply. In this mode, however, the residual fuel-gas stream had to be flared due to insufficient pressure to return the stream to the process. A project was undertaken to provide for a third mode of operation: Moderate Pressure mode. Company personnel consulted with the PSA manufacturer to have the operating parameters adjusted for the Moderate Pressure mode. New piping and pressure control systems were installed to regulate the pressure in the off-gas stream that feeds the waste heat boiler burners. Then, new operating software from the PSA manufacturer was installed in the PSA unit's dedicated PC. Operating pressure for the PSA unit was manually adjusted to the new Moderate Pressure mode and then automatically controlled with the new operating software. The Moderate Pressure mode is now the normal mode of operation. In this mode the PSA unit can produce high purity hydrogen at 94% of maximum hydrogen production capability and also recover 100% of the residual fuel-gas stream by re-routing the fuel-gas to an alternate user, the waste heat boilers. The project resulted in a reduction in operating costs as well as reduced use of the flare. Annualized energy savings are approximately 73,015 MMBtu, or 1.4%.

Number: 33
Company: Nalco/Exxon Energy Chemicals, L.P.
Category: Non-Manufacturing Improvement - Corporate/ Business Unit
Entity: Sugar Land, Texas Research Facility
Title: HVAC Energy Conservation Upgrade Project

Description: The Company's Corporate Administration Offices and Research Facilities are comprised of four main buildings constructed between 1960 and 1984. Each building
had its own independent HVAC system consisting of boiler, chiller(s) and air-handling units. Chillers and boilers were sized to provide comfort during peak demand periods during the year but remained in the same mode of operation during non-peak periods. Following a study of the situation, a project was undertaken to install a continuous loop system that would tie equipment from the existing HVAC systems together and allow for automated computer controlled operation. The study also indicated that the new loop would allow for some of the existing equipment to removed altogether, and for other equipment to be placed into a mode of emergency back-up only. The construction phase connected the four mechanical rooms by running approximately 1000 feet of 6” pipe and approximately 500 feet of 4” pipe to complete the chilled-water and hot-water loops respectively. In addition, variable speed drives were installed on four pumps and nine air-handling units. Temperature sensors were installed at various locations in the buildings to allow for automated control. Approximately 5 miles of control wiring was installed to operate the new controllers installed on the equipment via a digital control system (DCS) with a computer interface. (The DCS system can be accessed remotely via modem by Maintenance Department Staff to inspect the operational status of the system and determine if any adjustments are needed.) One air-handling unit, two boilers and three chillers were taken completely out of service, and one boiler and one chiller were placed into emergency back-up mode. Annualized energy savings are approximately 48,245 MMBtu, or 33.7% of total energy consumed within the four buildings.

Totals: Nominations: 33 from 11 companies
Winners: 23 from 10 companies

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