# State of Delaware

## Governor's Energy Task Force

## Conservation and Efficiency Working Group Final Report

**June 2003**

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Hockessin, Delaware

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# Executive Summary

In April 2002, Governor Ruth Ann Minner issued Executive Order 31 forming the Delaware Energy Task Force. As part of that Task Force, the Conservation and Efficiency Working Group addressed numerous issues related to increasing energy efficiency in Delaware. The Working Group was chaired by the Honorable Chris Coons, President of the New Castle County Council, and included participants from a wide range of business, industry and government. Following the development of a formal work plan, information was gathered and analyzed to help guide policy recommendations for consideration by the Task Force.

The issue areas considered by the Working Group reflect several different dimensions of conservation and efficiency. They include:

- Delaware's Baseline End-Use Energy Consumption
- Comparison with Other States
- Analysis of Conservation and Efficiency Measures

### Delaware's Baseline End-Use Energy Consumption

The starting point for the Working Group's analysis was to gain an understanding of energy consumption in the State today. The analysis considered both primary energy consumption and end-use energy consumption using information from the Energy Information Administration (EIA) for 1999, the last year for which complete data is available.

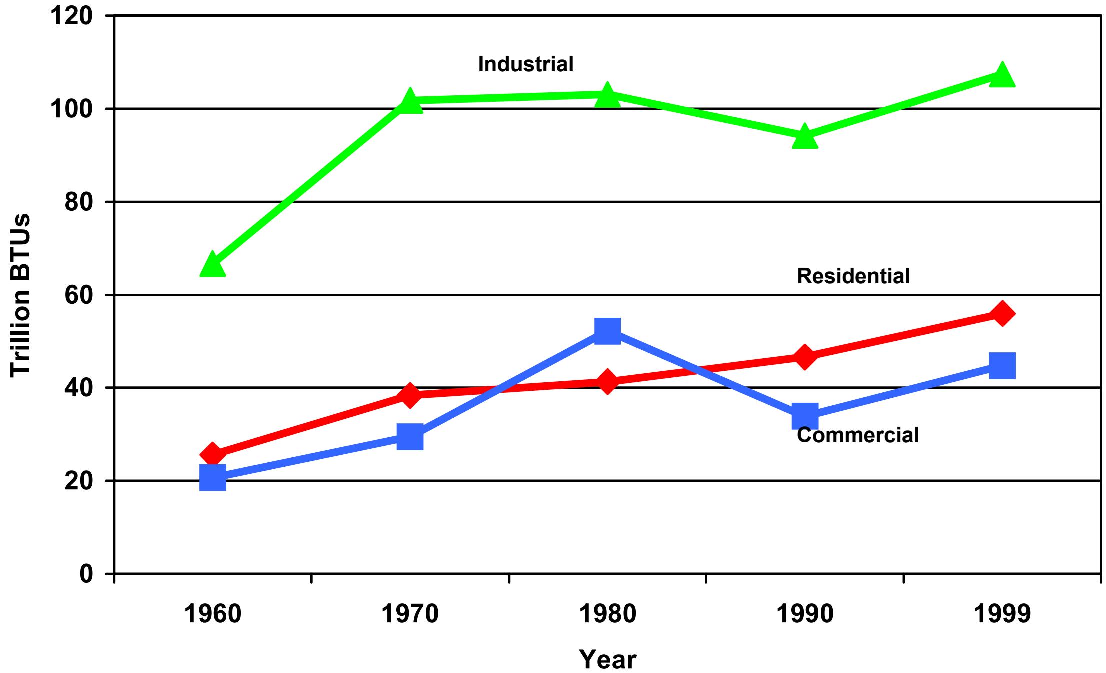
For the Conservation and Efficiency Working Group, the transportation sector was not included. The utility sector was included only to the extent that electricity system losses were allocated to the residential, commercial and industrial sectors. Specific efficiency measures in the transportation and utility sectors were outside of the Working Group's scope.

The amounts of energy consumed by each sector in 1999 are summarized in the following table. Electrical system losses, which include conversion, transmission and distribution losses are allocated to each sector based on its end-use electricity consumption.

**1999 Delaware Energy Consumption (trillions of BTUs)**

| *Sector* | *Coal* | *Natural Gas* | *Petroleum* | *Other* | *Electricity* | *Electrical System Losses* | *Total* |
|---|---|---|---|---|---|---|---|
| Commercial | - | 7 | 4 | 0 | 12 | 23 | ***46*** |
| Residential | - | 10 | 9 | 1 | 12 | 24 | ***56*** |
| Industrial | 4 | 23 | 44 | 0 | 12 | 24 | ***107*** |
| ***Total*** | ***4*** | ***40*** | ***57*** | ***1*** | ***36*** | ***71*** | ***209*** |

To place this in historical perspective, the following figure shows trends in the same sectors since 1960.




In the absence of additional energy efficiency measures, Delaware's energy consumption is expected to grow at a rate of approximately 1.7% annually in the residential, commercial and industrial sectors. Through 2010, this would result in total growth of approximately 13% under "business-as-usual" conditions. The environmental impacts would be proportional to the increased consumption levels.

The Working Group's analysis of energy consumption and end-uses reached several conclusions that affected the final recommendations:

- Space heating, water heating, air conditioning and major appliances account for the majority of energy consumption in the residential sector. Therefore it makes sense to focus on these areas for efficiency improvements in the short run. Delaware depends more heavily on fuel oil and LPG for residential heating, partly because natural gas is not available in many parts of the state. Efforts should specifically include fuel oil and LPG heating equipment efficiency. Building envelope measures aimed at reducing thermal losses should complement space heating and air conditioning equipment programs.

- The commercial sector is very electricity intensive, and the highest priority should be placed on measures that improve electricity utilization efficiency. Lighting, electric space heating, air conditioning, commercial refrigeration and office equipment efficiency should be targeted to accomplish this. Space heating and air conditioning equipment programs should be complemented by building envelope measures aimed at reducing thermal losses

- In spite of the difficulties collecting data about the Delaware industrial sector, it is dominated by a few end-uses. Fuels are used primarily in boilers and for direct process heating. Electricity is used predominantly to operate electric motors. To improve industrial sector efficiency overall:
    - Target motor efficiency to reduce electricity consumption in this sector
    - Target boiler efficiency, maintenance practices and proper sizing to reduce fuel consumption for steam and hot water production.
    - Target steam and condensate system maintenance to reduce energy consumption for steam generation.
    - Target process heating systems to reduce fuel consumption for drying, curing, and other industrial heating processes.
    - The industrial end-users with potentially the greatest needs are small to medium sized firms with limited access to expertise and capital.

**Comparison with Other States**

In her opening remarks to the Task Force in June 2002, Governor Minner stated that she wanted Delaware to be the "most energy-efficient state." In order to achieve this, it is important to understand where Delaware currently stands with respect to other states. There are several ways to make this comparison. The following information helps to put Delaware's energy consumption in perspective nationally based on 1999 EIA data.

- Delaware is approximately at the median for per capita energy consumption, including energy used for transportation.
- The State is ranks thirteenth on the basis of average energy prices.
- Partly as a function of price, Delaware also ranks fourteenth in the nation for per capital annual energy expenditures.

Delaware and four other states that comprise the Mid-Atlantic region were also compared. The other states are Maryland, New Jersey, Pennsylvania and New York. The basis for comparisons with other states is energy intensity, that is, the amount of energy consumed per capita, per household or per dollar of economic output. New York is the most energy-efficient state in the continental United States based on per capita consumption, and thus establishes a benchmark for comparison.

Based on total consumption, Delaware has the highest per capita energy consumption of the five states. However, based on energy consumed per dollar of GSP, Delaware is approximately in the middle of the range between New York (the least energy intensive) and Pennsylvania (the most energy intensive).

The largest differences between the states appear in the industrial sector. Per capita energy consumption in the industrial sector differs by a factor of nearly three between Delaware (highest) and New York (lowest). Delaware is surpassed in industrial energy consumption per dollar of GSP only slightly by Pennsylvania. Based on energy intensity per dollar of GSP, it is apparent that Delaware's industrial sector is still a major part of the State's economy. In comparison, New York, New Jersey and Maryland appear to have less energy-intensive industry, and these industries play a smaller role in those states' economies.

Compared to New York:

- In the residential sector, per capita energy consumption in Delaware is about 27% higher, and Delaware's homes are more electricity intensive, probably reflecting the higher saturation of electric heat pumps and electric hot water heaters. Total electricity consumption for air conditioning is also probably higher due to climatic differences. Finally, homes in the heavily urbanized New York metropolitan area are probably somewhat smaller on average, leading to lower overall energy consumption.

- The situation between Delaware and New York is reversed in the commercial sector. In this case, New York's per capita commercial energy consumption is about 12% higher than Delaware's. This may indicate, among other things, that the size of the commercial sector in relation to the overall state economy is larger in New York than in Delaware. This is bolstered by the relatively low level of industrial energy consumption in comparison to Delaware. Commercial activities in New York may also be more energy intensive, and the commercial building stock in New York is probably older and therefore less efficient than Delaware's. It is also apparent that the commercial sector in Delaware is more electricity intensive than in New York. This is probably due, at least partially, to higher energy consumption for air conditioning.

- There are major differences between Delaware and New York in per capita industrial energy consumption. When compared to New York, Delaware uses about three times as much energy in the industrial sector. Even if the two most energy intensive industries in the State are removed from the data, Delaware would still consume about twice as much energy in the industrial sector. It is likely that Delaware's industrial sector constitutes a larger portion of the state's economy in relative terms. Also, given Delaware's small population in comparison to New York, it has more energy-intensive industrial activities.

If overall energy intensity measures are used as the basis for establishing a target for Delaware, and New York is used as the benchmark for comparison, energy consumption per capita would have to be reduced by approximately 35% and energy per dollar of GSP would have to reduced by about 30%. Coincidentally, this corresponds with the level of reduction suggested by the

Delaware Climate Change Action Plan (DCCAP) in 2000.[1] The DCCAP analyzed policy measures that would help the state achieve greenhouse gas emission levels that would be 7% lower than 1990 levels by 2010. The DCCAP was the result of a collaborative between the State Energy Office, the U.S EPA's State and Local Climate Change Program, the University of Delaware's Center for Energy and Environmental Policy and numerous public and private sector stakeholders.

Although overall energy intensity is a useful measure of Delaware's energy efficiency, it is incomplete. A more complete evaluation would consider each sector individually and make appropriate adjustments. For example:

- The residential sector comparison should correct for climate by evaluating energy consumption based on heating and cooling degree-days per square foot.

- In the preceding analysis, Gross State Product was used to evaluate commercial and industrial sector energy intensity. However, economic output should be separated into commercial and industrial categories. This would provide a truer picture of energy intensity in these sectors relative to their importance in each state's economy.

The basis for comparing Delaware to other states in order to measure progress towards the Governor's goal will require further study. However, there are clearly opportunities to improve efficiency and reduce energy intensity, regardless of how the overall results are measured. This is corroborated by the Delaware Climate Change Action Plan.

## Analysis of Conservation and Efficiency Measures

Based on energy end-use analyses, the Conservation and Efficiency Working Group began the development of recommendations to improve efficiency in the State. The basis for developing the Working Group's recommendations was the Delaware Climate Change Action Plan. The DCCAP focused much of its work on energy efficiency policies as the means to reduce greenhouse gas emissions. The Working Group went one step further by using the policy framework provided by the DCCAP to develop more specific program recommendations. In addition to the role played by the DCCAP, the Working Group also briefly assessed on-going conservation and efficiency programs in the State. The majority of these are utility-based information programs, with additional information provided by the State Energy Office, the Delaware Million Solar Roofs Coalition and the U.S. EPA/DOE Energy Star Program.

The types of programs analyzed by the Working Group included:

*Education and Outreach:* Educational programs provide the core of many other types of programs, including financial incentives, and are viewed as the first step towards achieving higher efficiency levels.

[1] Byrne, J.B., et. al., Delaware Climate Change Action Plan. University of Delaware Center for Energy and Environmental Policy, Newark, DE, January 2000. Full report available at www.udel.edu/ceep/reports/deccap/deccap.htm.

*Building Codes:* Energy codes prescribe minimum design and construction standards and therefore have a very large influence on building stock efficiency for many years into the future.

*Incentive Programs:* Incentive programs include both non-financial and financial incentives. Non-financial programs generally provide recognition of efforts that go beyond conventional practices. Financial and tax incentives are powerful tools which should be used to encourage adopting technologies or products that have clear energy and environmental benefits but face significant market barriers. They should not be used to promote technologies or products that are clearly cost effective or are already in widespread use.

*Renewable Energy in Buildings:* Finally, the Working Group considered renewable energy in buildings. Although not directly related to conservation and efficiency, the use of renewables is made considerably more effective when done in conjunction with efficiency improvements.

## Recommendations

The Working Group developed a series of recommendations based on all of the issues and information considered in this report. Each recommendation is summarized below. Recommendation priorities and cost-effectiveness, if applicable, are provided in the full report.

### Recommendation CE1: Update residential and commercial building energy codes

Several different versions of building and energy codes are in use across the State. To date, only New Castle County has adopted the latest residential building codes. Residential energy codes are still based on the 1993 Model Energy Code and commercial energy codes are still based on ASHRAE 90.1-1989.

Residential building and energy codes should be uniformly updated in each jurisdiction. The 2000 International Building Code (IBC) and the 2000 International Energy Conservation Code (IECC) should be adopted in each county and municipality having jurisdiction over building and energy codes.

### Recommendation CE2: Provide training for building code inspectors

Residential and commercial energy code compliance is uneven and enforcement is not uniform across the state.

Training on the IECC for code inspectors, builders and developers is needed in order to comply with and to enforce energy codes. Funding should be provided to support training in conjunction with an implementation timetable.

**Recommendation CE3: The State should join the U.S. EPA/DOE Energy Star Program**

The Energy Star Program is underutilized within the State. The Energy Star Program provides considerable support in key areas of energy efficiency and conservation, from individual appliance and consumer information to building construction practices and benchmarking.

The State should join the Energy Star Program as a partner and make full use of available Federal resources. The State would be required to sign a Memorandum of Understanding. As part of joining Energy Star, the State should also urge other government and business entities to join the Energy Star Program.

**Recommendation CE4: Promote Energy Star equipment and construction practices**

Consumers, builders and contractors are often unaware of the cost-savings and environmental benefits of energy-saving equipment. Contractors often do not promote cost-effective measures for new construction.

The State should aggressively promote the use of EnergyStar Program rated appliances, space conditioning equipment, office equipment and construction practices. A concentrated public relations and advertising campaign should be initiated to raise awareness among energy users at all levels. EnergyStar should also be promoted through the use of conferences, workshops, training and benchmarking tools available through the EPA.

**Recommendation CE5: Develop residential consumer information and audit websites, hotlines and other outreach tools**

Information for residential energy consumers is fragmented and often hard to understand. The State should sponsor the development of a "self-audit" website, energy hotline and/or other tools and information kits for residential energy consumers.

**Recommendation CE6: Consumers should be made aware of the link between energy use and environmental and economic impacts**

Consumers are generally unaware of the economic and environmental impacts of energy use in their homes.

In conjunction with the Energy Star promotional campaign, the State should develop and implement a comprehensive consumer education program regarding the use of energy in residential settings. The program should prominently feature the economic and environmental benefits of energy efficiency, conservation and renewable energy options.

**Recommendation CE7: Provide incentives to spur the purchase of energy-efficient appliances in the residential sector**

The initial costs of energy-efficient major appliances (e.g., air conditioners, furnaces, refrigerators, etc.) are often a barrier when consumers must make purchasing decisions in the residential sector. In most cases, the additional costs are repaid quickly by energy savings.

Direct incentives for selected appliances should be established to reduce the initial cost barrier to the purchase of energy-efficient appliances. Incentives may be directed to retail or wholesale purchasers, builders or contractors. Incentives should be provided for EnergyStar rated air conditioners, furnaces, heat pumps, hot water heaters, refrigerators and freezers and clothes washers.

The initial step should be to evaluate the Delaware market to insure that such incentives are appropriate for local conditions.· The level of incentives, payment mechanisms, target markets and all other aspects of program design should be developed separately as part of a comprehensive energy planning process.

**Recommendation CE8: Increase the current rebate levels for photovoltaic and solar thermal systems through the Environmental Incentive Fund**

The direct incentives for residential photovoltaic and solar water heating systems offered by the Environmental Incentive Fund's Energy Alternatives Program are too low to stimulate the market. To date only four residential photovoltaic systems have been installed that were eligible to utilize an EIF incentive.

**Recommendation CE9: Promote energy efficient mortgages**

Energy efficient mortgages are available from several lenders, although they are not widely used. Energy efficient mortgages offer buyers a lower interest rate in return for purchasing a home meeting certain energy efficiency levels.

The State should develop outreach programs to builders, lenders and consumers to increase awareness of energy-efficient mortgages. Information provided by FNMA indicate that an average home spends $1,900 per year on energy and that an efficient home can save up to 50% on energy bills. Energy efficient homes make mortgages more affordable and have higher market value.

**Recommendation CE10: Include energy efficiency criteria in publicly funded low income housing renovations**

Low-income households spend as much as 25% of their income on energy. In comparison, higher income households spend only 3.5 to 5% on energy. The Delaware State Housing

Authority (DSHA) does not currently include energy efficiency in ranking multi-family low income housing renovation projects.

DSHA should include energy efficiency as a criterion for ranking and selecting multi-family renovation projects. Criteria for selecting renovations projects, including consideration of energy efficiency, should be established as part of a comprehensive energy planning process.

**Recommendation CE11: Evaluate low income weatherization funding**

The current backlog for weatherization assistance is now about five years. The weatherization assistance program is currently funded from utility payments, the U.S. DOE, and oil overcharge funds. The current backlog is expected to worsen as oil overcharge funds are finally exhausted.

Funding for weatherization should be examined with the aim of reducing the backlog and ensuring that Federal money to support the program continues to be available.

**Recommendation CE12: Develop new regulations to promote the current uses of the Environmental Incentive Fund**

The Environmental Incentive Fund lacks the administrative, marketing and education budgets needed to appropriately manage and promote the program. The Delaware Million Solar Roofs partnership, through a $50,000 grant from the US DOE, has supported a significant portion of the marketing and promotion of the existing program. However, these funds are available only through a competitive bidding process and may not be available year-to-year.

New regulations should be developed and approved to allow the use of EIF monies to support the administration, marketing and educational needs of EIF’s Energy Alternatives Rebate Program.

**Recommendation CE13: Develop commercial sector energy audit and information programs**

Many building owners and operators do not understand or do not think about the value of energy efficiency in day-to-day operations or design and construction of new facilities.

The state should sponsor a program of commercial building energy audits, web-based information and other forms of information to help commercial building owners and operators evaluate energy efficiency options. The program should include the promotion of building operator educations and certification programs, such as those developed by AEE.

**Recommendation CE14: Provide incentives to spur purchases of energy-efficient equipment in new and renovated commercial buildings**

Initial costs of energy-efficient equipment (e.g., lighting, motors, HVAC equipment, refrigeration equipment, office equipment, etc.) are often a barrier when commercial buildings are constructed or renovated.

Rebates or tax incentives, including tax credits and accelerated depreciation, should be developed to encourage the procurement and use of cost-effective, energy-efficient equipment. The level of incentives, payment mechanisms, target markets and other aspects of program design should be developed separately as part of a comprehensive energy planning process.

**Recommendation CE15: Establish a "Governor's Award" for excellence in energy-efficient residential and commercial buildings**

Residential and commercial buildings can be designed to significantly exceed the minimum standards established in energy codes. For example, the EPA and DOE have developed the Energy Star Homes Program as a way to encourage energy-efficient design and construction practices in the residential sector that go beyond conventional practices. Similarly, the U.S. Green Building Council has established Leadership in Energy and Environmental Design (LEED) design standards for commercial buildings.

The State should sponsor a "Governor's Award" program to recognize the efforts of builders and building owners who design in accordance with Energy Star (residential) and U.S. Green Building Council "LEED" (commercial) standards. Design of the award program should include separate categories, e.g., small business, large business, residential, school, hospital, etc.

**Recommendation CE16: Establish an Energy Star construction pilot program for public housing**

Energy Star residential construction practices can be showcased in public housing, thus providing builders and lenders tangible examples of how to construct such housing.

The State should mandate that at least a portion of publicly funded housing be constructed to meet Energy Star standards as a pilot program.

**Recommendation CE17: Provide financial incentives for commercial buildings designed in accordance with LEED Standards**

Although commercial buildings can be designed in accordance with LEED and other advanced energy efficiency standards, there is usually little impetus to do so. In addition to the official recognition that can be provided by the Governor's Award, rebates or tax incentives, including tax credits and accelerated depreciation, should be developed to encourage commercial building design in accordance with LEED certification standards.

**Recommendation CE18: Develop an industrial audit and information program for small and medium sized industrial energy users**

Many small and medium sized industrial energy users do not understand or do not think about the value of energy efficiency.

The state should sponsor a program of industrial audits, web-based information and other forms of information to help industrial consumers evaluate energy efficiency options. In particular, the state should take full advantage of the U.S. DOE''s industrial assessment programs to assist small and medium sized manufacturers identify energy efficiency opportunities· The Delaware Manufacturing Extension Partnership (DMEP) should be enlisted to help promote energy efficiency and conservation in the industrial sector, especially for small to medium sized firms. Some of this work is already in progress under a grant from the U.S. DOE Industries of the Future Program. The University of Delaware's Center for Energy and Environmental Policy is managing this grant on behalf of the State Energy Office, including some industrial audits.

**Recommendation CE19: The State should take full advantage of the U.S. DOE Motor, Steam, Process Heating and Compressed Air Best Practices Programs**

The industrial sector is typically far more sensitive to energy costs because they make up a much larger share of total operating costs. Efficiency measures play an important role in managing these costs and enhancing industrial sector productivity and competitiveness. The U.S. DOE Office of Industrial Technologies offers industrial efficiency programs targeting the largest energy end-uses within the sector.

The state should fully engage the U.S. DOE's Motor Challenge, Steam Challenge, Process Heating and Compressed Air Best Practices Programs.

**Recommendation CE20: Establish a financial incentive for high efficiency electric motor retrofits**

Motors account for nearly two-thirds of industrial electricity consumption, making them a primary target for efficiency upgrades.

A prescriptive incentive program should be established to promote the procurement and installation of energy-efficient motors, variable speed drives and other motor efficiency improvement measures.

### Recommendation CE21: Develop a custom incentive program for industrial energy users

Industrial consumers are often very difficult to characterize as a group. The vast number of energy end-uses in the industrial sector, combined with the specialized nature of much manufacturing and process equipment means that financial incentives must be very flexible to account for the diversity in this sector.

A custom rebate/incentive plan should be developed based on the amount of energy saved through the implementation of eligible energy-efficiency measures. Measures could include upgrades and retrofits ranging from lighting to process specific improvements.

### Recommendation CE22: The State should continue funding appropriate energy demonstration projects

Targeted technology demonstrations serve an important purpose in establishing the viability and performance of energy efficiency and renewable energy technologies that may be appropriate for Delaware. The State Energy Office has supported this type of activity to date with oil overcharge funds. Since these funds are nearly depleted, additional resources are needed.

The State should continue to sponsor energy efficiency and renewable energy demonstrations, through cost-sharing, competitive grants, and other appropriate mechanisms.

### Recommendation CE23: The association between energy and water consumption should be explored to take advantage of opportunities to conserve both resources.

Energy use in all sectors is often directly related to water consumption. In addition, the water supply and treatment infrastructure uses a significant amount of energy. Green building standards, such as LEED certification, often include standards for water consumption. Given recent water shortages in Delaware, water conservation is an important goal in itself and can be facilitated by appropriate energy conservation measures.

Water conservation should be further investigated as a means to save energy. Specific measures can be integrated into energy codes and standards, especially where hot water consumption could be affected.

### Recommendation CE24: The State should establish and maintain an energy end-use data collection and analysis system to support future energy planning activities

End-use data collection, monitoring and analysis are not currently done in Delaware. Data collection at the national level often “regionalizes” Delaware in ways that obscure how energy is actually used within the state. End-use information is vital to on-going efficiency efforts.

The State Energy Office should establish and maintain a data collection and analysis system that can be used to detect progress towards efficiency goals, emerging trends and the impacts of specific programs and policies. The Delaware Climate Change Action Plan, which was developed by the Center for Energy and Environmental Policy at the University of Delaware, initiated a significant data collection effort, which can be used as the foundation for future data collection and analysis.

**Recommendation CE25: Evaluate expanding the Environmental Incentive Fund to include additional utility customers and increasing annual revenues**

The Environmental Incentive Fund was established to encourage the adoption of renewable energy technologies through direct incentives. Funds are only collected from and can only be used by Conectiv Power Delivery customers and can be applied only to PV, solar thermal, small-scale wind, and ground source heat pumps. The current restrictions on the fund limit its potential impact. An analysis should be undertaken to:

1. Assess how the EIF has worked to date

2. Examine how the EIF could be used to promote and provide incentives for certain high-efficiency technologies and other efficiency-related activities

3. Expand the EIF to cover all other Delaware utility customers and increase the contribution rate to be more in line with neighboring states.

If an increase in the EIF rate is recommended, the rate change should be implemented gradually. The rate of change should be tied to the level of increase, with higher increases taking place over a longer period of time.

**Recommendation CE26: Investigate expanding the use of demand response to reduce peak electric loads**

Demand response can be a very effective way of controlling peak loads and insuring reliability during high demand periods. A range of technologies are available that facilitate control of air conditioners, water heaters and other residential and commercial equipment for the purpose of load reduction. Load reduction strategies have been employed on the Delmarva Peninsula with varying degrees of success since the late 1980s, although interest has waned in recent years.

A study should be undertaken to investigate the applicability of demand response/direct load control technologies for the purpose of reducing peak loads, especially in high growth areas.

**Recommendation CE27: Investigate utility rate structures that encourage energy efficiency**

Utility rate structures can be used to encourage energy efficiency and load control for customers. This is a complex area requiring additional investigation, but examples include various types of time-of-use rates, real time pricing, and new information technologies that provide price signals to certain customers.

Utility rates, such as real time energy pricing, that encourage higher efficiency should be investigated. Pilot programs should be developed to implement viable alternatives. These activities should be coordinated with on-going Public Service Commission studies.

# Introduction

In April 2002, Governor Ruth Ann Minner issued Executive Order 31, which created the Delaware Energy Task Force. The Task Force's efforts were then divided among six Working Groups, including the Conservation and Efficiency Working Group. The central role of the Conservation and Efficiency Working Group was to address issues related to non-transportation energy end-use and efficiency in Delaware. The Working Group was therefore charged primarily with responding to Section 5.b.i. of Executive Order 31:

> *"5. The Delaware Energy Plan shall address the following goals and objectives:*
>
> *b. The development of conservation programs to reduce the need to build more electricity generation facilities through:*
>
> *i. Identification and promotion of business and residential energy use reduction opportunities."*

The Conservation and Efficiency Working Group addressed the goals and objectives set forth by the Governor in conjunction with five other Working Groups:

- Diversity of Fuels
- Transmission and Distribution (electric and natural gas)
- Transportation Fuels
- State Procurement
- Economic Development

Although the Conservation and Efficiency Working Group was largely autonomous, it communicated with the other working groups frequently through the Task Force, the Governor's Office and the Task Force support contractor. In addition, several members also participated on other working groups, which provided additional communication channels.

Members of the Conservation and Efficiency Working Group were:

| | |
|---|---|
| Chris Coons | President, New Castle County Council, Chair |
| Diane Jackewicz | Office of State Planning and Coordination, Staff Support |
| Bob Palmer | DNREC, Staff Support |
| Ralph Nigro | Applied Energy Group, Task Force Support Contractor |
| Marianne Abdul | Conectiv |
| Sandra Burton | Green Plains Energy |
| Gordon Carlisle | Delaware State University |
| Alexine Cloonan | Homsey Architects |
| Susan Frank | Fannie Mae Foundation |
| Ken Green | Carl Freeman Homes |
| Jack Hilaman | Blenheim Homes |
| Andrea Kreiner | Office of the Governor |
| James Loar | Ciba Specialty Chemicals |
| Thomas Marston | Energy Services Group |
| Brad North | Constellation Energy Source |
| Mindee Osno | U.S. EPA Region III |
| Robert Ruggio | Commonwealth Development |
| Dr. Paul Sample | Technical Advisory Office, Legislative Council |
| Sue Sebastian | State Energy Office |
| Anisha Shankar | Delaware Nature Society |
| Charlie Smission | State Energy Office |
| Bruce Smith | U.S. EPA Region III |
| Darren Stevenson | U.S. DOE Philadelphia regional Office |
| John Tower | GB2 Corporation |
| Young–Doo Wang | University of Delaware, Center for Energy and Environmental Policy |

The Conservation and Efficiency Working Group held ten meetings between August 2002 and March 2003 on a wide range of topics, including several presentations.

The purpose of this report is to present the Delaware Energy Task Force with the findings and recommendations of the Conservation and Efficiency Working Group. The report is divided into broad issue areas that reflect different dimensions of conservation and efficiency. They include:

- Delaware’s Baseline End-Use Energy Consumption
- The Importance of Electricity
- Comparison with Other States
- Energy Consumption in Delaware’s End-Use Sectors
- Conservation and Efficiency Measures and Potential Impacts

In her initial address to the Energy Task Force in June 2002, Governor Minner envisioned Delaware becoming the “most energy-efficient state.” The Conservation and Efficiency Working Group does not underestimate the challenges ahead in meeting the Governor’s goal. This report and its recommendations represent the general consensus of the group’s members in addressing the Governor’s goals and objectives.

# Delaware's Baseline End-Use Energy Consumption

The starting point for the Working Group's analysis was to gain an understanding of energy consumption in the State today. The following sections provide summaries of Delaware's energy consumption from the standpoint of primary and end-use consumption. All of the data is derived from the Energy Information Administration (EIA). The last complete EIA data set was for 1999, and is the basis for all of the figures and tables used in this section.

In general, energy consumption can be viewed in two ways:

**Primary Energy Consumption:** Primary energy consumption is the total input of basic energy resources (coal, oil, natural gas, etc.) into the State's economy. Primary energy consumption includes conversion losses. For Delaware, nearly all primary energy is in the form of fossil fuels. Because Delaware is interconnected to a regional power grid, electricity imports are treated differently. In this case, only the imported electricity is included in the State's total. The conversion losses from producing electricity outside of the State are not included.

**End-Use Consumption:** End-use consumption is the amount of energy delivered to consumers. Electricity losses may be allocated to each end-use sector as a way of indicating how much primary energy is used to generate electricity for that sector.

The EIA and many other analysts also break down energy consumption by end-use sector. The EIA categorizes end uses as follows:

- *Residential:* Includes all household use of energy.
- *Commercial:* Includes energy use by commercial establishments, public sector buildings, churches, schools, and a wide range of others. This sector may also include certain agricultural end uses, such as energy consumed by farmers, but not the energy used to process food products.
- *Industrial:* Includes a very wide range of manufacturing and process energy consumption
- *Transportation:* Energy consumed by all modes of transportation
- *Utilities:* Energy consumed by utilities to produce electricity from all resources, including fossil fuels, nuclear energy, hydro, and others.

Residential, commercial and industrial end-uses can be summarized not only by the amounts of specific fuels used within each sector, but also by their end-uses. These include the energy services provided by the various forms of energy delivered to the consumers, such as heating, air conditioning, lighting, motor drives, etc.

For the Conservation and Efficiency Working Group, the transportation sector was not included. The utility sector was included only to the extent that losses were allocated to the residential, commercial and industrial sectors. Specific efficiency measures in the transportation and utility sectors were outside of the Working Group's scope.

The amounts of energy consumed by each sector in 1999 are summarized in Table 1. Electrical system losses, which include conversion, transmission and distribution losses are allocated to each sector based on its end-use electricity consumption.

**Table 1: 1999 Delaware Energy Consumption (trillions of BTUs)**

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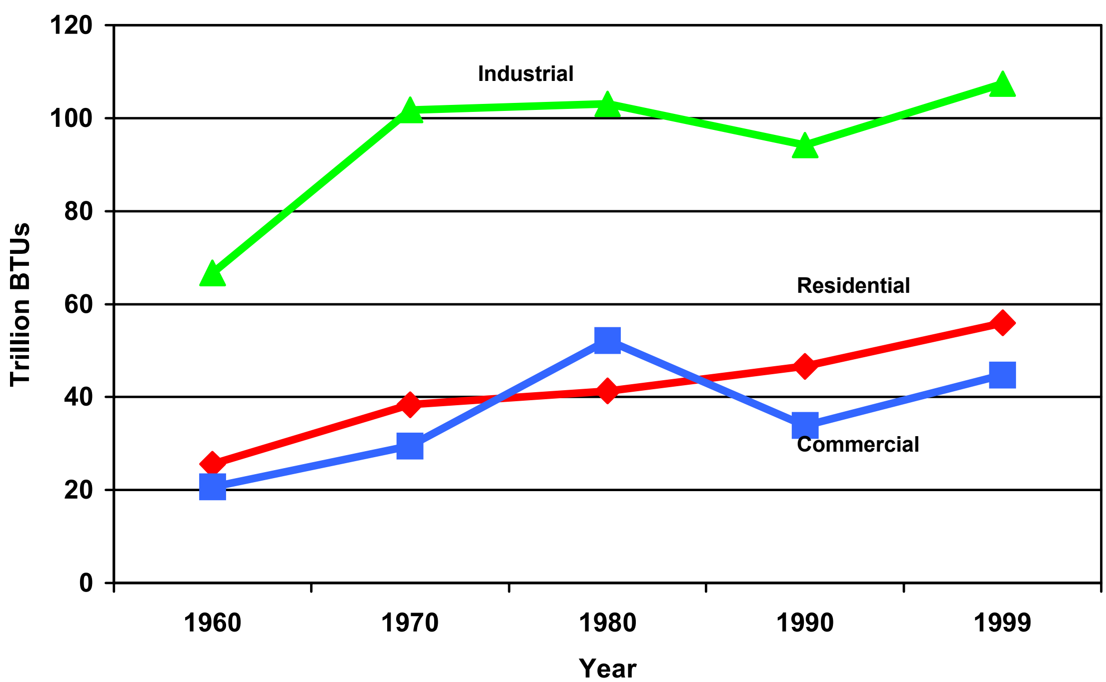


**Figure 1: Energy Consumption Trends in Delaware 1960-1999**

## The Importance of Electricity

Because of its convenience and versatility, electricity use is growing at a faster rate than any other form of energy. However, it is important to understand that electric power generation and delivery have inherent and significant losses. On average, only about 30% of the total energy input at power plants is converted to electricity for delivery to consumers. Even the most efficient fossil-fueled power plants in service today can achieve efficiencies of only about 50%. Generation losses are a result of largely unavoidable thermal losses at power plants.[2] Of the electricity generated at the power plant, about six to 10% is lost in transmission and distribution.

Effectively, this means that less than 30% of the energy delivered to a power plant in the form of coal, oil or natural gas can be delivered to the end user in the form of electricity. This has significant consequences when considering the environmental effects of power generation and the opportunities for improving efficiency. Improvement in electricity utilization provides a "three-for-one" leveraging effect in reducing primary energy consumption and associated environmental impacts.

When compared against other forms of energy, electricity and electricity system losses account for 51% of non-transportation primary energy input.

### The Need for Additional Generation

Base-case load growth forecasts indicate that Delaware's consumption of electricity will increase at a rate of slightly over 2% annually for the next decade.[3] Figures 2 and 3 show business-as-usual forecasts for growth in Gigawatt-hour (GWh) consumption for Delaware and corresponding peak load growth for the entire Peninsula in MW. Appendix A provides detailed forecast information. Growth in base load at this time is being met by increased purchases of energy from PJM, and this is likely to remain the most cost-effective means of meeting base load requirements. Given the rates of load growth, additional generating capacity will be required to meet future needs on the Peninsula. However, much of the load growth is taking place in areas that are also constrained by the transmission infrastructure. As load grows, constrained transmission operations and associated higher costs could become more frequent in the absence of either transmission or generation investments.

[2] Fossil-fueled power plant efficiencies are governed individual power plant designs. The vast majority of conventional fossil-fueled steam power plants in service today, which account for about 75% of the nation's generating capacity, are limited by both theoretical and practical constraints to efficiencies ranging from about 25 to 40%. Newer gas-fueled combined cycle power plants are more efficient, ranging from 40 to 50%. Efficiencies are constrained by the theoretical limits set by the laws of thermodynamics, and the practical limitations of materials, fuels and major components.

[3] Growth rates in southern Delaware are expected to be substantially higher as new residential and commercial development spreads. Parts of Sussex County may experience growth rates exceeding 10% annually for at least part of the forecast period.

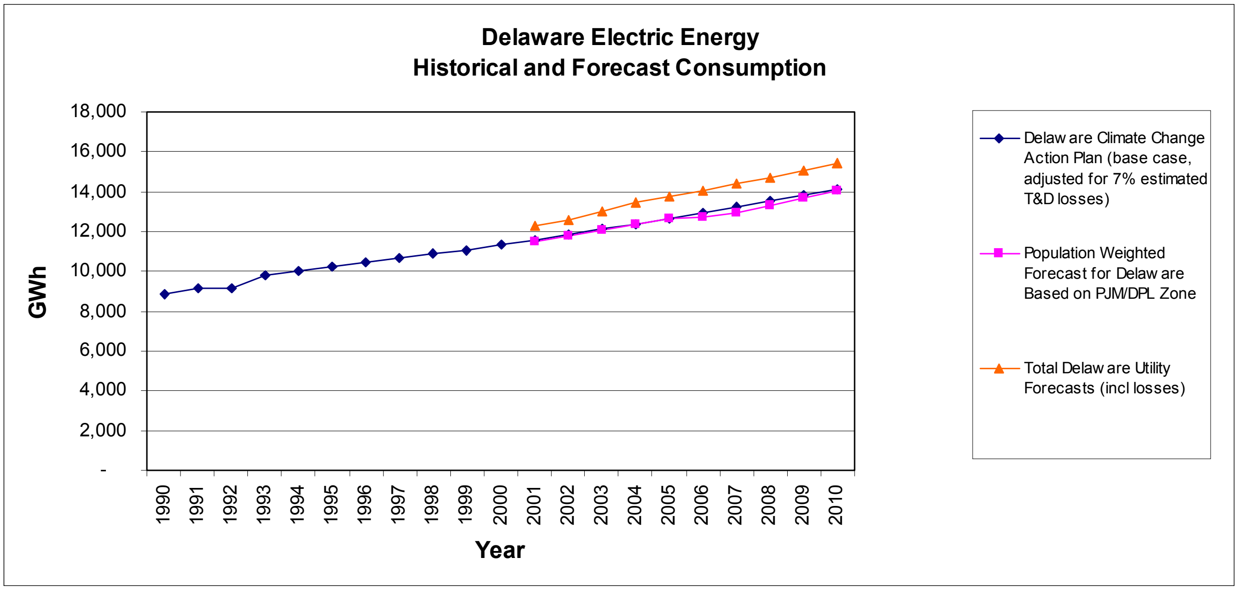


**Figure 2: Historical and Forecast Electric Energy Consumption**[4]

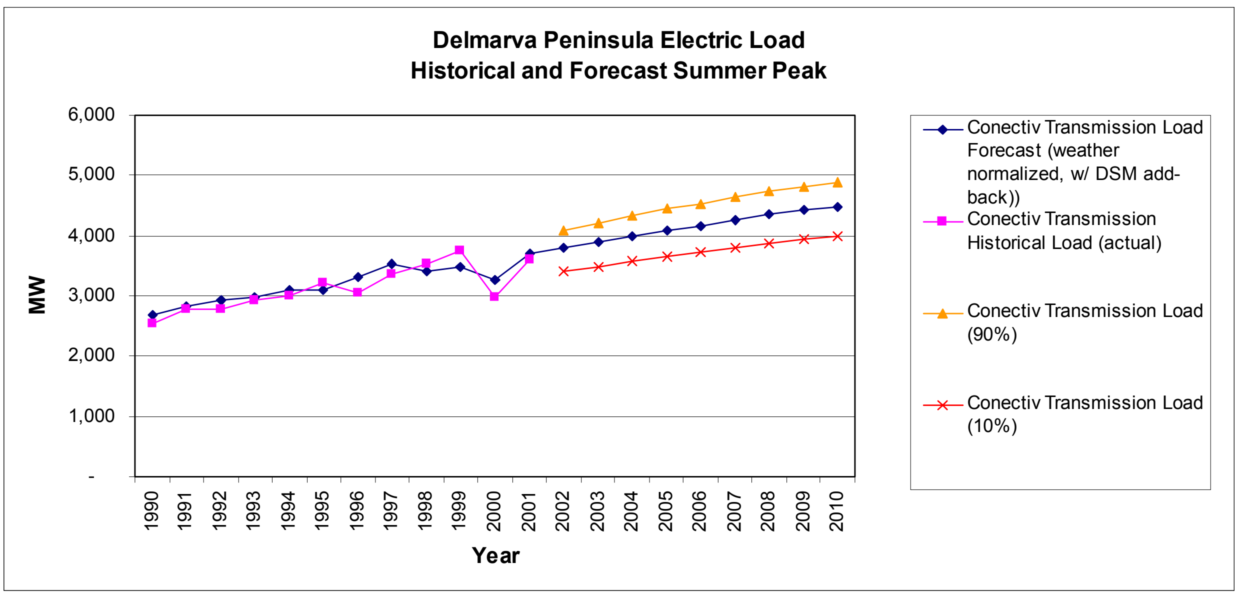


**Figure 3: Historical and Forecast Summer Peak Electricity Demand**[5]

[4] These forecasts were developed from information provided by three sources to estimate the total generation required to meet end-use consumption:

- Byrne, J.B., et. al., Delaware Climate Change Action Plan. University of Delaware Center for Energy and Environmental Policy, Newark, DE, January 2000. DCCAP forecast was a projection of end-use consumption, which was adjusted for T&D losses.
- www.pjm.com. PJM generation forecast for the Delmarva Zone, which includes Delaware and parts of Maryland and Virginia, was adjusted based on population.
- Utility forecasts were provided Conectiv, the Delaware Electric Cooperative and the Delaware Municipal Electric Corporation and combined to estimate total generation.

Environmental Impacts of Electricity

The environmental impacts of electric power generation are significant. Fossil fuel combustion releases sulfur dioxide, oxides of nitrogen, carbon monoxide, particulates and various air toxics. In most cases, environmental permits limit emissions of criteria pollutants from stationary sources such as power plants in order to meet National Ambient Air Quality Standards (NAAQS). However, New Castle and Kent counties are currently out of compliance with NAAQS requirements for ground-level ozone (smog). Both counties are classified as "serious non-attainment areas."

Total air emissions from Delaware's power plants have a significant impact on the environment. Figure 4 shows that total average daily emissions of the two key precursors to ground level ozone, NOx and volatile organic compounds (VOC). Although power plants emit very small amounts of VOCs in comparison to other sources, approximately 22% of NOx emissions within state boundaries are from power plants. Nearly all sulfur dioxide emissions from within Delaware are from power plants.

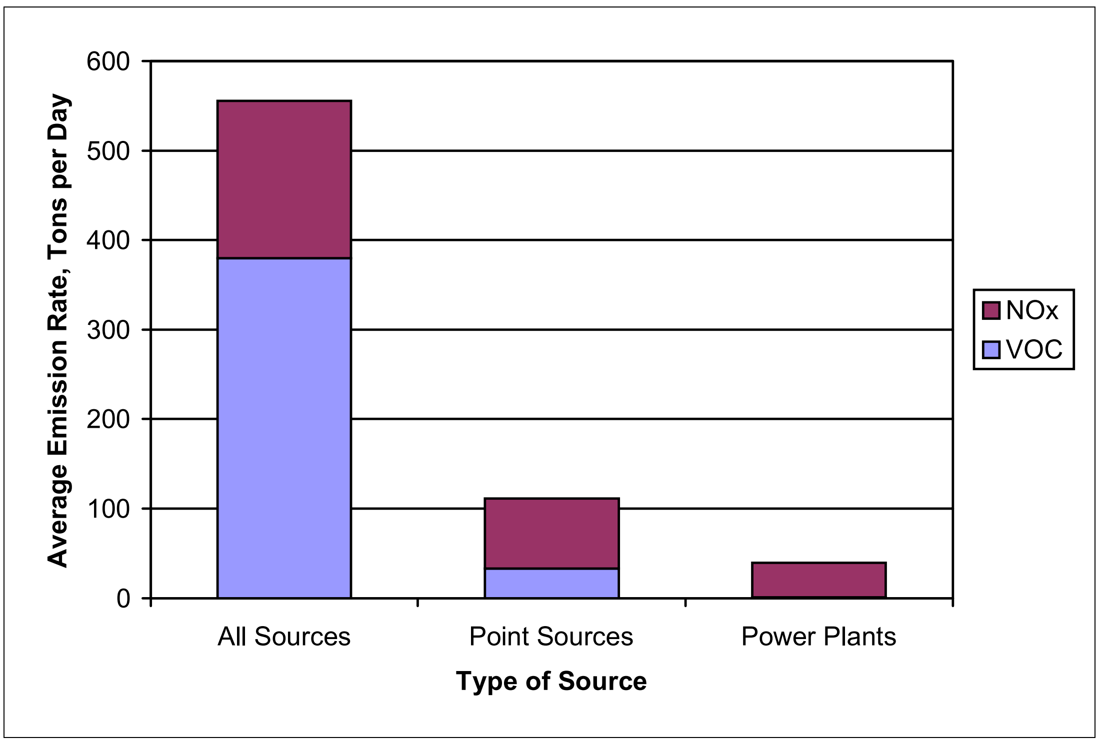


**Figure 4: NOx and VOC Emissions from Delaware Sources**

[5] Historical information was provided by Conectiv Power Delivery for the Delmarva Zone. Summer peak demand forecasts were provided by Conectiv Power Delivery to PJM and are available at www.pjm.com. Forecasts for peak loads are based on "weather normalized" (typical weather) conditions. Weather is one factor that affects forecast accuracy. To account for variables like extreme weather, the base forecast is presented within a range of high and low forecasts (90% and 10%). These 90%/10% forecasts represent probabilities that the peak load will be equal to or less than the median forecast.

This excludes emissions from out-of-state generating plants. A large portion of Delaware's electricity is imported from neighboring states, and at least some of the emissions from these out-of-state plants are transported to Delaware with corresponding effects on the State's air quality.

Electric power generation also has other environmental impacts. Approximately one-third of carbon dioxide emissions, a contributor to global warming, are a result of burning fossil fuels for power generation.

## Residential Sector

In 1999, the residential sector in Delaware consumed a total of approximately 56 trillion BTUs of energy in all forms. The following conclusions, which reference associated figures, aid understanding how this energy was consumed in this sector.

- From Figure 5, two-thirds of the primary energy consumed in Delaware's residential sector is electricity and electricity system losses. Natural gas, fuel oil and propane (LPG) account for the remainder of energy resource consumed in the residential sector.

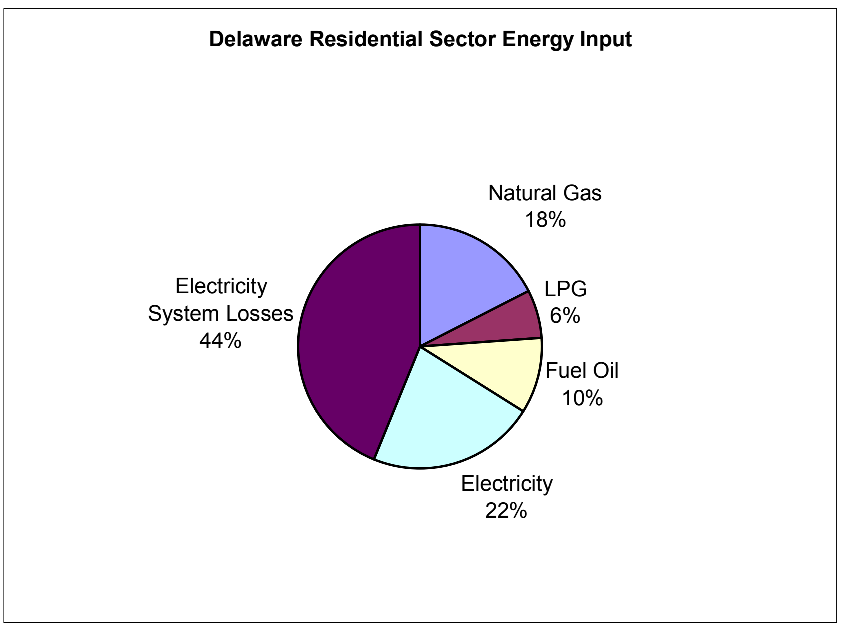


**Figure 5: Residential Sector Energy Input**

- Figure 6 shows that space heating, which accounts for 34% of all primary energy input in this sector, is the largest single end-use. From an end-use perspective, space heating can be provided from electricity, natural gas, fuel oil or propane. Water heating, and air conditioning are also large individual end-uses. However, 35% of energy consumption in the residential sector is in a wide array of electric appliances.

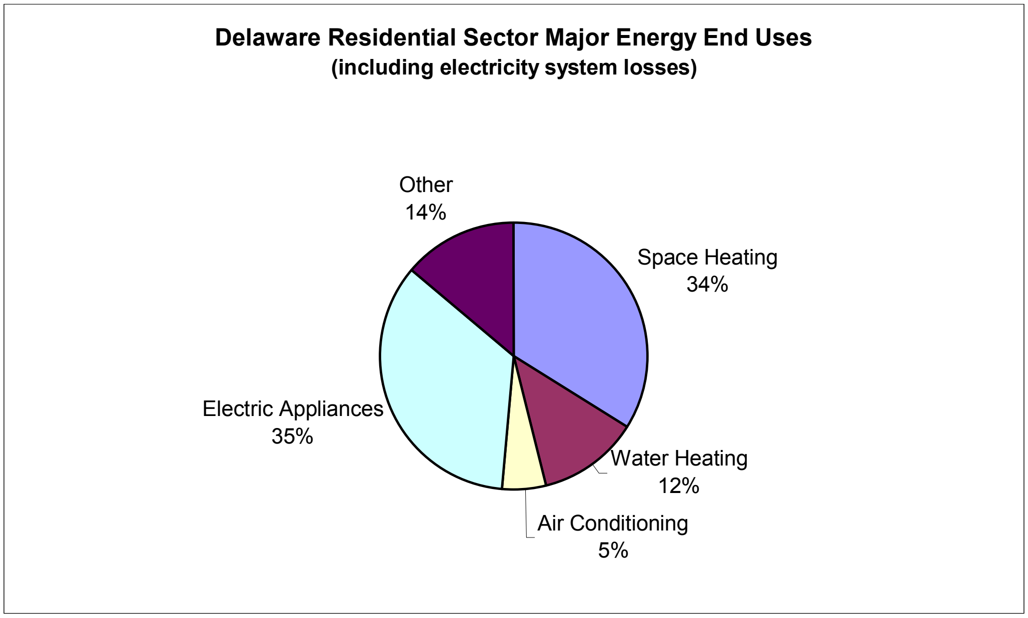


**Figure 6: Residential Sector Major End Uses**

- The electricity consumed by residential appliances is further broken down in Figure 7. The most important electricity-consuming end-uses shown in Figure 7 are refrigerators, freezers, clothes dryers and lighting.

- Other small end-uses for electricity abound, but are very difficult to quantify or address through efficiency programs.

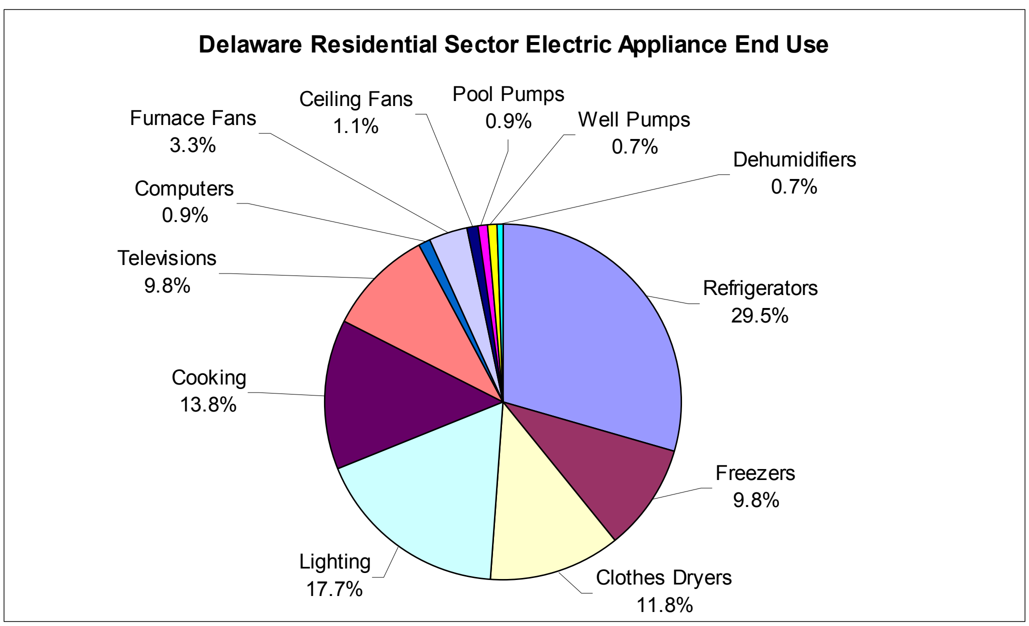


**Figure 7: Residential Sector Electric Appliance End Use**

- Space heating and water heating end-uses are shown in more detail in Figures 8 and 9. Natural gas, fuel oil and propane account for 79% of space heating energy consumption. Electricity accounts for only 7% of space heating energy (on the basis of primary energy consumption), but for 21% of total primary energy consumption because of electricity system losses. Similarly, electric hot water heaters account for 20% of hot water heating (on a primary energy basis) but for 60% of total primary energy consumed.

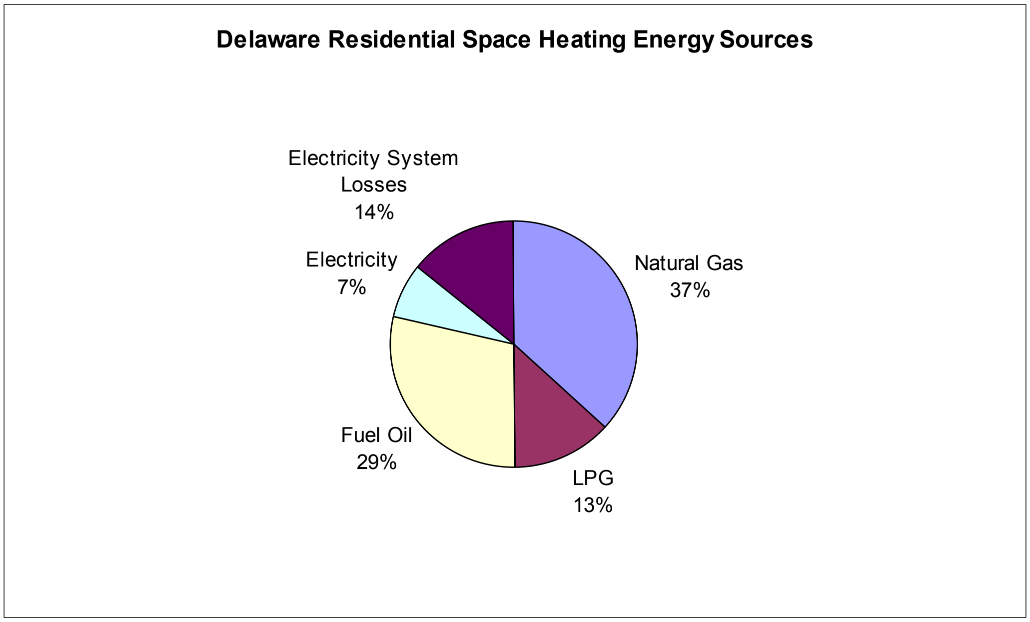


**Figure 8: Residential Space Heating Energy Sources**

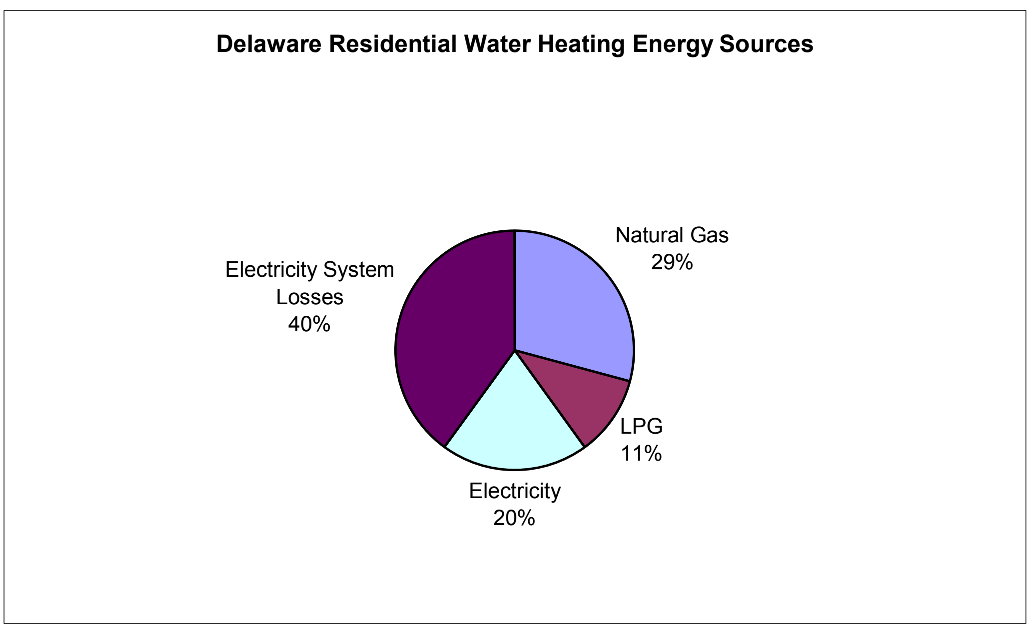


**Figure 9: Residential Hot Water Heating Energy Sources**

The Working Group's analysis reached several conclusions about how to develop recommendations for the residential sector:

- Space heating, water heating, air conditioning and major appliances account for the majority of energy consumption in the residential sector. Therefore it makes sense to focus on these areas for efficiency improvements in the short run.
- Delaware depends more heavily on fuel oil and LPG for residential heating, partly because natural gas is not available in many parts of the state. Efforts should specifically include fuel oil and LPG heating equipment efficiency.
- Building envelope measures aimed at reducing thermal losses should complement space heating and air conditioning equipment programs.

**Commercial Sector**

In 1999, the commercial sector in Delaware consumed a total of approximately 46 trillion BTUs of energy. In comparison to the residential sector, the uses of energy were more limited in the commercial sector, but are heavily concentrated on the use of electricity. The following conclusions, which reference associated figures, aid understanding how this energy was consumed in this sector.

- Figure 10 illustrates how dominant electricity is in the commercial sector. Nearly 80% of commercial sector energy consumption is electricity and electricity system losses. The commercial sector is also growing fastest. Natural gas accounts for nearly all the remaining energy consumption, mainly for space heating.

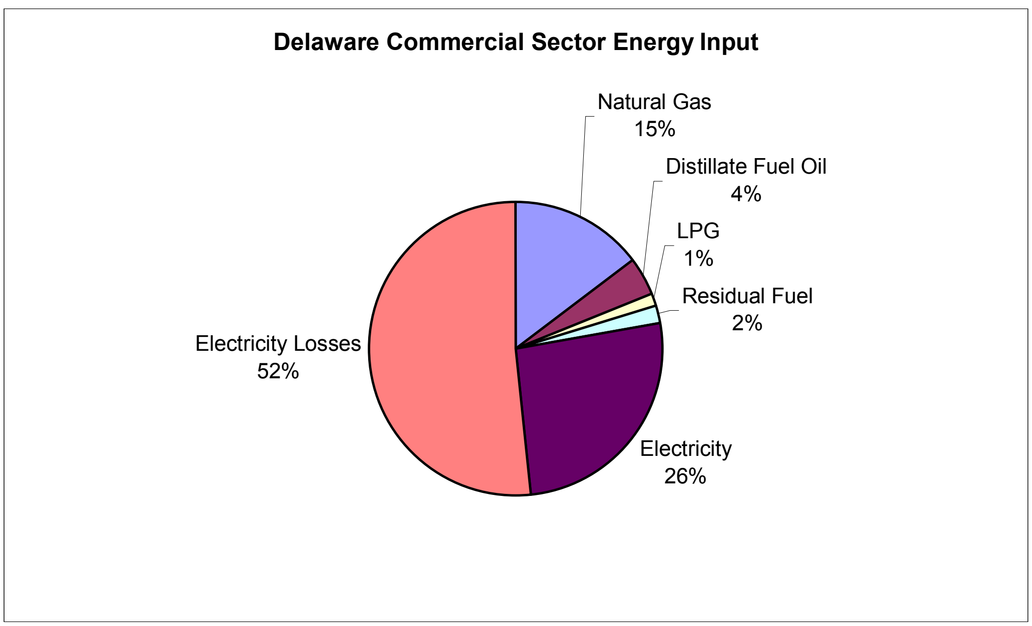


**Figure 10: Commercial Sector Energy Input**

- Figure 11 shows how energy from all sources is used in the commercial sector. End-uses that consume electricity, such as lighting, cooling, office equipment and others are dominant. The next largest end-use is space heating, which accounts for approximately 19% of total energy end-use.

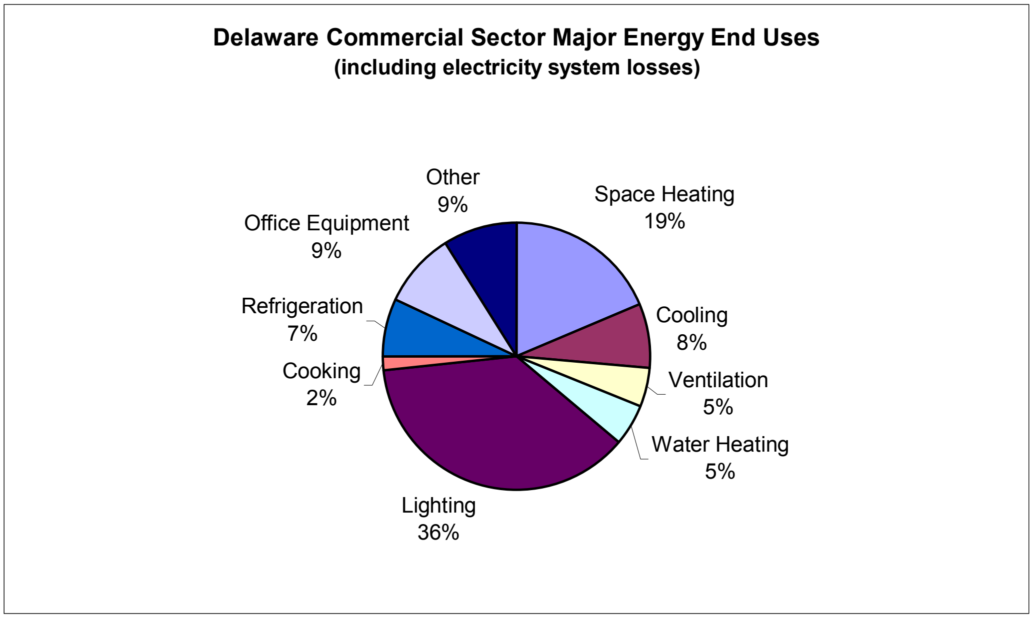


**Figure 11: Commercial Sector Major End Uses**

- When electricity end-uses are examined, lighting is the largest single end-use, accounting for about 47% of total electricity consumption in the commercial sector, as shown in Figure 12. In comparison, electric heating, air conditioning, ventilation and electric hot water heating combined account for 23% of total electricity consumption.

- Other major electricity end-uses are office equipment, and commercial refrigeration systems.

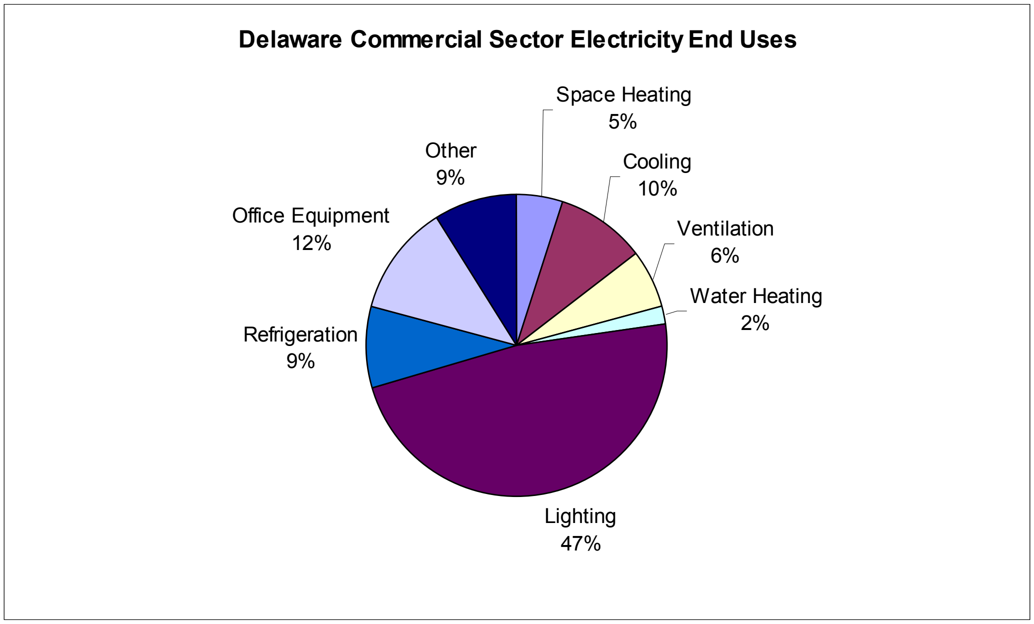


**Figure 12: Commercial Sector Electricity End Uses**

- In Figure 13, natural gas and oil (including distillate oil and residual oil) account for approximately 79% of commercial space heating. Like the residential sector, electricity provides about 7% of space heating energy (on a primary fuel basis), but 21% of total primary energy consumed for heating.

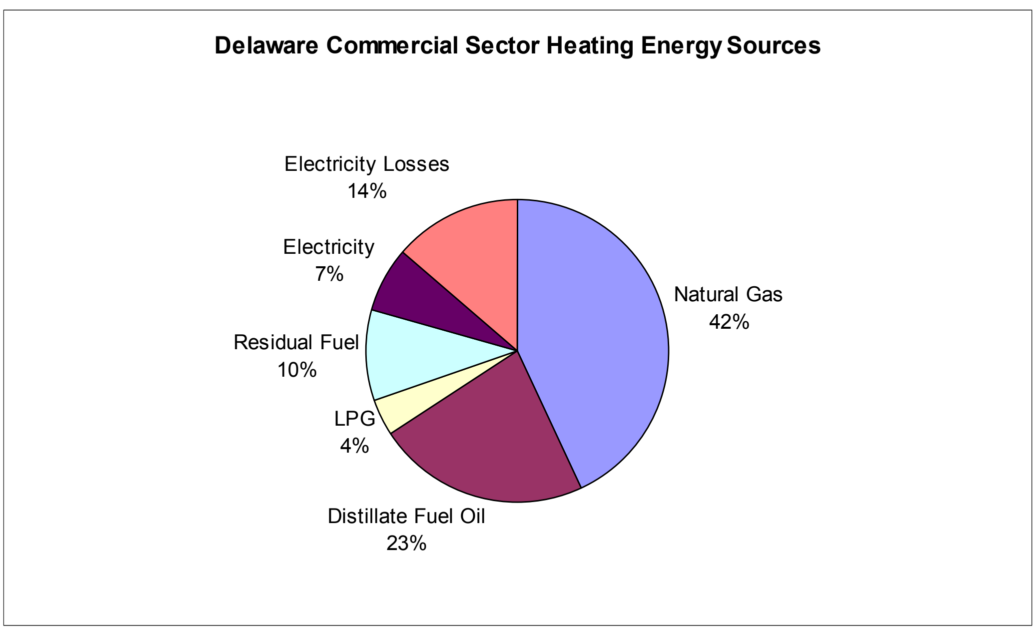


**Figure 13: Commercial Sector Heating Energy Sources**

The Working Group's analysis of commercial sector energy consumption is summarized in the following points:

- Because the sector is very electricity intensive, highest priority should be placed on measures that improve electricity utilization efficiency.
- Lighting, electric space heating, air conditioning, commercial refrigeration and office equipment efficiency should be targeted to accomplish this.
- Space heating and air conditioning equipment programs should be complemented by building envelope measures aimed at reducing thermal losses

**Industrial Sector**

Delaware's industrial sector is the largest end-use sector in the State. In 1999, industrial end-users consumed a total of approximately 107 trillion BTUs of energy from all sources. Unlike residential and commercial energy end uses, the industrial sector is difficult to characterize accurately because of a lack of Delaware-specific data. As a result, the following figures are partly based on national averages. The following conclusions, which reference associated figures, aid understanding how energy was consumed in the industrial sector.

The industrial sector in Delaware is energy-intensive compared to surrounding states and states of similar size. The reason for this is that two major end-users account for about half of industrial sector energy consumption. The Motiva refinery processes very large amounts of crude oil to make petroleum products in its Delaware City facility. Crude oil feedstock and fuels used in the refinery are recorded by the EIA as energy consumed in Delaware. This is somewhat misleading since refined products are sold in a regional market. Likewise, OxyChem's chlor-alkalai production facility in Delaware City use an electricity-intensive electrolytic process. This plant uses approximately 13% the electricity consumed in Delaware's industrial sector.

- Figure 14 shows that the industrial sector in Delaware is generally less electricity intensive than the residential and commercial sectors. This is because fuels like natural gas and oil are used directly in much greater quantities to provide process heat.
- A significant feature of industrial energy use in Delaware the large amount of petroleum coke consumed in the State. Petroleum coke is a byproduct of oil refining and accounts for about 31% of total primary energy consumption in the industrial sector. In Delaware, petroleum coke is used at the Motiva refinery to generate electricity and steam that are used in the refinery.

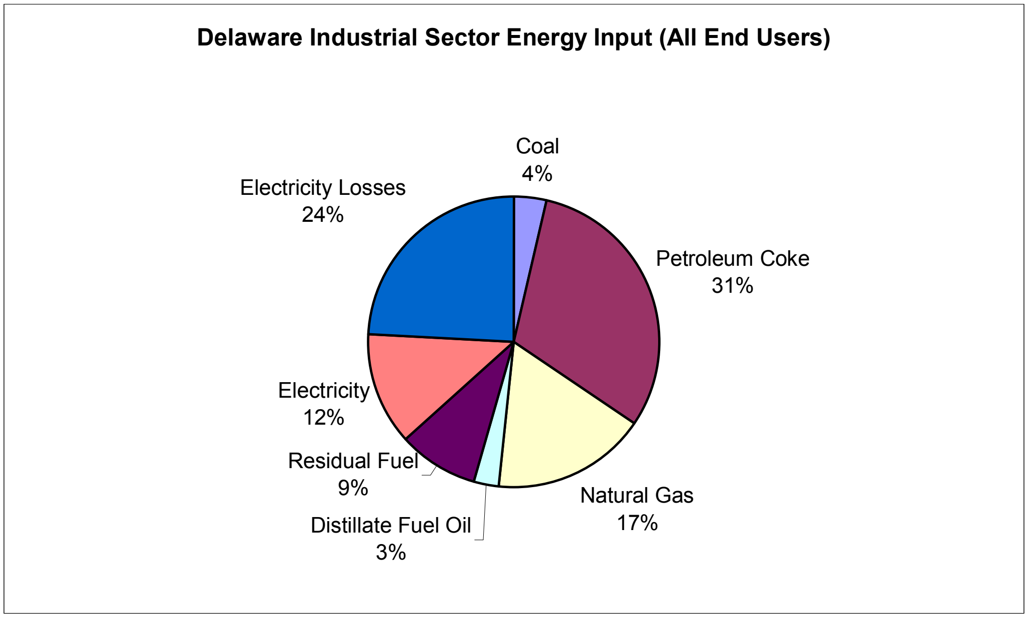


**Figure 14: Industrial Sector Energy Input (all end users)**

- From Figure 15, 46% of all primary energy input is either feedstock or fuel for the Motiva refinery. The largest end-use after this is for motors and machine drives.

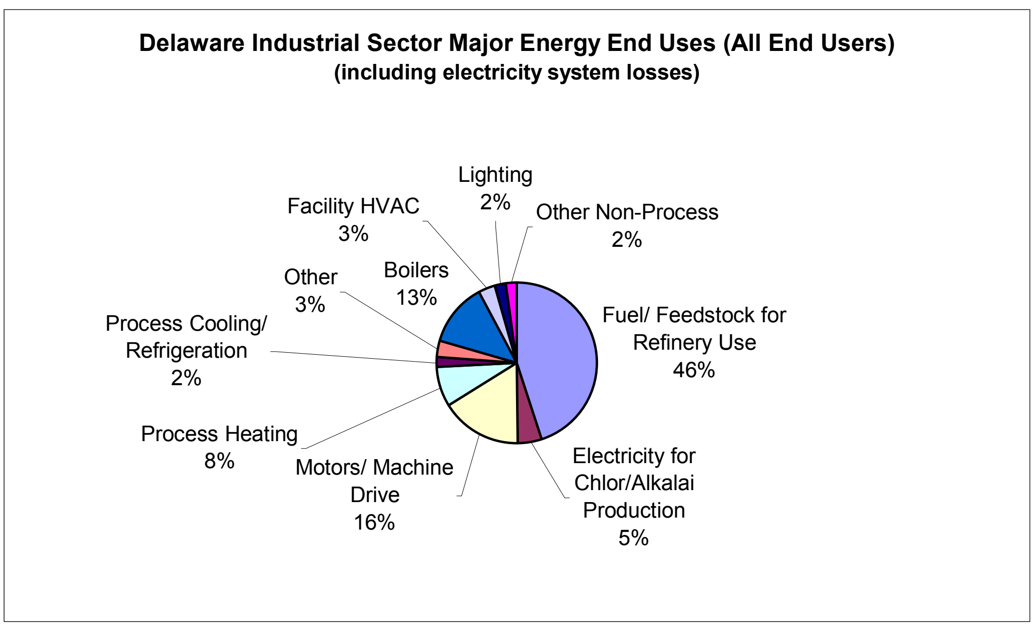


**Figure 15: Industrial Sector Major End Uses (all end users)**

- The distribution of primary energy consumption changes if the two major end-users are taken out of the data, as shown in Figure 16. When this is done, electricity and electricity system losses regain a considerable share of industrial energy consumption, approximately 54%. Petroleum coke disappears altogether because it is not used outside of the refinery.

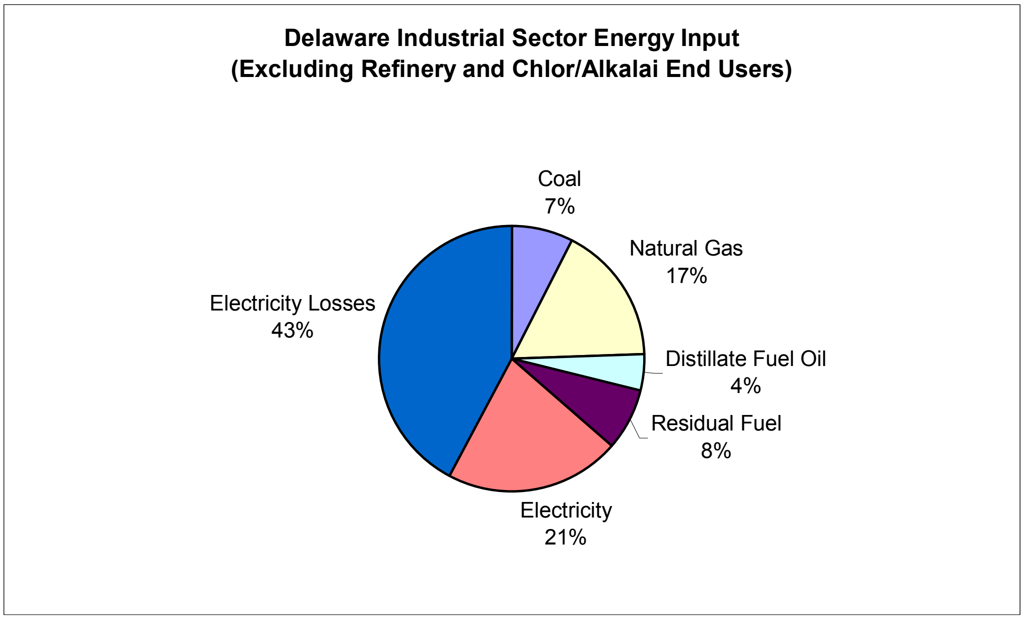


**Figure 16: Industrial Sector Energy Input (excluding refinery and chlor/alkali end users)**

- In the absence of the influence of the two largest end-users, the overall distribution of end uses also shifts. In Figure 17, motors and machine drives clearly become the largest energy end use in the industrial sector, followed by boilers and process heating. This is not surprising, since nationally the main use of fuels in the industrial sector is to produce steam or other forms of heat for countless processes.

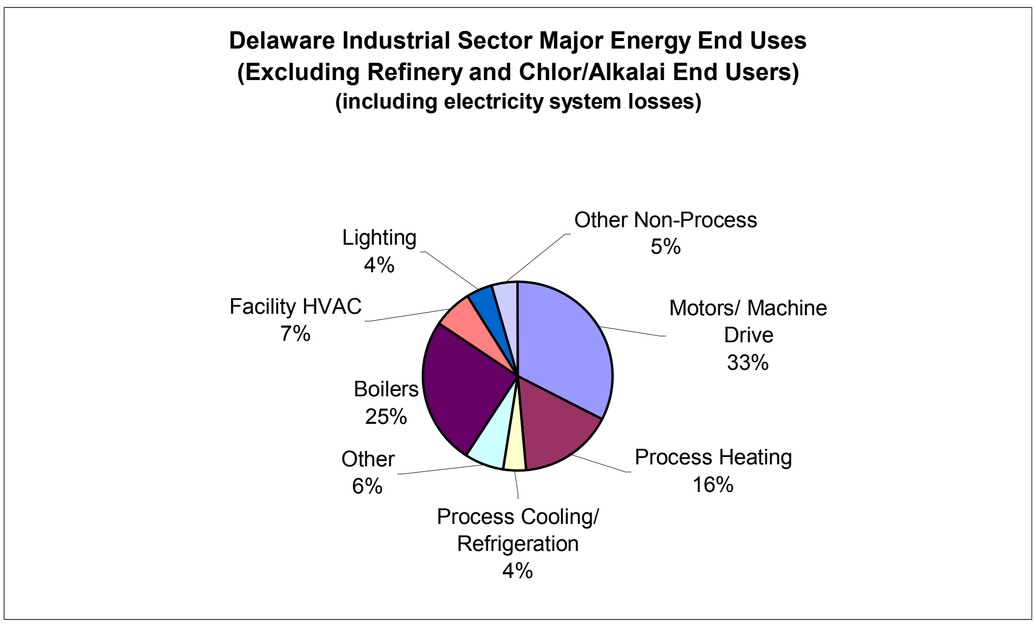


**Figure 17: Industrial Sector Major End Uses (excluding refinery and chlor/alkali end users)**

- Figure 18 considers only industrial electricity consumption (including chlor-alkalai production). Once again, the important role of motors and machine drives are evident.

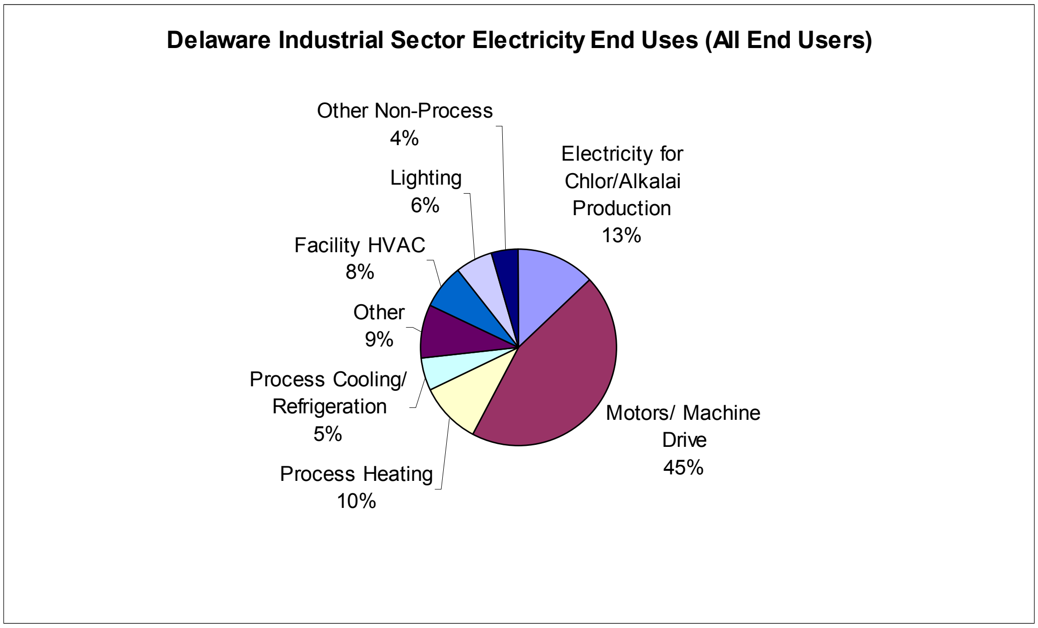


**Figure 18: Industrial Sector Electricity End Uses (all end users)**

Industrial energy end-users are a very diverse group. Energy intensive industries, especially those owned by large parent companies, tend to be very sophisticated about energy use and have access to technical and capital resources. In very large and/or energy-intensive industrial plants, many of the opportunities for efficiency improvements are in areas that require highly specialized expertise. The two largest end-users fall into this category, which may affect the scope of industrial efficiency programs, but should not change the overall approach.

The Working Group's conclusions about the industrial sector are summarized in the following points:

- In spite of the difficulties collecting data about the Delaware industrial sector, it is dominated by a few end-uses. Fuels are used primarily in boilers and for direct process heating. Electricity is used predominantly to operate electric motors.

- To improve industrial sector efficiency overall:

    - Target motor efficiency to reduce electricity consumption in this sector

    - Target boiler efficiency, maintenance practices and proper sizing to reduce fuel consumption for steam and hot water production.

- o Target steam and condensate system maintenance to reduce energy consumption for steam generation.

- o Target process heating systems to reduce fuel consumption for drying, curing, and other industrial heating process.

- The end-users with potentially the greatest needs are small to medium sized firms with limited access to expertise and capital.

## Forecasts for Growth

In January 2000, the Center for Energy and Environmental Policy (CEEP) at the University of Delaware published the Delaware Climate Change Action Plan (DCCAP). The complete DCCAP is available at www.udel.edu/ceep/reports/deccap/deccap.htm. The DCCAP was a two-year collaborative effort led by researchers at CEEP and sponsored by the State Energy Office, the U.S. EPA State and Local Climate Change Program. Numerous stakeholders from the private and public sectors also provided guidance and input. One purpose of the plan was to analyze greenhouse gas emissions and possible policy measures to reduce them to 7% below 1990 levels[6]. Since greenhouse gas emissions, especially carbon dioxide, are tied very closely to energy consumption, the DCCAP provides a large amount of information that is relevant to the Conservation and Efficiency Working Group and the Governor's Energy Task Force.

In particular, the DCCAP provided "business-as-usual" energy and greenhouse gas emissions forecasts for each of Delaware's major end-use sectors using 1990 as the baseline year. These forecasts are summarized in Table 2 below:

**Table 2: DCCAP Energy End-Use Consumption Forecasts**

| *Sector* | *1990 Energy Consumption (trillion BTUs)* | *2010 Energy Consumption (trillion BTUs)* | *Annualized Growth Rate (%)* |
|---|---|---|---|
| Residential | 26.7 | 33.4 | 1.1 |
| Commercial | 16.3 | 28.9 | 2.9 |
| Industrial | 75.5 | 105.0 | 1.7 |
| TOTAL | 118.5 | 167.3 | 1.7 |

By 2010, a total consumption level of 110.2 trillion BTUs would be required in order to meet the target of 7% below the 1990 consumption level. The total reduction from the business-as-usual forecast would be approximately 34%.

[6] This level of reduction was tied to the Kyoto Protocol. Although the Kyoto Protocol was not ratified by the United States, it provides a useful benchmark for comparison.

## Delaware in Comparison to Other States

As part of Governor Minner's challenge to make Delaware the most efficient state, it is important to understand where Delaware currently stands with respect to other states. There are several ways to make this comparison. The following tables help to put Delaware's energy consumption in perspective nationally based on 1999 EIA data.

- Table 3 shows that Delaware is approximately at the median for per capita energy consumption, including energy used for transportation. Per capita energy consumption is influenced by numerous factors including climate, the amount of energy intensive industry and energy prices.

**Table 3: Comparison of Per Capita Energy Consumption**

| State | Rank | MMBTU Per Capita |
|---|---|---|
| Alaska | 1 | 1,122 |
| Wyoming | 2 | 879 |
| Louisiana | 3 | 827 |
| North Dakota | 4 | 577 |
| **Delaware** | **22** | **370** |
| Massachusetts | 48 | 254 |
| California | 49 | 253 |
| New York | 50 | 235 |
| Hawaii | 51 | 204 |
| **US Average** | | **351** |

- Table 4 shows that the State is ranked about thirteenth on the basis of average energy prices. A number of factors are important in this ranking including fuel prices and motor fuel taxes in the transportation sector. A more detailed comparison of Delaware and the states of the Mid-Atlantic region is provided in the next section.

**Table 4: Comparison of Energy Prices**

| State | Rank | $/MMBTU |
|---|---|---|
| DC | 1 | 13.23 |
| Hawaii | 2 | 12.34 |
| Connecticut | 3 | 11.62 |
| Vermont | 4 | 11.56 |
| **Delaware** | **13** | **9.54** |
| Wyoming | 48 | 6.54 |
| North Dakota | 49 | 6.21 |
| Alaska | 50 | 5.99 |
| Louisiana | 51 | 5.77 |
| **US Average** | | **8.41** |

Partly as a function of price, Delaware also ranks fourteenth in the nation for per capita annual energy expenditures, as shown in Table 5.

**Table 5: Comparison of Per Capita Energy Expenditures**

| State | Rank | $ Per Capita |
|---|---|---|
| Wyoming | 1 | 3,861 |
| Alaska | 2 | 3,294 |
| Louisiana | 3 | 3,073 |
| North Dakota | 4 | 2,703 |
| **Delaware** | **14** | **2,292** |
| Colorado | 48 | 1,726 |
| Utah | 49 | 1,723 |
| California | 50 | 1,690 |
| Florida | 51 | 1,674 |
| **US Average** | | **2,049** |

A more detailed comparison is provided for the Mid-Atlantic States and New York in the following sections. Given Delaware's location in the Mid-Atlantic region, and the similarities its shares in climate and other features, it is relevant to compare it to nearby states. The purpose of comparing Delaware to New York is that New York is the most energy-efficient state in the continental United States based on total per capita energy consumption. As such, New York establishes a preliminary benchmark for comparison.

## Delaware in Comparison to the Middle Atlantic Region

Delaware and four other states that comprise the Mid-Atlantic region are considered in this section. The other states are Maryland, New Jersey, Pennsylvania and New York. The basis for comparisons with other states is energy intensity, that is, the amount of energy consumed per capita, per household or per dollar of economic output.

All of the figures that follow are based on non-transportation energy consumption. The figures are grouped into four categories, and the comparisons are shown in two different ways for each[7]:

- Total energy consumption (MMBTU per capita and MMBTU per $ GSP)
- Residential energy consumption (MMBTU per capita and MMBTU per household)
- Commercial energy consumption (MMBTU per capita and MMBTU per $ GSP)
- Industrial energy consumption (MMBTU per capita and MMBTU per $ GSP)

[7] Comparison are made using million BTUs (MMBTU) per capita in all cases to normalize energy consumption against population. In the case of the residential sector, an additional comparison is made per household. Total, commercial and industrial sector energy consumption is also compared per $ of Gross State Product (GSP).

- Based on total consumption, Delaware has the highest per capita energy consumption of the five states shown in Figure 19. However, based on energy consumed per dollar of GSP shown in Figure 20, Delaware is approximately in the middle of the range between New York and Pennsylvania.

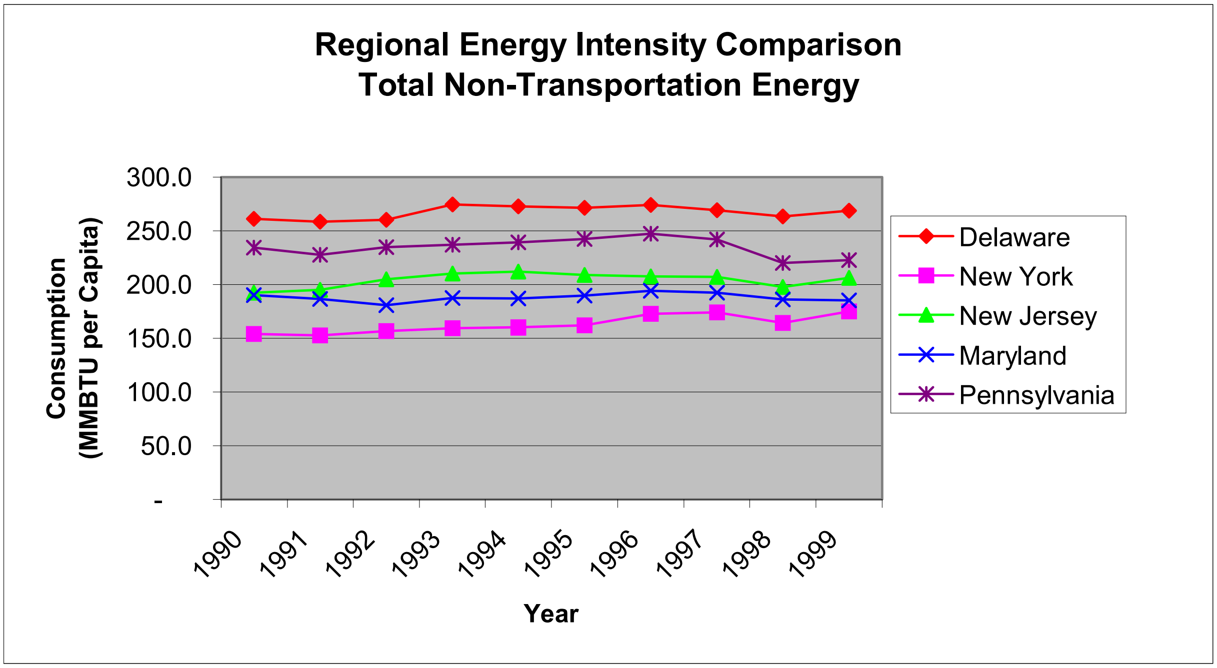


**Figure 19: Regional Energy Intensity Comparison – Total (MMBTU per capita)**

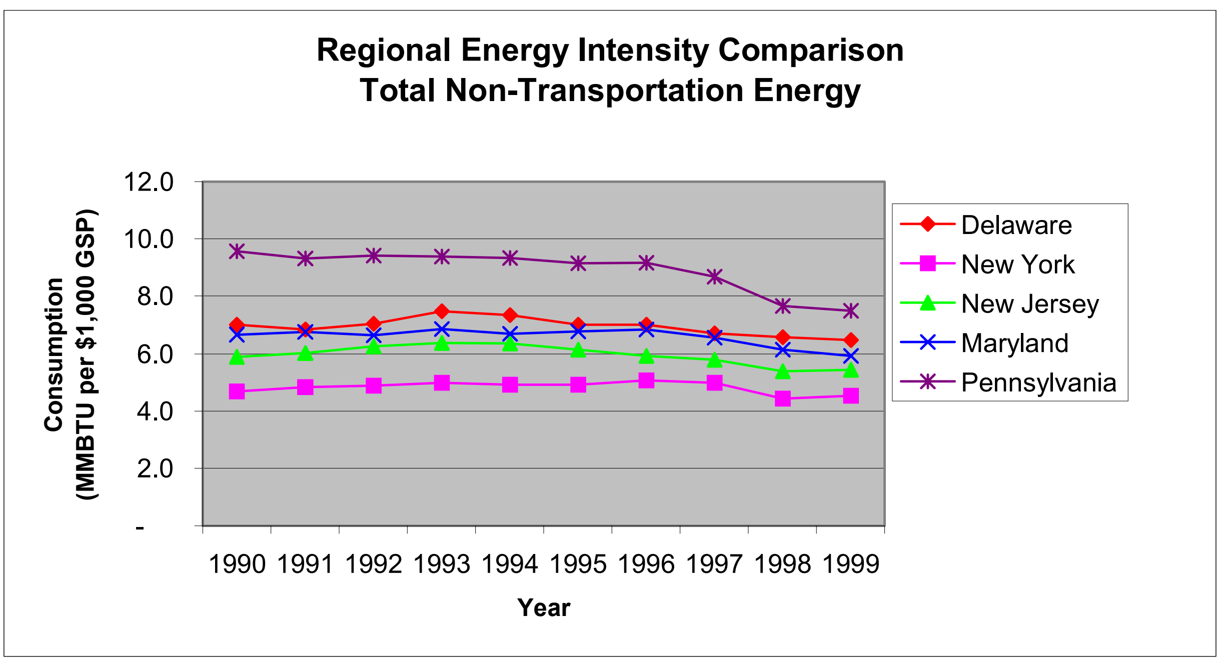


**Figure 20: Regional Energy Intensity Comparison – Total (MMBTU per $1000 GSP)**

- In the residential sector, Delaware, Maryland and Pennsylvania are grouped closely together. Delaware has the highest per capita energy consumption of all five states (Figure 21) as well as the highest consumption per household (Figure 22), but only by a slight margin. New Jersey and New York are significantly lower. Possible reasons for this may be differences in average home sizes. Both New York and New Jersey have large numbers of housing units, especially multi-family housing, concentrated in urban areas around metropolitan New York City. Homes in these areas tend to be smaller, which translates into lower gross energy consumption. In addition, upstate New York's climate reduces the amount of energy consumed for air conditioning.

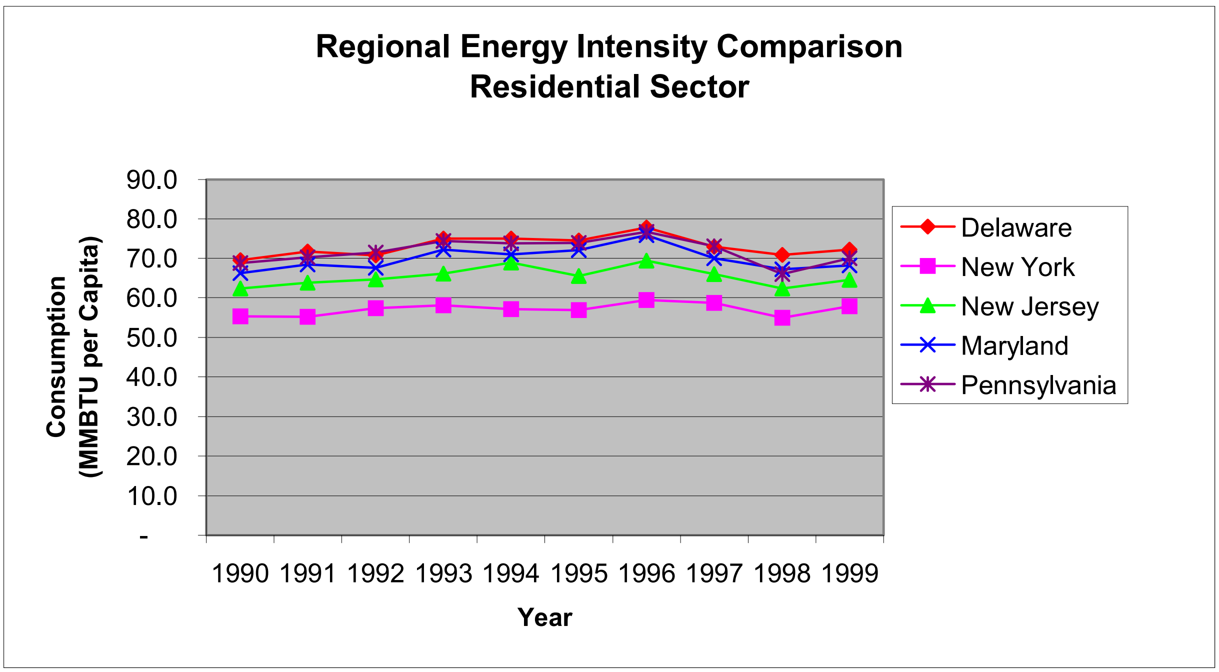


**Figure 21: Regional Energy Intensity Comparison – Residential (MMBTU per capita)**

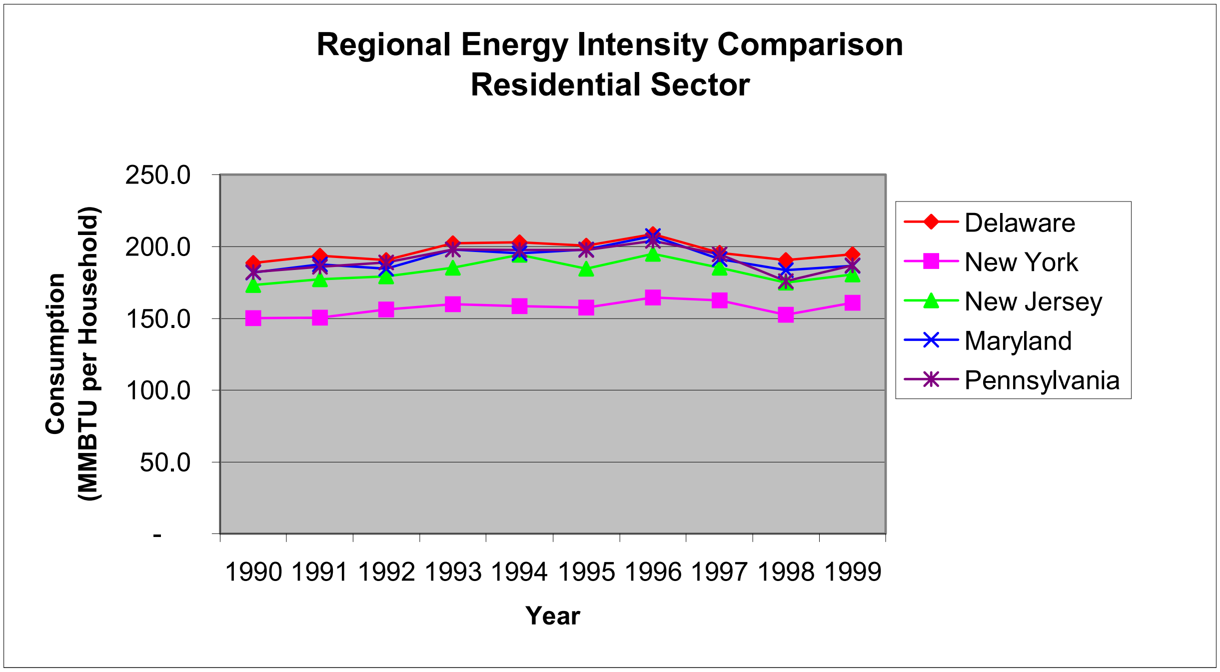


**Figure 22: Regional Energy Intensity Comparison – Residential (MMBTU per $1000 GSP)**

- In the commercial sector, Delaware is grouped with New York, New Jersey and Maryland at the upper end of the scale for per capita energy consumption, as shown in Figure 23. However, Delaware is the lowest when compared on the basis of consumption per dollar of GSP in the commercial sector (Figure 24).

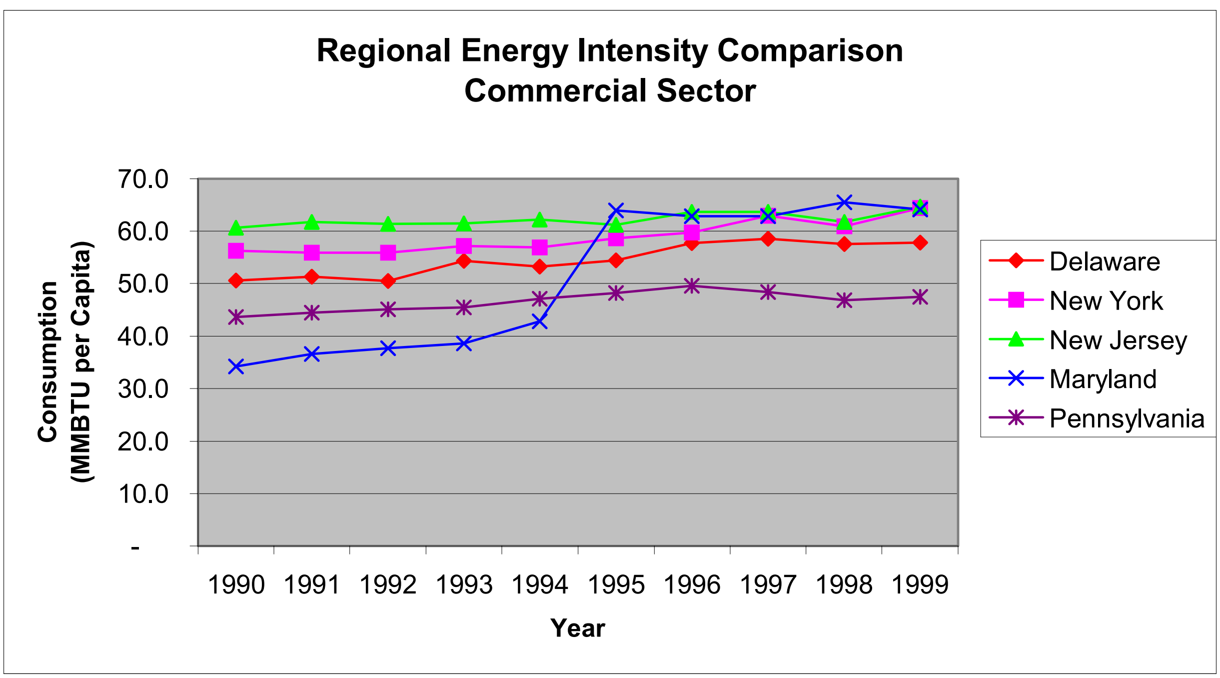


**Figure 23: Regional Energy Intensity Comparison – Commercial (MMBTU per capita)**

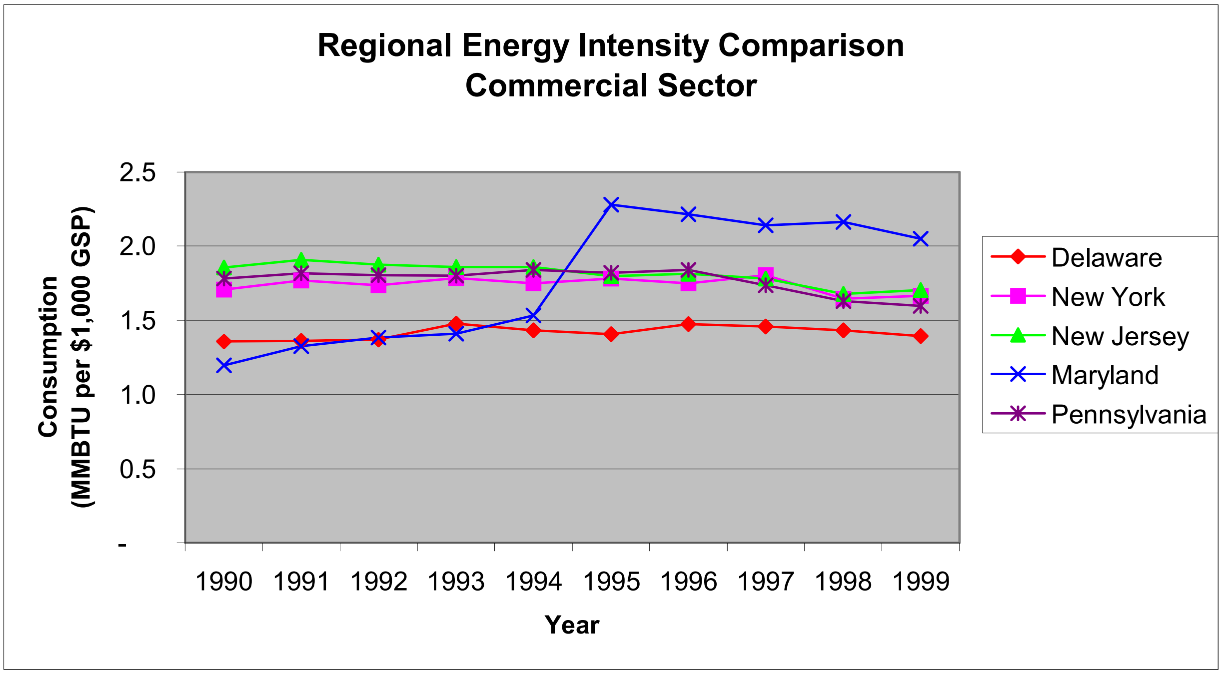


**Figure 24: Regional Energy Intensity Comparison – Commercial (MMBTU per $1000 GSP)**

- The largest differences between the states appear in the industrial sector. Figure 25 shows that per capita energy consumption in the industrial sector differs by a facto of nearly three between Delaware (highest) and New York (lowest). Delaware is surpassed in energy consumption per dollar of GSP only slightly by Pennsylvania, as shown in Figure 26. These figures show the significant differences in the relative sizes and efficiencies of the industrial sectors in each state's economy. Based on energy intensity per dollar of GSP, it is apparent that Delaware's industrial sector is still a major part of the State's economy. In comparison, New York, New Jersey and Maryland appear to have less energy-intensive industry, and these industries play a smaller role in those states' economies.

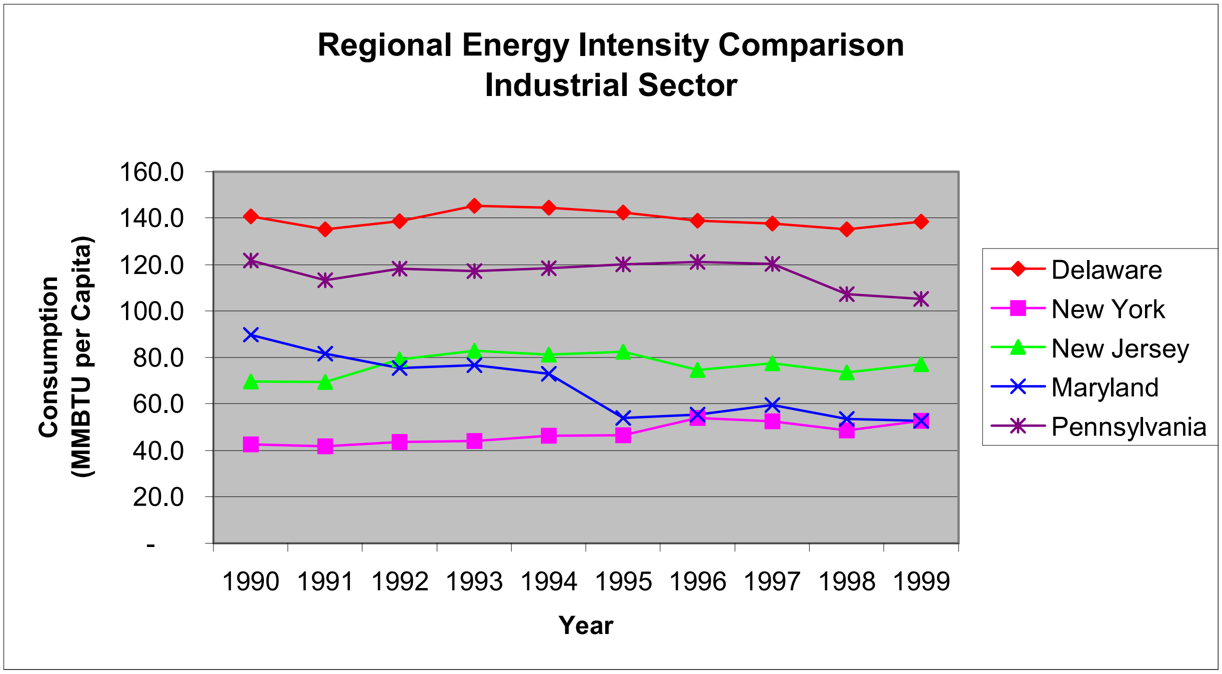


**Figure 25: Regional Energy Intensity Comparison – Industrial (MMBTU per capita)**

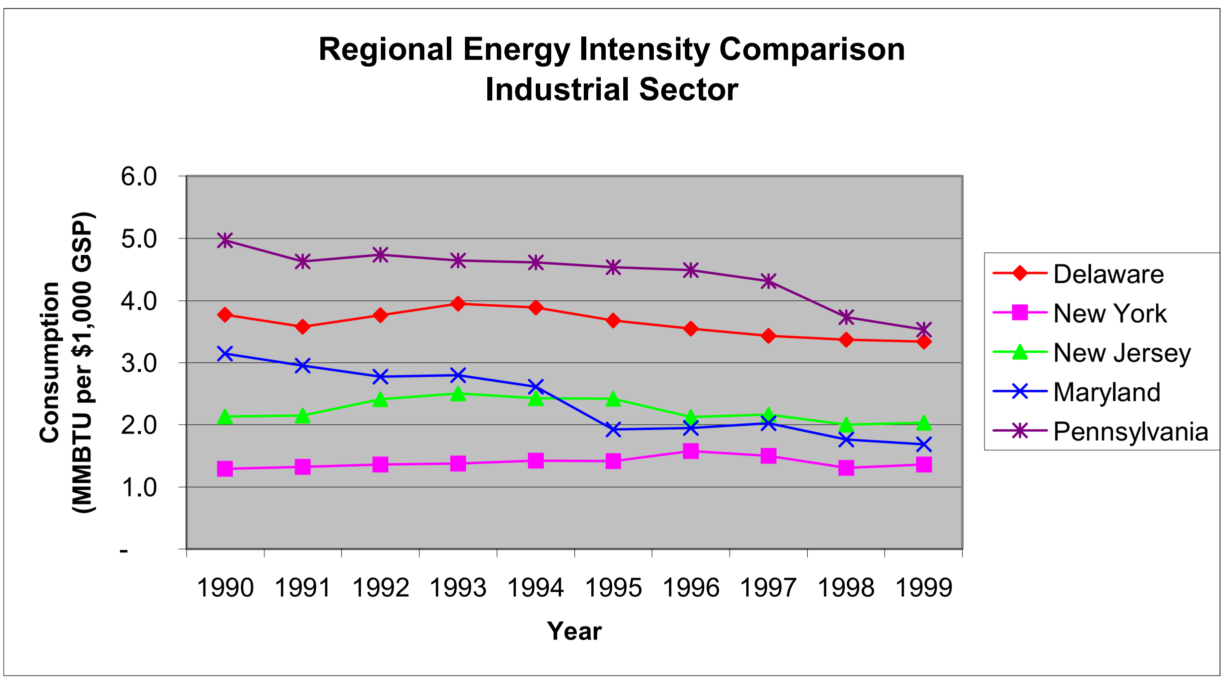


**Figure 26: Regional Energy Intensity Comparison – Industrial (MMBTU per $1000 GSP)**

## Delaware in Comparison to New York

A more in-depth analysis of Delaware's energy consumption in comparison to New York is provided in this section. As noted previously, New York is the most energy-efficient state in the continental United States, and thus establishes a benchmark for comparison. The following figures provide a more complete picture of the differences between the two states based on how specific fuels are used.

- Figures 27 and 28 show the differences between the residential sectors in Delaware and New York. Per capita energy consumption in Delaware's residential sector is about 27% higher than New York's.
- From the figures, it is apparent that natural gas plays a more significant role in New York for home heating and water heating. Delaware's homes are more electricity intensive, probably reflecting the higher saturation of electric heat pumps and electric hot water heaters
- Total electricity consumption for air conditioning is also probably higher due to climatic differences.
- Finally, homes in the heavily urbanized New York metropolitan area are probably somewhat smaller on average, leading to lower overall energy consumption.

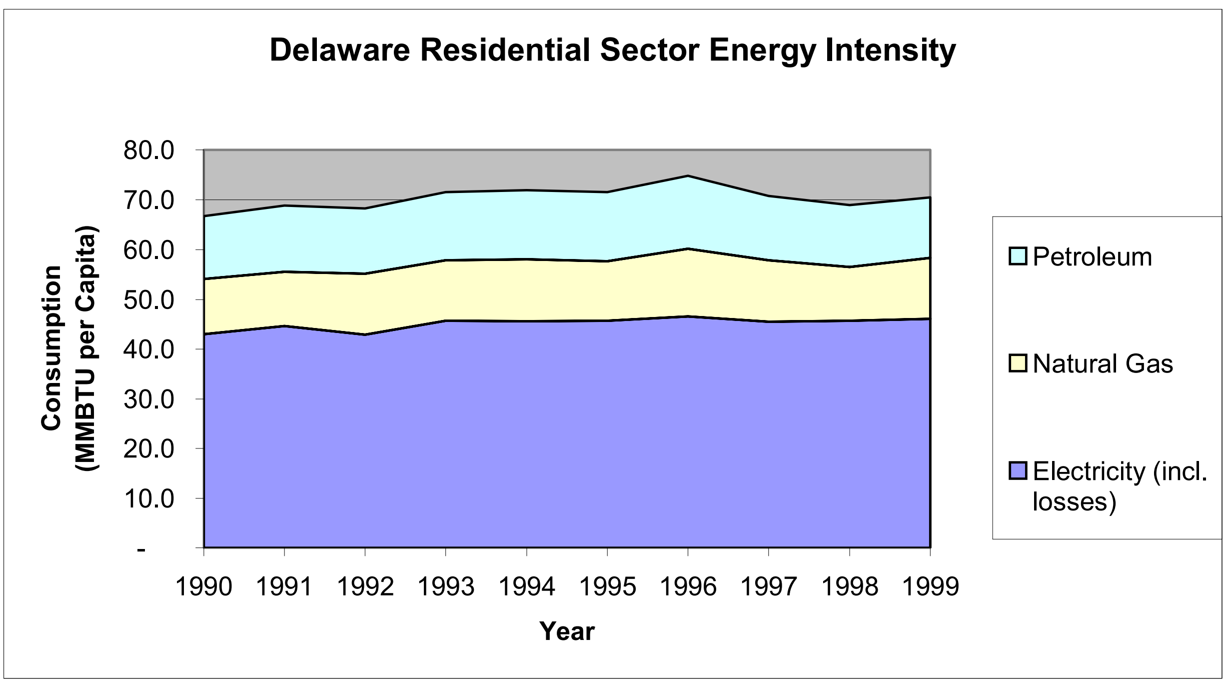


**Figure 27: Delaware Energy Intensity – Residential (MMBTU per capita)**

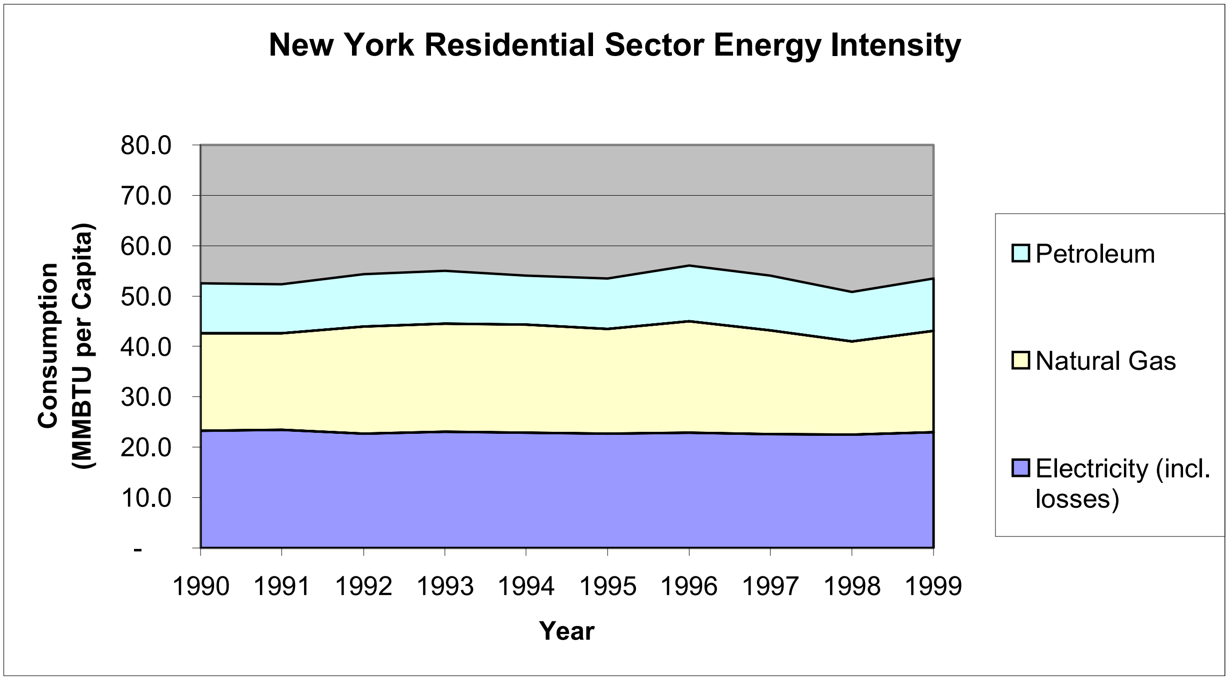


**Figure 28: New York Energy Intensity – Residential (MMBTU per capita)**

The situation between Delaware and New York is reversed in the commercial sector (see Figures 29 and 30). In this case, New York's per capita commercial energy consumption is about 12% higher than Delaware's. Some possible explanations are:

- The size of the commercial sector in relation to the overall state economy is probably larger in New York than in Delaware. This is bolstered by the relatively low level of industrial energy consumption in comparison to Delaware.
- The nature of commercial activities in New York may be more energy intensive. Examples of these activities include hotels and health care.
- The commercial building stock in New York is probably older and therefore less efficient than Delaware's.

It is also apparent that the commercial sector in Delaware is more electricity intensive than in New York. This is probably due, at least partially, to higher energy consumption for air conditioning.

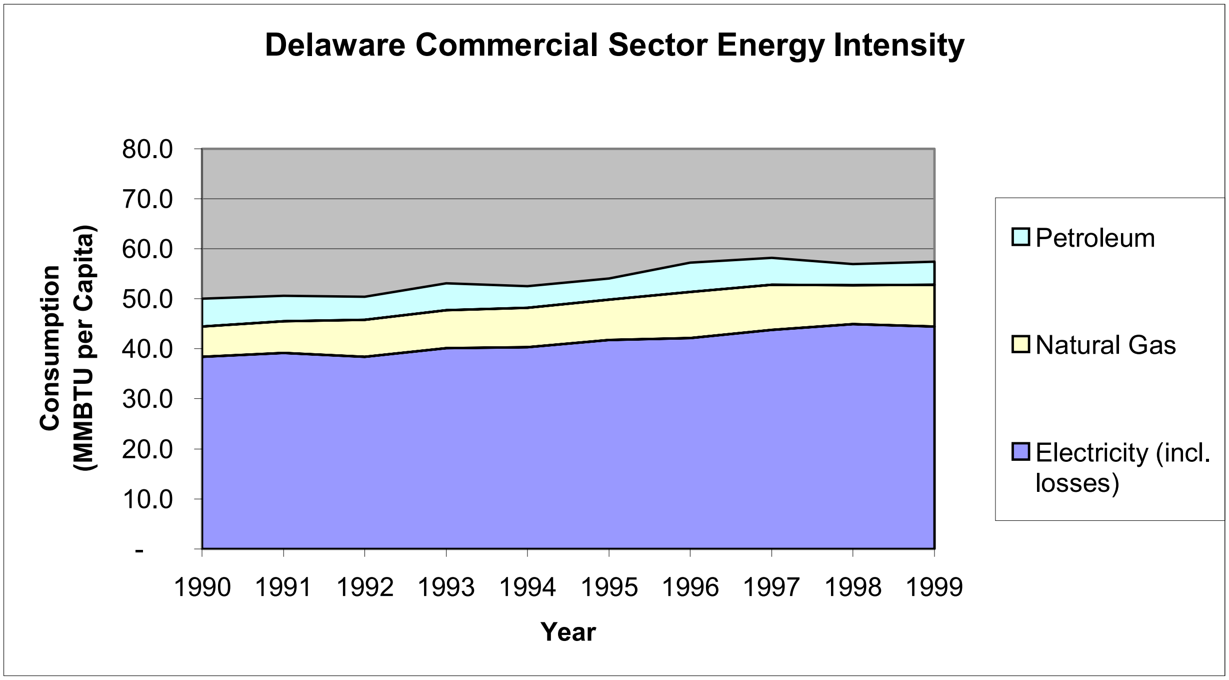


**Figure 29: Delaware Energy Intensity – Commercial (MMBTU per capita)**

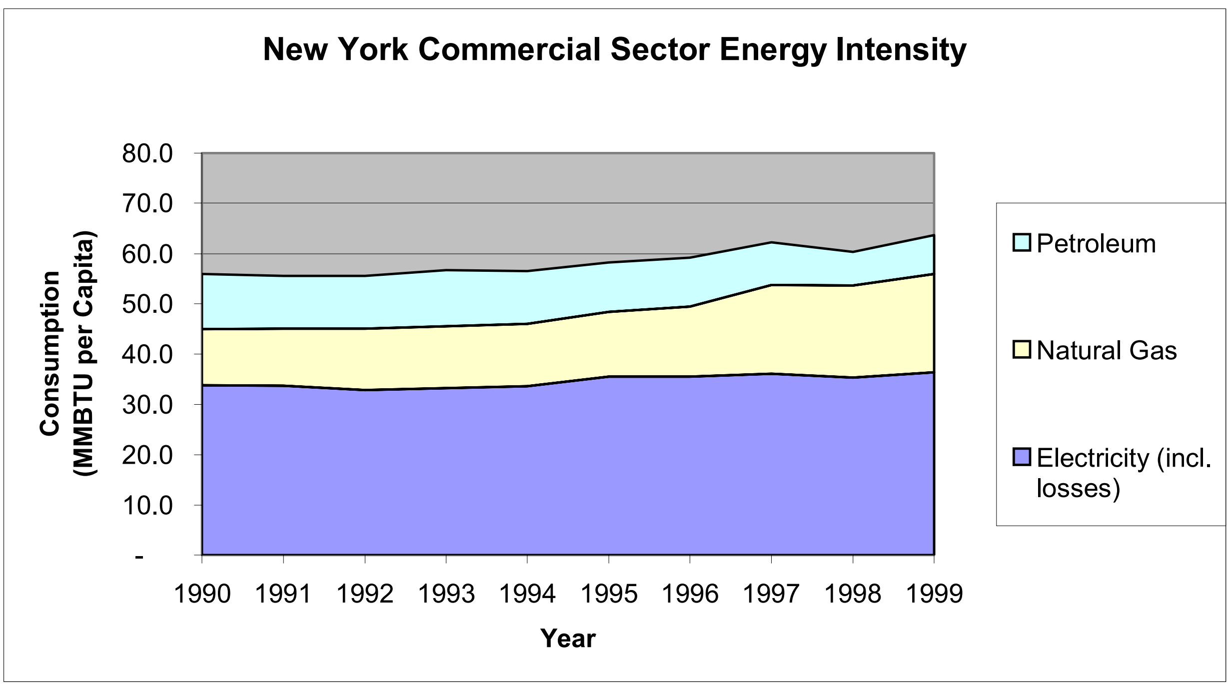


**Figure 30: New York Energy Intensity – Commercial (MMBTU per capita)**

Figures 31 and 32 show a very wide difference between Delaware and New York in per capita industrial energy consumption. As noted previously, Delaware's industrial sector is relatively energy-intensive in comparison to other states in the Mid-Atlantic region. When compared to

New York, Delaware uses about three times as much energy in the industrial sector. Even if the two most energy intensive industries in the State are removed from the data shown in Figure 31, Delaware would still consume about twice as much energy in the industrial sector. There are at least two important reasons for these differences:

- Delaware's industrial sector constitutes a larger portion of the state's economy in relative terms.
- Given Delaware's small population in comparison to New York, Delaware has more energy-intensive industrial activities.

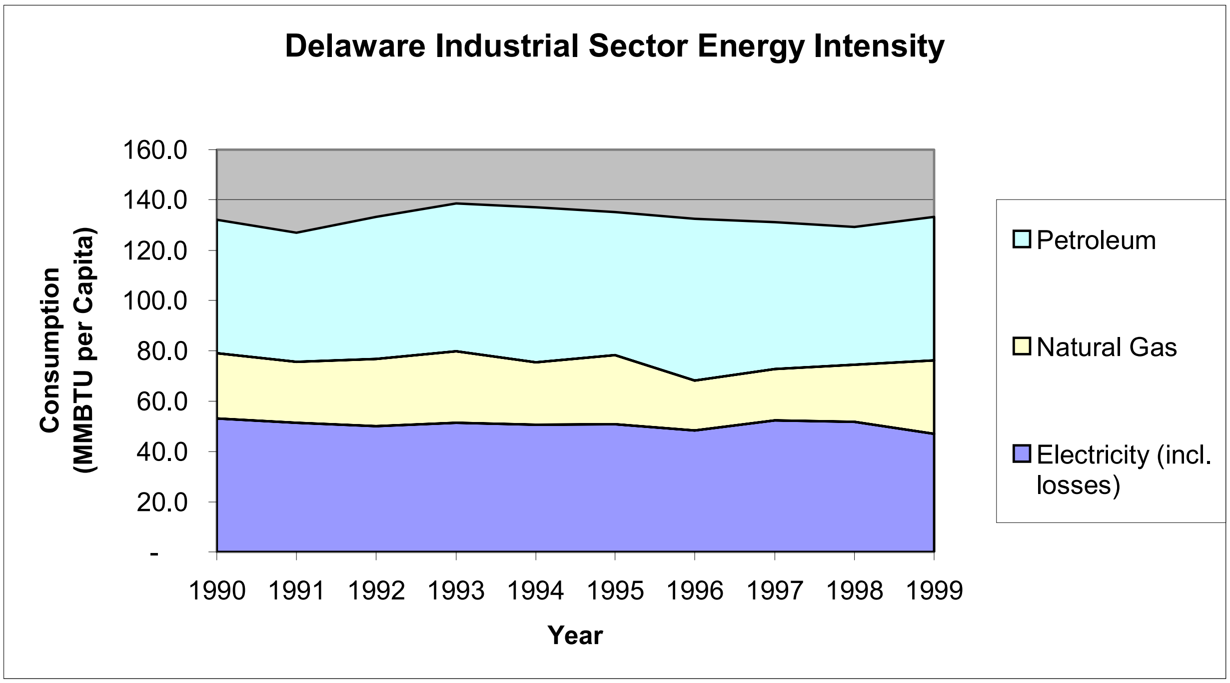


**Figure 31: Delaware Energy Intensity – Industrial (MMBTU per capita)**

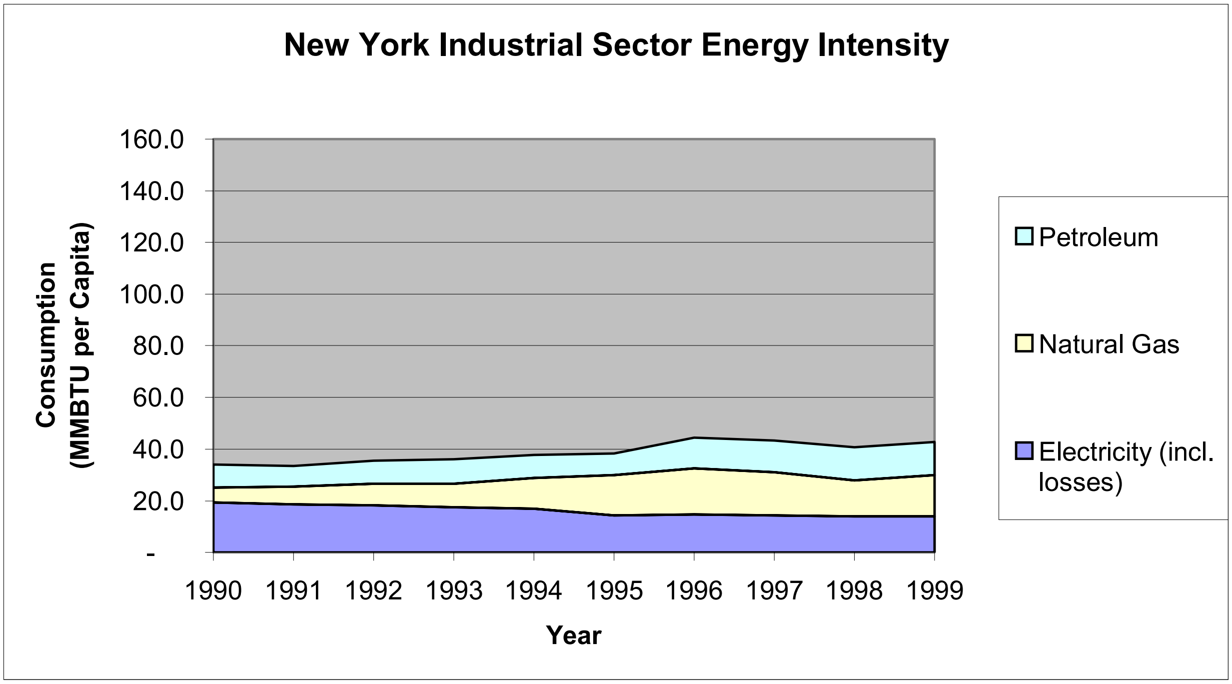


**Figure 32: New York Energy Intensity – Industrial (MMBTU per capita)**

### Basis for Comparison Against Other States

From the above comparisons to other states in the Mid-Atlantic region, it is difficult to reach specific conclusions about where Delaware stands in terms of energy efficiency without further analysis. However, there are several preliminary conclusions that can be reached:

- Residential sector energy intensity in Delaware appears to be in line with Maryland, Pennsylvania and, to a lesser extent, New Jersey.
- Commercial sector energy intensity in Delaware is lower than in New York on the basis of per capita consumption and per dollar of GSP.
- Industrial sector energy intensity in Delaware is clearly one of the highest in the region, although the size of Delaware's industrial sector is also larger in relative terms.
- In comparison to New York, Delaware's residential and commercial sectors are more electricity intensive. Climatic differences, especially higher energy consumption for air conditioning may account for at least part of the difference. The availability of natural gas for home and commercial heating may also be a factor.

If overall energy intensity measures are used as the basis for establishing a target for Delaware, and New York is used as the benchmark for comparison, energy consumption per capita would have to be reduced by approximately 35% and energy per dollar of GSP would have to reduced by about 30%. Coincidentally, this corresponds with the level of reduction suggested by the Delaware Climate Change Action Plan.

Although overall energy intensity is a useful measure of Delaware's energy efficiency, it is incomplete. A more complete evaluation would consider each sector individually and make appropriate adjustments. For example:

- The residential sector comparison should correct for climate by evaluating energy consumption based on heating and cooling degree-days per square foot.

- In the preceding analysis, Gross State Product was used to evaluate commercial and industrial sector energy intensity. However, economic output should be separated into commercial and industrial categories. This would provide a truer picture of energy intensity in these sectors relative to their importance in each state's economy.

The basis for comparing Delaware to other states in order to measure progress towards the Governor's goal will require further study. However, there are clearly opportunities to improve efficiency and reduce energy intensity, regardless of how the overall results are measured. This is corroborated by the Delaware Climate Change Action Plan.

# Analysis of Conservation and Efficiency Recommendations

Based on the analysis of energy end-use the Conservation and Efficiency Working Group began the development of recommendations to improve efficiency in the State. The range of options is very broad, which is not surprising, because energy consumption is embedded into virtually every aspect of modern life. The following sections describe how the measures were developed and define several categories for the final recommendations.

### Role of the DCCAP in Developing Recommendations

The basis for developing the Conservation and Efficiency Working Group's recommendations was the Delaware Climate Change Action Plan. The DCCAP focused much of its work on energy efficiency policies as the means to reduce greenhouse gas emissions. The Working Group went one step further by using the policy framework provided by the DCCAP to develop more specific program recommendations.

### Measures Already in Progress

In addition to the role played by the DCCAP, the Working Group also briefly assessed on-going conservation and efficiency programs in the State. The major activities, which concentrate on consumer education and awareness, are summarized below:

*U.S. Environmental Protection Agency and Department of Energy:* The EPA/DOE Energy Star Program labels energy-efficient products like clothes washers, TVs/VCRs, heating and cooling equipment to help consumers save money on energy bills. Energy Star also has programs that encompass entire buildings and systems within the residential and commercial sectors. The Energy Star program maintains an extensive informational website for consumers at www.energystar.gov. Energy Star also provides program development and marketing assistance through the EPA regional office in Philadelphia.

*Conectiv Power Delivery:* The company offers energy information and conservation tips on its website *www.conectiv.com*, includes conservation articles in issues of *Energy News You Can Use* which is included as a monthly billing insert, and offers brochures on conservation and efficiency including: *Conectiv For Your Information*, *Conectiv Conservation Tips* and *More than 100 Ways to Improve Your Electric Bill.*

*Delaware Electric Cooperative:* The Delaware Electric Cooperative often features a column written by their Coordinator of Energy Services, entitled "Energy Solutions" which covers topics ranging from the pros and cons of heat pumps to questions and answers about topics such as insulation, windows & doors, refrigerators, washing machines, clothes dryers and crawl space vents.

*Delaware Municipal Electric Corporation:* The Delaware municipal electric utilities collectively serve approximately 55,000 residential, commercial and industrial customers. All of the municipal utilities have customer education efforts consisting of periodic newsletters sent to electric customers. Among other items, the newsletters contain articles that provide education on demand management in the form of how to save money on electric bills. The larger municipals have, in addition to newsletters, programs to educate residential and larger electric users, primarily commercial and industrial customers. These larger customer programs include energy audits, demand management rate incentives, and consultation on equipment usage and efficiency efforts. The municipals also respond to customer requests for information.

*Delaware State Energy Office:* The Delaware State Energy Office, in cooperation with Energy Services Group, promotes the Energy Star Program to residential builders and homeowners through ongoing activities with the Delaware Home Builders Association. The Delaware State Energy Office, Energy Services Group and EPA were title sponsors at the Delaware Home Show in September 2002 where more that 6,000-show visitors had the opportunity to learn about saving energy by using Energy Star products. The State Energy Office also distributes the US DOE's *Energy Savers Tips on Saving Energy & Money at Home.*

*Delaware Million Solar Roofs Coalition:* Besides promoting solar energy, the Delaware Million Solar Roofs Coalition also promotes energy efficiency to Delaware residents and builders as a means to maximize the value of solar energy investments. The Delaware Million Solar Roofs Coalition educated Delawareans at the 2002 Delaware Home Show on the benefits of photovoltaics, solar water heating and the "Zero Energy Home". The US DOE "Zero Energy Home" concept combines Energy Star products and solar energy to maximize residential energy efficiency.

*Environmental Incentive Fund:* The Environmental Incentive Fund (EIF) was created in 1999 as part of Delaware's electricity restructuring legislation. Funds are collected through a small surcharge paid by Conectiv Power Delivery customers. These funds are used to provide rebates to consumers who install photovoltaic power systems, solar hot water systems, small wind power systems or geothermal heat pumps.

*Energy Efficient Mortgages:* Energy-efficient mortgages are available through a number of Delaware lending institutions. These mortgages are similar to conventional home loans except that they offer a lower interest and/or allow the purchaser to qualify for a larger loan on the basis of the home's lower operating costs.

**Education and Outreach**

A natural starting point for conservation and efficiency programs is education and outreach. There are numerous sources of information available to consumers, with much of the on-going education provided by electric utilities to their customers through billing inserts, newsletters and the like. Very large amounts of information are also available through the Internet.

However, the array of information available can be daunting and confusing, especially for residential consumers. There are also significant gaps in information and it is often not available at the time it is most critical in the decision-making process. For example:

- Information about energy consumption is available inconsistently at the point of purchase for major appliances.

- Little information is provided to new homebuyers that would encourage them to consider options that would reduce the long-term operating costs of their homes.

- For larger consumers, standard design and procurement practices may not be questioned, leading to inefficient designs for major energy-consuming systems like heating and air conditioning, or installing more than minimum required insulation.

Educational programs provide the core of many other types of programs, including financial incentives, and are viewed as the first step towards achieving higher efficiency levels. Education programs can include:

- Advertising and informational campaigns
- Information provided to consumers, wholesalers and sales personnel
- Energy audits
- Technical extension services
- Websites and other internet resources
- Technical workshops and conferences

Education programs should always be designed with specific targets in mind in order to be effective.

**Building Codes**

Buildings in the residential and commercial sectors account for a very large portion of the energy consumed in the State. Energy codes prescribe minimum design and construction standards and therefore have a very large influence on building stock efficiency for many years into the future. The Working Group agreed that building codes are an important area for helping to improve overall efficiency in the State's residential and commercial sectors.

**Incentive Programs**

The third category of measures examined by the Working Group was financial incentive programs. Incentives cover a wide range of options including:

- Non-financial award programs
- Direct rebates to consumers
- Wholesale incentives

- Tax credits
- Accelerated depreciation
- Real estate tax reductions

Non-financial programs generally provide recognition of efforts that go beyond conventional practices. They may be tied to expanded support, such as technical advice, for specific projects to encourage energy consumers to explore alternative technologies, products and practices.

Financial and tax incentives are powerful tools when properly employed. In general, the Working Group believes that financial incentives should be used carefully. They should be used to encourage adopting technologies or products that have clear energy and environmental benefits but face significant market barriers. They should not be used to promote technologies or products that are clearly cost effective or are already in widespread use.

Incentives must also be tailored to the specific market or sector. For example, rebates generally work best with individual consumers for specific products. Tax credits may be applied to both individual consumers and businesses, but accelerated depreciation can only be applied to businesses. Proper program design is a very important factor in the success of financial incentives.

**Renewable Energy in Buildings**

A fourth area considered by the Working Group was renewable energy in buildings. Although not directly related to conservation and efficiency, the use of renewables is made considerably more effective when done in conjunction with efficiency improvements.

# Conclusions and Recommendations

The Working Group developed a series of recommendations based on all of the issues and information considered in this report. Each recommendation is summarized below, along with the Working Group's assigned priority (1 = "High," 2 = "Medium," 3 = "Low"), the type of action required, and where appropriate, a summary of costs and benefits.

**Recommendation CE1: Update residential and commercial building energy codes**

*Priority: 1*

*Type of Action: Legislative*

Several different versions of building and energy codes are in use across the State. To date, only New Castle County has adopted the latest residential building codes. Residential energy codes are still based on the 1993 Model Energy Code and commercial energy codes are still based on ASHRAE 90.1-1989.

Residential building and energy codes should be uniformly updated in each jurisdiction. The 2000 International Building Code (IBC) and the 2000 International Energy Conservation Code (IECC) should be adopted in each county and municipality having jurisdiction over building and energy codes.

The State should also develop legislation that mandates adoption of uniform building and energy codes in each jurisdiction within a specific time frame. Adoption should be tied to training (see Recommendation CE2). The Delaware Home Builders Association and other building trade groups should be targeted for outreach activities prior to the introduction of any legislation.

Costs to adopt the new building and energy codes are expected to be minimal. Energy codes have alternative compliance mechanisms that allow deviations from prescriptive aspects of the codes. For example, higher insulation values may be traded for higher efficiency heating equipment. End-users will benefit from lower energy costs overall.

**Recommendation CE2: Provide training for building code inspectors**

*Priority: 2*

*Type of Action: Education Program – Residential and Commercial Sectors*

Residential and commercial energy code compliance is uneven and enforcement is not uniform across the state.

Training on the IECC for code inspectors, builders and developers is needed in order to comply with and to enforce energy codes. Funding should be provided to support training in conjunction with an implementation timetable.

Previous costs to provide training for the adoption of the 1993 Model Energy Code were approximately $60,000. Costs are expected to be higher since residential and commercial sectors will be affected simultaneously. A reasonable range is $150,000 to $200,000. Funding to offset these costs is available under the U.S. DOE's State Energy Plan Special Projects Solicitation.

**Recommendation CE3: The State should join the U.S. EPA/DOE Energy Star program**

*Priority: 1*

*Type of Action: Executive Order*

The EPA/DOE Energy Star Program is underutilized within the State. The Energy Star Program provides considerable support in key areas of energy efficiency and conservation, from individual appliance and consumer information to building construction practices and benchmarking.

The State should join the Energy Star Program as a partner and make full use of available EPA resources. The State would be required to sign a Memorandum of Understanding with the Federal EPA. As part of joining Energy Star, the State should also urge other government and business entities to join the Energy Star Program.

There is no direct cost to the State for joining the Energy Star Program. The State will benefit from positive public relations and by positioning itself to "lead by example." In addition, the State has full access to all national Energy Star Program marketing materials.

**Recommendation CE4: Promote Energy Star equipment and construction practices**

*Priority: 2*

*Type of Action: Education Program – Residential and Commercial Sectors*

Consumers, builders and contractors are often unaware of the cost-savings and environmental benefits of energy-saving equipment. Contractors often do not promote cost-effective measures for new construction.

The State should aggressively promote the use of EnergyStar Program rated appliances, space conditioning equipment, office equipment and construction practices. A concentrated public relations and advertising campaign should be initiated to raise awareness among energy users at all levels. EnergyStar should also be promoted through the use of conferences, workshops, training and benchmarking tools available through the EPA.

Earlier proposals for public relations and advertising indicate that annual costs for such an effort would be approximately $400,000 per year. As part of the program, costs in later years would be borne in part by retailers and builders who benefit from the program. Benefits for this type of program would be measured by tracking sales of Energy Star equipment before and after specific campaign steps.

**Recommendation CE5: Develop residential consumer information and audit websites, hotlines and other outreach tools**

*Priority: 3*

*Type of Action: Education Program – Residential and Commercial Sectors*

Information for residential energy consumers is fragmented and often hard to understand. The State should sponsor the development of a "self-audit" website, energy hotline and/or other tools and information kits for residential energy consumers.

Web Site development costs vary widely. Sites are available through third parties that may require only minor adjustments for Delaware's purposes. Costs for a site specifically developed for Delaware will depend on the level and type of information offered, as well as on-going update and maintenance costs. A conceptual outline should be completed prior to determining the best methods for disseminating energy information for residential consumers.

**Recommendation CE6: Consumers should be made aware of the link between energy use and environmental and economic impacts**

*Priority: 2*

*Type of Action: Education Program – Residential and Commercial Sectors*

Consumers are generally unaware of the economic and environmental impacts of energy use in their homes.

In conjunction with the Energy Star promotional campaign, the State should develop and implement a comprehensive consumer education program regarding the use of energy in residential settings. The program should prominently feature the economic and environmental benefits of energy efficiency, conservation and renewable energy options.

**Recommendation CE7: Provide incentives to spur the purchase of energy-efficient appliances in the residential sector**

*Priority: 2*

*Type of Action: Financial Incentive – Residential Sector*

The initial costs of energy-efficient major appliances (e.g., air conditioners, furnaces, refrigerators, etc.) are often a barrier when consumers must make purchasing decisions in the residential sector. In most cases, the additional costs are repaid quickly by energy savings.

Direct incentives for selected appliances should be established to reduce the initial cost barrier to the purchase of energy-efficient appliances. Incentives may be directed to retail or wholesale purchasers, builders or contractors. Incentives should be provided for EnergyStar rated air conditioners, furnaces, heat pumps, hot water heaters, refrigerators and freezers and clothes washers.

The initial step should be to evaluate the Delaware market to insure that such incentives are appropriate for local conditions.· The level of incentives, payment mechanisms, target markets and all other aspects of program design should be developed separately as part of a comprehensive energy planning process.

A preliminary assessment of energy savings based on a New Jersey rebate program indicates that electricity savings will start at 3,000 to 4,000 MWh per year and gas savings will start at 14,000 to 15,000 MMBTU per year at an investment of $2,000,000 to $3,000,000 per year. The Delaware Climate Change Action Plan indicates that higher potential is possible depending on incentive levels and available funding. (NOTE: The results of the New Jersey Program were used to provide a general indication of potential program performance in Delaware. New Jersey's experience may not be directly applicable to Delaware.)

**Recommendation CE8: Increase the current rebate levels for photovoltaic and solar thermal systems through the Environmental Incentive Fund**

*Priority: 2*

*Type of Action: Financial Incentive – Residential Sector*

The direct incentives for residential photovoltaic and solar water heating systems offered by the Environmental Incentive Fund's Energy Alternatives Program are too low to stimulate the market. To date only 3 residential photovoltaic systems have been installed that were eligible to utilize an EIF incentive.

The incentives for residential photovoltaic and solar thermal systems should be increased to a level similar to surrounding state programs. In comparison, the New Jersey Clean Energy program offers incentives up to $5.00 per installed Watt for photovoltaic systems.

### Recommendation CE9: Promote energy efficient mortgages

*Priority: 3*

*Type of Action: Financial Incentive – Residential Sector*

Energy efficient mortgages are available from several lenders, although they are not widely used. Energy efficient mortgages offer buyers a lower interest rate in return for purchasing a home meeting certain energy efficiency levels.

The State should develop outreach programs to builders, lenders and consumers to increase awareness of energy-efficient mortgages.

Information provided by FNMA indicate that an average home spends $1,900 per year on energy and that an efficient home can save up to 50% on energy bills. Energy efficient homes make mortgages more affordable and increase their market value.

### Recommendation CE10: Include energy efficiency criteria in publicly funded low income housing renovations

*Priority: 3*

*Type of Action: Regulatory*

Low-income households spend as much as 25% of their income on energy. In comparison, higher income households spend only 3.5 to 5% on energy. The Delaware State Housing Authority (DSHA) does not currently include energy efficiency in ranking multi-family low income housing renovation projects.

DSHA should include energy efficiency as a criterion for ranking and selecting multi-family renovation projects. Criteria for selecting renovations projects, including consideration of energy efficiency, should be established as part of a comprehensive energy planning process.

Costs are expected to be minimal to implement new ranking criteria. Costs for some projects may increase, although energy consumption and expenditures will be reduced over the life of the projects.

**Recommendation CE11: Evaluate low income weatherization funding**

*Priority: 3*

*Type of Action: Evaluation*

The current backlog for weatherization assistance is now about five years. The weatherization assistance program is currently funded from utility payments, the U.S. DOE, and oil overcharge funds. The current backlog is expected to worsen as oil overcharge funds are finally exhausted.

Funding for weatherization should be examined with the aim of reducing the backlog and ensuring that Federal money to support the program continues to be available.

**Recommendation CE12: Develop new regulations to promote the current uses of the Environmental Incentive Fund**

*Type of Action: Evaluation*

The Environmental Incentive Fund lacks the administrative, marketing and education budgets needed to appropriately manage and promote the program. The Delaware Million Solar Roofs partnership, through a $50,000 grant from the US DOE, has supported a significant portion of the marketing and promotion of the existing program. However, these funds are available only through a competitive bidding process and may not be available year-to-year.

New regulations should be developed and approved to allow the use of EIF monies to support the administration, marketing and educational needs of EIF's Energy Alternatives Rebate Program.

**Recommendation CE13: Develop commercial sector energy audit and information programs**

*Priority: 2*

*Type of Action: Education Program – Commercial Sector*

Many building owners and operators do not understand or do not think about the value of energy efficiency in day-to-day operations or design and construction of new facilities.

The state should sponsor a program of commercial building energy audits, web-based information and other forms of information to help commercial building owners and operators evaluate energy efficiency options. The program should include the promotion of building operator educations and certification programs, such as those developed by AEE.

Costs will depend on the level of demand for audits. Contractors could support auditing services and training, and costs could be met partially through participation fees.

**Recommendation CE14: Provide incentives to spur purchases of energy-efficient equipment in new and renovated commercial buildings**

*Priority: 2*

*Type of Action: Financial Incentive – Commercial Sector*

Initial costs of energy-efficient equipment (e.g., lighting, motors, HVAC equipment, refrigeration equipment, office equipment, etc.) are often a barrier when commercial buildings are constructed or renovated.

Rebates or tax incentives, including tax credits and accelerated depreciation, should be developed to encourage the procurement and use of cost-effective, energy-efficient equipment. The level of incentives, payment mechanisms, target markets and other aspects of program design should be developed separately as part of a comprehensive energy planning process.

The Delaware Climate Change Action Plan indicates that high potential for cost-effective savings is possible depending on incentive levels and available funding.

**Recommendation CE15: Establish a "Governor's Award" for excellence in energy-efficient residential and commercial buildings**

*Priority: 1*

*Type of Action: Non-Financial Incentive*

Commercial buildings can be designed to significantly exceed the minimum standards established in energy codes. For example, the EPA and DOE have developed the Energy Star Homes Program as a way to encourage energy-efficient design and construction practices in the residential sector that go beyond conventional practices. Similarly, the U.S. Green Building Council has established Leadership in Energy and Environmental Design (LEED) design standards for commercial buildings.

The State should sponsor a "Governor's Award" program to recognize the efforts of builders and building owners who design in accordance with Energy Star (residential) and U.S. Green Building Council "LEED" (commercial) standards. Design of the award program should include separate categories, e.g., small business, large business, residential, school, hospital, etc.

Costs to implement an award program will be minimal. Benefits include positive public relations for builders, building owners and the State for promoting design practices that exceed minimum standards.

**Recommendation CE16: Establish an Energy Star construction pilot program for public housing**

*Priority: 3*

*Type of Action: Pilot Program*

Energy Star residential construction practices can be showcased in public housing, thus providing builders and lenders tangible examples of how to construct such housing.

The State should mandate that at a portion of publicly-funded housing be constructed to meet Energy Star standards as a pilot program.

Costs/benefits should be determined on a project specific basis.

**Recommendation CE17: Provide financial incentives for commercial buildings designed in accordance with LEED standards**

*Priority: 3*

*Type of Action: Financial Incentive – Commercial Sector*

Although commercial buildings can be designed in accordance with LEED and other advanced energy efficiency standards, there is usually little impetus to do so.

In addition to the official recognition that can be provided by the Governor's Award, rebates or tax incentives, including tax credits and accelerated depreciation, should be developed to encourage commercial building design in accordance with LEED certification standards.

**Recommendation CE18: Develop an industrial audit and information program for small and medium sized industrial energy users**

*Priority: 3*

*Type of Action: Educational Program – Industrial Sector*

Many small and medium sized industrial energy users do not understand or do not think about the value of energy efficiency.

The state should sponsor a program of industrial audits, web-based information and other forms of information to help industrial consumers evaluate energy efficiency options. In particular, the state should take full advantage of the U.S. DOE's industrial assessment programs to assist small and medium sized manufacturers identify energy efficiency opportunities· The Delaware Manufacturing Extension Partnership (DMEP) should be enlisted to help promote energy efficiency and conservation in the industrial sector, especially for small to medium sized firms. As the primary point-of-contact, the State Energy Office will also need additional resources to support these activities.

Some of this work is already in progress under a grant from the U.S. DOE Industries of the Future Program. The University of Delaware's Center for Energy and Environmental Policy is managing this grant on behalf of the State Energy Office, including some industrial audits.

**Recommendation CE19: The State should take full advantage of the U.S. DOE Motor, Steam, and Compressed Air Challenge Programs**

*Priority: 1*

*Type of Action: Educational Program – Industrial Sector*

The industrial sector is typically far more sensitive to energy costs because they make up a much larger share of total operating costs. Efficiency measures play an important role in managing these costs and enhancing industrial sector productivity and competitiveness. The U.S. DOE offers industrial efficiency programs targeting the largest energy end-uses within the sector.

The state should fully engage the U.S. DOE's Motor, Steam, Process Heating and Compressed Air Best Practices Programs. The programs provide a wide range of information, software and technical expertise designed to help industrial plant operators identify opportunities to improve energy efficiency in these key areas.

Costs are expected to be minimal. Benefits accrue to industrial participants who use the programs to identify and install cost-effective improvements.

**Recommendation CE20: Establish a financial incentive for high efficiency electric motor retrofits**

*Priority: 3*

*Type of Action: Financial Incentive – Commercial and Industrial*

Motors account for nearly two-thirds of industrial electricity consumption, making them a primary target for efficiency upgrades.

A prescriptive incentive program should be established to promote the procurement and installation of energy-efficient motors, variable speed drives and other motor efficiency improvement measures.

**Recommendation CE21: Develop a custom incentive program for industrial energy users**

*Priority: 2*

*Type of Action: Financial Incentive -- Industrial*

Industrial consumers are often very difficult to characterize as a group. The vast number of energy end-uses in the industrial sector, combined with the specialized nature of much manufacturing and process equipment means that financial incentives must be very flexible to account for the diversity in this sector.

A custom rebate/incentive plan should be developed based on energy saved through the implementation of eligible energy-efficiency measures. Measures could include upgrades and retrofits ranging from lighting to process specific improvements.

**Recommendation CE22: The State should continue funding appropriate energy demonstration projects**

Priority: 2

*Type of Action: Financial Incentive – R&D*

Targeted technology demonstrations serve an important purpose in establishing the viability and performance of energy efficiency and renewable energy technologies that may be appropriate for Delaware. The State Energy Office has supported this type of activity to date with oil overcharge funds. Since these funds are nearly depleted, additional resources are needed.

The State should continue to sponsor energy efficiency and renewable energy demonstrations, through cost-sharing, competitive grants, and other appropriate mechanisms.

Costs/benefits should be determined on a project specific basis.

**Recommendation CE23: The association between energy and water consumption should be explored to take advantage of opportunities to conserve both resources.**

*Priority: 3*

*Type of Action: Future Planning*

Energy use in all sectors is often directly related to water consumption. In addition, the water supply and treatment infrastructure uses a significant amount of energy. Green building standards, such as LEED certification, often include standards for water consumption. Given recent water shortages in Delaware, water conservation is an important goal in itself and can be facilitated by appropriate energy conservation measures.

Water conservation should be further investigated as a means to save energy. Specific measures can be integrated into energy codes and standards, especially where hot water consumption could be affected.

**Recommendation CE24: The State should establish and maintain an energy end-use data collection and analysis system to support future energy planning activities**

*Priority: 1*

*Type of Action: Future Planning*

End-use data collection, monitoring and analysis are not currently done in Delaware. Data collection at the national level often "regionalizes" Delaware in ways that obscure how energy is actually used within the state. End-use information is vital to on-going efficiency efforts.

The State Energy Office should establish and maintain a data collection and analysis system that can be used to detect progress towards efficiency goals, emerging trends and the impacts of specific programs and policies. The Delaware Climate Change Action Plan, which was developed by the University of Delaware, initiated a significant data collection effort, which can be used as the foundation for future data collection and analysis.

**Recommendation CE25: Evaluate expanding the Environmental Incentive Fund to include additional utility customers and increasing annual revenues**

*Priority: 1*

*Type of Action: Evaluation*

The Environmental Incentive Fund was established to encourage the adoption of renewable energy technologies through direct incentives. Funds are only collected from and can only be used by Conectiv Power Delivery customers and can be applied only to PV, solar thermal, small-scale wind, and ground source heat pumps. The current restrictions on the fund limit its potential impact. An analysis should be undertaken to:

1. Assess how the EIF has worked to date
2. Examine how the EIF could be used to promote and provide incentives for certain high-efficiency technologies and other efficiency-related activities
3. Expand the EIF to cover all other Delaware utility customers and increase the contribution rate to be more in line with neighboring states.

If an increase in the EIF rate is recommended, the rate change should be implemented gradually. The rate of change should be tied to the level of increase, with higher increases taking place over a longer period of time.

Current contributions to the EIF total approximately $1,500,000 annually based on a contribution rate of $0.000178/kWh. The overall impacts on electric ratepayers are minimal (about $3.00 per year for residential, and $22.00 per year for commercial customers). Nearby states have rates from 5 to 10 times higher. In order to achieve funding for a meaningful impact, the rate should be increased and/or participation broadened.

**Recommendation CE26: Investigate expanding the use of demand response to reduce peak electric loads**

*Priority: 3*

*Type of Action: Evaluation*

Demand response can be a very effective way of controlling peak loads and insuring reliability during high demand periods. A range of technologies are available that facilitate control of air conditioners, water heaters and other residential and commercial equipment for the purpose of load reduction. Load reduction strategies have been employed on the Delmarva Peninsula with varying degrees of success since the late 1980s, although interest has waned in recent years.

A study should be undertaken to investigate the applicability of demand response/direct load control technologies for the purpose of reducing peak loads, especially in high growth areas.

**Recommendation CE27: Investigate utility rate structures that encourage energy efficiency**

*Priority: 3*

*Type of Action: Evaluation*

Utility rate structures can be used to encourage energy efficiency and load control for customers. This is a complex area requiring additional investigation, but examples include various types of time-of-use rates, real time pricing, and new information technologies that provide price signals to certain customers.

Utility rates, such as real time energy pricing, that encourage higher efficiency should be investigated. Pilot programs should be developed to implement viable alternatives. These activities should be coordinated with on-going Public Service Commission studies.

# Appendices

# Appendix A: Delaware Non-Transportation Energy Supply Forecasts

# Delaware Non-Transportation Energy Supply Forecasts

Prepared for Delaware Energy Task Force

Applied Energy Group, Inc.

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# Table of Contents

# INTRODUCTION

Governor Minner's Executive Order 31 places significant emphasis on improving the diversity of Delaware's energy resources. As this paper will show, virtually all of Delaware's primary energy is supplied by conventional fossil fuels. In the electric power sector, all but three percent of the electricity sold in the state is generated by fossil- and nuclear-fueled power plants. In the transportation sector, all but a tiny amount of energy is supplied by petroleum.

Given the current situation, the purpose of this white paper is to:

- Provide an understanding of the current non-transportation energy resource base;
- Forecast future demand for selected resources under "business-as-usual" conditions

Once the "business-as-usual" forecasts are established, they provide a baseline for comparing alternative energy supply resources as well as the potential impacts of energy efficiency and conservation strategies.

The resources that will be considered in this paper are electricity, natural gas, distillate heating oil, and propane. Forecasts for conventional transportation fuels (gasoline and diesel fuel) are considered in a separate paper.

# CURRENT RESOURCES AND DEMAND FORECASTS

The following sections present forecasts for the demand of electricity and certain fuels in Delaware based on a "business-as-usual" scenario. In other words, the forecasts are projections of expected demand if there are no policy interventions or significant changes in technology. These forecasts are actually compiled from EIA, utility and, in the case of electricity from University of Delaware sources.

At best, forecasting is an inexact science because of the difficulty of accurately predicting key variables such as economic growth, fuel prices and seasonal weather forecasts. Nevertheless, forecasters can make reasonable predictions over short periods of time based on recent trends. Over the long term, assuming that neither technology or policy change is an oversimplification. In the case of energy, technology can change on both the supply and demand sides. Two examples of this are:

- The extent to which information technology such as personal computers and the Internet have increased the demand for electricity, and

- The emergence of a range of distributed generation technologies as potentially significant contributors to electricity supply.

Energy policies can have even more significant impacts by accelerating changes in technology, altering market and industry structures, and changing the basis for regulation. One needs to look no further than the dramatic shifts in the electricity industry since the advent of deregulation and restructuring over a decade ago.

The forecasts below show historical demand and consumption since 1990 for electricity, natural gas, heating oil and propane. Projections are made for the eight-year period from 2002 through 2010.

## Electricity Load and Energy Forecasts

For purposes of forecasting, electricity is separated into two components. The first component is peak demand, usually expressed in Megawatts. The second component is total annual generation, usually expressed in Megawatt-hours or Gigawatt-hours.

Figure 1 shows historical and projected summer peak transmission loads for PJM's entire Delmarva Zone (Delaware and the eastern shores of Maryland and Virginia). Individual utility forecasts were not used in this instance because individual peak forecasts may not be coincident and combining them could result in overestimating peak loads. Consideration was given to separating the peak load attributable only to Delaware, but was rejected because the results would not be particularly meaningful from a transmission or generation planning perspective.

The Delmarva Peninsula tends to have higher overall peak loads during the summer because of the high saturation of air conditioning. In other regions of the country, particularly in northern New England and parts of the Upper Midwest, annual peaks occur during the winter.

For the period from 1990 to 2001, two values are shown: actual annual transmission loads and weather-normalized loads. Peak electricity demand is particularly sensitive to weather. Weather-normalized loads are calculated to eliminate the influence of extremely hot or cool weather by estimating demand under average rather than extreme weather conditions. As the figure shows, actual peak demands can vary significantly from weather-normalized trends year to year. Because of possibly wide variations in annual weather, the weather-normalized trend is used to avoid over- or under-forecasting future demand.

The load forecast is an important component in answering two questions:

- How much and what type of generating capacity must be installed or purchased from third-party suppliers to meet demand, and

- Is the transmission system robust enough under peak load conditions to deliver the required amounts of electricity

Over forecasting could result in excessive capital expenditures, while under forecasting could cause supply constraints or reliability problems.

Potential extreme variations in annual weather, as well as unexpected growth or system problems must still be taken into account when forecasting loads. Since the weather-normalized forecast represents a "typical" or "mean" case, an analysis of extremes is also done. These are represented as the "90%" and "10%" forecasts shown from 2002 to 2010 on Figure __. Simply stated, these lines represent the probability that the actual peak demand will be at or below the forecast value. In practical terms, the values in the "90%" line shown in Figure 1 are approximately 9% higher than the weather-normalized case.

Since there is always uncertainty in load forecasting, utility planners also apply safety factors to avoid situations where extreme weather or unexpected system problems could cause supply constraints or reliability problems. When considering generating capacity, "reserve margins" are added to the weather-normalized peak demand forecast to develop capacity requirements to insure reliable system operation. Reserve margin requirements vary, but typical values range from as low as 12 percent to as high as 18 percent. As long as installed and purchased capacity is at least equal to the forecast demand plus reserve margin requirements, the system is usually considered reliable from a generation point-of-view.

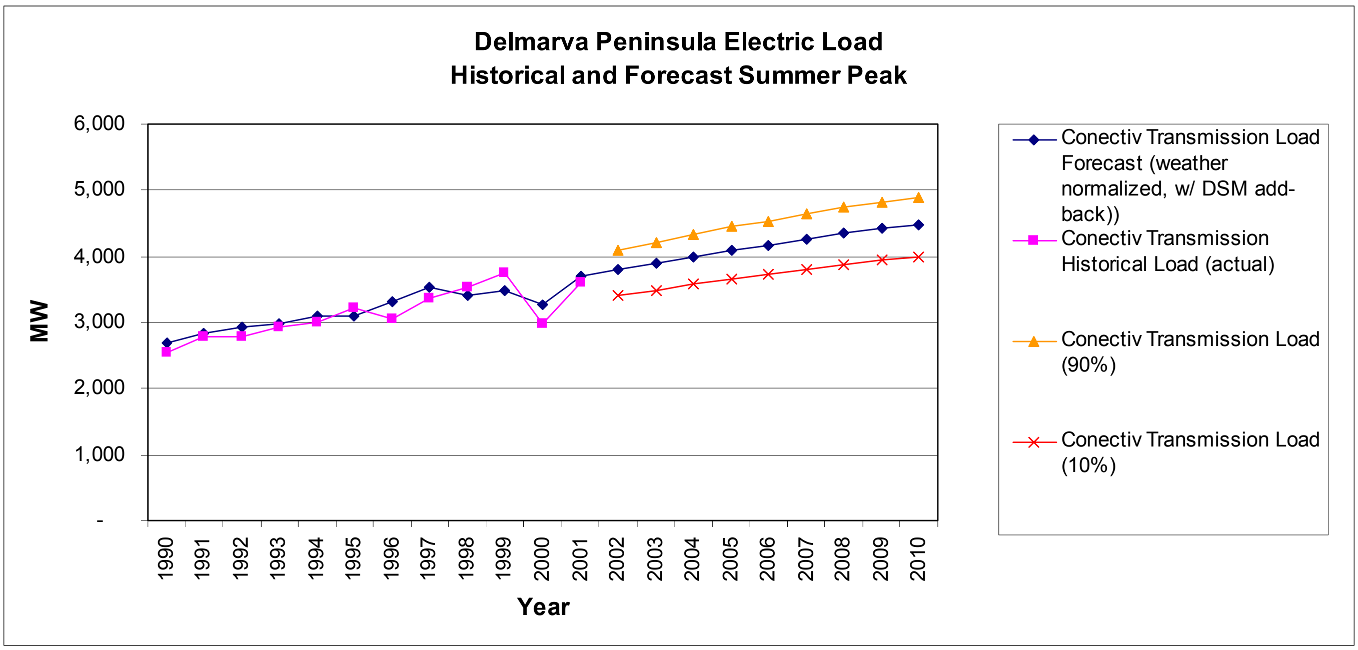


Figure 1: Delmarva Peninsula Summer Peak Load

Based on the forecast in Figure 1, weather normalized peak loads are expected to grow from about 3,800 MW today to about 4,500 MW in 2010, an increase of approximately 18 percent. There is currently slightly more than 3,900 MW of installed generating capacity on the Delmarva Peninsula, and the transmission system allows the purchase of substantial capacity off of the Peninsula.

While construction both on and off of the Peninsula is expected to add to available capacity resources, there is also uncertainty in this aspect of planning. In the past, vertically integrated utilities controlled the construction of generating plants based on internal and external planning criteria and regulatory requirements. However, this has fundamentally changed and the decision to install new generation resources is mainly a market function.

The second component of an electricity forecast is energy. The energy forecast estimates the annual cumulative generation or consumption. Unlike peak demand, the forecast shown is for Delaware only. Figure 2 shows historical data from 1990 and three separate forecasts for growth in electricity consumption through 2010. Like peak load forecasts, energy forecasts are also subject to uncertainties. However, there are differences in what influences the forecasts. Peak loads tend to be strongly influenced by extremes in weather conditions over relatively short periods of time. Energy consumption is also influenced by weather, but is more affected by seasonal or longer-term trends. In addition, consumption is more influenced by economic conditions than peak load.

Energy forecasts are important to the utility or generating company for projecting sales and revenues, and for estimating key operating expenses such as fuel and maintenance. They are also important for estimating annual emissions of greenhouse gases, sulfur dioxide, $NO_x$ and others.

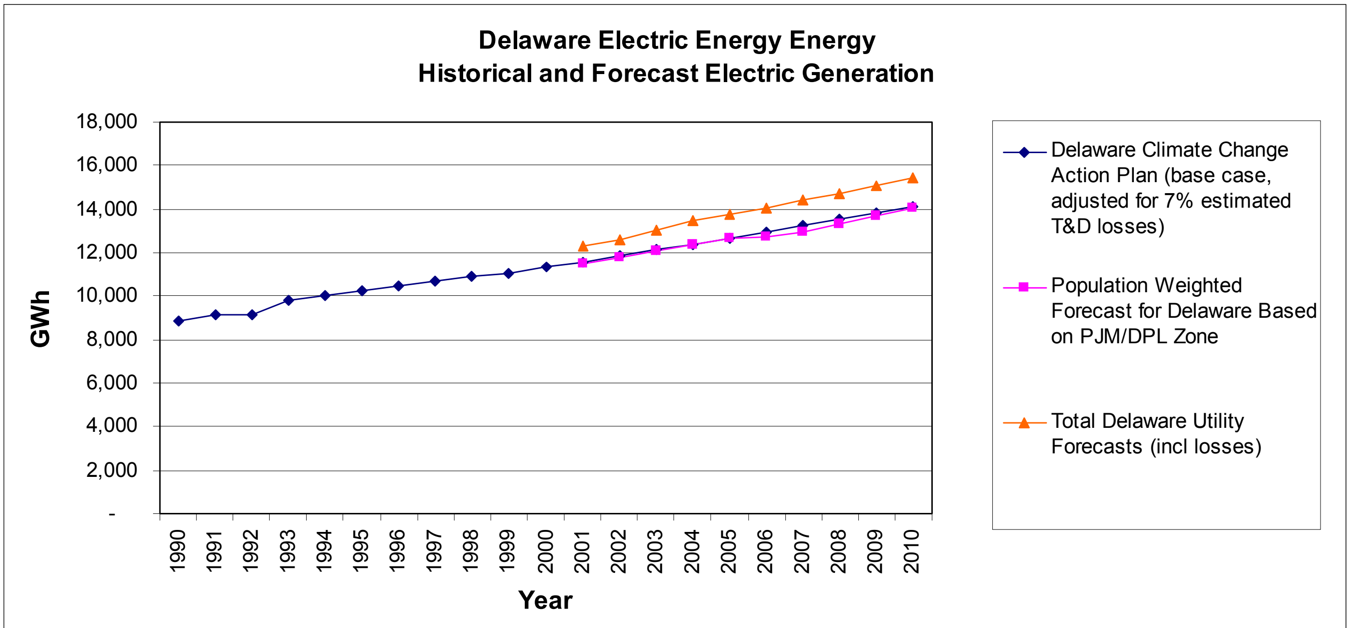


Figure 2: Delaware Electric Energy Forecast

The forecasts shown in Figure 2 are summarized below:

- The Delaware Climate Change Action Plan (DCCAP) forecasted growth in "business-as-usual" electricity consumption based on the Delaware Econometric Model for the period from 2000 through 2008. The DCCAP forecast was adjusted to include transmission and distribution system losses in order to estimate total generation rather than total end use.

Based on this forecast, total annual electric power generation is projected to increase from 11,900 GWh to 14,100 GWh from 2002 to 2010, a total increase of 18.5 percent. This translates to an average annual growth rate of 2.1 percent.

- The second forecast is based on PJM's Delmarva Zone forecast. Since the zone forecast includes Maryland and Virginia, allocations were made based on U.S. Census Bureau population forecasts for the counties on the Peninsula. This forecast agrees closely with the forecast produced by the University of Delaware.

- The third forecast is based on aggregated utility forecasts for Conectiv, the Delaware Electric Cooperative and the Delaware Municipal Electric Corporation. Because forecasting time frames in use at these utilities end before 2010, the results were extrapolated by two years to compare with other forecasts that extended through 2010. Based on the combined utility forecasts, total generation is expected grow from 12,600 GWh to 15,500 GWh from 2002 to 2010, and increase of 23 percent. The utility forecasts start from a higher base and project a higher annual growth rate of 2.6 percent compared to 2.1 percent.

## Fuels for Electric Power Generation

As electricity consumption increases, so does the demand for fuels to generate electricity. In Delaware's case, fossil fuels have been the sole primary energy sources for in-state electric power generation. Figure 3 shows primary energy consumption for in-state electric power generation from 1960 to 1999. Until 1985, primary energy consumption for electric power generation in the state was increasing steadily. Since then, it has declined steadily.

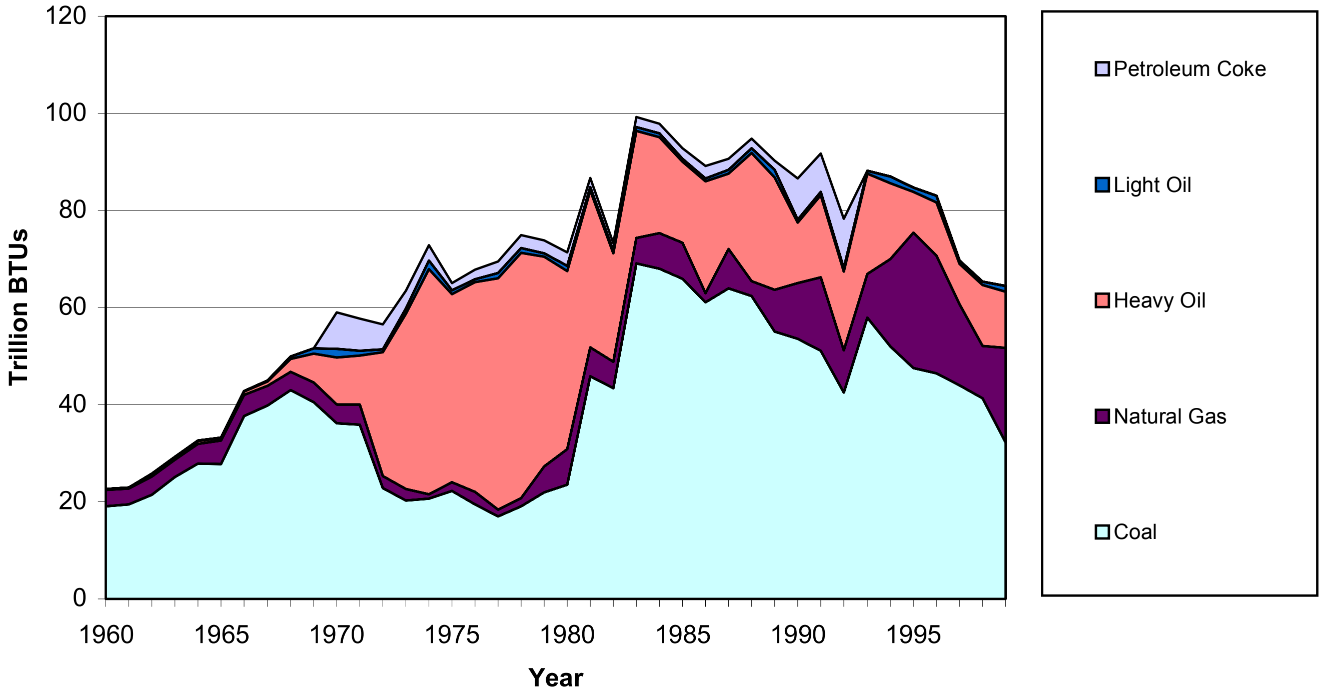


Figure 3: Fuel Consumption for In-State Electric Power Generation

This is illustrated in more detail since 1990 in Figure 4. As this figure shows, total electricity sales have continued to increase even though in-state generation has decreased. The gap between in-state generation and sales is made up by imports of energy from the PJM Interchange. As of 2000, approximately 45 percent of the electricity sold in Delaware was imported from the PJM Interconnection. The most significant factor contributing to this trend is the expansion of the unregulated wholesale electricity market, which encourages purchases of relatively low cost nuclear- and coal-generated electricity.

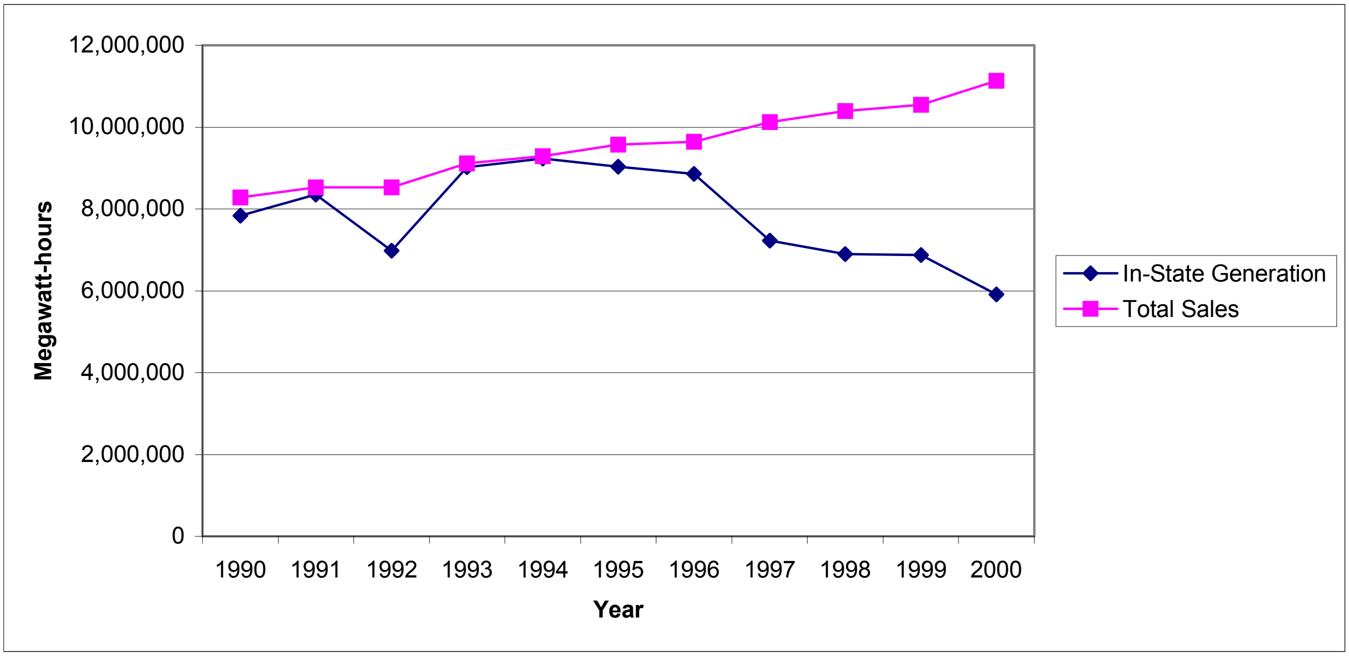


Figure 4: In-State Electric Power Generation and Total Sales Comparison

The role of interconnection sales makes it more difficult to forecast the future fuel mix for electric power generation in Delaware accurately. This is because energy sales are made up of a changing mix of in-state generation, bi-lateral long-term contracts and spot market purchases by many different purchasers. The decision to generate or purchase electricity from the PJM Interconnection is based primarily on economics, although practical limits are placed on imports by transmission system capacity. When out-of-state sources are considered, about 58 percent of Delaware's electricity is generated using coal, 27 percent from nuclear, 6 percent from oil, 6 percent from natural gas, and 1.5 percent each from hydro and biomass.

## Generating Plant Diversity

There are over 3,900 MW of electric generating capacity installed on the Delmarva Peninsula. Table 1 provides a summary of the installed units, including size, type and location.

Table 1: Installed Generating Capacity on Delmarva Peninsula

| Unit | Owner | County | State | Unit Type (see note 1) | Summer Capacity (MW) | Primary Fuel | Operating Category | Comments |
|---|---|---|---|---|---|---|---|---|
| Bayview 1 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Bayview 2 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Bayview 3 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Bayview 4 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Bayview 5 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Bayview 6 | Conectiv Energy | Northampton | VA | Diesel | 2.0 | Distillate | Peaking | |
| Christiana 11 | Conectiv Energy | New Castle | DE | CT | 22.5 | Distillate | Peaking | |
| Christiana 14 | Conectiv Energy | New Castle | DE | CT | 22.5 | Distillate | Peaking | |
| Delaware City 10 | Conectiv Energy | New Castle | DE | CT | 16.0 | Distillate | Peaking | |
| Edge Moor 3 | Conectiv Energy | New Castle | DE | Steam | 86.0 | Coal | Base | |
| Edge Moor 4 | Conectiv Energy | New Castle | DE | Steam | 174.0 | Coal | Base | |
| Edge Moor 5 | Conectiv Energy | New Castle | DE | Steam | 445.0 | Heavy Oil/Gas | Intermediate | |
| Edge Moor 10 | Conectiv Energy | New Castle | DE | CT | 13.0 | Distillate | Peaking | |
| Hay Road 1-4 | Conectiv Energy | New Castle | DE | CC | 511.0 | Gas | Intermediate | |
| Hay Road 5-8 | Conectiv Energy | New Castle | DE | CC | 541.0 | Gas | Intermediate | |
| Madison Street 1 | Conectiv Energy | New Castle | DE | CT | 11.0 | Distillate | Peaking | |
| Tasley 10 | Conectiv Energy | Accomack | VA | CT | 26.0 | Distillate | Peaking | |
| West Sub 1 | Conectiv Energy | New Castle | DE | CT | 15.0 | Distillate | Peaking | |
| Beasley | DEMEC | Kent | DE | CT | 50.0 | Gas | Peaking | |
| NRG Energy Center | NRG | Kent | DE | CT | 87.0 | Gas | Peaking | 2 x LM 6000 Sprint w/ gas compressors |
| Commonwealth Chesapeake | TECO | Accomack | VA | CT | 315.0 | Distillate | Peaking | 7 x LM 6000 w/ water injection and inlet chillers |
| City of Easton | City of Easton | Talbot | MD | Diesel | 50.0 | Distillate | Peaking | 16 diesel units |
| City of Berlin | City of Berlin | Worcester | MD | Diesel | 9.0 | Distillate | Peaking | 5 diesel units |
| City of Lewes | City of Lewes | Sussex | DE | Diesel | 2.0 | Distillate | Peaking | |
| City of Seaford | City of Seaford | Sussex | DE | Diesel | 7.0 | Distillate | Peaking | |
| ECI | State of Maryland | Somerset | MD | Steam | 4.0 | Wood | Co-gen | |
| DuPont Seaford | E. I. DuPont | Sussex | DE | Steam | 27.0 | Coal | Co-gen | |
| McKee Run 1 | City of Dover | Kent | DE | Steam | 17.0 | Heavy Oil | Peaking | |
| McKee Run 2 | City of Dover | Kent | DE | Steam | 17.0 | Heavy Oil | Peaking | |

| Unit | Owner | County | State | Unit Type (see note 1) | Summer Capacity (MW) | Primary Fuel | Operating Category | Comments |
|---|---|---|---|---|---|---|---|---|
| McKee Run 3 | City of Dover | Kent | DE | Steam | 102.0 | Heavy Oil | Intermediate | |
| Van Sant | City of Dover | Kent | DE | CT | 39.0 | Gas | Peaking | |
| Star | Motiva | New Castle | DE | Steam | 133.0 | Pet Coke | Co-gen | |
| Motiva IGCC | Motiva | New Castle | DE | CC | 178.0 | Pet Coke | Co-gen | Gross capacity includes air separation plant. Net capacity is 120 MW |
| General Foods | General Foods | Kent | DE | Steam | 16.1 | Coal | Co-gen | |
| Indian River 1 | NRG | Sussex | DE | Steam | 91.0 | Coal | Base | |
| Indian River 2 | NRG | Sussex | DE | Steam | 91.0 | Coal | Base | |
| Indian River 3 | NRG | Sussex | DE | Steam | 165.0 | Coal | Base | |
| Indian River 4 | NRG | Sussex | DE | Steam | 420.0 | Coal | Base | |
| Indian River 10 | Conectiv Energy | Sussex | DE | CT | 17.0 | Distillate | Peaking | |
| Vienna 8 | NRG | Dorchester | MD | Steam | 153.0 | Heavy Oil | Peaking | |
| Vienna 10 | Conectiv Energy | Dorchester | MD | CT | 17.0 | Distillate | Peaking | |

Notes:

1. CT = combustion turbine, CC = combined cycle

Figure 5 shows the geographic distribution of generating capacity based on fuel type and Figure 6 shows the geographic distribution of generating capacity based on duty cycle.

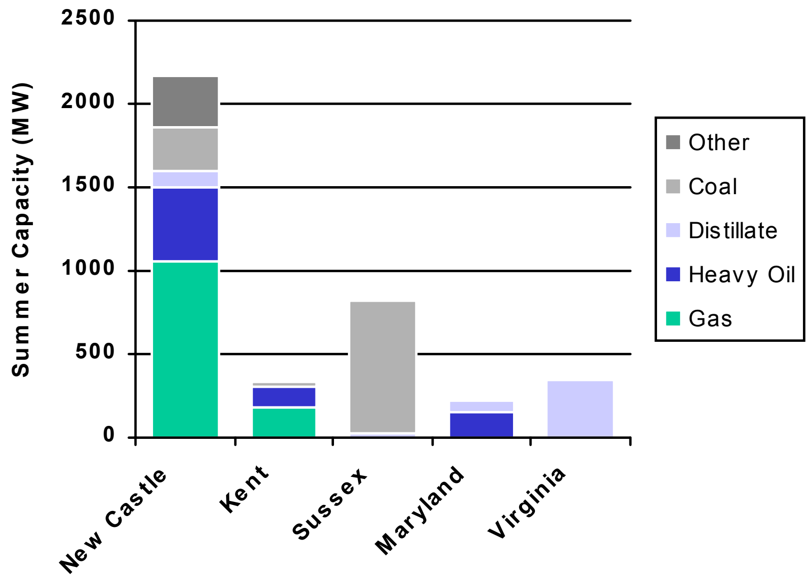


Figure 5: Geographic Distribution of Generating Capacity by Fuel Type

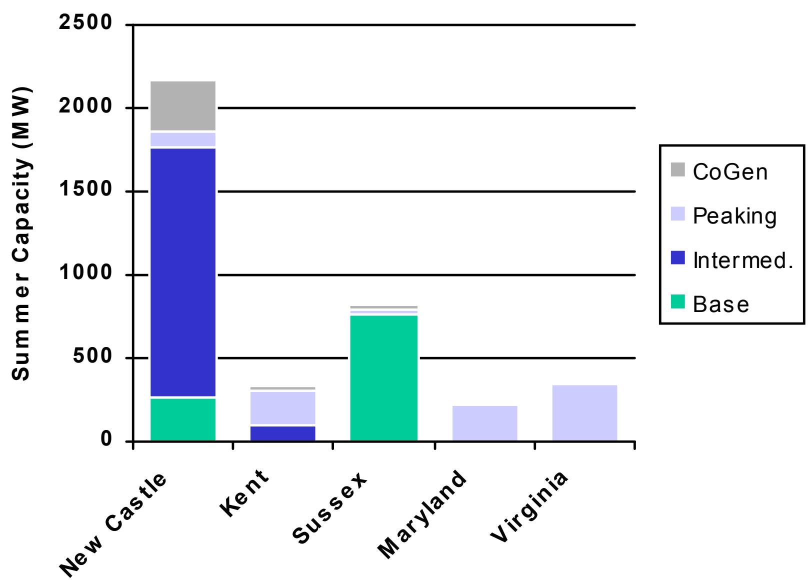


Figure 6: Geographic Distribution of Generating Capacity by Duty Cycle

Nearly 2,200 MW, over half of the installed generating capacity, is located in New Castle County, and nearly all of this is concentrated in the Wilmington area. Approximately 1,600 MW of the installed capacity on the Peninsula is classified as intermediate generating capacity, most of it fueled by natural gas. While New Castle County accounts for over half of the installed generating capacity on the Peninsula, it claims only 40 percent of the total Peninsula population. As more growth occurs outside of northern New Castle County, especially in the coastal areas, peak electric power demand and the need for base load energy in these areas will increase correspondingly.

While the exact mix of future resources is unclear, three important trends will influence how the future demand for electricity is met:

- First, virtually all new generation being installed nationwide, within PJM, and on the Delmarva Peninsula uses natural gas. This is occurring because natural gas-fueled power plants are generally less expensive and faster to construct, cleaner and easier to license. These features of gas-fueled plants are very influential because they mean lower overall financial risk to the companies constructing new facilities.

- Second, gas-fueled generating capacity is used in the wholesale marketplace as intermediate or "mid-merit" capacity. This type of capacity is based on combined cycle power plants, which are designed to start quickly and respond to rapid changes in load. These flexible operating characteristics help to make them more profitable, but because they burn a relatively expensive fuel, they are not used as base load power plants. As long as adequate supplies of base-load generation exist in PJM, prices are not expected to increase to the point of stimulating base-load plant construction.

- Third, Delaware currently imports approximately 5 million MWh of electricity annually, mostly from base-load coal and nuclear power plants. This is equivalent to 600 to 700 MW of base load generating capacity. Some of this imported base load electricity could probably be supplied by higher utilization of existing facilities. The construction of a coal-fired, base-load generating plant would cost between $1,500,000 and $2,000,000 per MW. Even a relatively small coal-fired power plant of about 300 MW would therefore cost between $450 and $600 million, which is two to three times the cost of a comparable combined cycle plant. In spite of lower fuel costs, power plant developers are reluctant to make an investment of this type because of the much higher fixed costs.

These trends are not expected to change in the near future and will have significant influence on how higher loads in southern Delaware and the lower part of the Peninsula will be served. Combined with the southward shift in population on the Delmarva Peninsula and the lack of natural gas service for large-scale power generation in these areas, it is likely that a large portion of the energy used in Delaware and on the Delmarva Peninsula will continue be imported.

## Natural Gas Forecasts

Natural gas forecasts are based on two separate data sources. EIA data is used to provide historical information in Figure 7 from 1990 to 2000. Utility forecasts are used to provide data from 2003 forward, and to provide the basis for interpolating gas consumption between 2001 and 2002. Figure 7 is divided into three major end-use categories: residential, commercial and industrial, which is consistent with EIA data. The utility forecasts for industrial gas consumption include transportation customers.[8] Gas consumed for electric power generation is not shown in Figure 7.

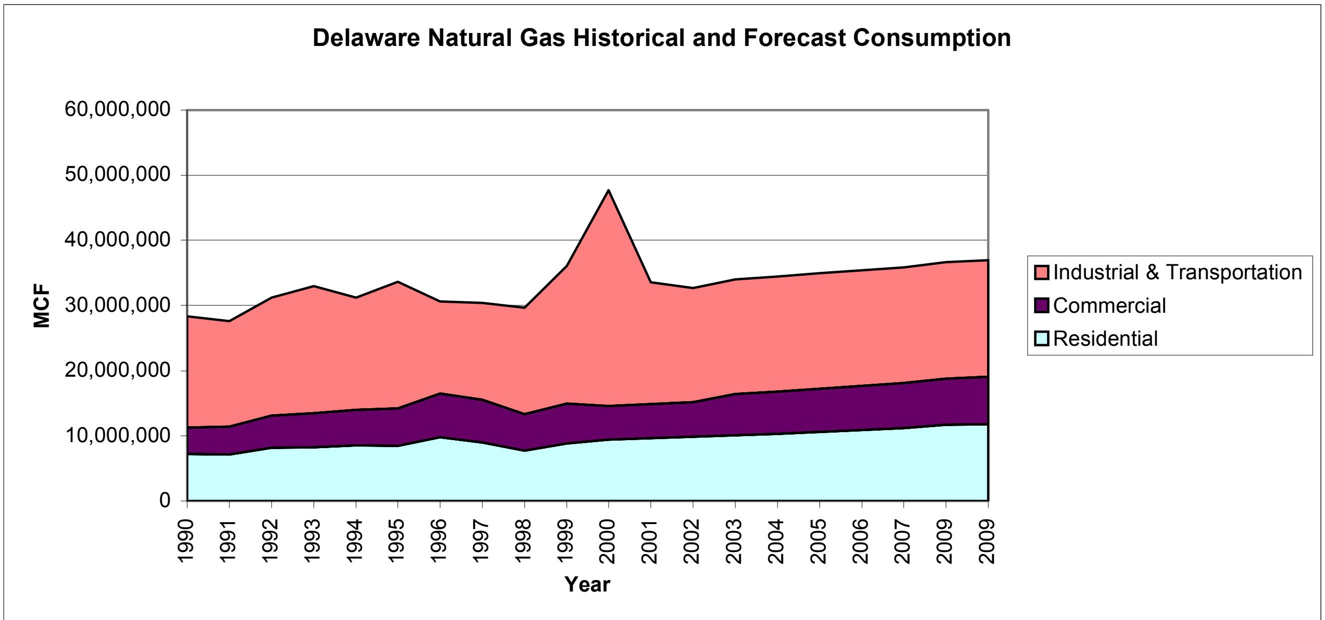


Figure 7: Natural Gas Forecast

The forecast data for residential and commercial consumption show a smooth continuation of the upward trend in actual consumption from 1990 through 2000. Historical industrial consumption, as recorded by the EIA data shows a very large increase in recorded consumption between 1999 and 2000. This occurred due to a very large short-term increase in gas consumption on the part on one industrial customer. Following this spike in consumption, overall gas consumption in the industrial sector resumes a smooth upward trend consistent with trends in the residential and commercial sectors.

Using this data, natural gas consumption is expected to increase by approximately 1.2 percent annually from 33,900,000 MCF to 36,900,000 MCF by 2010.

A major uncertainty in forecasting natural gas demand is the potential expansion of natural gas service. If service is expanded significantly, especially in the fast growing areas of southern Delaware, natural gas consumption could be much higher than indicated by the forecast. Natural gas is also expected to be the preferred fuel for distributed power generation. Increases in distributed generation capacity at end user sites could also affect natural gas consumption forecasts.

[8] Natural gas transportation customers are those who purchase the gas commodity from a supplier other than the local gas distribution company (LDC). The LDC provides transportation service only in these cases. The EIA does not distinguish between transportation-only and full service LDC customers when recording gas consumption data for the various sectors. Since transportation customers are almost exclusively in the industrial sector in Delaware, their gas consumption is included in the industrial sector.

## Distillate Heating Oil and Propane

Unlike electricity and natural gas, distillate heating oil and propane are not distributed by regulated companies. Fuel oil and propane distributors consider their forecasts confidential business information, and do not make them available.

To circumvent this problem, forecasts for consumption of distillate heating oil and propane in Delaware were derived from two sources. The first source is the EIA's State Energy database, which contains historical consumption information for the fuels in question. The EIA also forecasts future consumption for the South Atlantic region in the Annual Energy Outlook. The region includes Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia and West Virginia. Delaware's historical percentage of distillate heating oil and propane consumption for the region was calculated using the State Energy database from 1985 to 1999. Delaware's average consumption of propane over the 15-year period accounted for 2.9 percent of the regional total. Distillate heating oil consumption was 3.4 percent of the regional total. To calculate future consumption, the 15-year average historical percentage of regional consumption for both fuels was applied to the EIA's South Atlantic forecast. The forecasts for both fuels are shown in Figure 8.

Because of the methodology employed to develop these forecasts, Delaware's consumption is tied directly to the EIA's South Atlantic regional forecast. In the case of propane, consumption over the next eight years is expected to remain flat at approximately 4.0 trillion BTUs per year. This is a reasonable result because propane is used mainly in areas where natural gas service is unavailable. As the extent of natural gas service increases, it is unlikely that propane's market share will increase. Nevertheless, propane is an important fuel in rural areas for residential and commercial space heating, water heating and cooking. Propane is also unique since it is a byproduct of natural gas production and oil refining. This makes it relatively price inelastic because supply cannot easily be increased as demand increases.

Annual distillate heating oil consumption is expected to increase slightly from about 11.5 to 12.2 trillion BTUs between 2002 and 2010, a total growth of 6.1 percent and an average annual growth rate of about 0.7 percent. This type of fuel is used for residential and commercial space heating in many areas where gas service is unavailable. It is also used in some industrial and commercial facilities as a back up fuel when natural gas is purchased on an interruptible basis. Distillate oil is also used to by electric utilities to generate small amounts of electricity, primarily during peak demand periods.

Consumption of both fuels varies significantly because of weather and prices. For this reason, the forecasts shown in Figure 8 should be considered approximate trends.

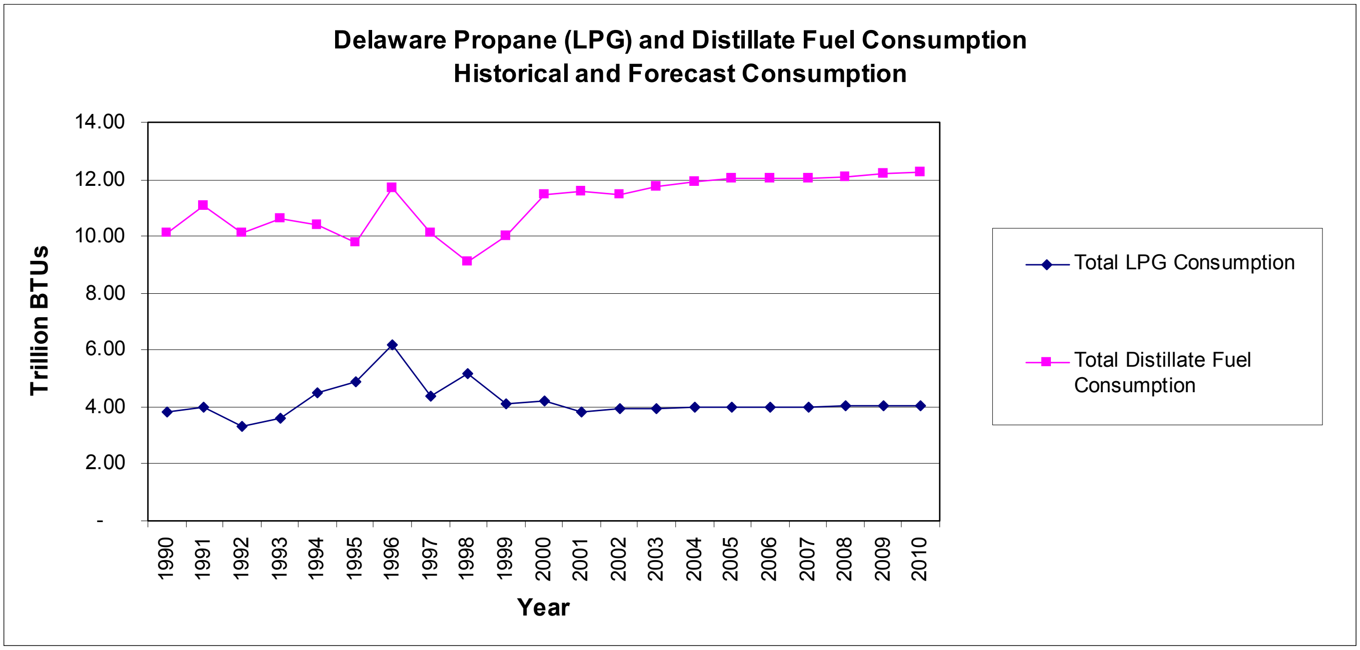


Figure 8: Natural Gas and Propane Consumption Forecasts

# SUMMARY AND IMPLICATIONS

The forecasts developed in the preceding sections can be summarized in the following points:

- The business-as-usual forecasts indicate significant overall growth in electricity demand and consumption over the next 8 years
- Fuel consumption for electric power generation in Delaware has declined as imports of electricity have increased from the regional wholesale market
- The future mix of electric generation capacity and fuels is very difficult to predict because Delaware is a small part of the regional market and is subject to larger market-based trends in supply costs and plant construction
- Natural gas consumption by end users will also increase, but more moderately than electricity consumption
- Natural gas consumption for electric power generation is also likely to increase, but it is difficult to forecast a growth rate for Delaware alone
- Heating oil and propane consumption will grow slowly, mainly serving smaller residential and commercial customers in areas where natural gas is unavailable

Some of the implications of the forecasts are provided below:

- BAU forecasts may be overly conservative, but it likely that electrification will continue to increase
- As electrification increases, so will the need for on-Peninsula generation and increased transmission capacity

- Environmental impacts of electrification are proportional to types of fuels used
- Economic impacts of constructing and operating the added infrastructure will be significant, especially if a major base-load power plant is considered
- The BAU forecasts indicate that there may also be large opportunities for improving end-use efficiency, renewables and clean generation technologies to mitigate the environmental and economic impacts of growing energy consumption