CHAPTER II

NEW APPROACHES TO MEETING POWER DEMANDS

The past decade has been a period of adjustment for electric utilities, regulators and ratepayers. The costs of providing electric service have risen very rapidly as a result of increasing boiler fuel prices, rising financing costs, sharply increased costs of constructing power plants, and general inflation. A baseload power plant which cost perhaps $300 per kilowatt to construct in the 1960s now might cost $1,500 to $2,000 per kilowatt, or more. The combination of enormous increases in construction costs and high interest rates make the financing of large new capacity additions financially burdensome to utilities.

These economic pressures have served to focus attention on alternatives to the construction and operation of conventional central station generating plants. The alternatives receiving most attention fall into three categories:

- weatherization and other conservation programs;
- improving utility load curves so to better utilize existing plant and slow peak demand growth; this can be accomplished through innovative rate designs and direct load control methods; and
- new or less conventional power sources, such as industrial cogeneration, photovoltaics, small-scale hydroelectricity, wind energy and power from burning solid waste.

The first two categories attack the problem from the demand side, while the third attacks it from the supply side.

This chapter discusses several studies and initiatives undertaken in Maryland and the role each option might play as an alternative to the building and operation of central station power plants. In doing so, the discussion emphasizes the technical studies conducted by Maryland agencies, actions taken by the Maryland Public Service Commission and programs currently being conducted by the State's major electric utilities. To place these options in perspective, the first section of this chapter describes the generation capacity planning process. The alternatives themselves are divided into two principal categories. Demand-side approaches, such as conservation programs, direct load control and time-of-use rates, which either lessen customer power demands or improve the utility system load curves. Supply-side options involve dispersed or non-utility power production such as cogeneration, small-scale hydro, solar energy, wind energy and municipal solid waste.

A. The Generation Planning Process

A generation expansion plan is the means by which a utility proposes to serve its expected future loads. A utility must provide adequate and reliable service to all of its "firm" customers, and generating capacity (or other means of satisfying demands) must be planned accordingly. Moreover, it is desirable that the utility provide reliable service at the lowest possible cost. Reliability (i.e., adequate capacity to provide reliable service)and long-run cost control are the twin goals of system generation planning. In attempting to meet these goals, the utility's capacity expansion plan must address the following key questions:

- When should new capacity additions be scheduled to begin service?

- How large should those capacity additions be?

- What are the feasible options (including demand-side options) available to the utility, and what are their costs?

- What kind of generating capacity (e.g., technology and fuel type) should be added?

The appropriate timing of new capacity additions is determined by the projected growth in loads in conjunction with judgments concerning the proper degree of reliability for the utility. Utility planners establish reserve margin targets by analyzing a number of factors including load curve shapes and power plant outage experience.

Given the load forecast (see Chapter I) and reserve margin target (or other reliability measures), the planner determines when the system needs its next plant. Once the timing of the capacity addition is established, the planner selects the power plant technology. Conventional power plants fall into three categories -- baseload, cycling and peaking -- and five major fuel types -- nuclear, hydroelectric, coal, oil and gas. There are also subcategories. For example, hydro may be run-of-river or pumped storage. A plant may, depending on its design, burn various types of coal -- high sulphur, low sulphur, coal-oil slurry, etc. Purchased power is another important option to plant construction that the planner may consider. Each different technology (including purchased power) involves its own unique trade-offs between fuel costs and construction costs.

The way in which a mix of these plants meet power demands can best be explained by reference to a system daily load curve. The load curve shows system demands at different times of the day. On a typical utility system, load falls in the early morning hours and then rises throughout the day reaching a maximum in the late afternoon. Loads gradually subside during the late evening hours. There is a certain minimum or "base" level of demand which is exceeded at virtually all hours of the day. This load is served by the utility's "baseload" units, which are large, operationally efficient generating plants which operate most of the hours of the year. Because these units require long time periods to be brought up to full power from a cold start, they can only be effectively operated in a continuous mode. Baseload units are normally coal or nuclear-fired steam plants with capacity in excess of 300 or 400 megawatts.

Above the baseload, demand may change rapidly from hour to hour. "Cycling" units are capable of altering their outputs on short notice to meet these sudden changes in load. The cost of this flexibility is some loss in energy efficiency as compared to baseload units. Cycling units are usually oil or coal-fired steam plants, although hydroelectric plants with reservoir storage are sometimes used for cycling purposes.

The very top of the load curve is served by "peaking" plants. These units tend to be expensive to operate, but are only run for the few hours per year when demand is at its maximum --usually less than 5 percent of the hours in a year. Also, peaking plants have flexibility and can be brought on line to serve sudden increases in load on very short notice. Although oil and gas combustion turbines are the most common type of peaking unit, there is growing interest in using pumped storage hydroelectricity to fulfill peaking and cycling functions.

The planning of capacity additions must also take into consideration differences in seasonal load shape. For example, a summer peaking utility with a substantial air conditioning load may exhibit great differences in summer-winter load shapes.

Baseload, cycling and peaking plants have different operating characteristics, construction costs and lead time requirements. At one extreme, baseload plants are very expensive to construct and install on a per kW basis compared to smaller peaking units. Offsetting that, baseload plants consume relatively inexpensive fuels (coal or uranium) and do so with a high degree of operational efficiency. At the other extreme, peaking units are inexpensive to construct but burn expensive fuels.

The choice of plant technology thus requires an evaluation of the capital cost/operating cost trade-off. Which type of plant is more economical depends ultimately upon the number of hours per year, on average, the plant will operate. For example, if additional capacity is likely to be operated for only a small number of hours, then peaking capacity is likely to be the less expensive option. However, if the new unit is needed to serve for a large number of hours, then baseload capacity may be more economical.

To evaluate alternative generation plans, it is necessary to obtain a great deal of information and to make numerous assumptions. Accurate estimates of the construction costs and operating costs associated with each alternative plan over an approximate time horizon must be developed. The operating costs are normally calculated using a production costing model. These models simulate the operation of a power system by dispatching the utility's power plants to meet its forecasted loads. In doing so, the simulations incorporate numerous factors and assumptions, including fuel costs and fuel cost escalation rates, load growth, unit outages, load shapes and unit maintenance requirements. Utility planners normally express the construction costs associated with a generation plan in terms of the revenue required to effect the plan ("revenue requirements"). This allows the operating costs and capital costs of a given plan to be expressed on a common basis.

Generation planning involves far more than calculating the revenue requirements associated with various plans. The planner must also cope with an assortment of complications and constraints. A partial list includes:

- Uncertainty -- Perhaps the single most important planning decision relates to the timing of capacity additions. Unfortunately, the load forecasts which are relied upon tend to be highly uncertain. Similarly, the calculation of the least cost plan depends upon some rather speculative assumptions concerning future fuel prices, equipment costs, interest rates and other factors.

- Lead Time -- Ten years or longer is now required to site, license and construct a baseload power plant. Long lead times have the effect of reducing planning flexibility by limiting the feasible generation alternatives. For example, if a load forecast is inaccurate, the utility may need new baseload capacity sooner than it is able to complete construction.

- Financial Capability -- Electric utilities do not have unlimited financial resources. The generation plan must therefore be consistent with the ability of the utility to raise the funds required for construction.

- Regulatory Constraints -- Generation planning options are sometimes limited by regulatory constraints on power plant construction and operation. The restrictions imposed by the Fuel Use Act limit the utility's freedom in selecting fuel type.

Generation planning is clearly not a simple, straight forward exercise. It requires reconciling the most economically attractive options with an assortment of risks, uncertainties and real world problems.

B. Demand-Side Alternatives

Within the last few years there has been an increased interest in managing customers' demands for power. Demand management programs can be classified as either conservation or load management. Conservation refers to programs or measures designed to reduce the customer's total consumption of energy. Load management is less concerned with the aggregate amount of energy consumed than *when* it is consumed. Specifically, load management programs are designed to shift energy usage out of the peak period (when system power demands are greatest) into the off-peak period. Utilities are particularly interested in load management because of its potential to lessen the need for new plant.

This section reports on initiatives undertaken in Maryland or by Maryland utilities in the area of conservation and load management. Emphasis is given to residential weatherization, rate design reforms and direct load control. This section also describes research conducted by the State.

Conservation Through Weatherization

A variety of conservation and weatherization programs are currently being offered by Maryland utilities. The Residential Conservation Service (RCS) was established by the National Energy Conservation Policy Act (NECPA) of 1978. Its purpose of is to provide households with the information they need to make informed, economically sound decisions regarding investments in weatherization. Maryland began to draft its plan in 1979, and the plan was approved in February 1981.

Currently, six utilities participate in the Maryland plan. They are BG&E, PEPCO, Potomac Edison, Washington Gas Light (WGL), DP&L and SMECO. Any residential customer living in a building with one to four dwellings can participate in the RCS programs offered by these utilities. Eligible customers are offered a detailed energy audit of their homes (referred to as the Class A audit) which includes a furnace efficiency test. Program participants are provided with other information (compiled by the Maryland Energy Office) including lists of installation contractors, and sources of financing.

The Maryland utilities have reported costs for providing RCS services of approximately $100 per participating customer. The National Governor's Association estimates the average cost nationwide to be $158 (1). At their discretion utilities are permitted to charge a fee up to $15 per customer, and all Maryland utilities do so with the exception of DP&L. The RCS costs in excess of the $15 fee are recovered by the utility in its retail rates as a cost-of-service item.

One measure of success of the RCS program is the extent to which customers have participated. Nationwide, utilities have achieved responses of approximately 2 to 5 percent of eligible customers per year. The participation rates experienced by the Maryland utilities, as of September 30, 1982, are shown below in Table II-1. PPSP estimates that the RCS program, if continued in its present form for the next ten years, will eventually achieve reductions in peak demand of approximately 0.3 percent and reductions in residential kilowatt-hour sales of approximately 0.8 percent (2).

Table II-1. Customer Participation in the Maryland RCS Program[a]

Utility	Participation Percentage
BG&E	3.9
DP&L	2.2
PEPCO[b]	1.2
Potomac Edison	0.6
SMECO	1.1
WGL[a]	2.1

(a) Data from Ref. 1.

(b) Since PEPCO and WGL generally serve the same service area in Maryland, their participation rates should be combined for a total participation percentage of 3.3 percent.

Although not required by the State's RCS plan, BG&E, PEPCO and Potomac Edison also offer "do-it-yourself" (Class B) audits at no charge. With this audit the customer records detailed information on energy usage in the household, and the utility analyzes the information and provides the customer with a set of findings and recommendations on energy saving measures.

The Maryland Energy Office recently conducted a mail survey of residential customers participating in the RCS program and as well as those not participating. Several important findings emerged from the survey. Paralleling national experience, it was found that the RCS program is primarily being used by the middle and upper income households and the better educated. The program appears to be largely unsuccessful in getting participation by lower income households, elderly and renters. This is particularly unfortunate because those individuals are believed to occupy housing most in need of weatherization (1).

The survey also found that most RCS participants (84 percent) undertake some energy conserving measures as a result of the audit, but in most cases the action is a modest, low cost measure such as caulking or weatherstripping. Most households refrain from making major investments because of the cost. Reasons cited by respondents for not participating in the program include the $15 cost of the audit, the belief that their homes are already adequately weatherized and a lack of awareness of the existence of the program.

In 1982, the Maryland General Assembly passed Resolution No. 28 (House Joint Resolution 94) requesting the Maryland Energy Administration and the Public Service Commission to hold public hearings and to prepare a report on the effectiveness of the RCS program in Maryland. The Public Service Commission held public hearings in October 1982 to review Maryland's RCS program. Areas of concern include the promotion and marketing of the program; participation by "hard-to-reach groups"; the cost-effectiveness of the program; assistance by community based organizations; whether the Class A audit needs to be simplified; and the feasibility of providing customers with financial assistance. New federal rules issued in November 1982 provide the State with greater flexibility in making changes to the RCS program.

The Maryland Energy Administration and the Public Service Commission transmitted a report to the General Assembly on January 1, 1983 (1). The report contained several recommendations as to how the RCS program can be modified to achieve more energy conservation and to ensure that the RCS program is structured so that it can benefit all sectors of the utilities' residential customers. In 1983, two bills were introduced to the Maryland General Assembly with the purpose of revising the State's RCS Plan in order to improve the response rate and effectiveness of RCS (3,4). The bills were not enacted. However, the Maryland Energy Administration began working with utilities, community based organizations, and other agencies to implement administratively many of the activities identified in the bills. In its role as lead agency for developing and modifying the RCS State Plan under federal regulation, the Maryland Energy Administration formally proposed changes to the Plan. The primary goals of these changes are to enhance the delivery of energy conservation services, to reach customers who have not participated in the RCS Class A audit program, and to motivate those customers to conserve energy in their homes. Public hearings were held on the proposed changes in June and July 1983.

Economic Impacts of Residential Weatherization

In late 1981 PPSP, in conjunction with the Maryland Office of People's Counsel, initiated a multiphase study on the economic impacts of utility-sponsored weatherization programs. The first phase developed a methodological framework and applied that methodology to BG&E (5). The second phase, completed in December 1982, extended the analysis to the other five utilities in the State currently providing RCS programs (2,6). Both phases were conducted with the assistance of an Advisory Committee consisting of utility staff, State officials and others.

The study was designed to provide information to utilities, the Public Service Commission and other policymakers in the State on the potential impacts alternative weatherization programs are likely to have on the utility and its customers. For each of the alternative weatherization programs considered, the study developed estimates of program costs, energy and power plant capacity savings, utility bill impacts upon participating and nonparticipating utility customers, and job creation effects.

For this study a number of hypothetical utility-sponsored weatherization programs were designed, ranging from the current RCS program to very elaborate programs with extensive customer technical assistance and financial incentives. The energy savings and dollar impacts from each program and on each of the six utilities were estimated on a year-by-year basis over an assumed 30-year time frame. The study made the key assumption in each case that the value of power plant capacity savings would be zero until the year 1990, since all Maryland electric utilities are projected to have excess generating reserves until at least that year.

The principal findings of the study include the following:

- Based upon the data from RCS audits, there is considerable potential for additional cost-effective weatherization in Maryland homes.

- The measures most often found to be cost-effective to the household are water-heater jackets and ceiling insulation.

- Weatherization programs will save generating capacity (in the 1990s), but the savings will be small. The most elaborate program could reduce system capacity needs by about one percent (57 megawatts in the case of BG&E).

- In virtually all cases, the programs considered would cause utility customers not particpating in the programs to pay higher utility rates. The increase, however, is rather small, particularly for programs that exclude oil-heated customers and concentrate on the most cost-effective measures.

- Customers participating in these programs reap extremely large net benefits in the form of lower utility bills. These savings are in most cases considerably larger than the net costs of the program to nonparticipants in the form of higher rates.

- With the exception of the Washington suburbs where gas-heat predominates, the vast majority of the benefits are reaped by oil-heated homes for most of the programs considered.

- A special program to install no-cost/low-cost measures targeted to "hard-to-reach" households (the low income, elderly, handicapped, renters) would benefit these customers at a minimal cost to other customers.

- Large-scale weatherization programs will create job opportunities. If the most ambitious program considered in the study were to be implemented on a statewide basis, it would create an estimated 1,200 permanent jobs in Maryland.

To demonstrate the impacts of these programs, Table II-2 shows the impacts upon the utility and its customers of the most elaborate program considered. This program offers customers a zero-interest loan, extensive technical assistance and includes aggressive program marketing. The costs and benefits of this program are somewhat larger than for the other program designs. All costs and benefits shown are in excess of those likely to be obtained from each company's existing RCS program. The first four columns represent the utility's cost outlays and resource savings (brought together in column 4) resulting from the program. Column 5 recognizes that participating customers will provide the utility with less revenue than if there were no program due to their reductions in energy purchases. Other customers must make up the difference. When this revenue loss is added to column 4, the necessary increase in utility rates resulting from the program is obtained. The increase in utility rates plus the net utility bill (including home heating oil) savings to program participants yield column 8, an overall net benefits measure.

<u>Other Conservation Programs</u>

In addition to the federally and State required RCS programs, the Maryland utilities operate a variety of conservation programs. Most of these programs are of an informational or promotional nature and do not involve a high degree of either financial or direct technical assistance to customers. Thus they are far more modest in scale and scope than the programs designed in the PPSP/ OPC study described in the last section.

Table II-2. Results from PPSP/OPC Weatherization Study[a] (Millions of 1983 present value $)

Utility	(1) Program Costs	(2) Generating Capacity Cost Savings	(3) System Fuel Cost Savings	(4) System Cost Savings (3)+(2)-(1)	(5) Shift in Revenue Requirements	(6) Total Impact on Utility Rates (5)-(4)	(7) Benefits to Incremental Participants	(8) (7)-(6)
SMECO	$ 12.40	$ 1.09	$ 1.94	$- 9.37	$ 4.8	$ 14.17	$ 23.29	$ 9.12
Pepco/WGL	56.45	5.61	82.13	31.29	97.30	66.01	105.43	39.42
DP&L	10.89	0.93	4.17	- 5.79	6.7	12.49	32.93	20.44
PE	25.20	5.33	2.27	-17.60	7.1	24.70	95.36	70.66
BG&E	173.07	16.6	—	—	—	139.0	526.8	387.8

(a) Above figures are over and above those for the current RCS program. These figures are based upon a weatherization program offering zero-interest loans with extensive technical assistance and marketing. Data from Ref. 5 and 6.

BG&E is involved in a number of conservation-related programs. Programs of an informational nature include bill inserts, a widely distributed newsletter, multimedia advertising, and a speakers' bureau which makes presentations before various groups. Part of that effort has involved promotion of the available low-interest conservation loans provided by the State. The Company operates a mobile conservation van that visits shopping centers, fairs and neighborhoods. The Company has also assisted the City of Baltimore and other organizations in their programs. It has assisted the City in processing loan interest energy conservation loans, and it has participated in the Baltimore Energy Alliance Program (BEAP) by providing funds and equipment to hire ex-CETA workers to insulate low-income homes. BG&E also assisted a BEAP program targeted to renters (1,7).

Potomac Edison promotes weatherization in its service area by use of media advertising, direct mail, seminars, exhibitions and personal contacts. The Company operates a special program designed to make sure that electrically heated homes are properly insulated and that customers are not utilizing oversized heating systems. Another program promotes the installation of thermal water heater jackets. The Company has also been disseminating information by providing energy conservation seminars to builders and vocational-technical schools (1,8).

PEPCO makes extensive use of multimedia advertising, a speakers' bureau, bill inserts and a newsletter. Special programs have been designed to promote conservation among the "hard-to-reach" customers. The Company has designed and introduced an energy audit for low-income customers and has worked with community groups such as the Ivy City Human Development Corporation, the Benning Heights Cooperative and the town of Landover Hills. PEPCO also provides conservation assistance to its nonresidential customers. In the case of large customers PEPCO engineering personnel perform on-site audits and help evaluate potential energy savings (1,9).

DP&L has attempted to promote conservation in its Maryland service area by use of speakers and seminars with local civics groups and government agencies. Delmarva's Super E+ program establishes energy efficiency standards for new home construction. New homes meeting the standards are certified by builders, and the new homeowner receives a computerized summary of energy information from the Company. Customers are not charged for this service (1,10).

The attitudes of these four utilities toward weatherization and conservation programs are mixed. Generally, they regard their programs as being of service to the community and a legitimate activity for the utility to undertake. Delmarva has expressed the belief that conservation is not a very reliable way of reducing peak demand and would prefer instead to emphasize direct load control (1). BG&E has concluded that the opportunity for cost-effective weatherization among electrically-heated homes is minimal (7). PEPCO observes that conservation probably is not cost-effective at this time (from a ratemaking standpoint), but cost-effectiveness should not be the only criteria for evaluating these programs (9).

Time-of-Use Pricing

The demand for electricity on most utility systems varies significantly by season of the year, day of the week (i.e., weekdays vs. weekend) and time of the day. During peak times utilities tend to burn more high cost fuel, and additional capacity investments are required to meet demand. Moreover, all of the major utilities with the exception of Potomac Edison, have historically exhibited rather low annual load factors.

The view that electric rates should reflect these time variations is gaining acceptance in Maryland. BG&E, PEPCO and DP&L have all introduced time-of-use rates for their largest nonresidential customers. Potomac Edison has not implemented time-of-use rates and has no plans to do so at present. The Company believes that because of its extremely high average daily load factor and an almost total dependence upon coal for generating electricity, the cost differences between the peak and off-peak periods are not sufficient to justify the implementation of time-of-use rates (8).

PEPCO has had time-of-use rates in effect for its 285 largest nonresidential customers in the District of Columbia for approximately three years. These customers account for nearly half of the Company's sales in the District. PEPCO is in the process of introducing time-of-use rates in Maryland for its 115 largest nonresidential customers. The first phase of this implementation involves "parallel billing." The customer is billed based upon the old rate but receives information on what his bill would be under the new, time-of-use rates. The purpose of parallel billing is to afford the customer (and the Company) an opportunity to adjust to time-of-use pricing before it actually takes effect. It is expected that actual implementation will occur in Maryland within the next year. The Company estimates that time-of-use rates in the District will reduce peak demand by 20 megawatts (9,15). In addition to introducing the nonresidential time-of-use rates, PEPCO plans to conduct a residential pilot time-of-use rate program.

BG&E industrial tariffs have contained time-of-day rate provisions (in the form of an on-peak demand charge) since the 1920s. Presently, the off-peak maximum demand is ignored for billing purposes for the large industrial customers. As a result of Case 7159, BG&E's PURPA compliance proceeding, a new time-of-use rate will be introduced. The new tariff incorporates time-of-use rate differentials for the energy charge. A parallel billing demonstration was begun in September 1982, and full implementation is scheduled for September 1983, pending a Commission review of the parallel billing experience. The

Company also plans to extend time-of-use rates to its largest commercial and residential customers, with parallel billing expected to begin in 1983 (7).

DP&L does not offer time-of-use rates in Maryland. However, its Delaware industrial customers have been subject to such rates for the past two years, and the Company intends to file similar time-of-use rates in Maryland during 1983. These rates would be mandatory for all customers who have summer peak demands in excess of 300 kilowatts or are receiving power at primary voltage. The Company has also been conducting a two-year residential experiment in New Castle County, Delaware, involving 250 customers. Initial results suggest that the experimental rates are successful in improving customer load profiles (10). DP&L has recently begun to offer residential time-of-use rates in Delaware on a non-experimental basis. Only a small number of customers are currently on the tariff, but the Company intends to promote the rates actively in the future.

A continuing theme in discussions of time-of-use rates is cost-effectiveness. The Maryland Public Service Commission has recognized it as a major consideration in its deliberations over time-of-use rates. For example, the Commission rejected time-of-use rates for Potomac Edison because it was not demonstrated that they were cost-effective. The utilities in the State have expressed interest in further expansion of time-of-use rates to the extent they are cost-justified.

The issue arises because time-of-use rates require a large front-end investment in special metering equipment designed to measure usage by time period. Time-of-use rates will lead to lower system costs only if the resulting improvement in system efficiency and avoided capacity costs outweigh the additional metering and administrative costs. A study funded by PPSP investigated this question for the BG&E system (16). Benefits were measured as changes in "consumer surplus" when moving from current rates to those reflecting marginal costs by time period. Time-of-use pricing was found to be cost-effective for the average size customer in each class though cost-ineffective for smaller residential customers. It was estimated that the potential present value of the net benefits over the lifetime of the metering equipment is roughly $85 million.

The Rand Corporation, under a PPSP contract, is conducting research on industrial responses to time-of-use pricing (17). The project is an econometric analysis of data on individual industrial firms across the country that have actually been subject to mandatory time-of-use rates for the past few years. The preliminary results from that study suggest that industrial firms do tend to shift usage from the peak to off-peak period in response to rate incentives, but the magnitude of the shift is small. The study also demonstrates that the propensity to respond to time-of-use pricing varies substantially by industry.

Despite the finding that the response is modest, the preliminary results do indicate that time-of-use rates are cost-effective for large industrial customers.

Direct Load Control

Time-of-use rates provide customers with an incentive to shift their power usage from the on-peak period to the off-peak period, thereby reducing use of expensive boiler fuels and the need for new capacity. One of the drawbacks of time-of-use rates is that the magnitude and precise timing of the shifting is uncertain. Another approach to improving system load profiles is for the utility to directly control the customer's load. This method of load management, known as direct load control, has received considerable attention and study in recent years.

There are two basic approaches to direct load control -- energy storage (in practicular storage of heat or "cold") and equipment/appliance cycling. With the former, electricity is used to heat water or some other thermal storage medium during the off-peak hours when power is less valuable. The utility, using some sort of communications device, shuts off the electric space heating system (or water heater) during the peak hours. The heat accumulated in the storage medium during the off-peak hours is then used to heat or cool the home or provide hot water during the on-peak hours.[1] The other approach, known as appliance cycling, involves interrupting the load on a major electric appliance (e.g., air conditioner, water heater, space heating system) for a short period of time during the periods of maximum demand on the system.

Appliance cycling is intended principally to reduce the system peak demand. It tends to involve only a modest amount of energy shifting because the service interruptions are generally of fairly short duration. Only a small amount of boiler fuel costs is saved. The storage heating approach can be effective in saving both capacity and energy since the daily service interruptions are usually for several hours. However, there is a large investment required. Heat storage equipment may cost several thousand dollars, and occupy a large area in a customer house. Cycling requires only a communications device (e.g., a radio receiver) and a set of switches, amounting to at most a few hundred dollars per customer.

Several observations concerning direct load control need to be made. First, interrupting service may involve a certain amount of customer inconvenience since the controlled appliance

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[1] It should be noted that thermal storage technologies can be operated by the customer in the absence of the direct load control. If the customer is subject to time-of-use rates, he or she has an incentive to install a thermal storage device and operate it during the off-peak hours when power is very inexpensive under the time-of-use tariff.

may be unavailable at certain times. Evidence from a Potomac Edison pilot program, however, suggests that customers find these interruptions acceptable (8). Second, at the present time heat storage technologies are more commercially advanced (and appear to be more economic) than cooling storage. Thus, storage load control is likely to be more attractive to winter peaking than to summer peaking utilities. Third, since appliance cycling saves only modest amounts of boiler fuel, it is only likely to be economically attractive to capacity constrained utilities. Maryland utilities are currently experiencing excess capacity; thus they cannot substantially benefit from appliance cycling load control at the present time.

SMECO is currently the only utility in the State conducting a direct load control program on a nonexperimental basis (18). The program involves the cycling of air conditioning and electric hot water heaters. The water heaters are shut off for two to three hours at a time, and air conditioners are cycled off seven minutes out of every 28 (25 percent of the time) during periods of greatest demand. Assuming the equipment is functioning properly, this should result in only minimal or no discomfort to customers. As of early 1983, SMECO was controlling several hundred switches, and it plans to install an additional 2,100 during 1983 and 1984. Projected peak demand savings is approximately one kW per switch.

SMECO's aggressiveness in the direct load control is probably best explained by the nature of its wholesale tariff with PEPCO. Under that tariff, SMECO is billed for its maximum monthly peak demand at a rate of almost $10 per kilowatt. Thus, reducing monthly peak demand by one kilowatt (if accomplished every month) would save $120 per year. On the other hand, SMECO's wholesale tariff does not contain any time-of-use provisions in the energy charge. Thus SMECO cannot obtain any energy cost savings from direct load control. The four major utilities in the State will gain nothing from load management since they are experiencing excess generating capacity at the present time. Although the major Maryland utilities cannot save any capacity costs at this time, direct load control does offer the possibility of reducing construction costs at some time in the future. BG&E has established a Load Management Task Force to investigate a variety of both storage and appliance cycling load control technologies. The Company's interest includes both the residential and nonresidential class. The Company has offered interruptible service to its large nonresidential customers since 1978. As of 1982, 5 MW of curtailable load is under contract (7). BG&E has introduced an "Economy Service" schedule on a test basis for its residential customers. In exchange for a rate discount, a 25-ampere demand limiter will be installed in the customer's home. If the household exceeds the established load, a circuit breaker will automatically be tripped, interrupting service (19).

Potomac Edison is conducting a variety of load management experiments, most of which are oriented toward controlling winter season demands. These experiments include heat pump water jackets, dual fuel heat pumps, and water heater insulation jackets. One planned project is a demonstration of a two-way microprocessor-controlled communications system that will involve 300 customers in the Frederick area. This system is intended to allow direct control of water heaters, remote meter reading and distribution automation. A similar project but with a different strategy will be tested by PE's affiliate, West Penn Power. During the period 1978 to 1980 Potomac Edison conducted a demonstration project with 195 residential customers involving control of electric space heating and cooling. The Company concluded that direct load control would not significantly benefit the system, primarily because of the system's broad-based peak and very high daily load factors. Moreover, PE and its APS affiliates regard their participation in the Bath County pumped storage project (under construction) as a form of load management which would reduce the need for direct load control (8).

PEPCO has a particularly strong interest in load control as a result of its relatively low load factor. Since 1977 the Company has conducted several research projects with 287 customers participating in emphasizing appliance cycling technologies. PEPCO is currently conducting a demonstration project with 700 residential customers. The project involves radio controlled cycling of central air conditioners and water heaters. PEPCO is also operating an experimental load curtailment program with 31 large nonresidential customers. For both of these programs customers receive a rate discount in exchange for their participation (9).

DP&L has been operating a two-year experiment in northern Delaware involving both time-of-use rates and direct load control. This project involved control of water heaters and air conditioners. The Company expects to implement a large, system-wide program in the later 1980s. Extrapolating from its experimental results, the Company projects a reduction of 35 megawatts by 1990 (10).

C. Power Supply Alternatives

At the present time at least five types of non-utility power supply technologies are in operation or under development in Maryland: municipal solid waste (MSW), small-scale hydroelectricity, cogeneration, solar energy and wind energy. The potential contributions to the state's energy supply are shown below in Table II-3. The annual potential energy supply from nonconventional sources of 35×10^{12} Btu compares to 868×10^{12} Btu of energy consumed in Maryland in 1980. (See Table I-6 in Chapter I.)

Table II-3. Availability of Nonconventional Energy Supply in Maryland[a] (10^{12} Btu/year)

Type	Quantity
Municipal solid waste (and refuse derived fuel)	24
Small-scale hydroelectric[b]	6.2
Cogeneration	(c)
Direct solar	3.5[d]
Wind energy	1.3
TOTAL (less cogeneration)	35.0

(a) Data from Ref. 11.

(b) Undeveloped.

(c) Estimates are not available.

(d) No direct estimate for Maryland is available. The above figure was obtained by multiplying Maryland's proportion of the total land area of the nation (0.29 percent) times the estimated national solar energy. The National Research Council projects national solar energy output of 1.2 quadrillion Btus in 1990 under its High Solar Energy Scenario (see its report, Energy in Transition 1985-2010).

Important legislation has been enacted in Maryland in recent years to encourage alternative energy development. In 1981 the Maryland General Assembly (Ch. 497) established the Maryland Energy Financing Administration (MEFA). This agency was created to mitigate the problems of high initial costs and unavailability of conventional financing for conservation and renewable resource investments. MEFA will be a self-supporting unit within the Department of Economic and Community Development, and is authorized to issue revenue bonds to finance low-interest loans for conservation, solar energy, alcohol fuel production, geothermal, hydroelectricity, cogeneration, synthetic fuel from coal, municipal solid waste, wood and wind energy projects (11).

Utility Interface

Recent changes in federal law and utility regulation in Maryland have provided considerable impetus for the development of non-utility power. The Public Utility Regulatory Policies Act

(PURPA) of 1978 and subsequent federal regulations issued in 1979 were designed to encourage the development of cogeneration and small power production in three principal ways. First, the local utility must interconnect with any "qualifying facility" (QF) and stand ready to buy all electricity the QF is willing to sell. Second, the QF is exempted from the Public Utility Holding Company Act, the Federal Power Act and all state laws which treat sellers of power as public utilities. This exempts the QF from cost-of-service ratemaking, i.e., basing rates paid to a QF on the QF's costs of production. Third, the utility purchasing must pay the QF rates that are based upon that utility's "avoided cost." This means that the "buy-back" rates must reflect estimates of the additional costs the utility would incur if it produced the power rather than purchased it from the QF. Avoided cost is thus very similar to the economist's notion of marginal cost of supplying electric power. But it specifically relates to the utility's marginal cost, not the QF's marginal cost. Although there is widespread agreement concerning the appropriateness of basing rates on avoided cost, there is considerable disagreement over how it should be quantified. Federal regulations leave state commissions with considerable discretion concerning interpretation and quantification of avoided cost.

Federal regulations give the states both the responsibility and authority to establish "standard tariffs" that, at a minimum, apply to QFs with generating capacity of 100 kilowatts or less. Within the past two years the Maryland Public Service Commission has held hearings on avoided costs and permitted standard tariffs to take effect.

The standard tariffs currently in effect in Maryland are shown on Table II-4 for BG&E, PE, PEPCO, DP&L, Conowingo and SMECO. The customer charges shown on that table are the monthly fees the QF pays to the utility. Staff has recommended buy-back rates somewhat higher for BG&E and PE than shown on Table II-4, but the Commission has not yet acted on those recommendations. The rates vary according to time of day and season, from approximately 2 cents to 6 cents per kWh, and capacity credits are generally not available. PE offers the lowest buy-back rates, averaging 1.6 cents per kWh.

Currently, there are only a small number of facilities selling power under these tariffs or under negotiated contracts. The remainder of this chapter identifies these facilities along with prospects for future expansion.

Cogeneration

Cogeneration is a familiar though, to some extent, underexploited power source. Widespread use of cogeneration has been taking place in the industrialized European nations for many

Table II-4. Buy-Back Rates Currently in Effect in Maryland[a]

BG&E[b]

	June 1 - Sept. 30	Oct. 1 - May 31
On Peak (weekdays 10 AM - 8 PM)	5.97/kWh	5.02/kWh
Intermediate (weekdays 7-10 AM, 8-11 PM)	4.55	5.02
Off Peak (weekends, holidays and weekdays, 11 PM - 7 AM)	1.98	2.345

PEPCO[b]

Customer charge of $11.00 per month

	June - Sept.	Oct. - May
On Peak (weekdays noon - 8 PM)	5.276/kWh	4.620/kWh
Intermediate (weekdays 8 AM - noon, 8 PM - midnight)	4.062	3.987
Off Peak (weekends, holidays and weekdays, midnight - 8 AM)	2.647	2.641

DPL[c]

Customer charge of $3.02 per month[d]

	June - Sept.	Oct. - May
On Peak (weekdays 8 AM - 9 PM)[e]	4.22/kWh	4.22/kWh
Off Peak (all other hours)	2.52	2.84

Potomac Edison[c]

On Peak (7 AM - 10 PM)	1.760/kWh
Off Peak (10 PM - 7 AM)	1.265
No Time of Day Metering	1.570

A 0.5/kWh credit is available during system emergencies.

Conowingo[b]

Monthly customer charge - $8.12

Energy payments shall be based on Conowingo's cost of purchased power from Philadelphia Electric and Susquehanna Electric. (Tariff does not specify.)

Table II-4. (Continued)

<u>SMECO</u>[b]

For 1983, the estimated payment is 0.52/kWh plus SMECO's fuel adjustment charge. (That charge averaged 2.79/kWh in 1980.)

The QF must also reimburse SMECO for the cost of the meter.

(a) Rates are based upon tariffs on file with the Maryland Public Service Commission as of July 1, 1983.

(b) For QFs with 100 kW or less capacity.

(c) For QFs with 1000 kW or less capacity.

(d) There is also a schedule of metering charges which range from $1.31 to $16.39 per month depending upon the type of meter.

(e) During the months of Daylight Savings Time the on-peak hours become 9 AM-10 PM.

years, and it has enjoyed some limited success in this country. Because of its efficiencies, proponents believe that the potential exists to substantially expand its usage.

The term cogeneration has been used by engineers to describe a process whereby both electricity and process heat in some form (e.g., process steam) are produced. It may arise from a situation where the primary purpose of consuming energy is to produce electricity, and in the process, waste heat is also produced. The firm may then find a productive use for that waste heat. Alternatively, an industrial or commercial firm may use energy primarily to obtain process steam, and in doing so it finds it can also produce electricity relatively inexpensively. As a result of jointly producing both types of energy (e.g., steam and electricity), total energy requirements may be reduced by as much as 30 percent.[1] Although there is potential for exploiting cogeneration from commercial and residential heating systems, it is believed that the bulk of the cogeneration will come from industrial applications.

It is widely believed that cogeneration, particularly coal-fired steam, is capable of producing relatively inexpensive energy (12). The cost tends to be competitive with both the short-run marginal costs of existing electric systems and the long-run marginal (and average) cost of a new baseload coal facility. Unfortunately, the contribution of cogenerators to system reliability is an unsettled issue and clouds a complete evaluation.

At the present time there is only a small amount of cogeneration in Maryland. Westvaco, a paper products producer in Luke, Maryland, operates 50 megawatts of cogeneration. However, it consumes most of its own power. Celanese Corporation, a synthetic fiber manufacturer in Cumberland, Maryland, has a 10-megawatt facility, but that plant has not been operational for several years. Kelly-Springfield Tire Company, also in Cumberland, operates a 2.5-megawatt unit, but normally consumes all of its generation. All of these companies are in PE's service area. Bethlehem Steel, a contract customer of BG&E, operates its own generating facilities to serve some of its own load. BG&E, PEPCO and DP&L report no cogeneration in their Maryland service areas (except for municipal solid waste), nor do they expect to see much in the future. PEPCO cites a lack of industrial base, and BG&E believes its relatively low avoided costs and the type of industrial plants in its service area make large-scale cogeneration development unlikely.

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[1]<u>Energy in America's Future</u>, Resources for the Future, p. 160. The RFF study reports four additional benefits: (1) capital savings in generation equipment; (2) transmission and distribution savings; (3) reduced cooling water requirements; and (4) reduced siting and licensing lead times.

Municipal Solid Waste and Refuse Derived Fuel

Municipal solid waste (MSW) or its derivative, refuse derived fuel (RDF), will soon be burned in Maryland as a partial replacement fuel for coal. Processing of MSW and production of RDF is taking place at the Maryland Environmental Service/Baltimore County Resource Recovery Facility on a commercial basis. There are several advantages to utilizing MSW as a fuel source for power production. It has been estimated that approximately 75 percent (net weight) of MSW consists of combustible material (23,24) with about 8 percent consisting of metal and 10 percent glass (23). Use of MSW can potentially reduce fuel costs and will aid in delaying the need to site and construct new landfills. RDF generally has a significantly lower sulfur content than coal[1] and can be cofired with higher sulfur content coal in order to produce less sulfur dioxide than results from burning coal alone. Finally, production of RDF in conjunction with other recycling processes allows recovery of recyclable material such as metals and glass (25). Recycling can provide significant energy savings over producing these products from raw materials (see Table II-5). The Maryland Environmental Service has estimated that about 2.7 million tons of MSW is produced annually in the state, with an energy content equivalent to approximately one million tons of coal (26).

The following process is used to produce RDF at the Baltimore County Resource Recovery Facility in Cockeysville, Maryland. Incoming trucks dump MSW into pits from where it is conveyed to large shredders which produce a nominal particle size of four inches. The shredded MSW is then conveyed to a magnetic separator where ferrous metals are removed. Following magnetic separation, the material is transported to a disc screen and other equipment for separating out the light, combustible material and glass. Following this step, the combustible stream is reshredded to produce a uniform product which is "fluff" RDF. Pelletized RDF can also be produced. The Resource Recovery Facility is designed to process up to 1,600 tons per day of MSW (27). Fluff RDF is to be sold to BG&E for combustion at the C.P. Crane power plant.

Cofiring of RDF in utility boilers is not without problems. Table II-6 lists some of the problems and possible solutions. The air pollutants from RDF combustion are primarily suspended particulates with chlorides, sulfur and nitrogen oxides, carbon monoxide, and hydrocarbons present to a lesser degree (29). Table II-7 indicates physical properties and ash analysis data for RDF produced at the Baltimore County facility and used in a 1980 test burn at the Crane plant; Table II-8 provides a comparison of trace elements in the coal and RDF used in the burn.

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[1]MSW sulfur content generally ranges from 0.1-0.2 percent by weight compared to 1.0-3.0 percent for most coals (24).

Table II-5. Estimated 1985 National Energy Savings of Recycling MSW Fractions vs. Production from Raw Materials[a]

	Recovered Materials		
	Ferrous Metals	Aluminum	Total
Tons recoverable annually for recycling (millions)	9.5	0.6	10.1
Energy required to manufacture a ton of new product using virgin material (kWhs per ton)	4,270	51,379	55,649
Energy required to manufacture a ton of new product using recycled material (kWhs per ton)	1,666	2,000	3,666
Energy saving per ton as the result of recycling (kWhs per ton)	2,604	49,379	51,983
Annual energy savings (million kWhs)	24,738	29,627	54,365
Annual energy savings (billion Btus)[b]	84,431	101,117	185,548
Equivalent barrels of oil (thousands)[c]	14,557	17,434	31,991

(a) Data from Ref. 24.

(b) Based on standard conversion of 3,413 Btus per kWh.

(c) Based on 5.8 million Btus per barrel of crude oil.

Table II-6. Problems Associated with RDF Cofiring in Utility Boilers[a]

Problem	Possible Solution
• Dropout of unburned material in bottom ash.	Install dump grate at bottom of boiler.
• Overload bottom ash handling system.	Reduce ash content of RDF.
• Formation of deposits on boiler sidewalls and convective tube surfaces.	Reduce glass, metal and ash contents of RDF. Avoid high-heat release rate boilers with inherent slagging and fouling problems.
• Reduced boiler efficiency and generating capability.	Reduce ash and moisture contents of RDF.
• Reduced electrostatic precipitator performance.	None.

(a) Data from Ref. 28.

Table II-7. Physical Properties and Ash Analysis Data for RDF Used in 1980 Test Burns at the C.P. Crane Plant[a]

RDF Physical Properties[b]

% Moisture	% Ash	Btu/lb[c]
18.9	13.4	6,289

Ash Analysis

	Coal Only	RDF Only
$\%SiO_2$	46.3	57.0
$\%Al_2O_3$	25.5	17.8
$\%Fe_2O_3$	22.5	2.5
$\%TiO_2$	1.0	1.8
%CaO	1.3	10.7
%MgO	0.5	1.7
$\%Na_2O$	0.4	2.2
$\%K_2O$	1.3	2.2
$\%SO_3$	1.5	2.2

(a) Data from Ref. 28.

(b) Data are averages based on 38 samples.

(c) As-received basis.

Table II-8. Trace Element (mg/l) Analysis for RDF Used in 1980 Test Burns at the C.P. Crane Plant[a]

	Coal Only	RDF Only	Coal Plus RDF
Lead	.025	<.01	<.01
Cadmium	.023	.023	.024
Arsenic	.0015	.0029	.0788
Mercury	.0016	.0005	.0006
Barium	8.75	8.36	20.0
Selenium	.006	.009	.006
Silver	.013	<.005	.013
Antimony	<.05	<.05	<.05
Chromium	.14	.04	<.01
Nickel	.27	.36	.08
Manganese	.084	.101	.048
Zinc	.231	.439	.072
Copper	.19	.04	.02
Tin	6.29	10.08	5.38
Vanadium	.52	.81	1.77

(a) Data from Ref. 28.

BG&E will cofire fluff RDF at the C.P. Crane plant in a cyclone furnace beginning as early as January, 1984. The RDF will be burned at a minimum rate of 26 tons per hour at full boiler load, providing about 17 percent of the heat input. Sixty tons per hour of coal will also be burned in this furnace. The RDF will contain approximately 0.24 percent sulfur, 11.36 percent ash and have a heat value of 6,289 Btu per pound (dry weight basis) compared with values of about 2.1 percent sulfur, 6.7 percent ash and 13,023 Btu per pound for the coal to be burned (30).

The Northeast Maryland Waste Disposal Authority is currently involved in the construction of one MSW facility and the planning of two others. The Southwest Resource Recovery Facility is under construction in Baltimore; commencement of commercial operation is presently envisioned for summer 1985. The maximum capacity of the plant will be approximately 2,000 tons per day; the annual average capacity will be 1,700 tons per day. Baltimore City will supply 900 tons per day of MSW with 300 tons per day supplied by Baltimore County. A small amount may be supplied by Anne Arundel County. Approximately 48 to 50 MW of electricity may be available for sale to BG&E (31). The Harford County Waste to Energy Facility is currently in the development stage. Commercial operation is anticipated to begin in late 1986 or early 1987. The facility will burn a maximum of 300 tons per day of MSW (annual average of 250 tons per day) to be supplied from Harford County's residential and light commercial wastes. Steam will be produced at the facility and sold to Aberdeen Proving Grounds (31). The second project under development is the Capital City Facility to be located in Annapolis. The facility would utilize MSW supplied by Anne Arundel County, the City of Annapolis, the U.S. Naval Academy and various commercial haulers. The analyses conducted thus far have shown that the most practical and economical facility is one of 250 tons of MSW per day capacity with a mass-burning incinerator.[1] The facility will produce both electricity (2-10 million kWhs per year) and hot water; some electricity will be used within the facility with any excess sold to BG&E and hot water will be sold to the Naval Academy for heating. The facility is expected to be in operation in 1986 (32).

The Maryland Environmental Service, in conjunction with the Maryland counties of Caroline, Dorchester, Queen Anne's and Talbot, and the Delaware Solid Waste Authority have also been examining the feasibility of using MSW from this region of the Eastern Shore to produce steam and/or electricity (33). The first phase of the study addressed the technical, legal, and financial feasibility of the concept. It is estimated that this region of the Eastern Shore will produce approximately 260 tons of MSW per day in 1985, increasing to 298 tons per day in 2005.

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[1] In a mass-burning incinerator MSW is loaded directly into the incinerator without sorting or processing.

The study concluded that three potential projects are technically and economically feasible and that two of these are capable of near-term implementation (see Table II-9; (34)).

The federal government provides financial incentives for the use of municipal solid wastes in energy-producing activities through the Windfall Profit Tax Act (1980) and the Energy Security Act (1980). A 10 percent tax credit is allowed for equipment designed to burn biomass fuel or used for converting biomass into synthetic solid fuel. Also, tax exempt Industrial Development Bonds may be used to finance facilities to produce electricity from solid wastes if the facility is owned and operated by a state or the federal government. Subsidized loans, loan guarantees and tax-exempt grants may also be obtained from the federal government.

Solar Energy

Solar energy systems are of two basic types: passive and active. Passive solar systems refer simply to devices used to permit sunshine to enter a structure or to exclude sunshine. Such devices include shutters, large windows, southern exposures, window shades, etc. Active solar systems are based on the collection, storage, and use of solar energy. Typically, water (or air) is heated via solar collectors and circulated throughout the heating system of the building or used to heat domestic hot water.

Because sunshine is not available at night or during periods of inclement weather, active solar systems are generally equipped with thermal storage capability. While it is possible to construct an active solar system with sufficient storage to supply all the hot water or space heating requirements of a building, the cost is generally prohibitive and a back-up system is usually relied upon.

The primary application of active solar heating systems is for residential use. Nationally, in 1979, approximately 80 percent of solar collectors were delivered to residential end users, and 60 percent of all collectors were used to heat swimming pools (11). Industrial and commercial applications have not been widespread.

The costs and productivity of solar units vary widely and depend upon the geographic area, the type of solar system used, and the housing structure to which the system is affixed. A 1979 study conducted by Resources for the Future shows that low-end estimates of solar costs make it competitive with electric resistance heat (12).

Purchase and installation costs for an active solar water heating system vary substantially. According to a recent survey, the average cost of purchase and installation in Maryland in 1979 was approximately $3,200, and repair and maintenance

Table II-9. Potentially Feasible Projects Identified in Maryland Mid-Shore Resource Recovery Project, Phase I[a]

Project Name	Features
Beulah	• Would provide steam to Americol, Ltd. and electricity to Delmarva Power & Light • Colocated with Americol • Immediately proximate to Beulah landfill which could serve project • Well-buffered 320 acre site in country
Easton	• Would provide electricity to Easton Utilities • Located at Airport Industrial Park • Access via Routes 50 and Maryland 322 • Easton landfill is about 5-1/2 miles away • Two potential parcels, 4.9 and 6.2 acres, have been identified at Industrial Park, near town
Federalsburg	• Alternative energy markets include steam to Solo Cup and American Synfuels and electricity to either Delmarva or Choptank Electric Cooperative • Located in Federalsburg Industrial Park • 1/4 mile from Route 313 • Beulah landfill is about 11 miles, could serve project • Sites available in Industrial Park, near town

(a) Data from Ref. 33.

expenses for the solar facilities have been negligible. This study also estimates the pay back time of a solar water heating system to be approximately 6.5 years (13).

A number of different federal, state and local financial incentives make the installation of a solar system more attractive to the homeowner. The 1980 Windfall Profit Tax Act stipulates a 40 percent tax credit for investment in solar systems up to a maximum of $4,000 per household. The 1978 National Energy Conservation Act allows FHA to increase its limit on low interest loans by 20 percent. Additionally, the Energy Security Act (1980) allows for the establishment of a Solar and Conservation Bank to administer loans for solar systems through HUD.

The Community Development Administration (CDA) administers a residential energy conservation program throughout Maryland. The purpose of the program is to provide low interest rate financing to all residential property owners of energy conservation and solar utilization improvements. The program began as a pilot program with $1 million in funding.

Maryland State solar legislation specifies that solar units cannot be used as a basis for increasing property assessments and allows local municipalities to grant tax credits for solar equipment. Harford and Anne Arundel Counties have established such property tax credits which appear to have stimulated considerable solar activity.

Currently, there is only a modest degree of utility involvement in solar energy. Each of the major utilities has conducted or funded research on solar hot water applications. But except as required by RCS, they are not actively promoting solar investments, although PEPCO is encouraging builders to incorporate passive solar measures (10).

The discussion thus far has emphasized solar energy as a method of reducing the demand for electricity. There is considerable commercial interest at present in photovoltaics, a solar technology that directly converts sunlight into electricity using semiconductor material (20). Copley Energy, Inc. began generating a nominal 15.8 kW of electricity in December 1982 at its Denton, Maryland photovoltaic array facility. This power is currently being sold to Delmarva Power & Light. The facility is completely automatic with a computer hookup to the owner's home computer (21). The Solarex Corporation has built and will soon be operating a solar cell breeder plant in Frederick, Maryland. Electricity produced using photovoltaic array roof panels (200 kW) will be used in the plant to produce solar cells. It is anticipated that approximately two million cells per year will be manufactured at this plant (22).

Wind Energy

Maryland, because of its diverse topographic features, experiences considerable variation in annual average wind speed. The annual average wind speed in most areas of Maryland is 8-10 mph. The wind energy potential in these areas is relatively low as current wind turbines require annual averages of greater than 12 mph. Some areas of Western Maryland, however, may have a potential for use of wind energy because topographic features in this region of higher elevation/high relief tend to increase wind speeds (35).

A wind measurement program is currently underway at three locations in Western Maryland (Dan's Rock, Savage Mountain and Garrett County airport). Mean monthly wind velocities taken from August 1982 to January 1983 indicate that values greater than 12 mph exist at the 50 foot level at Dan's Rock and Garrett County Airport. (See Table II-10.)

No definitive statement can be made about the feasibility of utility scale wind energy development in Maryland at this time, but it appears that there may be a potential for some electricity demand to be met on a seasonal basis.

Small-Scale Hydroelectricity

Interest in hydroelectricity as an energy source has been spurred in the last five years by federal legislation and regulatory reform and an increased awareness of potential fossil fuel shortages. Potential exists for significant expansion of small-scale hydro[1] in Maryland. The Maryland Energy Administration has estimated that the total undeveloped hydroelectric potential in the state is 560 million kWh per year with an energy equivalence of 6.2 trillion Btu per year (1).

The FERC retains licensing jurisdiction for virtually all non-federal hydropower projects under provisions of the Federal Power Act. Construction and operation of hydropower projects require either a license or license exemption from FERC. Normally, the first step in the licensing process is to obtain a preliminary permit which is routinely granted to the applicant for an 18-month to 3-year period. The permit allows the applicant the time to perform the necessary feasibility and environmental studies and during that time maintain exclusive rights to the site. Upon completion of the studies, the permit holder may apply for a license or license exemption which will allow project construction and operation.

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[1]Defined as installed capacity less than 30 MW by U.S. Department of Energy from the Public Utilities Regulatory Policies Act of 1978.

Table II-10. Mean Monthly Wind Speed at Three Locations in Western Maryland[a]

Month/Year	Mean Monthly Wind Speed (mph) Dan's Rock	Savage Mtn.	Garret Co. Airport
August 1982	9.2	7.4	7.6
September 1982	10.0	7.8	7.8
October 1982	11.9	8.7	8.9
November 1982	15.0	11.0	12.5
December 1982	15.0	10.1	12.5
January 1983	--	12.1	13.4

(a) Data from Ref. 36.

Licensing of all proposed small-scale hydroelectric facilities in Maryland is a federal procedure as described above. However, state involvement in the licensing process is considerable due to provisions in federal legislation (e.g., the Fish and Wildlife Coordination Act, the Endangered Species Act) which require that comments from federal, state, and local resource agencies be incorporated into federal licensing procedures. FERC has adopted the position that all state and local permits must be applied for and granted prior to issuance of a FERC license or exemption. Further, FERC is mandated to include resource agency conditions in an exemption; inclusion of agency conditions in a license is at the discretion of FERC.

There are several small-scale hydro projects at various stages in the licensing/construction process in Maryland. The planned annual generation of these facilities totals 72 million kWh. Additionally, feasibility studies have been performed at several other sites. It is anticipated that small-scale hydro activity will continue at a relatively constant level for the near future.

Federal initiatives aimed at encouraging further development of small-scale hydro are contained in the Public Utilities Regulatory Policies Act of 1978, the Crude Oil Windfall Profit Tax Act of 1980, the Energy Security Act of 1980, and the Economic Recovery Tax Act of 1981. Incentives include tax credits, loans and loan guarantees, and grants for the development and construction of demonstration projects. Additionally, regulatory reforms instituted by FERC over the last several years have been directed toward streamlining the licensing process and encouraging hydropower development.

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