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ABSTRACT

THIS REPORT DISCUSSES IN GENERAL TERMS THE POLITICAL AND SOCIAL CONSTRAINTS ON THE APPLICATION OF ENERGY CONSERVATION TECHNIQUES IN A NEW TOWN, BOTH IN THE PRIVATE AND PUBLIC SECTORS. GENERALLY, THE TONE OF THE REPORT IS THAT ALASKA ALREADY POSSESSES MOST OF THE POLITICAL AND ECONOMIC TOOLS WITH WHICH TO APPLY SUCH TECHNIQUES, BASED ON THE ASSUMPTION THAT GIVEN THE NECESSARY INFORMATION AND THE WILLINGNESS TO CONSIDER RELATIVELY INNOVATIVE APPROACHES, ALASKA'S CITIZENS CAN BUILD A NEW TOWN THAT WILL, IN ENERGY CONSERVING TERMS, PRODUCE SOCIAL AND ECONOMIC BENEFITS BOTH IN THE PRESENT AND THE FUTURE.

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FOREWORD

On November 2, 1976, Alaska's voters chose from among three alternatives offered them a 100-square mile site for their proposed new capital at Willow in the southwestern foothills of the Talkeetna Mountains. Willow is located at the juncture of the Matanuska and Susitna Valleys, approximately 30 air miles and 70 road miles from Anchorage. If the capital move goes forward, by 1980 approximately 19,000 persons can be expected to live and work there. This population is expected to grow and stabilize at about 30,000 persons by 1990.

The purpose of the move is to bring the headquarters of state government to a more central location than Juneau, thus increasing its accessibility to the voters. As such, state government employment is expected to make up the major portion of primary sector employment and is estimated at about 3,700 persons in 1980, growing to about 5,900 persons in 1990. Also, within the primary employment sector, federal government employment is expected to remain stable at about 300 persons from 1980 to 1990, persons in contract construction will go from 570 to 830 over the same period, and manufacturing will go from 140 persons to about 200.

Within the secondary employment sector, municipal government employment is estimated at about 660 persons in 1980, growing to 990 persons in 1990. Services are expected to account for 4,650 persons in 1980, and 7,075 in 1990. In total, it is estimated there will be 19,000 persons in the new capital in 1980, 10,000 who will be employed, and in 1990, there will be 30,000, of whom 15,000 will be employed.

Of the structures to be built between 1980 and 1990, it is estimated that 20 percent of them will be dedicated to government, 60 percent will be residential of varying densities, and the remaining 20 percent will be allocated to commercial uses. Of concern here is to what extent can energy conserving technologies and methodologies be applied, particularly in respect to the construction of buildings, which will also complement or influence similar applications in the design of transportation and energy delivery systems. The technical state of the art in all respects is such that major steps towards energy conservation can be taken, from a technical or scientific point of view. The techniques, methodologies, and methods currently are available and new applications are expected in the near future.

But the extent to which these innovations and methodologies will be applied is not so much a question of available technologies as it is one of what the persons who must approve, in the final analysis, the capital move and those who will live there will permit to be imposed. The extent to which such energy conserving constraints can be applied is translatable only in terms of what the citizenry may allow. And this choice, what they may or may not do from the energy conserving point of view, is measurable not so much in technical and engineering terms as it is in the political, economic, social, and cultural values of the persons who will be expected to live under such requirements.

Most of the land in the 100-square mile Willow site is vacant though there are a few small plots that are privately owned (mining claims and

recreational sites). In fact, the Willow site contained more private holdings than the other two alternatives (Larson Lake and Mt. Yenlo) offered the voters. Although a condition of the capital move proposition was that there would be no land acquisition costs to the State, if it is determined at a later date that these private holdings should revert to public state ownership, this could be accomplished through the State's eminent domain powers, coupled with a fair price to the private owners.

Depending upon the location of the privately owned lands, there is a potential for the evolution of characteristics that may not lend themselves to the development of energy conserving systems. Landowners may wish to transfer the use of the land to commercially oriented ventures (trailer courts, shopping centers, bars and cafes, apartment complexes, etc.) which may in the future develop service demands (roads, utilities, etc.) that may not fit into a developed energy conserving scheme.

Once a plan has been developed for the construction and configuration of the new capital site, a determination will then have to be made whether the existing private ownership patterns will be allowed to continue. If it is decided that it is necessary to buy back the land, this may be done on either a selective, individual basis, for just a few sites, or, for convenience's sake, a general buy-back of all privately held land.

If there is to be a minimum energy conservation controls, a buy-back may not be necessary. In any case, in order to accomplish either a selective or general buy-back, it will have to be shown in the face of owner

resistance that there is a public benefit and legitimate State use for the land. Seller resistance reasonably should be expected as the present owners of the land will not overlook the opportunity to transform the use of the land to greater economic benefit. These people are "in on the ground floor", so to speak, either by accident or design, and will probably fight to stay there.

It is not unreasonable to believe even at this point that attempts are already planned by those owners to "improve" the land, thus entitling them to a higher price in the event of a reversion to the State or else putting themselves into a position to reap legitimately expected profits once construction of the site gets underway by providing accommodations and services to the contractors and their crews and later to the workers in the new capital.

LEGAL AND POLITICAL CHARACTER

It is not known at this time exactly what the legal and political character of the new capital site will be. It could be a first-class municipality within the confines of the Matanuska-Susitna Borough, or it could be a new type of government, a special district, physically located within the Borough but exempt from its powers and with special powers of its own. It is assumed for the purposes of this report, however, that the new capital will be self-governing with an executive and representative legislature and will have home-rule powers. Whichever the case, it should be expected that the capital site will have the planning, zoning, platting and the taxing powers similar to those given by State laws to all municipalities (see AS 29.33.070-090, and AS 29.48.010, 29.48.030, and 29.48.035).

In addition, it should be remembered that the State will own the majority of the land within the capital site. As such, whether it sells or leases that land, it is in a position to, if not absolutely require, at least positively influence the use of energy conservation methodologies in the private sector construction activities.

As owner of the land, the State can, if it decides to sell in fee simple, set up covenants running with the land which will govern in broad terms the types and siting of structures that might be built. Such covenants, once agreed upon by the buyer, are looked upon favorably in Alaska law. Any purchaser of a lot in a subdivision in Anchorage is aware of their enforceability.

Additional controls the State can exercise are through the platting, authority granted to both the State and local governments. In energy conservation terms, this probably is most applicable in the realm of building orientation. Just as subdivision plats must conform to road widths, set-backs, et cetera, so also can a platting authority encourage the orientation of buildings in ways that would be energy conservative, yet take into consideration the topography and aesthetics of a particular site.

It should be pointed out here, however, that for such methods -- platting zoning, code regulation, tax incentive schemes -- to withstand legal tests, they must conform to a PLAN, which has, through the legislative and political process, been adjudged acceptable both on Statewide and local terms. As is indicated below, particularly with reference to zoning, such regulations must be "in accordance" with a plan. It is assumed for the purpose of this report, that such a plan will be in existence once actual building on the site begins and prior to any disposition of property, whether by outright sale or through some sort of leasing method.

ZONING:

Zoning regulations must be in accordance with a comprehensive plan, which is a compilation of policy statements, goals, standards and maps for guiding the physical, social and economic development, both public and private, of an area, and may include, but is not restricted to, statements of policies, goals, standards, a land use plan, a community

facilities plan, a transportation plan, and recommendations for plan implementation. Energy conservation should be covered by these statements.

Uniform zoning regulations, even-handed in their application to classes or kinds of buildings, structures or land and water areas within districts (though the regulations may differ among districts) include, but are not limited to, restrictions on land use; building location and use; the height and size of structures; the number of stories in buildings; the percentage of lot which may be covered; the size of open spaces; and population density and distribution. Whatever formulas are devised, energy conservation should be one of the factors considered.

The purpose of such regulations is to provide for orderly development, lessen street congestion, promote fire safety and public order, protect the public health and general welfare, prevent overcrowding, and to stimulate systematic development of transportation, water, sewer, school, park, and other public facilities.

Recent changes in the law permit "contract zoning" where the owner, either through a ~~ment~~ or covenant with the governing body, places restrictions on use of the land beyond the zoning requirements generally attaching to the district in which the zoning is placed. This is in exchange for a less restricted particular use. An example within the energy conserving context is that a person might be allowed to build a Planned Unit Development in an area normally considered useful primarily for single-family dwellings in exchange for incorporating energy conserving design features in the structure, among other things.

Thus, zoning regulations, because of their possibilities of broad application, covering a multitude of considerations, make up one of the strongest tools with which to impose or encourage the use of energy conserving techniques. However, at the risk of repetition, for such zoning regulations to withstand legal challenges, they must be in conformance with a plan and must be applied with an even hand. And the plan on which they depend must be acceptable in real social, economic, and political terms. A plan, and the platting, zoning, and code requirements it might give birth to, would not be acceptable in such terms, even though it met the most visionary energy conservation goals, if it essentially made it impossible for the middle class homeowner or entrepreneur to build or develop except at exorbitant expense. Nor would a plan which attempted to surmount the financial obstacles by a list of exceptions to stated goals be acceptable, primarily because of the possibilities of uneven and arbitrary application.

It should be pointed out that zoning regulation is by itself a brush that paints in broad strokes, and goes to the general rather than the particular. Areas are zoned in degrees of residential and commercial density: one can build multi-residential here, but not here; a supermarket complex here but only a corner grocery there; large lots here but smaller lots there. Zoning alone cannot accomplish particular energy conservation techniques. But, in combination with platting regulations and building codes, it can determine and encourage the development of a community which, in the vernacular "makes sense," that is, determine the gross patterns of development, and thus make the application of energy conservation in the particular -- an individual structure -- more acceptable.

CODES:

It can reasonably be expected that whatever the actual technical formal structure of the government of the new capital site might be, it will share with other local governments of the State the power to develop and impose fair and equitable building, housing, and related codes. Ideally, from the energy conservation point of view, the standards of ASHRAE 90-75 would be adjusted for the climatic conditions of the Willow site and incorporated into the building codes there at the very outset of any construction. These code requirements most likely would have to be imposed by the State through the legislative process and should be an integral part of whatever particular governmental structure was adopted.

Even so, as this imposition would have to be done through the legislative process, the difficulties in adopting such a code as pointed out in the Arthur D. Little, Inc. Report (Energy Conservation in New Building Design -- An Impact Assessment of ASHRAE Standard 90-75, Conservation Paper Number 43B, Arthur D. Little, Inc., and Federal Energy Administration, U.S. GPO, 1977), would probably similarly apply:

"Concerning code authorities, ASHRAE 90 faces two problems: implementation and enforcement. It would not be surprising if a standard dealing with an abstract objective - achieving national energy self-sufficiency - were not to succeed, since more concrete concerns with such visible problems as consumer and third-party health and safety have failed to motivate institutional change and code effectiveness. Those institutional barriers that have so far prohibited the adoption of a model code on a more limited basis, will continue to create barriers for the implementation of ASHRAE 90 or allow it to be implemented only in cannibalized form. These problems could be moderated with financial or economic arguments."

The A.D. Little Report went on to point out that because of limited resources, manpower, and commitment, enforcement of such codes is weak. The Report suggested that a combination of financial incentives built into utility rates and tied to energy-conserving construction methods, and of penalties aimed at excessive energy users, must be considered "if energy conservation in building design is truly to be achieved on a widespread basis." The Report also raised as an alternative, but did not discuss the possibility of, encouraging long-term financing institutions to demand energy efficient structures; in other words, devise a method to lower the first-cost syndrome threshold.

In the ideal world, strict, energy-conserving zoning ordinances and building codes could be imposed. In the real world, public sector structures might adhere to them, but the private sector, faced with the proposition: "Build this way or don't build at all," might take the latter course. More probably, the private sector would lobby to amend such a code. Imposition of the codes without at the same time offering direct and indirect inducements and incentives probably would not be successful.

According to existing State law, which may be modified depending upon the actual legal and political configuration of the new capital site, the government will have the power (within fairly broad Constitutional constraints) to design, develop, codify, and enforce energy conserving zoning and building codes. However, these codes will have to be politically "sold", probably to the State legislature, and thus, less directly,

to the persons and special interest groups which make up each legislator's constituency. They are the ones, more than any other, who will decide upon the legal and political structure of the capital site and the powers which that governmental unit can exercise.

POSSIBLE INDUCEMENTS AND INCENTIVES:

To sell the idea of practical energy conservation a spectrum of inducements and incentives is going to have to be offered. As already implied, only minimal adjustments will have to be made to existing zoning and code regulation schemes and powers to allow energy conservation considerations. It does appear, however, upon initial investigation, that more major modifications will have to be made in local government taxing powers, specifically the scope and extent of tax exemptions on real and personal property, in order to offer a set of inducements and incentives that will make the imposition of energy conserving applications more appealing.

TAXING POWERS:

Municipalities of the class and order assumed for the new capital site already have taxing powers and can levy special assessments in service areas. However, State law seems to limit the power of municipalities to levy and tax for any purpose in any one year to three percent of the assessed valuation of property within the municipality. No municipality may levy taxes which will result in tax revenues from all sources exceeding \$1,000 a year for each person residing within its boundaries.

In addition to required exemptions, such as property used exclusively for religious purposes, municipalities may exclude or exempt or partially exempt residential property from taxation by ordinance ratified by the voters at a regular or special election. However, according to State law, such exclusions or exemptions may not exceed \$10,000 for any one residence.

APPLICATIONS:

If authorized, such exemptions might be used as an inducement to residential builders to incorporate the energy conserving design features outlined in a proposed code. However, there may be due process and equal protection arguments which would have to be examined to see if such exemptions could be offered to one class of builders or landowners but not to others. Perhaps, because this would be a brand new city, there would be no distinction among types of builders as they would all more or less be in the same situation: i.e., all starting construction in the same area at roughly the same period of time.

It is noted, however, that this authorized exemption applies only to residential buildings, not to commercial structures which have the larger energy saving potential under the ASHRAE proposed standards. A particular effort should be made in setting up the legal and political structure of the new capital to give it the power to apply similar tax exemption or exclusion inducements to builders of commercial structures, as well as residential structures. This probably would require amendment of present State tax laws.

Another method of inducement through the taxing powers might be through the power given by the State to cities to establish, alter, and abolish differential tax zones to provide and levy property taxes for services not provided generally within the city or a different level of service than that provided generally within the city. Such power, coupled with the general zoning power, could be used to set up another range of inducements. For example, builders of commercial structures such as shopping plazas could be required to build only within certain zones, but in exchange for the incorporation of energy conserving techniques, which reduce the amount or quality of utilities the government might be expected to provide (the "different level"), the builders might be given some sort of tax incentive -- a "different level" of taxes (lower).

TRANSPORTATION ASPECT:

We have so far concerned ourselves only with the possibilities and powers of the capital government as applied to the construction of energy-saving structures. There are other areas which have energy conserving aspects that are also subject to the usual regulator, powers given municipalities. Transportation is a prime example, and municipalities are given the power to regulate the licensing and operation of motor vehicles, as well as the licensing of buses and the setting of fares. It is not clear, but it could be made possible, even if it takes legislative enactment, that control of vehicular traffic could be accomplished through this regulatory scheme (and accompanying licensing fees) shifting persons to public transportation modes which are more energy efficient. This approach is feasible only where the actual

design configuration of the entire capital site permits, along with the value assumption that public transportation is of such overall benefit that it deserves some kind of public subsidization.

CONFIGURATIONS AND DENSITY LEVELS

Crucial to all the above considerations is the aspect in an energy-conserving context of the density levels of the proposed new capital site. In the report by Smith (Identification of Environmental Impacts of Energy Conservation Technologies...Task J), five site configuration options are considered: (1) Base Line Case, Low Density; (2) Neighborhood Clusters, Low Density; (3) Neighborhood Clusters, Medium Density; (4) Neighborhood Clusters, Medium Density (altered mix); and (5) Central Cluster, High Density. Of the five, the first, Base Line Case, is potentially the most energy wasteful, being as it is consistent with presently normal community develop patterns in Alaska, using currently applied state-of-the-art planning, and without consideration of energy conservation. This configuration is prophetic of what the new capital site would be like should there be no steps taken to apply energy conservation methodologies.

The last of the alternatives, a High Density, Central Cluster, is potentially the most energy conservative, dealing as it does with massive, integrated structures located in a central core and obviating the need for widespread transportation and utility service distribution systems.

BASE LINE, LOW DENSITY:

Within the political and legal context, the first of the two is entirely possible if it is assumed (or decided) that no steps will be taken to introduce energy saving constraints on the planning, design and actual construction of the new capital. However, it is the subjective evaluation of this writer than even assuming a "worst case" construct of resistance to the imposition of energy saving technologies, the people of this State, through their legislators, will not allow the construction of the ill-designed capital. It should also be pointed out that Federal monies probably would not be available to assist in the planning, design and construction of a new capital site under those conditions. Nor does such a configuration fit into the concept of a "new", "model" capital.

There is already significant political opposition to moving the capital at all, especially from areas other than Anchorage, as daily review of the media and an awareness of the machinations of the legislature reveal. To allow to be built a sprawling, unplanned, wasteful community would be to strip away much of the justification for the new capital in the first place. All that would result under this configuration would be the opening up of new markets for a comparatively few Anchorage entrepreneurs, according to the perceptions of anti-move forces throughout the State. The question, "Why should it be moved at all?" would assume great substance and authority than it presently has.

HIGH DENSITY: CENTRAL CLUSTER:

When one deals with the other extreme, the technologically feasible high density, central cluster concept, one cannot help but to attempt to draw

parallels with the Brazilia experience of 15 years ago. Such drawing of parallels should not be dismissed as being merely whimsical or blindly obstructionist. Such perceptions may be very real and are real, and therefore have real political effects, which, in turn, reflect real social and cultural apprehensions.

The political perception is that Brazilia did not work, and it is not a totally incorrect perception. There is in the popular view a notion of sterility, excessive direct and indirect regulation and control, overcrowdedness, and a loss of individuality -- where a person might come to think of himself (and be thought of by others) as merely a member of the mass. The suspected cultural and social apprehension among Alaskans, whether new arrivals or persons who have lived here for some time, probably is that, except for a small minority, they would not care to live that way.

It is from these real or perceived concepts that many of the persons who have come to Alaska fled. Though these values probably would be cited by most U.S. citizens wherever they might live, they appear to have a greater intensity in Alaska. Many persons who live here willingly accept a harsh climate and a certain lack of amenities in exchange for these values. The measurable values that persons cite when asked why they live in this State are the very antithesis of what they perceive might occur under the central core concept. It is the fecundity of Alaska and the Alaska life style that attracts them. It is the perception of a relative lack of direct and indirect controls that keep them here.

It is these and the relative lack of crowding and the idea of open spaces, a sense of not being labelled or arbitrarily stuck in some societal slot that gives to Alaskans a peculiar but identifiable sense of individuality -- the Alaskan's individual responsibility and authority for how he might manage to run his own life and "do his own thing", with a minimum of interference from others.

THE POLITICAL ACCEPTABILITY OF NEIGHBORHOOD CLUSTERS:

The above factors are all very subjective value judgments on the part of the persons who hold them. Thus, any attempt to describe or define them also is a subjective exercise. Nevertheless, those subjective judgments will have real or objective effects, if only in a negative sense, as they translate themselves into political, social, and cultural resistance to the central cluster concept. This is not to say that these judgments cannot be changed, but the assumption for the purposes of this paper is that they cannot be so changed within the period of time allowed to begin construction of a new capital, not without changing the very character of the persons who can be expected to live and work there.

Thus, it would appear that the mid-range of configuration alternatives, those dealing with neighborhood clusters of varying density, would be the most acceptable and therefore politically, economically, culturally, and socially feasible.

These neighborhood configurations represent a compromise between the aforementioned possibilities. As such, they are demonstrative of a

political truism, to wit: Politics is the art of the possible. Politics is itself a distillation of the economic, social, and cultural perceptions of the citizenry. The neighborhood configurations are of greater political acceptance because they meet the subjective assumption that the persons who propose, design, plan, and construct a capital and the persons who will be expected to live and work there probably will accept only a site configuration that actually gives them a range of choices as to how, where, and why they will live and conduct their daily lives. Within this grouping, a greater or lesser extent of energy conserving technologies may be imposed or applied, while at the same time allowing for the political decision making and participation that can realistically be supposed persons living within and without the proposed new capital site will insist upon.

Although the low density cluster option is probably the most pleasing concept for most Alaskans, the medium density cluster and the altered mix cluster should still be acceptable, yet provide the most opportunities for energy savings. Design and planning, as well as actual construction, of such configurations can be accomplished with little modification to existing planning and zoning, taxation, and regulation powers that, as discussed above, are expected to be within the political and institutional authority of the capital site and the State. Such configurations also have the advantages of flexibility and time responsiveness.

In other words, though it is hoped that the new capital site will be "locked in" to a policy and plan of energy conservation, and will have

developed or have developed for it the codes and ordinances, zoning regulations, taxation schemes, etc., that will accomplish those goals, the neighborhood concept allows for the political and institutional framework to respond, without unduly limiting, the free choice of individuals as to where and how they wish to live on the larger scale. The neighborhood concept allows for the Adam Smithian play of the "invisible hand" of free enterprise, yet it can channel the fields in which the hand will play to the greater overall public welfare in energy conserving terms.

It is the position of this paper that the neighborhood cluster concepts - both medium and altered mix - offer a chance of achieving energy conservation, yet within terms that are politically, economically, culturally, and socially acceptable. For example, the structures housing and directly serving the State and local governmental units can be built and their energy supplies accommodated to the most rigid possible applications of existing technologies. In fact, in order to be eligible for the Federal money and State bonding authority necessary to fund construction, there may be no other choice within this sector. Yet, at the same time, individuals can be allowed to build (within code and zoning restrictions) at sites they determine they desire on the basis of subjective considerations (a "good" financial deal, aesthetic values, closeness to friends or acquaintances, access to recreational activities, a perceived need for some kind of neighborhood service - a laundry, a bakery, a bar, an ice cream or pizza parlor).

However, any person so desiring to build would have to conform to the energy conservation requirements spelled out in the code for the structure itself, and, if this site location did not fall within the zoning regulations, he would have the burden of proving to the appropriate governmental unit (probably a legislative authority) the legitimacy of his choice.

In other words, he would have to put forward a case for an exception. Any political structure within the State of Alaska constitutionally would have to set up a forum where he could voice those arguments with a reasonable expectation that those arguments would be given real consideration.

THE LEASING ALTERNATIVE:

The same degree of inexactitude with which the legal, institutional, and political structures of the new capital site are discussed above also applies to the land ownership patterns in the new capital. The underlying assumption has been throughout that traditional fee ownership will be the ruling regimen for the majority of the area. But, just as the exact political and institutional configuration has yet to be set, so also has the land ownership pattern to be formulated.

Thus, it is useful to mention, at least in passing, the possibility that land could be leased, rather than transferred in traditional fee title. Such leases could be of either short or long-term, with periodic options for renewal. Although opposition to leasing is predictable, in line with the traditional American and particularly the Alaska ethic of the individual desire to own one's own piece of land, such opposition should not be assumed to be insurmountable.* Persons will still want to build

* For instance, the dense central core concept implies some sort of leasing scheme, both for residences and commercial spaces, especially the "tower" concept.

at least their own homes, despite the fact they may rest on leased land, and entrepreneurs will still be attracted to the area in order to take advantage of the new markets there.

Though a similar even-handedness of application will have to apply to leasing decisions and concurrent controls as are constitutionally required in the application of zoning, code, and taxation regulations, leasing would give more power to the leasing authority to impose and require energy conserving technologies in construction. In other words, leases cannot be granted or withheld in an arbitrary or discriminatory manner, but the length, rates, and terms of the lease can be used to penalize or reward builders who incorporate energy conserving techniques in their designs and structures, whether private residential of any particular density, or of commercial buildings.

The possibility of leasing land and/or space should be given particular consideration during the construction phase, if not to the operational phase of the new capital site. It may be too much to require that the structures and facilities required to house and service the initial intensive construction phase of the new capital should conform to strict energy saving constraints. Many such structures, viewed in the long-term, can be seen as relatively temporary. Short-term leases of two, three, four and five-year durations should be offered to those wishing to build accommodations for workers, supply facilities, fabrication yards, etc. Such facilities could be expected to be removed at the end of the construction phase, or, if their owners desire to remain in place

with a greater degree of permanency, renewal options requiring conformance with energy conserving constraints can be built into the leases.

Whether under a leasing scheme the leasing authority or private enterprise should build the actual structures is not determined at this time.

Neither is the actual structure of the scheme and/or authority discussed in any depth or detail (e.g., would it be structured along the lines of ASHA?; or a quasi-public/private organization?). However, the feasibility of a leasing scheme and authority should be investigated rather than being dismissed out of hand. Such a scheme may provide means and methods to insure all aspects of energy conservation, including transportation and utility delivery systems in both a demand and time-responsive way.

It should be pointed out that for such a scheme to be acceptable and to work, it cannot be completely insulated from the same political, cultural, economic, and cultural constraints that will affect the traditional methods of control. To make a leasing scheme acceptable, citizen participation in formulating the policy itself, the method of its implementation, and any major changes or amendments should be allowed, just as it is on major zoning changes or exceptions, code application, and local taxation schemes, most of which traditionally must be made by legislative ordinance after public hearings.

TRANSITION ASPECTS:

Most of the foregoing speaks to the long-term aspects of the construction and eventual operation of the new capital site. It is a discussion of

the political and institutional framework that eventually could be put in place and fully operating, within the energy conserving context, by 1990, when the new capital stabilizes at roughly 30,000 population.

It must be assumed that the normal social, economic, and cultural expectations will, in the broad sense, be as generally pervasive in the new capital as they are elsewhere in the nation. It is hoped, however, and can also reasonably be expected, that a certain Alaska "character" arising out of the value systems we attribute to this state, will dilute or mitigate these expectations to at least some degree. At least to the degree that the new capital will reflect Alaska's physical and temperamental environment, rather than being just a replica of a new city or town that could be built anywhere Outside,* a "Holiday Inn" type city that is almost exactly like those stamped out across the nation.

Still, however, these general expectations can be expected to be nurtured by many, if not most, of the residents of the new capital, when considered in their roles of government worker, entrepreneur, secondary service worker, house owner, condominium sharer, apartment dweller, mobile home resident. And these expectations will compete against one another in a desire for fulfillment much as they do in other areas of the country. In short, the conflicts and stresses between the property owner and the rent payer, the boutique shopper and the mall or plaza aficionado, the restaurant goer and the McDonald's denizen, the small car owner and the large car driver, will be much the same in the new capital as the public prints and television depict them elsewhere. The resolution of these

* "Outside," as used in this report, refers to the contiguous lower 48 states, where the problems of energy conservation may not be so capable of solution as they might be "Inside," or in Alaska.

conflicts is the major interest, other than actual work, of most of the citizenry, and is the prime item of business of the governments they create and the focus of the laws those governments write.

Many of those expectations can be expected to take on an Alaska character to the extent that the persons holding them are willing to make or accept trade-offs. People may choose parks and undeveloped open spaces within the new capital as opposed to more capital and labor intensive forms of recreation facilities. They may be willing to emphasize the aesthetics of their environment over the convenience of fast food emporiums and a surplusage of shopping malls. However, the extent of these possible preferences is presently unknown.

One thing that should be noted, however, is that there is a significant proportion of Alaskans who proclaim themselves as advocates of a life style that rejects many of these normal expectations. Though they probably compose a numerical minority, they are highly articulate and reasonably successful in getting their point of view across and have reasonable support among the State's legislative bodies. These persons have been perjoratively characterized as "anti-development" or "anti-growth" by the mainstream. Though this characterization is probably unfair (they are not anti-growth or development in black and white terms) they can be expected to resist strongly many of the developmental characteristics they perceive to be part and parcel of the fulfillment of the normal expectations held by the majority.

It should be reasonably expected that the conflict in the expectations and aspirations of these two groups will be one of the major stress points in the development of the new capital. The extremes of each group have already staked out their positions. Those favoring the capital move want it accomplished as quickly as possible with few controls and tend to ignore cost data that promotes questions concerning the overall expense of the proposed move. Those on the opposite side of the fence tend to emphasize the possible costs and insist upon the kind of planning that will best reflect their "environmentalist" values.

Neither of the two positions necessarily take into account practical energy conserving aspects in the construction of the new capital, though the environmentalists might be expected to be more amenable to proposed energy conserving measures, especially in the realm of transportation, being as they are advocates of comprehensive (including mass transit system) planning and strict zoning and code regulation. The developers, advocates of free enterprise and minimum governmental interference, can be expected to resist "over planning" and strict regulation as being unnecessary. (Already at the cutting point of this latter group, the concept of life-cycle costing for new buildings is dismissed as ephemeral nonsense, as an unnecessary accounting manipulation, as articulated by a major advocate of the capital move in public hearings).

Unfortunately, the leaderships of the two groups have already adopted positions, even solely within the Anchorage context, that can only be characterized as doctrinaire. Especially in the construction of a brand

new capital in a relatively "unspoiled" location, each group can be expected to take even more dogmatic stands unless they are carefully informed of the possible energy savings options and induced to compromise their positions in order to reach realistically possible and practical solutions to the energy conservation problem.

It is not intended in this short discussion to characterize either group or point of view as good or bad, right or wrong. The implications of particular aspects of each point of view may or may not be energy wasteful over the long run. For instance, the environmentalists (for want of a better word) might resist taxing schemes and utility rate structures used as incentives for the builders of commercial spaces to incorporate energy conserving measures, perceiving them as unnecessary breaks given a dimly perceived power elite at the expense of the public at large, thus ignoring the long-run benefits.

The stress between these two groups can be expected to be more visible and more heated during all phases of the planning, design, and construction of the new capital. To resolve this conflict, intensive efforts will have to be made to educate each of the groups to the long-term rationales for the imposition of energy conserving constraints across all ranges of application.

Another major focal point of stress in the construction of the new capital lies within the two distinct phases of its creation - the construction phase and the operation phase. A different type of person and

different types of institutional interests will inhabit the capital site during the five year intensive construction phase than will be there when the capital moves into its operation phase.

During the construction phase, many workers can be expected to live in camps or commute from Anchorage and already established areas in the Matanuska-Susitna Valley, Palmer for example. Supporting services, such as lumber, concrete, and fabrication yards will be temporary in nature. However, the secondary industries that can be expected to spring up - cocktail lounges, food and hardware suppliers - probably will not be so temporary. These demands for services will be different from those required when a new type of population, the government workers themselves, move into the capital site during the operation phase.

During the interface between the two phases, the population characteristics will shift from seasonal workers employed for long hours at higher average salary rates than those for the government workers and who maintain their permanent homes elsewhere. As the operation phase begins, the population will take on the characteristics of the average government salaried worker, making about \$1,700 to \$1,900 a month, more family oriented (1.8 children of school age), who will plan to live in the area on a more or less permanent basis.

The stress will come at this interface and will be particularized in the problem of what to do with the relatively uncontrolled facilities and amenities that have been introduced to serve the construction phase

on a temporary, basis. The question is, which of these facilities should be allowed to stay, in what form, and subject to what energy conservation constraints.

The construction phase leasing configuration mentioned above may serve to mitigate the worst aspects of this problem. But, available data does not provide a basis upon which any hard solution to this stress problem, within energy conserving terms, can presently be based.

SUGGESTED ADDITIONAL EVALUATION WORK

An obstacle to any definitive solution to the possible problems stated throughout the above subjective analyses is the lack of refined demographic data. Steps should be taken as soon as feasible to investigate, in the greatest detail possible, the social and economic characteristics of the anticipated population of the capital during each distinctive phase - construction intensive and permanent operation.

It should be realized that such data is inexact itself and will not provide the hard line basis upon which definitive conclusions or approaches can be made. However, such data could provide a broad general context from which general policies can be drawn. How much people earn and how they hope to spend those earnings, directly and indirectly, is a major determinant of what the people will expect and accept.

Additionally, investigations should be made of the stresses experienced in similar situations, in Valdez for example, in order to get an idea of what actually happens in stress situations. Such information may be applicable to the new capital, especially during the construction phase.

In addition, the imposition of energy conservation is not new to the nation. Within the past few years, at the instigation of the federal, state and local governments, many communities have attempted, through the classical methods mentioned above, to make themselves less energy wasteful. It would be very instructive to examine a few of these

communities to draw indications of what legal and institutional forms work and do not work, the difficulties of formulating such schemes, and the difficulties of applying them in a fair and equitable way. Particular attention should be paid to time frames, and as much attention should be paid to non-conformance with these schemes as to conformance. In other words, attention should be paid to the instances where energy conserving regimens are broken or amended and the reasons why they have worked or not worked.

As the Little report pointed out, codes and regulations represent a compromise between the various forces and influences operating in the particular jurisdiction which develops those codes and regulations. The report warns that too often, the resulting legislation and requirements represent a "conservative compromise" that is competent in its engineering requirements but often is unimaginative and perhaps even uneconomic.

The report concludes that energy conservation standards cannot be simply imposed from above but will only be achieved gradually by a combination of innovative measures. The report emphasizes the necessity of intense educational efforts aimed at energy consumers to make them aware of possible cost/benefit advantages. And the report reiterates the necessity for providing financial incentives in both the public and private sectors.

However, most of the literature in this field deals with the problems of imposing energy conserving schemes on towns and cities already in place and that already have a history of zoning and code regulations. We here are dealing with a brand new town, starting off from square one so to speak. The concept of a new capital site is almost radically innovative in itself. Though there will be substantial resistance to the imposition of energy saving measures, it is not unreasonable to conclude that there is a chance the new capital can start off from ground zero in the right direction with innovative energy conserving schemes. There is empirical evidence concerning what works and does not work in energy conserving terms elsewhere. That evidence should be examined; lessons can be learned from what other jurisdictions have attempted in this field. Those lessons should prove valuable in developing energy conservation legislation and requirements for the new capital.

Climate

Aesthetics

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Vegetation

Wildlife

Soil

Surface Water

Ground Water

Geology

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ANALYSIS OF ENERGY USAGE ON LONG ISLAND FROM 1975 TO 1995
THE OPPORTUNITIES TO REDUCE PEAK ELECTRICAL DEMANDS AND
ENERGY CONSUMPTION BY ENERGY CONSERVATION, SOLAR ENERGY
WIND ENERGY AND TOTAL ENERGY SYSTEMS

BY

FRED S. DUBIN, P. E.

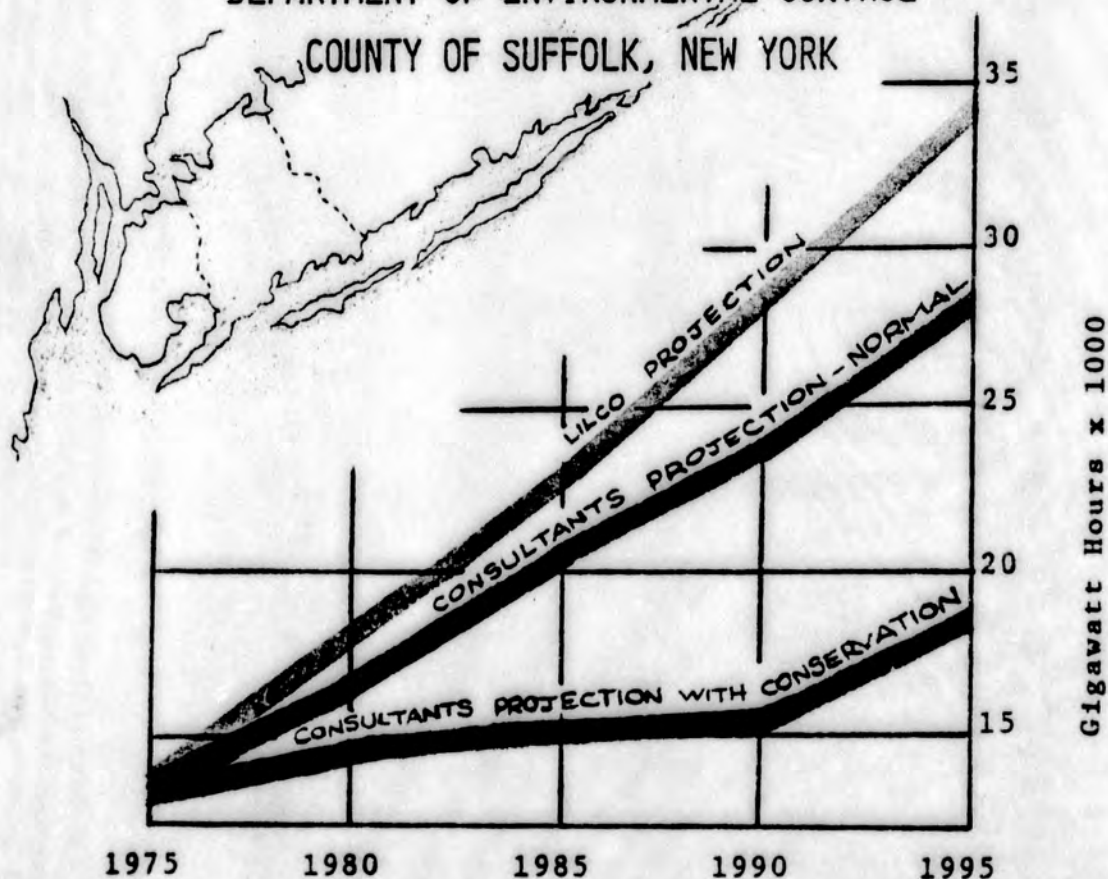
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COUNTY OF SUFFOLK, NEW YORK



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WIND ENERGY AND TOTAL ENERGY SYSTEMS

(A CONDENSATION OF A COMPREHENSIVE STUDY
DATED OCTOBER 31, 1975 DONE FOR THE
DEPARTMENT OF ENVIRONMENTAL CONTROL
COUNTY OF SUFFOLK, NEW YORK)

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**AN ANALYSIS OF ENERGY USAGE ON LONG ISLAND FROM 1975 to 1995
AND THE OPPORTUNITIES TO REDUCE PEAK ELECTRICAL DEMAND AND
ENERGY CONSUMPTION BY ENERGY CONSERVATION, SOLAR ENERGY,
WIND ENERGY AND TOTAL ENERGY SYSTEMS**

By

FRED S. DUBIN, P.E.

ABSTRACT

The Long Island Lighting Company (LILCO), serves virtually all of Long Island, New York, and a small section of Queens, New York, with electricity and gas. The company has under construction one nuclear powered, 830 megawatt electric generating plant, the Shoreham, scheduled to come on-line late in 1978; in addition, LILCO has made application to construct two new nuclear plants in the town of Riverhead in Suffolk County, Long Island, Jamesport I and Jamesport II, each with a capacity of 1150 megawatts are planned to come on-line in 1982 and 1984 respectively. LILCO's justification for these two new plants is based on the system required to meet the loads which, according to their forecasts will occur during the period 1975 - 1995.

This paper is a condensation of a more comprehensive report¹ of the study commissioned by the Suffolk County Department of Environmental Control and conducted by Dubin-Mindell-Bloome Associates, P.C., Consulting Engineers and Planners, under the direction of Fred S. Dubin, P.E.

The projection of the peak electric demand and the yearly consumption of electricity and the method of forecasting (exponential smoothing analysis), by LILCO are analyzed. An alternative method of forecasting, devised by Dubin-Mindell-Bloome Associates, P.C., is presented, and indicates that the yearly electric energy consumption and peak electric demand for the "normal" case will be lower than LILCO forecasts, and the proposed new Jamesport nuclear powered plants, or their equivalent, are not likely to be required until 1986 and 1992 respectively.

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1. "A Study of Existing Energy Usage on Long Island and the Impact of Energy Conservation, Solar Energy, Total Energy and Wind Systems on Future Requirements," dated October 31, 1975, the testimony of Fred S. Dubin, P.E., before the Public Service Commission, on December 10, 1975.

An intensive energy conservation program is analyzed in detail. Suggestions are made for reducing energy consumption through operation and maintenance of a) buildings, b) mechanical/electrical systems, and c) energy intensive industrial processes; the implementation of energy conservation measures for existing and new buildings using hardware, equipment, materials, and systems which are now commercially available, and for instigating a load management program. A modest utilization of solar energy for domestic hot water and space heating and cooling, coupled with the energy conservation program is shown to have the potential of reducing the normal loads to the extent that not only could the Jamesport I and II plants be cancelled, but also that the completion of the Shoreham plant could be delayed.

In addition, the energy in the winds, offshore and over Long Island, is shown to exceed all of Long Island's energy requirements for the next twenty years or more, and the potential for converting wind energy into electricity and heat with arrays of wind generators is developed by Dr. William Heronemus who was under contract to DMBA to examine this alternative; recommendations are made for further research in this area.

On-site total energy systems and the use of solid waste for fuel are cited as two additional measures to further reduce the need for raw source energy (fossil fuel or nuclear), for central electric generating plants.

Outlined are institutional constraints and the actions required, individually or in combination, by the N. Y. State Public Service Commission, LILCO, Suffolk, and Nassau Counties, the N. Y. State and U. S. Federal Governments, and by consumers on Long Island to implement and realize the full potential of these alternatives to erecting new central utility electric generating plants and the economic benefits in doing so.

BACKGROUND AND SCOPE

Up until 1973, the consumption of raw source energy through conversion of fossil fuels to electricity and by combustion of fossil fuels for thermal end use in buildings increased annually at an accelerated rate in Long Island. In 1973, the rate of growth began to slow down; it further declined in 1974 due to a number of factors including the oil embargo, rapidly escalating fuel and electricity costs, a slow down in the rate of economic growth, at the adoption of limited energy conservation measures and practices. This pattern held true for oil consumption, gas consumption, electricity consumption (Kwh), and to a lesser extent, peak electric demand (Kw). Then in 1975, with the lifting of the oil embargo and a somewhat slower escalation of fuel and electricity costs, along with a small measure of economic recovery in Long Island, the rate of growth of electrical consumption and demand rose especially in residential buildings; the 1975 rise, however, was still at a lower rate than the rate of growth prior to 1973.

Since Long Island produces no primary energy, such as oil or gas, both are imported for use in generating electricity and for on-site use in boilers, for heating buildings and for industrial heat processes.

If the demand for electricity, even at the current 1975 growth rate (4% to 5%), continues unabated on Long Island, additional electric generating capacity will be required. In anticipation of such increased demand, LILCO plans to bring on-line, new generating plants of approximately 400 megawatts, mainly fossil-fuel fired, in 1977 - 1978; in addition, the 820 megawatt Shoreham nuclear-powered plant which is now under construction will become operable in late 1978. Predicting demands further into the future, LILCO applied in 1974, for permission to construct two new nuclear powered electric generating plants, each with a design capacity of 1150 megawatts. Both plants would be built at LILCO's Jamesport site in Suffolk County, New York, on Long Island Sound, in the town of Riverhead; LILCO's current plans call for completion of the Jamesport Unit 1 in 1982, with Jamesport Unit 2 to be in operation in 1984.

LILCO has predicated the need for the new nuclear-fueled generating plants on several factors. Basically, LILCO predicts a) that the population on Long Island will continue to increase and that additional non-residential buildings will be constructed, and b) that the need for electricity will increase not only in proportion to the increase in population but also in accordance with an increased use per capita, a trend that has held true in the past. The increased use per capita, in the past has been due to a greater penetration into the market of appliances, air conditioners, and other equipment in existing facilities. LILCO also predicts that increased use of electricity for space heating and water heating will prevail in the future partly because the shortage and increased costs of fossil fuels followed by the eventual unavailability of gas and oil for domestic use. As an example,

LILCO predicts that the use of electricity for space heating and hot water will increase 10 fold on Long Island in the next twenty years while the population is predicted to increase by only 25% in the same length of time.

As a matter of reference, LILCO predicts that the annual consumption of electricity will increase at a compound rate of 4.7% from 1975 to 1995 (down from the compound rate of 7% prior to 1973); other predictions are that summer peaks will increase at the compound rate of 4.4%, winter peaks at the compound rate of 4.8%.

In making these predictions, LILCO employed a modified version of the traditional method of forecasting electric loads. The traditional method, known as "load forecasting based on regression analysis" uses recorded increases of the recent past to anticipate the increases for the near future. In the present situation, LILCO based its forecasts on "an exponential smoothing analysis", a method in which some of the components leading to load growth were selectively weighted.

One further important item in the background of utility company practices is the issue of "peak demand". In order to accomodate the few hours in the year when a very high generating capacity is required, a utility company must construct and maintain facilities capable of generating at that capacity all year long. In other words, peak demands set the requirements for new generating plants! And once the peak demand has been forecast and the generating plant constructed, the utility company, in order to operate economically, must promote a greater use of electricity in off-peak hours. Therefore, in the past, electrical need has grown, symbiotically, according to the utility company's capacity to provide service.

Long Island, like the rest of the United States, is at a cross-roads in its history of power production. Fossil fuels, traditionally used for generating electricity and heat both centrally and on-site, are running short. The utility company has made its predictions and has applied for permission to construct nuclear powered electric generating plants with all their inherent faults and potential hazards. Is there an alternative?

Perhaps the first concern, in considering an alternative to nuclear power production, should address the current need for an over all energy policy--an energy policy sensibly arrived at, to govern future uses of energy and to be based upon genuine needs of the area and realistic assumptions about fuel supplies. Such a policy could eliminate or interrupt the perpetual interaction of supply determining demand determining supply determining demand...which otherwise may continue until the final and ultimate energy crisis.

To begin to develop an energy policy, the issue of load forecasting must be thoroughly examined and an accurate forecast must be made of the annual fossil fuel requirements and, in the use of

electricity, the annual consumption and the peak hourly demand for each week, month, and season.

Load forecasting was relatively simple and reliable in the past because the major factors affecting load growth changed at a fairly constant and predictable rate, and regression analysis, based on recent historical performance, could be employed with confidence to forecast the future. Under present conditions however, even a forecast based on an exponential smoothing analysis which selectively weights some of the components contributing to load growth and therefore may be more dependable than a simple regression analysis, is not reliable enough to base the serious decisions which must be made in formulating energy policy and planning for the facilities to implement it; no longer do the major factors affecting growth--i. e., construction activity, appliance and air conditioning sales, fuel costs, and fuel supplies, educational programs, building and construction codes, the performance standards of equipment and appliances, shortage of capital, and other local, regional, national and international influences--neatly conform to historical patterns, for all have been greatly altered by recent events.

Since the prediction of both the quantity and type of energy required on Long Island is an essential ingredient in the evaluation of the alternatives available, the importance of load forecasting becomes more evident when the alternative for energy supply and most directly, electrical energy supply, are weighed.

In formulating an energy policy for Long Island, two major alternatives exist: first, central utility electrical generating capacity may be increased as it has been in the past, or secondly, demand may be reduced, and new alternative sources of energy introduced, thereby reducing the capacity of, or eliminating completely the need for new central utility electric generating plants. Each of these major alternatives may be effected through a number of possible options, some of which may well be eliminated in the near future by Federal Government policy nevertheless, the options--choices that will have to be made--are set forth here under each of the major alternatives.

I. Increase Central Utility Electrical Generating Capacity.

- a) Expand LILCO's, or municipal fossil fueled central electricity generating plants; continue to import greater amounts of fossil fuel, and/or increase domestic fuel oil production by measures which include off-shore drilling. Continue to utilize oil fired boilers for space heating, hot water, and industrial heat processes in existing and new facilities.
- b) Convert existing large industrial, commercial, and the central electric utility boiler plants from oil or gas to coal fired equipment and build additional coal fired plants as Long Island's energy requirements grow; and

utilize electric heat to a greater extent in existing and new buildings.

- c) Increase nuclear powered electrical generating capacity with new plants to handle the growing demand for electricity, and utilize electric heat and air conditioning to a greater extent in new buildings and by conversion of oil and fired heating and domestic hot water heating systems to electric heating in existing buildings--LILCO has opted for this alternative.

II. Reduce the Capacity of, or Eliminate Completely, New Central Utility Electrical Generating Plants.

- a) Reduce the demand for electricity, both annual consumption and peak hour demand, and reduce consumption of electricity and fossil fuels, in existing and new buildings through operation, better maintenance, and the use of energy conserving equipment, materials, and systems in buildings, street lighting, industrial process, and public transit. Use fossil fuels for heating and air conditioning in place of electric resistance heating.
- b) Improve the utilization of existing and new power plants by extensive load management measures including time-of-day metering, load shedding, peak shaving and energy storage, so that peak hour demand is reduced and less generating capacity is required.
- c) Utilize solar energy for space heating, cooling, and domestic hot water heating now and as the technology matures and capital costs decrease, wind energy for thermal and electricity end-use, photo-voltaic conversion of solar energy to electricity, and solar heat powered thermal engines for air conditioning and electric power generation.
- d) Finally, supply some of the electrical energy and thermal energy requirements for buildings by on-site total energy systems, truncated power systems, peaking cycles, bottoming cycles, and decentralized fuel cells instead of an equal amount of electricity generated in central plants and fuel used in separate on-site boilers.

While the options are clear, the environmental, economic, financial, social, legislative and technological factors which are inter-active for each option have not heretofore been well identified, quantified, or qualified. All of the considerations must be viewed from many points--the short term interests versus long term interests, private interests versus public.

In an evaluation of the above alternatives, many factors must be evaluated for the primary and secondary impact which each exerts--for example, dependence to a greater extent upon fossil fuel

imports contains the implications of unfavorable balance of trade; dependence upon foreign energy sources at unpredictable prices, the effect upon national security and foreign relations; and also upon the escalating rate of inflation. While these factors have not been fully quantified or evaluated, they are generally accepted by the Federal Government knowledgeable economists, scientists, and an informed public to be serious enough so that alternatives must be and are being sought.

The opportunity to increase the production of domestic oil and gas in the North East rests mainly on new offshore oil wells. The cost for these new resources will certainly be greater than present domestic fuel costs and involve technical, political, environmental and social decisions for which there is no consensus, as yet. Additionally, increased combustion of oil lead inevitably to greater air pollution.

A policy to increase the use of coal for generating plants and large boiler installations immediately brings to fore the problems of transportation, strip mining implications, the high capital costs of converting existing fossil fuel equipment to burn coal, and the problems of air pollution control and the cost to accomplish it.

As for nuclear power plants, escalating capital costs, decreasing availability and increasing costs of uranium, operating difficulties, anti-sabotage control measures, long lead time for construction, dissipation of waste heat, and transportation and disposal (storage), of radio-active wastes are all matters of concern.

In evaluating an intensive energy conservation option, the availability of equipment and systems and the technical know-how to use them for a large scale energy conservation program, combined with the efforts required by the consumer and legislative bodies to implement those measures which are immediately practicable, must be qualified.

Finally, the stage of technological development, capital costs, aesthetic considerations, institutional constraints, commercialization, design developments, and methods of financing--all are factors which influence large scale use of each of such alternative energy sources--solar energy, wind energy (reform of solar energy), on-site power generation, and the use of solid waste as fuel.

In analyzing the alternatives, the following objectives are paramount, although not necessarily of equal importance, nor are they listed in the order of priority:

- a. Health and safety.
- b. An adequate supply of energy in all forms for the necessities of life and desirable amenities.

- c. Clean air, pure water and unblemished recreational, agricultural and other land-use and water areas.
- d. Full economic opportunity - jobs.
- e. Agriculture to provide produce and goods for consumption at home and for trade.
- f. Aid and abet consistent with a national energy and resources policy (when it is finally promulgated).

The Suffolk County N. Y. Department of Environmental Control is concerned that LILCO's current plans for expansion of their electrical generating capacity may not be in the best interests of the citizens of Long Island, may not be in harmony with the objectives listed above, and question whether construction and operation of the Jamesport plants or their equivalent are needed in the time frame suggested by LILCO, if at all. For those reasons, in February 1975, they commissioned Dubin-Mindell-Bloome Associates, P.C., Consulting Engineers and Planners, to perform an eight month study culminating in an engineering report to include the following:

1. An examination of the historical growth pattern of peak electric power demand and annual electricity consumption in the LILCO service area as outlined in published and unpublished data furnished by LILCO.
2. A review of the LILCO forecast of system growth in as much detail as they have available--i.e., daily and seasonal peak and consumption load characteristics for various classes of buildings and facilities, and, where available, sub-systems within buildings.
3. An evaluation of existing a) master plans, b) land use development plans, c) demographic data, d) economic forecasts, and e) data on the physical characteristics and energy usage, where available, of existing buildings; the preparation then of a separate forecast of peak loads and annual energy consumption under normal conditions from 1975 - 1995, using the same data base as LILCO's, insofar as it is feasible, for saturation of appliances and air conditioning, street lighting, transportation, distribution and transmission losses, and utility company in-house use of electricity.
4. A selection of energy conservation and load management measures which are now technologically and economically feasible for existing buildings to the extent that they can be implemented in stages and for immediate use in all new building construction, to determine the reduction in electrical energy consumption and peak demand that would result from an intensive energy conservation and load management program.

5. A calculation of the effect that solar energy and wind generating systems as alternative energy sources, and total energy systems (on-site power generation), would have on reducing the net electrical energy load that LILCO would be required to supply by central utility power plants for the period 1975 - 1995 if the alternative sources of energy were used.
6. An outline of the practices, policies, and institutional changes required of consumers; state, federal, county, and municipal agencies; the N. Y. State Public Service Commission; and LILCO, in order to realize the full potential of energy conservation, load management, and alternative energy sources.

The final report entitled "A Study of Existing Energy Usage on Long Island and the Impact of Energy Conservation, Solar Energy, Total Energy and Wind Systems on Future Requirements," was completed on October 31, 1975. On December 10, 1975, in Suffolk County, N. Y., Fred S. Dubin, P.E., presented the findings in testimony before the examiners in the Public Service Commission Hearings, Case 26292, in Suffolk County, Long Island.

This paper, prepared for public presentation in Suffolk County, N. Y., on February 19, 1976, was made possible by an additional grant from the Suffolk County Department of Environmental Control. It is a condensation of the complete report, and is prepared to assist the public in deciding which policies they should support in their short and long term interests.

In order to provide as much information as possible within the scope of this paper, some of the sources of the data, and the calculations which support the findings are not included herein. For additional information consult the complete report which is available from the Suffolk County Department of Conservation.

ACKNOWLEDGEMENTS

Fred S. Dubin, P.E., was the principal investigator for Dubin-Mindell-Bloome Associates, P.C., and many other members of the firm participated in the study, principally David L. Hartman, Yvonne McDougal, Bernice Beharry, Selwyn Bloome, Linda Yowell, Vaughn Bradshaw, and Kathie Whipple.

Many other individuals made significant contributions to the study. It is not possible to name all of them, but we are grateful to them and particularly to Dr. Harris Fischer of the Suffolk County Department of Environmental Control; Regina Armstrong of the Regional Plan Association of New York; Robert Romancheck of the Pennsylvania Power and Light Co.; Earl Taylor, Jan Sayko, and Stu Gillespie of Northeast Utilities Service Co.; T. Owen Carrol of Brookhaven National Laboratory; Parker Mathusa of the Public Service Commission; Lee Koppleman of the Nassau Suffolk Regional Planning Board, and Irvine Like, Counsel to Suffolk County--for their valuable contributions and generous donation of their time.

LILCO SERVICE AREA

The Long Island Lighting Company serves an area of about 1230 square miles consisting of Nassau and Suffolk Counties, (hereafter referred to as Long Island or Bi-County area), plus a portion of Queens in the Rockaway Peninsula. Of the 846,000 LILCO electric customers in 1974, some 22,900 or 2.7% were located outside the Bi-County in Rockaway. At the same time, some 23,400 electric customers within the Bi-County area in 1974 were not served by LILCO, but were supplied with electricity by two municipal utilities, Rockville Centre and Freeport. LILCO did furnish a small portion, about 7%, of the electricity sent out by the two municipal utilities in 1974.

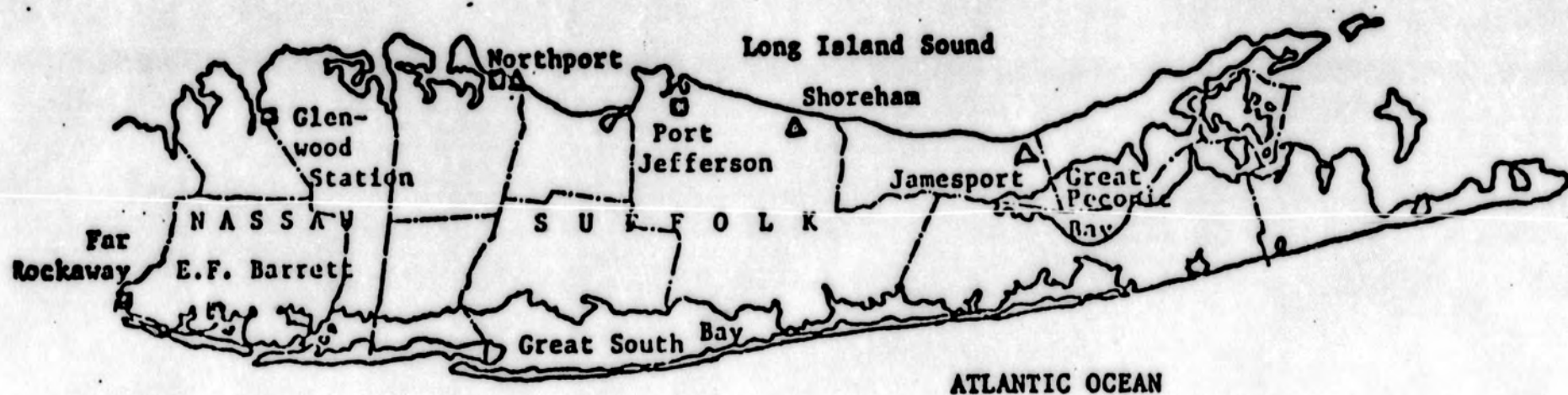
In 1972, Nassau and Suffolk counties were designated as a new Standard Metropolitan Statistical Area (SMSA), by the Federal Government. As a result of this designation, additional economic and demographic statistical data became available for the Bi-County area as a unit. The Nassau-Suffolk Regional Planning Board also provides data for the Bi-County area, as does LILCO. Due to the close correlation between the LILCO service area and the Nassau-Suffolk SMSA, some of the analyses made in this report have assumed an identity between the LILCO service area and the SMSA, rather than attempting to adjust the available data to account for the very small proportional of LILCO customers outside the SMSA.

In 1975, there were about 2.7 million persons living in the Nassau-Suffolk SMSA. This was a gain of 4.7% over the 1970 U. S. census count. However, this was a much slower growth rate than occurred in the booming 1950's and 1960's, when the rapid suburbanizing Bi-County area was one of the fastest growing places in the U. S. The slower growth rate has been reflected in the number of residential building permits issued in recent years (about 10,000 in 1974 versus 18,000 in 1971). Although multiple-family units have accounted for about a quarter of all residential building permits issued in 1970's, the Bi-County area remains overwhelmingly an area of single-family homes. In 1970, 80% of Nassau's housing units, and 90% of Suffolk's, were accounted for by detached single-family houses.

The aerospace industry, electronics, and research and development dominate the manufacturing base of the region, but most of the jobs located in the SMSA are white collar jobs in the sales and services category. Agriculture is also an important activity. Suffolk County is a leader in the state in the value of its farm produce.

The location of the Nassau-Suffolk SMSA within the giant New York-New Jersey-Connecticut megalopolis has tended to obscure the fact that on its own the SMSA is one of the largest in the U. S. It ranks ninth in 1970 population and seventh in per capita income among the ten largest SMSA's. However, the 1974-1975 recession has had a serious impact, as elsewhere, on the Bi-County economy driving up unemployment, sharply curtailing new construction and lowering retail sales.

Figure 1 is a map of the region, and shows the locations of LILCO's generating plants.



▲ PROPOSED STATIONS
■ EXISTING STATIONS

LOCATION OF LILCO POWER PLANTS

1
FIG

A. NEITHER THE TWO PROPOSED 1150 MEGAWATT NUCLEAR POWERED GENERATING PLANTS NOR THEIR EQUIVALENT WILL BE NEEDED IN LONG ISLAND UNDER NORMAL CONDITIONS, UNTIL LATE 1985 and 1991, RESPECTIVELY.

LILCO has predicted that Jamesport 1 and 2 will be needed as early as 1982 and 1984 to satisfy the future requirements for electrical energy in their service territory. However, LILCO's load projections were based on traditional historical methods of forecasting which are no longer appropriate.

LILCO's Forecast

DMBA analyzed LILCO's forecasts through 1995 from data included in the 1975 report of "Member Electric Corporations of the New York Power Pool and the Empire State Electric Energy Research Corporation pursuant to Article VIII, Section 149-b of the Public Service Law updated April 1, 1975." The general method of forecasting used by LILCO was detailed in that report, but further information was provided to DMBA by LILCO in meetings, through correspondence and through subsequent testimony at public hearings. LILCO employed two methods of forecasting loads, a) regression analysis, and b) an exponential smoothing analysis. LILCO had more confidence in the exponential smoothing analysis and based their final forecasts on that method.

LILCO first prepared a short term forecast for the years 1975 thru 1979 for summer peak loads, winter peak loads and annual energy consumption based on extending historical data and trends, modified by a series of judgemental factors of the future, including estimates of the net number of new electric customers, appliance and air conditioning sales and market saturation; also additional electric space heating and domestic hot water installations in new buildings and by conversion of existing fossil fuel installations in dwelling units, a modest amount of energy conservation and load management, and the general economic outlook based on "stated observations of leaders in the financial and building community." The forecast of annual consumption and seasonal peak demand for residential customers was more detailed than the estimate for non-residential customers, which was based mainly on an "estimate" of the number of new customers in the five year period and their per capita requirements.

LILCO's long range projections, 1980 - 1995, of peak demand and annual consumption are mathematical extrapolations of historical trends and the short range forecast. Past data can be adjusted and/or short range values weighted to add emphasis to the implicit effect of energy conservation on the long range trend line, but for LILCO's forecasts, crucial stage for representing the impact of conservation remains the short range forecast (1975 - 1979). Neither further reduction in the growth rate of specific activities and facilities, nor any other judgemental factor can be inserted into the long range analysis and

forecast; developments that will be occurring in the post 1979 period simply cannot be represented unless they are artificially introduced into the short range analysis. Thus LILCO's analysis cannot account for new energy conservation factors due to new equipment, building and appliance standards, cost and availability of fuels, or a national energy policy, which arise after 1979.

The exponential smoothing method provides emphasis on certain elements of the data entered without resorting to artificial adjustments of past history, by employing a smoothing constant in analysis. In the past, this statistical technique for predicting future electricity and power requirements has proven to be a fairly reliable system, given the consistent growth that characterized electric usage during the sixties and early seventies. However, the extraordinary events of the last two years have raised serious doubts about how reliable this approach will be in predicting future conditions. There is now a vast array of new developments that raise a danger signal in accepting even modified projections based on historical trends. To name just a few: a) quantum leaps in price of all forms of energy have occurred, providing real incentive for saving energy through operational changes in buildings (the verdict is not yet in on how "elastic" or "inelastic" the demand for electric energy is (it may prove to be far more elastic than it has been in the past), b) a slow-down in economic growth on Long Island, which a recent article in the "Wall Street Journal" has suggested might last for a decade, c) huge cost escalation and time delay in building central generating facilities d) the forecast of future decline in the school and college age population, e) possibilities of mandated energy performance standards¹ for appliances, equipment, and buildings, both old and new, and f) the glut of office and commercial space on Long Island due to overbuilding in the past eight years.

In addition, there are factors which will reduce the rate of growth of electrical energy consumption and peak demand, which LILCO did not fully take into account. For instance, a) more and more new energy conserving equipment is offered in the market place, and even without an intensive energy conservation program, a greater percentage of sales will be for the more efficient equipment, b) energy conservation standards² and guidelines³ for building construction have been promulgated

-
1. The Federal Energy Bill, S-622, dated 12/7/75, which President Ford has just signed into law contains these provisions.
 2. ASHRAE 90-75 Energy Conservation Standard for New Buildings.
 3. See References D, 1, 2, 3.

and architects and engineers are designing more efficient buildings now, c) a greater percentage of new housing are multi-family dwelling units which use less energy than single family units. Under these conditions, neither regression analyses nor exponential smoothing analysis methods of forecasting based mainly on an econometric approach are appropriate.

Given the new situations, DMBA felt it was appropriate and necessary to expand the methodology to provide explicit procedures for analyzing the impact of such factors as technological changes, shift in behavioral patterns, divergent growth rate of air conditioning, appliances and equipment each with a unique unit energy demand, and the varying growth rates of each building type and their individual contribution to peak demand. The peak load requirements are particularly important since they are the major factors which determine the need for new electrical generating plant capacity.

DMBA's Forecasts for "Normal Conditions"

DMBA developed a procedure of forecasting which is based on the loads which will accrue to each building type, appliances, equipment and system which are likely to be in use each year, under "normal" conditions. "Normal" conditions for the purposes of this study are defined as the loads which are most likely to occur if demographic projections, master land use plans, building construction activity, appliance and air conditioning sales and operation and maintenance of buildings and systems follow the predicted trends and some energy conservation measures are practiced, but without an intensive energy conservation program and without wide-spread utilization of alternative energy sources.

While the effort required to establish even the limited data base which is necessary for this type of forecast was time-consuming and tedious, it was important to do so in order to more accurately determine future energy requirements under "normal" conditions, and most important, disaggregating energy use by building type and sub-system provided the basis for developing a priority action program by identifying and measuring those systems and factors which might have the greatest impact in curtailing energy consumption growth or peak loads. In addition, it provided the data which enabled DMBA to estimate the potential for reducing fossil fuel consumption as well as electrical energy on Long Island. DMBA undertook five essential measures to forecast future loads:

1. Review of relevant literature: DMBA studied a wide range of published and unpublished data by LILCO and other sources such as consumers, fuel suppliers, planning authorities, and U. S. Census describing the demographic, land use, and economic characteristics of Long Island and the New York Metropolitan area. DMBA prepared an energy-use questionnaire and sent it to more than 200 building operators and owners in

Long Island, to obtain historical data on peak loads, annual consumption, and building characteristics. The data obtained from the questionnaires and the interviews with many of the respondents was not used directly in load calculations, but was used to authenticate the assumptions and the load calculations which were performed.

2. Projection of non-residential square footage and number of residential dwelling units: DMBA conferred with local and regional planning groups, and compiled, on a bi-county basis, historical data of building floor area; then projected future square footage for each of 10 categories of non-residential buildings in five year increments. The projected number of single and apartment house dwelling units were obtained from the 1975 149-B report.
3. Estimate of the unit peak demand and annual energy consumption for appliances and equipment for residential and non-residential buildings: DMBA drew on its own experiences as well as published data on energy use patterns to establish the unit peak demand in watts per square foot at utility company peak hours (both summer and winter), and the annual energy consumption in kilowatt hours per square foot for characteristic space heating, water heating, lighting, cooling, industrial process and miscellaneous energy uses for non-residential Long Island buildings. Similarly, unit peak demand and annual energy consumption were established for residential equipment and appliances.

The efficiency of air conditioning, appliances, lighting fixtures, industrial process equipment, and miscellaneous equipment, as well as average hours of operation, were projected, based on performance data of commercially available equipment in average use.

4. Resultant DMBA "Normal Case" Projections: The contribution to annual energy consumption and peak hour demand of each appliance type, window air conditioners, central air conditioning systems, electric space heating and domestic water heating systems, and miscellaneous motors and equipment was obtained by multiplying the unit demand and unit yearly annual consumption respectively, by the saturation of each system in the existing and estimated number of new structures; in residential buildings by number of dwelling units, in non-residential units on a number of square feet. For residential units the existing and predicted saturation rates of electrical equipment was based on LILCO's estimates. For non-residential buildings the existing and future saturation rates were calculated by DMBA. The unit energy consumption and demand in all cases was based on published data of Edison Electric Co., measures data by Con-Ed, LILCO, North East Utilities Co., Pennsylvania Power and Light Co., and design calculations and historical data from DMBA files.

5. Authentication of forecasting method: Using the available data for population, number of dwelling units, square footage of non-residential space, and the disaggregated values of Kw and Kwh loads for each building type and individual appliances and services such as for lighting, domestic hot water, power, heating and ventilating, air conditioning, and industrial processes in each building type, and the saturation rates in 1970, DMBA performed a decrement analysis using 1974 historical data as a base. They then calculated what the loads would have been in 1970 using the disaggregated load method. The calculated loads were within 1% of the actual system load in 1970. Because of this close correlation, the same method of forecasting the loads for the future warranted confidence.

The major difference between historical trend extrapolation and the DMBA approach is that in trend extrapolations most of the assumptions are implicitly burried in the forecast, whereas in the DMBA approach all the component assumptions are separated out (disaggregated), identified, and individually quantified.

A more extensive data base which includes an accurate analysis of the characteristics of each existing building and the current energy usage and peak hour demand related to the type of structure and mechanical and electrical systems and industrial process in use is necessary to further refine forecasts and provide a deeper insight into the potential for controlling load growth without adversely affecting commerce and social structure.

It is important to understand why electrical energy consumption and peak demand has grown in the past on both an absolute and on a per capita basis, and the factors which will modify, reduce, or reverse the growth patterns in the future under "normal" conditions. DMBA estimated the magnitude of the load due to each factor and included them in their forecasting procedures, to a) estimate future loads under "normal" conditions, and b) to calculate the impact on future loads that could occur if the modifying factors are purposely intensified through a more extensive and purposeful energy management program.. "Energy management" includes energy conservation through better utilization of resources, load management, and selective use of fuels, such as switching from one fuel source or type to another depending upon availability, cost, heat value, and efficiency of utilization.

A partial list of the factors and their effect on load growth are listed below. They can be viewed in two contexts, a) existing buildings, and b) new construction:

A. Existing Buildings - Loads Increase

1. Air conditioning units, appliances, and motors deteriorate with age, and consume about 2% more energy each year

they are operated; peak demand increases by a slightly lower percentage each year.

2. Each year, the sales of major appliances, air conditioners, business machines, and motor driven equipment exceed the number taken out of service.
3. A percentage of the new appliances, which are sold to replace existing models, especially in single family dwelling units, are larger, and for that reason, consume more electricity for each hour of operation and have a higher peak power demand.
4. Improper maintenance of filters, condenser coils and evaporator coils in refrigeration units increase operating time and energy consumption of the unit and raise the utility company peak hour demand because the longer hours of operation are, in part, at the time of peak hour demand.
5. Additional lighting is added in sub-standard buildings to bring them up to par with modern facilities.
6. Increased saturation of electric water heaters and resistance space heating resulting from replacement of oil or gas heaters and/or installed for the first time in summer homes which have been winterized and are occupied year-round.
7. Greater use of instant-start television sets which consume energy even in the off-positions; and increased saturation of color TV.
8. Creeping deterioration of building materials creating a greater rate of infiltration through leaks and poorly fitted and warped windows and doors. The additional leakage of outdoor air into the building increases the heat loss in the winter and heat gain in the summer; hence, a) electrically heated buildings consume more electricity for space heating, b) peak demand is increased, c) pumps and fans must operate longer and more electricity is consumed by these auxiliaries in oil or gas heated buildings, & d) air conditioning units and their auxiliaries operate longer.
9. During periods of expanded business activity, existing equipment is used longer, and large new energy consuming process equipment is purchased and operated.
10. Alterations and additions to existing buildings, such as finishing off basement rooms and attics to provide additional occupied area, increase energy usage and peak hour demand.

In addition to the end use increase in consumption and demand, the total burden on the utility plant is increased by another 8-1/2% to 9% of the increased loads due mainly to distribution and transmission losses, and to a smaller extent, in-house use of electricity in the utility plant.

B. Existing Buildings - Loads Decrease

1. Buildings abandoned due to obsolescence, fire, or structural deficiencies--usually less than one half of one percent per year on Long Island.
2. Buildings vacated due to a lower demand for rental (or owner occupied), space--cyclic economic conditions.
3. Some appliances and air conditioning units are replaced when they become obsolete or inoperative, with more efficient units which have become available.
4. Because of escalating fuel and energy costs and a greater consumer awareness, some voluntary energy conservation measures are undertaken.

C. New Buildings - New Loads are Added

Of course, new buildings increase the amount of energy consumed each year and the peak demand as they are constructed and come on-line each year. Compared to existing buildings, new buildings in general use more energy in non-residential buildings per square foot of space and per dwelling unit of residential construction for the following reasons:

1. A larger percentage of new buildings are air conditioned. The increase in LILCO's annual peak demand is due mainly to the added load incurred by air conditioning.
2. New homes and apartments have a greater saturation of major appliances, i.e., more dryers, freezers, washing machines; and more window air conditioners, central air conditioning and a greater number of smaller appliances, fans, dehumidifiers and electrical equipment. The electrical service entrance equipment has greater capacity than in the average older building, and when it is available it is usually utilized.
3. The excessive and injudicious use of glass in new construction and the "quick" construction methods using panel walls increase electricity consumption and peak demand for heating and air conditioning conduction use, and infiltration losses are greater. In spite of somewhat better insulation standards, new buildings with panel wall construction are more energy intensive than

many of the older buildings which have been constructed with brick or masonry walls which provide thermal mass.

4. Increase saturation of electric heat and electric hot water heating in residential and non-residential construction. So far, these have only added to the winter peak which is now below the summer peak on Long Island; however, they do increase energy consumption, and eventually could change LILCO to a winter peaking system if the trend continued. In fact, LILCO projects a 4.8% compound growth rate for winter peaks, and a 4.4% rate for summer peaks. The DMBA "normal" forecast compound growth rate, tho lower than LILCO's, also predicts a greater compound growth rate in the winter.
5. New industrial plants are generally more energy intensive rather than labor intensive, and the energy loads per square foot for processes are greater in new buildings.

D. New Buildings - Factors Which Will Modify Growth Rate

There are several conditions which will modify the load growth rate for new construction beyond 1975 as compared to the recent past. These "normal" conditions can be greatly enhanced by an intensive energy conservation and load management program.

1. A greater percentage of new housing will be multi-family dwelling units, with fewer occupants per unit. Reduced heat loss and heat gain, smaller appliances, and community laundry facilities will reduce energy consumption and demand per dwelling unit.
2. There will be fewer hospitals, universities and public school building constructed after 1980.
3. Energy conservation will be more extensively practiced, since construction standards for new buildings are changing--better and more insulation, double glazing, load limiting control systems, more light switches to control artificial illumination, and more efficient equipment and systems. Architects, engineers, and owners are becoming increasingly aware of the techniques and opportunities to conserve energy in the design of new buildings and are undertaking energy conservation programs now¹ which will impact on future demand. Energy conservation requires a

1. Some examples include the energy conservation studies by DMBA performed for the Kings Point Merchant Marine Academy, and underway at Brookhaven National Laboratories on Long Island.

smaller initial investment in new buildings, compared to existing structures.

4. There will be an increasing number of solar domestic water heating solar space heating, and cooling systems in new buildings.
5. There will be an increase in the use of heat pumps in place of systems which might normally be resistive heating.

LILCO and DMBA forecasts under "normal" conditions are tabulated below for summer and winter peak demand, and annual electricity usage.

	<u>SUMMER PEAK DEMAND (MW)¹</u>					<u>Compound Annual Growth Rate</u>
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	
LILCO	3,120	4,170	5,250	6,330	7,430	4.4%
DMBA--"Normal"	3,138	3,933	4,513	5,185	6,073	3.4%

	<u>WINTER PEAK DEMAND (MW)</u>					
LILCO	2,470	3,310	4,240	5,220	6,240	4.8%
DMBA--"Normal"	2,522	3,147	3,905	4,728	5,531	4.9%

	<u>ANNUAL ENERGY USE (GWH)²</u>					
LILCO	13,474	17,590	22,670	27,850	34,140	4.7%
DMBA--"Normal"	13,431	17,189	20,302	23,703	27,439	3.6%

Figures 2 through 7, curves A, B, and C, indicate LILCO's present and projected generating capacity and LILCO's and DMBA's projections of peak power loads and electrical energy usage under "normal" conditions. Curves D are DMBA's projections if an intensive energy conservation program were to be implemented a) alone, and b) coupled with solar energy utilization as later described herein.

1. (MG), one megawatt = 1,000,000 watts, or 1,000 kilowatts (Kw).

2. (GWH), one gigawatt hour = 1,000,000 kilowatt hours (Kwh).

B. NEITHER JAMESPORT 1 NOR JAMESPORT 2 WOULD BE REQUIRED IN THIS CENTURY IF AN INTENSIVE ENERGY CONSERVATION AND LOAD MANAGEMENT PROGRAM WERE TO BE UNDERTAKEN.

In fact, the Shoreham Plant, or its equivalent, would not even be required until 1993.

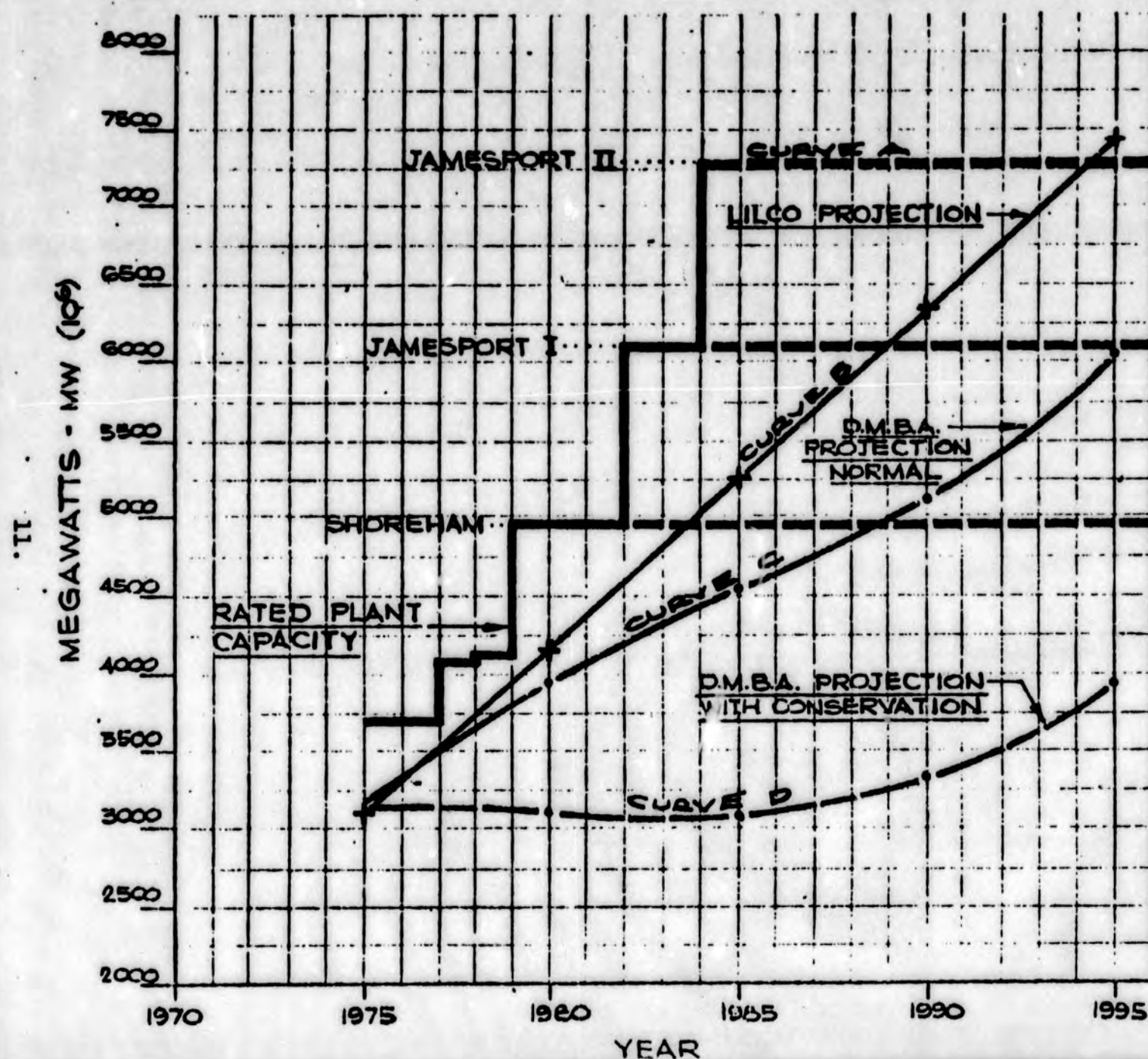
Energy conservation does not mean unmitigated curtailment of goods and services, nor restricted use of energy for essential health, educational, economic, social, governmental, recreational and pleasureable activities. It does involve eliminating, or at least, greatly reducing waste by utilizing all resources more wisely, taking critical stock of our real and perceived needs, and in some instances, substituting human effort for mechanical and electrical energy. Conservation requires improved maintenance and operating procedures utilizing the energy conserving equipment, systems, and materials which are now available; and in the longer run, developing more efficient equipment.

Given the environmental and health hazards of all types of central electrical generating plants, escalating fuel costs, growing dependence upon foreign sources for fuels, and the high capital costs of conventional and alternative energy sources, it would appear that reducing demand by energy conservation and load management, which can be rather quickly implemented at costs which are much more favorable than increasing supply by the same amount, is the most rational energy policy for the short and long term. Coupling reduced demand with increased supply through alternative renewable sources of energy are options that are available now--in Long Island and in the nation.

DMBA selected a series of energy conservation measures and calculated the cumulative impact that those measures, in aggregate, could have on annual electricity consumption and peak demand on Long Island. The conservation measures which were selected from hundreds of available options, and the conditions governing their use, meet the following criteria:

- The maintenance and operating procedures and systems are well known, have been widely publicized and depend only upon further incentives and continuous dissemination of information to insure that they are followed. They are applicable to existing buildings as well as new construction.
- All hardware, equipment, materials and systems are commercially available now.
- The engineering and architectural design considerations and methodology are well documented.
- All of the measures are currently being implemented to various degrees in the United States.

FIG
2

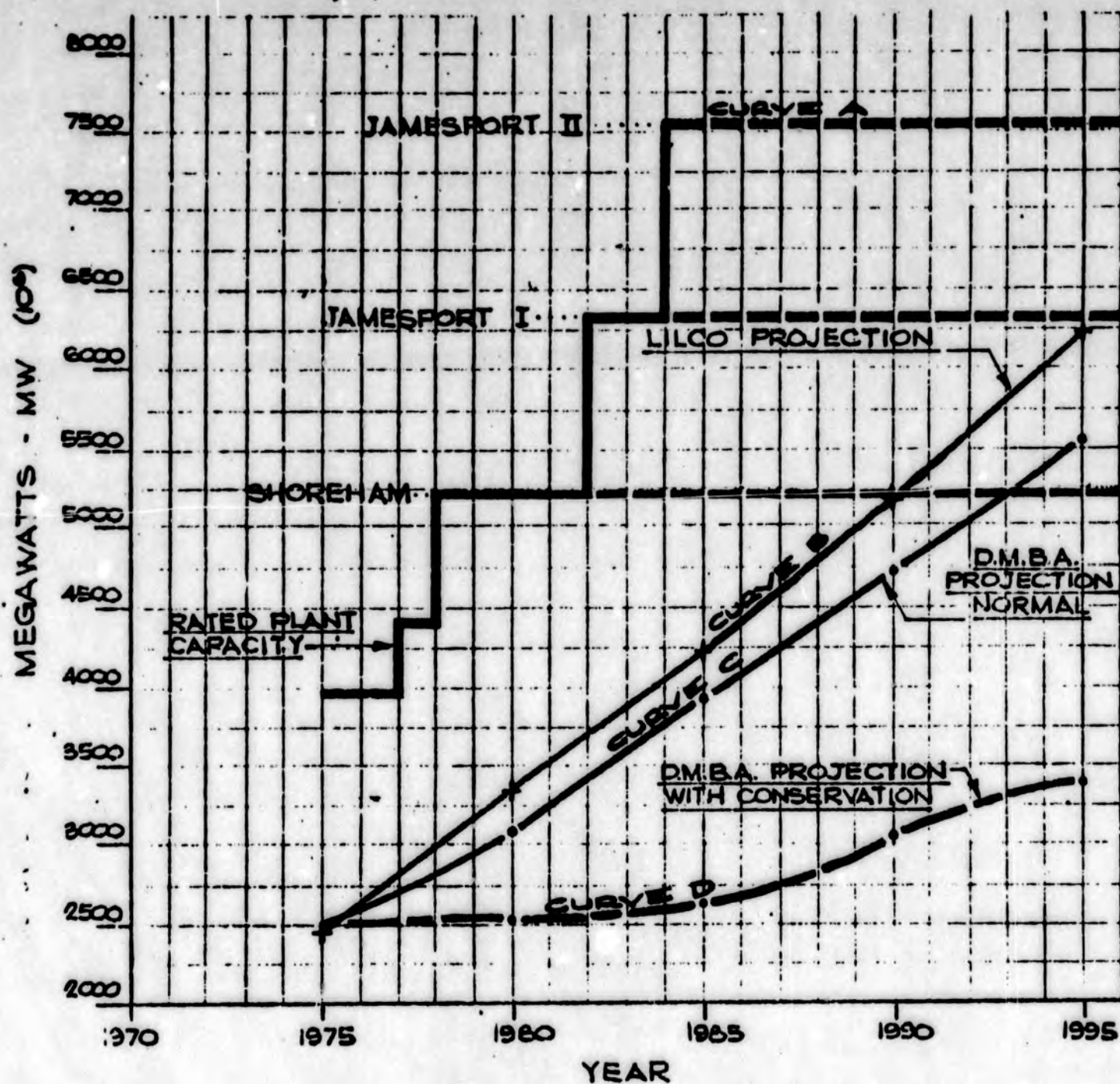


DM.B.A. PROJECTIONS OF
SUMMER PEAK DEMAND
AND CONSERVATION
POTENTIAL

PREPARED BY:

DUBIN-MINDELL-BLOOME
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CONSULTING ENGINEERS
AND PLANNERS
NEW YORK, NEW YORK

FIG
3



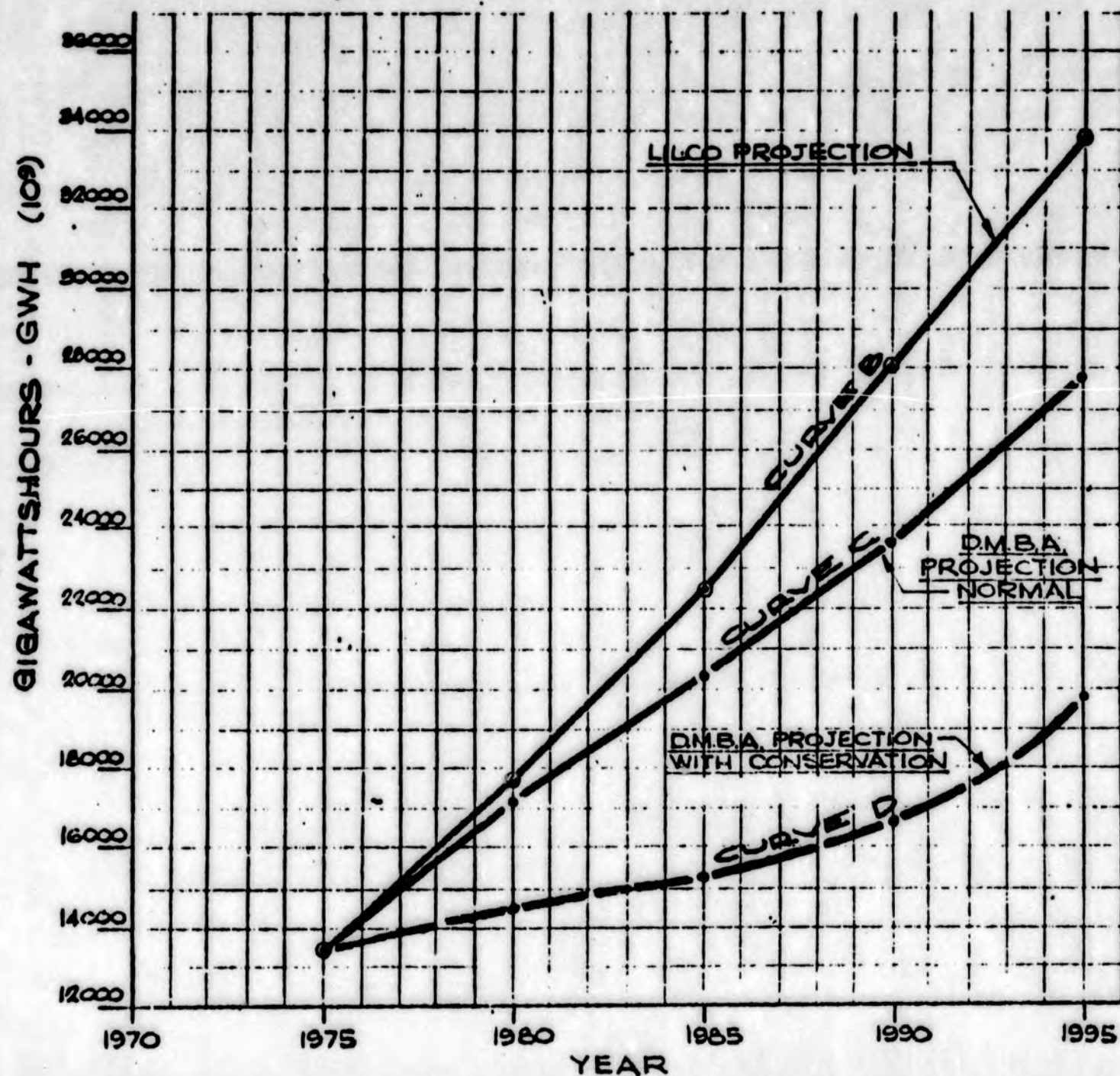
D.M.B.A. PROJECTIONS OF
WINTER PEAK DEMAND
AND CONSERVATION
POTENTIAL.

PREPARED BY:

DUBIN-MINDELL-BLOOME
AND ASSOCIATES, P.C.
CONSULTING ENGINEERS
AND PLANNERS
NEW YORK, NEW YORK

FIG

4

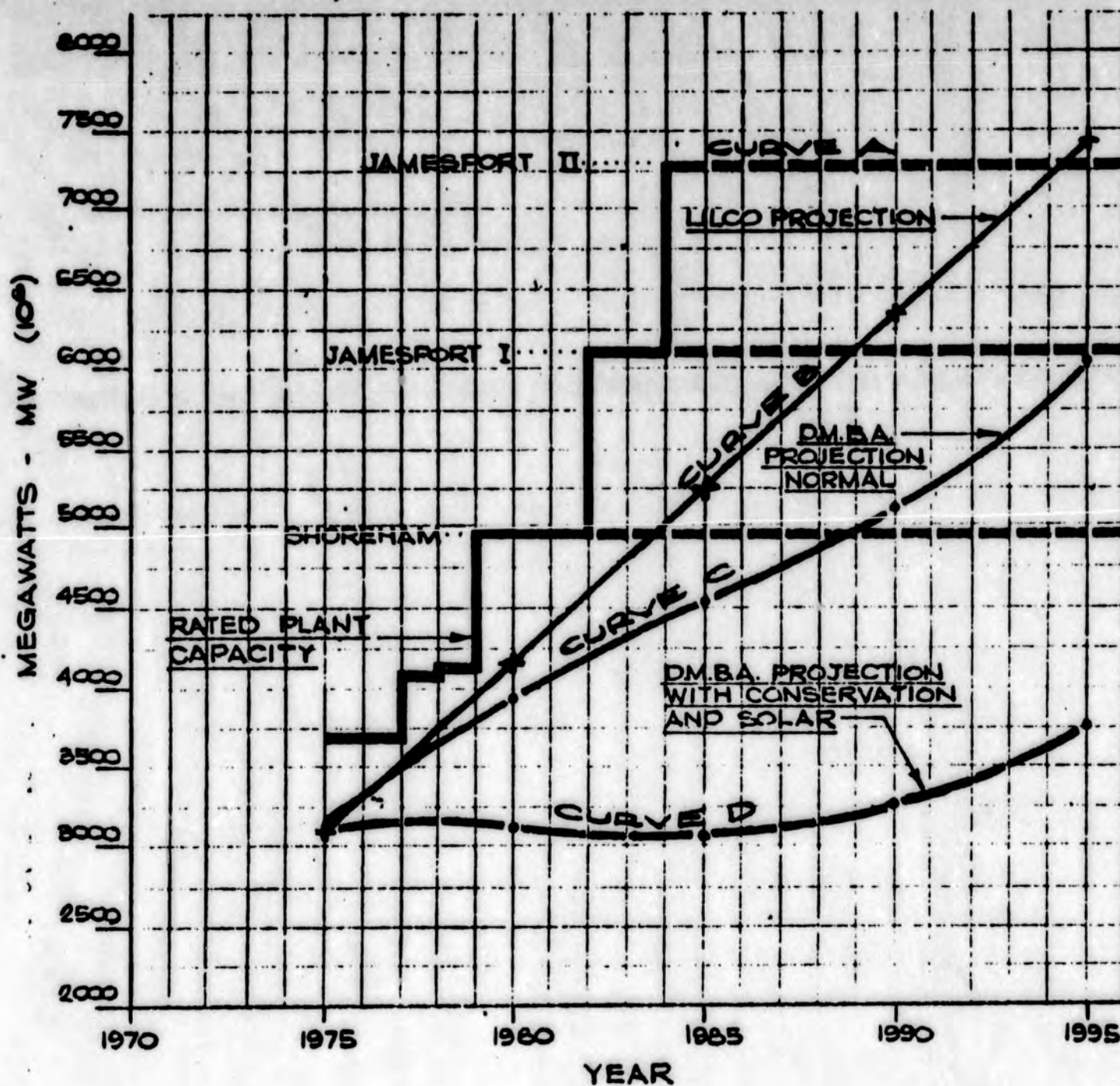


D.M.B.A. PROJECTIONS OF
ANNUAL ENERGY
CONSUMPTION AND
CONSERVATION POTENTIAL

PREPARED BY:

DUBIN-MINDELL-BLOOME
AND ASSOCIATES, P.C.
CONSULTING ENGINEERS
AND PLANNERS
NEW YORK, NEW YORK

FIG
5



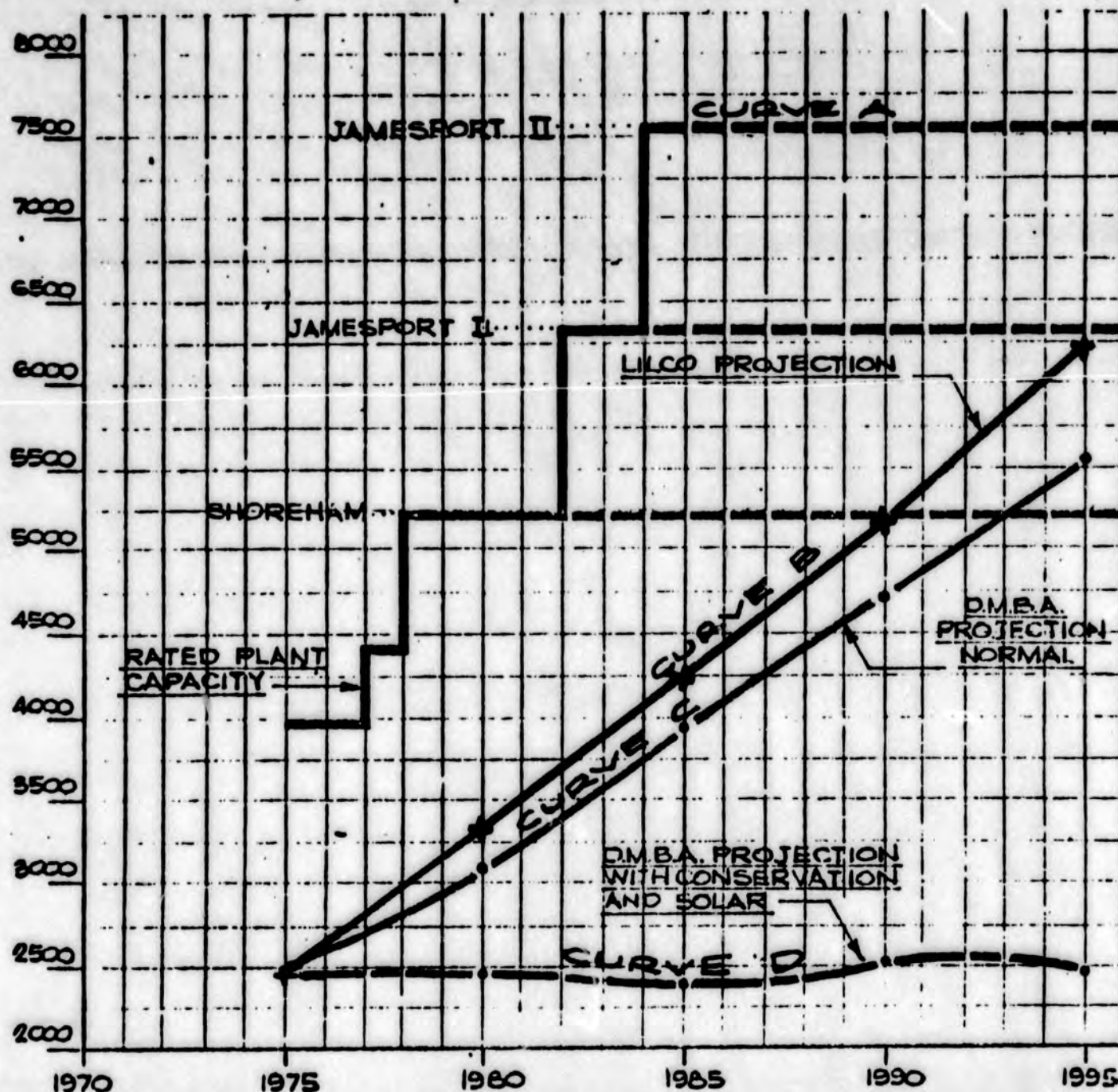
D.M.B.A. PROJECTIONS OF
SUMMER PEAK DEMAND
AND CONSERVATION PLUS
SOLAR ENERGY POTENTIAL.

PREPARED BY:

DUBIN-MINDELL-BLOOME
AND ASSOCIATES, P.C.
CONSULTING ENGINEERS
AND PLANNERS
NEW YORK, NEW YORK

MEGAWATTS - MW (10⁶)

15.



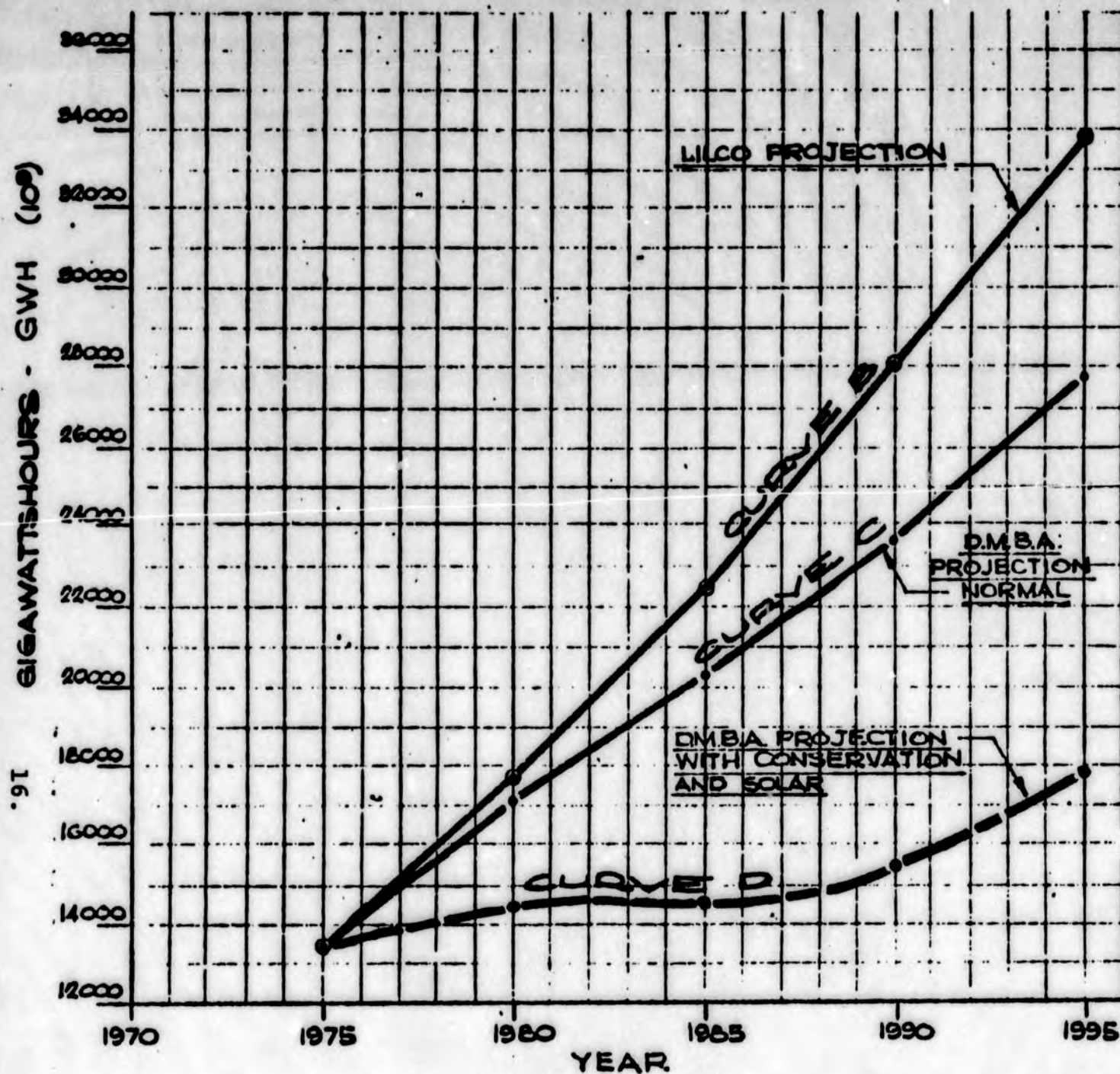
FIG

6

D.M.B.A. PROJECTIONS OF
WINTER PEAK DEMAND
AND CONSERVATION PLUS
SOLAR ENERGY POTENTIAL

PREPARED BY:

DUBIN-MINDELL-BLOOME
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AND PLANNERS
NEW YORK, NEW YORK



DMBA PROJECTIONS OF
ANNUAL ENERGY
CONSUMPTION AND
CONSERVATION PLUS
SOLAR POTENTIAL

PREPARED BY:

DUBIN-MINDELL-BLOOME
AND ASSOCIATES, P.C.
CONSULTING ENGINEERS
AND PLANNERS
NEW YORK, NEW YORK

- The measures involving building construction and mechanical and electrical system design, which are appropriate for each building type, would be implemented to the fullest extent in all new construction.
- The measures which are suitable for existing buildings, but require retrofitting, would be done progressively within ten years, except that increasing the insulation in roofs and walls of existing electric space heating buildings would be done within a twenty year period.
- All existing inefficient appliances and mechanical and air conditioning equipment would be replaced by the most efficient equipment available progressively within a fifteen year period.
- Labor and materials are available or can be imported into Long Island within the time-frame selected for implementation.

Energy conservation through operation and improved maintenance will reduce annual energy consumption to a greater extent than lowering the peak demand, although most of those practices will have an impact on both loads. There is ample evidence now from operating experiences and case history reports that electricity consumption and demand loads can be reduced from 10% to 20% by these measures alone. The actual amount varies with the conditions that prevail before implementation, and the extent and continuity of the effort exerted. Building modifications and more efficient mechanical and electrical systems and controls will result in a further reduction in peak demand (reducing the need for new power plants), and annual energy usage.

Since buildings differ from one another in configuration, materials, orientation, usage, solar heat gain control, insulation, amount and type of lighting, and very widely, in heating, air conditioning and ventilation system types, sizes, and controls, all energy conservation measures are not suitable for, nor will they exert the same impact on every building. Each building and program must be separately evaluated. Since this was obviously impossible to do within the scope of this study, assumptions were made of average existing conditions based on observations, limited surveys in Long Island, data from other areas, national records, and calculations performed previously for individual buildings and complexes. Operating records and data from a number of existing buildings, including supermarkets, residences, universities, municipal buildings, public schools, commercial buildings and industry were also obtained to confirm the order-of-magnitude of loads and typical construction details.

The calculations, based on assumptions and historical data, were made to estimate the impact, which an intensive energy conservation program would have on annual electricity consumption and peak demand.

Figures 2, 3, and 4, Curves D, indicate what the peak hour demand and annual electric energy requirements would be with an intensive energy conservation program. Since the values plotted for Curve D were based on a calculated percentage reduction of DMBA's "normal" forecast, the same percentage reduction would also apply to LILCO's projections, and the net result is that Curve D would not change very much even if LILCO's forecasts for "normal" conditions were to be used as the base. (The same percentage reduction applied to a larger value, results in a greater decrement.)

The resultant peak demand and annual energy usage with an intensive energy conservation program are tabulated below:

<u>SUMMER PEAK DEMAND (MW)</u>					
	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>Compound Growth</u>
DMBA-CONSERVATION	3,211	3,106	3,359	3,964	1.4%
<u>WINTER PEAK DEMAND (MW)</u>					
DMBA-CONSERVATION	2,578	2,678	3,058	3,412	1.9%
<u>ANNUAL ENERGY USE (GWH)</u>					
DMBA-CONSERVATION	14,662	15,152	16,627	19,882	2.1%

Details of the Intensive Energy Conservation Scenario

Group I Energy Conservation Measures - Little or No Capital Costs Required

Energy conservation begins at home (business, industry, institution). No new standards, codes, laws, studies, nor design manuals are required for the operational and maintenance measures suggested below. They are all cost effective. Many will apply to all buildings; most of them to most buildings. Consider the following which is a partial list of those which were evaluated.

1. During the heating season, set thermostats back to 68°F during occupied periods and 8° to 10° lower during unoccupied periods. In commercial and industrial buildings do not operate the cooling system during the heating season.

2. During the cooling season, maintain indoor temperatures at 78°F during occupied periods and shut off air conditioning completely during unoccupied periods.
3. In buildings that have wasteful reheat systems, operating changes can be made to reduce the impact of reheat; in those cases summer temperatures should be maintained at temperatures lower than 78°F.
4. In the winter time, do not maintain relative humidities above 20% except where needed for process or for special health care facilities. In the summer time, do not control humidity in air conditioned buildings until it reaches 60% or more.
5. Reduce the rate of ventilation in non-residential buildings to about 5 cfm per person during occupied periods and shut off ventilation completely when buildings are unoccupied. At present many buildings are operated with 15 to 100 cfm per person, and often for 24 hours per day, 7 days per week.
6. Reduce hot water temperatures to 110°F, or below, except for dish washing and sterilization. Most buildings now provide hot water at 140° or more. Also, reduce the rate of flow by careful operation, or by installation of restriction valves, low flow rate shower heads, or orifices.
7. In buildings with chilled water air conditioning systems raise the chilled water temperature from the usual settings of 42°F, 44°F to 46°F, 48°F, or even 50°F when the air conditioning load is not at peak (this can be done during most of the operating hours).
8. Reduce the level of illumination by changing lamps to lower wattage and/or to those which provide more lumens per watt and remove excess lamps and disconnect ballasts. The greatest opportunities occur in corridors, lounges, and other areas where there are no critical reading or writing tasks which extend beyond one hour's time.
9. Turn off all unnecessary lights and use natural illumination when available. Shut off exhaust fans, escalators, elevators, appliances, TV sets (unplug instant-on), vending machines and other electrical appliances when not required during occupied periods and at all times during unoccupied periods. These measures will save approximately 10% to 20% in electricity consumption and about 10% in peak electrical demand without requiring any investment.
10. Additional and more frequent maintenance such as cleaning oil burners, boilers, radiators and air filters; oiling motors; cleaning light bulbs; repairing torn insulation;

cleaning condenser and evaporator coils in air conditioning units; and repairing steam leaks and hot water leaks, provide an opportunity to save as much as 15% or more in energy consumption and can easily reduce peak electrical loads by 5%.

11. Reduce the number of elevators in service during hours when the majority of persons are not leaving or entering the building.
12. De-energize transformers supplying unused offices or other areas.
13. De-energize refrigeration chiller transformers during the heating season.
14. De-energize heating equipment transformers during the cooling season.

It is beyond the scope of this paper, and indeed beyond the scope of the full report to list, much less quantify all of the energy conservation options and opportunities in Group 1, operation and maintenance measures, listed above and in Group 2, investment opportunities through retrofit and system modifications in existing buildings and energy conservation design in new buildings. Refer to references D-1, D-2, and D-3 for a more comprehensive list of the conservation options which are available now in both groups.

Reference 2, ECM-2, includes charts, graphs, calculations, and instructions for quantifying each of the many energy conservation measures which are available now. The operating cost savings which accrue from them are also shown. Some of the energy conservation measures, and the extent to which they were considered in the study are enumerated below under the Group 2 listing. As examples of the concepts which were considered and quantified, three specific systems, i.e., domestic hot water, lighting and electric space heating are first described.

Group 2 - Energy Conservation Measures

A. Domestic Hot Water

Reduction of Annual Energy Consumption

The annual energy consumption for heating domestic or service hot water will be reduced if:

1. The generation, storage and utilization temperatures of hot water are at lower levels.

2. The quantity of water usage is reduced.
3. The thermal losses from the systems are reduced.
4. The seasonal efficiency of the hot water generation system is improved.
5. Alternative sources of energy such as solar, and wind energy, or waste heat from other processes are used in place of electricity or fossil fuels.

The first three options are common to all domestic and service hot water systems, regardless of fuel used. The fourth option is more applicable to the systems that heat hot water with gas, and particularly with oil, since electric hot water heaters have a conversion efficiency of nearly 100%.

By supplying domestic hot water at 110°F, instead of 140°F, consumption of energy can be reduced by about 20%. By reducing quantity of flow, e.g., showers, hot water taps, kitchen sinks, and other uses, there is an opportunity to save 25% to 30%. These two measures are not additive, but do result in a combined savings of about 40%. With proper insulation on hot water piping and storage tanks, more than 15% of the annual energy consumption required to heat hot water can be saved in the average installation. The aggregate of these would amount to more than 2,000 Kw saved per year in the average Long Island house using electric water heaters. Approximately 300 gallons of oil per year can be saved in houses with oil water heaters and the equivalent for gas.

Using the building's space heating boiler to heat domestic hot water, is particularly inefficient in the summer time, but with proper boiler maintenance and frequent adjustments of the oil burner, 10% to 15% additional savings in fuel are possible. A separate water heater will be a good investment.

Reduction of Peak Electric Demand

Reducing hot water temperature and quantity, and improving the thermal efficiency of the storage and distribution systems, reduces electric peak demand for these heaters in about the same proportion (slightly less), as the reduction in consumption. The demand due to electric water heating can be virtually reduced to zero at the utility peak demand hours by time-of-day metering, employing time clocks, central control or other available hardware, but does not reduce electrical consumption, whereas the other alternatives conserve energy as well as reduce peak demands.

Using waste heat from industrial processes, hot water drain lines, and hot gas heat exchangers in refrigeration units or heat pumps are additional methods of reducing energy consumption and peak demand.

B. Lighting

Reduction of Annual Energy Consumption

The consumption of electricity for lighting can be reduced by 20% to 40% in the average existing building, and by 40% to 50% in new construction as compared with current practice. Greater utilization of natural illumination to replace electric lighting, more efficient lamps, more efficient lighting fixtures, and the design and installation of systems to provide selective lighting levels with only the amount of illumination provided, as necessary and when necessary, for specific tasks and functions within buildings, are the major options available to reduce energy consumption for lighting. Most of these can be done with very little investment in existing buildings, and frequently at a savings in capital costs in new buildings.

By proper design, only 1-3/4 to 2 watts per square foot are required to provide illumination of adequate intensity and good quality in office buildings. However, most new buildings are designed for 3-1/2 to 6 watts per square foot with inadequate switching facilities to turn off unnecessary lights for portions of the day where little if any lighting is required. Providing fluorescent lighting for homes, in place of incandescent lamps will reduce the consumption of electricity for illumination by about 40%.

Reduction of Peak Electric Demand

Virtually all of the measures which reduce electricity consumption will reduce peak electric demand as well, and almost in the same proportion. Utilization of natural illumination, and switching off lights for portions of the day do not have as great an impact on reducing peak loads as they do on reducing energy consumption. Generally, peak load reduction will be 60% to 80% of the energy consumption savings--still a sizable amount. In addition, reducing power for lighting, also reduces the load on the air conditioning system, with additional savings in consumption and reduction of peak loads.

C. Electric Heat

Reduction of Annual Energy Consumption

Electric heat will comprise a greater proportion of electric energy usage and contribute a greater proportion to the LILCO peak winter demand as the saturation of electric space heating increases. The consumption of electricity for heating can be reduced to zero (except for small motors for pumps and fans), if no electric heating is used. The amount of oil saved in the electric generating plants will exceed the amount of oil required for heating the same buildings with on-site boilers. If power is generated by nuclear

energy, and fossil fuels are substituted for electric space heating, the nuclear plant capacity can be reduced and the fuel for heating the buildings can easily be supplied by the savings in fossil fuel through energy conservation of existing fossil fueled buildings: The average oil heated house in Long Island uses 1600 gallons of oil per year, and the average non-residential oil heated building uses about 1 gallon of oil per square foot. But, if the 250,000 new dwelling units predicted to be built on Long Island in the next twenty years were to be built in an energy conserving manner, with efficient oil heating systems in place of electric resistance heating, they would use about 200,000,000 gallons of oil per year for heating. If an intensive energy conservation program were undertaken, the oil consumption for the existing 760,000 residential dwelling units and the 440,000,000 sq. ft. of non-residential buildings would be vastly reduced and the savings in fuel would amount to more than 600,000,000 gallons per year--3 times as much the energy required to heat the new homes.

The most effective way to reduce consumption of electricity for electric heated buildings is to install efficient heat pumps in place of electric resistive heating. Air-to-air heat pumps are available with a coefficient of performance of 3¹ at optimum conditions--and at 2.0 or higher at the outdoor design conditions in Long Island of 10°F. The total system COP of heat pumps and supplementary electric heating could readily attain an annual COP of 2.5 resulting, in a 60% reduction of electricity consumption for space heating. There are other heat pump systems, including the use of ground water or well water as a heat source, closed loop heat pumps in commercial and industrial buildings, using excess heat from interior areas of the buildings or from the sunny side of the building, double bundle condensers used in the heat pump mode, or solar energy as a heat source. The COP of heat pumps in these codes is higher than air-to-air heat pumps--up to 5 on a seasonal basis--and the annual electricity can be reduced by 60% to 80% as compared to resistance heating.

Reducing the heat loss of the building by additional insulation, double or triple glazing or storm windows, by reduced ventilation loads and reduced infiltration rates will reduce the seasonal energy requirements for space heating by an amount equal to the reduction in heating load. Even in electric heated buildings, which are better insulated than

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1. COP is the ratio of the work performed (expressed in BTU's), to the power expended (expressed in the BTU equivalent). The COP of electric resistance heating is 3,413 BTU's per 1 Kwh of electricity. With a COP of 3, 10,239 BTU's are produced per 1 Kw (3,413 BTU's), input.

the average fossil fuel heated building, opportunities exist to retrofit existing buildings to reduce heat loss by 15%, and in new buildings by about 25%. Thermal barriers such as insulated shutters or slides alone can reduce heat loss by 12% to 15%.

Reduction of Peak Electric Demand

Any measure which reduces heat loss, will also reduce peak electric demands by about the same percentage or a little more. Although it would appear that the use of heat pumps would not materially reduce peak demand (LILCO stated that they took no credit for reduction of peak demand on the utility system peak hour, for heat pumps in place of electric resistive heating in their forecasts), in reality, analysis shows that peak demand can be reduced by 50% or more with heat pumps for the following reasons:

- a) A customer's peak electric heating demand occurs from 6 to 8 A.M. on the coldest days, whereas LILCO's system winter peak demand occurs on somewhat milder winter days and from 5 to 6 P.M.
- b) While the winter peak demand is, and will continue to be lower than the summer peak demand, given a greater saturation of electric heating, the system peak demand could eventually occur in winter, and at somewhat lower outdoor temperatures, and at earlier hours than at present. However, the coefficient of performance of good quality heat pumps at LILCO winter peak hours is greater than 2.5. Heat pumps, sized for the buildings' cooling load, will be large enough to handle more than 75% of the heat loss of the building at the LILCO system peak demand hours--thus requiring supplementary heat for only 25% of the load at that time. If electric resistance heating is used as the supplementary source of heat, the system COP in this case would be approximately 2.15, resulting in a 45% reduction in peak demand for air-to-air heat pumps. With water-to-air, or water-to-water heat pumps, the reduction in peak load will be even greater.

Heat storage systems alone, using either hot water or ceramic heaters, could reduce the electric peak heating demand to zero at LILCO's peak hours, but they will not reduce energy consumption.

The major energy conservation measures and the rate of implementation which were used to determine the impact of an intensive energy conservation program on annual electricity consumption and peak demand are detailed below. All measures which reduce the heat loss and improve the efficiency of the heating system in fossil fuel heated buildings will reduce the number of gallons of oil or cubic feet of gas required each year.

DMBA selected specific energy conservation measures which are most appropriate to each individual building type from a comprehensive list of energy conservation measures which a) DMBA previously identified, quantified, and analyzed, and b) are noted in existing studies, reports, and literature, and are representative of the work of recognized authorities. Many measures are common to all geographic areas. Where studies had been performed for other climatic zones, adjustments were made for the Long Island climate for those measures which are sensitive to climate, i.e., heat loss, heat gain, solar radiation, wind, etc.

I. For Existing Buildings

A. Modification of the Building Envelope:

Measure

Effect

It is assumed that 50% of all electrically heated dwelling units are equipped with storm sash or double glazing.

1. Provide double glazing for the remaining electrically heated dwelling units at the rate of 10% of the buildings per year.

1a. Reduces electrical consumption and peak demand for space heating by reducing heat loss and infiltration. Also reduces the cooling load slightly, thereby reducing both electrical consumption and peak demand.

It is assumed that 10% of all fossil fuel heated buildings have storm sash.

2. Provide storm sash or double glazing for the remaining 90% of dwelling units at the rate of 10% of the buildings per year.

Optionally, provide thermal barriers to insulate windows at night at a rate of 10% per year of the buildings per year.

2a. Reduces fossil fuel consumption and peak demand for fan and pump motors in the winter time (fan speed and pumps should be adjusted in accordance with lighter loads). The cooling load is also reduced slightly, thereby reducing both electrical consumption and peak demand in the summer time.

Measure

Effect

It is assumed that the roof or ceiling insulation for the average electrically heated house has an average R value of 10 and a wall R value of 7.

3. Provide insulation to raise the R value of the roof or ceiling to 20 and the R value of the wall to 10 at a rate of 5% of the buildings per year.

3a. Reduces electricity consumption and peak demands for space heating in the winter and for cooling in the summer. Wall insulation has less effect in summer than winter.

It is assumed that the average fossil fuel heated house has an average R value of 6 for roof or ceiling and walls.

4. Provide insulation to raise R value of walls and roof to an average of 20 for all fossil fuel buildings at a rate of 10% of the buildings per year.

4a. Reduces fossil fuel consumption for space heating, and electricity consumption and peak demand for fan motors and pump motors in the winter time; reduces electrical consumption and peak demand for air conditioning in the summer time.

5. It is not known how many existing buildings are built with uninsulated floors over a crawl space, therefore no credit was taken for floor insulation in the existing buildings. However, where applicable, insulation with an R value of 7 should be added to the floors over crawl spaces, or to basement walls.

5a. Same as 4a.

Measure

Effect

It is assumed that 20% of all existing buildings are equipped with weather stripping to limit infiltration to .2 cfm per linear foot of crack area, and 30% of all exterior doors are provided with weather stripping.

6. For the remaining buildings provide caulking, and weather stripping to reduce infiltration to an average rate of .2 cfm per linear foot of crack area at a rate of 10% of the buildings per year. Also, limit infiltration by reducing the amount of exhaust air for ventilation, shut fire place dampers, seal cracks in building construction, install vestibules, remove window air conditioners in winter or cover them with plastic cover.

Install door closers on exterior doors and seal elevator service shafts. Caulk openings around pipes, louvres or other openings which penetrate the building envelope. Install odor absorption devices and recirculate exhaust air rather than introducing new makeup air.

6a. Reduces heat loss for all buildings, and electricity consumption and peak demand for space heating in the electrically heated buildings. Reduces oil or gas consumption of the fan and motor horse-power for fossil fuel heated buildings. In all buildings, latent heat gain is reduced in the summer, thereby reducing electrical consumption and peak demand for air conditioning.

It is assumed that in air conditioned buildings the glazing has an average shading factor of .7 in combination with venetian blinds, awnings, shades, reflective glazing, or reflective coatings, overhangs, trees, or sunscreens.

7. Provide devices which will reduce the shading factor to .35 at the rate of 10% of the buildings per year. Also

7a. Reduces heat gain due to solar loads. Reduces electricity consumption and to an even greater extent,

Measure

provide reflective roof covering for 25% of the existing commercial space at a rate of 5% of the buildings per year.

Effect

peak demand for air conditioning.

B. Modification of Lighting:

Measure

1. For residential buildings change 80% of the incandescent lighting in dwelling units and in all non-residential buildings, except where incandescent or other lamp sources are required for special effects, to fluorescent lamps at the rate of 10% per year; provide more efficient incandescent lamps such as krypton for all incandescent lighting which must remain.

For high bay areas, provide mercury vapor and high intensity lamps in place of lamps with lower efficiency.

Effect

1a. Reduces yearly electrical energy consumption and summer and winter peak demand for lighting, and reduces consumption and peak demand for air conditioning because of lower internal heat gain.

Under normal conditions, it was assumed that an average of 3 watts per square foot was installed and operated for lighting in non-residential buildings.

2. Modify the lighting system by more efficient lamps, additional switching, more efficient fixtures, multi-level ballasts and task lighting to reduce the average lighting load to 2 watts per square foot at the rate of 10% of the buildings per year.

2a. Reduces yearly electrical energy consumption and summer and winter peak demand for lighting and during the cooling season, for air conditioning.

C. Electric Power

There is no data on specific conditions in all buildings on Long Island to provide a base for a precise analysis of the total impact of conservation measures to reduce energy consumption and peak demand for power systems within buildings. However, there are many opportunities to reduce power requirements, and an individual analysis of each building is required to identify them.

The effects on the power system, by reducing heating, cooling and lighting loads have already been discussed, and their impact has been taken into account in the analysis. In addition, the following can be accomplished to a varying degree in existing buildings to further reduce consumption and demand:

- Install manual or automatic controls to disconnect loads when they are not required.
- Install remote control manual or automatic load shedding devices to reduce the peak loads due to electric water heaters, clothes and dish washers and dryers, air conditioning units, elevators and escalators, industrial drying processes, fan and pump motors.
- Correct low power factor with capacitors or synchronous motors to reduce I^2R losses.
- Change oversized motors to improve the system power factor and motor efficiency.
- De-energize MG elevator sets, or use SCR controllers. Select more efficient elevators and control devices when replacing elevators or expanding elevator service.
- When new additions or major remodelling involving the installation of new equipment, including entrance equipment, use 480/277 volt systems instead of 120/208 where the electric service is in the vicinity of 300 KVA or more. When using 480/277 volt systems, use as much 480 and 277 volt equipment as possible.
- Reduce copper losses in the wiring by ventilating transformer banks to maintain lower temperatures.

D. Heating and Air Conditioning Equipment:

Measure

Effect

A majority of buildings with electric heating systems are also equipped with window air conditioners which will deteriorate. It is assumed that 10% of all units are replaced per year.

1. Replace the window air conditioner cooling units with heat pumps, with an EER of at least 7 (7 BTUs per watt), for units below 5,000 BTUs, and 9.0 for larger units for residential use, and 12 for commercial, institutional and industrial units.

1a. Reduces the electrical consumption due to space heating by about 60% and reduces peak demand during the winter by about 30%. Reduces the electrical consumption and peak demand in the summer for air conditioning, each, by about 33%.

The average window air conditioner now installed has an EER of 5 to 6. It is assumed that 10% of all units are replaced each year.

2. When replacing or adding new window air conditioners, provide units with an EER of 7.0 or more, for units below 5,000 BTUs, and 9 for larger ones.

2a. Reduces the electricity consumption and peak demand for air conditioning.

The same efficiency is assumed for residential central air conditioning systems and for commercial package type equipment. It is assumed that 7-1/2% of all units are replaced each year.

3. Provide all new and replacement central air conditioners with units having

3a. Reduces the electricity consumption and peak demand for air conditioning.

Measures

Effect

an EER of 9 for residential units, and an EER of 12 for non-residential air conditioning systems larger than 25 tons.

4. It is not known how many or the size of the HVAC systems that employ some type of reheat system such as terminal, reheat, dual duct, multizone systems, or induction in peak demands and consumption by modifying these systems. However, there are probably 10% or more of these systems now installed in non-residential buildings. By modifying them in accordance with the options listed in ECM-2, the consumption of electricity can be reduced by about 15% and peak demand by about 5%.

4a. Reduces the electricity consumption and peak demands for air conditioning. There will also be savings in fuel oil or gas used for reheating.

5. For HVAC and industrial systems, provide central control systems to replace manual control systems where applicable. Many central control systems have been installed in new and existing buildings, and the payback periods have been from one to ten years, depending upon the complexity of the system.

5a. Reduces annual electricity consumption and peak demand (both summer and winter).

E. Industrial Process

It is assumed that the efficiency of industrial processes have been increased

Measure

by about 5% on an average, since 1973. In reality, there is a potential of 15% to 30% improvement.

1. Provide heat recovery equipment for exhaust air systems, hot water drains, and heat processes.

Provide more efficient equipment for electric drive, electric furnaces, air compressors, etc.

Effect

1a. Reduces electricity consumption and peak demand for air conditioning, and processes. Will result in reduction in fossil fuel used for heating.

II. For New Buildings

It is assumed that all new buildings will be operated and maintained in the energy conservation mode as note in ECM-1 and summarized in "I" above for "Existing Buildings," and that they will be constructed and equipped in accordance with energy conservation opportunities and options detailed in Energy Conservation Measure 2, and "Energy Conservation Design Guidelines for New Office Buildings," prepared by Dubin-Mindell-Bloome Associates, P.C., the AIA Research Corporation and Heery and Heery, Architects, for the General Services Administration. A partial list of the energy conservation measures are listed below. Where the effects of each measure are similar to the equivalent measures for existing buildings, the effects are not repeated.

A. Building Envelope and Plan

1. Design to optimize energy conservation by reducing heat loss and heat gain through proper orientation, configuration, window size and location, double glazing and weather stripping, thermal mass, exterior colors, insulation type and thickness and location, and selective facade treatment to take maximum advantage of solar heat gain in the winter, maximum wind shielding, and reduced solar heat gain in summer, as follows:

- Window U factor, .55
- Thermal barriers over windows at night, U factor, .1
- Infiltration rate, .15 cfm/linear foot of crack
- Wall U factor, .06

- Combined wall-window U factor, .17
- Roof and ceiling U factor, .05
- Edge insulation, 2" foam board
- Vestibules or revolving doors
- Wall mass for commercial and industrial buildings, 80 p.s.f.
- Shade factor, summer, .15
- Shade factor, winter, .6
- Maximum utilization of space

A combination of these conservation measures will conserve about 35% of the annual energy usage for heating, and about 25% of the annual electricity consumption and peak demand for air conditioning (somewhat less in large buildings with high internal heat gain).

In electrically heated buildings, the peak electric demand for heating will be reduced by about 25%.

2. Provide landscape planning in office buildings in place of more numerous smaller rooms in order to reduce the power for illumination. Walls absorb energy as well as reflect it. In the study for G.S.A., landscape planning was shown to reduce the power required for illumination by 25%. Electricity consumption will also be reduced by about the same amount.

3. The reduction in energy consumption for heating and cooling due to increased saturation of apartments in accordance with Suffolk-Nassau County master plan was taken into account in assuming the "normal" case. If a greater percentage of the new dwelling units are high density multi-housing units, additional peak load reduction and savings in energy consumption would be accomplished. For instance, the heating and cooling loads for a two story house are approximately 20% less than a single family house; a four dwelling unit garden apartment, about 30% less than a single family house; forty dwelling unit apartment house about 45% less, and larger apartments even lower.

B. Lighting

1. Use fluorescent lighting for 90% of the lighting requirements for each dwelling unit, with a maximum connected load of one watt per square foot.