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ENERGIZING URBAN ECOSYSTEMS IN THE PHILIPPINES: MANILA

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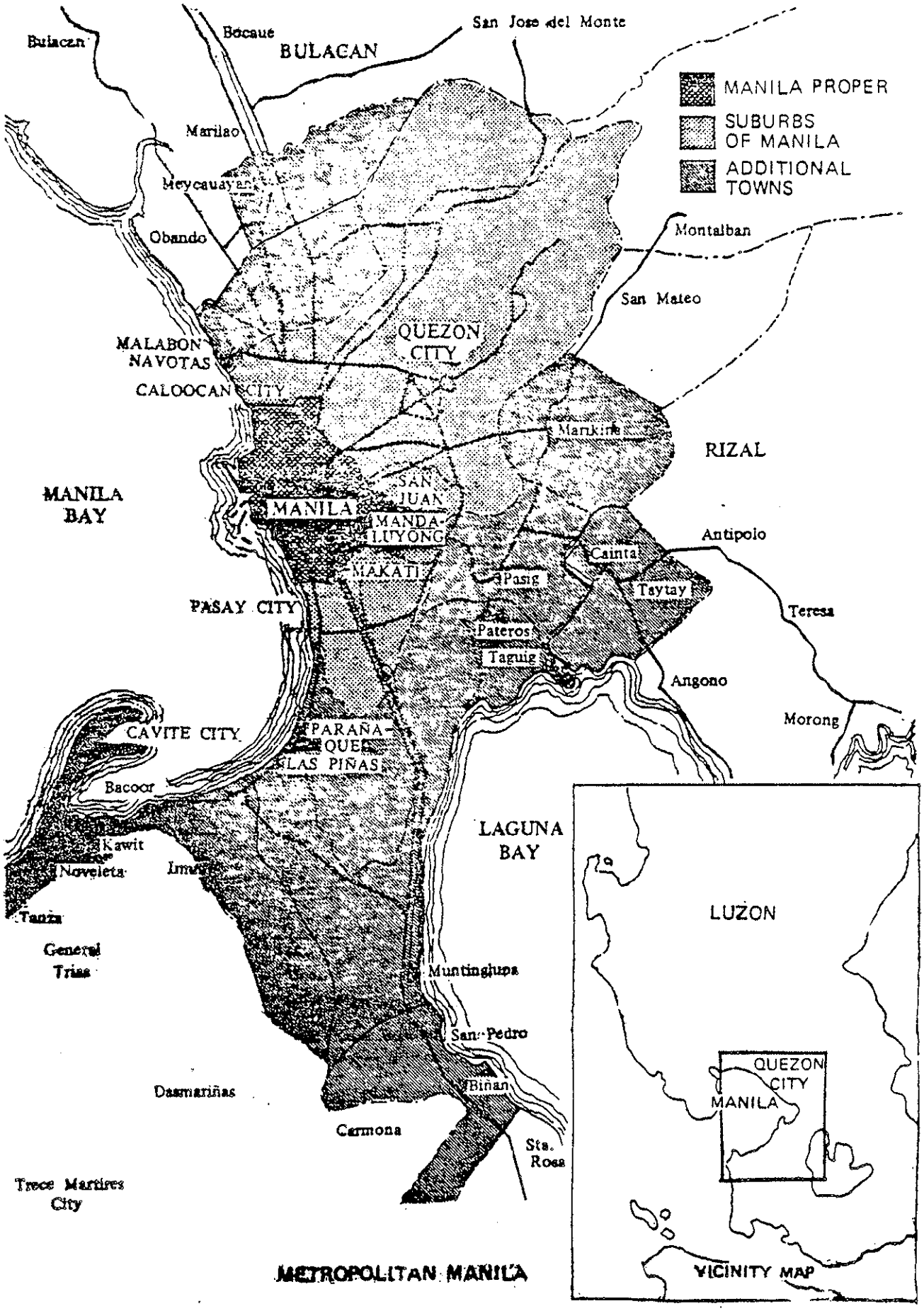
MANILA PROPER
SUBURBS OF MANILA
ADDITIONAL TOWNS
Bulacan
Bocaue
BULACAN
San Jose del Monte
Marilao
Meycauayan
Obando
Montalban
San Mateo
QUEZON CITY
MALABON
NAVOTAS
CALOOCAN CITY
Marikina
RIZAL
MANILA BAY
SAN JUAN
MANILA
MANDALUYONG
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Pasig
Taytay
PASAY CITY
Teresa
Pateros
Taguig
Angono
Morong
CAVITE CITY
PARAÑAQUE
LAS PIÑAS
Bacoor
LAGUNA BAY
Kawit
Noveleta
Imus
Tanza
General Trias
Muntinlupa
San Pedro
Binan
Dasmariñas
Carmona
Sta. Rosa
Trece Martires City
METROPOLITAN MANILA
LUZON
QUEZON CITY
MANILA
VICINITY MAP

ENERGIZING URBAN ECOSYSTEMS IN THE PHILIPPINES: MANILA

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Introduction

An urban ecosystem is a human community that has grown large and complex. It is made up of populations of actors, together with a variety of more passive transformers (which expedite the action and make possible the recycling of matter). It is also firmly attached to a site which for some reason or other has been favored over others. In theory, the structure of a community is most simply described as made up of *positions* (sociologists, when analyzing their slice of community, call them *roles,* while geographers refer to *places)* and *relations,* which are the bonds of interdependence that link up individuals, groups, and organized substructures occupying these positions.

(This language sounds a bit out of the ordinary because ecological terms and references have not penetrated common usage to the extent that economics and sociology have. Wherever ordinary English and ecological language share terms I shall use them to construct a sentence which has precision for the scientists but is generally understandable to others, while elsewhere the argument will be conducted in standard English that should be translatable into scientific propositions with as little ambiguity as possible. Policy can then be discussed in words that clearly relate to observed phenomena and inferred relationships.)

A contemporary city has a propensity for survival far beyond normal expectations because, in an environment with aggressors, predators, and many natural hazards, it has survived for more than a century (in almost all cases), primarily through the use of its collective wits. Each city is confident it can last through many more fluctuations in world conditions.

Kenneth Boulding, in his *Ecodynamics* (1978), concludes that the fundamental categories for transfer in an ecosystem are Energy, Information, and Matter. Anything that is produced in a city requires at least a little bit of all three, while the urban community itself requires a large amount of each. Thus cities come into being because modest settlements on that site had superior access to raw material, could make available useful forms of energy, and were able to acquire critical information. Growth was experienced because people were attracted to it from a less well-endowed countryside. In recent years the process has been accelerated by access to cheap fossil fuels, but conditions are now changing very rapidly. Although many surplus people from the countryside remain to be absorbed, world scale consumption of fossil fuels is reaching a peak, very likely in the late 1990s, and from then on can only decline. How will the extra people be supported?

Can cities provide for people's needs by recombining matter and information with a much smaller amount of energy? If they have suitable options, and there is much evidence that they do (although such reports are rarely found in the news media), what restructuring of the community is associated with the responses to diminished supply? Is the surplus rural population accustomed to the Philippine way of life more easily accommodated in centers smaller than Manila?

Boulding's redefinition of basic inputs to production offers us a new kind of logic for analysis of alternatives. The issue is whether matter or information can substitute for energy when it becomes scarce. The best source of information is the *Annual Review of Energy,* which reviews hundreds of approaches to substitution. Small cities use wood, paper, cloth, asphalt,

aluminum, glass, synthetic fibers, and concrete, but on a surface or volume basis the energy account shows no significant differences in building up an urban ecostructure. Although less energy is expended in congestion in smaller cities, this is counterbalanced by the need to fly out to other centers in order to manage the pacemaking adaptations and obtain access to crucial information about energy conservation. Small cities like Batangas will not possess much indigenous information on energy conservation, just as the local materials seldom conserve energy.

It is readily apparent that small cities are at a strong disadvantage with respect to information about new options. If a small urban center has universities, telecommunications centers, government offices, computing services, communications satellite stations, and consultants, it is not likely to stay small long. Manila has all of these, often in several forms; therefore Boulding would suggest that Manila should adapt more rapidly to shifting conditions than smaller cities. To maintain a competitive quality of life the lesser city must be almost equally an *energy sink.* The final issue, covered less well by Boulding, is that of resilience, or survival in the face of shock or stress. Large settlements are able to mobilize resources to prevent, or patch up, injuries more quickly than smaller urban communities, although the magnitude of the initial loss may be greater.

As a means of dealing with such questions, a model familiar to all the sciences will be introduced:

input / process / output

where the processing is guided by internal structure. We shall be satisfied for the moment with this input-output structure (see Figure 1), except where the fine structure makes a crucial difference with respect to energy conservation. The metropolitan vulnerability due to shortages should be deducible from these considerations, especially if one also pays attention to the manner in which all relevant kinds of information are drawn upon in the decision-making processes that control the urban ecosystem.

I. General Impressions of Manila: August 1979

Early impressions create a set of expectations. They direct the beginnings of on-the-spot inquiry. They are available only to visitors, or to natives who have been away for a long time, since they are based almost entirely upon comparisons.

According to the analysis of tourism statistics, almost a million visitors were expected from outside the country in 1979, virtually all of whom see Metro-Manila. After discounting the Japanese tour groups, they are mostly individual Americans, more than half of Philippine origin, along with Chinese (perhaps likewise) and Australians. After these origins the sources fall off to very tiny fractions. (These statistics were assembled by the national tourist agency and released to the press in August 1979, appearing in the *Business News* and elsewhere. The optimistic projection was dashed by failed negotiations in airline network expansion which occurred shortly thereafter.) The opinions of overseas tourists regarding energy use in the Metropolis will be quite homogeneous as compared to the uncounted number of visitors from the countryside. These Filipino visitors are believed to be two or three times as numerous.

A foreigner, upon arriving in Manila, will see "a little bit of America" in Asia. Many of the physical forms and institutions have been borrowed with only minor modifications. The traffic is the way it was in America twenty years ago—highly congested while trying to move along four-to-six-lane boulevards, avenues, and toll roads. Hotels are fitted out with air conditioners designed for Florida and Puerto Rico; they provide uncompromisingly hot water, toilets that flush liberally even on the top floors, lights that allow one to read if he wishes, and plentiful taxis (at rates about thirty to fifty percent of those in America). Office buildings used by the various multinational firms (some of them with Philippine origins, as with San Miguel beer and beverages) parallel the forms popular in the American Southwest. Shopping-center design, and many of the products featured in the shops, seem to follow those see in America, but with about a decade's lag. But a more modest use of light is evident in Manila than in, say, Los

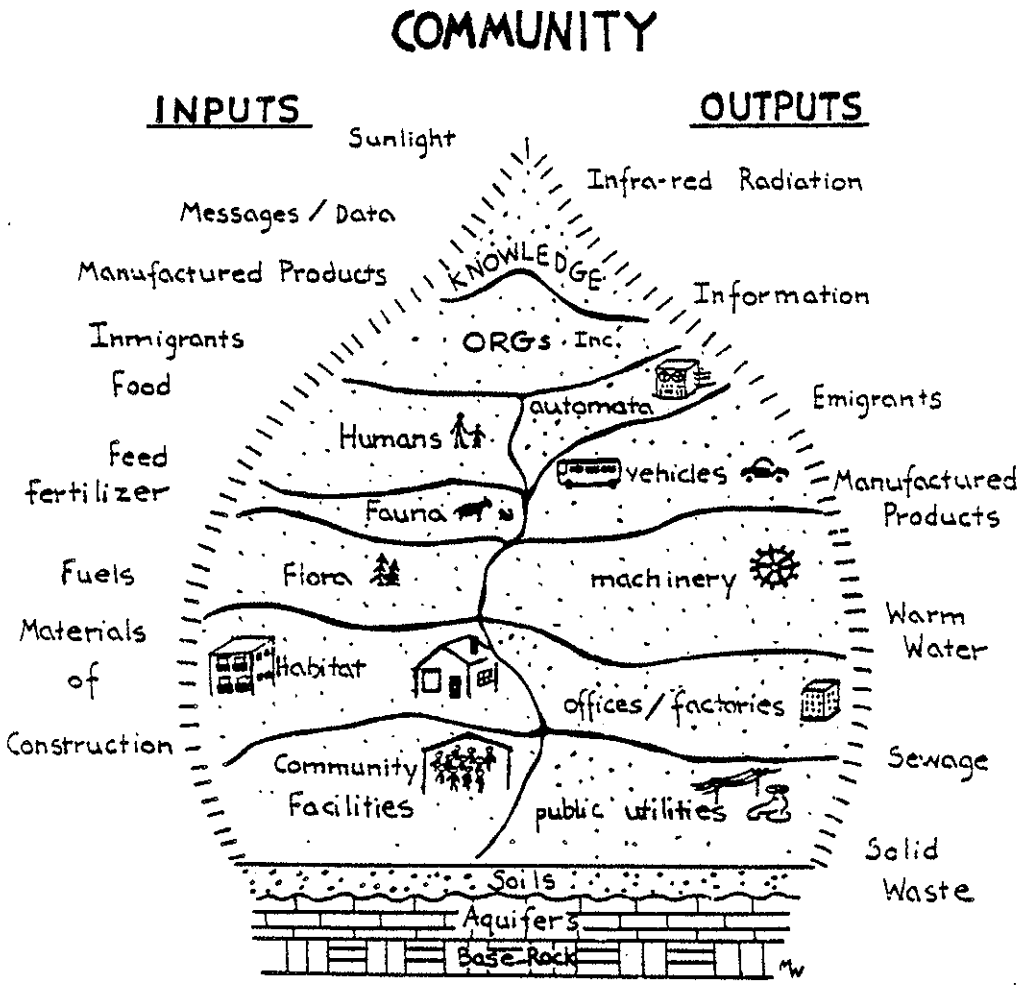

Figure 1. The urban ecosystem as energy converter

Angeles. Thus one expects that most American forms of conspicuous consumption of energy will carry over into the Philippine metropolis.

Transport equipment, however, is markedly different. Oversize American vehicles can occasionally be seen, but they have been banned from the highways on weekends by Government edict, so station wagons and full-sized sedans have been almost completely replaced by smaller, lighter cars, with Toyota models beating out the competitors. Within the population of vehicles as a whole one sees an unusual breed refered to as AUV (Asian Utility Vehicle); they were designed to meet the local needs for easy repair and maintenance. Many provide a jitney service, and so are known as "jeepneys." Curiously, the newer vehicular types remain undecorated, appearing quite spartan, while the original *jeepney* is overlaid with imagery, and has become as much the trademark of Manila as the cable car is of San Francisco. But most of the people are moved through the city in buses, the majority of which are quite ancient. As they die off, the family enterprise seems to disappear as well, since they are now displaced by more serviceable Metro-Manila city buses.

Manila newspapers are filled with many complaints about traffic delays and the quality of service, while on the other hand the experts say that the great variety of buses and the number of independent operators unduly multiply the maintenance problems and breakdowns. It is intended that the new transit authority will bring order out of threatened chaos and introduce economies of scale as well.

In odd, unexpected places the motorized tricycle, complete with sunshades and rain curtains, will be found carrying women, babies, and old men on their neighborhood rounds, besides taking children to private schools and delivering parcels. The low fuel requirements of the trishaw per trip may give it a new lease on life in the future.

A sophisticated observer of traffic in Manila can arrive at an estimate of the passenger-miles produced during the normal life of a vehicle. It is expected to run three or four times the average in America because the labor cost of repairs is small. The standards for traffic control suggest that the money value of human time wasted while using urban transport appears to average no more than ten percent of what it is in the West.

Few visible evidences of economies in energy use were noted in Manila's public facilities—even though a major price rise (thirty to forty percent) had been instituted about three weeks earlier. High-status Government offices are still as heavily air-conditioned as banks and computer centers (which have more justification, since both human and computer errors are reduced in frequency), and lower-status employees often open doors to let the cool air spill out onto the hot pavements. Power cuts occur almost daily in the lower-priority zones of the city, but key facilities, such as elevators and Xerox machines, are backed up with portable generating equipment producing emergency power supplies. Foreigners will note that factories and some hotels belch black smoke, giving evidence that the boilers are inefficient, and must be wasting considerable quantities of fuel oil.

Most of the Filipinos arriving by air are expected to see Manila in a similar light. They belong to a "working elite" which has been fortunate enough to get to America, Australia, or Europe, and are therefore able to make global comparisons. They see Manila as having made "progress" by installing facilities and equipment that spend energy liberally, and congratulate their relatives if they live in a community which has reached that level of affluence. The bulk of the Filipinos who visit Manila, however, arrive via boat and bus from the provinces. For the most part they have come to visit relatives and friends, but many also intend to make purchases for gifts, and sometimes they must shop for spare parts or supplies for enterprises back home. Almost all of these provincials are deeply committed to their families, but many are involved in sports activities, or religion, so the topic of energy is a theoretical concern for them that is best left to the appropriate Ministry, and certainly not anything they worry about until they are forced to search for gasoline after the regional supplies have experienced a "run-out."

Quite a few of these bus-and-boat Filipino visitors arrive in the city hoping that they can find some kind of employment that will allow them to stay on. More than half of them are

already familiar with *elektrisidad,* because the National Electrification Administration has supplied it off-and-on to the provincial towns and settlements in the most developed valleys. They have come to know the convenience of kerosene for cooking and lighting, and more recently how to use LPG for the same tasks. They will also recognize the usefulness of LPG wherever energy is needed, particularly for heavy field work and for pumps. The ways in which the *barangays* of Manila use fuels will appear to them very much the same as those in the provincial towns. In both locales quite a few households remain unconnected to the power lines, in order to avoid the monthly bills or because they have illegal tenure. The difference is that in Manila astonishing amounts of energy-using equipment are to be seen, and much more of it in working order.

Energy supply and energy news are talked about in all the media almost every day. Nevertheless, exceedingly little discussion of the implications of the recent price rise is heard. Perhaps this is because the change is so recent that there has not yet been time for the first electric bills to arrive. The penalties to be imposed upon the householder consuming more than 500-600 kWh per month—in other words, those who live like Americans—remain to be implemented. Quite a different impression is expected in October when the first major bites into the paycheck are felt. Some people may then realize that they cannot go on in the way to which they have become accustomed.

The impressions of an urbanist spending two weeks returning to Manila are based largely upon systematic observation and upon interactions with the professional classes. He would rediscover a four-stratum city, socioeconomically speaking, with each stratum obtaining its share of the core, the city proper, and the peripheral areas. Due to occasional overlap and a few contested territories, a fair amount of disorder is generated and tolerated by the citizens: a situation likely to continue for some time. People from the top stratum, who behave like the "big rich" and "beautiful people" of the old days, probably number less than 100,000, including their traditionally large families. Below them an advanced professional and business class, serving the private sector more frequently than government, focuses upon Makati, which is a suburban community that has become Manila's management and finance center. This stratum, including somewhat smaller families, adds up to about a million people. Below them is a struggling clerical, white-collar, technician, shopkeeper, artisan, skilled factory-worker class containing about four million people. At the bottom are about three million who make something close to the minimum wage ($3 per day) or less. The per-capita income for Manila as a whole is estimated at a little over $1,000 per year.

The energy shortage affects the upper class by cramping its predominant life style, which is based upon conspicuous consumption. The upper-middle is also squeezed, although for them work is more important than socializing. The lower-middle groups will feel the impact upon their jobs, because some energy-intensive service employment will disappear altogether, and feelings of insecurity will be exacerbated, since new jobs requiring their skills are unlikely to appear elsewhere in the city. The poor will be buffeted again far beyond their control or understanding. Cooking fuel may sometimes disappear, lights wink out, and buses not appear.

This review of general impressions of Manila as experienced by various kinds of people is provided at the beginning because a new analysis must compete with them. Anyone who has been to Manila will use his own impressions to assess the trustworthiness of another report on its future prospects. The boat-and-bus visitors to Manila are unlikely to be consulted about the reliability of an analysis, but their attitudes and behavior must be taken into account in any overview that attempts to be comprehensive. Indeed, if many of Manila's factories and some portion of its shops are ever shut down for lack of energy, it is expected that the bus-and-boat visitors may be asked to reciprocate hospitality. In the towns and villages of the provinces they are the most likely hosts for the "energy refugees" from the lower-income stratum of Manila. Kinship and friendship ties take the place of opinions in their case.

II. The Ecosystem of Metro-Manila

"'Urban ecosystem' is a term that does not really apply to Manila," argues Dr. Celso Roque, director of the Philippine National Environmental Protection Council, "because *system* has not come to Manila. Integration is a long way off."

That is a statement that gains hearty agreement from visitors and residents alike. The harmony observed when a broad spectrum of activities relate to each other, which one expects to see in a well-ordered ecosystem, is yet to be found. Therefore precise measures of the structure of the community are meaningless: rough approximations are sufficient for making the inferences likely to be valid. This lack of unambiguous representation shows up as soon as an attempt is made to define the entity itself, distinguishing what is *not* Manila from what is certainly part of it. The procedure followed here is the same as for the better-characterized metropolises: we shall start with an identification of the geographic boundary, and continue with a quantitative description of the populations and infrastructure contained within it. Then, proceeding counterclockwise in Figure 1, the quantity of the inputs together with an estimate of their energy content will be reported. Efforts will then be made to trace the outputs from the community and their impact upon the environment, before undertaking the analysis of vulnerability and energy-saving opportunities. Some parts of the ecostructure do not appear to be closely linked to the energy economy or to its resilience to energy shocks, but one does not know this until the field work reports a lack of connections.

1. **Boundary.** The limits of Metro-Manila are defined in a number of ways which differ markedly in the area covered. Metro-Manila is an administrative unit that deals primarily in traffic management and water/sanitation issues. The Mayoress, Imelda Romualdez Marcos, is primarily concerned with those two sources of headaches. Her staff claims that they serve a territory comprising "three provinces and eight communities" for such activities. But the roads, drains, and aqueducts are being extended monthly, thus embracing new communities. The map shows a common version for the bounding of Metro-Manila for the mid-1970s. A more restricted territory applied to fuel distribution in 1978.

The Census Region IV is often used to represent Metro-Manila, but it was chosen originally as much for linguistic reasons (Southern Tagalog speakers) as for physical geography or economic influence. The electrical power grid is even larger than Region IV, but the telephone system ranges over a smaller area. Foreign trade pulls a part of Manila out to the rocky, windy fringes of Manila Bay, because of the recent establishment of the Export Processing Zone and the toll roads running north and south more than 50 km. They are attracting the new industries.

Large military reservations at one time acted as a physical barrier at the eastern and southern edges of the metropolis, serving very much like a greenbelt (but better defended against squatters!). But Metro-Manila has now leaped over it and, according to present plans, also expects to envelop large areas in the hills to the north and northeast.

Manila will soon become the core of a South Central Luzon Urban Region, with more than 40,000 km^2 area, some of it currently under water. The pressures of urbanization are sufficient to produce a conurbation as large as Tokyo, but no one wishes to face that future administratively, so the programmed expansions are considered the figment of the imagination of those aggressive young planners in the new Ministry of Human Settlements who distribute maps indicating the directions for future growth. Outsiders who become familiar with the rates of change are inclined to agree with the dimensions of future growth, even if they do not accept the proposals for accomplishing it.

2. **Population.** The young technocrats were able to persuade the Government that an Interim Census, taken along modern scientific lines, was needed. So a full count of the population in the nation was undertaken; using this enumeration as a sampling base, several sample surveys followed. With the aid of computers, the results were reported quite promptly in most cases. One very common definition of Metro-Manila's boundaries can be projected backwards to the Census, and an estimating procedure carried forward (Table 1).

Table 1
Population (1975)

Political Unit	*Population*
Rizal Province	3.95 million
Manila Province	1.53 million
Quezon Province	1.16 million
Eight communities	0.40 million
Total	7.04 million

Estimated growth rate 1975-1980, 4-6% per year.

Therefore the extrapolation to 1980, taking into account a few small communities that were captured during 1975-1980 in the process of circumferential growth, leads to the following estimate:

Population (1980): 8.5-9.0 million

3. **Fauna.** Domesticated animals are quite scarce in Manila, except for pigs. It appears that more meals feature homegrown pork than fish or chicken. The rich have horses for riding, and guard dogs to defend the house. Dairy establishments are rare, since reconstituted milk (coconut flavor) dominates the supermarkets. The principal livestock species, in terms of population size, is *bangus* (milkfish), grown in brackish ponds along the shoreline.

Wild animals, except for a few birds, have been extinct for some time. More concentrated observation reveals some small lizards, and perhaps a larger number of cockroaches that hide in the shadows. Legislation protecting endangered species, therefore, does not seem likely to affect Manila.

4. **Flora.** About twenty to twenty-five percent of the Metro-Manila settlement area is shaded by trees (according to a visual assessment of the air photos), which appear to be mostly planted (rather than regrowth). A very large share of the land is awaiting speculative development, so it remains in weeds. Very few productive gardens are seen in August. In the peripheral ponds large amounts of algae are growing; there are green, red, blue-green, and brown varieties. Most of them blend into the estuarine soil, but the remainder are grazed upon by the fish. The blue-green algae fix nitrogen, and so contribute to the fertility of the zone with relatively fresh water; all species capture pollutants and convert them into plankton food.

5. **Habitat.** Approximately 1.6-1.8 million households are expected to exist in Metro-Manila in 1980. The perennial shortage of housing keeps the number of persons per household high (4.9 to 5.5 per unit), and probably deters immigration to some extent.

Streets are laid out largely in a rectangular or concentric grid, except for the "villages" of Makati and their most recent competitors in the tracts at the edge. Circulation space in the form of streets is at the American scale; it makes up about twenty percent of the area. A city street where the road work contractor went bankrupt is free land, however, and is immediately filled with squatters. On the other hand, the older squatter settlements of Manila have had broad concrete streets cleared through them. The principal reason is reported to have been not the need for local transportation, but to serve as a fire break and a means of access for the fire trucks. The construction of these roads accounts for the removal of a sizable share of the in-town squatters to settlements prepared in the periphery, but the government is now moving in to take over land for other purposes as well. Access to work from the edge of the metropolis becomes so difficult that many households will maintain a place in a hut decent enough to hold off the rain that is located somewhere close to the job, with the worker making frequent connubial visits to homesteads in the workers' suburbs.

The main arteries are literally beginning to bloom. Metro-Manila aides are gradually clearing away the weeds and the automotive litter, replacing them with hedges, and sometimes grass with flowers, in the ribbons of land used for lane separators. Already they look vastly different from two years ago, when debris collected in dirt ruts, and dust swirled as each bus wheeled by.

A threat remains that has been brought on by the fuel shortage: diesel exhaust lays down a ghastly grey-blue pall which cannot be filtered out even by an air conditioner. Livability of the habitat is significantly reduced each day by the end of the rush period, while Saturday shows noticeable improvement and Sunday is very fine except in the vicinity of a few bottleneck intersections.

Otherwise the housing and the neighborhood elements of the habitat reflect very faithfully the relative power of the four strata of urban residents described earlier. Indeed, levels of maintenance and the images displayed in the habitat remain the strongest single indicator of social class.

6. Community Facilities. Schools have now been opened to virtually all children up to ten years of age, and the enrollment is virtually one hundred percent in the lower grades. A large fraction of the teenagers are going on to high school, and (for a developing metropolis) an astonishing number of them eventually complete work for bachelors' degrees in the many private colleges and universities occupying key sites in the metropolis. In addition, the American High School, originally established to meet the needs of families of American military personnel and expatriates, has now enrolled about half Filipinos and many expatriates other than Americans who help maintain academic performance standards equal to those of a top-rank suburban American high school.

Churches are virtually all Catholic. About two percent of the residents belong to standard Protestant denominations and another two percent (heavily concentrated in suburban Quezon) are committed to La Iglesia de Christo, a fundamentalist movement that arrived somewhat later.

Because open space is vulnerable to squatters, only defensible areas are developed into parks. One is the *Intramuros* and its outliers, which were walled Spanish forts. Another is the waterfront, unfortunately under construction and engaged in land reclamation for years to come, with only the Cultural Center and the Convention Center kept green and pleasant. The elite have their Yacht Club, and several country clubs.

The central areas lost their dominance after the War, due to a combination of destruction and congestion. This allowed Cubao to develop as a shopping center for people largely arriving by bus, and Makati/Magellanes for people arriving by personal car or taxi. The distinctive institution of Manila, and of the Philippines in general, is the *sari-sari* store, a general-purpose neighborhood shop run by the women and girls in a family. They seldom close.

7. **Public Utilities.** The key utility in the city is potable water. In contradistinction to many rapidly growing tropical metropolises, the water delivered from the grid is almost always potable, but the pressure may be low (to prevent the loss of too much from leaky mains). Until now the system has been embarrassed by inability to meet demand during the short, sharp droughts that recur every several years in the humid tropics. The present capacity is 330×10^6 gallons per day (1.1×10^6 Te/day), with a seventy-three-percent addition due to be provided in 1980, and more in 1982. The Metro-Manila Waterworks and Sewage System would serve about seven million in 1980. A few smaller places remain separate.

Sanitation is graduated according to tolerance for smells. The moneyed classes demand, and usually obtain, sweet-smelling sewers, the middle class get facilities that maintain public health but cause inconvenience occasionally, and the poor get what's left. Most of their facilities drain into slow-moving streams or sewers that flow into Manila Bay untreated. All of this is against the law, but there are no capital funds available to assemble all of the treatment facilities which the situation would suggest. The unplanned settlements will always generate sewage and litter in places unexpected by urban management.

The squatting on land valued for public purposes is now diminishing. An impatient Government prepares some areas in the periphery with surveyed plots of land, communal water supply, and a presumed bus service. The people get a tiny grant to help them reestablish their households. Notices to move are followed by trucks to carry the people and their belongings. The bulldozer arrives simultaneously. Police vigilance prevents resettlement while the land is prepared for the construction crew. The slums around the city dumps, which support thousands engaged in salvage, never receive notice of removal, because the metropolis is dependent upon their efforts—as are thousands of pigs and many more thousands of chickens.

The power grid is also built up along American lines. The new supply coming in is principally hydropower, but some will be coal and the geothermal units are now being added at a steady rate. All through 1979-1980 the generators and the distributors are being improved so that less diesel fuel is consumed in the backup generators owned by all office buildings and factories, and some apartment buildings and homes.

Electric power demand in the Philippines is rising some twelve percent per year; this signifies primarily the pressure of frustrated users already tied onto the grid. A very aggressive rural electrification program, however, has been encouraged by the Government, so more frustrated users are being created. Manila shares its grid with the rural population north and south on the whole island of Luzon.

8. Offices and Industry. The offices of Manila are more impressive than the factories. They are modern and as well maintained as any in the Orient. In large part the abrupt transition from colonial-style buildings based upon ceiling fans and natural ventilation, avoiding any elevator but a freight lift, such as may still be found in half the University today, was due to the destruction of the War. Philippine firms moved out of temporary quarters in the 1950s and 1960s into spanking new buildings clustered in Makati, while the Government built up the waterfront and Quezon City, the new capital area ten to fifteen kilometers inland on well-drained ground. In the 1970s the Government was willing to rent space in Makati on the low-rise fringe, away from the "Miracle Mile" created in imitation of Los Angeles.

Also in the 1970s the multinational firms started arriving, some in the form of chain hotels. Previously there had been a few in sugar, mining, copra, wood, and similar traditional activities, but then the overseas banks, IBM, General Motors, and their ilk appeared on the scene. Building is still very brisk, because office space is short.

The office facilities may very well be the basis for Manila's ability to compete on the world scene. The prevalence of the English language in the services means that it has greater depth and diversity than Bangkok or Hong Kong; this makes up for lesser diligence and unwillingness to work overtime.

The factories are at best standard, and often makeshift. Their product ranges from beer to bricks and from pipe to plastic, producing the materials that make and maintain a metropolis, substituting for imports. They grow as the market develops and the licences are lobbied.

The garment industry is largely invisible. It has crept out of the households themselves, where one or two treadle-type sewing machines would be working, to old buildings, abandoned stores, and the like. Its rhythms depend upon the seasons in New York and Los Angeles, and its cycles follow American fads. At the moment parts of the industry are heavily penalized because they exceeded American quotas (the regulatory group was unable to control a chaotic industry in order to meet the criteria set by the U.S. to deal with paranoia in its "rag trade").

The boom industry is sophisticated electronics—engraving microcircuits on silicon chips—but it has not made itself physically significant, nor does it consume much energy per unit of output. With about 30,000 jobs in 1980, and growing ten to thirty percent per year, it may displace most of the export garment production. It uses many workers who might otherwise be sewing fine stitches. They will take over a loft, or an old warehouse, install better lighting, dust and lint control, air conditioning, and microscopes with micromanipulators instead of the sewing gear. If the industry is to become well-established, as in Singapore, Taiwan, and

Hong Kong, the firms may need 3,000 or more specialist women, three shifts a day, with low rates of turnover, at a minimum. But entrepreneurs in integrated circuits are fickle. At the moment Colombo, Sri Lanka, is beckoning, and Bangkok claims it has eliminated its service bottlenecks. In 1981-1982 the Chinese will be opening up Shenchen, across the border from Hong Kong. Manila will have to bestir itself to hold on to these promising potentials.

9. Machines. The stationary machines are the same as those in America, except for the frequency of backup generators in Manila, but they are found in numbers appropriate for about half a million Americans living in suburban houses and apartments.

High-prestige firms are a minority likely to possess modern energy-intensive machinery in their factories (and the mines and plantations in the provinces), along with up-to-date equipment in the home offices. These organizations all have strong international connections. The majority, however, are improvised, with old machines that require hard work and close attention from employees partially replaced by modern semi-automatic units.

10. Vehicles. Reports obtained from the Philippine Automobile Association for calendar year 1978 provides us with the number of vehicles in a region very nearly approximating Metro-Manila. Surprisingly, the vehicles per thousand human population in Batangas is roughly equal to that in Metro-Manila, or perhaps somewhat higher.

	Private Cars/Jeeps	*Total Vehicles*
Philippines	456,000	1,121,000
Region IV	279,000	474,000
Batangas City	—	7,660

New cars were selling slowly in the latter part of 1979. Five manufacturers are competing for an average of about 70,000 vehicles per year. The larger private passenger vehicles are disappearing from the roads very rapidly and will soon become collectors' items.

Vehicle Population (1980): 450,000
(60% passenger cars)

11. Automata. These are the routine control systems which can be programmed to achieve most of the eventual energy economies. The growth rate of automata determines the capacity to apply new knowledge to the local scene. The greatest need encountered for computerized feedback systems in the Philippine Islands has been experienced by the Luzon electrical grid in its efforts to cope with demand and a multiplicity of new generators. Therefore MERALCO (Manila Electric) could justify going to IBM for the largest computer facility. Since it needs this capacity for very short periods, it can sell the redundant time on the computer to other organizations.

Not far behind is the Technology Resources Center of the Ministry of Human Settlement, operating a UNIVAC plus PDP-11s, while the third is a Japanese Facom system used mainly by businesses. By 1980 the largest of all will be the new IBM system (fourth generation) at the International Rice Research Institute in Los Banos. The current estimate of the number of computers dedicated to special purposes (mostly PDP types) is 130 as of August 1979. All this suggests:

Automata (1980): approximately 300

The National Computer Center in Quezon City has been assigned the task of modernizing government enterprises and carrying on in-house training. Training programs are also carried

out by the various multinational computer firms and are very well attended. Therefore the supply of programmers is quite good as compared to Seoul. A few Filipino programmers are exported to the United States, but many more have recently gone to Australia.

The Technology Resources Center was asked by President Marcos to take the lead in organizing an interdepartmental task force to assemble information regarding *energy* and *food*. Therefore an incentive to organize the data in a systematic fashion already exists. Instructions were received in July 1979.

12. Organizations. Organizations compete with households for energy, materials, and information; increasingly they are taking over Manila, Makati, and Quezon City. They will undoubtedly be first to employ resource-conserving technologies.

A viable organization in Manila either is a traditional face-to-face association of some kind, which is now very rare, or has managed to obtain a telephone. The lines are very scarce, despite a rapid rate of addition, and the exchanges are overloaded. (I was dialing an average of five times to obtain my party's phone once.) The organization uses the telephone primarily for dealing with representatives of other organizations.

Thus the definition of the population of organizations in Manila differs considerably from Hong Kong (where registration each year determines viability) and Seoul (where the city and provincial governments register many types, but not all). The *growth* in population of organizations has not been estimated because the telephone system is only about now becoming comprehensive over the middle and upper classes in Manila, and the difference between two telephone books adds a lot of extra complications. A surprising number are organizations run out of offices maintained in the home. A remarkably small proportion are associated with churches.

The telephone book (1979) contained about two percent extra numbers on the periphery of the metropolitan area, but otherwise it represented present-day Metro-Manila. The number of entries was approximated at 210,000. The sample suggested 35,000 private and small community organizations. Add to that four hundred apiece for various offices and schools in Manila and Makati, and 7,000 entries for units of national government. There were, of course, many more telephones reached through the various private exchanges, but these are not as common as in the West. The number of entries in this phone book will be an overstatement of specific arms of government that have a modest degree of autonomy, due to the assignment of two or more numbers to one organized unit. A fair estimate is 5,000.

By adding public to private, our estimate is

Organizations (1980): approximately 45,000

13. Knowledge. Knowledge allows organizations and households to change their strategies when both shortages and new opportunities arise. The accumulation of a stock of knowledge is one of the principal functions of city life. The city that does it best has a strong competitive advantage.

The stock of knowledge accessible to Makati is more extensive than the share available in Quezon City. Makati is computer-oriented and a number of the staffs actually depend upon San Francisco, Tokyo, and New York via the satellite system rather than keep a private set of files. The University, the Medical Center, and the respective Ministries in Quezon City depend heavily upon libraries which are only partially up to date. The journals of the major subspecialties are not likely to be found. In many professions now of consequence to Philippine development it is impossible to catch up to the frontier and keep up. At the same time conditions are much better than in Indonesia or even in Malaysia and Thailand. There is no documentary service parallel to KORSTIC in Korea.

Judging from the policy papers, such as those in the *Journal of Natural Resource Management*'s Forum, the information is sufficient to arrive at solid, well-informed proposals on complex issues. It is at the implementation stage where things break down. The detail is not available, and failures to make a new policy work are routinely forgiven, with very few exceptions.

III. INPUTS

The overall strategy employed here is to estimate the inputs into the metropolis which have either some embodied energy content or some indirect substitute for energy expenditure (as when the arrival of data substitutes for a trip or prevents loss). We shall diverge slightly from the sequence shown on the left-hand side of Figure 1, for reasons supplied at that stage.

The discussion of these inputs will focus upon various aspects of energy policy for the metropolis. How do the inputs immediately affect the life of the city? In what way are they different for Manila than for other cities? In order to be comprehensive each category of inputs must be considered, but those which introduce no significant or novel elements for the case of Manila will be treated very briefly. In each instance the information is not available in the desired form, so that energy and its substitutes cannot be metered or counted as they enter Manila. Therefore we are satisfied at this stage with identifying the characteristics—quality, magnitude, variability, cyclical changes, growth rates, potential for control, locus for reception within the city, sources, and the like. Many interesting insights are obtained regarding Manila's dependence upon the rest of the nation and upon the outside world, including expectations for further change, but the discussion is subordinated to the need to identify responses to "energy shocks."

One input that remains unmeasured could be of central significance. It is the ebb and flow of people. In earlier days important messages and shipments were transmitted by courier and supercargo, and in contemporary Manila this mode of information exchange has not been totally transcended. But the openness to people movement has been covered in the discussion of general impressions and overview concerning visitors.

An investigator discovers that inflows are even more difficult to appraise than structure, because repeated, standardized observations must be made over a duration of years. He is dependent upon existing organizational routines, rather than explorations in the field. The energy crisis provides a strong incentive to improve some of these routines. But when one is attempting to cope with a metropolis still in the process of organizing itself, some of the energy-related flows remain indeterminate for policy purposes.

14. Sunlight. In the humid tropics the sunlight is rarely viewed as an energy resource and is seldom used as such. It is not used for water heating in large part because warm water is not needed by the mass of the population for bathing, laundry, and most household purposes. Sunlight is not dependable enough to boil the rice with any of the solar cookers that have been invented.

The most promising applications of solar energy in the Philippines will be those on thinly settled islands and peninsulas many hours away from Manila. The USAID has a number of projects that it has sponsored for demonstration, a good example being an ice-making plant for an isolated fishery. In Manila, for most of the year, shade is an asset people appreciate, rather than the sun.

15. Messages. According to the *Philippine Yearbook, 1978,* overseas communications show a curious imbalance. Overseas telephone calls coming *in* for 1977 were only 2,999, going out, 10,400. Was this due to differential costs? Telegrams received were not recorded, but presumably approximated those sent (132,000). What do the numbers mean? This information is mentioned to illustrate some of the ambiguities encountered in official sources.

In general messages will rise up to channel capacity during peak periods, necessitating more channels. The Philippines Long Distance Telephone Company (PLDT) operates eighty-five percent of all the telephones in the country and has been completely Philippine-run for the last decade. It added four percent to its domestic capacity in 1977-1978, and twenty percent to its international capacity.

	1977	1978	
Domestic tolls	7,345,000	8,342,000	+13%
International	1,084,000	1,344,000	+24%

Almost all these calls were to Manila. Meanwhile, calls within Manila were growing by only seven percent. The latter are awaiting a Siemens-designed electronic exchange for Makati. In 1978, for the first time in history, toll traffic exceeded internal traffic, and the trend is accelerating, according to the Annual Report for 1978.

In 1973 the PLDT asked applicants for new lines to invest in its preferred stock; 154,000 people did so by 1978, and now hold fifteen percent of the equity. The first rapid improvement in services is likely to begin in 1980. It will occur in distribution-oriented locales and is therefore intended to expedite the outsiders calling in.

Messages (Calls) (1980):

Outside Manila	11,000,000
International	2,200,000

The pattern that emerges is that of an international center growing on top of a national center which in turn is on top of regional centers. The regions are integrating at about five to seven percent per year, the national operations at about twice that rate, and the international at about four times. Regional integration occurs in scores of places in Manila; the national activity is in old Manila, Quezon City, and the older buildings of Makati; the international is located in the newer buildings of Makati.

16. Data. So far I have not encountered any way of segregating data inflow from the messages. The *Asian Wall Street Journal* has helped a great deal, but the *Far East Economic Review* is still banned. The *Herald Tribune* was not seen in Manila, but has now returned to the newsstands of a few luxury hotels.

17. Manufactured Products. Manufactures possess a form, style, and impressed pattern which carries some information, but requires much more energy.

Of all the manufactures coming to the Philippines a large share go through the Port of Manila, but those redirected to the minor ports have very little effect upon the metropolis. From twenty to fifty percent of the total recorded in the *1978 Foreign Trade Statistics of the Philippines,* National Census and Statistics Office, will stay in Manila. Manila will also receive a driblet of manufactures from elsewhere in the Philippines which are not recorded, the largest category being wood products and paper, but also some textiles.

The predominant category of energy-intensive imports is "Machinery and Transport Equipment," which amounted to $1,400,000,00 in 1978, and $1,100,000,000 in 1977 (current dollars). The trend in 1979 is for similar growth, but not for 1980, when energy price rises triggered a slump. But inflation has been accelerating, so we should assume that the Philippines will import $2,300,000,000 of machinery and transport equipment, valued in 1980 dollars. Of this inflow about half has been automotive vehicles and related equipment, of which we have seen about forty to forty-five percent is destined for Metro-Manila. The best guess is that the remainder in this category is divided up the same way.

For the Philippines as a whole there will be about $3,000,000,000 of other nonfood imports, which on the average contain less energy than was consumed to produce a dollar of average consumption. Most of it is distributed widely through the Islands. Therefore we shall estimate for Metro-Manila:

Manufactured Goods (1980):

World imports	$1,000,000,000 (energy-rich)
World imports	$1,000,000,000 (energy-poor)
Internal imports	$ 500,000,000 (energy-rich)
Internal imports	$ 500,000,000 (energy-poor)

One of the internal imports is *very* energy-intensive: Portland cement. If its supply becomes important one would go on to look at the location of the Government contracting work, to determine what part actually supports Manila.

18. Food. Despite the abundance of poverty in Manila, there seems to be very little malnutrition. In part this is due to active social welfare programs, which are usually practicing in Manila before they get to the provinces.

The principal components of the diet are rice, beans, pork, bananas, root crops, sugar, bread, and skimmed milk solids. Everything but the last two items is homegrown, with exportable surpluses in most years.

We should assume that 3,500 Calories per day are imported per capita, with the waste going to the pigs to be later recycled back to Manila residents. Human intake is about 2,500 Calories per capita.

Food (1980): 10×10^{12} Calories

19. *Feed.* The livestock in Metro-Manila are uncounted but not numerous—except for the plankton-feeding fish. Reconstituted milk is the norm, so the dairy herds are small. Although once pigs were kept underneath the houses in the poorer communities, this is no longer seen.

Most of the feed would probably go into poultry and egg production, which has become rationalized. Some of the imported maize and soya goes into chicken mash. A fair estimate at this stage is:

Feed (1980): 2×10^{12} Calories

20. Liquid Fuels. This is by far the major component of energy flow into Metro-Manila. Fortunately for our calculations, all five oil companies have their bulk plants at a single refinery which is dedicated to Metro-Manila almost exclusively. A separate bulk plant facility serves these five companies in Batangas to the south, and others to the north are similarly shared. Pandacan is in Manila Bay and a balanced refinery which nowadays requires very few imports of products to fit the local demand. The internal statistics are left over from times when merchandising was more important than energy conservation, so one detects frequent aggregation by volume when density and energy contents may vary by as much as twenty-five percent. Year-to-year variations of ten percent could be meaningless due to such potential artifacts in the basic energy accounting.

It is apparent that LPG—low-pressure gas—will go out of balance in the future, so the Philippine Government (meaning the Ministry of Energy) is negotiating with the Indonesians to tap some of these products that are currently flared. The problem is credit, since both countries are stretched to the limit. The Philippines are suggesting some innovative "prepurchases" that supply the base capital. LPG demand is growing in the Philippines at five to seven percent per year. It is a domestic fuel that takes the place of kerosene, wood, and charcoal in the kitchen and the small enterprise. The equipment required for distribution and use of LPG are well known everywhere by now, so it does not operate as a deterrent, as in Indonesia.

I had an opportunity to see the computerized reports from the five liquid fuel distributors as they were submitted to the Government and being processed for statistical purposes. The accompanying Table 2 summarizes information from that source to show the breakdown into several components, designed to serve special end-uses.

The Ministry of Energy must modify these according to inventory changes and spot shipments. Industrial Fuel Oil (Bunker C) often goes directly to large industrial plants by barge; although those plants probably serve Metro-Manila with electric current, cement, glass, etc., many are not parts of it geographically. Shipments of gasoline and diesel fuel from Pandacan to points outside are the most important, while significant quantities of LPG are distributed separately in Manila.

Some time after 1980 it is anticipated that alcohol prepared from sugar cane (whenever

sugar is cheap) and cassava will be added to motor fuel in fifteen-to-twenty-percent proportions to save foreign exchange.

Table 2
Liquid Fuels Shipped in Philippines (1978)

	000s kg.	*000s kiloliters*							
	LPG	*AVG*	*MS*	*MR*	*KERO*	*AVF*	*SOLV*	*DIES*	*IFO*
Petrophil	67,415	17.2	321.9	389.7	171.0	94.4	811.0	1,616.4	
Caltex	15,142	5.1	286.6	346.4	137.0	137.7	1.5	619.6	1,534.3
Shell	38	—	2,112.3	260.3	119.9	119.9	16.1	556.0	1,091.8
Mobil	13,610	—	166.0	196.6	90.7	90.7	1.8	141.9	1.5
Getty	—	—	58.8	115.6	61.5	61.5	—	135.8	36.3
OFFICIAL TOTAL	412.9	22.3	1,086.2	1,334.7	585.5	412.9	36.6	2,447.3	5,983.0

Naphtha: 112.7 Asphalt: 63.1 Refinery Gas: 33.5

Reported by Bureau of Energy Utilization, Ministry of Energy)

Pandacan Shipments (1978)

	000s kg.	*000s kiloliters*							
	LPG	*AVG*	*MS*	*MR*	*KERO*	*AVF*	*SOLV*	*DIES*	*IFO*
Petrophil	—	10.2	193.1	131.6	59.6	57.0	7.9	291.7	307.9
Caltex	1,122	0.1	201.5	161.8	56.1	0.2	1.3	272.5	277.7
Shell	33	—	137.7	91.7	46.0	79.1	16.1	228.6	765.0
Mobil	—	—	109.4	60.4	22.6	44.1	1.4	126.7	189.9
Getty	—	—	24.4	24.6	9.2	—	—	32.7	35.6

Reported Metro-Manila Consumption

Total	33.5	9.9	536.2	282.4	134.7	176.5	21.8	777.0	1.461.8

LPG = Low Pressure Gas
AVG = Aviation Gasoline
MS = Motor Fuel, Special
MR = Motor Fuel, Regular
KERO = Kerosene
AVF = Aviation Jet Fuel
SOLV = Solvent
DIES = Diesel Fuel
IFC = Industrial Fuel Oil

It is possible to separate out some districts in these data and compare shipments in Manila with a small bulk plant serving a little over a million people, mainly agriculturally employed, from Batangas (Table 3). The consumption of high-test gasoline (MS) is about forty percent of Manila on a per-capita basis, but regular gasoline is seventy percent higher, as is kerosene. Diesel fuel is about the same. Thus Batangas supports a substantially lower quality of life (half the children migrate away, despite the strong family bonds of Filipinos, during a period when Manila is highly attractive and overseas destinations are even more so), with a markedly higher level of liquid fuels (energy basis) distributed in its territory for domestic and commercial use. As noted earlier, the capital of the province appears to have a somewhat higher vehicle registration than Metro-Manila on a per-capita basis, but this is only an indirect confirmation because Batangas City accounts for only fifteen percent of the population of the service area.

Qualitatively it is possible to explain some of the differences. Batangas has much poorer roads, so its vehicles are much more often four-wheel drive, offering less mileage per liter of fuel. More important, however, is the much lower level of electrification in Batangas, so that

Table Three
Batangas Liquid Fuel Deliveries (1978)

	000s kg.	*000s kiloliters*				
	LPG	*MS*	*MR*	*KERO*	*DIES*	*IFO*
Petrophil	—	6.9	13.6	8.6	19.7	—
Caltex	2,598	7.9	16.3	9.0	18.4	—
Shell	2	7.7	16.3	5.1	34.8	—
Mobil	—	4.2	6.3	3.5	9.2	—
Getty	—	2.2	7.9	3.6	9.7	0.8
TOTAL	2,600	28.9	59.4	29.8	91.8	0.8

kerosene is used for domestic lighting as well as cooking, and diesel fuel for pumping as well as for trucks, buses, and boats. Manila draws upon the Grid for a greater share of its energy uses; the Luzon Grid uses fuel oil independent of Pandacan shipments.

It will be noted that the Official Totals are different from totals shown in the respective columns. That is because there is an active commerce in small-scale transshipments of fuels to keep refineries, bulk plants, and captive facilities at mines, cement plants, and sugar centrales in balance. The official annual figures try to keep up with those exchanges.

An analysis of all the reports available suggests that Metro-Manila is consuming about twenty-five percent of the liquid fuel, other than what goes into the electric power grids, available in the Philippines. The motor fuel of the nation is distributed so that thirty-four percent disappears in Metro-Manila; all of this is clearly automotive. The diesel fuel goes into stationary engines and marine craft, as well as trucks and buses, but still Metro-Manila was taking thirty-two percent in 1978. On the other hand, it was taking only eight percent of the LPG distributed in the nation, and the twenty-four percent registered for fuel oil was used for industry, with a small part going to international shipping.

The above proportions should be compared with an estimated seventeen to eighteen percent of the national population residing in Manila. The numbers suggest that the whole of the Philippines has moved to a dependence on liquid fuels, and its primate city contains a similar bias. After one allows for about thirty percent of the liquid fuels being spent in manufacturing, Manila seems to require no more energy for its higher-quality services than is being spent in the provinces.

Total Energy	Philippines	1980 (planned):	115 MMBOE	or	710×10^{15} joules
	Metro-Manila		39-42 MMBOE	or	$240\text{-}260 \times 10^{15}$ joules

MMBOE = million barrels oil equivalent

The dependance of the Philippines upon world petroleum supplies is scheduled to decline. In 1980 it was anticipated that offshore fields would produce thirty percent of its requirements. But early in 1980 the major producer began to deliver salt water along with the oil, and was eventually shut down to reconsider the oil production policy. The reserves may be much less than original estimates, or the oil may need to be extracted more slowly from these structures. In any case production may be only ten to fifteen percent of national requirements. Metro-Manila itself is not regarded as suitable territory for prospecting for petroleum.

The Ministry of Energy has published some demand prospectives *(Economic Monitor 14,* August 20-26, 1979, p. 1) which suggest the household sector will increase perhaps seven percent per year while transport will decline by one percent per year, due mostly to improved engine efficiencies (the rolling stock is dieselizing, primarily).

21. Water. At present the Metro-Manila water mains import a maximum of 330,000,000 gallons per day, treating it before distribution. In 1980 240,000,000 gallons per day extra capacity will be added. The project was funded by the ADB and the World Bank. It will serve about 7,000,000 people, the remainder apparently depending upon local wells.

The energy requirement is minimal. Gravity flow is being utilized from a dam in the foothills. Only the treatment, which includes chlorination, will have an energy impact. Annual data have yet to be collected on treatment costs.

Water (1980): 4-500,000,000 gallons/day

22. Gas. Thus far gas supplies have been a secondary product in the Philippines. Originally produced from coal, gas is now made from light oil (naphtha) or propane, usually by the mine or factory that needs it. Therefore gas is not imported in significant quantities.

Gas (1980): Zero

23. Coal. The Philippines have started to use coal again for power production, but the first plant to come on stream in the Luzon grid is scheduled for 1983. Tiny amounts are used for forges and similar specialties. Therefore, for the moment it does not need to be considered.

Coal (1980): Virtually none

24. Geothermal. The Philippines are now just behind the United States and New Zealand in developing geothermal power. Four to six plants are due to come in by mid-1980 near the souther tip of the island, about 400 km. from Manila, each producing 360 GWH (55 MW capacity).

Geothermal (1980): 1,440-2,160 GWH

Digression on Energy Planning

At this point it is necessary to introduce a discussion of the Ministry of Energy's *Ten-Year Energy Program 1979-88,* published in February 1979, by its Planning Service. It contains a revision of a hastily prepared plan that responded to the crisis of 1973-1974. President Marcos says in his foreword message that the society has "demonstrated resiliency" and must expect to consume eight percent more energy per year to meet growth targets. The Minister of Energy, G. Z. Velasco, emphasizes the change from emphasis on development of internal supplies to consideration of demand management and utilization efficiency. The Ministry itself is very young, having been created by presidential decree on October 6, 1977, and assigned the needed enforcement powers by a second decree that came into force on June 11, 1978. It operates from temporary locations, many of which did not appear in the 1979 telephone book. The Energy Program, however, has produced a glossy report, illustrated in color, edited with verve, and therefore a major production by itself.

The Ten-Year Program sets forth the global context, the opportunities for new production and conservation, an energy flow diagram for the Philippine economy in 1977, the impacts upon environment, risks, priorities, and regional development programs. There are maps, tables, schedules, and discussions of anticipated shifting structure of the industry, followed by estimates of capital, labor, and land requirements. All things considered, it is an admirable piece of work, and belies the earlier comment about the lack of integration in Manila. Closer inspection reveals details that are questionable, but that will happen in the most advanced bureaucracies in the most stable times. The main difficulty is that it is a national document, while our interest is in Metro-Manila. Some arbitrary assumptions must be made when separating the primate city from the national aggregates and regional grids.

This difficulty appears when estimating the importation of electrical power into Metro-Manila. The geothermal fields are so close to Manila that their output could clearly be assigned to the metropolitan demand. But what about the hydropower much more distant?

The Program assumes that a megawatt of hydro capacity produces as much power as a megawatt of thermal capacity, so we shall assign 500 MW of the 746 MW in the Luzon Grid to Manila at 3,000 hours per year:

Hydroelectric (1980): 1,500 GWH

All of this means that oil-fired capacity in the grid will drop from seventy-nine percent in 1978 to seventy-five percent in 1980, but the oil-burning equipment will be much more thermally efficient. The fraction produced from fuel oil will decline significantly thereafter. By 1990 the Luzon grid should have less than thirty percent dependence upon oil, according to the Plan. But those prospects have been seriously dimmed by the decision to halt the nuclear reactor project taken a year later—it may take years to get it restarted.

The Plan for the development of the Luzon Grid *and* the electrification of the barangays is the most ambitious in Asia and engenders a number of doubts among interested outsiders. Where will the money come from? What will all the electricity be used for? The Ministry of Energy is itself trying to stretch out the schedule for installation of new capacity proposed by the Plan by penalizing the big power users. Interestingly, the senators are objecting. It may put a crimp in their personal life style. They are searching for all kinds of excuses to keep the rich from paying extra!

(One economist, Alejandro Herrin, did an exploratory study which suggested that electrification of the barangays leads to changes in the use of human time (mostly due to better light at night and to television), to more agricultural opportunities, to more household enterprises, and to more productive use of time by women, which then leads to more rapid reductions in fertility. *[Population and Development Review 5,* 61-68 (1979).] Now he is trying to measure the impact of electrification quantitatively. How much change, how fast, from how many kilowatts? In August 1979 he faced his peers trying to justify his proposed approach. The methodologists objected quite strenuously. Multiple regression, they said, is not the way to do it, even if one wishes to measure the contribution to income. The trouble is that there are not enough trained field investigators around to apply the more persuasive techniques and methods.

(Meanwhile, the rather expensive rural electrification program is continued without explicit economic justification. Various comments have been heard which suggest that intellectuals here in Manila feel guilty about their electrical conveniences, so electrification is really a matter of "equal opportunity." The feelings among those offered service appear to be reciprocated more than half the time, judging by the numbers that join the power cooperatives.)

24. Wood. The distant mountains and hills are verdant because the LPG and kerosene supplies have been plentiful. Only once (on an empty lot at the University) did I see people scrounging for cooking fuel. Most of the charcoal made from copra husks—a relatively recent industry on some islands—is exported from the Philippines and does not arrive in Manila. The principle use here is for *lechon asado*—roast whole pig.

Since the nation is a major wood exporter—logs, plywood, particle board, and a small amount of furniture—some of this output goes through the Port of Manila. Any amount that Manila needs, it can obtain. National policy has for some time been to require increased plywood manufacture and further processing at the logging sites or the shipping points. This means that a larger share of wood waste is available in the Philippines than a decade or to ago when logs were shipped directly to the United States or Japan.

Charcoal briquettes with better combustion qualities than wood or plain charcoal can now be made from wood waste in the Philippines. The National Science Development Board has a Forest Research and Industrial Development Commission in Laguna which has worked out the

techniques. They use a low-grade cassava flour as a binder (according to the *Times-Journal,* 4/12/79). Although designed for export to places like Hawaii, they could be used in Manila for some cooking purposes. The storage is safer than wood chips, and the cost of transport to Manila from other islands would be less than half. The current estimate is order-of-magnitude.

Wood (1980): ~ 10,000 tonnes
Charcoal (1980): ~ 3,000 tonnes

25. Building Materials. Manila appears to be remarkably self-contained with respect to building materials. Starting from its own sand, gravel, and rock, it prepares its own pipe, block, siding, glass, asphalt, aggregate, etc. The principal material is cement, made in a number of sites where it can be easily shipped in. The next most important is zinc-coated corrugated iron sheets. Surprisingly, it has maintained this market in competition with aluminum. For these materials Manila cannot be separated readily from the national exports. It may account for twenty-five to thirty percent of the total.

The most important energy consumer is the cement. It used 75,000 kl of industrial fuel oil in 1979 for all the Philippines; therefore, if we add a bit of brick and glass and metal processing:

Building Materials (1980): 80,000 kl fuel oil

IV. OUTPUTS

One expects that the energy flow out of Manila will not be uniform over time or space. But the actual data on the shape of the "heat island" are not scheduled to be available until next year, when the Landsat photos should have been analyzed. The best approximation at the moment is that one peak of "heat waves" will emanate from the biggest thermoelectric power plant on the margin of Manila Bay at the southern edge of Metro-Manila. It is not so far from the geothermal plants of Mt. Makiling, which produce even more waste heat per unit of power generated.

26. Low-Grade Infrared Radiation. Manila is surrounded by evidences of volcanic activity. Recognizing the presence of molten rock underground, it will be hard to distinguish a natural "heat island" from a man-made one.

Another concentration of heat would be along EDSA, a six-to-eight lane avenue with relief roads on the side, which serves as a cross-town beltway, even though it is afflicted with an uncoordinated series of stoplights about a mile apart.

Heat Radiation Expected (1980): 1-2°C Heat Island

27. Information. Since the metropolis is the center of government and diplomacy, the conveyance of information therefrom is a crucial function. Many different channels are employed.

At the executive level instructions are given by telex and telephone, with airmail to follow with the details. Many of these messages are sent to implement the latest decisions in government and the larger private organizations.

Below that are the more routine functions of government which are carried out by mail but need to be expedited and adjusted by using the telephone. Newspapers and trade journals carrying market opportunities are an equivalent category in the private sector.

Finally there are detailed instructions, examinations, and textbooks which go out of Manila in packets. Manila programs the young minds of the nation, by instructing the teachers of the teachers, setting the examinations, and providing the props for education.

Manila also has a rapidly increasing number of things to say about world business, Asian affairs, and maritime activity. The twenty-five-percent growth rate in telecommunications outward signifies a catching up with Hong Kong and Singapore. The push came first from garments, then banking, and in the future it should be electronics manufacture. Government participation in ASEAN and similar recent diplomatic developments seems to be small-scale as compared to business.

There appears to be no way, so far, to quantify this export of information from the *knowledge* level of the urban ecosystem, at least not by means of a single indicator. *Quality* is more important than quantity. The rising influence of messages from Manila, particularly in the private sector, does not reflect major accumulations of capital, because the Philippines have stretched their credit to the limit, but to a steadily enlarging knowledge base regarding natural resources, securities, trade, and outside organizations' capabilities. Henceforth quite a large share of the capacity of the communications channels out of Manila will be taken up by information relating to energy issues.

28. Manufactured Goods. About half of what Manila manufactures is for its own consumption, about ten percent is exported to the rest of the world, and the remainder is shipped off to the provinces. It assembles refrigerators, television sets, automotives, and garments.

A "new" industry has already been identified which is just beginning to expand explosively. Pure solid-state materials and basic components are shipped in, and women are used to inscribe circuits and assemble small computers or instruments for reshipment. Because labor cost in this industry has gone up so rapidly in Hong Kong, Taiwan, and Korea, and world demand is growing by perhaps fifteen to twenty percent per year, a significant amount of business is spilling into the Philippines. Conditions in the world are ripe for Manila to follow behind Seoul in electronics assembly. Five years hence the sophisticated tasks might well be carried out in Manila, and much of the circuit inscription will be taken to provincial towns with airports (cf. *Asian Wall Street Journal,* about August 10, 1979).

Machinery, Equipment, and Mfrs.	International (1980): $200 million Provincial (1980): $300-500 million

29. Warmed Water. Altogether fifty percent of the energy obtained from the combustion of Bunker C fuel is left in the cooling water. It appears outside the normally assigned bounds of Metro-Manila, however, and is not readily distinguished from sunwarmed water (much of the Bay is shallow) and geothermal warming.

Although needed to complete double-entry-type energy accounts, this export of low-grade energy so far is of little significance to the urban ecosystem of Metro-Manila.

30. Sewage. Metro-Manila's sewage permeates the ground water, and the ground water is eventually delivered into Manila Bay, thereby improving natural food production conditions for fishermen, unless the Bay becomes anaerobic in patches (not yet reported, but could happen with further expansion of the metropolis). The Pasig River (which is more of a bayou than a river) has been assigned the status of a "special cleanup river," but its filth was as much attributable to industrial waste, particularly oil slicks, as to the slums on its banks.

Theoretically about half the energy contained in human and livestock feces is recapturable as methane after anaerobic fermentation, but Manila's settlement is so helter-skelter that only a minor portion of this promises ever to be recapturable. In 1980 no significant amount of biogas will be produced, unless it is done inside some industrial firms processing foodstuffs and treating their own wastes.

31. Solid Waste. Manila's waste is quite carefully picked over by scavengers who recycle the metal, paper, rubber, and glass back into use. The weighty material that remains is made up of concrete fragments, brick fragments, broken pottery, beer caps, abaca matting, broken glass. Continued raking brings up shredded plastic sheet, which floats around like duff on dry

days. This solid waste is valued for land reclamation—a whole new Government capital complex is due to appear on reclaimed land at the waterfront in the 1990s—because it is more stable than the muck at the bottom of the Bay. One might easily conclude that the solid waste of the metropolis today should become a part of the foundation of the future—it helps get the city out of the muck.

V. VULNERABILITY

For the *Malacanang,* Manila's decision center for the Philippines, the exercise of adjusting to a major price increase in petroleum (say, fifty percent) would seem like walking into another rerun of a recent tragic drama. That is what policy-makers were preoccupied with around mid-year 1979 and again in early 1980.

The top levels of government are now shared about equally between politically astute civil servants and military officers on one side and young technocrats on the other. President Marcos has more substantive experience than any of them and frequently suggests to the assistant ministers *how* they can get the assigned jobs done in time. This group has very successfully managed the political clamor, where "cushions" against impact were demanded, because they understood the inflationary effects, which in turn would reduce the capacity to negotiate development loans. The vocal protests came from the established middle class, but they were told to go buy a small car and use less than 500 kwh per month of electric power. A continuous barrage of well-aimed publicity has deflected the blame from the Government, which takes credit for being a pacemaker in the new government-to-government oil diplomacy that has brought in substantial quantities of supplies expected to arrive over the 1980-1981 period.

The overall impact of the most recent oil price crises was to shift the balance of trade so that the first anticipated trade surplus in many years was converted into a continuing deficit. The price rise has been impoverishing; it is as if the country had to pay a ransom for Manila and its lifestyles amounting to several billion dollars, as well as giving up a large share of its mobility and other conveniences. As usual, it has been the unskilled worker who has paid the highest price. The last Annual Report of the Ministry of Labor shows that ever since the price of oil has been going up the real wages of unskilled workers have stayed constant, while those of skilled workers have been slowly rising. Therefore the Government felt compelled to make a rather generous allowance that resembles the "dearness allowance" in India in the latter stages of its adjustments to the energy price increase.

As noted earlier, the cement industry is the heaviest user of fossil fuels after the electric power grid. The impact of the last price rise has just been estimated for it; every other industry is less vulnerable. It is also the principal raw material for the construction industry in Metro-Manila, especially public habitat.

The thirty-five-to-forty-percent rise in OPEC prices became a thirty-percent rise for liquid fuel when stored in the tank farm. Products with rapidly rising demand pay more for their share of refinery runs, but bunker fuel oil only rose from 95.7 pesos per unit to 114.8. Table Four presents the estimated impact of a 50% price rise in fuel, most of which was imposed by OPEC in December 1979, and needs to be transmitted to the industry within two months.

With this cost picture in mind, and bolstered by a government-sponsored renovation and energy-conservation program, the cement companies went into the international market offering relatively long-term contracts.

Between August 1979 and February 1980 the price of imported crude oil rose from $19.00 per barrel to $27.50 per barrel, with most of the increase occurring in January. Prices to consumers in the Philippine Islands were held constant in the interim, with the Government making up the difference, but the attendant inflationary effects could not be tolerated after the January increases imposed by the petroleum-producing countries. Stern measures were required.

The policy chosen concentrated the impact of the cost increase upon the higher-income component within the population, and particularly upon Manila, although everyone had to share

Table Four
Typical Philippine Cement Costs
per bag

	January 1979	*August 1, 1979*	*Next 50% energy price rise*
Fuel	5.45 pesos	6.55 pesos	9.00 pesos
Power	1.36	1.60	2.00
Bags	1.75	1.95	2.25
Other Variable Costs	2.50	2.76	3.25
Fixed Costs*	8.94	9.25	10.00
Totals	19.50 pesos	22.11 pesos	26.50 pesos

*Depreciation, sales tax, interest, etc.
Source: *Bulletin Today*, August 31, 1979 (columns on left)

by paying at least part of the higher prices. On February 16, 1980, President Marcos decreed the following actions:

- gasoline up 50%
- kerosene up 36%
- diesel fuel up 36%
- industrial fuel oil up 36%
- jeepneys up 20%
- buses up 10%
- inter-island shipping up 10%
- price freeze on rice, corn, eggs, poultry, pork, cooking oil, sugar, tinned meat and fish
- price monitoring teams appointed
- cost-of-living allowances for industrial workers
- a search for Government budget cuts 10%
- encourage solar, wind, and biogas energy sources
- stagger hours in offices and schools
- close restaurants and entertainment places at midnight

Labor and business groups are said to be "restive," a term previously applied to Bangkok, Seoul, Ankara, and Canadian cities, where the energy price rises were strongly influential in bringing about an overturn of the national government. In one year it was reported that 121,000 Metro-Manila workers lost their employment, mostly because of the inability of the small to medium businesses to cope with the price shocks and the shortage of credit (Sheila Ocampo, "The Costs of Oil Dependence," *Far East Economic Review 107* No. 10, 7 March 1980, pp. 46 and 48). The shift to an energy-efficient economy has many more indirect, unwitting victims than it has practitioners of energy conservation.

Nevertheless, Manila has a strong turnaround capability. As indicated earlier, its telecommunications and airline connections are rapidly improving. Partly because of the army of underemployed in Metro-Manila, the cost of services is at the lowest level among forty-five "world cities" for which compilations are made by the Union Bank of Switzerland *(Far East Economic Review 107,* No. 11, 14 March 1980, p. 60). The universality of English in the city makes it a much more suitable base of operations for international business than Jakarta or Bangkok, where costs are about the same.

What further energy price shocks should be anticipated? Another fifty percent increase appears to be far beyond the capability of the OPEC monopolists. The United States would be forced to withdraw from the market by means of imposing rationing, thus inducing unsustainable shocks in the societies of the Middle East, which in turn prevents them from demanding such a high price. Indeed, there is some suspicion that the $32-37 per barrel charged in June 1980 cannot be maintained without causing bankruptcies in many smaller Third World countries. Program loans by the World Bank may be an insufficient prop to keep the fuel and food moving in international trade. Those prices may be eroded by the decline in the value of the U.S. dollar, the currency used for virtually all trading in petroleum, to bring about a new uneasy balance.

One must conclude that studying the effects of very large price rises upon Manila and similar Third World urban ecosystems is no longer realistic. By destroying the international system, the gouging governments would undo themselves in the short run. The people currently in power have no rational gambles remaining for extracting "all the traffic will bear."

The shocks we must anticipate are those caused by groups which have little to lose and have no knowledge of international trade and finance or petroleum technology. Many little-known groups of this sort exist, and some are impelled to take extreme action. The flow of petroleum from Iran has already been reduced to a dribble through the combined action of several such groups, and the chances that parallel situations will arise in neighboring countries are very considerable.

Suppose some fanatic elements in the Middle East cut the pipelines around the Arabian Gulf and prevented their repair. That would lead to about a fifty-percent cut in world supplies, about the worst reduction that could be brought about by a single cascade of political breakdowns. Then what would happen to Manila? The analysis presented here is drawn from discussions with civil servants who would become involved in the emergency responses. The scenario for the early 1980s goes as follows:

Day Zero—Catastrophic events in the Middle East.

Day 10—Confirmed seriousness leads to the formation of a crisis group chaired by the President with authority to rule by decree. Responsibilities assigned to various ministries.

Day 30—Last of the Arab Gulf oil arrives. The existing stock is seventy days' supply at current rate of consumption. People are coming to believe that the crisis will not blow over.

Day 55—Stocks are down to sixty days and consumption has dropped about ten percent. The Japanese have outbid everyone in the scramble for miscellaneous alternative supplies, so the flurry of diplomacy led nowhere.

Day 83—Stocks of fuel have dropped to fifty days at going rates of use. Cement plants have shut down. The long-discussed brownout goes into force. Fuel ration tickets are distri-

buted to barangay captains. Shiploads of wood waste are being brought into Manila from lumbering operations. The curfew comes back.

Day 115—Fuel stocks hit the peril point of forty days' supply. Ration coupons for private cars have no value. Air conditioning goes off. The bulk of each hotel becomes a "club" for commuters who can't get home at night (tourism had almost disappeared, so the hotels were having a rough time financially).

Day 167—Fuel stocks are now down to thirty days and it is becoming difficult to balance refineries and shipments, so "runouts" are reported daily for certain products in specific regional markets. Wood, and some coal, are coming onto the Manila markets. The Philippines are by this time producing thirty percent of the petroleum they consume, and a little bit of alcohol on the side. Hydroelectric, geothermal, and coal are the mainstays of the electric power grids. Crop prospects are excellent, but some of the mines have shut down. Construction is greatly reduced.

Day 260—Stocks are down to twenty days. But it will be noted that a new state of operations has been reached which is still not "steady," but promises viability over the long run. Sealed offices that cannot be used without air conditioning are reopened with a new conservation formula. Some cement plants using coal are back in production. Reduced traffic virtually eliminated congestion, thus saving ten percent of the transport fuel for this reason alone. The jeepneys had begun to reroute and serve the middle classes, while the buses move the ordinary workers. Radio taxies assembled the executive class and brought them to work. Visitors are beginning to return to the city. The spasm of unemployment caused by the crisis has already peaked and is now subsiding as new jobs *(e.g.,* wood distributors, engine tuners, energy auditors) have come into being. Because most of the exports appreciated in value as a consequence of the world fuel crisis, the national economy is in good shape. Because of an inability to buy many vehicles or build houses, savings markedly increased.

Day 366—Stocks have revived to twenty-three days of an energy flow that is again rising. Energy management is becoming ever more rationalized by means of a shadow price that carefully calculates the re-entry of the Arabian Gulf into the market. If factories and other energy-consuming enterprises *(e.g.,* airlines, iron mines, aluminum reduction, petrochemicals, etc.) could develop a market at that price, they were encouraged to do so.

Obviously another model, besides that of the urban ecosystem, was introduced to generate this scenario. It was formulated, as hinted at in the introductory paragraphs of this section, from the structure and style of national decision making that has evolved in the Manila milieu. The government itself is a user of models, and will have its own to review alternative policies. But official data do not as yet segregate Metro-Manila—the brain of the nation—from the body to allow discovery of its special requirements. Filipinos have been taught to think in official census categories and economic sectors, which are not very relevant in times of energy, food, and water scarcity. The classical models will give fuzzy indications, so most decisions will rest upon style and experience.

The conclusion to be reached from these hypothetical tests is that Manila's strong dependency upon imported fuel need not be fatal, even given the worst case. It has, in the accessible wood supply, greater reserves than it measures; and it has in the stock of private cars and air-conditioning units more "fat" than most residents are willing to admit.

Like most metropolises, Manila is vulnerable to a "double hit" of two simultaneous catastrophes. When one of these is of extended duration, as with an energy crisis, the chances are not infinitesimal that a volcanic eruption or a 300-year flood might occur. Then the city may be crippled and partially depopulated. That happened in 1942-1945, when Old Manila was the scene of calculated exploitation and lengthy hand-to-hand fighting, to the extent that a large share of it remains barren to this day. A metropolis grew up outside the wounded city.

Therefore, with respect to energy, the urban ecosystem of Manila is now remarkably robust. It can act upon itself, and negotiate with others, so as to make adjustments that reduce

its dependency upon petroleum imports. Within a year it can reorganize itself to meet the worst likely threat, and remain a reasonably healthy, functioning, competitive community.

Oil imports had been an Achilles heel, but a combination of petroleum exploration inside territorial waters, geothermal exploitation, biomass utilization, hydroelectric development, and the reform of the price structure, together with a major overhaul in public administration, promises to be able to cope with the direct effects of the most stressful exigencies now anticipated. The Philippine society as a whole is experiencing many strains as it modernizes, with Manila no less than the provinces suffering from antagonisms, so the real threat of an energy crisis may arise from the way it happens to affect the alignment between opposing factions. One side may erupt in anger at the time when a cooperative response to losses of supplies is required.

These secondary and tertiary consequences are not so far profitably studied by means of ecological analysis. What is performed is a guide for administrative response that is better informed than was possible otherwise. The rather significant wood resource had been completely overlooked in the *Ten-Year Energy Program.* The significance of substitution and savings at the point of liquid fuel consumption were recognized only in theory. The tools for acting at the micro level were not comprehended.

VI. "FAIR WEATHER" OPTIONS

It is rather unfair to test any model under conditions of extreme turbulence and ask that it give useful suggestions. Ecosystems behave in predictable ways when external conditions are close to normal. Although the odds that major catastrophes involving energy flow (fuel and food) will occur in the next half decade are strong, there is also a fair chance that present trends will continue for a time with only ordinary perturbations. What they should be considered?

One question continually posed by Western intellectuals and technical assistance experts is whether it is not possible to prevent the massive accumulation of poor people in major metropolitan regions. They foresee unparalleled problems of crowding and congestion with attendant social costs. Is it not feasible to deflect the growth to smaller, more humane centers? Would not energy be used more efficiently, for example, in smaller urban units? Would not an increasing cost of energy, for example, encourage deconcentrated settlement? Most of the Asian top professionals have acquired similar concerns in recent years, so these questions are troubling to an increasing degree.

The second question is merely concerned with the direction of evolutionary change in urban structure. If energy, including food, is increasingly expensive, then what are the concomitant adjustments? How would Manila, with its history, culture, settlement pattern, and external relationships, best go about economizing?

A few insights can now be thrown upon the first question. Before this brief study of Manila was attempted, a study of the Census was made in an attempt to identify the most likely site for growth that would compete with Manila. The geography of the archipelago is such that other islands are already developing their candidates for urbanization, so the search was restricted to Luzon. The most likely candidate was Batangas, a city of a little over 100,000 persons and about three hours to the south of Manila by two-lane road, according to the map.

Batangas is the port city and center of an apparently stable agricultural district. The rural areas appear to have maintained a stable population since World War II, despite the improvement in public health. Improvements in transport, communications, water supply, and higher education, together with a modern industrial estate, should set off a spurt of growth.

A trip out of Manila in the direction of Batangas revealed that the hopes for providing a counter-magnet for migration to Manila were not justified. The new toll-road to the South (not on the map that was studied) was obviously building up a corridor of industry and shortening the trip. Batangas contractors were already at work building the extensions to Manila. About

the time any additions to the infrastructure of Batangas could have an effect, it would also pay to extend the toll road and Batangas would be transformed into a part of Greater Manila.

It is true that the planned growth of Manila is to the north and northeast of the central city, but the corridor through Los Banos is the best location for many industries. Electric power should be more dependable due to the proximity of the expanding geothermal production. Meanwhile, extending Batangas City in any other direction than the road to Manila would be a waste of public funds. Thus the promotion of Batangas would only accelerate the rate at which it becomes an integral part of the Manila conurbation. It appears that the physical geography of the Philippines has conspired against a strategy of deconcentration, because other sites do not have the necessary watershed or access to compete effectively for industry. Metro-Manila does seem to be destined to become much larger than Tokyo before the Filipino population reaches stability.

The second option considers what economic extension of energy and food conservation might be made during the 1980s. It was mentioned earlier that the Technology Resources Center in Makati has been charged with developing a program. A general set of proposals is presented in my *Planning for an Urban World: Design for Resource-Conserving Cities* (1974). Those that best fit the ecosystem of Manila are:

1. Cooking fuel can be sold in convenient dimensions and designs suited to preparing one pot of rice. Small portable stoves using briquetted charcoal or wood chips can displace kerosene and LPG now delivered for domestic use.

2. An integrated, solar-energized neighborhood water center that provides water for baths, food preparation, laundry, artisans, toilets, and waste removal. It saves pumping and water treatment.

3. Design of air-conditioning substitutes based upon fans and ventilation, while still providing protection against tropical rains and continuous high humidity.

4. Develop transport networks that encourage the use of bicycles, tricycles, and mo-peds as personal vehicles, reserving buses for inter-sectoral trip-making.

5. Use of a communications satellite for reducing air-trips to provincial cities by providing a series of telecommunications and computing services, including advanced telepostal services to outlying points. Equipment repair, medical advice, education, commerce, and consulting of government officials can all be expedited.

6. Develop a cadre of "energy doctors" for small factories, commercial establishments, offices, and larger homes who can do energy audits, make recommendations, assist in redesign of facilities, and monitor performance of new installations. Manila has a surplus of college graduates, so it is relatively easy to retrain a sizable crew and put them to work in this way.

7. Develop vegetable protein substitutes and new "fast food" snacks that displace the rising demand for beef and chicken. This means borrowing methods from Taiwan for fish production, *Chlorella* processing from Japan, developing the *ipul-ipul* tree *(Leucena* spp.) from which the leaf juice can produce edible protein, and a variety of beans suited for intensive gardening.

8. Ways of economizing on refrigeration, starting from equipment design (the new electric motors will save thirty percent), to user convenience design for commercial facilities, apartments, transport, and processing.

9. Ways of using energy-intensive materials, such as cement, aluminum, steel, and glass, to better advantage. This usually means lighter structures that allow activities to move out-of-doors when overflow situations arise.

10. Introduction of management methods for extending peak periods in demands for transport and power, thus reducing waste due to congestion and underuse of physical facilities.

It seems quite possible to reduce energy consumption per capita as much as fifty percent without loss of free time and opportunity. It should be realized, however, that Manila has a deep pool of claimants who have not yet connected to the grid, and expects many immigrants.

As a result, the projected eight-percent growth in energy demand could be reduced to perhaps three or four percent, but there will still be an increase associated with social and economic development. Local production of fuel for power should very greatly decrease imports and their drain upon the economy. The reliability of service could improve at the same time that vulnerability to cutoff of imports diminishes. This is a feature of the Ten-Year Energy Program that was admittedly underemphasized because the necessary feasibility studies had not been undertaken.

VII. CONCLUSIONS

Looked at from the outside, it appeared that Manila was one of the most vulnerable cities of the Third World to perturbations in petroleum price and supply. The data available for comparison were collected in the 1970-1977 period, when upwards of ninety percent of Manila's energy was obtained from the world petroleum market.

A thorough analysis on the scene, applying an urban ecosystems approach which also looks for energy substitutes in the form of information flows to organizations, the energy content of exports and imports, potentials for expanding indigenous sources such as geothermal, wood, and alcohol, and at the control systems needed for conserving energy, suggests that Manila can survive even the worst case: the disappearance of Middle East oil. Readjusting the behavior of households and firms should allow virtually all to function effectively with only fifty percent of 1979 imports.

The short-run adaptations to shortage imply mobilization of biomass supplies in the hinterland, conversion of cement-making to coal, rescheduling of commutation and operating times, a wholesale reduction in air conditioning, and substitution of communications for some air transport.

New information about energy conservation and solar technologies generated elsewhere in the world should be transmitted to the Technology Resources Center of the Ministry of Human Settlements. It has been designated to be a long-range planning center for energy and food issues.

Decentralizing Manila's growth does not promise to save energy. The most promising alternative small city site was shown to use as much energy per capita as Manila, but yielded a quality of life found noncompetitive by the youth. Moreover, it and other peripheral cities were due to be captured by Metro-Manila's expansion in the 1980s and 1990s. The best long-term solution seems to be installation of resource-conserving features into the expansion of human settlements in the Manila region.

VIII. POSTSCRIPT: CONFIRMATIONS AND REDIRECTIONS

The analysis of data, writing, checking with sources, and rewriting in this brief monograph took many months, so the reports coming out of Manila for a half year after leaving the scene could be incorporated in the argument. If the ecological observer had remained in Manila's busy environment, he would have missed many of the gradual changes going on around him. This would be a loss, because the phenomena most important for *evolution* would not be detectible. An occasional visitor, especially one who has had an opportunity to observe a number of other urban ecosystems, can obtain contrasting snapshots in multidimensional depth. Systematic social scientists usually label observations like these "continuity and change;" they are trying to understand which transitions from one local state to another are likely and which are unlikely, and deduce what might happen if drift continues in the direction it had begun.

Seeing Manila fifty three weeks later allowed a few adjustments to be appended. As expected, the short-range forecasts were confirmed within the errors of measurement. But some new relationships came into view; they perceptibly shift patterns in the foreseeable future.

One important observation made when analyzing the ecostructure of Manila was that city-supporting action was growing faster then the human population, that the region-supporting

institutions and transactions were expanding more, the nation-serving still more, and the world-serving most of all, often at a twenty- to thirty-percent annual rate. Observations will be organized according to this ascending level of integration, noting significant trends in the surrounding areas last. The items are focused upon energy and its substitutes.

Life Supports

The spring and summer were dry, so the reservoirs did not fill. Hydropower for 1980 will be down ten percent or more from expected levels. This meant that fuel oil required for thermal plants, imported at peak prices, made up the difference. Oil imports for the Philippines went up from 1.6 billion pesos in fiscal 1979 to 2.7 billion in 1980. Consequences: escalating inflation, far beyond anticipations. Poor people are most affected, so the minimum wage was raised, causing job shrinkage.

The lifeline level for electricity was set at 200 kWh per month per household, which is being subsidized. At 650 kWh steep surcharges set in.

Flora/Fauna

Metro-Manila aides make great progress in the greening of boulevards and avenues.

The discovery has finally been made which allows a *bangus* crop to be raised in a fish hatchery. This will intensify fish culture on the swampy fringes of Manila.

Human/Habitat

Inflation and unemployment are reducing the growth of niches for people to survive in Manila. Net immigration must have been strongly reduced because of the increased stress on the poor. Unemployed people with farms or homes in the provinces are shipped back three months after they become dependent upon social welfare.

Improvement of housing and services in the urban core gains momentum.

Community/Metropolis

Steady improvements in the road networks and in bus equipment, combined with a sale of only 50,000 new vehicles instead of the expected 70,000, led to a smoothing of circulation and a speeding of flows.

With the computerization of the first exchange under way in Makati, the telephone system is also adding a seventh digit to the telephone numbers—a scale absolutely necessary for modern service in a 10,000,000-size metropolis, but requiring an expensive and inconvenient transition that is easily postponed by less forward-looking managements.

Control Systems/Organizations/National Bureacracies

The supply of computer programmers is suddenly threatened by a series of offers coming from Saudi Arabia.

Auto and petroleum products manufactures and distributors suffer large financial losses. Mining firms, sparked by the precious-metals boom, expand into the gap.

The Ministry of Energy is urged to complete its Ten-Year Plan in half that time. This implies accelerating the geothermal installations, which are going well, speeding up coal mining, transport, and utilization, emphasizing biomass uses and small hydro plants, while slowing down the big dams. Nuclear power development has been resumed, but will take at least six years.

Knowledge

The Agriculture Department of the University of the Philippines, Los Banos, has assembled the recently acquired information on *ipil-ipil* through the holding of an international confer-

ence. Its characteristics for hardwood lumber, posts, transmission poles, railroad cross-ties, floors, plywood, "living fence" windbreaks, and leafmeal feeds were compiled.

Batangas, the satellite city 150 minutes to the south, intergrates the new information about energy conservation and appropriate technology by creating a mini-park with a windmill and the International Rice Research Institute's pump using human foot power for irrigation. Also a biogas generation is cleverly linked to a pump-waterwheel cycle, and advertised as a "perpetual motion" machine.

Resilience to Energy Shocks

The Philippines are drawing upon their last-ditch sources of credit to meet the current deficit caused by energy prices.

The capacity to store petroleum reached 105 days of consumption in mid-year. On the other hand, the local production of petroleum is now expected to be ten to fifteen percent of normal requirements, instead of the twenty to twenty-five percent assumed in the scenario. The two shifts almost exactly counteract each other, so the scenario for the response to the "worst case" remains basically unchanged.

An LPG terminal will be created at Batangas as an expert processing zone. About seventy percent of the propane and butane will be shipped on to Hong Kong. A dozen industries will cluster around the terminal, serving both the Philippines and Southeast Asia. Wherever installations are replacements for prior facilities, the new plants will be energy-conserving. Another five percent of capacity will be added to the Manila region energy stocks about two years from now. Manila is helped because its rents are so much lower than in Hong Kong. Every little bit of economic stockpiling cushions the bottom of a future crisis.