Peri-Urban Electricity Consumers—

A Forgotten but Important Group: What

Can We Do to Electrify Them?

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PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance program run as part of the World Bank's Energy, Mining and Telecommunications Department. ESMAP provides advice to governments on sustainable energy development. Established with the support of UNDP and bilateral official donors in 1983, it focuses on the role of energy in the development process with the objective of contributing to poverty alleviation, improving living conditions and preserving the environment in developing countries and transition economies. ESMAP centers its interventions on three priority areas: sector reform and restructuring; access to modern energy for the poorest; and promotion of sustainable energy practices.

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FUNDING

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ESMAP Management"

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Acknowledgments

This report was prepared by Willem Floor and René Massé of the World Bank.

Acronyms

ESMAP	Joint UNDP/World Bank Energy Sector Management Assistance Programme
LPG	liquefied petroleum gas
LT	low-tension
MT	medium-tension
RE	rural electrification
UNDP	United Nations Development Programme

Units of Measurement

Ah	ampere-hour
kWh	kilowatt-hour
mm	millimeter
W	watt

1

Introduction

1.1 The lack of sufficient and sustainable supplies of energy constitutes what might be called an "energy poverty" or "resource poverty" that affects as much as 40 percent of people living in developing countries.[1] The lack of efficient, clean energy:

- Impedes development by inhibiting investment in productive activities
- Wastes human resources and reduces the productivity of current activities
- Threatens the environment through emissions of greenhouse gases and air pollutants.

1.2 Between 1970 and 1990 more than 2 billion people in developing countries were connected to electricity supply grids. At the same time, however, population growth has prevented all but the slightest increase in the electrification rate in the household sector, and the poor have not increased their access to electricity.

1.3 In this paper we will concentrate only on the peri-urban population, because that group needs to be our priority target if we want to rapidly improve electrification in poor households. This is for several reasons:

- *About 40 percent of the world's poor live in peri-urban areas.* According to the UNDP, of 1.3 billion poor people, about 40 percent live in peri-urban agglomerations. In Latin America 90 percent, in Africa 40 percent, and in Asia 45 percent of the poor live in peri-urban areas.
- *Peri-urban households are easier and cheaper to electrify than unserved rural households.* Unlike rural areas, peri-urban areas are densely populated and located on the grid or very close to it. Generation, transmission, and distribution costs are much lower than in isolated rural villages because lower-cost grid extension is feasible. This immediately makes possible a large range of specific solutions (see Chapter 4).
- *Promoting peri-urban electrification could be a win-win solution for utilities and poor consumers.* What worries power companies is that peri-urban communities are close to the low-tension (LT) distribution grid and thus can easily get illegal connections. A well-planned peri-urban

[1] This report was completed in April 1999 and reflects events only until that date.

electrification scheme will create a sound environment for a profitable, and expanding, business—for the peri-urban households are the potential future consumers of the utilities.

2

Typology and Characteristics of Peri-Urban Areas

Typology of Peri-Urban Areas

2.1 We may distinguish between two types of peri-urban dwellers:

a. Those living in urbanized areas that the government has been formally accepted as part of the urban scene. Often there are already public services and even infrastructure investments. In short, these are legal urban dwellers.

b. Squatters living in spontaneous communities (e.g., bidonvilles, favelas) that have sprung up around large cities. This population is considered to be in an *illegal* situation. Because this population is heterogeneous and growing rapidly, it often lacks a strong communal spirit. Governments want to discourage migration from rural areas, and providing migrants with services would give them a semblance of legality. Thus there are no government services—including roads, water, or electricity. The dwellers' illegal status means the area they inhabit may be bulldozed without notice or compensation. Only after years of gradually regularizing their situation might these people attain the legal status of urban dwellers.

Characteristics of Electrified Peri-Urban Areas

Low Consumption

2.2 The level of electricity consumption in peri-urban areas is typically very low. In many countries, such as Burkina Faso, India, Indonesia, Nepal, and Vietnam, the monthly consumption per household is below 25 kWh, whereas in others peri-urban households might consume between 50 and 100 kWh per month (Côte d'Ivoire, South Africa). There are even countries where the peri-urban client consumes between 150 and 200 kWh per month, such as in Argentina and Costa Rica; but this is still low in comparison with urban households. This low consumption also means that their contribution to total consumption is very low. In Jakarta in 1987, for example, the 25 percent of officially unconnected households that were using metered electricity represented only 6 percent of total residential demand. Providing access to electricity to all peri-urban households will thus increase the overall consumption of electricity by only 10–20 percent, which may obviate the need to upgrade the LT distribution network.

High Non-Technical Losses

2.3 Both the level and the variety of non-technical losses are high. For example, in Buenos Aires, the energy company Edenor[2] found in 1996 that 42 percent of its clients were in an irregular situation (illegal connection, non-payment). Similarly, SNEL[3] in Kinshasa, Uganda, determined that 30 percent of the population surveyed had an illegal connection. But illegal connections are not the only form of non-technical loss: there are both (a) tampering with electricity meters to reduce the formally recorded consumption and (b) agreements with meter readers to record a lower consumption. A variant of this is the billing of a client at a level lower than his real consumption, or his non-billing.

High Level of Arrears

2.4 In addition, there is the non-payment of bills, which is particularly high in the case of public distribution companies. Many consumers consider electricity consumption a right for which one need not pay unless forced to; it does not help that the government usually sets a bad example by being an even worse payer of its bills. In addition, bill payment is not always made easy for consumers, because of long distances to the billing office and the extra transportation cost involved for poor consumers. Also, the monthly billing statements, which may vary according to the tariff system, may outpace the consumer's cash flow, even though he or she might be willing to pay. Finally, billing systems are often cumbersome and technically inadequate. This not only raises the overhead costs of managing peri-urban consumers to a level that sometimes outstrips revenues derived from the service (see next section); it also causes disputes between the company and its customers about the system's reliability.

High Overhead

2.5 Although the figures in Table 1 are merely indicative, they nevertheless show that the impact of the overhead is higher when consumption is lower, which makes it less attractive to connect peri-urban consumers. Exacerbating this are a high incidence of non-payment of bills, a high level of high non-technical losses, and a low level of peri-urban monthly consumption. Also, in absolute figures, the overhead of distribution companies is about the same across countries; however, the use of users' groups appears to reduce overhead significantly.

2.6 Thus, if the overhead of managing electrified peri-urban areas is very high this is usually caused by:

- A high level of unpaid bills
- A high level of non- or under-billed consumption
- A low level of consumption per individual consumer.

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2 Empresa Distribuidora y Comercializadora Norte, S.A.

3 Société Nationale d'Electricité.

Table 1. The Cost of Overhead for Serving Electrified Peri-Urban Areas in Various Countries

Overhead	*South Africa*	*Argentina*	*Côte d'Ivoire*	*India*	*Nepal*
Billing system	pre-payment	monthly bill	monthly bill	flat fee	users group
Annual overhead per consumer (FF and *US$)*	180 *35.3*	120 *23.5*	150 *29.4*	100 *19.6*	13 *2.5*
Average consumption (kWh/year)	1560	2400	720	150	200
Overhead for managing consumers (FF/kWh and *US$/kWh)*	0,12 *0.023*	0,05 *0.010*	0,21 *0.041*	0,55 *0.108*	0,07 *0.014*
Overhead as % of average tariff	50	10	44,7	26–150	35

Note: 1 US$ = 5.1 FF.
Sources: Massé and Conan 1996, p. 11. World Bank, *World Development Indicators* 1996.

Low Rate of Return

2.7 The rate of return on investment in distributing electricity to peri-urban areas is much lower than in the cities they surround. Although the investment costs per kilometer of line are the same, in peri-urban areas the number of clients per kilometer of line is much lower, as is the unit consumption of households, which ranges from 15 kWh per month in India to 200 kWh per month in Argentina (see Table 1). For the utility this translates into a high connection cost per customer as well as low revenues. At the same time the non-technical losses are high, as are capital and O&M (operation and maintenance) costs.

3

Feasible Ways to Electrify Peri-Urban Areas

3.1 A full range of viable and commercial solutions is available to the problem of bringing electricity to peri-urban and rural areas. Cost recovery probably is the single most important factor determining the effectiveness of such programs, in addition to reducing capital costs. Commercially oriented distributors would expand service, if profitable, to low-income areas neglected before the restructuring, because:

- They will manage cash better
- They have fewer constraints on funding capital works
- Once a connection is made, incremental supply costs are often less than average system costs
- Wide cost (i.e., incentive to subsidize access cost)

3.2 To improve cost recovery, distribution companies must ensure that their commercial department is efficient and proactive and that measures are in place to reduce the scope for arrears by private consumers. This requires client management—that is, managing arrears if not preventing them altogether. Amongst preventive measures, we can distinguish between technical and non-technical measures.

Non-Technical Measures

3.3 Non-technical options include the following:

- *Advance payment of consumption.* In various countries consumers, when they receive their electricity connection, have to make a down payment, which serves as a guarantee, corresponding to one or two months of their consumption. This down payment explicitly serves as a preventive measure against non-payment, because the consumer knows that the distribution company is allowed to use the down payment to settle the arrears. In Cameroon, for example, the level of the one-month consumption down payment varies with the level of amperage. In Burkina Faso and Mauritania, the down payment represents two months of consumption, but it is three months in India and Bangladesh, and even seven months in Indonesia. Although this measure provides a nice addition to the company's treasury, it is an obstacle to the increase of access. In rural areas, the mechanism of a collective guarantee is used, where the peers of a prospective consumer commit to pay his arrears, if these were to occur.

- *Reduce distance between consumer and billing office.* One of the reasons customers fail to pay their bills is the time and money they must spend to do so: the office of the distribution company is usually located in the city at a great distance from the peri-urban area. However, because opening peri-urban billing offices is too expensive for the distribution company, other innovative means must be developed. In Buenos Aires, for example, Edenor certifies shopkeepers to serve as billing/payment offices. Their shops are well marked as such, and shopkeepers receive between 0.4 and 1 percent of the collected sums.

The Pre-payment Method of Preventing Arrears

3.4 Pre-payment mechanisms are like that of the down payment, with the difference that it is not a guarantee that the company keeps, but only an advance payment of future consumption. There are various technical solutions for realizing the pre-payment. In addition to the pre-payment meter (see below), there is a product called the Enerkey[4]—a plug-in key that, when inserted in the contact, triggers the electricity supply. When the key's charge is exhausted it has to be recharged at a level ranging from one week to one month's worth of consumption.

3.5 The pre-payment meter itself is a conventional meter with a magnetic circuit breaker and an electronic controller. Typically the consumer goes to a designated sales point and buys either a card or a pass number. The card can be of any value: it is like buying a phone card, except in this case the customer is buying kilowatt-hours. The machine at the sales point records the sale to the customer's personal number. At home the consumer passes the card through the electronic controller that reads the number of kilowatt-hours bought. The customer is electronically forewarned when his hours are running out.

3.6 The pre-payment method is not, however, a *passe-partout* for resolving issues such as fraud (except for the Enerkey, which is fraud-proof). The meter (not the card or the pass number, which only function for the designated meter) can be and is circumvented by consumers by, for example, bypassing the meter. In South Africa, for example, the level of non-technical losses accompanying the use of pre-payment meters is 20–30 percent; in certain parts of Cape Town, it can be as high as 70 percent. Adopting a pre-payment method does not substitute for good management.

3.7 Monitoring the occurrence of non-technical losses thus remains critically important. The company must work hard to inform consumers that the pre-payment meter is there to help them gain access to electricity, not to provide it free of charge. That is, it is like buying groceries at the shop: you buy when you have the money, and if you do not pay, no credit is given and you are cut off from any service. This requires getting used to, and not only for the consumer. The company too has to realize that it should be doing business in a different manner, for it does not bill for kilowatt-hours used, but rather sells

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4 See <www.enerkey.com/eng>.

kilowatt-hours not yet consumed. Thus, because the company is selling a product instead of a service, the nature of its business has changed.

3.8 The advantages of the pre-payment system is that it does not require meter reading or billing, it avoids the cash strain of periodic bills for consumers, no costs are incurred when consumers move to another location, and there are no complaints of errors in meter reading and/or billing. In the case of the Enerkey, it is also fraud-proof. The prepayment meter has the disadvantage that its cost is high, it can be circumvented, and it requires a well-organized support infrastructure. Just like the sale of kerosene and liquefied petroleum gas (LPG), the prepayment cards require that the service be brought close to the customer. This means that a widespread and decentralized network of agents must exist to sell and recharge prepaid cards and monitor their use.

Box 1. In South Africa, ESKOM Offers a Varied Service to its Potential Customers

ESKOM makes a distinction between poor rural and peri-urban consumers. Peri-urban clients are offered a scheduled pre-payment system:

- A pre-payment meter of 8 A for 60 FF (US$11.76) and a tariff of 0.30 FF/kWh (0.058 US$/kWh)
- A pre-payment meter of 20 A for 250 FF (US$49) and a tariff of 0.32 FF/kWh (0.062 US$/kWh)
- A pre-payment meter of 60 A for 500 FF (US$98.04) and a tariff of 0.34 FF/kWh (0.067US$/kWh)

For rural consumers ESKOM offers, at no cost, a load limiter of 2.5 amperes (A) for a flat monthly fee of 20 FF (US$3.92) (see under "Load-Limiting Measures" in the next section).

After the Arrears Occur

3.9 In case there are arrears, distribution companies currently have the following options:

a. If a formal warning of the customer does not result in payment, the company can disconnect the customer, take away the meter, and start procedures against the customer. This is the standard process set into motion when a customer refuses to pay his arrears. For example, in Cameroon, in the case of arrears, SONEL (Société Nationale d'Electricité) firsts disconnects the household (i.e., the circuit and lead). If the bill remains unpaid after two months, the meter is taken away; after six months, SONEL uses the down payment to settle all or part of the arrears. If the bill was only partly paid, the consumer is also disconnected and his file is flagged in case he demands a new connection in the future. However, these traditional processes are cumbersome and costly. Also, the pre-paid consumption of one or more months increases the connection costs and thus discourages low-income PE consumers from getting easy access to electricity. It is therefore better to abolish the pre-paid consumption fee and apply a more flexible, effective, and cheaper mechanism for disconnecting consumers. This is also necessary because disconnecting peri-urban consumers is sometimes a dangerous undertaking—power company staff have been threatened and beaten up. In Buenos Aires, Edenor has tested a local distribution box installed high on a 12-meter pole; each consumer connected to that box can be disconnected via an infrared remote signal transmitted by an anonymous Edenor employee simply driving by on a motorbike.

b. If the company wants to get all of its arrears it may have to take a consumer to court. In most countries this is not easy because the rules are restrictive and the consumers concerned are usually indigent and lacking a fixed address. Because the cost of this procedure may therefore be higher than its potential benefits, many companies only have recourse to this option if the unpaid bills exceed a certain sum. Apart from the potential monetary benefits, it also sends a strong signal to those who are also in arrears.

Reducing Technical Costs

3.10 Companies can reduce technical costs (a) in the distribution network or by using (b) load-limiting measures or (c) low-cost, prefabricated wiring.

In the Distribution Network

3.11 Cost reduction includes a variety of technical cost reductions in the MT-LT distribution network. The scope for cost reduction is significant (25–50 percent) and much higher than is usually assumed. Given the different consumption levels of peri-urban consumers, there is no need to apply the normal technical standards for reliability and safety in the LT distribution network. What is needed is technical and managerial innovation—or as much as is possible in developing countries given the often inhibiting legislation and risk-averse habits of government and utility staff.

3.12 This innovation can take various forms. First, cheaper forms of MT and LT lines can be strung in peri-urban areas, and these in the form of single-phase lines, without restricting the use to which electricity can be put.[5] Second, poles of 7–8 meters instead of 12 meters should be used, preferably wooden ones; this should cut LT distribution system costs by about 50 percent. These two innovations are among the measures applied in peri-urban distribution systems in countries such as Côte d'Ivoire, Gabon, Morocco, and Vietnam.

3.13 In addition, in rural areas of Vietnam and Nepal, bare conductors have been used (insulated only in inhabited areas), while in Gabon 4 x 25 mm^2 aluminum cables have been used. Finally, there is a relatively untried option that has nonetheless yielded good results in Nepal and elsewhere: the installation of properly sized transformers (in general, a larger number of smaller transformers), which reduces the overall cost of conductors and/or losses in the LT system (ESMAP 1999).

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5 There is no danger, for example, that existing or future investment in three-phase equipment cannot operate with single-phase supply, as experience in Australia, the United States, and elsewhere has shown. Nevertheless, this is a common argument against the application of the single-phase systems, particularly in francophone countries such as Côte d'Ivoire.

Load-Limiting Measures

3.14 The connection cost can be reduced by introducing load limiters with a fee-for-service arrangement. There are three kinds of load limiters: the miniature circuit-breaker, the positive temperature coefficient thermistor, and the electronic current cut-out (Smith 1995, p. 14). The various advantages and disadvantages are shown in Table 2.

Table 2. Advantages and Disadvantages of Load Limiters

Advantages	*Disadvantages*
- Low billing cost	- Restricted use of electricity
- Reduced cost of generation, transmission, and distribution	- Increased opportunities for theft
- Low connection cost	- Poor reliability
- Pre-payment to the utility	- Poor accuracy
- Easier budgeting of payments by the consumer	- Uneconomic use of electricity

3.15 The markets for load limiters in particular are those of consumers who use (a) little electricity and (b) normal quantities but with sudden bursts for high power demand, such as the use of irons. For households using less than 25 kWh per month (for perhaps a few lamps and a radio) a limiter of 5–250 watts is sufficient. The technology provides the solution that is financially and technically appropriate (simplicity, low billing and connection costs) for this category of consumers. The main obstacles are consumer acceptance, reliability, and bypassing. The first problem should be dealt with through education, and the other two through the development of more robust limiters located out of the reach of consumers.

3.16 Experience with load limiters is mixed. Although they have been discontinued in Malawi and Uganda because consumers preferred metered electricity, Zimbabwe has used them with success since 1960. South Africa wants to apply them on a larger scale but will not for fear of the political fall-out that might ensue.

Low-Cost, Prefabricated Wiring

3.17 In certain countries the cost of internal wiring can be so high so as to create an obstacle to access to electricity. Introducing prefabricated wiring may help overcome this barrier. This involves installing either a wiring harness or a motherboard, the two best-known options. A wiring harness—a prefabricated internal house-wiring system in standard sizes with in-line switches and light fittings—is best for consumers using 1–2 lamps and a radio. The harness is used in conjunction with load limiters and, if the consumer wants a higher load, the harness can be upgraded to permit extra loads. An alternative or addition to the prefabricated wiring harness is the motherboard, which is more expensive and allows the use of more appliances and high current appliances. The motherboard provides consumer protection as well as facilities for connecting cables, conduits, sockets, and circuit breakers. Some units come with a top-mounted light, and this system is often the only appliance used by low-income consumers.

Densifying Connections to the Existing Grid

3.18 Because the density of consumers per kilometer of LT line is often low, it is important that the distribution companies try to densify their peri-urban consumer base.

This also can take various forms. In the first place, connection charges should be low (certainly for low-income consumers), while the investment cost should be recuperated through the tariff. (See Table 3.)

Table 3. Connection Costs in Various Countries

Country	South Africa	Cote d'Ivoire	Gabon	India	Indonesia	Nepal
Cost	150 FF *US$29.4*	300 FF *US$58.8*	300 FF *US$58.8*	100–150 FF *US$19.6–29.4*	75 FF (5 A) *US$14.7*	250–300 (10A) *US$49 – 58.8*

Note: A amperes.
Source: Massé and Conan 1996, p. 28.

3.19 Power companies have attracted thousands of new customers by lowering connection costs. For example, SONEL in Cameroon reduced the charge by 25 percent and acquired 18,000 new clients. In Zaire a reduction of 10 percent resulted in 20,000 new consumers.

3.20 If the connection charge cannot be reduced, the company may extend credit. The consumer may not be able to pay the high up-front sum, but he can often pay the regular repayment, based on his income and savings on the use of other fuels.

Demand Management

3.21 To further reduce the cost for consumers, the distributor may consider initiating a simple demand-management program. This could take the form of recommending to consumers, and helping them learn how to use, low-consumption lamps such as 8–15-watt fluorescent lamps. The resulting lower demand throughout the LV network will allow a more appropriate design of the distribution systems and thus the use of minimum-tension (MT) lines—and thus a less costly system.

Batteries

3.22 Sometimes the possibility exists for batteries to be used in conjunction with grid supply. Although this may seem ridiculous at first, it becomes an economical proposition when power systems are constrained by peak capacity shortfalls and low cost base load (Bangladesh is a typical example). In such situations, the system can switch off consumers during the evening peak and power small rural loads using grid-rechargeable batteries. Most of the times, car batteries are used in peri-urban households, recharged from the grid outside their zone. ESMAP-financed surveys in Chad, Kenya, Mali, Mauritania, Uganda, and Zimbabwe have shown that the number of households using batteries is surprisingly high: between 5 and 10 percent.

3.23 Using a car battery does not come cheap for the end-user. The costs for a typical charge range between US$0.5 and US$1, to which the costs for transport should be added. The equivalent kWh costs range between US$1 and US$3. A 100-Ah battery that lasts 1–2 years and costs US$100 which will add approximately US$2 per kWh, making the total levelized costs of electricity from a car battery quite high: between US$3 and US$5 per kWh. This should be compared to the urban subsidies often provided through utilities because "consumers cannot afford to pay high tariffs."

Retrocession of Electricity

3.24 Retrocession of electricity, a practice usually forbidden, nevertheless is commonly practiced in peri-urban areas by households connecting to a neighbor's electricity supply using a simple electricity cable. The rate is either the same as what the connected household pays or, more frequently, a higher rate, usually expressed in a flat fee for a specified service (such as one TV and/or radio and/or three 60-watt lamps). In 1988, although only 60 percent of households in Jakarta were connected to the grid, a PLN[6] survey showed that in reality 85 percent were receiving electricity; the additional 25 percent obtained their metered electricity from the grid through this informal neighborly system. This shows that the poor have effectively sought to avoid the capital costs, the monthly power charge, and the trouble involved in obtaining a connection from the distribution company officials, by sharing a connection, though they end up paying higher block rates for their electricity (ESMAP 1990, Vol. 1, p. 17).

Communal Connections

3.25 Another way to bring electricity to peri-urban areas at reduced cost is to introduce communal connections. In Cambodia, for example, the distribution company sells power to a wholesaler—that is, someone with an electricity meter who pays the electricity bill to the power company. He has a small, primitive, monophase distribution system, which in the case of the poor is shared by more than one customer. Trees, car pieces, bamboo or wooden poles, and the like all serve as distribution poles. The consumer pays all losses, technical and non-technical, because the meter is at the wholesaler. Protection only exists in the form of fuses put on the main interrupter (one on the pole, the other in the house). Although the distribution company has formally set the tariff, the wholesaler often asks a price that is 2–3 times higher. Through this system the Cambodian power company has been able to quickly electrify most of the city, while for its billing it has to refer to only 250 wholesalers. Because of this and the reconstruction of the distribution grid, the non-technical losses on the MT system have been reduced by 50 percent.

3.26 However, the high number of complaints has prompted the Cambodian power company to consider abandoning this wholesaling system. This is unfortunate: although the system has its drawbacks, each household is in fact not paying more (even when its tariff has been illegally trebled) than it would be (or was) paying when using a car battery to power its television and a few lamps. In fact, the main source of friction is the knowledge that some households in the same area pay the power company less for the same service. Better regulation and a more stable political situation would take care of these negative aspects.

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6 *Perusahaan Listrik Negara*, the state-owned Indonesian electricity company.

Lifeline Rates

3.27 "Lifeline rates" for very low blocks of electricity consumption generally facilitate access by poor and rural people without creating significant efficiency losses. For urban areas such a rate could be defined for a basic consumption level of about 35 to 40 kWh per month; in rural areas, about 25 kWh per month. The poor consume very little electricity, so the subsidy is well targeted and does not require means testing. This is also why the lifeline rate's initial block should not be set too high: that would make it a general subsidy. Another attraction of the lifeline rate is that it is not easy to divert the subsidy to other income groups, because electricity cannot be stored and resold. Also, it does not create a financial problem for the electricity company because the company does not receive much income from the poor. Finally, lifeline rates are not really necessary because lack of access, not income, is the main obstacle for low-income households and lifeline rates work against the objective of providing access to electricity for the poor by encouraging cost-based energy prices.

Fee-for-Service Principle

3.28 Companies should use the fee-for-service principle where feasible. This could take the form of load limiters with a fixed lump-sum payment each month. It will be necessary to place a meter at the top of a pole to verify the level of consumption and regularly evaluate the level of the flat monthly fee. A variant of this option is to allow a number of households to have a communal meter, which will be in the name of one person. This person will be responsible for collecting electricity payments from the other households. If there is a difference between the more precise metering device of the distribution company (placed high on a pole) and a series of these communal meters, the difference is paid by the subscribers pro rata their consumption. This is the case in Vietnam, for example, where EVN (Electricité de Vietnam) lacks the capacity to connect every household that wants to be connected. Those households connected and metered thus have the formal right to sell electricity to non-connected households.

Pre-Payment Systems

3.29 If these forms of simplified connections are not possible, another option is the use of pre-payment cards to avoid cash-flow problems due to periodic bills for small consumers. As with the systems mentioned earlier in this chapter, the pre-payment meters do not constitute an anti-fraud measure, because they can be circumvented just like the conventional meters. (They mainly serve to bring down the level of unpaid bills by making it easier for consumers to pay when they have money.) It is not a cheap option either, particularly when taking into account the low level of consumption in peri-urban areas. However, households prefer pre-payment systems to load limiters.

Scope for Continued Cross-Subsidies

3.30 With the advent of power sector reforms, the scope for cross-subsidies to help low-income consumers can be reduced significantly, depending on the nature of the reform.

3.31 For commercialized, state-owned, vertically integrated monopolies there remains substantial scope for cross-subsidizing low-income consumers under a performance contract. This is the case in Côte d'Ivoire, where a special development fund has been financed partly through a cross-subsidy from other consumers and partly by a line item in the national budget. In addition, all new rural and peri-urban electrification is tax-exempt.

3.32 For unbundled structures (especially distribution separated from generation and transmission), the scope for subsidization is limited to each distribution franchise, for there will not be a uniform national tariff. In Argentina, for example, Edenor in 1994 came to an agreement with the central government and that of the province of Buenos Aires whereby the latter two systematically pay the equivalent of the VAT that is levied on the electricity bills of the poor into a special fund that serves to finance the electrification of all poor city quarters. As a result, Edenor has been able to connect 100 percent of the families in its peri-urban zone of distribution.

3.33 Finally, in the case of isolated load centers, particularly for rural and peri-urban electrification, the bulk supply cost can be subsidized at a low transaction cost.

4

Why Should We Worry About These People in The Dark?

4.1 Given that measures to electrify peri-urban areas can be highly unattractive, why should we worry about these people in the dark? There are several reasons. The Bank's mission is poverty alleviation and most of the world's poor live in peri-urban areas. Energy development helps reduce poverty because economic growth requires energy. Also, the nature and geography of growth matter, and thus peri-urban areas should be targeted as well as other areas. In addition to these general links between energy development and poverty alleviation, there are a number of specific reasons why we should increase access to electricity in peri-urban areas.

They Already Pay a Great Deal for Inferior Services

4.2 Those household not connected to the grid (or in the case of power outages) generally use kerosene for lighting purposes and/or use car batteries for both lighting and TV viewing. Typically, 50 percent of urban households spend about US$24 per person/month, and 25 percent about US$90 per person/month for lighting and TV. The efficiency of lighting with electricity is much higher than with kerosene or candles. One 60-watt light bulb has an output equivalent to 18 kerosene wick lamps and uses much less energy to produce that output. Thus the use of kerosene for lighting in urban households is significantly more costly to the nation and to households than the use of electricity. Households pay much less for a much better quality service when using electricity. The price consumers pay for their lighting service depends on government policy. In countries that promote universal service, both poor and rich urban households can avail themselves of this superior service. Poor urban households pay more, however, when access to electricity is not promoted, or even discouraged, by government policy or practice. Because in most countries kerosene is an imported fuel, the financial and economic cost is usually higher than the promotion of electricity. This is because of the superior efficiency of electric lighting, and because low-income urban households usually pay less for lighting than the rich due to the social tariff that they enjoy.

Adding Electricity to Other Activities Has an Accelerator Effect

4.3 Recent studies have shown that households will benefit significantly if they have access to electricity as well as sanitation, water, and telephone services.

Households who enjoy these services have a significantly higher growth rate of per capita consumption than households lacking such access. Equally significant, however, was the finding that the bundling of these services was even more important: the additional positive impact of one new service increases with the total number of services available. For example, in Peru it was found that electrification and sanitation services increased the returns to education significantly in both rural and urban areas (World Bank 1998, pp. 31–2).

They are Power Companies' Future Customers

4.4 The primary cause of the low penetration of electricity in the urban areas of the developing world is limited access to service. This stems from the company either not extending service to some parts of the city or charging high initial connection fees to discourage connections. When access is possible and facilitated, even low-income households in urban areas will chose to use it, although most often at low level of consumption. Also, increasing the number of consumers served can reduce the effective cost of electrification. By using appropriate lower-cost technology the revenue base can be increased at minimum cost. Thus, the near-universal desire for electricity, regardless of income or tariff, should be the guiding light for distribution companies to satisfy this unmet demand. Adoption of electricity is governed by access, though consumption is determined by income (ESMAP 1997).

4.5 One explanation for the wide adoption of electricity even at low levels of use is that low-level urban consumers use electricity primarily for low-demand uses such as lighting and black-and-white TV. The reason is that electric lighting provides a much higher quality for less money than kerosene, even at economic prices. A study in Indonesia (see Table 4) showed that electricity is not only less costly for the poorest households (112 rupiahs instead of 218 rupiahs, or almost 50 percent less), but also provides them with ten times more light than kerosene, of much better quality. It also gives the poor a cheaper alternative to the cinema and other public entertainment as well as a window on the world outside their immediate environment. Low-income users are willing to pay the economic tariffs involved. The result has been a welfare gain of 52 percent for the poorest 20 percent of urban households.

4.6 Households with access to electricity enjoy more and better lighting, which makes a host of labor-saving devices possible. Families can read without the strain, noise, and odor experienced with kerosene lighting. Women may engage in additional income generating activities in the evenings. The positive relationship between educational opportunities made possible by electric lighting and higher lifetime earnings as well as health benefits and public safety is well documented.[7] In addition, people are willing to pay for the services provided by electricity.

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7 Barnes 1985; Fitzgerald, Barnes, and McGranahan 1990; Taubman and Wales 1974; Paliwal 1985; Medical Research Group, Electrification and Health (Cape Town 1997).

Table 4. Advantages of Electricity over Kerosene for Urban Consumers in Jakarta, Indonesia, 1987

Income group	*Lowest 20 percent*	*20–40 percent*	*Total Sample*
Lighting demand (kWh/HH/m)			
Before electricity	22	288	414
After electricity	218	244	350
Cost of lighting (Rp/kWh)			
From kerosene	112	112	112
From electricity	6.3	6.3	6.3
Value of access to electricity			
Rp	23075	30485	43821
US$	13.19	17.42	25.04
Welfare gain as percentage of total HH expenditure	52	34	25

Note: Rp rupiahs. HH households.
Source: Peskin and Barnes 1994.

5

Peri-Urban Electrification as Part of Sector Reform

Institutional Arrangements Are Essential

5.1 An effective institutional framework is essential to any effort to reform the energy sector. Several factors weigh against private initiative in this arena. Private businesses naturally seek the highest rates of return, which generally means serving the most profitable markets first. For its part, the public sector has directed the small investments necessary to serve poor energy consumers largely toward government- and donor-selected interventions. When these targeted interventions have proved ineffective, they have often been aggregated into projects big enough to justify the further investments of government staff time and resources. Such top-down planning has often led to unwieldy, ineffective, unpopular, and unprofitable projects.

5.2 Two other factors are (a) uncertain safety conditions, which cause power companies avoid peri-urban areas so as not to risk their staff and investments, and (b) the lack of street addresses, which, because automatic billing is impossible, call for special mechanisms to bill customers.

5.3 The power companies' reluctance is being reinforced by the regulatory and incentive frameworks in which they must to operate. For example, in many countries power companies are not allowed to extend service to consumers living in peri-urban areas that, as yet, have not been adopted in the land registry as "urban." In Côte d'Ivoire and Tanzania a potential customer for an electricity connection needs a land registry number. In Argentina, a property deed or police certificate is required. In Gabon an all-weather road must exist before the utility is allowed to connect the house and/or place a meter. In South Africa, even if there is no problem with the address, the dwelling needs to satisfy security requirements that effectively exclude most shacks. As a result of current policies, distribution companies are ignoring peri-urban consumers, who constitute a major market.

Sector Reform Offers a Good Opportunity to Increase Access

5.4 The process of power sector restructuring (including, in several cases, the privatization of distribution) that has begun in many countries constitutes an opportunity for electrifying a large number of peri-urban (and rural) households. As is clear from the foregoing, because peri-urban electrification may not be financially attractive under current conditions, it is unlikely that privatize utilities will invest in peri-urban electrification. The subsidized public utilities that preceded them did not do much along these lines either. It is a telling fact that, so far in most power sector restructuring projects, the issue of access is usually ignored. However, from the little experience that is available it is also clear that the private sector is willing to carry out peri-urban electrification, if it is given the right incentives.

5.5 Under commercialization and privatization, both objectives of power sector restructuring, electricity prices generally have to rise—particularly for residential consumers, because these have usually been heavily subsidized. These mandated subsidies on electricity are generally counter-productive to improving supply quality because they undermine managerial autonomy. Although policymakers concerned with the equity implications of energy policy may be tempted to (continue to) provide energy price subsidies to the poor, they are more likely—with a few exceptions noted below—to help the poor gain access to energy services by encouraging cost-based energy prices and taxes.

5.6 The principle of pricing energy at the cost of energy supply or at the market price (see Box 2) is the proper policy for two reasons. The first is that targeting energy product subsidies to the poor often means that the poor end up without any energy service. That is, when supply (especially of liquid fuels, such as kerosene and LPG, used by poor and middle-income groups) is limited and the same product earns different revenues from different classes of consumers, sellers—legally or illegally—gravitate toward the most profitable, highest-priced markets; therefore the poorest are deprived of an opportunity to buy. The second reason for sustaining economic fuel pricing is that the import tariffs and taxes countries impose on modern fuels also end up hurting the poor, particularly in urban areas where all fuels are sold commercially and modern fuel prices act as a cap on traditional fuel prices. Thus, taxes that raise the effective price of more desirable modern fuels encourage retailers to raise the prices of scarce wood and charcoal prices as well. The poor end up spending a greater share of their income on energy (in urban areas, poor consumers often spend 15 percent of their cash incomes on energy—three times more than richer households).

5.7 Thus, not only do low-income consumers benefit least from electricity subsidies; they can also absorb large increases in electricity prices. Eliminating subsidies will aid power sector reform, which is necessary to promote increased access to electricity for all consumers, including low-income consumers. Otherwise, the subsidies will impede efforts to improve access to electricity because they undermine the suppliers' managerial autonomy. Also, the subsidies mainly benefit middle- and high-income consumers. Therefore, under restructuring, tariffs generally have to rise, in particular for residential consumers. As many studies have shown, large increases in electricity tariffs have a minor net macro impact, because the inflationary impact of raising the tariffs would be balanced by the deflationary effect of reducing government credit (ESMAP 1996).

Box 2. The Impact of Energy Price Reforms in Venezuela

In 1995 the Bank studied the social impact of removing energy subsidies in Venezuela. The study found that although the middle and upper classes, which benefit the most from energy subsidies, would thus be most acutely affected by the subsidies' removal, the poor would also experience a significant impact. For example, in 1992 it was estimated that the higher income groups received about 41 percent of total subsidies. The richest consumers received a subsidy of about 100 dollars, whereas poor consumers received subsidies of only 15 dollars, mainly because they spend less money on energy. It was estimated that removing the energy subsidy would cause the poor to spend 1.7 percent more on energy and to reduce their energy consumption by about 30 percent—a significant loss in welfare. These findings show that although it is economically efficient to remove the energy subsidies, the government also must consider how to deal with the problems the removal would cause for the poorest income groups.

The study concluded that, if the government wants to subsidize the poor at current levels without resorting to general energy subsidies, the required direct subsidies would be on the order of 0.2 percent of GDP rather than the 8.8 percent of GDP that was the level of energy subsidies for the economy in 1993. The released subsidies could be used, for example, to build 41 thousand primary schools or seven thousand secondary schools each year. The benefit to the economy would be a greater efficiency of resource allocation.

Source: World Bank (1995), *Venezuela: Efficiency Pricing of Energy*, Report 13581-VE, Energy and Infrastructure Operations Division, Latin American and Caribbean (Washington, D.C.)

6

Conclusion: The Way Forward

6.1 A number of conditions must be met for peri-urban electrification to be financially, institutionally, and technically sustainable.

Political Support

6.2 Private sector entrepreneurs will not by themselves undertake peri-urban or rural electrification on a large scale. Where peri-urban electrification has been successful there was strong political support for increasing access to electricity. Of the relatively few instances of this so far, two stand out. First is the "Electricity for All" plan in South Africa, which is the expression of the government's will to increase access to electricity to all groups in the society, including the urban and rural poor. The second example is the agreement between Edenor and the municipal and federal governments in Argentina to provide electricity to the peri-urban areas of Buenos Aires. Both cases demonstrate the need for strong government support for a peri-urban electrification program to be effective. Both peri-urban and rural electrification represent more than just a public service: there are also strong elements of poverty alleviation and social solidarity that go beyond the objective of a purely commercial operation.

Innovation

6.3 The peri-urban areas around the world are different, despite sharing common traits. Therefore, no single solution exists to the problem of increasing peri-urban electrification—as is also clear from the preceding discussion and the various examples given. The technical and organizational solutions will depend on the socioeconomic context of each individual country. The one thing these solutions have in common was *innovation.*

Flexibility

6.4 The rules that apply for the normal urban network cannot be used for the peri-urban electrification network. The utility needs flexibility to bring to peri-urban areas a service that is both affordable to consumers and financially sustainable for the utility. This flexibility needs to be applied at least in the following areas:

- *Financing.* Without concessional financing, utilities or private individuals will invest little in peri-urban electrification schemes. It is therefore necessary that the government provide the necessary arrangements for extra-utility financing. This can take several forms. As mentioned in Chapter 3, Côte d'Ivoire created a special electricity development fund replenished through a surtax on the electricity tariff. In addition, all new schemes financed out of this fund are tax-exempt. In Argentina in 1994, the federal government and that of the province of Buenos Aires agreed that the latter would pay to Edenor all value added tax (VAT) from electricity bills marked "poor." This VAT money is only used for peri-urban electrification schemes, as a result of which Edenor has now an urban electrification rate of 100 percent.

- *Regulation.* To enable and stimulate investment in private, low-cost mini-grids, governments should allow retrocession of the sale of electricity, revise tariff regulations to allow a fee-for-service tariff, and promulgate technical and safety standards. The electricity law should also allow private individuals to invest in decentralized distribution systems in concession areas when the concessionaire does not or refuses to connect households that have expressed a desire to be connected to the grid.
- Governments usually discourage utilities from extending service to areas containing illegal squatters—that is, peri-urban areas. By contrast, in Buenos Aires, Edenor carried out a census of the entire population in the peri-urban zone; it then marked the streets, gave them names, and installed nameplates. In return it received financial support from the European Union, and peri-urban households now constitute 28 percent of its customer base. This shows what can be done if a utility, with the assistance of a proactive government, wants to extend access.
- *Technical standards.* The number and variety of existing appropriate technologies to distribute electricity are significant. Their application has resulted in substantial cost-savings, thus making peri-urban electrification possible. It is also clear that no single, standard technical solution exists and that, even within the same city, different technical solution are being applied. The challenge is to reduce distribution and connection costs. Although the technology to do so exists, the minds of the people (government and power company officials) have yet to follow in many cases. As has been seen in South Africa and Vietnam, substantial cost reductions can still be achieved without reducing safety and availability standards.
- *Tariffs.* Currently, tariffs are based on kilowatt-hours consumed, which may not be the most appropriate system for peri-urban electrification schemes. National electricity laws should allow utilities to offer a tariff system that is adapted to the various categories of peri-urban electrification consumers, taking into account the technical delivery systems that provide them with the electricity service. As mentioned previously, these may include collective meters, load limiters, and delegation of electricity distribution. To provide utilities with more flexibility, the traditional kilowatt-hour tariff (which in many countries

already includes a lump-sum lifeline tariff) should be allowed to co-exist with flat fee-for-service tariffs.

Close Monitoring

6.5 Non-technical losses will remain a challenge for the utility despite the various cost-cutting means it has applied to extend electricity access to peri-urban areas. People will find it difficult to change habits and will continue to try to get electricity for free. Monitoring is necessary to find fraud, supported by a clear and firm policy to deal with that problem. Consumers in peri-urban areas should be told up front that they will get electricity, but that they have to pay for it. The utility's policy should be aimed to bring the peri-urban consumers within the normal formal market. This means that they should learn to pay—and learn that if they do not pay that there will be a heavy penalty. In Buenos Aires, Edenor allowed peri-urban electrification consumers in a high-theft area to pay a flat-fee tariff for two years, after which they had to pay the normal kilowatt-hour rate. In certain South African townships a peri-urban electrification connection costs 50 Rd, but in the case of a penalty the fee is 15 times higher, and 20 times higher in the case of recidivism.

Business Focus

6.6 There is no single model for peri-urban electrification that may be taken from the shelf and applied blindly. Where successful peri-urban electrification programs have been executed, the persons involved had to innovate not only organizationally and technically but, even more important, by realizing that they were in a different business. The peri-urban client is different from the traditional client. For peri-urban electrification and *mutatis mutandis*[8] rural electrification to be financially sustainable, this service must be the focus of the organization that sells it. Distribution cannot remain the stepchild of the utility, as is still the case in many countries. Only when those responsible at the highest level give their equal attention to distribution—and, by extension, to peri-urban electrification—that the 520 million peri-urban dwellers who are still in the dark will be illuminated. This requires an attitudinal change among government officials and sector operators.

Recommended Next Steps

6.7 In view of the above, the following is recommended:

- With ESMAP's assistance, one or two pilot peri-urban projects should be implemented that have been designed in collaboration with the local utility and the peri-urban population concerned. Once it has been demonstrated (after one year of field experience) that the delivery mechanism (i.e., technology, institutions, and rules) are effective, these pilots should be scaled up and converted into full-fledged, bankable projects.
- Before embarking on a project to restructure the power sector, government officials should instruct project managers to ensure that the concerns and

[8] With respective differences taken into consideration.

possibilities outlined in this paper will be reflected in the new legal and regulatory framework for the reformed power sector. This will require, inter alia, that a distribution company's license to operate will stipulate the extension of, or provide incentives to extend, access to peri-urban areas. The incentives should not only be of a financial nature, but should also include the appropriate adjustment of technical standards (ESMAP 2000), while the regulator should see to it that these incentives have the desired result.

- An international workshop should be held with the donor community, representatives of recipient countries, and interested utilities. This platform will serve to advance the agenda of increasing access to electricity for the unserved 520 million peri-urban households.

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ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
	Commercilizing Natural Gas: Lessons from the Seminar in Nairobi for Sub-Saharan Africa and Beyond	01/00	225/00
	Africa Gas Initiative – Main Report: Volume I	02/01	240/01
	First World Bank Workshop on the Petroleum Products Sector in Sub-Saharan Africa	09/01	245/01
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
	Africa Gas Initiative – Angola: Volume II	02/01	240/01
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cameroon	Africa Gas Initiative – Cameroon: Volume III	02/01	240/01
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94

Region/Country	*Activity/Report Title*	*Date*	*Number*
Comoros	Energy Assessment (English and French)	01/88	7104-COM
	In Search of Better Ways to Develop Solar Markets: The Case of Comoros	05/00	230/00
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
	Africa Gas Initiative – Congo: Volume IV	02/01	240/01
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95
	Africa Gas Initiative – Côte d'Ivoire: Volume V	02/01	240/01
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
	Africa Gas Initiative – Gabon: Volume VI	02/01	240/01
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
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Ghana	Energy Assessment (English)	11/86	6234-GH
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Guinea	Energy Assessment (English)	11/86	6137-GUI
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Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
	Implementation Manual: Financing Mechanisms for Solar Electric Equipment	07/00	231/00
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Madagascar	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
Republic of South Africa	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95

Region/Country	*Activity/Report Title*	*Date*	*Number*
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90
	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
	Rural Electrification Strategy Study	09/99	221/99
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--

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Zimbabwe	Rural Electrification Study	03/00	228/00

EAST ASIA AND PACIFIC (EAP)

Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94
	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
	Improving the Technical Efficiency of Decentralized Power Companies	09/99	222/999
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
	Institutional Development for Off-Grid Electrification	06/99	215/99
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Mongolia	Energy Efficiency in the Electricity and District Heating Sectors	10/01	247/01
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
	Strengthening the Non-Conventional and Rural Energy Development Program in the Philippines: A Policy Framework and Action Plan	08/01	243/01
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87

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Thailand	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
	Petroleum Fiscal Issues and Policies for Fluctuating Oil Prices In Vietnam	02/01	236/01
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
	Greenhouse Gas Mitigation In the Power Sector: Case Studies From India	02/01	237/01
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
	Clean Fuels	246/01	10/01
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84

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Sri Lanka	Industrial Energy Conservation Study (English)	03/86	054/86

EUROPE AND CENTRAL ASIA (ECA)

Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Central Asia and The Caucasus	Cleaner Transport Fuels in Central Asia and the Caucasus	08/01	242/01
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
	Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union (English and Russian)	08/00	234/00
	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan & Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Policy (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99
Turkey	Energy Assessment (English)	03/83	3877-TU
	Energy and the Environment: Issues and Options Paper	04/00	229/00

MIDDLE EAST AND NORTH AFRICA (MNA)

Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Morocco	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91

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	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
	Introducing Competition into the Electricity Supply Industry in Developing Countries: Lessons from Bolivia	08/00	233/00
	Final Report on Operational Activities Rural Energy and Energy Efficiency	08/00	235/00
	Oil Industry Training for Indigenous People: The Bolivian Experience (English and Spanish)	09/01	244/01
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
	Hydro and Thermal Power Sector Study	09/97	197/97
	Rural Electrification with Renewable Energy Systems in the Northeast: A Preinvestment Study	07/00	232/00
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94
	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91

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Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
	Energy Environment Review	05/01	241/01
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
	Reform and Privatization in the Hydrocarbon Sector (English and Spanish)	07/99	216/99
	Rural Electrification	02/01	238/01
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Sub Andean	Environmental and Social Regulation of Oil and Gas Operations in Sensitive Areas of the Sub-Andean Basin (English and Spanish)	07/99	217/99
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

GLOBAL

	Energy End Use Efficiency: Research and Strategy (English)	11/89	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
	Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93

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Global	Development of Regional Electric Power Networks (English)	10/94	--
	Roundtable on Energy Efficiency (English)	02/95	171/95
	Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
	A Synopsis of the Third Annual Roundtable on Independent Power Projects: Rhetoric and Reality (English)	08/96	187/96
	Rural Energy and Development Roundtable (English)	05/98	202/98
	A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms (English)	09/98	207/98
	The Effect of a Shadow Price on Carbon Emission in the Energy Portfolio of the World Bank: A Carbon Backcasting Exercise (English)	02/99	212/99
	Increasing the Efficiency of Gas Distribution Phase 1: Case Studies and Thematic Data Sheets	07/99	218/99
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	A Review of the Renewable Energy Activities of the UNDP/ World Bank Energy Sector Management Assistance Programme 1993 to 1998	11/99	223/99
	Energy, Transportation and Environment: Policy Options for Environmental Improvement	12/99	224/99
	Privatization, Competition and Regulation in the British Electricity Industry, With Implications for Developing Countries	02/00	226/00
	Reducing the Cost of Grid Extension for Rural Electrification	02/00	227/00
	Undeveloped Oil and Gas Fields in the Industrializing World	02/01	239/01
	Best Practice Manual: Promoting Decentralized Electrification Investment	10/01	248/01
	Peri-Urban Electricity Consumers—A Forgotten but Important Group: What Can We Do to Electrify Them?	10/01	249/01

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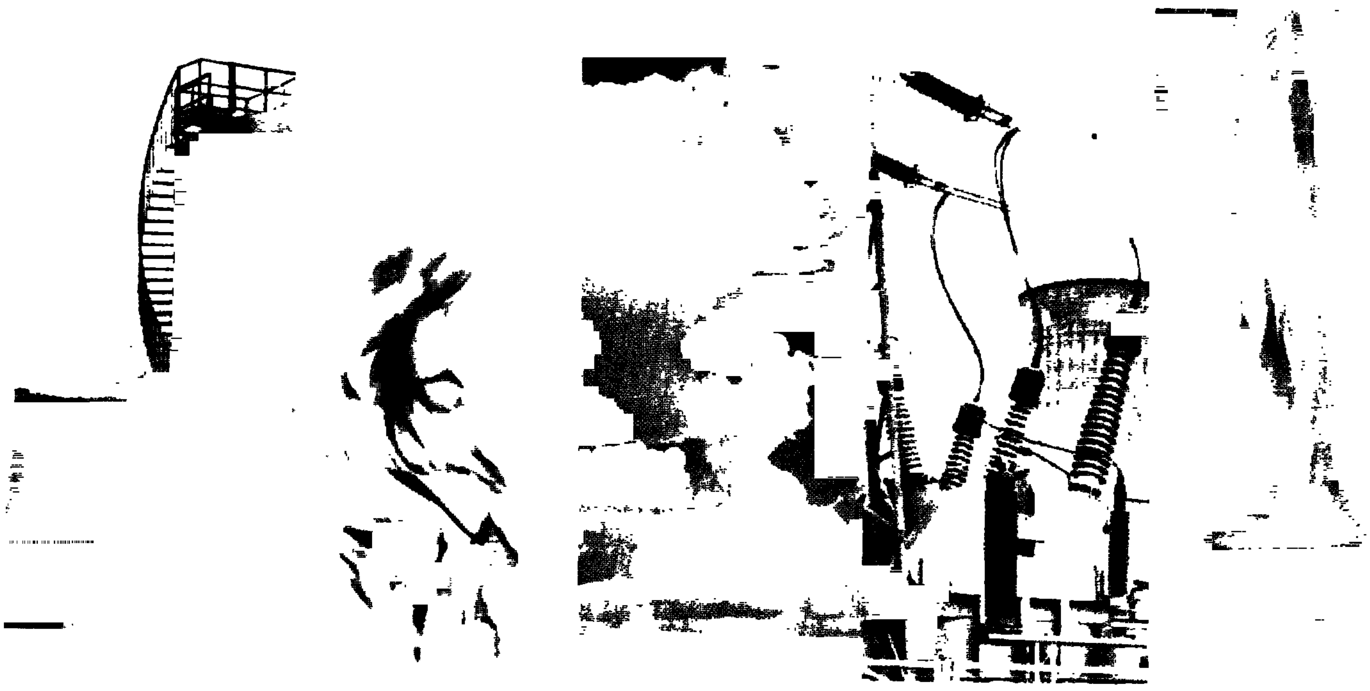

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