Section 1
Executive Summary

WELFARE EFFECTS OF POWER SECTOR REFORMS

The full welfare effects of the proposed power-sector reforms on electricity users will depend on a number of factors, among which are the following:

(a) the direction and magnitude of changes in the price of electricity;
(b) the level of electricity use and electricity consumption response on the part of users;
(c) the effects of changes in electricity price on the prices of other goods;
(d) the effects of price changes on output, employment and factor incomes in the production sector; and
(e) the implications of power-sector restructuring on taxation and government budgets.

Initially, a partial equilibrium model of the household sector was developed to analyze welfare changes at disaggregated levels – by province, for example. The effects of power sector reforms determined by partial equilibrium analysis, however, ignore the indirect effects of the production sector - items (c) and (d), above. Nevertheless, the welfare gains obtained from the partial equilibrium analysis can be treated as conservative estimates, which may be appropriate in the extreme case that the production sector fails to respond to the incentives offered by the reform. Alternatively, one may view the partial equilibrium outcomes as immediate and temporary since it is reasonable to expect that consumers' expenditure patterns are more flexible than producers'. The potential benefits to the production sector from the removal of cross-subsidies and greater efficiency in the power industry are too significant to ignore; hence the need for a general equilibrium analysis.

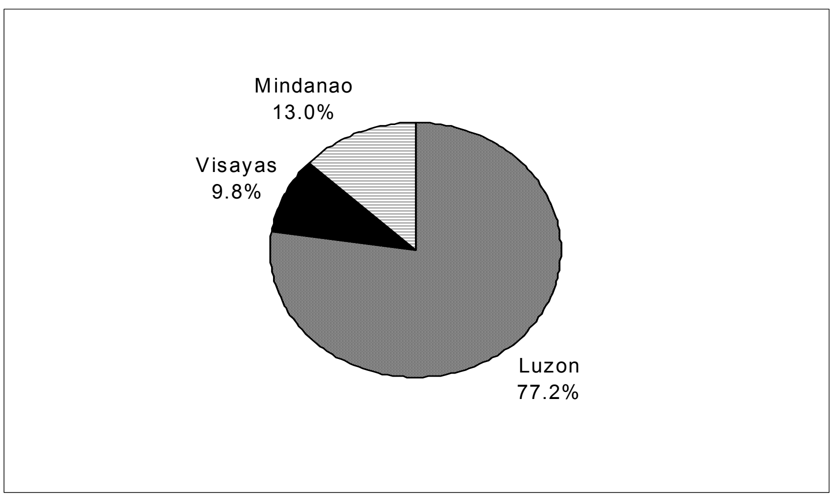
To assess the welfare impacts of the proposed electricity sector reforms, a computable general equilibrium (CGE) model was also used to capture the interaction of the producing and consuming sectors in the economy. The adjustments in power prices induced by the restructuring are expected to influence consumption and production not only of power, but also of other goods. A CGE model integrates the direct impact of electricity price changes on electricity consumption and the indirect impacts on the capital and labor markets through changes in production of electricity and other goods. In addition, a CGE model provides indications on movements of key macroeconomic variables such as gross domestic product (GDP), income distribution, trade balance and government budget.

However, while a CGE model can give a broader account of the impacts of reform, the model is designed primarily to describe the direction of changes in economic variables at the macro level. Using econometrically estimated household electricity demand parameters, the partial equilibrium analysis performed focuses on a narrower set of effects of the reform. On the other hand, the CGE approach, while accounting for a broader set of effects, has greater "arbitrariness" in the specification of model parameters. Appropriate caution must then be taken in interpreting the results.

ELECTRICITY CONSUMPTION BY GRID AND USE

In order to gain a perspective on the impact of the proposed power-sector reforms on the national economy, the electricity kWh-consumption for the year 2000 has been broken down by the three main grids (Luzon, Visayas, and Mindanao) and use (residential, commercial, industrial and others). Figure 1 shows the high electricity consumption within the Luzon grid relative to that in the Visayas and Mindanao grids.

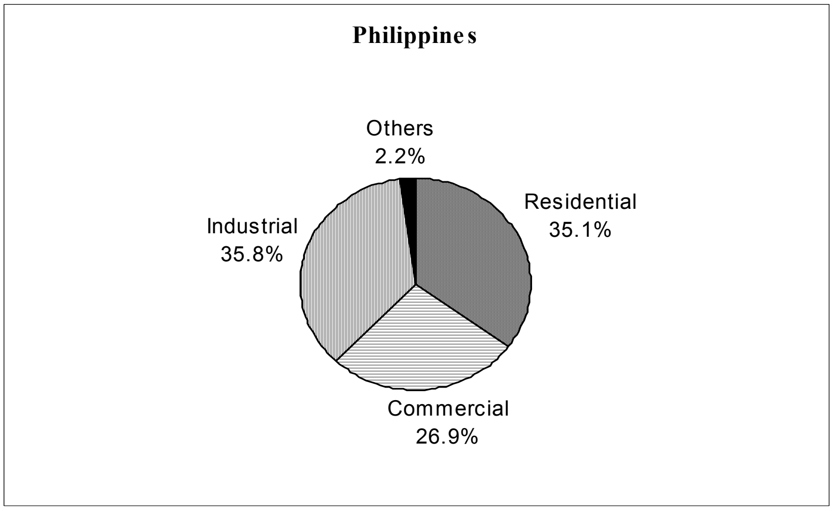
Figure 1
Electricity Consumption Shares by Grid: 2000



Luzon accounts for over three-fourths of the national electricity consumption. Although the growth rate in electricity consumption over the past five years has been slightly higher in the Visayas and Mindanao than in Luzon, the Luzon electricity sector impacts will tend to dominate the national impacts for many years.

As illustrated in Figure 2, residential end-use accounts for about a third of total electricity sales.

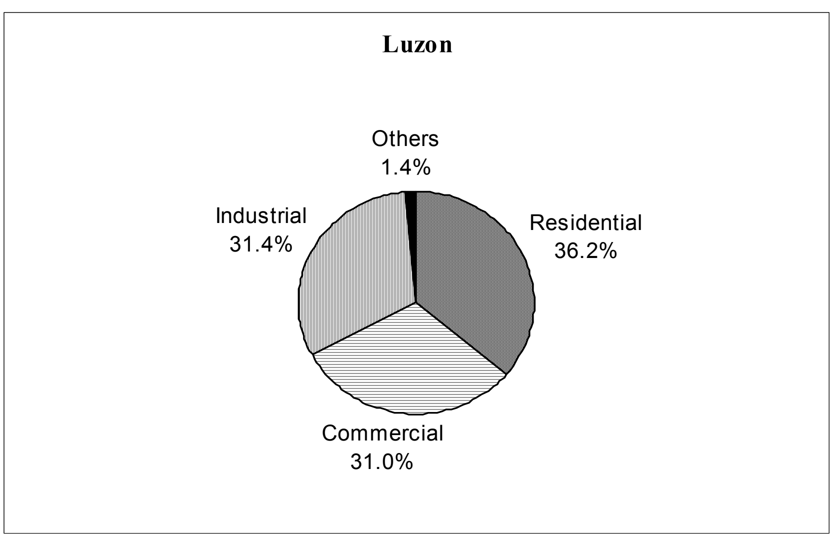
Figure 2
Electricity Consumption Shares by Use (Philippines): 2000

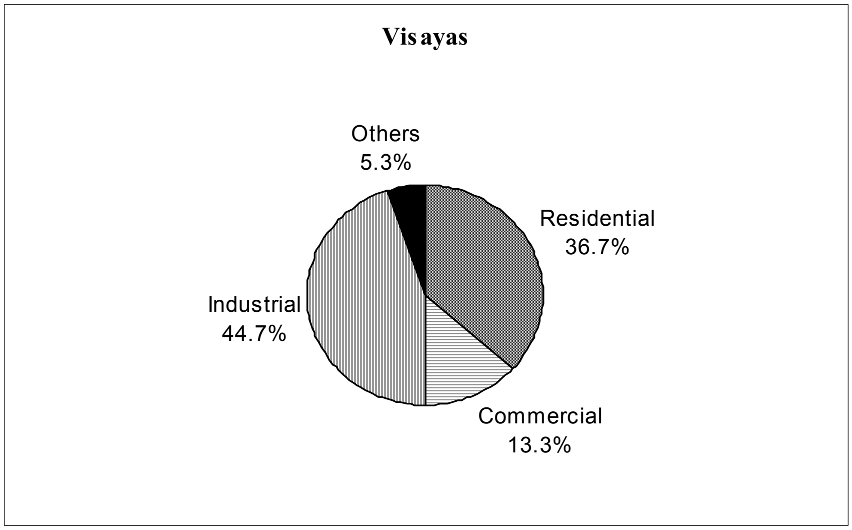


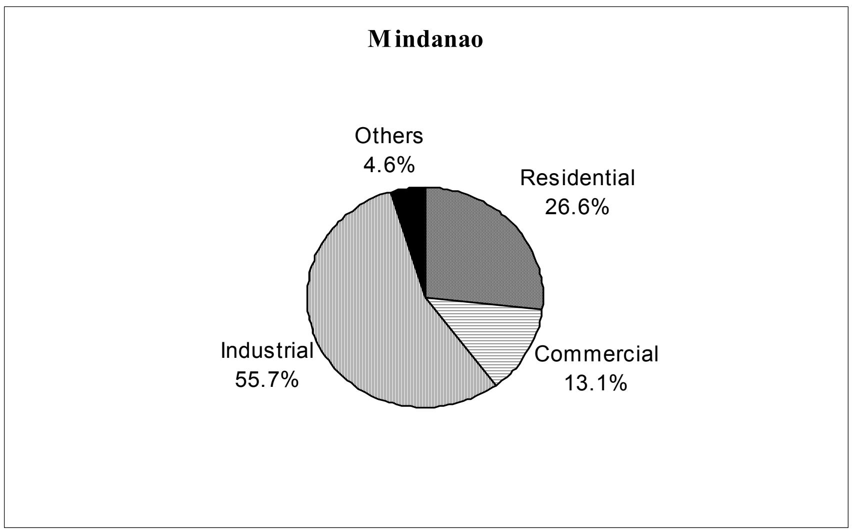
This may include the consumption by informal production units and some small manufacturers and service entities. The partial equilibrium analysis of the welfare impacts of the power-sector reforms on residential consumers focuses on this electricity end-use.

As indicated by industrial and commercial sales in Figure 2 above, over 60 percent of electricity sales are used for the production of goods and services in the economy. As shown in Figure 3 below, the high production use of electricity holds even in the Visayas and Mindanao, at 58 percent and 69 percent shares of total electricity use, respectively.

Figure 3
Electricity Consumption Shares by Use per Grid: 2000







Hence, the response of the production sector to the power-sector reforms, in particular to the lowering of industrial and commercial rates, can have significant indirect effects on the welfare of residential consumers through changes in employment and household incomes. These indirect effects are captured by the general equilibrium analysis of the power-sector reforms done in this study.

LONG-RUN MARGINAL COST OF ELECTRICITY

To estimate the tariff levels that are likely to be achieved by full restructuring of the electricity industry, we have developed long-run marginal costs (LRMC) of electricity supply to various end-user groups in the various franchise areas of the country. Prices are expected to approach LRMC with full restructuring as anticipated in the Philippines with the introduction of a competitive bulk power supply market, a competitive retail supply market, and performance-based regulation of the wires businesses along with open access.

Across the Philippines as a whole, LRMC electricity prices are expected to be roughly 73% of existing financial tariff levels. However, LRMC prices in Mindanao, because of existing pricing subsidies in Mindanao, are higher than the existing price levels.

A comparison of the component average LRMC costs with existing tariffs is given in the following table (Table 1) by grid. These represent prices at the retail meter in real 2000 pesos.

Table 1
LRMC Costs and Actual Embedded Costs By Grid
Pesos per kilowatt-hour

LRMC	Real 2000 Peso			
	Generation	Transmission	Distribution	Total
Luzon	2.10	0.10	0.79	2.99
Visayas	2.20	0.23	0.71	3.13
Mindanao	2.51	0.39	0.61	3.51
Philippines	2.16	0.15	0.76	3.07
	% Share			
Luzon	70%	3%	27%	
Visayas	70%	7%	23%	
Mindanao	72%	11%	17%	
Philippines	70%	5%	25%	

Actual Embedded Costs - 2000				
	Generation	Transmission	Distribution	Total
Luzon	3.24	0.36	0.83	4.43
Visayas	3.05	0.34	0.68	4.06
Mindanao	1.95	0.22	0.58	2.75
Philippines	3.05	0.34	0.78	4.18
	% Share			
Luzon	73%	8%	19%	
Visayas	75%	8%	17%	
Mindanao	71%	8%	21%	
Philippines	73%	8%	19%	

The existing and resulting estimated long-run marginal cost of electricity supply for various tariff categories are summarized in the following charts.

Figure 4

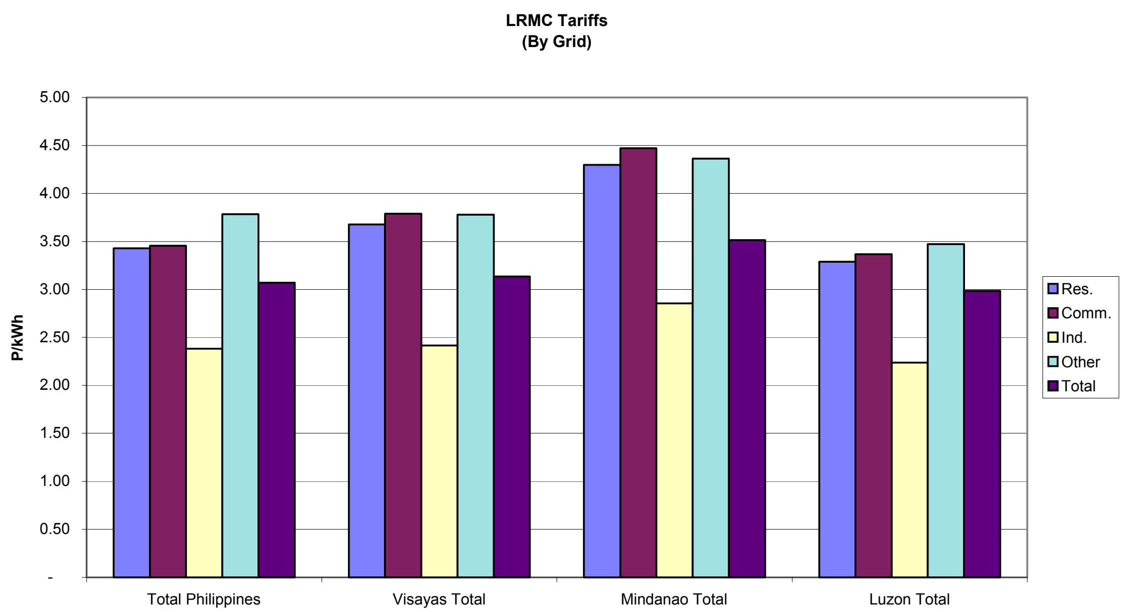
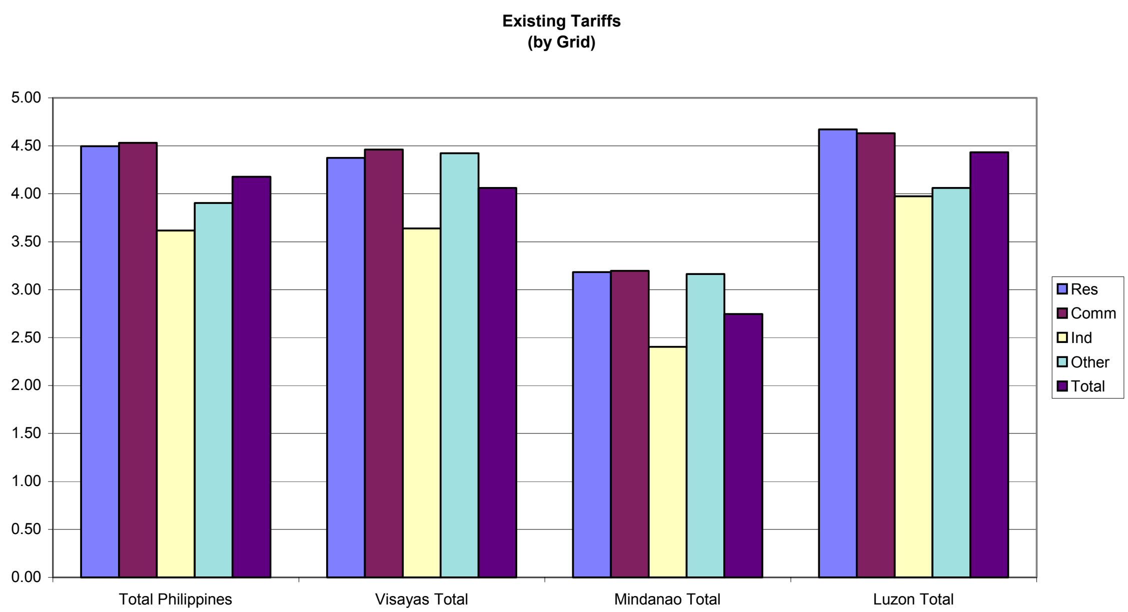


Figure 5



Long-Run Effects of Power Sector Reforms

The full long-run effects of power sector restructuring are simulated by allowing electricity prices to fall to a level of LRMC plus a universal levy of P0.30/kWh. The 30-centavo charge represents the amount estimated to recover the stranded costs of the National Power Corporation. The universal levy is generally termed as the Electricity Industry Reform Charge (EIRC).

Using the partial-equilibrium approach, the full gains and losses due to the direct effects of the power sector reforms (i.e., ignoring indirect benefits from the producing sector) are summarized in the following table. The bottom-line is a *net* **annual gain** of P7.3 billion (at 2000 prices) nationally[1]. This translates into P803 annually per household, or about 0.58 percent of the average annual household budget. Since the long-run rate configuration is expected to persist well into the future, this amounts to a significant gain in aggregate consumer welfare. Put another way, this amount represents the loss that households have effectively been bearing as a result of the inefficiencies in the power sector.

Table 3
Annual Long-Run Gains and Losses from Power-Sector Reform
Partial Equilibrium Results
(In millions of current 2000 pesos; all provinces*)

Region	Gains	Losses	Net Gains
Luzon	8,845	-2	8,843
Visayas	463	-11	452
Mindanao	0	-1,991	-1,991
Philippines	9,308	-2,004	7,304

*except those covered solely by small-island grids.
Source: Appendix Table I.4.1

However, the indirect impacts of the producing sector are large. Table 4 shows the results of the CGE analysis and indicates annual long-run gains for the household sector of P28.6 billion, almost four-fold the reported long-run gains of P7.3 billion in the partial equilibrium analysis. The gains are magnified in the general equilibrium analysis by the response of the production sector to the lower input price of electricity and greater consumer demand.

[1] The gain (loss) is measured in terms of compensating variation (CV). CV calculates the amount a change in electricity prices penalizes (or benefits) a household, and how much its current budget would have to be increased (or reduced) in order leave the household no worse (or better) off than it was before the price change.

Table 4
Welfare Effects on Households during Post-Reform Period:
Compensating Variation-Based Measure*
(In million pesos at 2000 prices, % of CV-based measure to base year's income)
CGE Results

	LRMC + 0.30	
CONSUMER GROUP	**Welfare gain (in million pesos at 2000 prices)**	**% of welfare gain to base year's income**
Luzon		
20 kWh or less per month		
Non-Meralco	714	2.02
Meralco	26	1.86
More than 20 kWh per month		
Non-Meralco		
Non-poor	5,466	1.82
Poor	828	2.85
Meralco		
Non-poor	16,029	2.34
Poor	694	3.06
Visayas		
20 kWh or less per month	421	2.08
More than 20 kWh per month		
Non-poor	2,369	1.59
Poor	247	2.50
Mindanao		
20 kWh or less per month	211	1.33
More than 20 kWh per month		
Non-poor	1,464	0.93
Poor	178	1.00
Net Gain	**28,646**	**1.97**

*Positive value denotes a welfare gain; negative value denotes a welfare loss.

Finally, as shown in Table 5, the potential growth in GDP upon completion of reforms is 2.85 percent. Except for income distribution, all macroeconomic indicators are expected to improve including the government budget balance. The economic expansion in the post-reform period is of a magnitude sufficient to enlarge the tax base and raise revenues for the government to cover its absorption of NPC's liabilities.

Table 5
Post Reform Impact on the Macroeconomy
(% change from base year's level)
CGE Results

	LRMC + 0.30
GDP	2.85
Employment	2.79
Capital utilization	2.86
Government budget balance	16.73
Trade balance	7.74
Gini coefficient	0.023

Most areas of the country will benefit from lower electricity prices in the long run. Certain areas, mostly in Mindanao, are expected to face higher electricity prices due to the significant levels of subsidies that are currently embedded in the electricity rates. In the worst cases, however, the partial equilibrium analysis (with no indirect effects from the production sector) indicates that *the losses occasioned by the long-run price changes represent less than two percent of average household budget*.

However, the level of overall national gains indicates that it is both feasible and desirable to design a compensation package for Mindanao. The compensation can take the form of annual payments to Mindanao of about P2.0 billion or a one-time payment or establishment of a trust fund of about P13 billion, depending on the assumed discount rate. Since these compensation values are obtained without taking into account the possible production gains to households, then these values can be considered upper bounds for the compensation. The general equilibrium results indicate that Mindanao households may possibly partake in the boom notwithstanding the increases in their electricity prices. Their annual welfare gain, after production gains are realized, can be as much as P1.85 billion, realized in terms of higher incomes and greater employment opportunities.

It should be made clear that current electricity rates in Mindanao are low mainly because of cross-subsidies provided by consumers in other parts of the country. Mindanao's participation in the proposed reforms appears beneficial for two main reasons:

1. The planned reforms contemplate a managed package of mitigating measures to address the negative impacts of tariff changes in the transition toward long-run marginal costs. Moreover, a special compensation package can be developed to address the impacts on vulnerable groups of electricity prices that they are expected to face in the long run

2. Our studies indicate that an integrated transmission backbone with the rest of the country actually reduces long-run marginal cost of electricity to the consumers in Mindanao.

However, the more significant effect of the electricity sector reform comes from the increased economic activity stemming from the lower electricity prices to production units. In addition, consumer groups, except those in Mindanao, will also be favored by lower electricity rates that would in turn increase consumer demand and consequent overall economic activity.

If sufficient tax revenues can be raised in the post-reform period to cover the government absorption of some P200 billion of NPC's liabilities, an issue that can be raised is whether ratepayers should contribute to financing NPC's stranded costs through payment of a universal levy. The simulation results of full government absorption are juxtaposed in Table 6 with those imposing a universal levy of P0.30 per kWh. Welfare gains from full government absorption are 54 percent more than that arising with the universal levy. The growth rates in GDP, employment and capital utilization are also higher with full government absorption of the NPC's liabilities. The results indicate that even with full government absorption of NPC's liabilities, the economic growth in the post-reform period will still be sufficient to enlarge the tax base and raise revenues for the government to cover the additional P18.2 billion annual transfers. Clearly, there is a case for government's absorption of NPC's debts to free the electricity market of its past baggage.

Table 6
Post-Reform Effects under Different Financing Strategies of Stranded Costs
(% change from base year's level except for CV)
CGE Results

	Universal levy: P0.30 per kWh	**Full gov't absorption**
Welfare gain* (*million pesos*)	28,646	44,173
GDP	2.85	4.50
Employment	2.79	4.10
Capital utilization	2.86	4.20
Govt. budget balance	16.73	9.26
Trade balance	7.74	7.34
Gini coefficient	0.023	0.033

*Positive value denotes a welfare gain; negative value denotes a welfare loss.

SHORT-RUN EFFECTS OF POWER SECTOR REFORMS

The foregoing analysis shows that significant long-run gains are to be had as a result of power-sector reforms. The short-run, however, roughly the next three to five years, represents a transition period, during which existing subsidies across and within grids (specifically the Economic Assistance Charges or EACs) and among consumer classes (interclass or IC subsidies) are to be removed before privatization is completed and thoroughgoing competition among power generators and distributors is attained. In essence this means there may be a period when prices may rise in areas where subsidies have been in place

It should be noted that in the absence of the power sector reform policies presently before the Philippine legislature, the electricity pricing policy in the Philippines in the past decade has been to move toward cost-reflective pricing and the elimination of existing cross-subsidies in the tariff structure. This was directed by an Executive Memorandum to the Department of Energy signed by then-President Fidel Ramos in 1995.

The current legislation pending before Congress will also move prices toward cost-reflective rates by introducing competition into the sector. The reforms provide a framework to manage the transition. The elimination of the existing cross subsidies can have negative welfare implications to various groups of end-users without the mitigating mechanisms contemplated in the proposed reform packages.

For example, the removal of the present Economic Assistance Charges (EACs) in tariffs of the National Power Corporation (NPC) will eliminate existing subsidies from the Luzon grid to the Visayas and Mindanao grids, as well as some subsidies within each grid. A second source of price adjustment in the interim is the removal of inter-class (IC) subsidies, from industrial and commercial users to residential users.

As in any removal of subsidies, there is scope for potential losses. These potential losses brought about by the realignment of electricity prices to reflect economic costs to residential consumers is estimated at around P5.7 billion annually, details of which are provided in Table 7 below. When households are classified into poor and non-poor, it becomes evident that the bulk of these losses -- some 94 percent -- are borne by non-poor households. About 82 percent of the estimated losses are due to the removal of the interclass subsidies, which also account for most of the potential losses for the non-poor households. The losses to non-poor households are largely due to their higher electricity consumption, which makes them more vulnerable to electricity price increases. However at worst, the potential welfare losses to poor households range from zero to 0.92 percent of poor-household budgets only.

Table 7
Estimated Welfare Losses from Removal of Energy Assistance Charges and Interclass Subsidies
(in millions of current 2000 pesos)
Partial Equilibrium Analysis

	Poor*	Non-poor*	Total
Removal of EAC	161	825	1,006
Removal of IC	156	4,534	4,690
Total	317	5,379	5,696

*regular billers only
Source: Appendix Tables I.4.5-I.4.7

Taking into account the indirect effects from the production sector, the CGE estimates of the welfare effects on consumers of the elimination of cross-subsidies are presented in Table 8. Despite the reduction in producers' electricity prices by 10.41 percent, all consumer groups will experience welfare losses amounting to P3.5 billion. This amount is less than the P5.7 billion losses reported in the partial equilibrium analysis due to the positive response of the production sector.

Table 8
Welfare Effects on Households of the Elimination of Cross-Subsidies Without Mitigating Mechanisms
(in million pesos at 2000 prices)
CGE Results

CONSUMER GROUP	Welfare Gain* upon Elimination of Cross Subsidies
Luzon	
20 kWh or less per month	
Non-Meralco	-7
Meralco	-3
More than 20 kWh per month	
Non-Meralco	
Non-poor	-55
Poor	-23
Meralco	
Non-poor	-1,795
Poor	-70
Visayas	
20 kWh or less per month	-24
More than 20 kWh per month	
Non-poor	-384
Poor	-29
Mindanao	
20 kWh or less per month	-27
More than 20 kWh per month	
Non-poor	-447

Poor	-70
Net Gain (loss)	**-3,516**

*Positive value denotes a welfare gain; negative value denotes a welfare loss.

MITIGATING MEASURES IN THE SHORT-RUN

As the proposed legislation has recognized, it becomes important to design mitigating mechanisms that leverage future gains to reduce near-term burdens of adjustment. Mitigating mechanisms must have the objective of easing the adjustment during the transition period for those negatively affected by the reforms. Although the majority of the population will benefit from lower electricity prices when competition sets in, households are likely to face higher residential electricity prices during the transition period. Most of these are non-poor households with high electricity consumption.

Nonetheless, it is important to ensure that mitigating mechanisms are created and directed for the poor that may be affected by the reforms. For this purpose it is useful to indicate how mitigating mechanisms might be focused to account for the differential effects between poor and non-poor, and between electricity coverage areas. The resource requirements of such measures must also be investigated.

Two transitory provisions of the proposed power-sector reform bill, the mandated 30-centavo reduction in residential rates and the setting of lifeline rates for marginalized end-users, are analyzed as possible mitigating measures to ease the adjustment of residential customers during the transition period.

Thirty-centavo reduction in residential rates. The first exercise performed is a simulation of the transitory provision featured in principal versions of the power-reform bill, namely, the mandated rate reduction for residential end-users. Earlier versions of the proposed power-reform bill stipulated that upon the national government's absorption of at least one hundred billion pesos of NPC's liabilities, a five-percent reduction in NPC's average rate should ensue and shall be entirely passed on to residential end-users. A latter January 2001 version of the reform bill stipulates a 30-centavo reduction in residential rates upon effectivity of the reform bill. Assuming year 2000 sales of 12,002 GWh to residential end-users, the value of the 30-centavo reduction in residential rates is about P3.6 billion a year. This report translates the stipulated measure in the proposed legislation as an **across-the-board reduction in all existing residential rates by 30 centavos per kWh** to be applied during the transition period.

The net welfare gains, in terms of compensating variation (CV) in income, from the removal of cross-subsidies and the 30-centavo reduction in per kWh residential rates to households for the major grids and relative to the current state are given in Table 9. For the household sector, the 30-centavo reduction in residential rates lowers the annual welfare loss from the elimination of cross-subsidies from about P5.7 billion to P2.9 billion, or a 49 percent reduction of welfare losses due to the elimination of cross-subsidies. The resulting average household welfare loss is then about 0.20 percent of the household budget. The incidence of welfare losses vary across grids with Luzon households having the smallest losses of about 0.13 percent of their household budgets while households in Visayas and Mindanao have higher losses of 0.36 and 0.44 percent of their household budgets, respectively.

Thus it can be inferred that the 30-centavo reduction in residential rates significantly reduces the negative welfare effects on households of the removal of cross-subsidies. The discount softens the rate adjustments to residential users significantly; the weighted average increase in residential rates is 7 percent with, and 14 percent without the P0.30 per kWh reduction[2]. However, if it is desired that the elimination of cross-subsidies have on average minimal or near zero welfare effects on residential end-users, a bigger rate reduction of at least 45 centavos per kWh may be required. It must be noted though that the partial equilibrium measurement of the welfare effects does not take into account the possible benefits that households may obtain indirectly from the lowering of industrial and commercial rates with the elimination of interclass subsidies.

Table 9
Annual Short-Run Welfare Gains from the Removal of Cross-Subsidies and 30-Centavo per kWh Reduction in Residential Rates
Partial Equilibrium Analysis

	Welfare Gains (millions of current 2000 pesos)	Gains as Percent of Household Budgets
Luzon	-1,530	-0.13
Visayas	-599	-0.36
Mindanao	-776	-0.44
Philippines	-2,905	-0.20

Source: Appendix Tables I.4.5 - I.4.10

Estimates of the general equilibrium welfare effects of the P0.30 per kWh reduction in residential rates are given in Table 10. Gains accrue to all residential consumer groups with the implementation of this mitigating mechanism. The total welfare gain for

[2] An analysis done by this study of a previous transitory provision mandating a 5-percent reduction in NPC's average rate to be entirely passed on to residential end-users indicates a resulting increase of about only 1 percent in residential rates. This earlier version of the mandated reduction in residential rates translates to about 45-centavo per kWh reduction, instead of 30 centavos per kWh as in the current version. The earlier study used 1998 electricity prices; the results reported here used year 2000 electricity prices.

households is P12.5 billion when a P0.30 per kWh discount is applied. Although welfare gains are smaller in the aggregate for poor than for nonpoor groups, the converse is true when reckoned relative to their income levels.

Table 10
Welfare Effects* on Households of the Elimination of Cross-Subsidies
With Mitigating Mechanisms
(in million pesos at 2000 prices)
CGE Results

CONSUMER GROUP	Post-EAC, IC + P0.30 per kWh Reduction in Residential Rates	Post-EAC, IC + P0.30 per kWh Reduction in Residential Rates + Lifeline Rates
Luzon		
20 kWh or less per month		
Non-Meralco	414	1,026
Meralco	13	46
More than 20 kWh per month		
Non-Meralco		
Non-poor	2,923	3,126
Poor	468	501
Meralco		
Non-poor	5,538	6,072
Poor	305	333
Visayas		
20 kWh or less per month	243	551
More than 20 kWh per month		
Non-poor	1,026	1,130
Poor	125	136
Mindanao		
20 kWh or less per month	160	385
More than 20 kWh per month		
Non-poor	1,163	1,280
Poor	141	158
Net Gain (loss)	**12,520**	**14,745**

*Positive value denotes a welfare gain; negative value denotes a welfare loss.

The comparable aggregate welfare effect in the partial equilibrium analysis is P2.9 billion losses. What accounts for the huge difference? First, the reprieve given to consumers by the mitigating scheme stimulates demand for other goods, thus the adjustments in the production sector are larger as producers not only face lower electricity prices but also greater consumer demand. Second, increased production activities lead to higher household incomes and expenditure. Third, the residential rate reduction is made feasible by the government's payment of some NPC liabilities, equivalent to P24 billion annually. This is akin to the government pumping such amount to the economy through the NPC[3]. Hence, the partial equilibrium gains are magnified by the adjustments in the production sector through increased demand for goods other than electricity, higher household incomes, and the multiplier effect of additional government spending.

The macroeconomic indicators, shown in Table 11, mirror the changes in production. Positive and significant increases in GDP, employment and capital utilization are registered after the P0.30 per kWh reduction in residential rates has been introduced. The most significant expansion is in the capital goods manufacturing sector, which includes the electronics sector that accounts for about two-thirds of total exports. Trade balance improves as the competitiveness of exports (due to lower electricity input price) is enhanced, and some of imports are replaced by local goods.

Table 11
Effects on the Macroeconomy in the Transition Period
With Mitigating Mechanisms
(% change from base year's level)
CGE Results

	With Mitigation	
	(Post-EAC, IC) -0.30	(Post-EAC, IC) –0.30 + lifeline rate
GDP	1.85	1.99
Employment	1.38	1.52
Capital utilization	1.32	1.50
Govt. budget balance	-15.68	-11.21
Trade balance	3.06	1.50
Gini coefficient	0.011	0.012

But a larger tax base, occasioned by the expansion in output, is insufficient to cover the government's annual payment of P24 billion in NPC's liabilities; the government budget balance deteriorates as a result. The marginal increase in the Gini coefficient, indicating slight deterioration in income distribution, is to be anticipated when price subsidies are eliminated. Nonetheless the small change in the income distribution measure suggests that the trade-off between efficiency and equity should not be a substantial issue when implementing the power-sector reform program.

Lifeline rates for marginalized end-users. A transitory provision of the proposed power-sector reform bill is the setting of lifeline rates for marginalized end-users by the Energy

[3] Note that it is assumed that in the transition period, the electricity prices are based on the "current" NPC rates with cross-subsidies removed and that competition has not set in to lower

Regulatory Board (ERB). The proposed legislative bill defines a lifeline rate as a subsidized rate given to low-income captive market consumers who cannot afford to pay at full cost. Presently, except for the Meralco franchise area, lifeline rates are generally not being offered but rather a system of minimum billing to cover the fixed costs of providing electricity services is in place for both investor-owned utilities (IOUs) and rural electricity cooperatives (RECs).

We have performed an exploratory study on lifeline rate implementation. The lifeline pricing structure is designed at a threshold level of 20 kWh a month and a discount rate of 70 percent. Such a structure will cover about 1.3 million or 14 percent of household connections. Electricity consumption in kWh increases by an average of 52 percent for these households, yielding an aggregate welfare gain of P1.1 billion, about the financial cost of the lifeline pricing scheme. Setting the threshold level at 20 kWh a month implies that less than 50 percent of poor households will benefit from the lifeline rates. However, even with such a design, about half of the welfare gains accrue to non-poor households.

The general equilibrium effects of the lifeline pricing scheme, presented also in Tables 10 and 11, reinforce the positive effects of the 30-centavo per kWh reduction on household welfare and production output. Yet even the introduction of lifeline rates is not sufficient to improve equity since close to 49 percent of households consuming not more than 20 kWh per month have incomes that qualify them as nonpoor. This result calls into question the effectiveness of lifeline pricing as a redistributive instrument.

The lifeline pricing scheme, an income redistribution measure, should be financed by the national government rather than through internal cross-subsidies at the utility level. In this case, the local utilities should be compensated for the discount given their customers enjoying the lifeline rates. Financing at the utility level will hamper retail competition and will put utilities with a larger proportion of small electricity consumers at a disadvantage.

Alternatively, the national government may require the NPC to finance the lifeline pricing in exchange for its absorption of some of the NPC liabilities. Equivalently, the cost of financing may be passed on to the smaller population of electricity rate-payers in a more transparent way through the EIRC, which is under ERB regulation, instead of passing the cost to the general taxpayer as in the case of national government financing.

In practice, the lifeline-pricing scheme must also be reconciled with the system of minimum billing now in place for most utilities. The lifeline tariff policy must also be supplemented by programs to improve and make less costly the access of poor

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basic rates.

households to electricity supply. The electricity access rate among poor households is 40.4 percent, much lower than the national average of 70.4 percent. Such programs include subsidized house connections for the poor and other missionary electrification programs.

SUMMARY

The power reform bill is designed to introduce competition in the electricity sector in the country. As the sector transitions into a market where electricity is priced efficiently, the government is expected to absorb a substantial portion of the liabilities of the National Power Corporation. Over time, the entry of competition in the sector is envisioned to bring electricity prices closer to marginal cost and force overall average electricity prices lower. The project has attempted to quantify the effects of these long-run changes in the sector on the Filipino consumer and the summarized effects are as follows:

- With the price decrease to residential consumers, there is a net annual **direct gain of P7.3 billion** for households nationwide. This translates to an annual **average gain of P803 per household**.

- As producers also face lower electricity prices, there are additional indirect gains for households nationwide. The total annual **gain for households amounts to P28.6 billion**.

- The economy as a whole is expected to benefit from the reforms, with an **increase in GDP of 2.85 percent and labor employment of 2.79 percent**.

Sizeable welfare gains to households from the full implementation of power-sector reforms would outweigh the earlier negative adjustment costs incurred even if no mitigating mechanisms are put in place during the transition period. The potential welfare losses from the elimination of cross-subsidies in the transition period accrue mostly to nonpoor households and are due mostly to the elimination of interclass subsidies. Put another way, existing subsidies benefit mostly residential customers, particularly nonpoor households. Nonpoor households have greater access to grid electricity and have higher levels of electricity consumption.

However, though most consumers will be made better off by the electricity reform program, certain sectors of society will necessitate mitigation mechanisms to minimize or cushion the adverse impacts of the elimination of cross-subsidies during the transition period. The government expenditure required for mitigating measures during the transition period are quite modest relative to the tremendous gains that are to be made from the reform program.

The positive response of the production sectors from the expected lowering of industrial and commercial electricity rates due to the elimination of cross-subsidies during the transition period and the approach of electricity prices toward marginal cost pricing in the longer run is a significant source of welfare gains for households. The indirect welfare effects operate through increases in household incomes arising from greater production activities and the consequent increase in household demand for goods and services.

The economic expansion that can be made possible by the power-sector reform program enlarges the tax base and raises revenues for government absorption of NPC liabilities. Full absorption by the national government of the NPC liabilities has greater positive welfare and output effects than the universal levy (EIRC). The government absorption of NPC liabilities can be welfare-improving due to efficiency gains in removing distortions in electricity pricing.

Mindanao is expected to face higher electricity prices due to the significant levels of subsidies that are currently embedded in the electricity rates. Without subsidies and even without the power sector reform program, electricity rates in Mindanao are expected to go up in the longer run once their hydro resources, mainly Agus and Pulangui, are exhausted and electricity has to be generated using other energy sources such as coal. If the response though of the production sector is sufficiently strong, the higher electricity prices need not lead to welfare losses for the Mindanao households.

The proposed mandated reduction in residential rates during the transition period in the form of a 30-centavo per kWh reduction lowers the annual direct welfare loss from the elimination of cross-subsidies from about P5.7 billion to P2.9 billion, or a 49 percent reduction of welfare losses due to the elimination of cross-subsidies. However, when indirect production benefits arising from the lowering of commercial and industrial rates are taken into account, the 30-centavo reduction in residential rates translates to a total welfare gain for households of P12.5 billion. Hence, the overall welfare effect of correcting electricity prices by eliminating the distortions due to cross-subsidies coupled with the 30-centavo residential rate reduction as a mitigating mechanism is general improvement in household welfare.

A simulation of lifeline pricing with a threshold level of 20 kWh a month and a discount of 70% indicates that this scheme leads to undercoverage of poor households and significant leakage of benefits to nonpoor households. With the scheme, less than half of poor households will be covered and about half of the gains will accrue to nonpoor households. The results question the effectiveness of lifeline pricing as a redistributive/safety net instrument.

The very small changes in the income distribution measure (the Gini coefficient) indicate that the efficiency-equity trade-off is not significant. Especially in the longer run when potential benefits of the power-sector reforms are larger, the positive effect on the government budget balance can enable the government to spend more on other poverty and income redistribution programs such as the provision of better health, educational and other social services to the poor.

With the limited budget of the government, improving access to electricity by poor households may be more effective in helping the poor. While the national electricity access rate is 70.4%, only 40.4% of poor households have access to grid electricity. This can be done through programs such as subsidized house connections for the poor and other missionary electrification programs.

The regulatory framework/environment to realize the potential gains from the power sector reform program is important. There is concern that weak regulations can hinder the development of real competitive markets and LRMC-pricing may not be achieved. An adequate competitive market framework and anti-competitive market behavior provisions in the proposed legislation are necessary for the welfare benefits of the reform program to be realized.

Section 2
Introduction

This report presents the findings of the Consumer Impact Assessment Technical Assistance Project. This was conducted under a grant from the Asian Development Bank in coordination with the Philippine Department of Energy as the Executing Agency. The project was undertaken by Navigant Consulting, Inc. (formerly Resource Management International, Inc.) in association with UPecon Foundation (essentially the School of Economics of the University of the Philippines) and Ian Pope & Associates.

Objectives of the Study

The major objectives of the study on the assessment of the consumer impacts of the power sector reform are:

- The estimation of the long-run marginal cost of electricity generation, distribution and transmission in different regions of the Philippines;

- The quantitative assessment of the impact of potential electricity price changes on various classes of electricity end-users; and

- The identification of vulnerable groups and the design of mitigating mechanisms for consumer groups who are likely to be adversely affected by the power sector restructuring.

Socioeconomic Profile of the Household Sector

This section seeks to provide a broad analysis of the socioeconomic state of the household sector within the different electricity franchise areas. This socioeconomic analysis aid in the identification of the impacts of the electricity sector restructuring, as well as the groups that will be most affected by the changes.

The analyses on the socioeconomic profiles by franchise areas, for rural electricity cooperatives (RECs) and investor-owned utilities (IOUs), have been completed and included in this report in Section 3. Bulk of the data come from the 1997 Family Income and Expenditure Survey (FIES), though other data sources were utilized including the 1995 Household Energy Consumption Survey (HECS), to aid in the understanding of the economic make-up of the sector. Due to the nature of the 1997 FIES, the sampling designs of the household surveys constrain inferences to be limited to either the provincial or regional level at the highest level of disaggregation. A cross-referencing of regions and provinces and franchise areas is then used to obtain franchise area socioeconomic profiles.

Household income, expenditure and energy use patterns have been analyzed at the national, island group, regional and provincial level. Electricity supply characteristics are also included in this section.

Economic Profile of the Production Sector

A separate but related analysis has been done on the production sector. This research was conducted utilizing the system of national accounts which reports the nation's economic activity in any given year. The production units of the economy are traditionally classified into three broad categories: (1) Agriculture, Fishery and Forestry, (2) Industry and (3) Services. These findings are presented in Section 4.

Residential Demand for Electricity

Section 5 contains an exposition on the determinants and responsiveness to price and income changes of residential demand for electricity. The analyses were conducted to calculate both the short-run and long-run demand. Besides their usefulness in examining the effects of a change in price on demand and expenditure, the demand functions obtained are subsequently used in determining the magnitude of welfare loss or gain experienced by consumers brought about by a change in electricity prices.

A description of residential electric tariff structures has been prepared for RECs (with a single electricity price but with a minimum bill) and IOUs (with varying pricing schemes: with or without minimum bill, single marginal price or multiblock pricing). A survey of estimated short-run and long-run price and income elasticities of demand for electricity has been undertaken.

Long Run Marginal Cost Analysis

Production, Transmission and Distribution Long Run Marginal Costs (LRMC) have been estimated. The estimates, methodology and findings are summarized in Section 6. The LRMC was developed to estimate the tariff levels that can be likely achieved by the electricity industry restructuring. The entry of competition in the bulk power supply market, a competitive retail market and a performance-based regulated transmission market is assumed to influence electricity prices towards LMRC. All prices developed in the LMRC analysis are economic prices and standard conversion factors were utilized to adjust the local prices to reflect economic pricing.

Partial Equilibrium Analysis: Welfare Effects

A partial equilibrium analysis has been conducted to model changes in household welfare in Section 7. In the partial equilibrium approach, the direct impacts of the potential changes in electricity prices on various groups of residential end-users have been quantified under the assumption that each household is a price taker and that there are no changes in the prices of other consumption goods and factors of production. Household incomes are assumed unchanged in this analysis.

General Equilibrium Analysis

The technical specifications of a "simple" computable general equilibrium (CGE) model has been developed and is described in Section 8. A CGE model captures the interaction between the producing and consuming sectors in the economy. The purpose of the model is primarily illustrative and is designed to capture the indirect effects on households of the restructuring program operating through changes in the input cost of industries and through changes in remuneration of factors of production. While the CGE can provide a more comprehensive account of the impact of reforms, the model is designed primarily to describe the direction of changes of macroeconomic variables.

Consultations

Consultations with electricity end-users, local government units and utility companies have been held in six areas throughout the country. Two franchise areas were selected from Luzon, Visayas and Mindanao. The franchise areas selected are as follows:

- Bohol
- Cagayan de Oro
- Cebu City
- Davao City
- Metro Manila
- Tarlac

The findings from these six consultations have been incorporated into the findings of each consultation are provided in Appendix H.

Section 3
(Not Available Yet)

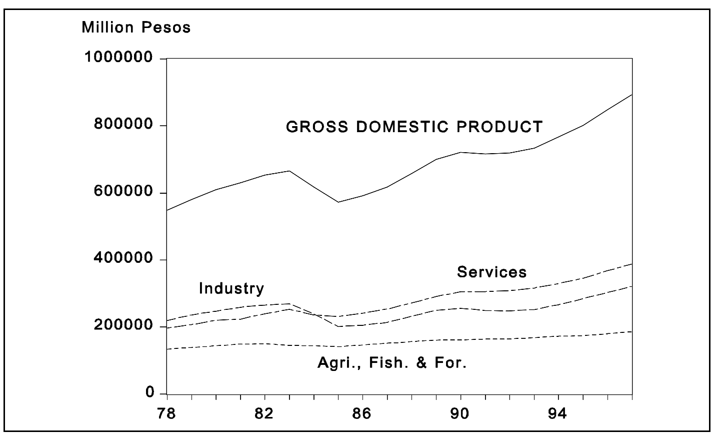
Section 4
Economic Profile of the Production Sector

Overview

A general picture of the production sector may be obtained from the system of national accounts which reports the nation's economic activity during a given year. The level of economic activity during the year is usually measured by the total value of the product created by the economy through the use of domestic factors of production. This total value, called the Gross Domestic Product (GDP), is the sum of gross value added of all the production units of the economy.

The production units of the economy are traditionally classified into three broad categories: (1) Agriculture, Fishery, and Forestry, (2) Industry, and (3) Services. Table F.1.1 presents the performance of the Philippine economy during the period 1978-1997 where GDP is given in real terms, i.e., at constant 1985 prices. In order to facilitate tracing the growth of production over time, GDP and its components corresponding to the three main sectors are graphed in Figure 1.

Figure 1
Real Gross Domestic Product and its Main Components
(1985=100)



Source: NSCB National Accounts

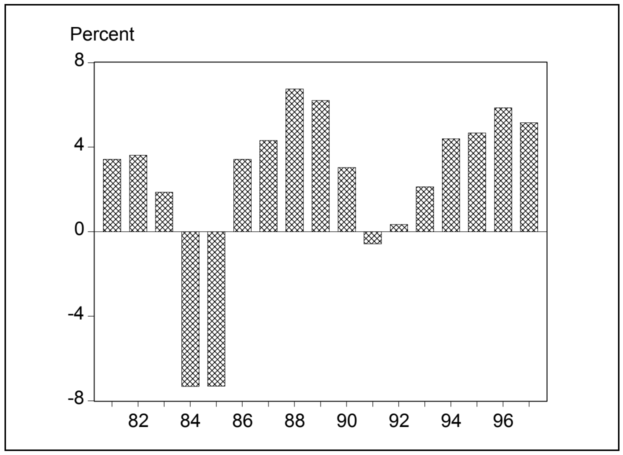
Between 1978 and 1997 real GDP grew at an average annual rate[1] of 2.6%. Services had the highest growth rate of 3.6%, followed by Industry which grew at 2%, and Agriculture, Fishery, and Forestry which grew at 1.7%.

The striking feature of the picture presented in Figure 1 is the downturn of the economy in 1984 when real

[1] The average annual growth rate *r* of a variable *X* during a period of *t* years is defined by the equation $X_t = X_0(1 + r)^t$, where X_0 and X_t are the initial and final values of *X*.

GDP fell by 7.3% (Figure 2) and was followed by a similar fall in 1985. Although the economy picked up in 1986, it took four years for real GDP to surpass its peak level in 1983. From 1985 to 1997 the economy grew at an average rate of 3.8% achieving its highest growth of 6.8% in 1988.

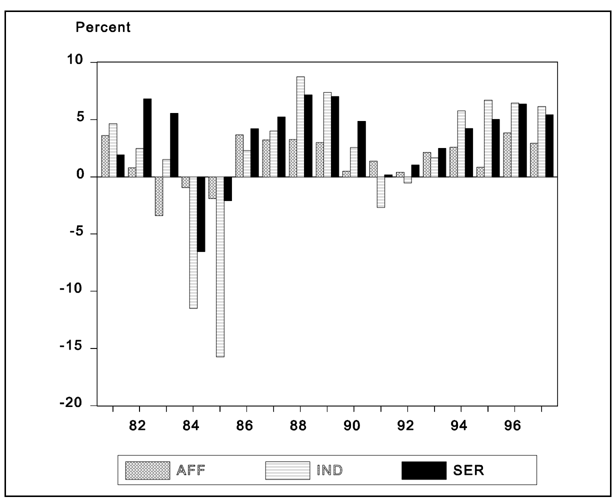
Figure 2
Annual Growth Rates of GDP



Source: NSCB

Hardest hit during the crisis was the Industrial sector whose output dropped by almost 12% in 1984 (Figure 3) followed by another drop of nearly 16% the next year causing its output to fall below that of Services and stayed that way up to 1997. The Services sector fell by 7% in 1984, followed by another fall of 2% in 1985. Although Agriculture, Fishery, and Forestry declined only by 1% in 1984 and 2% in 1985, the crisis came one year earlier in this sector when its output fell by 3% in 1983.

Figure 3
Annual Growth Rates of the Main Components of GDP



Source: NSCB

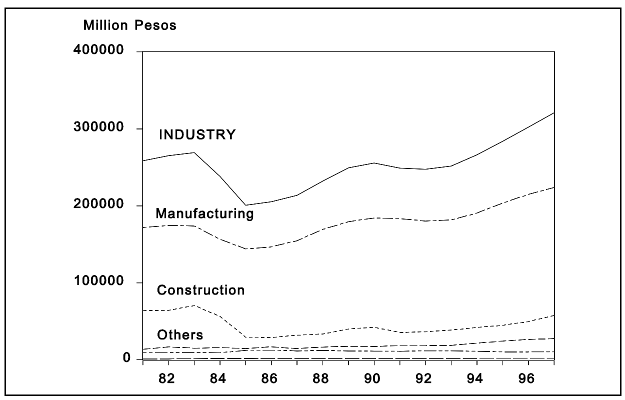
In 1997, after four years of continuous growth, the economy decelerated, slowing from 5.9% a year earlier to 5.2%. Expansion in 1997 was led by the Industrial sector which grew by 6.1%, followed by Services which rose by 5.4% and Agriculture, Fishery and Forestry which increased by 2.9%. The subsectors that experienced significant improvements included Construction (16.2%), Finance (13.0%), Transportation, Communication and Storage (8.2%) and Electricity and Gas (5.2%). No sector experienced a decline.

Sectoral Growth and Output Structure

To examine the development of production in more detail, we look at the graphs in Figure 4 which depict the outputs of Industry and Services from 1978 to 1997. Starting with Industry (Figure 4(a)), we see that Manufacturing, the predominant sector accounting for nearly 70% of Industry output in 1997, and Construction (accounting for 20% in 1997) were responsible for the development pattern of the Industry sector.

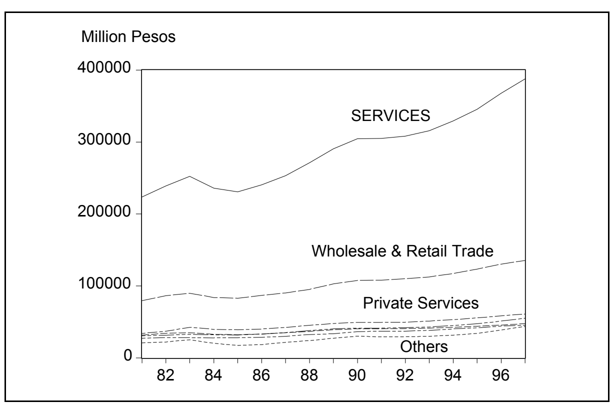
Figure 4
Gross Value Added: 1978-1997 (1985=100)

(a) *Industry*



Source: NSCB

(b) *Services*



Source: NSCB

Manufacturing grew at 2% annually while Construction grew at 1%. The Water subsector achieved the highest growth rate (7%) but it contributed less than 1% to total Industry output. Electricity and Gas, which contributed about 3% to Industry output in 1997, grew at 5.7%.

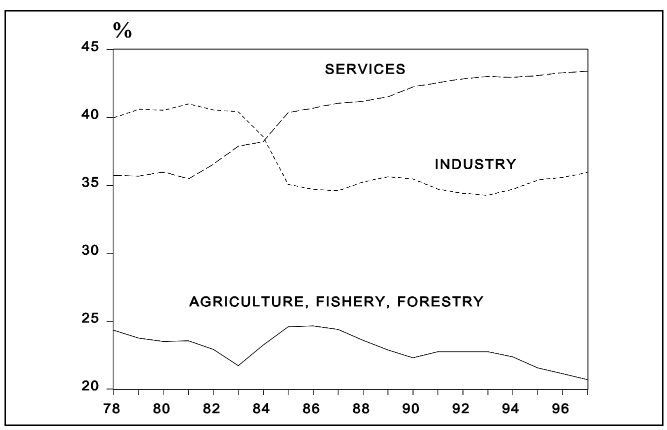
Wholesale and Retail Trade, the dominant subsector of Services (about 35% of Services output in 1997) grew at an annual rate of 3.6%. The highest growth rate (4.4%) in Services was achieved by 'Private Services' and 'Finance' while Ownership of Dwellings and Real Estate registered the lowest growth rate (2.4%).

Output Structure

We next turn to the output structure of production and how it changed during the period 1978-1997. Output structure refers to the sectoral shares of output expressed as percentages of each year's Gross Domestic Product. These are presented in Table F.1.2 and are graphically displayed in Figure 5.

It is immediately obvious from Figure 5 that there has been a shift from an economy dominated by Industry to one dominated by Services after the fall of GDP in 1984. In 1978 the Industrial sector accounted for about 40% of GDP (Figure 5), the Services sector contributed about 36%, while Agriculture, Fishery, and Forestry accounted for about 24%. In 1985, Industrial share fell to about 35% around which it fluctuated with small deviations and in 1997 its share was 36%. The share of the Services sector rose to 40% in 1985 and continued to rise, albeit slowly, to 43% in 1997. As a result, the share of Agriculture, Fishery, and Forestry declined from 24% in 1985 to 21% in 1997. Thus, Services became the dominant sector from 1985 to 1997.

Figure 5
Sectoral Output Shares, 1978-1997



Source: NSCB

The industrial patterns at the beginning (1978) and the end (1997) of the period under review are compared in Table 1 and summarized in the charts in Figure 6.

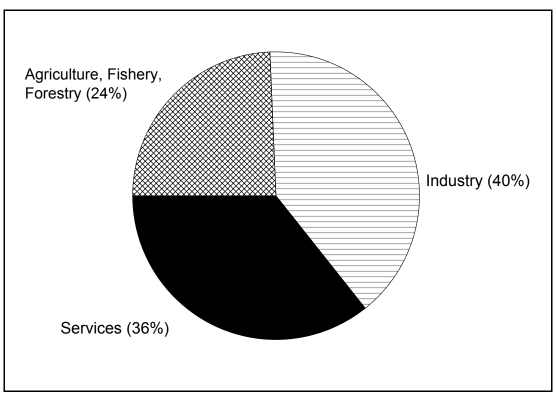
Table 1
Sectoral Output Shares, 1978 and 1997

Sector	Shares (%) 1978	1997
Agriculture, Fishery and Forestry	**24.32**	**20.68**
Industry	**39.97**	**35.92**
Mining and Quarrying	1.33	1.16
Manufacturing	28.11	25.05
Construction	8.68	6.42
Electricity and Gas	1.74	3.06
Water	0.10	0.23
Services	**35.71**	**43.40**
Transport., Communication and Storage	4.96	6.17
Wholesale and Retail Trade	12.65	15.16
Finance	3.53	4.87
Ownership of Dwelling and Real Estate	5.48	5.30
Private Services	4.92	6.84
Public Services	4.18	5.06
Total	**100.0**	**100.0**

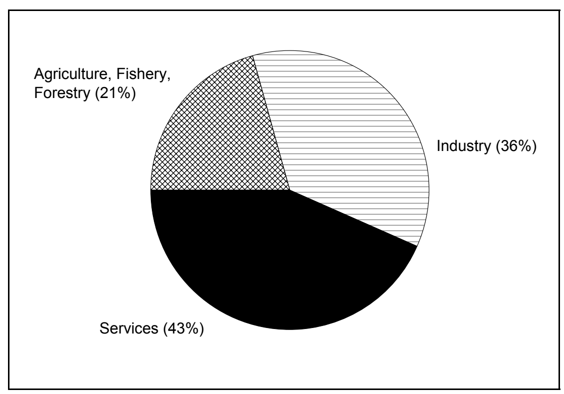
Source: NSCB National Accounts, 1999

Figure 6
Gross Domestic Product by Industrial Origin (1985=100)

1978



1997



Source: NSCB

Sectoral Contributions to Growth

Table F.1.3 shows the sectoral contributions to the annual growth rate of real Gross Domestic Product. We summarize the contents of Table F.1.3 by taking the simple averages of the annual sectoral contributions to growth of GDP as well as the annual growth of GDP. This summary is shown in Table 2 below:

Table 2
Average Contribution to Growth of Real GDP by Industrial Origin[2], 1978-1997

	Average, 1978-97
Agriculture, Fishery and Forestry	**0.41**
Industry	**0.77**
Mining and Quarrying	0.03
Manufacturing	0.53
Construction	0.06
Electricity and Gas	0.14
Water	0.01
Services	**1.49**
Transportation and Communication	0.21
Wholesale and Retail Trade	0.52
Finance	0.18
Ownership of Dwellings	0.13
Private Services	0.27
Public Services	0.18
Gross Domestic Product	**2.67**

Source: NSCB National Accounts, 1999

[2]The sectoral contribution to the growth rate of GDP is computed as follows. The growth rate of GDP, say R_{GDP}, is given by

$$R_{GDP} = \frac{GDP - GDP(-1)}{GDP(-1)}$$

$$= \frac{A + I + S - [A(-1) + I(-1) + S(-1)]}{GDP(-1)}$$

where **A, I**, and **S** are the gross value added in 'Agriculture, Fishery, and Forestry', 'Industry', and 'Services', respectively. Hence,

$$R_{GDP} = \frac{A - A(-1)}{GDP(-1)} + \frac{I - I(-1)}{GDP(-1)} + \frac{S - S(-1)}{GDP(-1)}$$

Each of the ratios on the right hand side of this equation is defined to be the contribution of the sector to the growth rate of GDP.

Evidently, from 1978 to 1997 the Services sector contributed the most (1.49 percentage points) to the average growth rate of GDP (Table 2). The Industrial sector accounted for 0.77 of a percentage point and Agriculture, Fishery, and Forestry contributed 0.41. Among the subsectors, the highest contributors to the growth of GDP were Manufacturing (0.53) and Wholesale and Retail Trade (0.52) while the lowest contributors include Mining & Quarrying (0.03), Construction (0.06), and Water (0.01).

The Informal Sector's Contribution to GDP

The National Statistics Coordination Board considers all activities not covered by the Census of Establishments (CE) and the Annual Survey of Establishments (ASE) as informal activities. The contribution of the informal sector to GDP is derived indirectly through the informal sector employment, being the difference between employment from the Labor Force Survey and employment from the CE/ASE. The gross value added per worker in the informal sector is assumed to approximate that of the small establishments in the CE/ASE. (For more details, see the Technical Notes in the Appendix).

Agricultural activities operated by household enterprises that are meant towards production for the market are considered part of the informal sector. These include growing of crops and livestock, catching and gathering of marine products, small-scale breeding, and gathering of firewood and minor forestry products. For the period 1990-1998, the informal sector of Agriculture, Fishery, and Forestry accounted, on average, for 64% (Figure 7(a)) of the sector output or about 14% of GDP with very little yearly fluctuations.

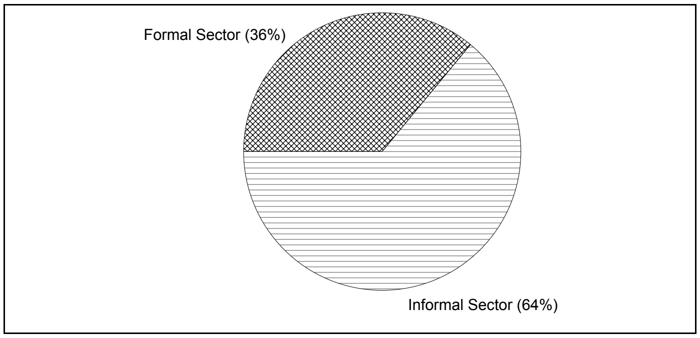
The informal activities of the Industry sector are characterized by an absence of division of labor and capital as factors of production. In the Mining and Quarrying activities, for instance, small family units are engaged in production where operations are not mechanized, employing tools like pans, picks, shovels, and other tools that complement labor. For the period 1990-1998, the share of the informal sector in Industry output generally stayed close to 33% (Figure 7(b)) or 12% of GDP. Manufacturing had the largest share at 43% while Construction had the lowest share at 10%.

Informal activities in the Services sector consist of those household activities characterized by the absence of division between household and production operations, and/or the absence of division between labor and capital of the operator. During the period 1990-1998, the informal sector's share of the Services output remained fairly stable around 44% (Figure 7(c)) or 19% of GDP. Within Services, some subsectors had large informal segments. For example, about 90% of the Ownership of Dwellings output, 52% of Wholesale and Retail Trade and 58% of Private Services were contributed by the informal sector. At the other extreme, less than 2% of the Finance output can be attributed to the informal sector.

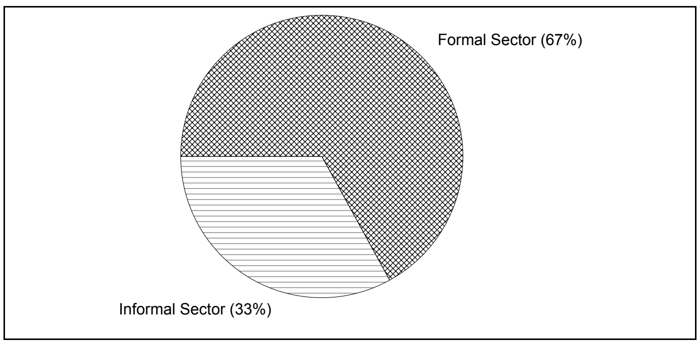
Figure 7

Informal Sector Share, Average for 1990-1998

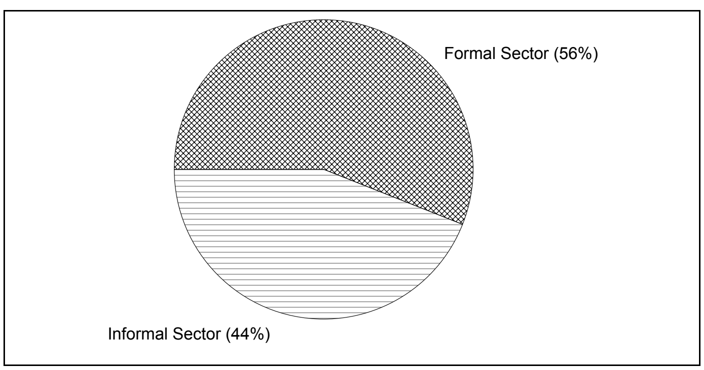
(a) Agriculture, Fishery, Forestry



(b) Industry



(c) Services

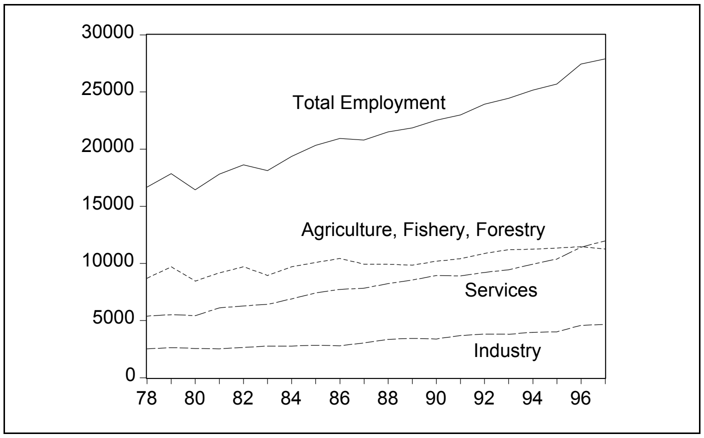


Source: NSCB

Employment and Compensation

Total as well as sectoral employment for the period 1978-1997 are presented in Table F.1.5. An overview of the employment picture is shown in Figure 8 where total employment and its components in the three major sectors of the economy are graphed.

Figure 8
Growth of Employment, 1978-1997

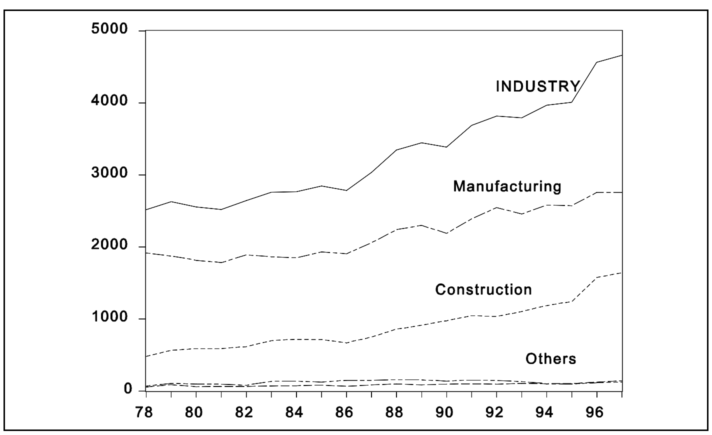


Source: Labor Force Survey, NSO

Figure 8 clearly shows that Agriculture, Fishery, and Forestry has provided more employment than each of the other two sectors. But employment in Services grew faster (4.28% annually) than employment in either of the other sectors (Industry, 3.29%; Agriculture, Fishery, and Forestry, 1.36%). By 1997 employment in the Services sector surpassed that of Agriculture, Fishery, and Forestry.

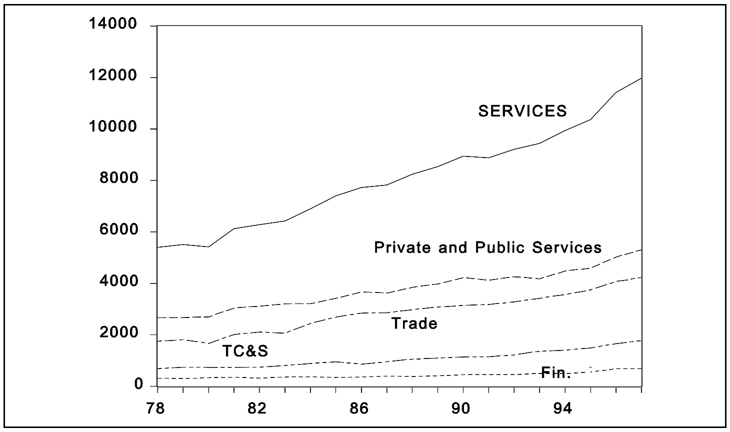
Turning to the Industry sector, we see from Figure 9 that the growth of industrial employment was mostly attributable to the growth of employment in the Manufacturing and Construction sectors. This is not surprising since these are the two dominant subsectors in Industry.

Figure 9
Employment in the Industry Sector, 1978-1997



Source: LFS, NSO

Figure 10
Employment in the Services Sector, 1978-1997



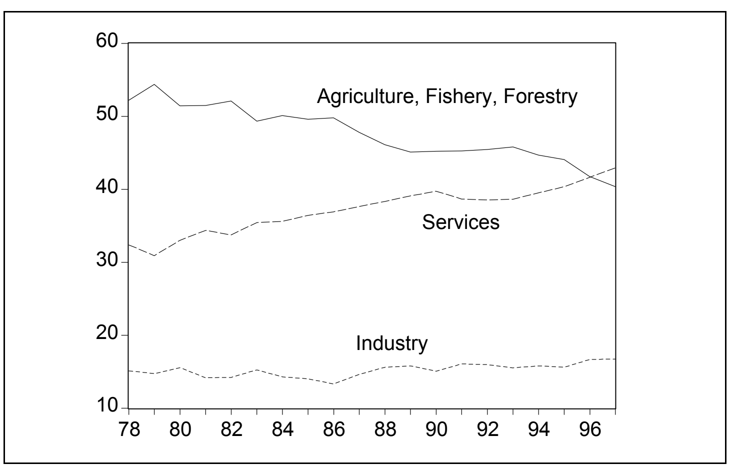
Source: LFS, NSO

From Figure 10, we see that the major contributors to growth in Services employment were the Private and Public Services sector, Wholesale and Retail Trade and, to a lesser extent, Transportation, Communication and Storage.

Sectoral Employment Shares

The sectoral employment shares from 1978 to 1997 are given in Table F.1.6 and graphed in Figure 11. What we see from Figure 11 is that Industrial employment share remained fairly stable around 15% over the whole period, deviating from it by less than 2 percentage points in either direction. This means that the employment shares of the other two sectors are mirror images of each other.

Figure 11
Employment Shares, 1978-1997
(Percent)



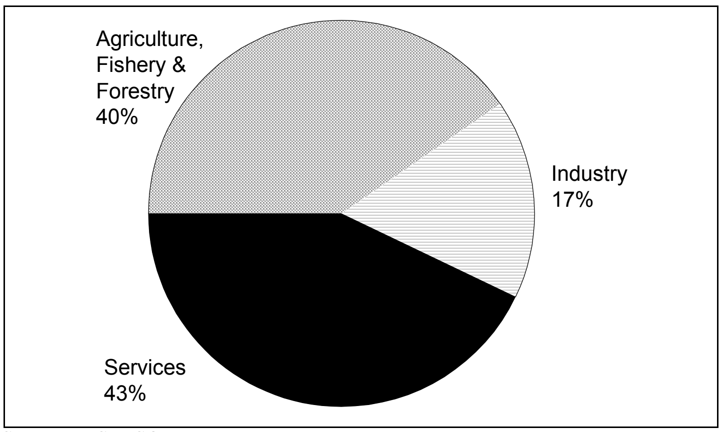
Source: LFS, NSO

We also note that from 1978 to 1995 Agriculture, Fishery, and Forestry had the largest share of employment but by 1997 the Services sector share rose to 43% while Agriculture, Fishery, and Forestry's share fell to 40% (Figure 12).

Employment in 1997

The economic growth in 1997 resulted in an increase in employment to 27.9 million, up by 1.6% from 1996, despite the decline in employment in Agriculture, Fishery, and Forestry by 1.7%. In the Industry sector, employment increased by 2% to 4.7 million while in the Services sector, it increased by 4.8% to 12 million. High employment growth rates occurred in Electricity and Gas (13%), Mining and Quarrying (7.8%), Transportation, Communication, and Storage (6.8%) and Private and Public Services (5.5%) while employment in Manufacturing and Finance declined by 0.04% and 0.15%, respectively. The employment shares in 1997 are shown in Figure 12.

Figure 12
Employment Shares by Major Sectors, 1997

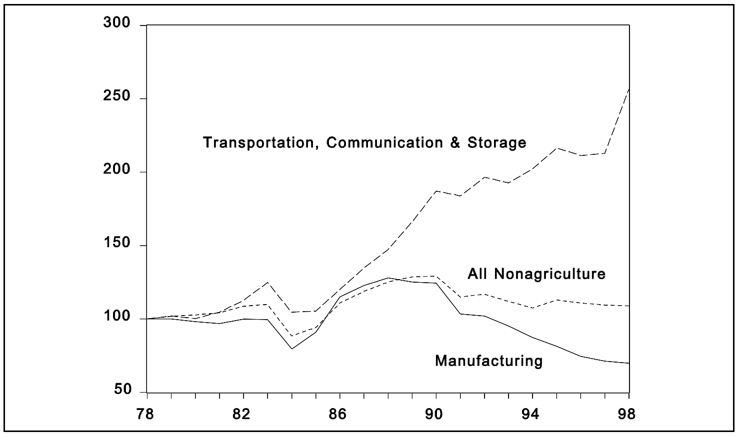


Source: LFS, NSO

Compensation Per Employee

A time series of the shows the movement of the compensation per employee over time. Table F.1.7 gives the indices for the nonagricultural industries by major industry groups during the period 1978-1998. For the entire nonagricultural sector, compensation per employee increased by 8.9% from 1978 to 1998, equivalent to an annual average growth rate of 0.43%. This low average growth rate is the effect of the decline in compensation per employee in four sectors (Manufacturing, Wholesale and Retail Trade, Finance, and Real Estate) which almost nullified the increases in the four other sectors (Mining and Quarrying, Electricity and Water, Transportation, Communication, and Storage, and Private Services). The highest growth rate occurred in Transportation, Communication, and Storage (4.8%) while the lowest was in Manufacturing (-1.8%). Figure 13 compares the growth of compensation per employee among the entire nonagricultural sector and the subsectors with the highest growth rate (Transportation, Communication, and Storage) and the one with the lowest growth rate (Manufacturing).

Figure 13
Compensation of Employees, Selected Industries
(1978=100)



Source: NSCB

Demand for Electricity

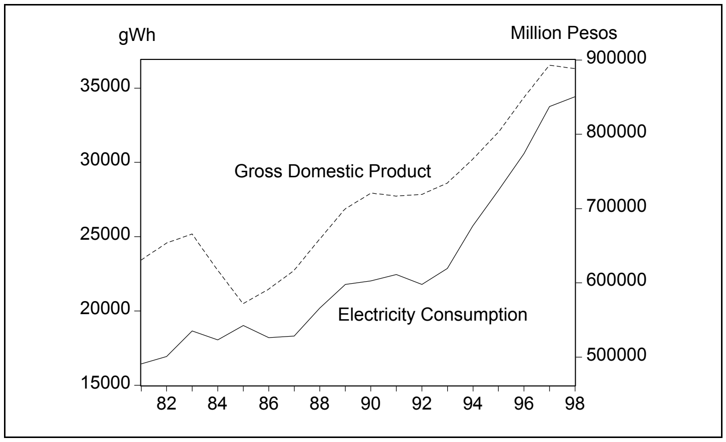
Electricity consumption in the Philippines more than doubled from 16,433 GWh in 1981 to 34,412 GWh in 1998 (Table 3 and Figure 14). This is equivalent to an average annual growth rate of 4.4% which was led by residential consumption which grew at 7.4%. Industrial and commercial electricity consumption grew at 2.4% and 6%, respectively. Figure 14 also shows that electricity consumption and Gross Domestic Product have similar growth patterns, indicating a high correlation between them and showing the importance of electricity to the growth of the national economy.

Table 3
Electricity Consumption Shares by Type of Use:
Philippines, 1981 & 1998

	1981		1998		Growth Rate
Type of Use	**GWh**	**% Share**	**GWh**	**% Share**	**1981-1998**
Industrial	7,597	46.2	11,386	33.1	2.4
Commercial	3,157	19.2	8,555	24.9	6.0
Residential	3,424	20.9	11,467	33.3	7.4
Others	1,098	6.7	1,412	4.1	1.5
Utilities Own Use	1,157	7.0	1,592	4.6	1.9
Total	16,433	100.0	34,412	100.0	4.4

Source: Department of Energy

Figure 14
Electricity Consumption and Gross Domestic Product: Philippines, 1981-1998

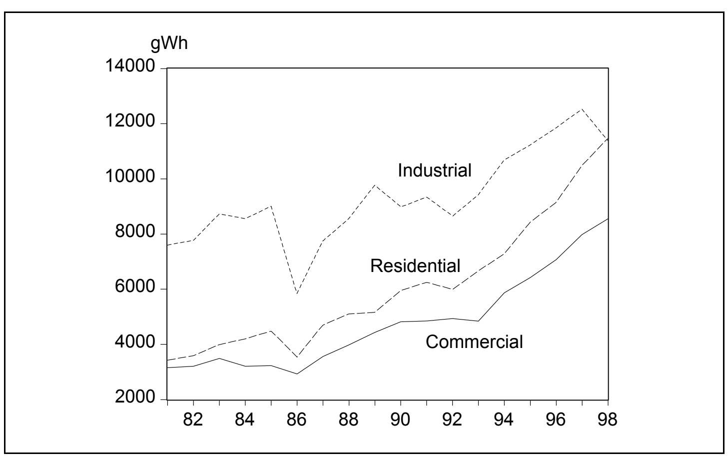


Source: DOE

Electricity Consumption by Customer Class

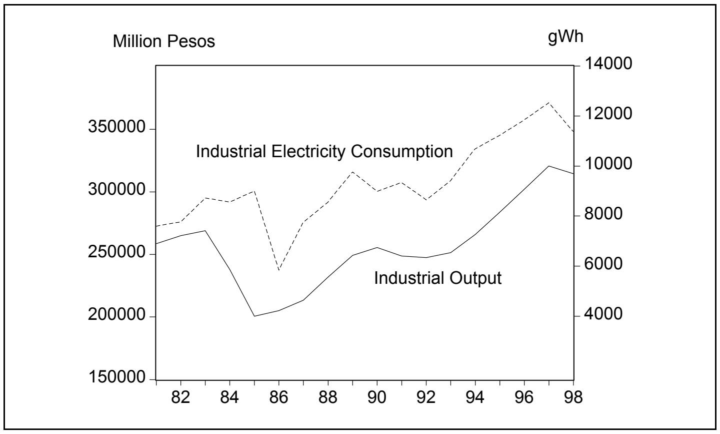
Figure 15 depicts a more detailed picture of electricity consumption. It shows that industrial consumption topped both commercial and residential consumption from 1981 to 1997 although in 1998 the decline in GDP reduced industrial consumption to the level of residential consumption. We note that only industrial electricity consumption dropped in 1998. This is closely tied to the industrial contraction that occurred that year . In fact, the industrial growth pattern during the period 1981-1998 is paralleled by a similar growth pattern in industrial electricity consumption (Figure 16).

Figure 15
Electricity Consumption by Customer Class: Philippines, 1981-1998



Source: DOE

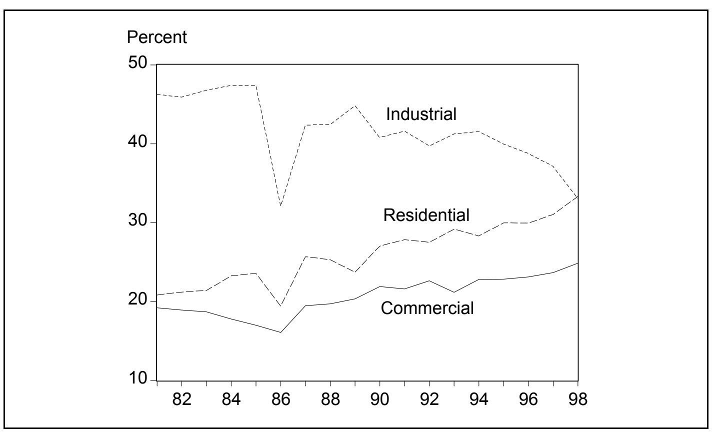
Figure 16
Industrial Output and Industrial Electricity Consumption: 1981-1998



Source: DOE

Turning next to the shares of the three customer classes, we see from Table 3 and Figure 17 that industrial use had a predominant share in 1981 at 46.2 percent. Over the next 17 years, residential and commercial shares increased by 12.4 and 5.7 percentage points, respectively, while industrial share decreased by 13.1 percentage points (Table 3). By 1998, the distribution of electricity consumption was as follows: industrial share, 33.1%; commercial share, 24.9%; and residential share, 33.3%.

Figure 17
Electricity Consumption Shares by Customer Class: 1981-1998



Source: DOE

Electricity Consumption by Grid

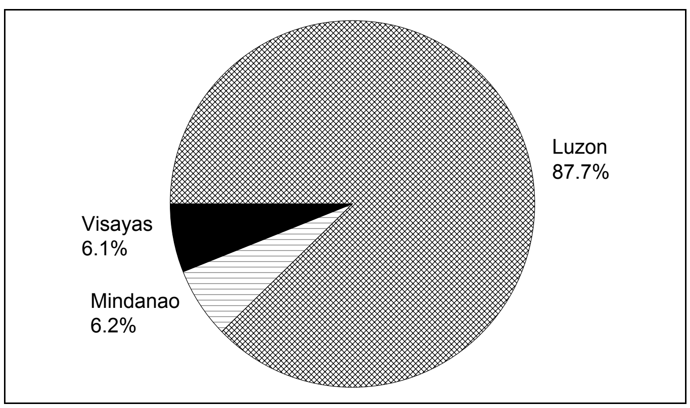
We now examine the use of electricity in the three grids (Luzon, Visayas, and Mindanao). Table 4 shows a high electricity consumption in the Luzon grid (88 percent in 1998) with the Visayas and Mindanao grids accounting for only a small portion of the total (about 6 percent each in 1998, Figure 18). The rates of growth of electricity consumption were about the same in Luzon and Mindanao (which increased 9.2 and 9.6 percent, respectively) but was particularly rapid in the Visayas (which increased 12.4 percent).

Table 4
Electricity Consumption by Grid: 1994, 1998

Grid	1994		1998		Rate of Growth
	GWh	%	GWh	%	1994-1998
Luzon	14,984	88.4	21,269	87.7	9.2
Visayas	920	5.4	1,467	6.1	12.4
Mindanao	1,049	6.2	1,512	6.2	9.6

Source: DOE

Figure 18
Electricity Consumption Shares by Grid: 1998

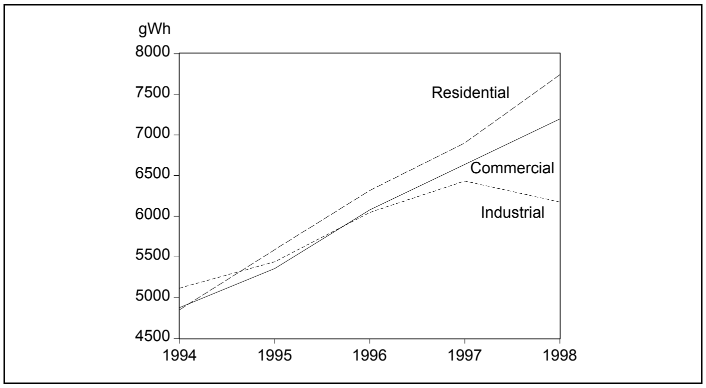


Source: DOE

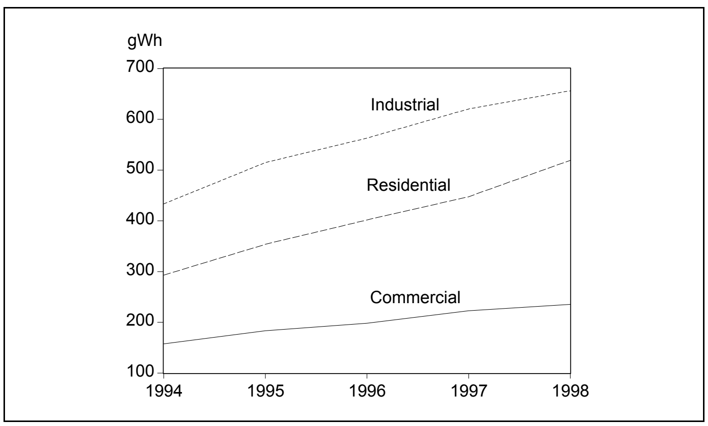
We next examine the development of electricity consumption by customer class in each grid (Figure 19). Figure 19 shows that the trends in residential, commercial, and industrial electricity consumption in Luzon are different from those in Visayas and Mindanao, the latter two being almost similar. The most striking feature of the Luzon electricity consumption is the decline in industrial consumption in 1998 by 4 percent compared to an increase of 6.4 percent in the previous year. No such decline happened in Visayas and Mindanao in 1998. Thus the fall in industrial electricity consumption noted earlier happened only in Luzon.

Figure 19
Grid Electricity Consumption by Customer Class

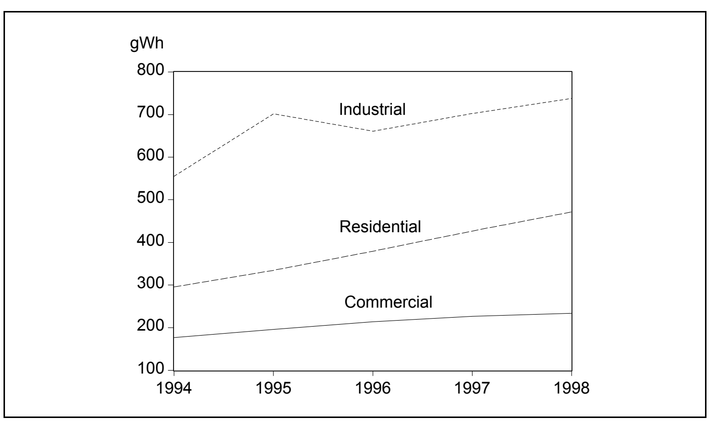
Luzon Grid



Visayas Grid



Mindanao Grid



Source: DOE

Use of Electric Power by Industries

Intensity of Electricity Use by Sectors

As noted earlier, electrical power is important to the growth of industrial activities. But obviously some industries are more electricity-intensive than others. The intensity of electricity use in an industry is measured by the *electricity input coefficient* defined as the centavo amount of electricity required to produce a peso worth of output. Table F.1.9 gives the 1994 intensity of electricity use for 60 disaggregated industries and are summarized in Table 5 for the usual aggregated sectors.

Table 5
Intensity of Electricity Use, 1994

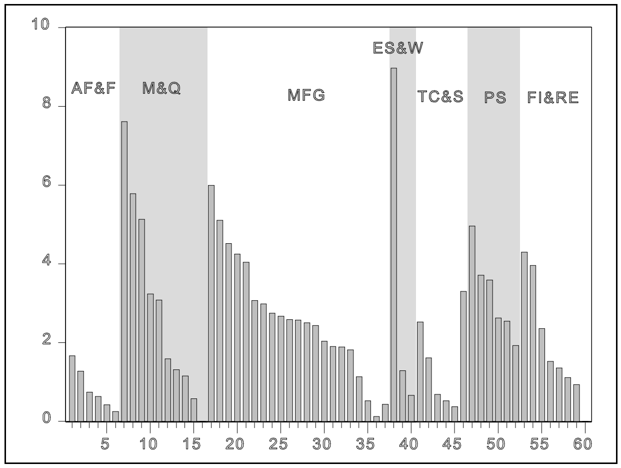
	Electricity Input Coefficients
Electricity, Steam and Water	3.6
Wholesale and Retail Trade	3.3
Private Services	3.2
Mining and Quarrying	2.9
Manufacturing	2.7
Finance, Insurance and Real Estate	1.9
Transportation, Communication and Storage	1.1
Agriculture, Fishery and Forestry	0.8
Construction	0.4

Source: NSCB

Table 5 shows that 'Electricity, Steam, and Water' is the most electricity-intensive sector, requiring 3.6 centavos per peso worth of output. In the internal structure of this sector, Water is the most electricity-intensive with a coefficient of 8.97. In fact, it has the highest electricity input coefficient among all subsectors (Table F.1.9).

The averages in Table 5, however, masks the sharp differences among the subsectors. To see these differences, the intensities of electricity use are graphed in Figure 20.

Figure 20
Intensity of Electricity Use by Industry: 1994
(Centavos per Peso)



Source: NSCB

AF&F- Agriculture, Fishery and Forestry
M&Q- Mining & Quarrying
MFG – Manufacturing
ES&W- Electricity, Steam & Gas
TC&S- Transportation, Communication and Storage
PS- Private Services
FI&RE- Finance, Insurance % Real Estate

Besides Water, there are other subsectors whose electricity input coefficient are "high" (i.e., exceeds 5.0). These are the Manufacturing subsectors 'Leather and Leather Products' (5.99) and 'Nonmetallic Mineral Products' (5.10); and the Mining and Quarrying subsectors 'Gold and Silver Mining' (7.61), 'Copper Mining' (5.78), and 'Chromite Mining' (5.13). At the other end of the spectrum are the subsectors with "low" (below 0.5) electricity input coefficients: Agricultural Crops Production (0.41), Forestry (0.25), Nickel Mining (0.00); Products of Petroleum and Coal (0.12), Construction (0.43); Water Transport (0.37), Ownership of Dwellings (0.00).

Intensity of Use by Establishment Size

The 1994 Census of Establishments classifies an establishment as large if its average annual total employment is at least ten. A comparison of electricity use by large and small manufacturing establishments is useful in investigating their technologies. Small establishments might employ production techniques different from their large counterparts. Moreover, they could face different electricity rates. (The Census of Establishments does not collect data on electricity use by small establishments. To compare electricity costs of small and large manufacturing firms, we assume that small manufacturers most likely face residential rates.)

Table 6 compares the electricity intensities of small and large establishments in 1994. It is immediately clear that 'Electricity, Gas, and Water' is the most electricity-intensive in both large and small establishments while at the other extreme, 'Construction' is the least electricity-intensive in both large and small establishments. Comparing large and small establishments, we see that small establishments are more electricity-intensive in the following sectors: 'Agriculture and Forestry', 'Manufacturing', 'Electricity, Gas, and Water' and 'Transportation'. On the other hand, small establishments are less electricity-intensive in 'Fishery', 'Mining and Quarrying' and 'Wholesale and Retail Trade'.

Table 6
Electricity Intensities of Small and Large Establishments
Philippines, 1994

Sector	Large Establishments	Small Establishments
Agriculture and forestry	1.57	3.90
Fishery	2.79	1.26
Mining and Quarrying	7.59	1.96
Manufacturing	2.78	2.97
Electricity, Gas and Water	9.24	12.77
Construction	0.69	0.95
Transportation	2.43*	2.79*
Wholesale and Retail Trade	3.81*	2.09*
Finance	2.00*	-
Private Services	4.18*	-

Source: NSCB
* Electricity and water intensity

Electricity Generation by Large Manufacturing Establishments

Some large establishments of the Manufacturing sector generate their own electricity. Table 7 shows the electricity generated by these establishments in 11 regions. Establishments in the National Capital Region and Region 4 generated large amounts of electricity compared with those in the other regions. However, the electricity generated as a proportion of total electricity used was very high (54.85%) in Region 6 compared with those in the other regions, the second highest proportion being only 8.82%. The top electricity-generating manufacturing establishments included Food, Glass and Glass Products, Paper and Paper Products, Textiles, and Beverage.

Table 7
Electricity Generation by Establishments by Region

Region	Electricity Purchased (MWh)	Electricity Generated (MWh)	Electricity Sold (MWh)	Percent Generated
Region 4 (Southern Tagalog)	1,299,694	125,654	3,412	8.82
National Capital region	2,410,695	124,361	13,345	4.91
Region 6 (Western visayas)	66,077	80,278	5	54.85
Region 3 (Central Luzon)	838,356	23,085	352	2.68
Region 7 (Central Visayas)	429,039	17,751	530	3.97
Region 10 (N. Minadanao)	218,119	13,338	-	5.76
Region 11 (S. Mindanao)	266,706	1,599	374	0.60
Region 1 (Ilocos Region)	208,465	510	-	0.24
CAR	38,474	325	-	0.384
ARMM	21,943	121	-	0.55
Region 5 (Bicol Region)	21,857	21	-	0.10

Source: NSCB

Table 8
Top Electricity-Generating Establishments

Industry	**Region**	**Electricity Generated (in kWh)**
Food Manufacturing	6	60,702
Mfr of Glass & Glass Products	NCR	38,630
Mfr of Paper & Paper Products	4	33,280
Food Manufacturing	4	31,971
Manufacture of Textiles	NCR	25,171
Manufacture of Textiles	4	23,788
Food Manufacturing	3	22,761
Beverage Manufacturing	6	16,897

Source: NSCB

Electricity Prices in the Commercial and Industrial Sectors

Commercial Electric Tariff Rates

Among Rural Electric Cooperatives (RECs), the commercial tariff structure is similar to the residential tariff structure. Each REC has a single electricity price but there is a minimum bill per month which equals the price times the minimum kilowatt-hours (Table F.1.10). The prices and the minimum kilowatt-hours vary across RECs and in 1997, the price ranged from P2.1292 per kWh to P6 per kWh while the minimum kilowatt-hours ranged from 8 kWh per month to 50 kWh per month. The mean commercial price for all RECs in 1997 was P3.68 per kWh.

The commercial electricity rates of private electric utilities follow the same structure as their residential rates. There is a minimum bill corresponding to a minimum kilowatt-hours per month which ranges from P23 per month (for 15 kWh or less) to P62.25 per month (for 100 kWh or less). In some cases, like the Bauan Electric Light System, there is only one price in excess of the minimum kilowatt-hours. In other cases an increasing block tariff structure is followed. An example of the commercial block structure is the tariff rate of the Ibaan Electric and Engineering Corporation:

First 50 kWh	P120.50 (minimum charge)
Next 100 kWh	2.41/kWh
Next 150 kWh	2.43/kWh
Over 300 kWh	2.45/kWh.

The Manila Electric Company, the largest private electric utility that serves the National Capital Region, has commercial rates that follow its industrial tariff rates. This is described below.

Industrial Electric Tariff Rates

Industrial electricity rates follow the two-part tariff structure which consists of (1) a demand charge at a specified rate for every kW of maximum load demand during the month and (2) an energy charge for the total energy consumption at a specified rate for each kWh. The demand charge assures the customer of the availability of electrical power up to the contracted maximum demand while the energy charge recovers usage-sensitive costs.

There are various ways of specifying the two-part tariff. The industrial tariff rate of a Rural Electric Cooperative has a simple structure. It has a single demand charge and a single energy charge. For example, the industrial rate of the REC Penelco consists of the following:

Demand charge	P25.00/kW
Energy charge	3.31/kWh

On the other hand, private electric utilities have a variety of two-part tariff structures. Some of them have block energy charges to provide lower rates to large consumers. The industrial rate of the Manila Electric Company in 1997 is illustrative:

Demand charge	P220.00/kW	
Energy charge		
Small (5 kW < demand < 40 kW)		2.00/kWh
Medium (40 kW < demand < 200 kW)		1.96/kWh
Large (200kW < demand < 2000 kW)		1.92/kWh
Very large (2000 kW < demand)		1.85/kWh

Summary and Conclusions

During the period 1978-1997, the Philippine economy grew at an annual average rate of 2.6% in real terms. This low growth rate could be attributed to the economy's collapse in 1984 when Gross Domestic Product (GDP) declined by 7.3% followed by a similar decline the next year. In recent years, say the five-year period 1993-1997, the economy grew at an average annual rate of 5%.

The crisis years (1984-1985) saw a shift in the structure of the economy that has remained up to the present. Before the crisis, Industry dominated the economy accounting for about 40% of GDP. After the crisis, Industry's share declined to 35%, yielding its position to Services whose share became 40% and rose to 43% in 1997.

During the period 1990-1998, Agriculture, Fishery, and Forestry had the largest informal sector in terms of volume of output. On average, the informal sector of Agriculture, Fishery, and Forestry was 64%, followed by Services with 44% and Industry with 33%. These shares remained fairly stable during the period.

Agriculture, Fishery, and Forestry provided more employment than each of the other two sectors until 1997 when it was surpassed by the Services sector. The major contributors to growth in Services employment were the Private and Public Services, Wholesale and Retail Trade, and Transportation, Communication, and Storage.

The importance of electricity to the growth of the economy has been demonstrated by the high correlation between the level of economic activity and the level of electricity consumption. The GDP growth pattern during the period 1981-1998 is paralleled by a similar growth pattern in electricity consumption. Industrial electricity consumption topped both commercial and residential consumption until 1998 when industrial consumption dropped to the level of residential consumption due to the decline in GDP. In terms of geographical distribution, Luzon accounted for 88% of electricity consumption while Visayas and Mindanao accounted for about 6% each in 1998.

Section 5
Residential Demand for Electricity in the Philippines

Short Run Residential Demand for Electricity

Introduction

Much of the econometric literature on the residential demand for electricity since Houthakker's (1951) classic study have been concerned with quantifying the responsiveness of electricity demand, both short-run and long-run, to price and income changes. (Short-run demand is derived from the demand for the services of a fixed stock of electricity-using appliances while long-run demand is one where the stock of appliances can vary). Specifically, the demand response to a price change, called price elasticity, has been recognized for its practical application in determining welfare gains and losses due to price changes. It is also useful in examining the short-run impact on residential demand for electricity of a given price change.

Modelling the residential demand for electricity is complicated by the presence of a multiblock tariff structure which could either be decreasing or increasing. Two econometric problems immediately arise. One problem is specifying the price variable in the demand function given that the consumer faces not a single price but a schedule of prices. The second problem is concerned with estimating the demand function. The multiblock price structure makes price a function of the level of consumption resulting in the endogeneity of price and making ordinary least squares estimates biased and inconsistent. How these problems are treated could affect the elasticity estimates.

There is considerable variation in the estimates of short-run price and income elasticities of demand for residential electricity as Table 1 shows. These differences in estimates may be explained by, among others, differences in the type of data (unit of analysis), the treatment of price, the estimation procedure, and the type of model used.

Table 1
Short-Run Price and Income Elasticities from Selected Studies

Study	Price Elasticity	Income Elasticity	Country
McFadden et al. (1997)	-0.37	0.20	US/Household
Barnes et al. (1981)	-0.55	0.20	US/Household
Maddigan et al. (1983)	-0.22 to –0.13	0.03 to 0.42	US/RECs*
Berndt & Samaniego (1994)	-0.35	0.32	Mexico/Regions
Branch (1993)	-0.20	0.23	US/Household
Lyman (1994)	-0.52 to –0.36	0.085 to 0.94	Philippines/RECs*

*Rural Electric Cooperatives

The Model

The short-run residential demand for electricity is derived from the demand for the services (such as lighting, entertainment, refrigeration, and cooling) of a fixed stock of equipment powered by electricity. In the short-run, household electricity consumption depends on this stock of electrical equipment and the intensity with which they are utilized. This rate of utilization is a function of household budget, the price of electricity, household size, the location of the household (urban or rural) and the stock of electrical appliances in the household.

The economic variables (household budget and price of electricity) are standard variables in a demand function. Household size affects the demand for electricity because, in general, larger households will use their electrical equipment more intensively than smaller households (the user effect). However, for poorer households, where household budgets are generally fixed, an increase in household size means a reduced allocation for energy (the income effect). Thus, depending on which of these two effects dominates, it is possible for household size to have a positive or a negative relationship with electricity consumption. This ambiguity may be resolved by using household budget per capita in the model since, in this case, only the user effect will be captured by the model. The urban/rural characteristics of the area where the household is located has an impact on electricity consumption since urban and rural areas differ in the availability of substitutes for electricity. Thus, we specify the residential demand for electricity as

$$KWH = f(BUDPC, PE, HSIZE, URB, EA, A_j , PE*A_j). \quad (5.1)$$

where *KWH* = quantity of electricity consumed by the household
BUDPC = household budget per capita (i.e. *BUD/HSIZE*, where *BUD* is household budget)
PE = price of electricity
HSIZE = household size
URB = dummy for urban/rural location
EA = dummy for entrepreneurial activities
A_j = dummy for electrical appliance A_j (where A_1 could be a tv set, A_2 a refrigerator, etc.)
$PE*A_j$ = interaction between the price of electricity and the appliance dummy

and the interaction variable captures the effect of the appliance on price elasticity.

In traditional demand analysis, the demand for electricity is derived from the utility-maximizing behavior of the household facing a single electricity price. But, as pointed out earlier, there are consumers of electricity who do not face a single electricity price but a block-rate structure with an increasing or decreasing marginal price. Under this structure, marginal price differs for different blocks but is constant at each block. In this case a consumer will not be affected by a price change in a block above his own but he will be affected not only by a price change in his own block but also by price changes in the blocks below his own. This has an implication on which price variable to include in the demand function.

Utility-maximization suggests that marginal price (the price in the block where consumption level falls) is the appropriate variable to include in the demand function. However, marginal price does not reflect the amount paid for intrablock units of consumption. The payment for these intrablock units has an income effect on the quantity of electricity consumed. This income effect is due to the difference between the amount paid for block units up to but excluding the final block where the user's consumption level falls and the amount the user would pay if marginal price were used for all units (Nordin (1976); Barnes et al (1981)). In short, this income effect is the difference between the actual expenditure and the cost of consumption priced at the marginal cost. Barnes et al. refer to this amount as the rate structure premium (*RSP*). Thus, the *RSP* for the *n*th block, assuming that the first block is a fixed charge block and the consumer pays the intramarginal prices, is given by

$$RSP_n = FC + \sum_{i=2}^{n-1} (PE_i - PE_n) KWH_i \quad (5.2)$$

where FC = fixed charge in the first block, PE_i = marginal price in the ith block, and KWH_i = number of kWh in the *i*th block. (This formula does not hold for block pricing where a consumer in the *n*th block does not pay the intramarginal prices. For example, a consumer in the last block of the MERALCO rate schedule has zero *RSP* since he pays the last block marginal price for all kWh consumed). The *RSP* is positive for decreasing block rates and negative for increasing block rates. The *RSP* adjustment ensures that the effect of the marginal price is the standard own-price effect. Following Barnes et al., we subtract *RSP* from the budget in order to capture this effect. The demand function would then become

$$KWH = f(Y, PE, HSIZE, URB, EA, A_j, PE^*A_j). \tag{5.3}$$

where $Y = (BUD - RSP)/HSIZE$.

Block pricing complicates the estimation of the demand function since the price of electricity is a function of the quantity of electricity consumed. This makes the price of electricity an endogenous variable and introduces simultaneity bias. If the demand function is estimated by Ordinary Least Squares (OLS), the parameter estimates will be inconsistent. To get consistent estimates, the demand function is estimated by Two-Stage Least Squares (TSLS).

The demand function assumed in double log form with linear terms is given by:

$$\ln KWH = \beta 1 + \beta 2 \ln Y + \beta 3 \ln PE + \beta 4 HSIZE + \beta 5 URB + \beta 6 EA + \sum_j \delta j Aj + \sum_j \gamma j \ln PE * Aj \tag{5.4}$$

With this functional form the coefficient β_2 is the income elasticity of demand for residential electricity since income elasticity ε_Y is given by

$$\varepsilon_Y = \frac{\partial \ln KWH}{\partial \ln Y} = \beta_2. \tag{5.5}$$

This means that a one percent change in income *Y* leads to a β_2% change in household electricity consumption. Similarly, the coefficient β_3 is the price elasticity of demand for residential electricity.

The Data

The unit of analysis is the individual household because it is the decision-making unit as well as the "customer" of the electric utility. It also avoids the problem of aggregation bias. Household data on electricity consumption expenditure, total expenditures, household size, stock of electrical appliances, and the urban/rural classification of the area where the household resides were drawn from the 1997 Family Income and Expenditure Survey (1997 FIES) of the National Statistics Office. The 1997 FIES is a national survey with a sample of 39,520 households. This makes this study national in scope.

To get the electrified households from the FIES sample, the geographical location of a household was matched with the electric utility serving that particular location. The prices of electricity in effect during the survey period were then obtained from the electric utility and from the National Electrification Administration.

The 1997 FIES does not report the quantity of electricity consumed by the household. This quantity can be calculated by using the marginal prices obtained from the electric utilities. With the calculated marginal prices, the electric bill for each level of consumption in kilowatt-hours can be computed. Thus, given the household expenditure for electricity, the associated consumption in kilowatt-hours and the corresponding marginal price can be obtained.

Household budget (or income) is measured by total household expenditure. Household expenditure is a preferred measure since the experience with household survey data analyses is that expenditure is generally collected with greater accuracy than income. The rate structure premiums were incorporated into household budget and the results adjusted using provincial deflators to reflect real income differences across provinces. The provincial deflators were constructed from provincial price indices which were obtained from the National Statistics Office.

Although households were asked about entrepreneurial activities, electricity expenditures recorded by the FIES excluded those related to entrepreneurial activities. Thus, electricity consumption due to these activities were not measured. Consequently, we dropped the entrepreneurial activities variable from the demand equation.

Exploratory regressions showed that price and the interaction variables between the price of electricity and the appliance dummies were highly multicollinear resulting in imprecise parameter estimates. Consequently, the interaction variables were dropped and equation (5.4) becomes

$$\ln KWH = \beta_1 + \beta_2 \ln Y + \beta_3 \ln PE + \beta_4 HSIZE + \beta_5 URB + \sum_j \delta_j A_j \quad (5.6)$$

This form, however, fails to make a distinction between the price and income elasticities of a household with, say, a refrigerator and that of another without a refrigerator (which would have been captured by the interaction variables). We solve this problem by partitioning the households into classes where each class possesses a given set of appliances and estimate the regression for each of the classes. This can be done since the model is short-run, i.e., the households' stocks of appliances are fixed. Thus, elasticities are estimated with respect to household appliance ownership. In this case, it is not necessary to include appliance dummies.

In the interest of parsimony, the households are classified according to the following ladder of appliance ownership: H_N consists of the households with none of the appliances enumerated in the FIES (radio, tv, stereo, refrigerator, freezer, airconditioner); H_E consists of the households that own an entertainment (a radio or a tv set or a stereo) but not a refrigeration (refrigerator or freezer) nor a cooling (airconditioner) appliance; H_R consists of those households that own a refrigeration but not a cooling appliance; H_A consists of households that own an airconditioner. The relative sizes of these classes of households are shown in Table 2.

Table 2
Distribution of Households and Electricity Consumption: H_N, H_E, H_R, H_A

Household Appliance Class	Distribution of Households	Distribution of Electricity Consumption
H_N	3.48%	1.07%
H_E	43.33%	20.86%
H_R	48.92%	58.94%
H_A	4.27%	19.13%
All	100.00%	100.00%

Although the last two classes, H_R and H_A, constitute slightly over 1/2 of the households, they account for almost 4/5 of electricity consumption, showing the considerable use of electricity by refrigerators, freezers, and airconditioners.

In view of the foregoing, the final form of the demand function estimated for each of the classes of households enumerated in Table 2 is as follows:

$$\ln KWH = \beta_1 + \beta_2 \ln Y + \beta_3 \ln PE + \beta_4 HSIZE + \beta_5 URB \qquad (5.7)$$

Model Estimation

The demand equations were estimated using subsamples totaling 24,137 regular billers (those whose electricity consumption are above the minimum kilowatt-hours per month) since the electricity consumption of the minimum billers cannot be determined. The subsample also eliminated the households with missing or absurd data. The bias that might be introduced by the absence of the minimum billers is, to a certain extent, mitigated by the presence of regular billers in some franchise areas whose electricity consumption would classify them as minimum billers in other franchise areas.

Indeed, as Table G.1.11 shows, the characteristics of the minimum billers and regular billers with less than 15 kWh consumption per month are similar.

The description and sample means of the variables used in the regression equations are shown in Table 3.

Table 3
Variable Description and Sample Means

Variable	Description	Sample Mean			
		H_N	H_E	H_R	H_A
KWH	Annual household electricity consumption (kWh)	374	546	1,450	4,273
Y	Household budget*	P 14,418	P 17,246	P 32,999	P 98,279
PE	Marginal price of electricity (per kWh)	P 3.48	P 3.66	P 3.70	P 3.73
HSIZE	Household size	4.73	5.22	5.18	5.21
URB	Dummy: 1 if household is in urban area; 0, otherwise	0.66	0.65	0.80	0.93

*Annual per capita household expenditure adjusted for rate structure premium and for price differences across provinces

Estimation was done by Two Stage Least Squares with White's Consistent Covariance Matrix Estimator (White [1980]) to get the correct standard errors in view of the presence of heteroskedasticity. The regression results are shown in Table 4.

As seen in Table 4, all parameter estimates are highly significant in explaining the residential demand for electricity and have the expected signs - budget effect is positive, price effect is negative, urbanization effect is positive and household user effect is positive.

Table 4[1]
Regression Results
IV (2SLS) regression with robust standard errors

lnkwh	H_N	H_E	H_R	H_A
lnpe	-.4569870 (-7.401)*	-.3386494 (-14.146)	-.2513986 (-7.755)	-.4543544 (-2.860)
lny	.5542717 (12.014)	.6435425 (49.982)	.5642622 (56.023)	.7865528 (26.889)
hsize	.1037570 (10.671)	.1091012 (36.115)	.1144095 (43.450)	.1562903 (14.177)
urb	.1753321 (4.216)	.3388147 (28.251)	.2577694 (19.887)	.3640029 (4.560)
constant	.4173098 (0.921)	-.4917567 (-3.848)	.8500277 (7.939)	-1.2625630 (-3.664)
F	90.47	1210.70	1205.97	218.49
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared	0.2596	0.3098	0.3089	0.5239
No. of observations	859	10560	11718	1000

* numbers in parentheses are *t* values

Budget and Price Effects

Budget elasticity for the various household classes ranges from 0.55 to 0.79 (Table 5), showing that electricity is a normal good and that residential demand is income inelastic. Thus, in the class H_E, a one percent increase in budget leads to a 0.64% increase in electricity consumption. The price elasticity ranges from – 0.25 to – 0.46. In H_E a one percent increase in the price of electricity leads to a 0.34% decrease in electricity consumption. The households with refrigerators but no airconditioners (H_R) are the least sensitive to price changes since households do not turn refrigerators on and off with price changes.

Table 5
Short Run Budget and Price Elasticities

Budget Elasticity	**Budget Elasticity**	**Price Elasticity**
H_N	0.55	– 0.46
H_E	0.64	– 0.34
H_R	0.56	– 0.25

[1] The budget variable in Table 4 incorporates the rate structure premium (*RSP*). On the average, *RSP* is 0.1% of total expenditure. Another set of regressions were run without the *RSP* adjustment and the differences between the two sets of regressions are negligible.

H_A	0.79	– 0.45

Household Size and Urban/Rural Location Effects

Household size has a significant effect on electricity consumption. Other things equal, electricity consumption rises by 10.9% per additional household member in the H_N households (see Appendix G.1 for the calculation). By a similar calculation, we get the following percentage increases in electricity consumption per additional household member for the other classes:

H_N	10.9%
H_E	11.5%
H_R	12.1%
H_A	16.9%

These percentages increase since going up the appliance ladder means that an additional household member has more appliances to use.

In interpreting the coefficients of the urban/rural location variable (*URB*), it is important to remember that this variable is defined relative to the rural households. Thus its positive signs indicate that urban households use more electricity than rural households, other things equal. This is consistent with the findings of the 1995 Household Energy Consumption Survey (Table G.1.4a). The percentage difference in consumption between urban and rural households is obtained by using the following equation:

$$\% \text{ increase} = (e^{\beta} - 1)\times 100$$

where $e \approx 2.71828$ and β is the coefficient of the urban location variable (see Appendix G.2 for the derivation). We get the following percent increases for the various household classes:

H_N	19.2%
H_E	40.3%
H_R	29.4%
H_A	43.9%

Thus, in the class H_N, urban households consume 19.2% more electricity than rural households.

The Impact of a Price Change on Residential Electricity Consumption

In the short run some of the variables in the demand function can be assumed to remain constant. Suppose that only the price of electricity is changed. Let

KWH = existing demand
PE = existing price of electricity
ε = price elasticity of demand
ΔPE = change in the price of electricity

We wish to find the corresponding change in demand ΔKWH. Assuming everything else constant, ΔKWH may be derived from equation (5.7) and we get

$$\Delta KWH = \left[\left(1 + \frac{\Delta PE}{PE}\right)^{\varepsilon} - 1\right] KWH \qquad (5.8)$$

(See derivation in Appendix G.3, where an approximation formula is also given).

Simulation

We present two simulations based on the following price changes:

(1) removal of the intergrid and intragrid subsidies (measured by the economic assistance charge (EAC));

(2) removal of the intergrid and intragrid subsidies as well as the interclass subsidies (IC).

Simulation 1. Removal of the intergrid and intragrid subsidies (measured by the 1998 EAC).

The resulting price changes are mostly increases except in regions served by MERALCO where there is a price reduction of P0.17 (see Table 6). These reductions occur in the National Capital Region, Central Luzon, and Southern Luzon. The increases range from P0.04 in the Cordillera Autonomous Region to P0.95 in CARAGA. The large increases - greater than P0.75 - occur in the Visayas and Mindanao.

Table 6
Price Change

Region	Price Change (Pesos)	
	Minimum	Maximum
National Capital Region (NCR)	-0.17	-0.17
Ilocos Region	0.00	0.13
Cagayan Valley	0.06	0.17
Central Luzon	-0.17	0.58
Southern Luzon	-0.17	0.18
Bicol	0.00	0.16
Western Visayas	0.51	0.82
Central Visayas	0.00	0.76
Eastern Visayas	0.54	0.82
Western Mindanao	0.64	0.84
Northern Mindanao	0.00	0.88
Southern Mindanao	0.62	0.83
Central Mindanao	0.64	0.91
CAR	0.04	0.56
ARMM	0.71	0.88
CARAGA	0.67	0.95

The simulation takes 1998 as the base year. Electricity consumption for 1998 is the consumption predicted by the equations assuming 1998 prices. The change in electricity consumption was calculated for each household and adjusted by the FIES survey inflation factors to get the national values. The results were aggregated for each province, region, grid, and the entire country. The summaries for the grids and the regions are presented in Tables 7 and 8; the results for the provinces are shown in Appendix G.4. (The simulation is done for regular billers only; hence, the simulation results are for this group of customers).

Simulation 1: Effects on Residential Demand for Electricity

As expected the households with reductions in price registered increases in electricity consumption. These households are found only in Luzon and their total increase in annual electricity consumption amounted to 54.8 GWh (Table 7). On the other hand, Visayas and Mindanao experience decreases in consumption of 43.2 GWh and 73.3 GWh, respectively. The net change in consumption for the Philippines is a decrease of 69.4 GWh.

Increases in consumption occur in the NCR, Central Luzon, and Southern Luzon with NCR being the only region without any decrease. The largest reduction occurs in Southern Mindanao (28.5 GWh) followed by Western Visayas (20.0 GWh). On a per-household basis, Southern Mindanao has the largest reduction per household (55.5 kWh) followed by Western Mindanao (52.9 kWh). The smallest reduction per household is in Southern Luzon (2.5 kWh).

Table 7
Results of Simulation 1: Change in Demand (ΔkWh) by Grid

Grid	Change in Demand (Households Facing Price Increase)		Change in Demand (Households Facing Price Decrease)	
	Total (kWh)	Ave. per Household	Total (kWh)	Ave. per Household
Luzon	-7,680,466	-3.7	54,788,482	15.9
Visayas	-43,225,241	-34.2	-	-
Mindanao	-73,267,827	-50.7	-	-
Philippines	-124,173,535	-26.0	54,788,482	15.9

Table 8
Results of Simulation 1: Changes in Demand by Region

Region	Change in Demand for Households Facing Price Increase		Change in Demand for Households Facing Price Decrease	
	Total (kWh)	Ave. per Household	Total (kWh)	Ave. per Household
NCR	-	-	40,020,857	20.3
Ilocos Region	-1,637,507	-3.8	-	-
Cagayan Valley	-1,205,253	-4.1	-	-
Central Luzon	-2,212,424	-4.7	4,040,305	7.5
Southern Luzon	-896,823	-2.5	10,727,320	11.3
Bicol	-1,019,956	-2.6	-	-
Western Visayas	-20,000,169	-34.5	-	-
Central Visayas	-16,145,408	-39.2	-	-
Eastern Visayas	-7,079,665	-26.0	-	-
Western Mindanao	-11,392,793	-52.9	-	-
Northern Mindanao	-9,597,245	-45.8	-	-

Southern Mindanao	-28,489,796	-55.5	-	-
Central Mindanao	-12,069,574	-50.8	-	-
CAR	-708,502	-5.6	-	-
ARMM	-2,248,365	-38.2	-	-
CARAGA	-9,470,054	-44.9	-	-
Philippines	-124,173,535	-26.0	54,788,482	15.9

Simulation 1: Effects on Household Expenditure

Any price change also affects the household's allocation of its budget. Table 9 shows the average electricity expenditure shares in the regions before and after the price change.[2] Households in regions where reductions in price occurred - National Capital Region, Southern Luzon and Central Luzon - experience a decrease in electricity expenditure share of the total budget.

The rest of the regions experience increases in electricity expenditure shares. This means that in these regions more of the household budget will be allocated to electricity after the price change. The increases in electricity expenditure share range from a low of 0.86% in the Bicol Region to a high of 17.38% in ARMM.

Table 9
Simulation Results: Electricity Expenditure Shares by Region

Region	Electricity Expenditure Share Before Price Change (%)	Electricity Expenditure Share After Price Change (%)	% Change
NCR	3.28	3.19	-2.67%
Ilocos Region	3.20	3.24	1.16%
Cagayan Valley	3.14	3.19	1.66%
Central Luzon	3.02	3.01	-0.45%
Southern Luzon	3.19	3.14	-1.77%
Bicol	3.06	3.09	0.86%
Western Visayas	3.12	3.44	10.33%
Central Visayas	3.03	3.33	9.85%
Eastern Visayas	3.20	3.53	10.41%
Western Mindanao	2.36	2.76	16.89%
Northern Mindanao	2.77	3.09	11.58%
Southern Mindanao	2.50	2.91	16.43%
Central Mindanao	2.67	3.14	17.21%
CAR	2.98	3.04	1.97%
ARMM	2.36	2.77	17.38%
CARAGA	2.74	3.19	16.50%
Philippines	3.06	3.15	3.09%

[2] The calculations assume that expenditure on other items (other than electricity) do not change.

Simulation 2. Removal of the interclass subsidy (IC).

This simulation was performed only for households for which interclass subsidy figures are available. These are the households served by the following electric utilities:

1. Meralco
2. Tarlac Electric Inc.
3. Visayan Electric Co., Inc.
4. Panay Electric Co.
5. Davao Light and Power Co., Inc.

The simulation calculates the percentage change in demand for electricity based on the demand after removal of the EAC. In the provinces where the above utilities operate the prices resulting from the removal of the IC are shown in Table 9 together with the 1998 prices and the prices resulting from the removal of the EAC only. We see from Table 9 that, with the exception of Tarlac, the Luzon provinces experience a decline in prices after EAC removal. The prices in Tarlac, Iloilo, Davao Norte, and Davao Sur increase. After removal of the IC, prices in all provinces increase with the provinces in Mindanao getting the largest increases.

Table 10
Residential Prices

Province	1998 Price	Price after Removal of EAC	% Change from 1998	Price after Removal of IC	% Change from 1998	% Change from Price after EAC Removal
Luzon						
NCR	4.38	4.21	-3.8	5.01	14.4	19.0
Bulacan	4.22	4.05	-4.0	4.85	15.0	19.8
Cavite	4.25	4.08	-3.9	4.88	14.9	19.6
Laguna	4.27	4.12	-3.6	4.87	13.9	18.2
Quezon	4.28	4.20	-1.9	4.76	11.3	13.3
Rizal	4.33	4.16	-3.9	4.96	14.6	19.2
Tarlac	4.24	4.56	7.5	4.80	13.3	5.3
Visayas						
Iloilo	4.23	4.82	14.0	5.13	21.4	6.4
Mindanao						
Davao Norte	2.77	3.44	24.0	3.70	33.3	7.5
Davao Sur	2.73	3.38	23.9	3.92	43.8	16.0

The results of the simulation are presented in Table 11 where the percent change in demand after EAC removal is also shown. Because of the limited coverage of the simulation only the provinces where the above utilities operate are included in the table. Because prices increased in all provinces with the removal of the IC, the demand for electricity decreased in all provinces. The decreases range from 3.21% in Tarlac to 5.61% in the National Capital Region.

Table 11
Results of Simulation 2

Province	Percent Change in Electricity Demand After Removal of EAC	Percent Change in Electricity Demand After Removal of IC
National Capital Region	1.31	-5.61
Bulacan	1.22	-5.24
Cavite	1.16	-4.99
Laguna	-0.16*, 1.22	-5.23
Quezon	-0.98, 1.21	-5.48
Rizal	1.20	-5.15
Tarlac	-2.12	-3.21
Iloilo	-3.83	-4.84
Davao Norte	-6.03	-4.98
Davao Sur	-6.30	-5.40

*The negative values are percentages for households facing an increase in price; the positive values are for those facing a decrease in price.

LONG-RUN DEMAND FOR RESIDENTIAL ELECTRICITY

Introduction

The long-run household electricity consumption corresponds to the stock of electrical equipment that has fully adjusted to the long-run equilibrium or "desired" level of household appliance holdings. We postulate that the desired electricity consumption KWH_t* at period t is a function of income Y_t, the price of electricity PE_t, the prices of competing fuels PF_{it}, and a vector of household characteristics Z_t, i.e.,

$$\ln KWH_t^* = \beta_1 + \beta_2 \ln Y_t + \beta_3 \ln PE_t + \sum_{i=1}^{m} \delta_i \ln PF_{it} + \sum_{j=1}^{n} \lambda_j Z_{jt} + u_t \tag{5.9}$$

where u_t is a stochastic disturbance term. At any period t the actual stock of electrical appliances may not equal the long-run equilibrium stock; consequently, the actual electricity consumption KWH_t is not equal to the desired consumption KWH_t*. Thus, the household partially attains only a fraction of the gap between the desired consumption KWH_t* and the actual consumption KWH_{t-1}, i.e., movement towards the long-run equilibrium is governed by a partial adjustment mechanism given by

$$\ln KWH_t - \ln KWH_{t-1} = \alpha(\ln KWH_t^* - \ln KWH_{t-1}), \qquad 0 < \alpha \leq 1, \tag{5.10}$$

where KWH_t is the actual electricity consumption in period t and α is the adjustment rate. We may solve for ln KWH_t* in (5.10) and get

$$\ln KWH_t^* = (1/\alpha) \ln KWH_t + [(\alpha-1)/\alpha] \ln KWH_{t-1} \tag{5.11}$$

Equating (5.9) and (5.11) and simplifying, we get

$$\ln KWHt = \alpha\beta 1 + (1-\alpha)\ln KWHt - 1 + \alpha\beta 2 \ln Yt + \alpha\beta 3 \ln PEt + \alpha \sum_{i=1}^{m} \delta i \ln PFit + \alpha \sum_{j=1}^{n} \lambda jZjt + \alpha ut \tag{5.12}$$

Note that the long-run equilibrium (5.9) is achieved when α = 1. Thus, the long-run elasticities β_2, β_3, ... are obtained by dividing the coefficients of (5.12) by α. The speed of adjustment α may be obtained from the coefficient of ln KWH_{t-1}. (A more detailed discussion of this model is found in Berndt (1991)).

The Empirical Model

This section implements the model in equation (5.12) by using Family Income and Expenditure Survey (FIES) data at two points in time, i.e., the 1994 FIES and the 1997 FIES. Because the sample of households in these two surveys are not the same, we use the province as the unit of analysis, i.e., we take the average household of each province as the representative household.

In preliminary regression runs, household size turned out to be insignificant because there is not much variation in the average household size for the provinces; hence, household size was dropped from the equation. The average provincial prices of competing fuels are not available.[3]

Following Westley [1992] and Lyman [1994], we include an appliance variable whose importance exerts a strong influence on the desired long-run demand for electricity. Among the most commonly used household appliances, the refrigerator is considered a necessity that households aspire to have. At the same time it is also the most electricity-intensive.[4] Thus we include a preference variable represented by the change in the percentage of households that own a refrigerator. This variable is denoted by *DELREF*.[5] Thus, we specify the model as follows:

$$\ln KWH_{i,t} = \alpha\beta_1 + (1-\alpha) \ln KWH_{i,t-1} + \alpha\beta_2 \ln Y_{i,t} + \alpha\beta_3 \ln PE_{i,t} + \alpha\delta_1 \ln URB_{i,t}$$
$$+ \alpha\delta_2\, DELREF_{i,t} + \alpha u_{i,t} \tag{5.13}$$

where KWH_{it} = average household electricity consumption,
Y_{it} = per capita average household expenditure (adjusted for provincial price differences),

[3] Regression runs using the 1994 FIES households in Rural Electric Cooperatives (RECs) service areas showed the prices of LPG and kerosene to be insignificant.
[4] According to the 1995 Household Energy Consumption Survey (HECS), the average annual household electricity consumption of a refrigerator is 479 kWh (1,147 kWh if frost-free). This is more than twice the average consumption of its nearest rival, the electric fan with 215 kWh annually and 2.75 times that of the color TV with 173 kWh annually.
[5] Similar variables for the other appliances were tested and found insignificant.

PE_{it} = average price of electricity,
URB_{it} = percent of households located in urban areas,
$DELREF_{it} = REF_{it} - REF_{i,t-1}$, where REF_{it} is the percentage of households with refrigerators,
i = province,
t = year, and
ln denotes natural logarithm.

Data and Estimation

Household data on total expenditure (representing income), electricity expenditure, and the urban or rural location of the households were obtained from the 1994 and 1997 Family Income and Expenditure Surveys. Total household expenditure was adjusted for provincial price differences by using provincial Consumer Price Indices. Electricity price data were obtained from the Energy Regulatory Board and the National Electrification Administration.

The sample means of the variables used in the model are given in Table 12.

Table 12
Sample Means of Variables

Variable	Description	Sample Mean
*KWH*97	Average household electricity consumption in 1997	754.26 kWh
*KWH*94	Average household electricity consumption in 1994	564.94 kWh
*Y*97	Average household per capita total expenditure in 1997	P22,333.98
*P*97	Average price of electricity in 1997	P3.83/kWh
*URB*97	Proportion of households in urban areas	0.62
DELREF	Change in proportion of households with refrigerators	0.07

The presence of a lagged dependent variable as a regressor can create two econometric problems namely, (a) autocorrelated error terms and (b) correlation between the lagged regressor and the error term. Estimation by ordinary least squares (OLS) showed no autocorrelation. Case (b) may be remedied by maximum likelihood estimation. Since the residuals were found to be normally distributed, maximum likelihood will be identical to ordinary least squares. We, therefore, kept the OLS results.

Table 13
Regression Results

Number of observations	=	73
F (5, 67)	=	53.66
Prob > F	=	0.0000
R-squared	=	0.8002
Adj R-squared	=	0.7853
Root MSE	=	0.17322

ln*KWH*97	Coef.	Std. Err.	t	P>|t|
ln*KWH*94	.3725151	.0870975	4.277	0.000
ln*P*97	-.526258	.1220373	-4.312	0.000
ln*Y*97	.4924367	.1392194	3.537	0.001
ln*URB*97	.2172813	.1004351	2.163	0.034
DELREF	1.212324	.2895858	4.186	0.000
CONSTANT	.042727	1.121826	0.038	0.970

Long-Run Elasticities

To calculate the implied long-run elasticities, we first calculate the speed of adjustment α from the coefficient of ln KWH_{t-1} in equation (5.13). Thus,

$$1 - \alpha = 0.3725151;$$

hence, $$\alpha = 0.6274849.$$

This means that about 63% of the long-run adjustment is achieved within three years, the length of the period (1994-1997).

The long-run elasticities are calculated as follows:

$$\text{Long-run price elasticity} = \frac{-0.526258}{0.6274849} = -0.8386783$$

$$\text{Long-run budget elasticity} = \frac{0.4924367}{0.6274849} = 0.7847785$$

These values look reasonable when compared to the following results of previous studies:

US Mean of 16 residential studies cited in Westley [1992]:

Price elasticity	- 0.99
Income elasticity	0.65

Mexico	Berndt & Samaniego [1984]:	
	Price elasticity	- 0.81
	Income elasticity	0.76

The Effects of a Price Change: Long-Run Marginal Cost Pricing

The long-run residential demand model can be used to examine the effect on the long-run residential demand for electricity of a change in the price of electricity from any benchmark price (PE_b) to a specified simulation price (PE_s). In the simulation, only the price of electricity is changed. The benchmark price is taken to be the price in 1998 while the simulation price is the long-run marginal price (*LRMC*) plus the electricity industry reform charge (*EIRC*)[2]. By holding the other variables constant, the formula[3] for calculating the percent change in long-run demand is

$$\frac{kWh_s - kWh_b}{kWh_b} \times 100 = \left[\left(\frac{PE_b}{PE_s} \right)^{\gamma} - 1 \right] \times 100$$

where

kWh_s = long-run residential demand for electricity corresponding to $PE_s = LRMC + EIRC$;
kWh_b = long-run residential demand for electricity corresponding to PE_b = price of electricity in 1998;
γ = the coefficient of ln PE_t in equation (5.13).

The benchmark prices (1998 prices) and the simulation prices (*LRMC* + *EIRC*) are given in Table G.5.1 (Appendix G.5). These prices are average prices for the 58 provinces included in the simulation (counting the National Capital Region as a province). The benchmark prices range from P2.67/kWh to P6.45/kWh and the national average is P4.12/kWh. On the other hand, the simulation prices range from P3.04/kWh to P5.76/kWh with a national average of P3.31/kWh. The largest decrease in price (P1.74/kWh) occurs in the province of Aurora (Luzon grid) while the largest increase (P1.89/kWh) occurs in Sultan Kudarat (Mindanao grid). Of the 58 provinces included in the simulation, 40 provinces experience a decrease in price, 18 experience an increase, while in two provinces, Bohol (Visayas) and Zambales (Luzon), the price remains constant. All the Mindanao provinces experience price increases. The prices in Luzon and the Visayas decrease except in Antique where price increases by P0.07/kWh.

The results of the simulation for the grids and the regions are presented in Tables 1 and 2 (provincial results are reported in Table G.5.2, Appendix G.5) where the benchmark and simulation prices are also given. Residential demand in Luzon increases by 19.4% while demand in the Visayas increases by only 7.6%. In Mindanao, where the post-reform price is higher than the price in 1998, demand decreases by 15.4%. The net increase for the entire country is 12.2%.

Turning to the regions, we see that the largest increases in demand occur in the National Capital Region (21.1%), Bicol (19.9%) and Southern Luzon (18.7%) while the smallest occurs in Central Visayas (6.8%). In

[2]The *EIRC* represents the charge per ckilowatt-hour to recover stranded costs, a charge that is planned to extend over 36 years. Its value has been calculated to be P0.23 per kWh.

[3]Please see Appendix G.3 for the derivation.

Mindanao, all regions will decrease their demand with the largest decrease (18.7%) occurring in Western Mindanao.

Concluding Remarks

A model for short-run residential demand for electricity has been estimated based on the assumption that the short-run response of a household to price and income changes depends on the mix of electrical appliances that it owns. The results support earlier findings that the short-run residential demand for electricity is income and price inelastic. Price elasticities range from - 0.46 to - 0.25 while income elasticities range from 0.55 to 0.79. The results also showed that household size and urban location have significant effects on household electricity consumption.

A simulation of the short-run model based on changing electricity price by removing the intergrid and intragrid subsidies was performed. With this assumption, most utilities would experience price increases ranging from P0.04 to P0.95 per kWh. The largest IOU (MERALCO) would decrease its price by P0.17. Based on these assumptions, the simulation showed increases in electricity consumption in three regions (National Capital Region, Central Luzon, and Southern Luzon). The rest of the regions, responding to price increases, reduce their electricity consumption, the reductions in Visayas and Mindanao being much larger than those of Luzon with the largest reduction occurring in Southern Mindanao.

Households in regions facing price reductions (NCR, Central Luzon, Southern Luzon) will reduce their electricity expenditure share in the total budget while the rest of the country will increase their electricity expenditure shares, i.e., they will allocate more of their household budgets to electricity.

The long-run residential demand for electricity model was derived using the partial adjustment approach. The estimated long-run price and income elasticities are -0.84 and 0.78, respectively. A simulation of the long-run model was performed to examine the effect of a change in the price of electricity on long-run demand while holding other variables constant. The price change was taken to be the post-reform price (long-run marginal price plus electricity industry reform charge) less the pre-reform price (1998 price). The results showed an increase in the demand for residential electricity of 19.4% in Luzon and an increase of 7.6% in the Visayas. In Mindanao, where the post-reform price exceeds the pre-reform price, the demand for residential electricity reduces by 15.4%. The net increase in demand for the entire country is 12.2%.

Besides their usefulness in examining the effects of a change in electricity price on residential demand and expenditure for electricity, the estimated demand functions are also used to determine whether a price change will raise or lower economic welfare. Specifically, a change in the price of electricity results in a change in electricity consumption which, in turn, leads to a welfare gain or loss. The welfare gain or loss may be measured by the amount by which the household's income has to change in order to hold the household to its initial utility level. The formal method of calculating welfare gains and losses is presented in another part of this report. The short-run welfare gains and losses are calculated using the short-run demand function and the assumed short-run price change while the long-run welfare gains and losses are calculated using the long-run demand function and the long-run marginal price adjusted for the electricity industry reform charge.

Section 6
Determination of Long-Run Tariff Levels

To estimate the tariff levels that can likely be achieved by full restructuring of the electricity industry, we have developed long-run marginal costs (LRMC) of electricity supply to various end-used groups in the various franchise areas of the country. Prices are expected to approach LRMC with full restructuring as anticipated in the Philippines with the introduction of a competitive bulk power supply market, a competitive retail supply market, and performance-based regulation of the wires businesses along with open access.

All prices developed in the long-run marginal cost studies are economic prices. The local content portion of capital asset items has been adjusted by standard conversion factors to reflect economic costs.

GENERATION LRMC

Long run marginal costs have been determined using a regional capacity and energy market forecasting system that simulates the fundamentals associated with competitive power markets. MarketPower™, a computer program developed by NewEnergy Associates of the U.S., was chosen as the analytical tool to support this project because it advances market price forecasting forward from the typical cost-based simulation approach to a fundamental approach which is market-based or bid-based.

A dual-commodity market has been simulated. For the Energy Market, Philippine power system parameters were used in a linear program that is solved for each month, over a fifteen year planning horizon, with the objective to minimize total price over all areas subject to generation and transmission constraints. Market prices are defined to be the "shadow" prices for each area. It is the price incurred by an incremental increase in demand, which may be served by a generator in the area, curtailed by demand in the area, or purchased from a neighboring area via transmission links.

For the Capacity Market, each generator's bid is a function of its "residual costs" or fixed costs (including annualized investment costs for new capacity) minus the energy profits. New units are built when it is determined that they will be profitable (a "look ahead" feature determines this). Thus an optimum mix of new generation is determined, based on market indicators.

Transmission constraints will cause market prices to differ between interconnected areas. For this study, we have assumed an existing 400 MW link between Luzon and the Visayas and a new 500 MW link between Visayas and Mindanao in 2004. No other transmission constraints have been modeled and it is assumed power can freely be dispatched with each major grid.

The MarketPower program essentially generates a series of short-run marginal prices within each year. Long run marginal price of generation is determined to be the net present value of these marginal revenues (capacity and energy markets) divided by the net present value of the load.

The following generating plants were considered economic sunk costs and non-deferrable and were included in the expansion plan along with existing units:

Committed Units		
Name	MW Capacity	Commercial Operation Date
Bakun Hydro	70 MW	7-1-01
First Gas A	1,000 MW	7-1-01
Mambucal Geothermal	40 MW	7-1-02
Ilijan	1,200 MW	7-1-02
First Gas B	500 MW	7-1-03
San Pascual	300 MW	7-1-04
San Roque	345 MW	7-1-05

The retirement schedule used over the first fifteen years is as follows:

Retirements

Name	Category	Area	RetirementDate	Maximum Capacity (MW)
Sucat 1-2	Oil Thermal Existing	Luzon LDC	12/31/01	175
Hopewell GT 1-4	Gas Turbine Existing	Luzon LDC	12/31/02	310
Enron Pinamucan	Diesel Existing	Luzon LDC	12/31/03	105
Toledo Power	Diesel Existing	Visayas LDC	12/31/03	55
Edison Global	Diesel Existing	Luzon LDC	12/31/04	58
Naga LBGT 1&2	Gas Turbine Existing	Visayas LDC	12/31/05	50
PB Diesel	Diesel Existing	Visayas LDC	12/31/05	128
Bataan GT	Gas Turbine Existing	Luzon LDC	12/31/06	120
Malaya GT	Gas Turbine Existing	Luzon LDC	12/31/06	90
Magellan Cavite	Diesel Existing	Luzon LDC	12/31/06	48
GT Barges	Gas Turbine Existing	Mindanao LDC	12/31/06	90
PB GT	Gas Turbine Existing	Visayas LDC	12/31/06	150
Enron Subic 2	Diesel Existing	Luzon LDC	12/31/09	108
Bataan CC	Combined Cycle Existing	Luzon LDC	12/31/10	600
MakBan	Geothermal Existing	Luzon LDC	12/31/10	410
Tiwi	Geothermal Existing	Luzon LDC	12/31/10	330
Sucat GT	Gas Turbine Existing	Luzon LDC	12/31/10	30
Angeles Power Corp	Diesel Existing	Luzon LDC	12/31/10	30

Retirements

Name	Category	Area	RetirementDate	Maximum Capacity (MW)
Bauang PPC	Diesel Existing	Luzon LDC	12/31/10	235
East Asia 1-4	Diesel Existing	Luzon LDC	12/31/10	195
FCVC	Diesel Existing	Luzon LDC	12/31/10	32
Tarlac	Diesel Existing	Luzon LDC	12/31/10	20
Malaya 1-2	Oil Thermal Existing	Luzon LDC	12/31/10	650
Maco Power Barge	Diesel Existing	Mindanao LDC	12/31/10	100
Nasipit Power Barge	Diesel Existing	Mindanao LDC	12/31/10	100
NMPC Diesel	Diesel Existing	Mindanao LDC	12/31/10	98
ACMDC Coal	COAL EXISTING	Visayas LDC	12/31/10	145
Cebu Thermal 1&2	Oil Thermal Existing	Visayas LDC	12/31/10	105
Palimpinon I & II	Geothermal Existing	Visayas LDC	12/31/13	180
Tongonan I	Geothermal Existing	Visayas LDC	12/31/13	112
East Asia UC	Oil Thermal Existing	Visayas LDC	12/31/13	50
Calaca 1-2	COAL EXISTING	Luzon LDC	12/31/14	600
General Santos	Diesel Existing	Mindanao LDC	12/31/14	22
Southern Phils Power	Diesel Existing	Mindanao LDC	12/31/15	32
Western Mindanao Power	Diesel Existing	Mindanao LDC	12/31/15	100
Minergy	Oil Thermal Existing	Mindanao LDC	12/31/15	50
NMPC 1&2	Oil Thermal Existing	Mindanao LDC	12/31/15	108.6
PICOP	Oil Thermal Existing	Mindanao LDC	12/31/15	30

New capacity was placed in-service when economically viable. The following types of units were available for expansion in each grid:

Expansion Unit Candidates

Name	Category	Area	Maximum Capacity (MW)
Generic CC_300	Combined Cycle Generic	Luzon	300
Generic GT_150	Gas Turbine Generic	Luzon	150
Generic GT_20 L	Gas Turbine Generic	Luzon	20
GT_20 Generic M	Gas Turbine Generic	Mindanao	20
GT_20 Generic V	Gas Turbine Generic	Visayas	20
Diesel Generic LB50 V	Diesel Generic LB50	Visayas	50
Diesel Generic LB50 M	Diesel Generic LB50	Mindanao	50
Coal Generic CFB100 V	COAL GENERIC CFB100	Visayas	100
Coal Generic CFB100 M	COAL GENERIC CFB100	Mindanao	100
Coal Generic CFB50 V	COAL GENERIC CFB50	Visayas	50
Coal Generic CFB50 M	COAL GENERIC CFB50	Mindanao	50
Generic FGD600	COAL GENERIC FGD 600	ALL	600

The resulting generation LRMC for each grid, year 2000 base, is as follows. Capacity costs are all allocated to the peak period.

Table 1
Generation LRMC

	Luzon	Visayas	Mindanao
On Peak Energy (P/kWh)	1.74	1.91	2.21
Off-Peak Energy (P/kWh)	1.32	1.26	1.65
Capacity (P000/kW-Yr)	2,080	2,785	2,863

TRANSMISSION LRMC

For the transmission component of LRMC, we calculated the long run average incremental cost (LRAIC) of transmission on a system-wide basis. To determine transmission LRAIC, we have compared the transmission capital expansion program with forecast transmission peak demand growth over the same period. The Table below shows the capital expenditures on transmission projects forecast by NPC over the period 1999 to 2010 as provided in its 1999 PDP.

NPC is undertaking a number of transmission projects associated with the interconnection of the three Philippine grids (including the Leyte-Mindanao interconnection). Expenditure associated with interconnection projects is included in the totals given.

Table 2
NPC Forecast Transmission Capital Spend 1999 To 2010
(Millions Of Pesos)

	System	Luzon Grid	Visayas Grid	Mindanao Grid
On-going projects	35,808	16,300	14,788	4,720
Implementation projects	25,770	2,702	2,310	20,758
Indicative projects	29,870	13,514	5,598	10,758
Total	91,448	32,516	22,696	36,236
Total $m	2,286.2	812.9	567.4	905.9

From NPC's demand forecast in the PDP we have derived the incremental demand for each of the three grids and for the system as a whole. These incremental demand figures are given in the following table.

Table 3
Forecast Incremental Demand for Each of the Philippine Grids (MW)

	Luzon	Visayas	Mindanao	System
1997 to 1998	194	10	29	233
1998 to 1999	479	142	-12	609
1999 to 2000	265	73	67	405
2000 to 2001	448	81	87	616
2001 to 2002	509	97	342	948
2002 to 2003	632	79	79	790
2003 to 2004	531	72	45	648
2004 to 2005	600	72	114	786
2005 to 2006	703	133	131	967
2006 to 2007	800	149	155	1104
2007 to 2008	907	168	178	1253
2008 to 2009	1007	203	197	1407
2009 to 2010	1127	218	225	1570
1997 to 2010	8202	1497	1637	11336

Significantly more capital expenditure on transmission per MW of incremental demand is projected for both the Mindanao and Visayas grids than is the case for the Luzon grid. This reflects the fact that a number of major reinforcements on the Luzon grid have recently been completed.

Using a 12% discount rate, we have calculated a long run average incremental investment cost for transmission for the three grids at $106/kW, $202/kW, and $393/kW for the Luzon, Visayas, and Mindanao grids respectively. These costs are annualized over a 40 year asset life to determine annual LRMC for transmission. These figures exclude capital expenditure associated with the Visayas-Mindanao tie on the basis that it is primarily a reliability related investment.

DISTRIBUTION LRMC

We collected data on the capital program for all REC's and many of the investor-owned utilities as well as unit costs for distribution components (such as substation transformers, primary circuits, and pole-top transformers).

NEA data on distribution equipment units costs supports the use of $500/kW of incremental demand as a 'benchmark' estimate of system expansion costs. The average incremental cost in the Meralco supply areas for the period 1996-98 was around $450/kW. The incremental cost of distribution capacity expansion will be a function of the load density in the service territory, with less-dense utilities having a higher incremental cost than more dense franchise areas.

Basic assumptions used in the distribution LRMC analysis are as follows:

Discount rate	12%
Exchange rate (P:$)	44.2
Asset life (T&D equip)	30 years
NCP/CP Diversity	1.035
Standard Conversion Factor	0.83
Local Content for Transmission	20%
Local Content for Distribution	20%

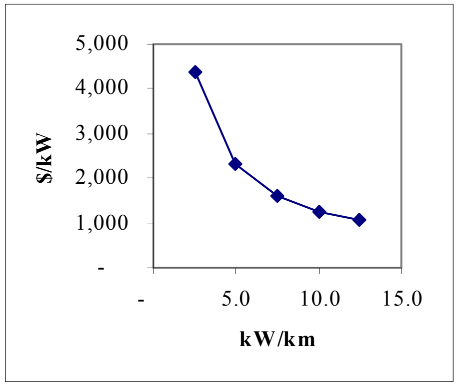
Based on the data collected for the Philippine distribution sector and supplementing that with our international experience, we have constructed the following table of incremental distribution capacity costs as a function of franchise-area load density in the Philippines.

Table 4
Capital Costs of System Expansion
($/kW of Peak Demand)

			Load Density (kW/km)				
			2.5	5.0	7.5	10.0	12.5
	Financial Cost	Economic Cost					
Substation cost ($/kVA)	52	54.13					
S/s capacity factor		1.5					
S/s cost per kW of peak load		81.20	81.20	81.20	81.20	81.20	81.20
Line cost ($/km)	10500	10,930.12					
Line cost per kW of peak load			4,372	2,186	1,457	1,093	874
Distribution transformer cost ($/kVA)	53	55.17					
TX capacity factor		1.5					
TX cost per kW of peak load		82.76	82.76	82.76	82.76	82.76	82.76
Service Drop & Meter	70	72.87	72.87	72.87	72.87	72.87	72.87

This results in a franchise area cost curve for incremental distribution capacity as follows:

Figure 1



ALLOCATION OF LRMC TO TARIFF CATEGORIES - ILLUSTRATIVE

LRMC has been allocated to the following retail tariff categories for each franchise area:

- Residential
- Minimum Biller
- Commercial
- Industrial HV (primary voltage delivery)
- Industrial LV (secondary voltage delivery)
- Other

The remainder of this section presents the procedure and assumptions illustrative of the methodology used for fuctionalizing and allocating capacity and energy costs to the various retail customer categories and ultimately the calculation of for the full long-run marginal cost of electric supply at the retail meter.

This process was conducted for each franchise area based on the applicable generation and transmission grid LRMC and the density and loss characteristics of the particular franchise area.

ILLUSTRATIVE FRANCHISE AREA ASSUMPTIONS:

Load Density: 20.2 peak kW demand per kilometer of distribution line

Average Loss: 15%

The numbers above are used in the illustrative calculation below; however, in calculation of the franchise area tariffs, the actual load density and loss for the franchise area was used.

BASIC ASSUMPTIONS:

Transmission losses	
Average loss (% of energy delivered to each level)	
- hv transmission	0.5%
- sub-transmission	0.8%
Peak loss factor (transmission)	1.09
Distribution system	
% of energy sold at primary voltage	25%
% of energy sold at lv level	75%
Allocation of losses in distribution	
% of technical losses at primary voltage	20%
% of technical losses at lv level	80%
Split of distribution capacity costs	
Primary system	20%
Secondary system	80%

Table 5
Distribution Loss Analysis:

	Primary system	Secondary system
Energy reaching each level (% of units sent out)	100%	72%
Energy consumption at each level (% of units sent out)	25%	75%
Technical loss at each level (% of units sent out)	3%	12%
Energy loss at each level (% of units reaching level)	3%	16%
Input to supply 1 kWh at each level	1.03	1.24

DISCUSSION OF LOSSES

System losses in 1998 totaled just under 16% of units supplied, and comprised NPC system losses of just under 3% and losses in the distribution utilities' systems (IOUs and ECs) of 13.4% of energy provided at bulk supply points. If it is assumed that non-technical losses accounted for around 3% of bulk supply, then technical losses amounted to just under 13% of energy sent out.

The major shares of these losses occur at the lower voltage levels of supply. Our assumption on the split of losses across the system are shown in the table above. The lower part of this table shows our calculation of cumulative losses at each level, expressed as the (average) quantity of generation required to supply 1kWh to the final consumer at each supply level[1].

In this example, assuming (i) that total system losses are 15% of energy supplied (as in 1998); (ii) that these losses occur in a 10%:30%:60% distribution across the EHV/HV, MV and LV systems (respectively); and (iii) that around 25% of sales are taken at higher voltage levels (with the balance at LV), then the average quantity of generation required to supply 1 kWh at LV level is just under 1.25 kWh. Thus, the unit generation cost would have to be factored up by this amount to achieve the 'cost-recovery' rate for energy sales delivered to LV consumers.

This however would be an over-simplification of the impact on losses on supply costs. A significant proportion of total losses are variable in nature, their level dependent on the level of the load. Variable losses typically account for around 75% of total technical losses. In the tables below we demonstrate how variable losses are distributed over the daily load curve. The load curve used for this example is that of the interconnected Philippine national system. In such a system - with a very high system load factor - the variability of losses across the day is relatively muted; nevertheless, peak losses are around 5% higher than average losses, and - for a broadly-defined 14-hour 'peak' period - some 16% higher than off-peak losses[2]. *Ceteris paribus*, the lower the system load factor, the greater the variability of losses over the load curve.

At this point it is appropriate to note that load characteristics of the IOU and EC supply areas - and indeed the load characteristics of individual utilities within each category - are far from homogeneous. For example, the average level of losses in the EC franchise areas is significantly higher than in the IOU areas; and further, average load factors are considerably lower in the EC areas, which will result in an even greater disparity with respect to peak losses.

FUNCTIONALIZATION OF COSTS

The generation and transmission costs below are illustrative; the final recommended numbers are used in the actual tariff calculations.

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[1] Note that the cumulative loss figures applying to supply at each level are influenced by the proportions of total energy taken at each level (for example, to the extent that a higher proportion of sales was taken at MV level, LV losses - as a percentage of sales at LV - would be higher). It can be noted that we do not have definitive data on the split of sales by voltage level, nor on the allocation of total losses across the system.

[2] In this example it has been assumed that losses are distributed uniformly across all sales, and that the load shape is uniform across all levels of the system.

Table 6
Ilustrative Costs

		$/kW	$/kW/yr	P/kW/yr	
LRMC Generation	G	0	44.8	1,792	
AIC transmission	T1	32	3.9	158	500kV / 350kV / 230kV
AIC sub-transmission	T2	74	9.2	368	138kV / 115kV / 69kV
AIC primary distribution	D1	212	26.3	1,051	34.5kV / 13.8kV / 6.2kV / 4.8kV
AIC secondary distribution	D2	847	105.1	4,206	lv

Cost at:	Av loss	Peak loss factor	Peak loss		Cost component (P/kW/yr)					
				Cum	Generation	Trans 1	Trans 2	Dist 1	Dist 2	Total
Generation level					1792					1792
Transmission level	0.5%	1.09	0.6%	0.6%	1802	158				1960
Sub-transmission level	0.8%	1.09	0.9%	1.4%	1818	159	368			2344
Primary distribution level	3.0%	1.53	4.6%	5.9%	1905	167	385	1051		3509
Secondary distribution level	16.7%	1.53	25.5%	29.9%	2558	224	517	1412	4206	8916

Table 7
Allocation of Capacity Costs to Tariffs by Voltage Level

Tariff category	Applicable capacity charges (P/kW/yr)						
	Generation	Trans 1	Trans 2	Total G&T	Dist 1	Dist 2	Total D
EHV tariffs	1802	158		1960			0
HV tariffs	1818	159	368	2344			0
MV tariffs	1905	167	385	2457	1051		1051
LV tariffs	2558	224	517	3299	1412	4206	5617

Table 8
Capacity Charge Converted to Energy Charge, by Voltage Level

Time	Cost allocation		EHV	HV	MV	LV
	G&T	D				
1		4.2%	0.00	0.00	0.17	0.90
2		4.2%	0.00	0.00	0.17	0.90
3		4.2%	0.00	0.00	0.17	0.90
4		4.2%	0.00	0.00	0.17	0.90
5		4.2%	0.00	0.00	0.17	0.90
6		4.2%	0.00	0.00	0.17	0.90
7		4.2%	0.00	0.00	0.17	0.90
8		4.2%	0.00	0.00	0.17	0.90
9	6.6%	4.2%	0.49	0.59	0.79	1.73
10	7.1%	4.2%	0.53	0.64	0.83	1.79
11	7.3%	4.2%	0.55	0.66	0.86	1.83
12	7.1%	4.2%	0.53	0.64	0.84	1.79
13	7.2%	4.2%	0.54	0.65	0.85	1.81
14	7.4%	4.2%	0.56	0.67	0.87	1.84
15	7.3%	4.2%	0.55	0.66	0.86	1.82
16	7.1%	4.2%	0.53	0.64	0.84	1.80
17	6.9%	4.2%	0.52	0.62	0.81	1.77
18	7.2%	4.2%	0.54	0.65	0.84	1.81
19	7.7%	4.2%	0.58	0.70	0.90	1.88
20	7.4%	4.2%	0.56	0.67	0.87	1.84
21	7.1%	4.2%	0.53	0.64	0.84	1.80
22	6.6%	4.2%	0.50	0.59	0.79	1.73
23		4.2%	0.00	0.00	0.17	0.90
24		4.2%	0.00	0.00	0.17	0.90
	100%	100%				

			EHV	HV	MV	LV
Peso/day			7.5	9.0	13.5	34.2
Annual charge	261peak days		1960	2344	3509	8916
Peak rate (weighted average)		P/kWh	0.54	0.64	0.84	1.80
		$/kWh	0.013	0.016	0.021	0.045
Off-peak rate		P/kWh	0.00	0.00	0.17	0.90
		$/kWh	0.000	0.000	0.004	0.022

Table 9
Energy Cost Allocation

	$/kWh		P/kWh	
	Peak	Offpeak	Peak	Offpeak
At generation level	0.038	0.028	1.50	1.14
At bulk supply points	0.038	0.029	1.52	1.15
At primary distribution level	0.039	0.030	1.57	1.19
At secondary distribution level	0.047	0.036	1.88	1.43

Table 10
Total Unit Cost of Supply (Capacity + Energy)

		P/kWh			$/kWh		
		HV	MV	LV	HV	MV	LV
Peak period							
	Capacity	0.64	0.84	1.80	0.016	0.021	0.045
	Energy	1.52	1.57	1.88	0.038	0.039	0.047
	Total	2.17	2.41	3.69	0.054	0.060	0.092
Offpeak period							
	Capacity	0.00	0.17	0.90	0.000	0.004	0.022
	Energy	1.15	1.19	1.43	0.029	0.030	0.036
	Total	1.15	1.36	2.33	0.029	0.034	0.058

Table 11
Average Rates by Consumer Category

		Residential	Min biller	Comm	Ind lv	Ind hv	Other	Trans.
% of annual energy taken in peak period		48%	51%	56%	53%	46%	49%	46%
% of annual energy taken in off-peak period		52%	49%	44%	47%	54%	51%	54%
Weighted average rate	P/kWh	2.97	3.02	3.08	3.04	1.84	2.99	1.62
	$/kWh	0.074	0.076	0.077	0.076	0.046	0.075	0.041
		2.97	3.02	3.08	3.04	1.84	2.99	1.62

The above Rates by Consumer Category calculation is illustrative of the procedure conducted for each franchise area to determine LRMC.

RESULTS

Across the Philippines as a whole, LRMC electricity prices are expected to be roughly 73% of existing financial tariff levels. However, LRMC prices in Mindanao, because of existing pricing subsidies in Mindanao, are higher than the existing price levels.

A comparison of the component average LRMC costs with existing tariffs is given in the following table, by Grid

LRMC	2000 Real Peso			
	Generation	Transmission	Distribution	Total
Luzon	2.10	0.10	0.79	2.99
Visayas	2.20	0.23	0.71	3.13
Mindanao	2.51	0.39	0.61	3.51
Philippines	2.16	0.15	0.76	3.07
		% Share		
Luzon	70%	3%	27%	
Visayas	70%	7%	23%	
Mindanao	72%	11%	17%	
Philippines	70%	5%	25%	

Actual Embedded Costs Year 2000				
	Generation	Transmission	Distribution	Total
Luzon	3.24	0.36	0.83	4.43
Visayas	3.05	0.34	0.68	4.06
Mindanao	1.95	0.22	0.58	2.75
Philippines	3.05	0.34	0.78	4.18
		% Share		
Luzon	73%	8%	19%	
Visayas	75%	8%	17%	
Mindanao	71%	8%	21%	
Philippines	73%	8%	19%	

The existing and resulting estimated long-run marginal cost of electricity supply for various tariff categories are summarized in the following charts.

Figure 2

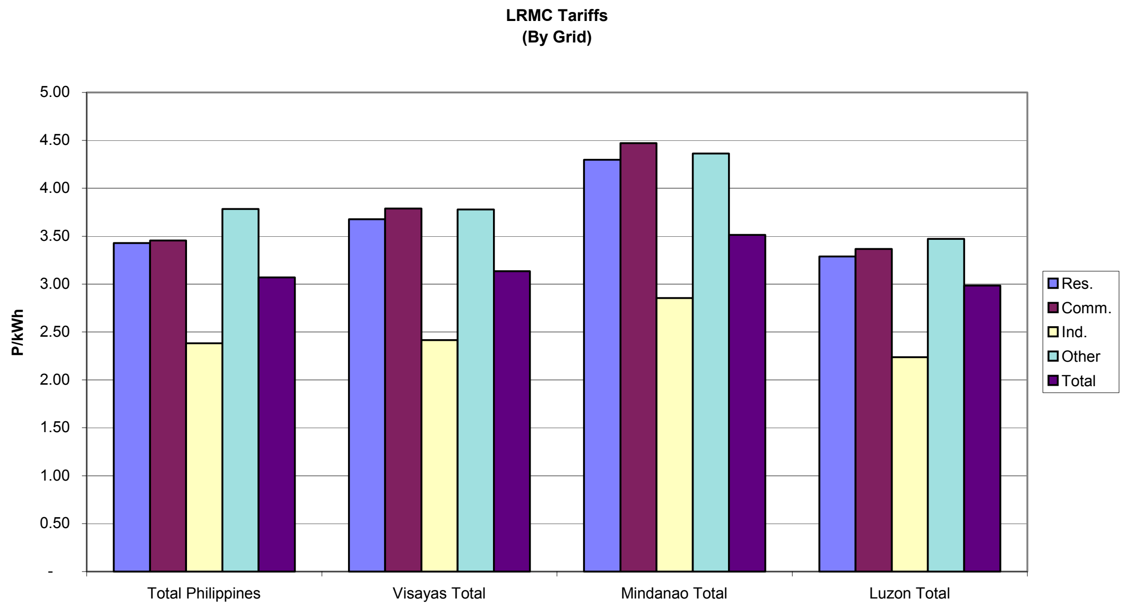
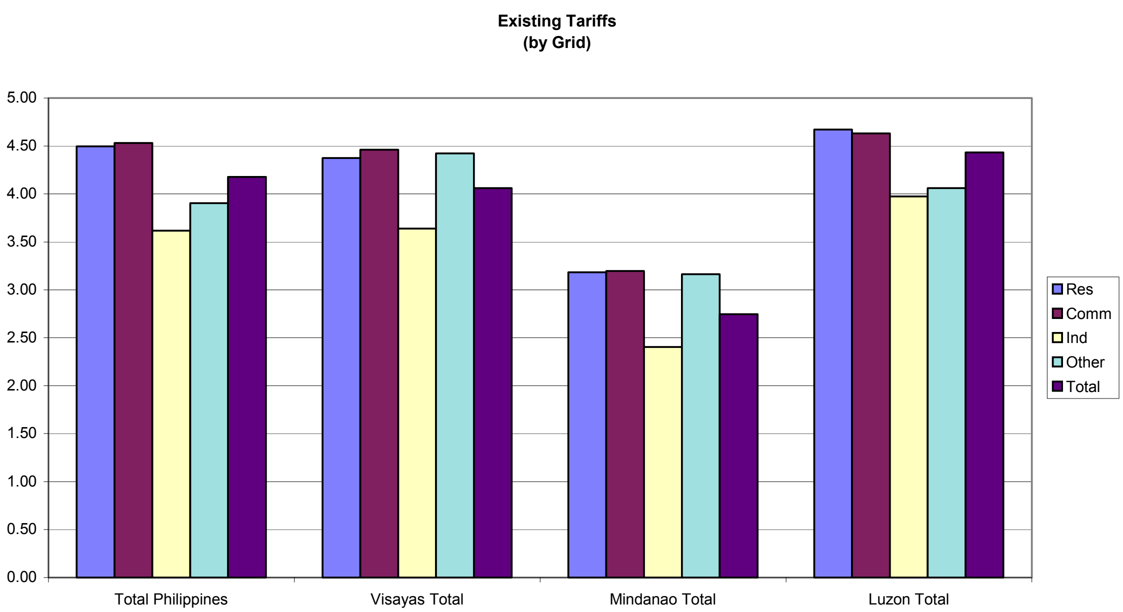


Figure 3



Section 7
Welfare Effects of Power-Sector Reform on Residential Users, A Partial Equilibrium Approach

Introduction

The full welfare effects on users of the proposed power-sector reforms will depend on a number of factors, chief of which are the following: (a) the direction and magnitude of changes in the price of electricity; (b) the level of electricity use and electricity consumption response on the part of users; (c) the effects of changes in electricity price on the prices of other goods; (d) the effects of price changes on output, employment and factor incomes in the production sector; and (e) the implications of power-sector restructuring on taxation and government budgets. The analysis in this section takes into account the direct effects (a), (b), and (e) using partial-equilibrium models. A proper analysis of effects on other prices and on output, employment and factor incomes is possible only through general-equilibrium models, which is done in Section 8.

Residential Users

Once completed, the proposed power-sector reforms are expected to have a powerful downward effect on electricity prices to end-users. The biggest reason for this is the expectation that the introduction of competition and the absorption of some NPC debts and other stranded costs by the national government will bring the price of electricity closer to the long-run marginal cost of producing it.

However, the short-run, roughly the next three to five years, represents a transition period, during which existing subsidies across and within grids (specifically the Economic Assistance Charges or EACs) and among consumer classes (interclass or IC subsidies) are to be removed before privatization is completed and thoroughgoing competition among power generators and distributors is attained. In essence this means there may be a brief period when prices may rise in areas where subsidies have been in place.

Residential consumers clearly benefit whenever the price of electricity they consume falls, holding other prices constant. The benefits enjoyed will be greater, the larger is the price fall and the more electricity a household is already consuming. In the limit, unelectrified households would neither benefit nor lose directly from the power sector reform, except to the extent that the reforms make greater investments in electrification projects in marginal areas more economically viable. A change in the price of electricity may be likened to a change in the income of households in that it either increases or reduces what a household can afford.

As already seen in a previous section, electricity is a normal good, that is, the demand for electricity rises as household budgets increase. From the viewpoint of welfare analysis, this implies that poor households, which are smaller consumers of electricity, would generally neither be greatly harmed nor greatly benefited by electricity price changes. A second circumstance is that the demand for electricity is price-inelastic. Quantities of electricity demanded rise or fall by smaller proportions than the changes in electricity prices. This is because for electrified households there are few substitutes for electricity.

Full Gains and Losses in the Long Run

The computation of long-run electricity demand is based on the long-run demand function reported in Section 5, which it will be recalled features lagged adjustment to a long-run desired stock of electric appliances. The reduced-form representation gives electricity demand of the representative provincial household as a function of price, expenditure per capita, electricity demand lagged three years, and variables representing household characteristics, of which the urban location and the propensity to purchase consumer durables (particularly, refrigerators) are significant. Owing to the need in a long-run model to take into account observations over two or more periods and the noncomparability of household-level observations over the survey periods available, province-level data from the 1994 and 1997 surveys of family income and expenditure were used instead to profile representative provincial households. The price of this has been the loss of detail with respect to the differentiation between poor and nonpoor households that was possible in the short-run regressions. As a result, the estimate of long-run gains and losses could be made only for the "average" household for each province.

As a measure of the welfare change from the full implementation of power-sector reforms, the *compensating variation* (*CV*) in income was estimated, using the difference between **current rates** and the estimated **long-run marginal costs** reported in Section 6 in the price-variable of the long-run demand function reported in Section 5. The year 2000 electricity tariff rates are used as "current rates" in the policy simulations for the welfare analysis. When more than one franchise operates in a province, the relevant price is taken as an average of the price for the different franchise areas, weighted by their shares in residential consumption. On top of the long-run marginal cost, it is assumed that an additional 30 centavos per kWh is charged, representing the universal levy called the **Electricity Industry Reform Charge** (EIRC). This is the amount calculated as being necessary to carry out the whole set of power sector reforms, particularly to recover the stranded costs of the National Power Corporation (NPC)[1], net of national government absorption of some of the NPC liabilities. Hence, for each franchise, the price per kWh used here to reflect the effects of the reforms once they have been completed is as follows:

post-reform price = (franchise-specific long-run marginal cost) + (30-centavo EIRC).

The price change used in the long-run demand function is then given by the following:

long-run price change = (post-reform price) - (current price).

Recalling that a price change is akin to a change in a household's real budget, the compensating variation essentially asks what the effect on the welfare of typical residential consumers in different provinces would be if the rates immediately changed from their current levels to post-reform prices for the various franchise areas. More specifically, it asks, if a change in electricity prices penalizes (or benefits) a household, by how much would its current budget have to be increased (or reduced) in order leave the household no worse (or better) off than it was before the price change. The exact algorithm used to generate the compensating variation is that suggested originally by Vartia (1983), also as discussed by Bacon (1995). A more detailed discussion of this methodology is provided in Appendix I.1.

The full results by province are given in Appendix Table I.4.1, while the summary of the results by region is shown in Table 1 below. The bottom-line is a *net* **annual gain** of P7.3 billion (current 2000 pesos) nationally. This translates into P803 annually per household, or about 0.58 percent of the average annual household budget nationally. Especially since this long-run rate configuration is expected to persist well into the future -- the implied planning horizon being at least fifteen years -- this amounts to a significant

[1] The assumed EIRC of 30 centavos per kWh does not cover other possible purposes of the EIRC such as missionary electrification and the equalization of taxes between indigenous and non-indigenous energy fuels.

gain in aggregate consumer welfare. Put another way, this amount represents the loss that households have effectively been bearing as a result of the inefficiencies in the power sector. These estimated gains can be considered underestimates of the likely benefits from the full implementation of the power-sector reforms because the partial equilibrium approach used in this section ignores the possible changes in household incomes arising from increased production activities due to lower commercial and industrial electricity rates for the production sector of the economy.

Table 1
Annual Long-Run Gains and Losses from Power-Sector Reform
(In millions of current 2000 pesos; all provinces*)

Region	Gains	Losses	Net gains
Luzon	8,845	-2	8,843
Visayas	463	-11	452
Mindanao	0	-1,991	-1,991
Philippines	9,308	-2,004	7,304

*except those covered solely by small-island grids
Source: Appendix Table I.4.1

The largest gains to households are found in Luzon, particularly Metro Manila where the gains amount to some P4.7 billion annually, or 65 percent of total gains. The benefits from this price decline are equivalent to a 0.88 percent addition to the available budget of the average Metro Manila household. The size of this figure is due to the significant price decrease expected for the Metro Manila franchise, and the large share of electrified households it represents (23 percent), and the higher-than-average electricity demand per household there. Except for Antique, Eastern Samar and Southern Samar, all provinces in the Visayas are expected to benefit, albeit on a smaller scale than households in Luzon.

To gain an idea of relative magnitudes, expected gains and losses may be scaled by taking them as proportions of provincial average household budgets. Ranking provinces this way gives the distribution shown in Table 2, which shows that 23 of 58 provinces, or some 62 percent of all household in the country may be expected to enjoy gains amounting to at least half a percent of household budgets. On the other hand, 21 provinces, or 19 percent of all households, may be negatively affected by prices increases in electricity. Table 3 enumerates the provinces where households are expected to experience significant gains (arbitrarily defined as those amounting to one percent or more of household budgets).

Table 2

Distribution of Provinces According to Relative Size of Gains (Losses)

Gains as percent of household budgets	Number of provinces	Percent of households*
1.0 to 1.49	4	9.54
0.5 to 0.99	19	52.64
0 to 0.49	14	18.88
-0.5 to –0.01	4	1.11
-1.0 to –0.51	5	6.55
-1.5 to –1.01	10	10.20
-2.0 to –1.51	2	1.07
Total	58	100.00

*Refers only to regular billers; 2000 (estimated) distribution
Numbers may not add up to 100 due to rounding
Source: Appendix Table I.4.1

Table 3

Provinces with Potential Full Gains of at Least One Percent of Household Budgets

Province	Gains per household (pesos)	Gains* (%)	Province	Gains per household (pesos)	Gains* (%)
Zambales	2,009	1.44	Nueva Ecija	1,095	1.09
Rizal	1,696	1.12	Cavite	1,598	1.04

*compensating variation as percent of provincial average household budget
Source: Appendix Table I.4.1

On the other hand, Table 4 enumerates all potential losers under a regime of competition and long-run marginal cost pricing. Taken together, these consumer losses run to about P2.0 billion (in current 2000 pesos) annually. Most of these provinces are in Mindanao, reflecting the fact that current prices are much lower than the long-run marginal cost of producing electricity in that region and therefore embody significant subsidies. As a proportion of average provincial household budgets, however, the impact is small and the losses range from 0.04 to 1.67 percent, the highest losses being in Davao Oriental and Sultan Kudarat. The magnitude of the welfare losses involved is likely to be somewhat smaller than suggested in these average figures, which include the nonpoor as well. This is because the inclusion of the larger electric consumption of nonpoor households tends to increase the magnitude of the average losses.

Table 4
Long-Run Welfare Losses Per Household (In Current 2000 Pesos)

Province	Gains per household (pesos)	Gains* (%)	Province	Gains per household (pesos)	Gains* (%)
Davao Oriental	-1,692	-1.67	Bukidnon	-1,244	-1.02
Sultan Kudarat	-1,639	-1.57	North Cotabato	-932	-1.00
Zamboanga del Sur	-1,546	-1.38	Misamis Oriental	-964	-0.84
Lanao del Norte	-1,553	-1.35	Davao Sur	-1,158	-0.84
Agusan del Norte	-1,278	-1.30	Surigao del Norte	-658	-0.79
Agusan del Sur	-1,140	-1.25	Maguindanao	-604	-0.69
Zamboanga del Norte	-1,491	-1.23	Mt. Province	-246	-0.23
South Cotabato	-1,366	-1.21	Antique	-225	-0.15
Davao Norte	-1,257	-1.20	Southern Samar	-82	-0.09
Misamis Occidental	-990	-1.12	Eastern Samar	-45	-0.04
Surigao del Sur	-988	-1.07			

*compensating variation as percent of provincial average household budget
Source: Appendix Table I.4.1

The negative wedge between current rates and long-run marginal costs for Mindanao can be considered implicit subsidies currently flowing to both poor and nonpoor households. The true public issue with respect to nonpoor households is not a permanent subsidy but at most a transition subsidy to ease the shock of adjusting to the long-run price configuration. The magnitude of adjustment losses for poor households is likely to be smaller, since they consume less electricity.

Nonetheless, it may still be decided to ease this transition for Mindanao, whether in a targetted or across-the-board manner, in order to lessen its adjustment costs and to improve the constituency for the power-sector reforms as a whole. **It may be necessary to design a compensation package for Mindanao for the political acceptability of the power-sector restructuring program in order for the country to attain the long-run benefits of such reforms.** The compensation can take the form of annual payments to Mindanao of about P2.0 billion at the maximum or a one-time payment or establishment of a trust fund of about P13 billion[2], depending on the assumed discount rate.

Elimination of Cross-Subsidies in the Short Run

The foregoing analysis shows that significant long-run gains are to be had as a result of power-sector reforms. In the short-run, however, some adjustments will affect residential electricity prices even before competition takes effect and long-run marginal costs are reflected in electricity tariff rates. A necessary condition for competition, particularly at the generation and distribution/retail sectors of the power industry, is the elimination of cross-subsidies across and within grids and among customer classes[3].

During the transition period, it is envisioned that "transition contracts" will be concluded between distributors and power generators so that current price configurations will be maintained until full competition kicks in. These contracts, however, are understood to eliminate existing subsidies embedded in current rates faced by end-users. With the elimination of cross-subsidies, there are two important sources of electricity price adjustments. Firstly, the removal of the Economic Assistance Charges (EACs) does away with existing subsidies from the Luzon to the Visayas and Mindanao grids, as well as some subsidies within each grid. A second source of price adjustment in the interim is the removal of interclass

[2] This assumes a 15 percent discount rate.

[3] A description of cross-subsidies in the existing rate structure is given in Section 3.

(IC) subsidies, from industrial and commercial users to residential users. The latter is expected to reduce the price of electricity to industrial and commercial users - a major distortion the power-sector reform wishes to address - while tending to raise the electricity prices faced by residential customers.

The short-run welfare analysis done in this section explores the likely impacts of the elimination of cross-subsidies on residential consumers. It is deemed that the elimination of cross-subsidies is a necessary condition for the full implementation of the power-sector reforms. During this transition period, roughly the first three to five years from the start of the power-sector restructuring, it is assumed that the NPC has not fully turned over the privatized power plants and hence still sets the wholesale rates subject to ERB regulation. Distribution rates are also assumed to be subject to ERB regulation. The two scenarios considered separately are:

(a) the elimination of cross-subsidies within and across grids, that is, residential consumers face the transition price, current rate minus the EAC[4]; and
(b) the elimination of cross-subsidies within and across grids and among customer classes, that is, residential consumers face the transition price, current rate minus the EAC plus the IC, where IC is the interclass subsidy being currently received.

It is expected that the elimination of inter-grid and intra-grid cross-subsidies would be easier to implement through the removal of the EACs at the wholesale level than the elimination of interclass subsidies from commercial and industrial users to residential consumers at the retail level[5]. The resulting short-run price configurations by province are given in Appendix Tables I.4.2-I.4.4, while the summary of results by island grid and poor/nonpoor customers is presented in Table 5.

Table 5
Residential Prices by Grid, Poor/Non-poor, P/kWh
(Weighted by kWh consumption, small island grids removed)

Grid	Current	Post EAC	Post	(Post EAC,	LRMC+0.30

[4] A positive (negative) value for the EAC implies that the consumer currently pays (receives) the subsidy.

[5] The original data on EACs and ICs obtained from the NPC and some utilities are approximately 1998 values. The analysis in this section assumes that the EACs and ICs in year 2000 are in the same proportion to retail rates as in 1998.

	(2000)		EAC, IC	IC) – 0.30	
Luzon	4.86	4.74	5.39	5.09	3.63
Non-Meralco					
Non-poor	4.8830	4.9578	4.9683	4.6683	3.8710
Poor	4.9881	5.0694	5.0757	4.7757	3.9533
Meralco					
Non-poor	4.8578	4.6711	5.5634	5.2634	3.5393
Poor	4.3306	4.1439	5.0362	4.7362	3.5393
Visayas	4.46	5.16	5.29	4.99	4.06
Non-poor	4.4515	5.1427	5.2784	4.9784	4.0536
Poor	4.5968	5.3203	5.3789	5.0789	4.1415
Mindanao	3.27	4.01	4.15	3.85	4.71
Non-poor	3.2619	3.9961	4.1431	3.8431	4.6927
Poor	3.3365	4.1464	4.2012	3.9012	4.8399
Philippines	4.57	4.68	5.19	4.89	3.85
Non-poor	4.5883	4.6901	5.2135	4.9135	3.8291
Poor	4.3222	4.6069	4.8791	4.5791	4.0948

Source: Appendix Tables I.4.2-I.4.4

Except for the Meralco franchise area where its block pricing has higher marginal prices for higher electricity consumption, the poor generally pays slightly higher prices per kWh consumption in non-Meralco franchise areas. Because of the significant market share of Meralco, overall the poor currently pays lower prices per kWh consumption. The removal of the EACs increases the residential electricity rates in the country, except for six provinces in Luzon[6]. The changes range from a reduction of 4 percent to an increase of about 28 percent of the present rates, or an average increase of 2.5 percent for the whole country. Rate-reductions are to be found mainly in Metro Manila and Southern Luzon, notably the Meralco franchises, which reflects the existence of subsidies from these regions to the Mindanao and Visayas grids.

The additional removal of interclass subsidies will tend to further raise residential electricity rates and correspondingly reduce rates for industrial and commercial customers. Information regarding interclass subsidies is more difficult to obtain, maybe partly because such cross-subsidies are not practiced by all franchises. The biggest franchise, however, namely Meralco, does practice such cross subsidies. For illustrative purposes, the present calculations use the reported interclass subsidy rates for five IOUs that have undertaken cost of service studies[7]. Interclass subsidies for the Meralco franchise are particularly large; the removal of the interclass subsidies to residential consumers reverses the price fall resulting from the removal of the EAC.

In terms of price changes relative to current (year 2000) rates, the elimination of cross-subsidies within and among grids and among customer classes will have the largest impact on Mindanao, followed by the Visayas and Luzon, with price increases of 26.9 percent, 18.5 percent, and 11.0 percent, respectively. The national average price increase is 13.6 percent of which 2.5 percent is accounted for by the removal of the EACs. **Hence, it is expected that the elimination of the interclass subsidies is likely to have a bigger impact on residential rates compared to the removal of inter-grid and intra-grid subsidies.**

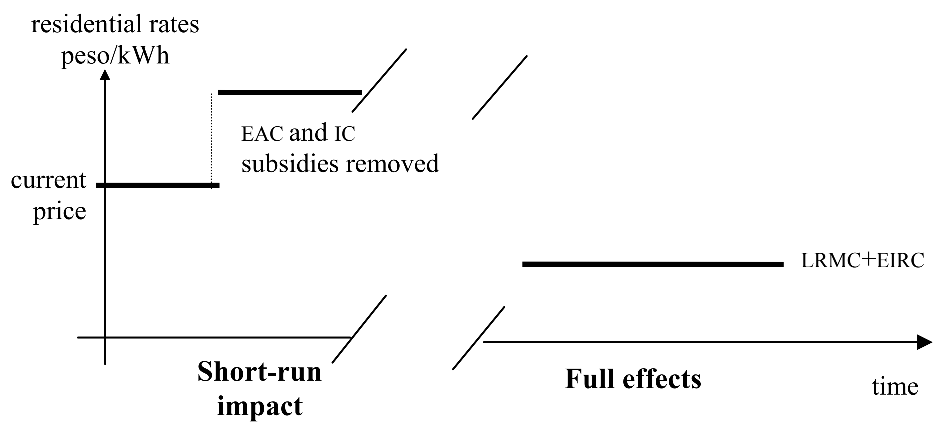
[6] These provinces are Metro Manila, Bulacan, Cavite, Laguna, Quezon and Rizal.

[7] These five IOUs, namely Meralco, Visayas Electric Company, Panay Electric Company, Davao Light and Power Company and Tarlac Electric Inc., account for about 40% of total residential kWh sales in the country. See Section 3 for a description of the interclass subsidies.

However, in the Visayas and Mindanao which together account for about 20 percent of total residential kWh consumption, the bigger impact on electricity prices is expected to come from the elimination of the inter-grid and intra-grid subsidies.

On the other hand, current rates for most franchises except for those in Mindanao are significantly higher than those reflecting long-run marginal costs. The likely path of average electricity rates for residential customers may therefore be described as: (a) an initial *increase* over current rates during a transition period before full competition occurs when EAC and IC subsidies are removed, followed by (b) a fall to levels *below* current rates that are consistent with long-run marginal cost (plus EIRC) once full competition in the power-generation market begins. This trajectory is sketched in Figure 1 below. Residential electricity prices that are higher than current rates and long-run marginal costs are therefore expected to prevail during the transition period.

Figure 1
Likely Price Trajectory



The difference between the post-reform price (LRMC + EIRC) and the current price is the long-run price change considered in estimating the full effects of the power-sector reform program in the preceding subsection. This subsection now attempts to measure the impact of the elimination of cross-subsidies in the short run on the welfare of the residential consumers. As was done in the case of long-run analysis, welfare changes due to short-run price changes are estimated by taking the franchise area-specific price-changes and substituting them into the estimated short-run demand functions to obtain predicted changes in electricity demand for each household[8].

In these experiments, the short-run price change is calculated as the difference between the **transition price**, which is defined for each franchise area as follows:

transition price = current price – EAC + IC ,

and the current price. Hence, the price changes expected in the transition period, in the absence of any mitigating measures, simply represent the effect of removing the inter-grid and intra-grid subsidies and interclass subsidies from current residential rates. Again it is evident that, *ceteris paribus*, households confronting lower electricity prices in the transition benefit directly, while those facing higher prices suffer losses in welfare. The magnitude of the short-run welfare impact on the household is represented

[8] The short-run demand function for electricity by residential users is dicussed in Section 5.

by the compensating variation (CV) measure, which indicates the money-amount required to restore a household to its former level of welfare. This exercise of estimating the compensating variation is done in this study only for regular billers[9]. The CV estimates of welfare gains and losses from the elimination of cross-subsidies from current rates are reported by province and by poor and nonpoor household classification in Appendix Tables I.4.5-I.4.7.

The scope of the potential losses, measured in compensating variation terms, to residential consumers is estimated at P5.7 billion annually, details of which are provided in Table 6 below. When households are classified into poor and nonpoor, it becomes evident that the bulk of these losses -- some 94 percent -- are borne by nonpoor households. About 82 percent of the estimated losses are due to the removal of the interclass subsidies, which also account for most of the potential losses for the nonpoor households. The losses to nonpoor households are largely due to their higher electricity consumption, which makes them more vulnerable to electricity price increases.

Table 6
Estimated Welfare Losses from Removal of Energy Assistance Charges and Interclass Subsidies (In millions of current 2000 pesos)

	Poor*	Non-poor*	Total
Removal of EAC	161	845	1,006
Removal of IC	156	4,534	4,690
Total	317	5,379	5,696

*regular billers only
Source: Appendix Tables I.4.5-I.4.7

The welfare losses to poor households range from zero to 0.92 percent of poor-household budgets, with an average loss of 0.34 percent of poor-household budgets. For nonpoor households, the average welfare loss from the elimination of cross-subsidies is higher at 0.41 percent of their household budgets. Of a total of 66 provinces included in the study, the losses exceed half of a percent in only 22 provinces and are half a percent or less of household budgets in the other 44 provinces. The complete results are shown in Appendix Tables I.4.8-I.4.10.

Mitigating Measures in the Short Run

From the previous discussion, a pure efficiency-viewpoint clearly indicates that the sizeable welfare gains to households from the full implementation of power-sector reforms (a levelized P7.3 billion annually over at least fifteen years) would outweigh the earlier negative adjustment costs of an annual P5.7 billion over a much shorter transition period. On this basis alone, there would be a strong case for the implementation of the reforms. In addition, the overall economy gains from the expected lowering of commercial and industrial electricity rates that can lead to an increase in production activities. Indirectly, residential consumers can benefit through increased factor incomes.

Nonetheless, adjustment costs are expected to be incurred by residential end-users in all areas in the short run, and even with the onset of full competition, some areas (particularly Mindanao) would still experience price increases. These may cause hesitation among policymakers and the public about the political feasibility of carrying out the reforms fully. It thus becomes important to design mitigating

[9] Inclusion of minimum billers in the sample for the regression analysis will require alternative econometric techniques since actual electricity consumption of minimum billers are unobserved.

mechanisms that leverage future gains from long-run marginal cost pricing of electricity to reduce near-term burdens of adjustment, especially those arising from the elimination of cross-subsidies, in order to build a constituency for reforms. Two general provisions of the proposed power-sector reform bill (January 17, 2001 version), the 30-centavo reduction in residential retail rates and the setting of lifeline rates for marginalized end-users, are next analyzed as possible mitigating measures to ease the adjustment of residential customers during the transition period.

Thirty-centavo reduction in residential rates. The first exercise performed is a simulation of the transitory provision featured in principal versions of the power-reform bill, namely, the mandated rate reduction for residential end-users. Earlier versions of the proposed power-reform bill stipulated that upon the national government's absorption of at least one hundred billion pesos of NPC's liabilities, a five-percent reduction in NPC's average rate should ensue and shall be entirely passed on to residential end-users. A latter January 2001 version of the reform bill stipulates a 30-centavo reduction in residential rates upon effectivity of the reform bill. Assuming year 2000 sales of 12,002 GWh to residential end-users, the value of the 30-centavo reduction in residential rates is about P3.6 billion a year. This report translates the stipulated measure in the proposed legislation as an **across-the-board reduction in all existing residential rates by 30 centavos per kWh** to be applied during the transition period. Hence it is taken that the residential rate after the removal of cross-subsidies and the 30-centavo reduction is:

mitigated price = transition price – P0.30 per kWh.

The resulting price configurations by province and by poor/nonpoor households are presented in Appendix Tables I.4.2-I.4.4 and are summarized in Table 7 below.

Table 7
Residential Electricity Rates After Cross-subsidy Removal and 30-Centavo per kWh Reduction

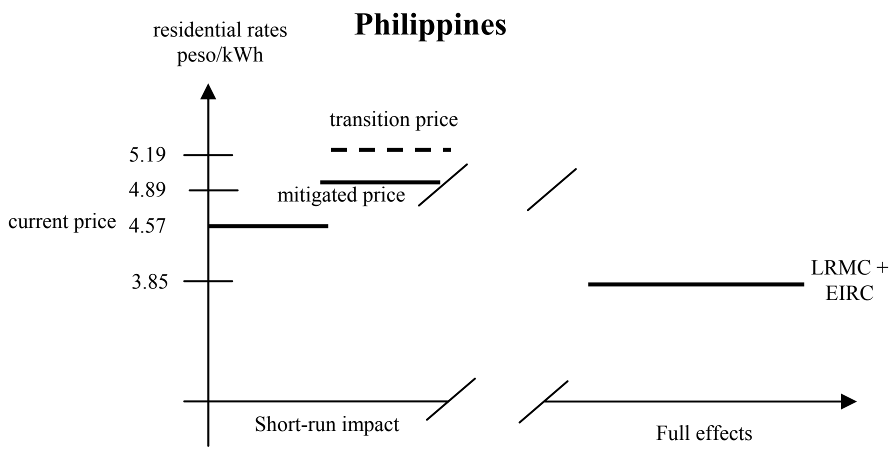
Residential Electricity Prices, P/kWh				
Grid	**Current (2000)**	**(Post EAC, IC) -0.30**	**% change from current**	**LRMC + 0.30**
Luzon	4.86	5.09	4.73	3.63
Visayas	4.46	4.99	11.88	4.06
Mindanao	3.27	3.85	17.74	4.71
Philippines	4.57	4.89	7.00	3.85

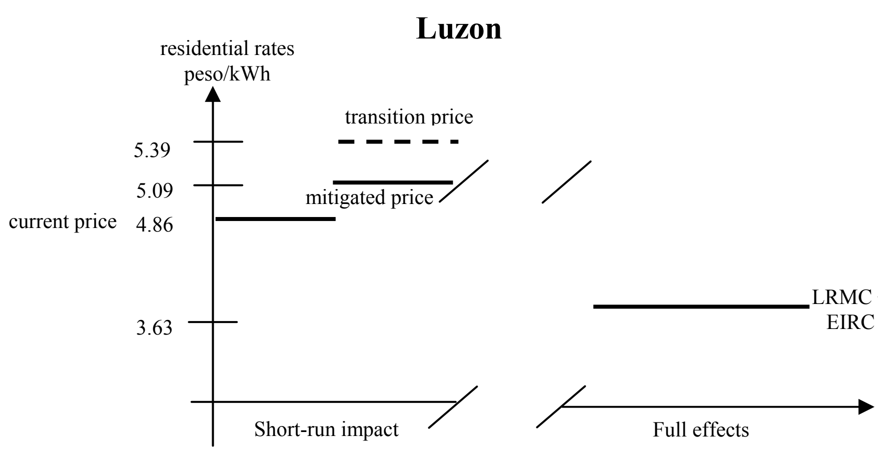
Source: Appendix Tables I.4.2-I.4.4

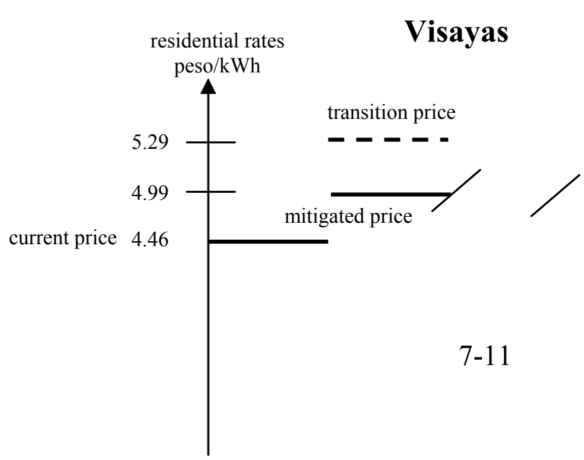
Overall, the weighted average increase in residential electricity rates is reduced to 7.0 percent by the 30-centavo reduction in residential rates. The weighted average increase in residential rates due to the elimination of cross-subsidies alone is about 14 percent. Hence, the 30-centavo reduction in residential rates can be expected to reduce the impact of the elimination of cross-subsidies on the welfare of households during the transition period. The 30-centavo mandated reduction in residential rates will about halve the increase that would otherwise occur in residential rates with the elimination of the cross-subsidies.

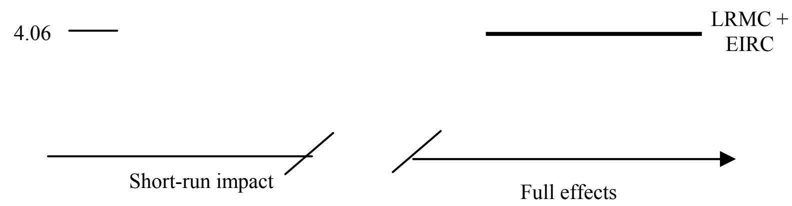
In Luzon that currently bears the burden of intergrid subsidies, there is an expected increase of 4.7 percent in residential rates. Since they are currently receiving substantial intergrid subsidies, the Visayas and Mindanao are expected to have higher net price increases of 11.9 and 17.7 percent, respectively, even after the 30-centavo reduction in residential rates. The likely paths of residential electricity prices in the three major grids, with and without the 30-centavo reduction in residential rates, are illustrated in Figure 2.

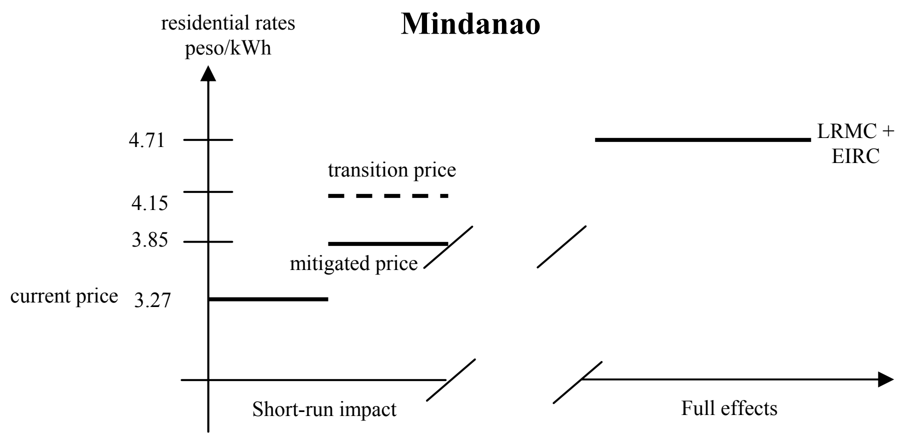
Figure 2
Likely Price Trajectories With and Without the 30-Centavo Reduction in Residential Rates











Current, transition (post-EAC, IC) and mitigated (post-EAC, IC and after the 30-centavo reduction) residential rates are highest in Luzon, followed by the Visayas and Mindanao. The post-reform residential rates, at LRMC plus P0.30 EIRC, are highest in Mindanao and lowest in Luzon. With the reversal of the ranking of prices among the three major grids going from current to long-run prices, we can then expect Luzon to gain the most from the power-sector reform. During the transition phase, the net effects of the elimination of cross-subsidies together with the 30-centavo per kWh reduction are still increases above current rates for Luzon, Visayas and Mindanao, with the smallest increase in Luzon and the largest increase in Mindanao.

The net welfare gains, in terms of compensating variation in income, to households for the major grids relative to the current state and after the removal of cross-subsidies and the 30-centavo reduction in per kWh residential rates are given in Table 8. For the household sector, the 30-centavo reduction in residential rates lowers the annual welfare loss from about P5.7 billion with the elimination of cross-subsidies to P2.9 billion, or a 49 percent reduction of welfare losses due to the elimination of cross-subsidies. The resulting average household welfare loss is then about 0.20 percent of the household budget. The incidence of welfare losses vary across grids with Luzon households having the smallest losses of about 0.13 percent of their household budgets while households in Visayas and Mindanao have higher losses of 0.36 and 0.44 percent of their household budgets, respectively. Thus it can be inferred that the 30-centavo reduction in residential rates significantly reduces the negative welfare effects on households of the removal of cross-subsidies. However, if it is desired that the elimination of cross-subsidies have on average minimal or near zero welfare effects on residential end-users, a bigger rate reduction of at least 45 centavos per kWh may be required. It must be noted though that the partial equilibrium measurement of the welfare effects in this section does not take into account the possible benefits that households may obtain indirectly from the lowering of industrial and commercial rates with the elimination of interclass subsidies.

Table 8
Annual Short-run Welfare Gains from the Removal of Cross-Subsidies and 30-Centavo Reduction in Residential Rates

	Welfare gains (millions of current 2000 pesos)	Gains as percent of household budgets
Luzon	-1,530	-0.13
Visayas	-599	-0.36
Mindanao	-776	-0.44
Philippines	-2,905	-0.20

Source: Appendix Tables I.4.5 - I.4.10

The large amount of NPC debts being absorbed by the national government (totaling some P200 billion) and consequent relief given to NPC suggest that an annual 4 to 5 billion peso cost of the 30-centavo reduction in residential rates can be sustained even over a transition period well exceeding the three to five years envisioned before full competition in the industry drives prices down to marginal costs. Actual net welfare gains from the 30-centavo reduction in residential rates may be higher than P2.8 billion annually since the estimates obtained in this study using the partial equilibrium approach do not include the indirect income benefits the residential end-users may derive from lower commercial and industrial rates during the transition period. The faster competition takes effect in the power sector and electricity tariffs approach long-run marginal cost pricing, the shorter will be the transition period, and the less will be the welfare costs of the elimination of cross-subsidies.

Lifeline rates for marginalized end-users. A transitory provision of the proposed power-sector reform bill is the setting of lifeline rates for marginalized end-users by the Energy Regulatory Board (ERB). The proposed legislative bill defines a lifeline rate as a subsidized rate given to low-income captive market consumers who cannot afford to pay at full cost. Presently, except for the Meralco franchise area, generally lifeline rates are not being offered but a system of minimum billing to cover the fixed costs of providing electricity services is in place for both IOUs and RECs. The analysis of lifeline rates in this study can be considered, at best, an exploratory study.

On the basis of equity arguments, lifeline rates for electric power have been suggested to supply the basic electricity needs of poor consumers, especially in countries where the cost of electricity consumption is high compared with income levels[10]. Theoretically, assistance to the poor through lump sum income transfers is preferable to subsidies on specific commodities such as electricity. The economic literature finds that lifeline pricing, with the main objective of providing assistance to the poor, is a poorly targeted instrument, with the bulk of the assistance going to the nonpoor. Difficulties in the administration of direct income redistribution programs, persistence of large disparities in income and other political reasons force government authorities to use subsidized prices as a redistributive measure. In this case, lifeline rates for electricity should be set for the most basic electricity consumption need; otherwise, substantial benefits accrue to the nonpoor and the incentive to use electricity efficiently is distorted.

In this study, the simulation experiment for the lifeline pricing structure assumes a threshold level of 20 kWh a month and a discount rate of 70 percent. It is assumed that only residential customers consuming 20 kWh or less a month are given the lifeline rate of 70 percent discount from the mitigated price (after

[10] A brief review of literature on lifeline rates is presented in Appendix I.2.

the removal of cross-subsidies and the 30-centavo per kWh reduction). The 20-kWh-a-month threshold ensures that at least 25 percent but less than 50 percent of poor households (see Table 9) are covered by the lifeline rate. This threshold level covers the electricity requirement for basic lighting and minimal use of some appliances like radio and electric fan.

Table 9
Electricity Consumption of Poor Households

Household coverage	Maximum kWh/year	Maximum kWh/month
25% of poor	196	16.3
50% of poor	284	23.7
75% of poor	436	36.3
100% of poor	960*	79.9

*Outliers (top 10%) removed. If only top 5% were removed, this would be 1,216 kWh/year.

To obtain the discount rate, the maximum willingness-to-pay for 20-kWh monthly electricity consumption of households consuming 20 kWh or less a month was estimated by running a demand regression model for this subsample[11] from the 1997 FIES data. The regression results are described in Appendix I.3. A priori, the low price and income elasticities of demand for electricity implies that large reductions in rates may be needed to induce significant increases in the consumption of electricity for this group. Also, the increase in electricity consumption will be less than proportionate to the reduction in price.

Using the 1997 FIES subsample, it is estimated that these households are willing to pay P1.18 per kWh for a monthly consumption of 20 kWh. After the removal of cross-subsidies and the 30-centavo per kWh reduction, the average price faced by poor households is calculated to be P4.05 per kWh. Therefore, on average, a household in this subsample has to be given a discount of about 70 percent in electricity tariffs to consume 20 kWh a month. At this specified lifeline rate, a monthly consumption of 20 kWh at year 2000 rates[12] will entail a monthly electricity bill of P27.48, about half to one percent of the incomes of households currently consuming 20 kWh or less a month[13].

The simulation results, given in Appendix Table I.4.11, illustrate the incidence of undercoverage and leakages in the lifeline pricing structure. The twin problems of undercoverage and leakages are commonly found in social amelioration programs. Narrowly defining the beneficiaries lowers the cost of the targeted intervention. This may result, though, in *undercoverage*, which refers to the possibility that some legitimate target beneficiaries may fail to secure the benefit, owing to too-stringent qualifications. *Leakage* refers to the possibility that benefits may be partly captured by a nontarget group.

The assumed lifeline pricing structure will cover about 1.3 million or 14 percent of household connections, including some current minimum billers. Electricity consumption in kWh increases by an average of 52 percent for these households, yielding an aggregate welfare gain of P1.1 billion. Setting the threshold level at 20 kWh a month implies that less than 50 percent of poor households will benefit from the lifeline rates. The distribution of household beneficiaries is given in Table 10.

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[11] Note that this subsample includes both poor and nonpoor households.

[12] The average residential rate, post-EAC, IC and after the 30-centavo reduction, in year 2000 is P4.58 per kWh for poor households. See appendix Table I.4.4.

[13] The average budget share of electricity for poor households is 1.2 percent, less than half that of the general household population.

Table 10
Number of Households with Monthly Consumption of 20 kWh or Less

Region	No. of Households		
	Nonpoor	Poor	Total
Luzon			
Non-Meralco	302,635	300,496	603,131
Meralco	9,410	21,849	31,258
Visayas	217,497	167,408	384,905
Mindanao	127,744	187,407	315,151
Philippines	657,286	677,159	1,334,445
Welfare gain (pesos)	526,512,326	536,046,765	1,062,559,091

The lifeline pricing also subsidizes some nonpoor households, hence, constituting the "leakage". Forty-nine percent or about half of the household beneficiaries is nonpoor. As the subsidized consumption ceiling is raised, the proportion of the poor covered will increase, but so will the nonpoor coverage. It is expected that as the ceiling on subsidized consumption is raised and consequently the coverage of the poor increased, the proportion of the subsidy going to the nonpoor households will tend to exceed the benefits accruing to the poor. This result may bring into question the use of observed electricity consumption in identifying and targeting subsidies to the poor. There are indications that electricity consumption may be a poor proxy for income.

About half of the welfare gains also accrue to nonpoor households, though a caveat can be offered that the social welfare weights of the poor should be greater than those of the nonpoor. Following this line of reasoning, a peso gain for a poor household is worth more than a peso gain for a nonpoor household. At an average lifeline rate of P1.40 per kWh and subsidized aggregate residential consumption of 320 GWh, the financial value of the subsidy is approximately P1.04 billion, about the same magnitude as the aggregate welfare gains from the lifeline pricing. The actual cost of the lifeline-pricing scheme should include the administrative cost of implementing the program.

The lifeline pricing scheme, an income redistribution measure, should be financed by the national government rather than through internal cross-subsidies at the utility level. In this case, the local utilities should be compensated for the discount given to those given the lifeline rates. Financing at the utility level will hamper retail competition and will put at a disadvantage utilities with a larger proportion of small electricity consumers. Alternatively, the national government may require the NPC to finance the lifeline pricing in exchange for its absorption of some of the NPC liabilities. Equivalently, the cost of financing may be passed on to the smaller population of electricity rate-payers in a more transparent way through the EIRC, under ERB regulation, instead of passing the cost to the general taxpayer as in the case of national government financing.

In practice, the lifeline-pricing scheme must also be reconciled with the system of minimum billing now in place for most utilities. The lifeline tariff policy must also be supplemented by programs to improve and make less costly the access of poor households to electricity supply. The electricity access rate among poor households is 40.4 percent, much lower than the national average of 70.4 percent. Such programs include subsidized house connections for the poor and other missionary electrification programs.

Section 8
Effects of Power Sector Reform: A General Equilibrium Approach

Introduction

The previous section reported the effects of power sector reform on residential users when changes in the production sector are ignored. However, the production sector can be expected to respond positively to the significant reduction in their electricity prices as cross-subsidies are removed and as the power sector improves its efficiency. In this sense, the welfare gains obtained from the partial equilibrium analysis may be considered as the lower bound of the total potential gains from the reform. Alternatively, one may view the partial equilibrium outcomes as immediate and temporary since it is reasonable to expect that consumers' expenditure patterns are more flexible than producers'. Given the adjustment lags in the production sector, the outcomes suggested by the partial equilibrium analysis can happen but only briefly. Thus, a general equilibrium analysis that considers the responses of both consumers and producers is appropriate.

A computable general equilibrium (CGE) model captures the interaction of the producing and consuming sectors in the economy. The adjustments in power prices induced by the restructuring are expected to bear on consumption and production not only of power, but also of other goods. A CGE model integrates the direct effects of electricity price changes on consumption, and the indirect effects on the capital and labor markets through changes in production. In addition, a CGE model provides indication on movements of key macroeconomic variables such as gross domestic product (GDP), income distribution, trade balance and government budget. Nonetheless, while a CGE model can give fuller account of the effects of reform, the model is designed primarily to describe the direction of changes in economic variables at the macro level. Thus, a CGE model complements the partial equilibrium model that is more suitable in analyzing welfare changes at disaggregated levels.

In the foregoing, results of the simulation exercises using a CGE model are presented. A CGE model is constructed to address two major policy issues that arise with power sector reform. The first is whether the removal of cross-subsidies is on net, welfare enhancing to various consumer classes. If consumers face unsubsidized electricity prices, which are generally higher than current rates, are lower prices of commodities (due to lower electricity prices to producers) and increases in factor incomes sufficient compensation for their immediate losses? A second issue is the choice of scheme to finance stranded costs. Until the stranded costs are fully paid for, electricity prices are prevented from falling to competitive levels, *i.e.,* at the long-run marginal costs. One scenario would have the government fully absorb the losses and liabilities of the National Power Corporation (NPC), thereby allowing consumers to benefit from distortion-free power rates. There are indications however that the government is only willing to partially assume the stranded cost. The alternative scenario therefore is for some of the burden to be passed on to consumers through a universal levy or the so-called "Electricity Industry Reform Charge (EIRC)" stipulated in the proposed power sector reform bill. In the latter, the electricity prices to consumers are adjusted according to some burden-sharing arrangement with the government.

The simulation results provide a strong case for the removal of cross-subsidies. It is found that lowering electricity charges to producers stimulates expansion in production and factor employment. Thus despite having to face higher electricity prices, residential users benefit from the reform because of increases in their incomes. The economic gains are reflected in the positive changes in macroeconomic variables, such as GDP, labor employment and capital utilization. The results also suggest that the growth of the production sector would create sufficient additional revenues for the government, which can be used to spare consumers from taking up the burden of financing the stranded cost. This suggests that consumer levies may not be necessary, and that the option of government absorbing NPC's liabilities in full and servicing the same through general taxation, is worth considering.

Basic Structure of the Model[1]

The analytical framework is that of a small economy (*i.e.,* a price taker in the world market) with six production sectors and twelve consumer groups. The parameters of the model are calibrated to approximate the economy in 1997, before the Asian crisis made a major dent on the economic structure. The results of the simulation performed on this model can be interpreted as the likely effects of the power sector reform on the economy had the financial crisis been averted. This approach isolates the effects of the power sector reform from other crisis-induced changes in the economy.

A social accounting matrix is constructed for the benchmark year 1997 to describe the equilibrium interaction of consumers, producers, government and external sector. The starting point in generating this matrix is the 1994 input-output (IO) table, the latest survey available. The IO data was updated using National Income Accounts for 1997. Moreover, the IO data was expanded to incorporate the demand and incomes of household groups consistent with production side accounts and with the expenditure and income patterns found in the 1997 Family Income and Expenditure Survey (FIES). Taxes paid on incomes and goods by households and firms were imputed using published tax rates.

Consumer preferences are modeled as Cobb-Douglas over four commodities, namely: food, durables, electricity, and other goods. Consumers derive their incomes from labor and capital services, and receive transfer payments from the government. All savings come from consumers and are invested in producer goods.

The production function for each of the six producing units, namely: agriculture, consumer goods manufacturing, intermediate goods manufacturing, capital goods manufacturing, services, and electricity, describes a fixed-proportion or Leontief technology of combining intermediate inputs and valued added. The value added is a Cobb-Douglas function of capital and labor inputs. Intermediate inputs are also represented by Cobb-Douglas functions of domestic and imported inputs. The outputs of the six producing units are combined to produce the four consumer commodities. A linking matrix based on the FIES and the input-output data was constructed to establish this relationship.

The country's exports and imports adjust with movements in exchange rate and world prices. Consistent with the assumptions of a small country and absence of trade barriers (except for tariffs on imports), prices of domestic goods move with exchange rates and world prices. Government expenditures on the outputs of the six producing sectors are exogenously determined. Revenues to cover for these expenditures come from taxes on income, consumer goods, domestic inputs and imports.

Unemployment in the labor and capital markets are assumed to exist in the benchmark year. Hence, output expansion, spurred by increases in demand, can be accommodated without raising factor prices.

With these assumptions, the only perturbations considered in the model are the adjustments in electricity prices and corollary changes in government outlays as the national government absorbs the liabilities of NPC.

[1] The technical specification of the model is presented in Appendix J.1.

Simulation Scenarios

The first phase in the power-sector restructuring program entails the elimination of cross-subsidies. The subsidies are of two types: the economic assistance charge (EAC) which is mainly an inter-grid subsidy that flows from the Luzon grid to the Visayas and Mindanao grids; and an inter-class subsidy that flows from commercial and industrial users to residential users. When these subsidies are removed, the electricity charges to residential users are expected to increase; conversely, electricity prices to producers are likely to fall. In the second phase, the pressures of market competition are expected to drive electricity prices toward long-run marginal costs (LRMCs). However, a universal levy of P0.30 per kWh is being considered to finance the stranded costs of NPC.

Until the benefits of market competition are realized, prices to residential consumers will remain higher than pre-reform levels. Two mitigation mechanisms are considered. As described in Section 7, one scheme is a P0.30 per kWh discount to residential consumers after the subsidies have been removed. Another is a lifeline rate, *i.e.,* a 70% discount from the regular bill, given to households whose electricity consumption does not exceed 20 kWh per month.

Simulation exercises are performed under the same scenarios considered in the partial equilibrium analysis. In the transition, subsidies are to be removed in two stages: EACs being eliminated ahead of inter-class subsidies. The mitigation mechanisms may also be applied in stages: the P0.30 discount being implemented ahead of lifeline rates. The P0.30 discount is contingent on the government absorbing P200 billion (P167 billion in 1997 prices) of NPC's liabilities. It is assumed that this amount will be serviced through an issuance of a perpetual bond bearing 12% interest. Thus, the annual budgetary requirement to the government for servicing NPC's liabilities is P24 billion (P20.03 billion in 1997 prices).

Based on NPC's calculations, some P152 billion in liabilities will remain with NPC after the government's absorption and sale of assets. This amount may be passed on to consumers in the form of a universal levy. Hence, in the post-reform period, *i.e.,* when power markets become competitive, a P0.30 per kWh universal levy will be added to LRMC prices.

Actual prices to residential consumers vary depending on the distribution franchise area. The consumer groups in the model are defined geographically and by income class. Consequently, there are several franchise areas within consumer groups, except for the Luzon Meralco groups. The electricity price used for each consumer group is an average price faced by households belonging to the group. The model, however, does not distinguish producers by their geographical location. Instead, for simplicity, a single electricity price is applied, which is a weighted national average of industrial, commercial and residential electricity prices.[2] Table 1 shows the price changes under different scenarios, using year 2000 electricity prices as base year prices.

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[2] Residential rates are included in the weighted average price that applies to producing units to account for the presence of small manufacturers/producers and the informal sector. The weights applied are 40% each for industrial and commercial rates and 20% for residential rates.

Table 1
Changes in Electricity Prices
(% change from 2000 prices)

	Post-EAC	Post-EAC, IC	(Post-EAC, IC) – 0.30	LRMC + 0.30
Consumers				
Luzon				
20 kWh or less per month				
Non-Meralco	2.10	2.24	-3.60	-20.67
Meralco	-5.26	19.89	11.43	-0.22
More than 20 kwh per month				
Non-Meralco				
Non-poor	1.53	1.74	-4.41	-20.72
Poor	1.53	1.66	-4.39	-20.82
Meralco				
Non-poor	-3.85	14.52	8.35	-27.15
Poor	-4.29	16.18	9.30	-18.80
Visayas				
20 kWh or less per month	16.05	16.53	10.00	-8.51
More than 20 kwh per month				
Non-poor	15.52	18.61	11.87	-8.96
Poor	15.67	17.19	10.65	-9.98
Mindanao				
20 kWh or less per month	25.83	26.03	17.14	48.27
More than 20 kwh per month				
Non-poor	22.47	27.03	17.83	43.82
Poor	24.01	25.90	16.89	44.40
Producers*	0.45	-10.41	-10.41	-20.06

*Weighted average of commercial, industrial and residential rates. One-fifth of total kWh sales to the production sector is assumed to be priced at residential rates.

Transition Period: Elimination of Cross-Subsidies

The welfare effects are measured by the compensating variation (CV) in income, defined as the additional income required by consumers to maintain their old utility levels at new prices. A negative CV indicates that consumers gain at new prices[3]. This amount is also the theoretical income that can be taken from consumers without diminishing their welfare before the reform. Conversely, a positive CV indicates that consumers are worse off at new prices and the amount is the compensation required to restore consumers welfare at pre-reform level.

Table 2 presents the welfare effects on residential consumers during the transition period. Four scenarios are reported. The largest gains from the removal of inter-grid and intra-grid subsidies and the implementation of mitigating mechanisms accrue to the Meralco households, who also absorb the biggest losses from the removal of interclass subsidies. Similar findings are reported in the partial equilibrium analysis.

[3] For ease of interpretation, the indexing of gains (+) and losses (-) adopted in this study is opposite that of the conventional theoretical interpretation of the CV.

Table 2
Welfare Effects on Households in the Transition Period:
Compensating Variation-Based Measure
(In million pesos at 2000 prices, % of CV-based measure to base year's income)

	Without Mitigation		With Mitigation	
Consumer Group	**Post-EAC**	**Post-EAC, IC**	**(Post-EAC, IC) - 0.30**	**(Post-EAC, IC) - 0.30 + lifeline rates**
Luzon				
20 kWh or less per month				
Non-Meralco	-17	-7	414	1,026
	(0.06)	(0.02)	(1.17)	(2.90)
Meralco	1	-3	13	46
	(0.07)	(0.29)	(0.96)	(3.33)
More than 20 kWh per month				
Non-Meralco				
Non-poor	-132	-55	2,923	3,126
	(0.05)	(0.02)	(0.97)	(1.04)
Poor	-28	-23	468	501
	(0.12)	(0.10)	(1.61)	(1.72)
Meralco				
Non-poor	409	-1,795	5,538	6,072
	(0.07)	(0.31)	(0.81)	(0.89)
Poor	23	-70	305	333
	(0.12)	(0.37)	(1.35)	(1.47)
Visayas				
20 kWh or less per month	-30	-24	243	551
	(0.18)	(0.14)	(1.20)	(2.73)
More than 20 kWh per month				
Non-poor	-379	-384	1,026	1,130
	(0.30)	(0.31)	(0.69)	(0.76)
Poor	-29	-29	125	136
	(0.35)	(0.36)	(1.27)	(1.38)
Mindanao				
20 kWh or less per month	-31	-27	160	385
	(0.24)	(0.20)	(1.01)	(2.43)
More than 20 kWh per month				
Non-poor	-419	-447	1,163	1,280
	(0.32)	(0.34)	(0.74)	(0.81)
Poor	-79	-70	141	158
	(0.54)	(0.48)	(0.80)	(0.89)
Net Gain (loss)	**-854**	**-3,516**	**12,520**	**14,745**
	(0.06)	**(0.24)**	**(0.88)**	**(1.05)**

Note: A positive value denotes a welfare gain; a negative value denotes a welfare loss.

When EACs are removed sans mitigation, all residential consumer groups except those in the Meralco franchise area, are expected to lose. This stems from the fact that only Meralco customers will experience rate reduction, whereas electricity rates in Visayas and Mindanao will rise[4]. It will be recalled that EACs are mainly intergrid subsidies, with the Luzon grid subsidizing the Visayas and the Mindanao grids. The net loss amounts to P854 million, less than the P1 billion loss reported in the partial equilibrium analysis. The difference can be attributed to increases in the disposable incomes of Meralco subscribers that have feedback to the rest of the economy. Thus, the gains to Meralco subscribers dampen the losses of other consumer groups as well as of the production sector whose electricity rate increases slightly by 0.45 percent.

The simultaneous removal of inter-class and inter-grid subsidies, however, will raise the electricity prices faced by all residential groups. Despite the reduction in producers' electricity prices by 10.41 percent, all consumer groups will experience welfare losses amounting to P3.5 billion. This amount is again less than the P5.7 billion losses reported in the partial equilibrium analysis due to the positive impact of the price adjustment on the production sector.

Gains accrue to all consumer groups when mitigating mechanisms are introduced. The total welfare gain for households is P12.5 billion when a P0.30 per kWh discount is applied, and P14.7 billion when lifeline rates are also introduced. The mitigating mechanisms soften the rate adjustments to residential users significantly; the weighted average increase in residential rates is 7 percent with mitigation, and 14 percent without the P0.30 per kWh reduction.

The comparable welfare effects of the elimination of cross-subsidies in the partial equilibrium analysis are P2.9 billion loss with a P0.30 per kWh discount, and P1.8 billion loss when the discount is coupled with lifeline rates. What accounts for the huge difference? First, the reprieve given to consumers by the mitigating schemes stimulate demand for other goods, thus the adjustments in the production sector are larger as producers not only face lower electricity prices but also greater consumer demand. Second, increased production activities lead to greater employment of labor and capital, thus higher household incomes and expenditure. Third, the use of mitigating schemes is made feasible by the government's payment of some NPC liabilities, equivalent to P24 billion annually. This is akin to the government pumping such amount to the economy through the NPC[5]. Hence, the partial equilibrium losses are compensated by the adjustments in the production sector through increased demand for goods other than electricity, higher household incomes, and the multiplier effect of additional government spending.

Some redistributive pattern can be discerned from the reported welfare gains when the mitigating schemes are used. Although the welfare gains are smaller in absolute scale for poor than for nonpoor groups, the converse is true when reckoned relative to their income levels. For example, when the P0.30 per kWh discount and lifeline rates are implemented, the welfare gain of the poor in the Meralco franchise area is P333 million, representing a mere 5 percent of the welfare gain of the nonpoor which is P6 billion. But the welfare gain of the poor represents 1.47 percent of their base year income, while the welfare gain of the nonpoor is 0.89 percent of their income.

Clearly, mitigating mechanisms are called for in the transition period when distortions in electricity prices are removed. The mitigation allows all consumers groups to benefit from the reform despite upward adjustments in residential electricity rates. The provision of lifeline rates adds significantly to the gains realized from a P0.30 per kWh discount. The gains are derived from the expansion in production which raises factor utilization, both labor and capital, and hence, incomes to households. Production expands because local goods become competitive against foreign produce as the price of electricity declines with

[4] Another way of viewing this price change is that current inter-grid and intra-grid subsidies are mostly borne or paid by Meralco subscribers.

[5] Note that it is assumed that in the transition period, the electricity prices are based on the "current" NPC rates with cross-subsidies removed and competition has not set in to reduce basic rates to the level of long-run marginal cost.

the elimination of inter-class subsidies. Accordingly, the changes in outputs, reflected in Table 3, show that the most significant expansion is in the capital goods manufacturing sector, which includes the electronics sector that accounts for about two-thirds of total exports.

Table 3
Effects on Producers in the Transition Period: Changes in Output
(% change from base year's output)

	Without Mitigation		With Mitigation	
	Post-EAC	**Post -EAC, IC**	**(Post-EAC, IC) -0.30**	**(Post-EAC, IC) - 0.30 + lifeline rate**
Agriculture	-0.05	0.44	1.54	1.63
Consumer goods mfg	-0.04	0.32	1.32	1.41
Intermediate goods mfg	-0.08	0.39	1.26	1.47
Capital goods mfg	-0.09	1.54	2.17	2.23
Services	-0.05	0.41	1.32	1.41
Electricity	-0.53	-3.04	-0.53	2.05

The macroeconomic indicators, shown in Table 4, mirror these changes in production. Positive and significant increases in GDP, employment and capital utilization are registered after mitigating mechanisms have been introduced. Trade balance improves as the competitiveness of exports (due to lower input price of electricity) is enhanced, and some of imports are replaced by local goods. But a larger tax base, occasioned by the expansion in output, is insufficient to cover the government's annual payment of P24 billion in NPC's liabilities; the government budget balance deteriorates as a result.

Table 4
Effects on the Macroeconomy in the Transition Period
(% change from base year's level)

	Without Mitigation		With Mitigation	
	Post-EAC	**Post-EAC, IC**	**(Post-EAC, IC) -0.30**	**(Post-EAC, IC) –0.30 + lifeline rate**
GDP	-0.05	0.04	1.85	1.99
Employment	-0.06	0.40	1.38	1.52
Capital utilization	-0.07	0.32	1.32	1.50
Govt. budget balance	-1.39	1.35	-15.68	-11.21
Trade balance	0.0002	9.59	3.06	1.50
Gini coefficient	-0.001	0.004	0.011	0.012

Since this is only a transition period and a different condition can be expected post-reform, one may choose to ignore the adverse impact on the government budget. However, considering the magnitude of current government budget deficits and the announced goal of the present government to achieve a balanced budget, it may well be prudent to consider some options to avert the negative impact. Two of these options, adjustments in value-added and income taxes, are explored in Appendix J.2.

Finally, the marginal increases in Gini coefficients, indicating slight deterioration in income distribution, are to be anticipated when price subsidies are eliminated. Yet even the introduction of lifeline rates is not sufficient to improve equity since 49 percent of households consuming not more than 20 kWh per month have incomes that qualify them as nonpoor. Nonetheless the very small changes in the income distribution index suggest that the trade-off between efficiency and equity should not be an issue when implementing the power-sector reform program.

Post-Reform Period: Competition in the Power Sector

The advent of competition in the power sector can only be expected to amplify the gains already achieved in the transition. As noted, the big push in economic activity comes from the lower electricity prices to production units. When competition kicks in, the electricity prices faced by producers will be reduced further; their long-run electricity prices are estimated to be 20 percent lower than year 2000 levels. In addition, consumer groups, except those in Mindanao, will also be favored by lower residential rates as indicated in Table 1. Long-run residential rates are 16 percent less than year 2000 prices.

Table 5 presents the effects on residential consumers in the post-reform period. The welfare gains amount to P28.6 billion, almost four-fold the reported long-run gains of P7.3 billion in the partial equilibrium analysis. As in the transition, the gains are magnified in the general equilibrium by the response of the production sector to lower electricity input price and greater consumer demand.

It is significant to note that Mindanao consumers are able to partake in the boom notwithstanding the increases in their electricity prices. Their welfare gain is P1.85 billion, to be realized through higher incomes and more employment opportunities.

Table 5
Welfare Effects on Households during Post-Reform Period:
Compensating Variation-Based Measure
(In million pesos at 2000 prices, % of CV-based measure to base year's income)

	LRMC + 0.30	
Consumer Group	**Welfare gain (in million pesos at 2000 prices)**	**% of welfare gain to base year's income**
Luzon		
20 kWh or less per month		
Non-Meralco	714	2.02
Meralco	26	1.86
More than 20 kWh per month		
Non-Meralco		
Non-poor	5,466	1.82
Poor	828	2.85
Meralco		
Non-poor	16,029	2.34
Poor	694	3.06
Visayas		
20 kWh or less per month	421	2.08
More than 20 kWh per month		
Non-poor	2,369	1.59

Poor	247	2.50
Mindanao		
20 kWh or less per month	211	1.33
More than 20 kWh per month		
Non-poor	1,464	0.93
Poor	178	1.00
Net Gain	**28,646**	**1.97**

The growth pattern in the production sector, presented in Table 6, differs slightly from the pattern found in the transition. Post-reform, the electricity sector will grow fastest as the general rate reduction stimulates electricity demand. But among non-utility industry groups, the capital goods manufacturing sector is again expected to register the biggest growth.

Table 6
Post-Reform Effects on Producers: Changes in Output
(% change from base year's output)

	LRMC + 0.30
Agriculture	2.78
Consumer goods mfg	2.32
Intermediate goods mfg	3.04
Capital goods mfg	4.74
Services	2.48
Electricity	9.38

Finally, as shown in Table 7, the potential growth in GDP upon completion of reforms is 2.85 percent. Except for income distribution, all macroeconomic indicators are expected to improve including the government budget balance. Unlike in the transition period, the economic expansion in the post-reform period is of a magnitude sufficient to enlarge the tax base and raise revenues for the government to cover its absorption of NPC's liabilities.

Table 7
Post Reform Impact on the Macroeconomy
(% change from base year's level)

	LRMC + 0.30
GDP	2.85
Employment	2.79
Capital uilization	2.86
Government budget balance	16.73
Trade balance	7.74
Gini coefficient	0.023

Financing Stranded Costs

If sufficient tax revenues can be raised in the post-reform period to cover the government absorption of P200 billion of NPC's liabilities, an issue that can be raised is whether ratepayers should contribute to financing stranded costs through payment of a universal levy. The possibility arises for the government to assume in full the liabilities of NPC. Which of these options yield the largest benefits to the economy?

Can the government be made to assume in full the liabilities of NPC without creating a budget deficit debacle? If it were possible, then consumers and producers can benefit from lower electricity prices. Specifically, without the levy, electricity prices to producers will be reduced by as much as 27 percent, instead of 20 percent. The same can be said about residential electricity prices in Luzon and Visayas, which may fall from current levels up to 33 percent, instead of 27 percent. The rate increases to residents in Mindanao are also smaller; the maximum increase is 39 percent, instead of 48 percent, for households with consumption of no more than 20 kWh per month. But to realize these adjustments in electricity prices, the government has to shoulder additional annual transfers to the electricity sector of P18.2 billion (P15.2 billion in 1997 prices). This amount is equivalent to NPC's net stranded costs of P152 billion, serviced through a perpetual bond carrying 12% interest.

The simulation results of full government absorption are juxtaposed in Table 8 with those imposing a universal levy of P0.30 per kWh. Welfare gains under the scenario of full government absorption are 54 percent higher than the gains obtained with the universal levy. The growth rates in GDP, employment and capital utilization are also higher with full government absorption of the NPC's liabilities. The government budget balance will still improve by 9 percent from base period level. This implies that even with full government absorption of NPC's liabilities, the economic growth spurred by the reform will be sufficient to enlarge the tax base and raise revenues for the government to cover the additional P18.2 billion annual transfers. Clearly, there is a case for government's absorption of NPC's debts to free the electricity market of its past baggage.

Table 8
Post-Reform Effects under Different Financing Strategies of Stranded Costs
(% change from base year's level except for CV)

	Universal levy: P0.30 per kWh	Full gov't absorption
Welfare gain (*million pesos*)	28,646	44,173
GDP	2.85	4.50
Employment	2.79	4.10
Capital utilization	2.86	4.20
Govt. budget balance	16.73	9.26
Trade balance	7.74	7.34
Gini coefficient	0.023	0.033

Sensitivity Analysis

In the preceding exercises, the own-price elasticities of supply of exports and demand for imports are assumed lower in the transition than in the post-reform. Lower price elasticities in the transition imply than when electricity prices are reduced and hence local goods become more competitive vis-a-vis foreign goods, the anticipated expansion in export supply and substitution of local goods for imports are more limited in the short run than in the long run. This assumption embodies the belief that there can be lags in the responses of export supply and import demand to changes in input prices.

Indeed, the results of the model are sensitive to the elasticity assumption. The power sector reform has greater potential to boost production when export supply and import demand are more price-elastic. Support to this claim is given in Table 9 that demonstrates the effects of the reform on consumers and the macroeconomy under varying assumptions on trade elasticities. As may be expected, the economic gains are larger when export supply and import demand are more responsive to price changes. This may happen when there are fewer export supply constraints, hence production is more flexible and can easily respond to price incentives. One may argue that the presence of unemployment in the factor markets, as assumed in the model, should have merited an assumption of production flexibility, hence elastic export supply and import demand. Yet there are other constraints such as technology, mismatch of factor demand and supply, and difficulty of penetrating the export market that can prevent production from responding to price incentives. If there were fewer of these constraints, then there could be more basis for optimism on the welfare and output effects of the reform.

Table 9
Effects of the Power Sector Reform under Different Assumptions on Trade Elasticities
(% change from base year's level except for welfare gain)

	Inelastic**		**Unitary Elastic**		**Elastic**	
	Transition*	**Post-reform**	**Transition***	**Post-reform**	**Transition***	**Post-reform**
	$\theta = .7; \eta = -.7$	$\theta = .9; \eta = -.9$	$\theta=.8;\eta=-.8$	$\theta = 1; \eta = -1$	$\theta=1.2;\eta=-1.2$	$\theta=1.4;\eta=-1.4$
Welfare gain (*million pesos*)	12,520	28,646	13,451	30,365	17,067	37,075
GDP	1.85	2.85	1.97	3.07	2.43	3.92
Employment	1.38	2.79	1.51	3.04	2.03	3.99
Capital utilization	1.32	2.86	1.45	3.09	1.95	4.02
Govt. budget balance	-15.68	16.73	-12.74	24.04	0.66	59.15
Trade balance	3.06	7.74	3.97	9.44	7.64	16.38
Gini coefficient	0.011	0.023	0.012	0.025	0.016	0.032

*Post-EAC, IC less P0.30 discount.
**Results earlier reported in this section assumes this scenario for the export supply and import demand elasticities.
Note: θ denotes the export supply elasticity; η denotes the import demand elasticity.

Summing Up

The results of the general equilibrium simulation exercises yield decisive endorsement for the proposed power sector reform. When upward adjustments in residential electricity prices are coupled with mitigating mechanisms in the transition period, households can potentially benefit from the elimination of cross-subsidies. In the post-reform, even consumer groups in Mindanao gain despite the substantial increases in their electricity rates. However, some households within the aggregate groupings considered above may be adversely affected. The net gains are nonetheless substantial to effect the necessary transfers. Thus, the social acceptability of the power sector reform should not be imperiled by the prospects of higher electricity prices for some consumer groups.

Support is also found to recommend the government's absorption of NPC's stranded costs. The advantages of giving the electricity market a fresh clean slate should be sufficient to dismiss concerns about the possible negative impact on the government budget balance of opting for general tax, instead of universal levy, to finance stranded costs.

Significant features of the power sector restructuring program are the correction of distortions in electricity pricing due to cross-subsidies and the lowering of electricity prices towards long-run marginal costs as competition takes effect in the sector. If the power sector reform fails to deliver the expected economic benefits, blame can only be placed on external constraints that inhibit the production sector from responding to the growth stimulus laid by the reform. The general equilibrium analysis in this study highlights the importance of the response of the production sector in augmenting the gains or alleviating the losses to households yielded by the reform program.