THE POLICY OF POWER AND THE POWER OF POLICY: ENERGY POLICY IN HONDURAS

by

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ABSTRACT

Development and energy demand are synonymous. The rapid industrialisation of Latin America and the high ranking accorded to electrification projects by the region's development planners in the post-war period have combined to ensure a growing demand for energy in the region. This has led, at times, to various supply constraints resulting in excess demand. The response to the problem has been varied. Some countries, such as Mexico and Colombia, have addressed the problem by developing domestic extraction capacity. Others, such as Brazil, have experimented with alternative energy sources, most notably, ethanol. In Central America, the absence of known depletable energy resources allied to a shortage of foreign exchange has ensured an almost exclusive dependency upon hydro-electric power sources for electricity generation.

In the case of Honduras, the reliance on hydro-electricity proved costly. Environmental degradation allied to a lack of maintenance of the country's principal plant resulted in serious energy shortages in 1994/5 with electricity being rationed for up to 12 hours each day. As a direct consequence, GDP growth declined, the import bill rose due to the switch to alternative fossil fuel sources and air pollution rose due to increased generator usage.

This paper traces the evolution of energy supply and demand in Honduras, showing why the crisis of the 1990s emerged. It then forecasts future energy demand and examines the way this demand might be met. A concluding section spells out the difficult decisions small developing countries have to face in their desire to achieve economic growth without sacrificing environmental capital.

1. INTRODUCTION

The relationship between development, whether evaluated in terms of GDP/GNP per capita or through more composite measures such as the Human Development Index (HDI)[1] and per capita energy consumption is conventionally accepted as being unambiguously positive (Choucri, 1982, Szekely, 1983, Munasinghe, 1994)[2]. The development process thus entails either the growing exploitation of latent domestic energy resources or the sourcing of requirements from the international energy markets. For small, low-income and low-ranking HDI economies without proven fossil fuel reserves the scenario is particularly bleak. One such economy is Honduras, a heavily-indebted Central American country (see Figure 1) with a population of around 5½ million and a HDI ranking of 115. In focusing on Honduras this paper hopes to precipitate discussions on the energy-development dilemma faced by similar (fossil) energy deficient nations in Africa, the Caribbean and the Pacific archipelago.

The paper commences by providing an inventory of the country's currently proven energy reserves, showing how a rapidly escalating demand was historically satiated through a growing reliance upon hydro-power (for electricity generation), biomass (domestic cooking requirements) and imported fossil fuels (transport) [Section 2]. The 1990s heralded a new phase in national energy policy as economic crisis forced the government to seek external funding. The price, economic adjustment, prompted a revision of national energy strategy, although these modifications were unable to prevent serious energy shortages emerging in late 1994/early 1995. In fact, such shortages may well have hastened the de-regulation of, and liberalisation within, the sector [Section 3]. Whether these reforms will be sufficient to enable estimates of the country's likely energy demand for the period to 2005 [Section 4] to be met is a moot point and one that is discussed in our concluding remarks.

2. THE HONDURAN ENERGY POSITION PRIOR TO 1990

Inventory of Primary Honduran Energy Sources

At present there is no evidence of commercially viable hydro-carbon deposits within Honduran territory. Although sporadic drilling both onshore (18 wells) and off-shore (13 wells) since 1920 has detected the presence of either **oil** (7 wells) or **gas** (9 wells), none of the samples extracted have excited commercial interest. **Coal** deposits do exist, as evidenced by the aptly-named Montaña del *Carbon* in Yoro[3] but once again, there is little current evidence to support large-scale commercial extraction.

The picture is rather more positive on the renewable energy front. Private generating projects are presently in hand to exploit between 10-20% of the country's estimated 5,000 MW hydroelectric potential (SECPLAN, 1996). Six sites have been tentatively identified as capable of providing a potential 120 MW of **geo-thermal** energy, while the country's geographic location offers opportunities to exploit a **solar** radiation estimated at around 1900 kWh/m^2 per annum. Much less is known about the country's **wind-power** potential.

Forest stocks have traditionally supplied the bulk of the country's **bio-mass**-derived energy. This, in conjunction with commercial timber extraction (Fandell, 1994) and 'slash and burn' farming practices (Mausolff and Farber, 1995, Lindarte and Benito 1991), has put increasing pressure on this depletable resource. Forest cover dropped from 7.05 million hectares (63% of national territory) in 1961 to 3.13 million hectares (28%) by the start of the 1990s and localised wood shortages are becoming increasingly common (Thorpe, 1996b). That said, agricultural expansion has provided a number of alternative bio-mass sources, most notably **sugar cane** and **palm oil** *bagazo* - whose current potential is estimated at around 50-70MW apiece. The energy potential of other common agricultural residues such as rice and coffee-bean husks, citrus fruit peel and banana waste, however, currently remains unquantified.

Energy Supply and Policy

"The high rates of economic growth necessary to deliver improved living standards to a growing population demands *significant increases in energy supply* - at the same time, the high cost of providing this supply *can imply the transfer of large sums of money to the energy sector, transfers*

which could impose limitations upon the same economic growth" (SECPLAN, 1996:1, our italics).

An immense task faced the post-war Honduran governments. The lack of physical infrastructure - by 1965 the country could still only count upon 24 miles of paved roads (Blutstein et al, 1971) - was parallelled by the absence of any meaningful energy infrastructure. Electricity generation rested in the hands of 29 proprietors (local municipalities, two US banana companies operating on the North Coast or private entrepreneurs) and was oriented towards supplying the needs of local residents and small-scale industry. Fuel oil was imported principally through El Salvador. Realising that these arrangements seriously impeded growth prospects, the military junta, which took power in October 1956, embarked upon an ambitious programme of infrastructural investment.

In energy terms the key decision was the creation of a state electricity company, *La Empresa Nacional de Energía Eléctrica* (ENEE) in February 1957. Charged with supplying electricity at low cost, ENEE first assumed responsibility for running a small residential service in the capital previously operated by the Ministry of Development, Agriculture and Labour (Blutstein et al, 1971). It grew rapidly, swallowing up local municipal and private enterprises and, by 1970, provided between 60-70% of the country's electric power. In the following years it came to monopolise provision through the take-over of the fruit companies' electricity interests.

Fuel oil imports also became the prerogative of a single supplier. As the country's's motor fleet expanded, the country's first refinery/importer *Refinería Texaco de Honduras SA* (REFTEXSA) opened in Puerto Cortés in 1968. A year later, the 'football' war with El Salvador provided the impetus for capacity enlargement and REFTEXSA - thanks to the tariffs levied on refined fuel imports - remained the sole fuel oil importer until the 1990s.

The foreign exchange implications of an over-reliance upon imported fuel for domestic energy needs were manifestly clear to the Honduran government. Consequently, the utilisation of local energy resources was prioritised - in particular, for electricity generation. Aided by international loans, ENEE had already established a hydro-electric project (HEP) on the river Lindo, just north of lake Yojoa. Other projects followed and, by 1970, hydro-electricity accounted for just over half the country's installed capacity. The most significant of the HEP schemes was the *El Cajón* project undertaken in the early eighties. The *Cajón* dam, the sixth highest of its type in the world,

doubled the electricity output available to the manufacturing sector, albeit at a high fiscal cost[4]. The scale of the *Cajón* project also provided an opportunity for the generation of foreign exchange receipts. However, while electricity could be exported to either Nicaragua, Costa Rica or Panama through an interconnecting transmission system, the low voltage of the connection (138kV) militated against significant sales, net electricity exports peaking in 1990 at 338 GWh (UDAPE, 1994:6). By 1990, hydro-electric power had grown to account for about three quarters of installed capacity (see Table 1).

TABLE 1: HONDURAN INSTALLED GENERATING CAPACITY (KW) 1990

System	Plant	Type	Capacity	Total
GRID	Cañaveral	Hydro	28,500	
	Rio Lindo	Hydro	80,000	
	El Nispero	Hydro	22,500	
	El Cajón	Hydro	292,000	
				423,000
GRID	Puerto Cort	Diesel	60,000	
	La Ceiba	Diesel	26,600	
				86,600
GRID	La Puerta	Gas		15,000
				524,600
NON-GRID	Santa Maria	Hydro		1,200
NON-GRID	Amapala	Diesel	900	
	Catacamas	Diesel	1,840	
	Copán Ruin.	Diesel	540	
	Danlí	Diesel	2,910	
	Gracias	Diesel	310	
	Juticalpa	Diesel	2,140	
	Ocotepeque	Diesel	830	
	Sn Mar.Colon	Diesel	1,165	
	Sn Mar.Oct	Diesel	340	
	Santa Rosa	Diesel	2,375	
	Utila	Diesel	185	
	Yoro	Diesel	830	
				14,365
TOTAL INSTALLED CAPACITY				**540,165**

(Source: ENEE, 1997)

Note: Sante Fe (diesel, 5,000), San Lorenzo (diesel, 4,160) and Miraflores (gas, 13,580) were counted as part of total capacity installed until 1989. Mothballed in 1990, Sante Fe, 1994, and Miraflores, 1995, were subsequently re-opened.

The sharp reduction in international capital inflows which followed the country's blacklisting by both the IMF and World Bank in mid-1989 (Thorpe, 1996a) made domestically generated HEP an even more attractive option. Consequently, in 1990, national electricity demand was met exclusively from HEP sources. This surfeit of capacity and reliance on HEP was not to last.

Consumption

Although electricity had been introduced into the country by the administration of Policarpo Bonilla Vazquez (1894-98), consumption growth was restricted by: (i) the low degree of urbanisation and (ii) the absence of an industrial base of any significance[5]. While this began to change as the country modernised in the post-war period, by 1961 only 15% of households (57% of urban, 2% of rural households) had access to electricity. The majority relied upon either kerosene, pine torches or candles for lighting and wood or charcoal for cooking. Demand for petroleum rose as the road network expanded however and, by 1968, fuel for the country's 22 thousand registered motor vehicles already accounted for 7% of the import bill (Blutstein et al, 1971). Although recent growth in energy demand has not been quite as dramatic as the rates of 30% recorded in the immediate post-war period, it is still in marked contrast to consumption trends seen in the developed world. This is apparent from Table 2 and Figures 2-5 which summarise Honduran population, GDP and energy consumption growth over the period 1971 to 1990 compared to the UK.

TABLE 2: ENERGY AND ECONOMY STATISTICS FOR HONDURAS AND THE UK 1971-90 (% CHANGE PA)

	Population	GDP	GDP per Capita	Total Energy Consumption	Energy per capita	Energy Intensity
Honduras						
1971 - 80	3.4%	4.6%	1.2%	3.6%	0.1%	-1.0%
1980 - 90	3.3%	2.4%	-0.9%	2.6%	-0.7%	0.2%
1971 - 90	3.4%	3.5%	0.1%	3.0%	-0.3%	-0.4%
UK						
1971 - 80	0.1%	2.0%	1.9%	-0.1%	-0.2%	-2.0%
1980 - 90	0.2%	2.6%	2.4%	0.3%	0.1%	-2.3%
1971 - 90	0.2%	2.3%	2.2%	0.1%	0.0%	-2.2%

(Source: IEA, DUKES, IMF Statistics, UK National Accounts)

Figure 2: Honduras Summary

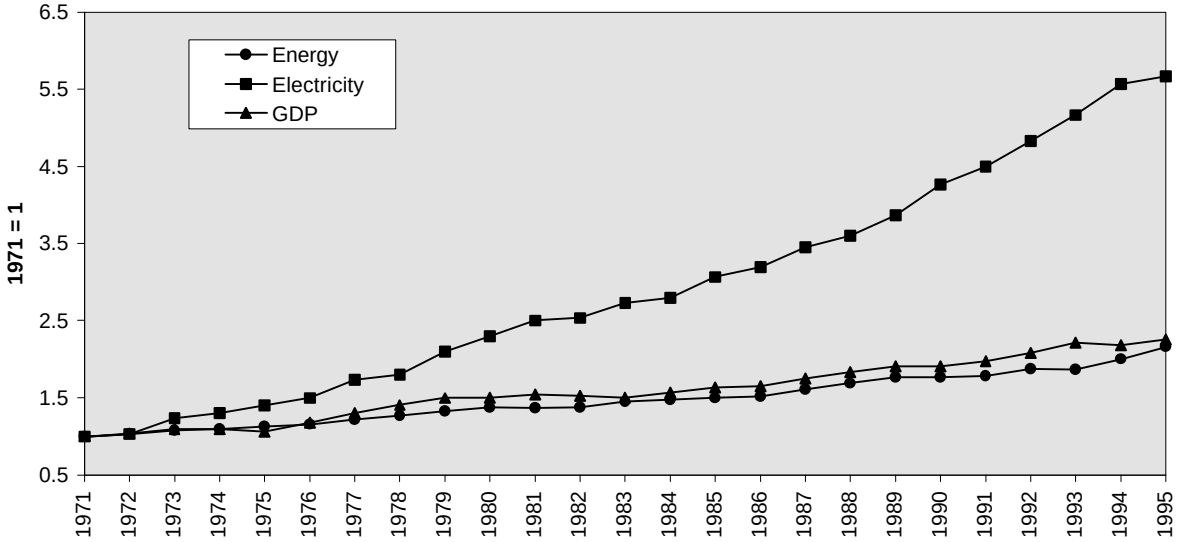


Figure 3: UK Summary

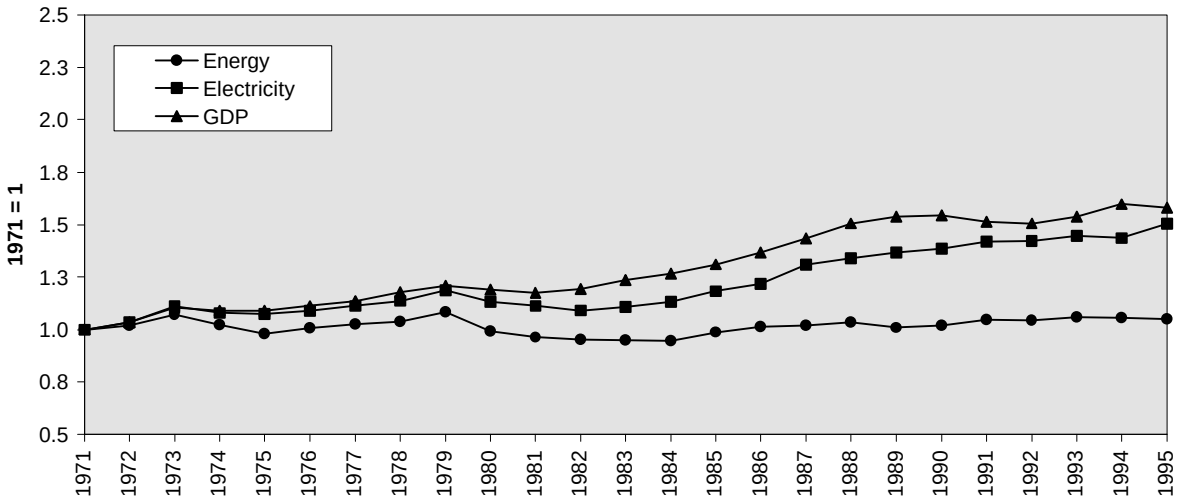


Figure 4: Honduran & UK Energy per Capita

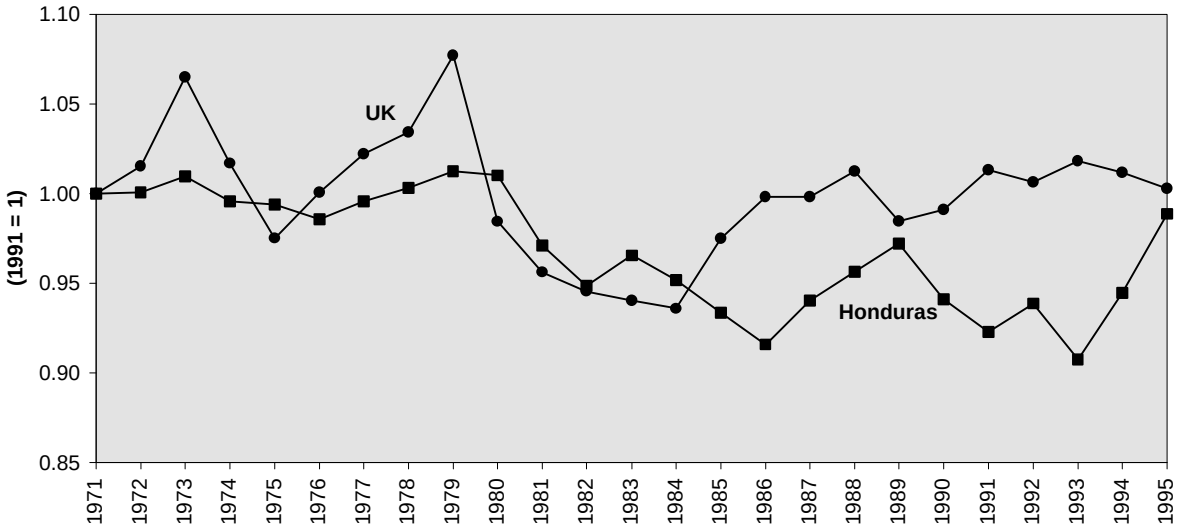
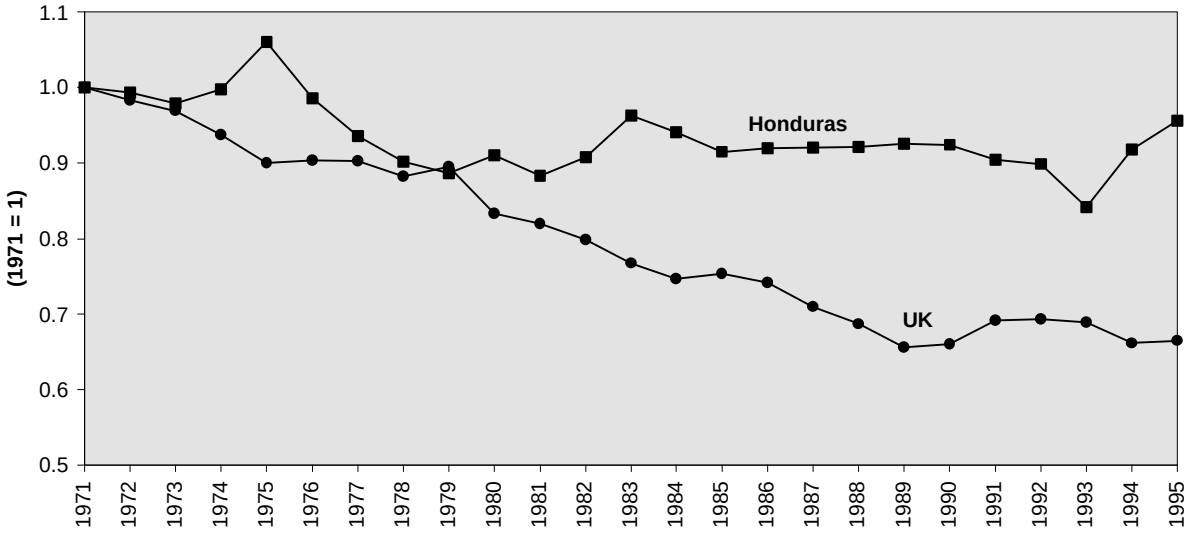


Figure 5: Honduran & UK Energy Intensity



Honduras clearly outperformed the UK on the criteria of output growth over the 1971-90 period, however the situation is reversed when population growth is taken into account. High population growth rates in Honduras saw per capita GDP decline, whereas low rates of population increase in the UK resulted in an annual improvement in GDP per capita of about 2¼% per annum over the same period. A similar story unfolds with respect to energy consumption. Honduran energy consumption grew on average by 3% per annum over this period - compared to just 0.1% per annum for the UK. However, population growth in Honduras caused per capita energy consumption to fall by 0.3% per annum, from 0.482 to 0.453 tonnes of oil equivalent (toe)[6]. In contrast, the UK decline was negligible, down from 2.567 to 2.544 toe. Honduran aggregate energy intensity (energy consumption/GDP) fell over the 1971-90 period by 0.4% per annum,

compared to the UK where intensity has fallen by about 2¼% per annum.

Table 3 summarises the growth in Honduran energy consumption for the main sectors and fuel types, where 'combustible, renewables and waste' refers largely to wood. In 1971, 75% of the country's energy needs were provided by wood, 22% by petrol and 2% by electricity (Figure 6)[7]. Despite demand for wood growing somewhat slower than electricity and petrol (Figure 7), it has remained the country's principal fuel source, accounting for 64% of final consumption in 1990. Petroleum products (30%) and electricity (6%) supplied the remainder of requirements.

Figure 6: Honduran Energy Consumption (mtoe)

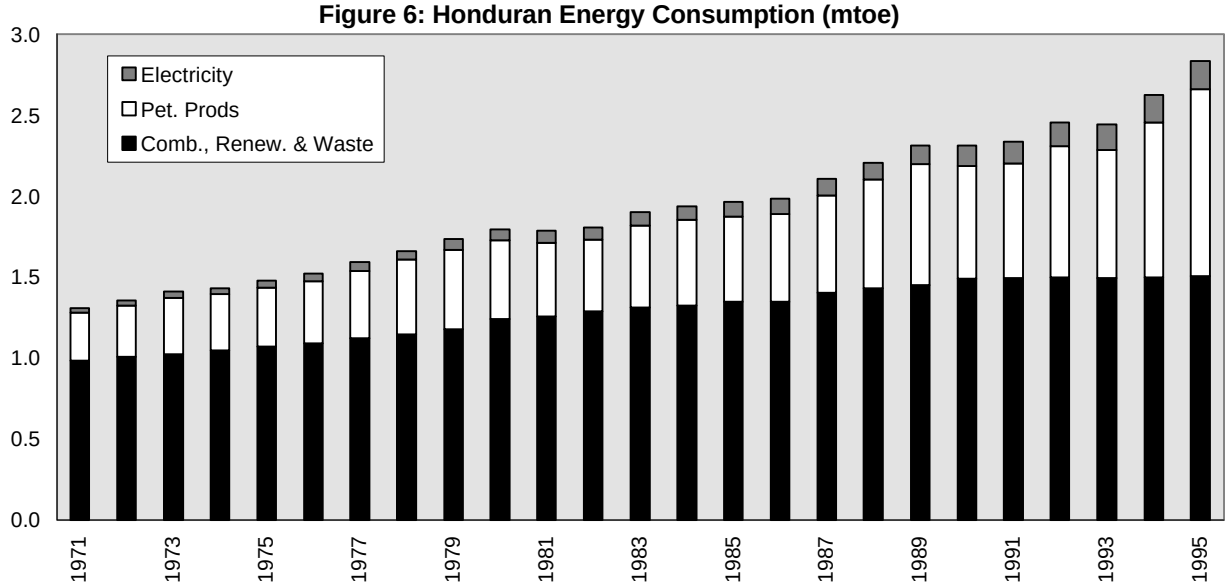


Figure 7: Honduran Energy Consumption (1971 = 1)

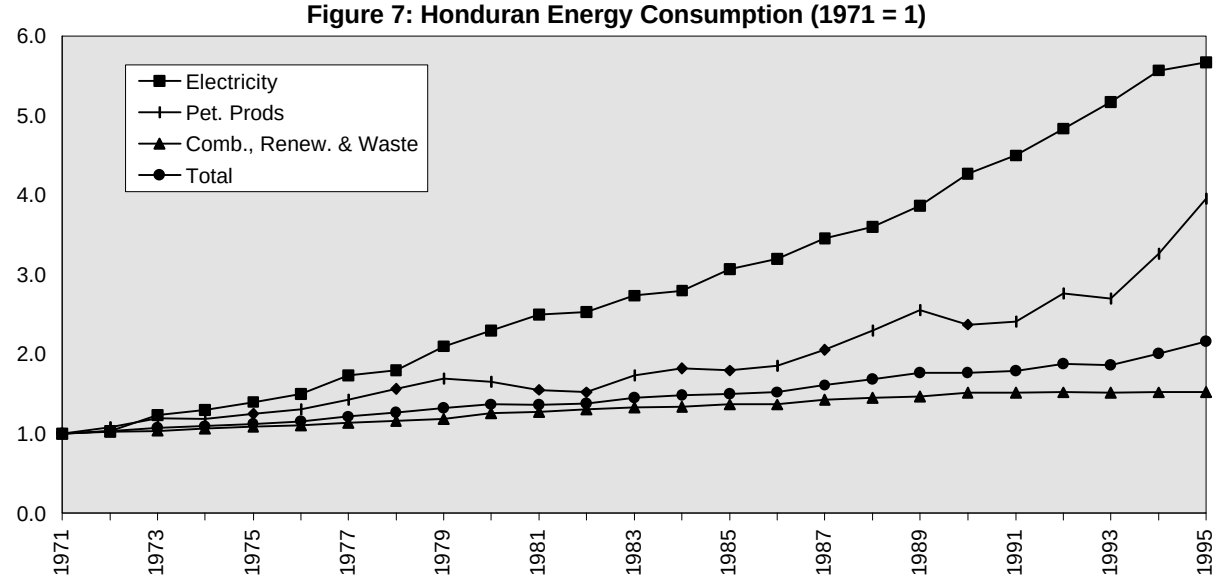


TABLE 3: HONDURAN ENERGY CONSUMPTION GROWTH 1971-90 (% CHANGE PA)				
	Electricity	**Petroleum Products**	**Combustible, Renewables & Waste**	**Total Energy Consumption**
Industrial Sector				
1971 - 80	8.4%	7.5%	6.8%	7.2%
1980 - 90	3.4%	3.4%	1.6%	2.5%
1971 - 90	5.7%	5.3%	4.0%	4.7%
Transport Sector				
1971 - 80	n/a	4.1%	n/a	4.1%
1980 - 90	n/a	2.5%	n/a	5.2%
1971 - 90	n/a	4.7%	n/a	4.7%
Residential Sector				
1971 - 80	11.9%	4.1%	1.8%	2.1%
1980 - 90	7.5%	-3.1%	1.9%	1.9%
1971 - 90	9.6%	0.3%	1.9%	2.0%
Total				
1971 - 80	9.7%	5.7%	2.6%	3.6%
1980 - 90	6.4%	3.7%	1.8%	2.6%
1971 - 90	7.9%	4.7%	2.2%	3.0%
(Source: IEA)				

Figures 8 and 9 illustrate demand growth within the main sectors of the Honduran economy. Residential demand continues to dominate, although its share has declined from 69% to 59% of total consumption over the period 1971-90. In part this was to be expected as the growing industrialisation of the Honduran economy, the number of factories increased from 634 to 3,876 between the years 1967 and 1993 (Blutstein et al, 1971:151, SECPLAN, 1995: *Cuadro* 1), saw industry's share rise from 18% to 24%. The explosion in public, private and commercial vehicle ownership - estimates suggest a 1996 automobile stock of around 300 thousand (SECPLAN, 1996) - underpinned the growth in transport share from 11% to 15%.

Figure 8: Honduran Energy Consumption (mtoe)

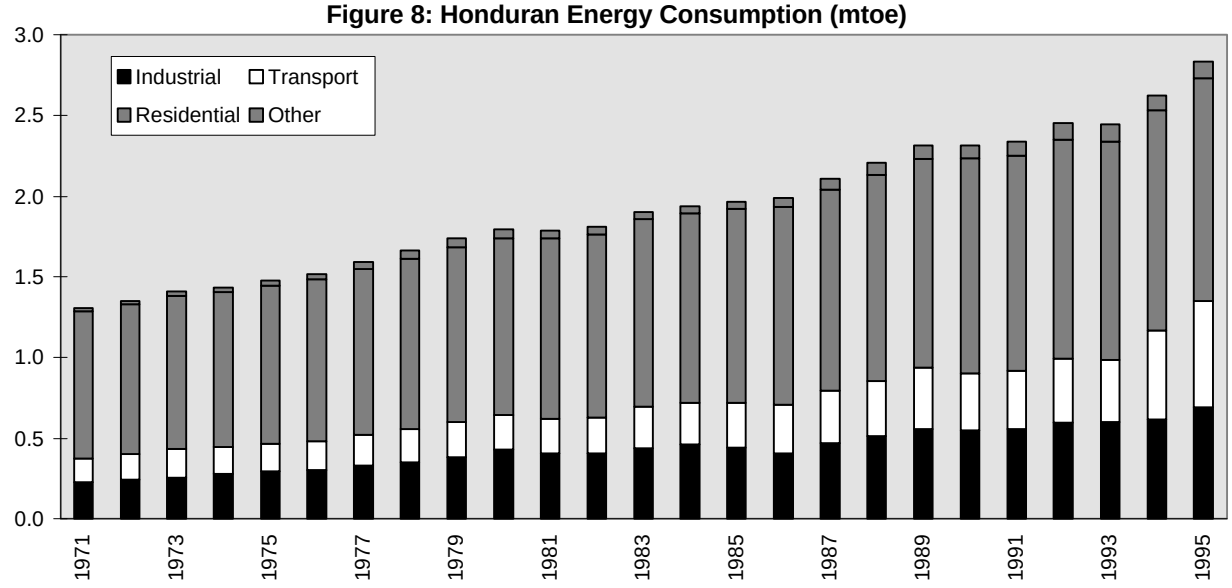
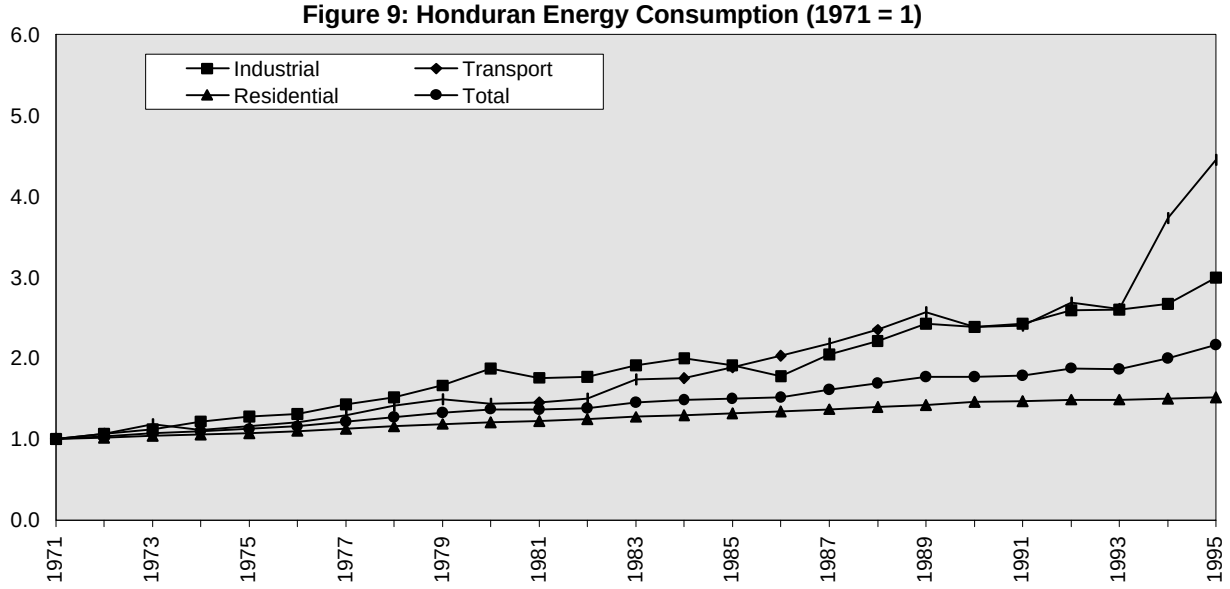
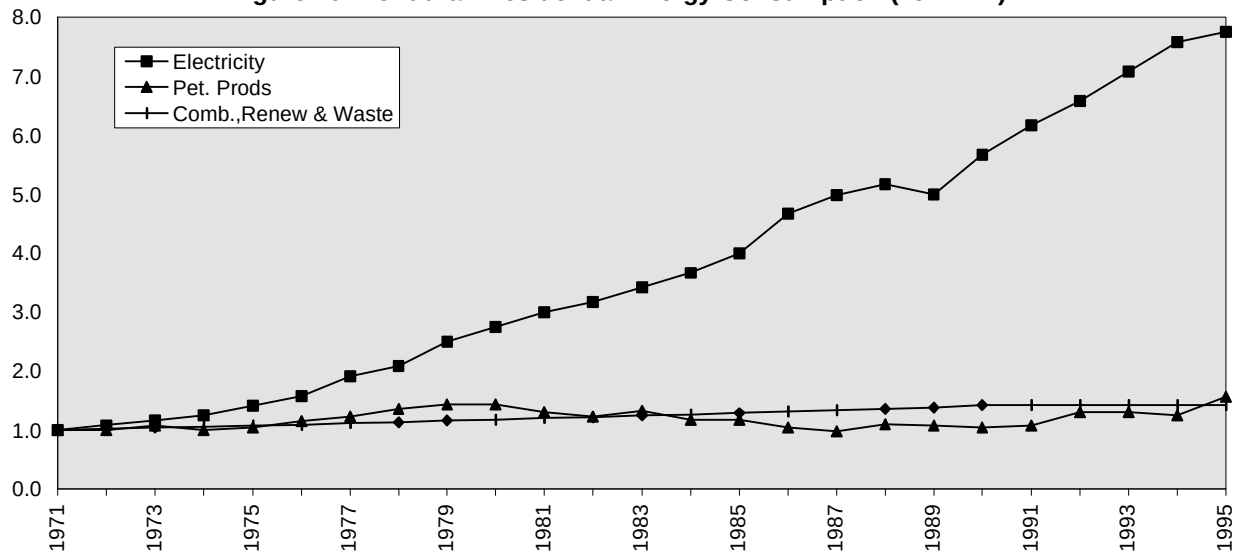


Figure 9: Honduran Energy Consumption (1971 = 1)



The residential sector is particularly interesting (Figure 10), as the marked increase in access to electricity and the substitution away from wood reflects a trend seen across the developing world. In the Honduran case, the principal factors driving this substitution have been: (i) the increasing number of households connected to the national grid - thanks to a combination of increased urbanisation and state-sponsored electrification programmes and (ii) subsidised tariffs (UDAPE, 1994). The degree of substitution has been constrained, however, by the cost of electrical appliances, in particular, electric cookers[8]. While 46.2% of households (82% of urban, 29% of rural) have access to electricity, only one in four of such households (one in six in rural regions) use it for cooking (SECPLAN, 1996). Hence, while the potential for further substitution is substantial, the actual rate of substitution - and, ultimately, the key determinant of the growth in residential energy demand remains dependent upon: (i) the cost of electrical appliances diminishing in real terms and (ii) future trends in the relative price of electricity to wood.

Figure 10: Honduran Residential Energy Consumption (1971 = 1)



3. THE 1990s: MODERNISATION AND CRISIS IN THE ENERGY SECTOR

The 1990s saw a marked change in the Honduran energy position as growing tensions forced the government to 'modernise' its sectoral policy.

Consumption

The strong growth in energy consumption continued into the 1990s (Table 4). In addition to the growth driven by population and GDP increases[9], energy consumption rose for a number of reasons. First, ENEE remained committed to develop and execute both urban and rural electrification programmes. By the end of 1994 expansion of the national grid had replaced local provision in all but the Amapala and Utila islands (Table 1). The current objective - ensuring 70% of Honduran households have access to electricity - is to be achieved through extending provision to another 143 communities across 11 departments at an estimated cost of $24 million (SECPLAN, 1996). Second, electricity over-consumption was encouraged by both ENEE's operational inefficiency and its pricing strategy. Real electricity prices fell 53% as tariff levels set in the mid-eighties remained operative. Rather belatedly, six new residential tariff bands were introduced in 1990. Operational inefficiency encouraged over-consumption in two senses. Excessive losses (25-28% of total production) through the distribution system, inadequacies in the metering system and theft[10] raised generating requirements. Inadequate payments procedures led to lengthy settlement periods[11] (GRH, 1994) and served to reduce the real cost of electricity consumption from the end-user's perspective, particularly in 1991, when inflation hit 34%.

Operational inefficiency furthermore undermined ENEE's financial solvency, losses alone costing the company 578 million lempiras (approximately US $61 million) in 1995 (UDAPE, 1995:II). Third, the exponential growth of *maquila* ('assembly' for re-export) enterprises based in newly-established industrial parks has significantly augmented manufacturing energy demands (SECPLAN, 1996). Finally, the maintenance of both direct (payments to urban transport providers) and indirect subsidies (subsidised fuel oils) to the transport sector was compounded by tariff liberalisation[12], spawning a 14% annual growth in national car ownership in the early 1990s (SECPLAN, 1996). Demand for gasoline products grew accordingly.

TABLE 4: HONDURAN ENERGY CONSUMPTION GROWTH 1990-95 (% CHANGE PA)

	Electricity	Petroleum Products	Combustible, Renewables & Waste	Total Energy Consumption
Industrial Sector	5.5%	8.5%	0.6%	4.7%
Transport Sector	n/a	13.3%	n/a	13.3%
Residential Sector	6.5%	8.3%	0.1%	0.7%
Total	5.8%	10.7%	0.2%	4.4%

(Source: IEA)

Supply and the Policy Response

Serious preoccupations over the country's ability to satisfy this growing demand began to surface in 1991. As financial constraints were imposed upon ENEE by the new Nationalist government of Rafael Callejas, investment and capacity maintenance programmes were cut back. This saw installed capacity decline by about 35MW over the period 1989-93 (Mimeo, 1995), making ENEE ever more dependent upon sourcing its energy needs from the *Cajón* complex. Energy exports dropped as *Cajón* output was switched to the internal market and, when this proved insufficient to meet domestic needs, capacity utilisation was raised from 52% to 56% (UDAPE, 1994). Increased utilisation unfortunately coincided with a series of droughts. As the *Cajón* water level dropped, energy imports from Costa Rica and Panama rose and thermal generating plants were brought back into service[13].

There was growing concern within ENEE's planning department over likely medium-term energy shortages. This resulted in a memorandum being despatched to management in June 1993 detailing the need for urgent remedial action. Unfortunately, its contents went unheeded (Mimeo, 1995). Voices favouring action on the energy front were not just limited to planners within the electricity sub-sector however. While the country's rehabilitation with the IMF and World Bank at

the start of the decade had brought new capital inflows, the price was economic reform. The new macro-economic package introduced by the Callejas government was supplemented by a series of World Bank funded sectoral reform packages intended to harmonise policy formulation and implementation. The energy sector was not excluded for, in the words of the Bank:

> "Due to the lack of either a formal sectoral policy or strategy compatible with macroeconomic policy, it is necessary to establish and apply a policy which increases private participation in the supply and use of energy - specifically petroleum derivatives in the hydro-carbon sub-sector and generation and distribution in the electricity sub-sector" (World Bank, 1996:2).

A US$50.6 million World Bank loan (1991) was conditionalised upon the government: (i) drawing up both a strategy and an effective regulatory framework for the sector, (ii) strengthening the operational autonomy and restoring the financial solvency of ENEE, (iii) improving distribution and raising prices in the electricity sub-sector, (iv) promoting exploration for oil, (v) liberalising the petroleum markets and (vi) allowing greater private participation in the sector[14]. The Bank also requested that the strategy selected addressed the environmental impacts associated with continued fuelwood usage.

Reform pressures grew as the IADB stepped in with a $55 million loan in early 1992, disbursement being contingent upon broadly similar conditions to those stipulated in the World Bank agreement (IADB, 1992). Additional funds - albeit with less strings attached - were secured for the rehabilitation of the Rio Lindo and Canaveral generators and for the enhancement of planning in the electricity sub-sector (UNDP, 1994). Yet, despite this avalanche of funds, the country was unable to avoid substantive energy rationing in late 1994.

It is our firm contention however, that while a crisis of some sort was inevitable given the rapidity of demand growth, government (in)action[15] exacerbated the crisis. Although aware, since early 1993, of internal ENEE documents predicting impending energy shortfalls, the Callejas government chose to ignore them (Mimeo, 1995). The reason was simple - 1993 was an election year and an unpopular Nationalist government was understandably reluctant to undermine its re-election chances[16].

It was not completely inactive on the energy front however. The National Energy Commission (*La Comisión Nacional de Energía* - CNE), later replaced by *La Comisión Nacional de Energía Eléctrica* (CNEE) under the 1994 *Ley Marco del Subsector Eléctrico* Law, was entrusted with drawing up a new *modus operandi* for the electricity sector. An OFFER[17]- type body (*La Comisión Nacional Supervisora de Servicios Públicos* - CNSSP), set up in July 1991 to approve proposed electricity tariffs, began operating in early 1993. Consultants were appointed to oversee the negotiation of oil and gas exploration contracts and studies on both the consequences of fuel substitution and the institutional reforms needed in the electrical sub-sector were undertaken. In liberalising the import regime for refined petroleum products the Callejas government prompted four new fuel importers to emerge[18]. The fact that the new tariff levied on such products (12%) undercut that levied on crude (20%) led REFTEXSA to shut down its refining operations and concentrate upon importing refined products instead.

Crucially, however, all these measures were relatively costless in terms of political support. In sharp contrast, two potentially damaging - in an electoral sense -measures demanded by both the World Bank and IADB prior to the release of the second tranches of their respective loans, were not implemented . First, liberalisation of the hydro-carbon market did not occur. Instead, liberalisation was restricted to imports (see above), exports and the price of lubricants, grease, aviation fuel and asphalt. Subsidies on diesel, kerosene and LPG gas remained, as did strict price controls at the point of consumption. Second, the directive to raise electricity prices so that they approached long-run marginal supply costs was disregarded and residential tariffs were reduced instead[19]. This vote-garnering strategy worsened ENEE's already parlous financial position. Political expediency also saw: (i) the National Congress reassign funds originally designated for the rehabilitation of ENEE's thermal generators (late 1993) to non-energy purposes and (ii) the continuation of the rural electrification programme, notwithstanding ENEE's failure to acquire the 70MW gas turbine which underpinned the whole strategy (Mimeo, 1995).

Rather belatedly, the Callejas government took steps to head off the looming electricity crisis. Negotiations were opened with a recently established local company, *Electricidad de Cortés SA* (ELCOSA), which was prepared to construct, operate and maintain a generating station located at Puerto Cortés. The weakness of the government's position, however, was exemplified by the terms of the deal struck. The deal permitted ELCOSA to supply its 'HECO' shareholders first[20] , selling the residual electricity produced - up to 48MW - to ENEE, without regard to ENEE's

actual requirements, at agreed prices (*Decreto* No 240-93). Furthermore: (i) supply prices could be revised upwards if new environmental legislation increased ELCOSA's variable costs and (ii) ENEE was expected to refund any import tariffs or duties incurred by ELCOSA when constructing/operating the plant, while (iii) indemnifying ELCOSA in the eventuality that the sales tax was extended to fuel. The agreement, due to terminate in July 2010, was heavily criticised and did little to alleviate the energy crisis which hit the country in 1994, shortly after the Liberal government of Roberto Reina had taken power.

The first systematic cuts in electricity supply began in February 1994. By August, as water levels at both the *Cajón* and Rio Lindo dams reached critical levels, twelve hour cuts were the norm. These cuts had three principal socio-economic consequences. First, they reduced industrial production levels, particularly after May as rationing became more pronounced. Most affected were: (i) those small textile and footwear companies which lacked back-up generators, (ii) the dairy product industry (milk, cheese, etc) - as supermarkets reduced their inventory holdings due to the highly perishable nature of such products in the absence of refrigeration and (iii) meat-processors. Industries such as the cement industry - where ovens needed to function for 15 hours consecutively - mitigated the effects of the crisis by negotiating favourable rationing schedules with ENEE and/or modifying working hours. The *maquila* (thanks to the ELCOSA contract), shrimp export (reliance upon own generators), melon export and sugar processing (where shortages pre-dated harvest) sectors escaped relatively unscathed. Consequently, the reduction in manufacturing output was far less than that predicted by either the Central Bank (BCH, 1994) or UDAPE (1994). Second, they adversely affected the balance of trade. Three thermal generating plants with a capacity of 60MWh were imported, leased from the Mexican government, at a cost of 72 million lempiras (US$8.6 million) and energy was also purchased through the Central American grid. The re-orientation of generating strategy towards oil-based fuels saw diesel imports increase 10.5% in 1994 alone. In addition the cuts contributed to the 19.1% increase in regular gasoline purchases (17.6% in superior) due to corporate purchases of generators as a palliative to energy shortfalls. Finally, the proliferation of small generators, particularly in the larger population centres, contributed significantly to problems of noise and air pollution.

The 1994 crisis forced the new administration to recognise that:

> "it is not possible to satisfy present and future levels of demand by the methods

currently employed [pledging in response to] *improve the situation through management based on commercial criteria, realistic prices for services supplied, greater attention to maintenance and encouraging greater private sector participation in service provision*" SECPLAN, 1996:26, our italics).

The first step was the delineation of a new framework for the electricity sector, *La Ley Marco del Subsector Eléctrico* (LMSE), in November 1994. The Law extended and operationalised the conditionality criteria agreed with the IADB/World Bank, most notably in the realm of tariffs and private participation. It also committed the government to supporting the continuation of the rural electrification programme through the creation of a social development fund[21]. While the LMSE did make concessions to enhance the utilisation of renewable energy sources these were overshadowed by the March 1998 incentive law for renewable energy projects. The law, which grants tax holidays (15 years on sales, 10 years on profits) to private developers, has been accused of promoting hydro-electric projects at the expense of the environment (Patuca River Campaign).

In practice, **management based upon commercial criteria** has meant administrative and operational restructuring at ENEE, backed up with a financial rehabilitation package. Progress is measured against a series of financial (average prices, net profit, investment rate, debt service cover, debt-equity ratio, debt collection period and solvency ratio) and efficiency (number of employees, sales/number of customers per employee, losses and the frequency and duration of power cuts) targets laid down in a *Contrato-Plan* agreed with the government. Although efficiency improvements over the period 1994-6 were ratified as 'acceptable' by the World Bank (1996) and led to the belated release of the second tranche of its adjustment loan, two factors militated against progress on the financial front. First, the sharp decline in the lempira's international value saw the cost of servicing the company's external debt soar[22]. Second, losses - at 24.78% in the fourth quarter of 1996 - remained well above the desired level of 19%. While the first of these factors is outside ENEE's direct control, plans are in hand to curb losses[23].

More realistic prices have seen continued price de-regulation in the petroleum markets. Kerosene subsidies were removed, prompting growing substitution in favour of diesel and fuel oil in the industrial sector (SECPLAN, 1996). Refined product prices were subsequently freed in 1996, while diesel and gasoline prices were finally freed in May 1998. In the electricity sub-sector, 'more realistic prices' have meant a shift towards marginal cost pricing with Article 46 of the LMSE

requiring non-residential tariffs to be set at between 100-120% of total supply costs[24].

Residential tariff increases are set on a sliding scale based on usage[25]. The unpopularity of such rises was clearly illustrated when an ENEE office was bombed in November 1997.

Although the World Bank recognised that average tariffs covered 90% of ENEE's long-run marginal costs by 1996, this did not stop ENEE's policy of subsidising provision for consumers with low energy consumption from coming under fire. In 1995, the IADB made continued energy funding conditional upon: (i) research into the link between household income levels and energy consumption, the intention being to re-draw the 300KWh cut-off point if the study warranted it and (ii) ENEE drawing up an Action Plan which would more closely align tariffs for such low-consumption groups with long-run marginal costs.

Maintenance of existing capacity and the encouragement of greater private sector participation in service provision have both been accorded high priority by the Reina administration. The Callejas government's failure to maintain the ENEE thermal-generating plants at Puerto Cortés and La Ceiba (Table 1), a failure which deepened the 1994 crisis, was quickly circumvented. Private companies were invited to tender for the plants' rehabilitation, operation and maintenance. In August 1994, a ten-year contract was awarded to the *Empresa de Mantenimiento, Construcción y Electricidad* (EMCE) (*Decreto* No 145-94)[26]. The Reina government's first experiences of contracting new generating capacity from private sector suppliers was not a happy one, however. Both the $45 million contract for 75MWh agreed with the American International Power Corporation (27 July 1994) and the $26.9 million contract for 40MWh signed with New Mark Representations (25 August 1994) came to nothing. Consequently, it was not until early 1995 that a contract for 39.5MWh with *Luz y Fuerza de San Lorenzo* (LUFASSA) was finalised. Generation commenced later that same year.

As these private operations (ELCOSA, EMCE and LUFASSA) came on-line, electricity production from thermal sources increased. Whereas in 1990 all the country's requirements came from hydro-electric production, from 1995 onwards thermal plants have accounted for around one-third of needs, (ENEE, 1997). The Achilles heel of such a strategy was, and remains however, its foreign-exchange cost. In 1996, thermal power stations consumed over 30 million gallons of imported diesel at a cost of around $17.9 million(own calculations from ENEE, 1997 and UDAPE,

1994). The government response was to examine cheaper energy sourcing options. These have included: (i) greater recourse to the *Sistema de Interconexión Electrica para los Países de América Central* (SIEPAC) grid as a means of equilibrating short-term domestic supply and demand[27], (ii) assessing possible new hydro-electric ventures (notably at Cangrejal and Patuca), (iii) negotiating a 60MWh wind-power contract with Zond, Honduras (at Cerro de Hula, near Tegucigalpa) and (iv) contracting to purchase 30MWh of bio-mass generated power from the *Biomasa Generación* (BIOGEN) company (at Guaimaca, Francisco Morazán and Sabá, Colón). To date, however, these initiatives - SIEPAC apart - have yet to get off the ground.

The same can be said with regard to the LMSE's proposal to spin-off electricity distribution to private companies, municipalities and unions/professional associations (*Decreto* No 158-94, Articles 20-6). While the proposal has strong parallels with the British experience, the prospect of a privately run distribution network remains a pipe-dream at present.

4. FUTURE DEMAND PROSPECTS

Extrapolating likely future energy demand is somewhat problematic. First, despite the availability of information on energy consumption by fuel type/sector, econometric estimation of energy demand functions is hindered by the lack of good quality data on relative fuel prices. Second, any forecasts, however derived, are subject to a high degree of uncertainty given the current winds of change blowing through the energy sector in Honduras.

Despite these caveats we have attempted to estimate energy demand functions for Honduras and construct an 'indicative scenario' until the year 2005. As far as is known, there has been no previous published work on estimating energy demand functions for Honduras and hence no estimates of the income and price elasticities. There are, however, a number of studies of energy demand for developing countries, the more recent estimates being summarised in Table 5. This table indicates that the majority of estimated long-run income elasticities are greater than unity and, where estimated, the majority of long-run own price-elasticities lie between -0.2 to -0.5.

Table 5: Selection of Energy Demand Studies for Developing Countries Published Since 1990

Study	Countries analysed	Type of Energy	Long-Run Energy Elasticities: Own-Price	Income	Data Frequency & Period	Model and estimation technique	Notes
Ibrahim & Hurst (1990)	Oil Importing Developing Countries				Annual Data	Log-linear equations,	Some equations included additional variables
	- Brazil	Total Energy	-0.27	1.16	From 1970 to	(no lagged dependent variable	such as 'the level of foreign transfers', 'the
		Total Oil	-0.32	0.60 to 0.98*	mid 1980s.	hence long-run elasticities	proportion of GDP coming from agriculture or
	- India	Total Energy	n/e	1.56	(the end year	are equal to short-run)	manufacturing' and 'the non-oil energy price.
		Total Oil	n/e	1.39	ranged form1983	OLS	
	- Korea	Total Energy	-0.24	1.22	to 1985, but was		In addition some oil demand equations included
		Total Oil	-0.21 to -0.26	1.09	1984 for most		a 'coal price' variable.
	- Morocco	Total Energy	n/e	1.03	countries)		
		Total Oil	n/e	1.63			* direct and indirect estimates
	- Pakistan	Total Energy	-0.25	1.33			of these elasticities are within the
		Total Oil	-0.34	0.62 to 1.09*			paper.
	- Philippines	Total Energy	-0.17	1.14			
		Total Oil	-0.14	0.85			
	- Taiwan	Total Energy	-0.53	1.24			
		Total Oil	-0.64	1.33			
	- Thailand	Total Energy	-0.15	1.08			
		Total Oil	-0.72	0.73			
	Oil Exporting Developing Countries				Annual Data	Log-linear equations,	Some equations included 'the proportion
	- Algeria	Total Energy	-0.89	0.89	From 1970 to	(some with a lagged	of GDP coming from manufacturing'.
		Total Oil	-0.26	0.84	mid 1980s.	dependent variable -	
	- Egypt	Total Energy	-0.27	0.85	(the end year	hence for some estimates	
		Total Oil	-0.24	0.67	ranged form1983	there is no distinction	
	- Indonesia	Total Energy	n/e	1.19	to 1985, but was	between the short- and	
		Total Oil	n/e	1.03	1984 for most	long-run)	
	- Mexico	Total Energy	-0.12	1.27	countries)	OLS	
		Total Oil	n/e	1.46			
	- Saudi Arabia	Total Energy	-0.24	1.23			
		Total Oil	-0.19	1.26			
Pourgerami & Hirschhausen (1991)	Non-Oil developing Countries				Annual Data	Log-linear models with a	'Standard' models are estimated which additional
	- Bangladesh	Total Energy	-0.46 to -0.91	0.79 to 2.00	1972-82	lagged dependent variable	variables to represent 'population' and 'the
	- India	Total Energy	-1.25 to -1.48	0.93 to 1.18	1950-82	OLS	acceleration of an expected change in the price
	- Pakistan	Total Energy	-0.37 to -0.93	1.11 to 1.38	1950-82		of energy' and shift dummies for 1973 and 1979.
		(The estimated long-run 'population elasticities' are:)				(In addition time varying	'Structural' models are also estimated by adding
		(Bangladesh:	17.8 to 29.6)			elasticities are estimated but	two variables to the standard model: 'the growth
		(India:	3.2 to 3.7)			not reported here)	in capital formation' and 'the growth in
		(Pakistan:	3.5 to 6.6)				agricultural output.
Westley (1992)					Pooled annual data	Linear and log-linear models	A number of various dynamic models are investigated
	Costa Rica	Residential Electricity	-0.50	0.20	1970-79	estimated some with lagged	as well as the inclusion of other variables such as 'gas
		Commercial Elasticity	-0.50	0.50		dependent variable.	prices', 'urbanization rate', appliance stock prices',
	Paraguay	Residential &	-0.50	0.38	1970-77	OLS/2SLS	various shift and other dummies, etc. The elasticity
		Commercial Elasticity					estimates given are the means of all estimates obtained.
Balabanoff (1994)	Argentina	Total Oil	-0.25	1.98	Annual Data	Log-linear equations.	Some equations include a linera trend.
		Total Electricity	n/e	1.00		(some with a lagged	The income variable was GDP other than for
		Total Gas	-0.26	1.60	1970-90	dependent variable -	the Colombian and Ecuadorian Oil demand
	Brazil	Total Oil	-0.43	1.73		hence for some estimates	functions which used Income per capita.
		Total Electricity	n/e	1.93		there is no distinction	
	Chile	Total Oil	-0.20	0.85		between the short- and	
		Total Electricity	n/e	1.65		long-run)	
		Total Coal	-0.43	1.33		OLS	
	Columbia	Total Oil	n/e	1.26			
		Total Electricity	-0.18	1.88			
		Total Gas	n/e	1.96			
		Total Coal	-0.08	0.85			
	Ecuador	Total Oil	n/e	1.50			
		Total Electricity	n/e	1.95			
	Mexico	Total Oil	n/e	1.29			
		Total Electricity	-0.08	0.69			
	Peru	Total Oil	-0.11	1.02			
		Total Electricity	n/e	0.70			
	Venezuela	Total Oil	n/e	1.05			
		Total Electricity	-0.29	n/e			
Al-Mutairi & Eltony (1995)	Kuwait	Total Energy	-0.23	1.21	Annual Data 1965-89	i) Engle & Granger Two-Step Cointegration Method	Conclude that "for forecasting the final demand for energy, the cointegration and error-correction
			-0.43	1.13		ii) Two Equation Simultaneous Equation Method	model should be utilized" (p. 183)

NB: Studies are listed in chronological order of publication. n/e = not estimated due to omission of variable from preferred equation.

The estimated energy demand functions for electricity, petroleum and wood are described in Appendix 1. Electricity demand is found to be dependent upon GDP and population with long-run elasticities of 0.79 and 1.33 respectively. Petroleum demand is dependent upon GDP and the international oil price with long-run elasticities of 1.58 and -0.24 respectively[28]. These are generally in line with the elasticity estimates presented in Table 5. The exception is the long-run income elasticity of electricity demand which is less than unity. This, however, is not too unexpected since population is included in the equation with a long-run elasticity in excess of unity.

The equation for wood is a simple first difference equation dependent upon the change in population.

The estimated equations are used as the basic structure to build our 'indicative scenario'. To achieve this we assume population growth is in line with the 1992-200 PNUD (1994) estimate of 2.8% per annum. We assume GDP grows at a rate of 3% per annum, based upon the premise that the country's recent economic performance will be maintained for the scenario period. This is, however, somewhat lower than the 4½ per annum growth that the IADB considers to be sustainable/potential - providing the country continues to liberalise its economy (IADB, 1997). We prefer to use 3% since this would appear a more reasonable 'central case', however, if the IADB's view proves to be correct, then our ' indicative scenario' will somewhat under-estimate future energy consumption levels[29].

A summary of this 'indicative scenario' is given in Table 6, suggesting an increase in aggregate energy demand of just under 3% per year over the 1995-2005 period. Within this, demand for petroleum products grows by just over 5% per year, far less than in the early 1990s. The demand for wood grows relatively slowly, whereas electricity increases a little over 6% per annum. The strong growth in electricity, particularly in the residential sector, will be driven by population and GDP growth, further urbanisation, increased coverage as more households are connected to the Grid, and further substitution away from the more traditional fuel, wood. This increase could be even stronger if GDP grows faster than our conservative growth assumption[30]. The issue, therefore, given current energy policy, is whether capacity will be available to meet this demand - or are power cuts like those seen in 1994 going to reappear in the not too distant future?

TABLE :6 TOTAL HONDURAN ENERGY DEMAND INDICATIVE SCENARIO

	Electricity (mtoe)	Petroleum Products (mtoe)	Combustible, Renewables & Waste (mtoe)	Total Energy Consumption (mtoe)	Energy per Capita (toe)	Energy Intensity (toe/Lem.90)
Levels						
1990	.128	.696	1.491	2.316	.453	.185
1995	.170	1.159	1.504	2.833	.476	.191
2000	.233	1.500	1.508	3.242	.475	.186
2005	.314	1.907	1.513	3.734	.476	.187
Growth (% p.a.)						
1971-95	7.5%	5.9%	1.8%	3.3%	0.0%	-0.2%
1995-2005	6.3%	5.1%	0.1%	2.8%	0.0%	-0.2%

(Source: IEA and authors' estimates)

Note: Population increased by 3.3% per annum and GDP by 3.5% per annum over the 1971-95 period.

5. SUMMARY AND CONCLUSION

It is clear that the Honduran energy position has seen a dramatic transformation since 1990. Where there was once a sole oil importer there are now a number. Where once hydro accounted for about three-quarters of installed electricity generating capacity now it is down to 60%. Where once there was just one company with sole responsibility for generating electricity now there are three new privately owned generating companies. Where there was once an unconsolidated national grid network now almost all regions are connected. Where once there was cheap (subsidised) electricity now there is a system of tariffs that has some resemblance to marginal cost pricing. Liberalisation of the energy market is likely to continue, with greater private sector involvement in generation and distribution complementing the regional drive towards increased competitiveness in national energy markets.

The country's most pressing energy-related problem remains the immediate demand shortfall, a shortfall which saw Congress approve the emergency purchase of 120 MW from LUFASSA/ELCOSA in late March 1998 at a cost of $0.054 per kWh[31]. In the longer term, if the country is to meet the estimated 'central case' demand in 2005, it will be necessary to licence further private sector generating projects. While the major new initiative is the US$213 million 230 MW project being carried out by the US companies, Panda Energy and Harza on the River Patuca, serious doubts have already been voiced about its effects in environmental terms (River Patuca Campaign).

A less contentious alternative would be to improve the efficiency of energy supply. The most effective path would be via the reduction of current transmission and distribution losses (around 25%) to more acceptable norms (6-8%), although past endeavours on this score do not engender much optimism. A less palatable option is to restrict demand growth through wider reliance upon economically efficient pricing policies. This would undoubtedly require the removal of reduced tariffs for low-consumption electricity users and/or the elimination of fuel oil subsidies. Besides the obvious equity implications of such a strategy - and the likelihood of a new bombing campaign directed at ENEE offices that it brings - there is also an environmental issue at stake. More economically efficient pricing policies will encourage substitution towards 'cheaper' alternative energy sources. In the rural and semi-urban areas this is likely to be wood, thereby prompting increased forest depletion and its concomitant problems.

Energy policy has a vital role to play in both the economic development and environmental future of Honduras then. If the current dilemma that we have outlined above is not addressed, then the sector is likely to be an obstacle to, rather than the driving force behind, future economic growth as well as a significant contributor to environmental degradation.

APPENDIX 1: ESTIMATED HONDURAN ENERGY DEMAND FUNCTIONS

The indicative scenario presented in the main text is based upon estimated energy demand functions for electricity, petroleum and wood. For electricity and petroleum the relationships are estimated using the two step cointegration methodology (Engle and Granger, 1987)[32]. The long-run elasticities of energy demand for electricity (with respect to GDP and population) and petroleum (with respect to GDP and real international oil price[33]) are obtained by estimating a general lagged function with lags of up to two years. The Engle-Granger methodology suggests there is no need to worry about the diagnostics of the first stage regression since the parameter estimates are superconsistent. However, given the length of the time series used, small sample bias could be substantial hence the long-run cointegrating relationships are derived from the estimated general lag functions and presented in Table A1[34]. For electricity the cointegrating Durbin Watson statistic (DW) (Sargan and Bhargava, 1983) suggests there is a long-run cointegrating relationship between the logarithm of electricity consumption (e), the logarithm of GDP (y) and the logarithm of population (n), but unfortunately this is not confirmed by the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests (Fuller, 1976). For petroleum the DF and ADF tests suggest there is a long-run cointegrating relationship between the logarithm of petroleum consumption (p), the logarithm of GDP (y) and the logarithm of the real international oil price (o), but the DW statistic is less conclusive[35]. Table A2 gives the estimated restricted error-correction dynamic equations for the change in the logarithm of electricity (Δe) and the change in the logarithm of petroleum (Δp). Both equations are well defined passing all diagnostic tests, although R^2 for the Δp equation is a little on the low side. Moreover, the error correction terms (ECe & ECp derived from the long-run relationships) are significantly different from zero.

FIGURE A1: LONG-RUN COINTEGRATING EQUATIONS FOR ELECTRICITY AND PETROLEUM

Electricity (e)		**Petroleum (p)**	
Independent Variables	***Long -run Coefficient***	***Independent Variables***	***Long -run Coefficient***
Constant	-6.378	Constant	-3.411
y	0.786	y	1.578
n	1.335	o	-0.236
Diagnostics			
DW	1.19	CRDW	0.73
DF	-0.60	DF	-2.01
ADF(1)	-0.09	ADF(1)	-2.14

FIGURE A2: SHORT-RUN DYNAMIC EQUATIONS

Dependent Variable: Δe_t			***Dependent Variable:*** Δp_t		
Independent Variables	***Coefficient***	***t-value***	***Independent Variables***	***Coefficient***	***t-value***
Constant	0.008	0.13	Constant	0.018	0.77
Δe_{t-1}	-0.309	2.85*	ECp_{t-1}	-0.235	2..23*
Δn_t	6.122	3.19*			
ECe_{t-1}	-0.826	7.39*			
Diagnostics					
Time-Period	1973-95		1973-95		
R^2		0.79		0.19	
σ		2.0%		6.9%	
Zero slopes	$F_{(3,19)}$ =	24.28*	$F_{(1,21)}$ =	4.99*	
AR(1)	$F_{(1,18)}$ =	0.47	$F_{(2,19)}$ =	1.20	
ARCH(1)	$F_{(1,17)}$ =	0.05	$F_{(1,19)}$ =	0.13	
Normality	$\chi^2_{(2)}$ =	0.60	$\chi^2_{(2)}$ =	1.00	
Heteroscedastic errors	$F_{(6,12)}$ =	2.20	$F_{(2,18)}$ =	0.93	
Reset	$F_{(1,18)}$ =	0.22	$F_{(1,20)}$ =	0.78	
Preferred equation against general model	$F_{(3,16)}$ =	0.88	$F_{(5,16)}$ =	0.41	

Notes: * = significant at the 5% level

The results suggest that the long-run GDP-elasticity of electricity demand is 0.79 and the long-run population-elasticity 1.33, whereas the long-run GDP-elasticity of petroleum demand is 1.58 and the long-run oil price-elasticity -0.24. These are generally in line with the elasticity estimates presented in Table 5 in the main text. The exception is the long-run income elasticity of electricity demand which is less than unity. This, however, is not too unexpected since population is included in the equation with a long-run elasticity in excess of unity.

FIGURE A3: DIFFERENCE EQUATION FOR WOOD

Dependent Variable:	Δw_t	
Independent Variables	***Coefficient***	***t-value***
Constant	-0.093	2.72*
Δn_{t-1}	3.403	3.24*
Diagnostics		
Time-Period	1972-95	
R^2		0.32
σ		1.11%
Zero slopes	$F_{(1,22)}$ =	10.47*
AR(1)	$F_{(1,21)}$ =	0.00
ARCH(1)	$F_{(1,20)}$ =	0.00
Normality	$\chi^2_{(2)}$ =	3.96
Heteroscedastic errors	$F_{(2,19)}$ =	0.20
Reset	$F_{(1,21)}$ =	0.01

Notes: * = significant at the 5% level

The estimated relationship for wood is a simple first difference equation with the difference in the logarithm of wood (Δw) dependent upon the change in the logarithm of population (Δn). The results are given in Table A3 and, although only a simple relationship, all diagnostic tests are passed.

BIBLIOGRAPHY

Al-Mutairi, N. H. And Eltony, M. N. (1995) 'Price and Income Elasticities of Energy Demand: Some Estimates for Kuwait using Two Econometric Models', *The Journal of Energy and Development*, 20(2): 175-185.

BCH (Banco Central de Honduras) (1994) Efectos del Racionamiento de la Energia Eléctrica en la Producción de la Industria Manufacturera, Depto. De Estudios Económicos, Mimeo, Tegucigalpa.

Balabanoff, S. (1994) The Dynamics of Energy Demand, *OPEC Review*, XVIII(4), pp. 467-488.

Blutstein, H. I., Betters, E. C., Lane, D. H., Leonard, J. A. And Walpole, N. (1971) *Area Handbook for Honduras*, US Govt. DA PAM 550-151, Washington, DC.

CHE (Colegio Hondureño de Economistas) (1993) *Analísis del Comportamiento Económico Nacional*, Documento de Posición 2-93, Mimeo, Tegucigalpa.

Cheng, B. S. (1997) 'Energy Consumption and Economic Growth in Brazil, Mexico and Venezuela. A Time Series Analysis', *Applied Economic Letters*, 4:671-74.

Choucri, N. (1982) *Energy and Development in Latin America*, Lexington Books, Massachusetts.

Decreto No. 52-95 (1995) 'Contrato entre la ENEE y la LUFUSSA'.

Decreto No. 158-94 (1994) La Ley Marco del Subsector Eléctrico (LMSE).

Decreto No. 145-94 (1994) 'Contrato entre la ENEE y la EMCE para la Rehabilitación, Operación y Mantenimiento de las Centrales Termoeléctricos'.

Decreto No. 240-93 (1993) 'Contrato de Compra-Venta de Energia Eléctrica entre la ENEE y ELCOSA'.

ENEE (1997) Información General, Mimeo, Tegucigalpa.

ENEE (1996) Contrato Plan - IV Trimestre de 1996, Mimeo, Tegucigalpa.

Engle, R. F. And Granger, C. W. J. (1987) 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, 55:251-276.

Fandell, S. E. (1993) 'Foreign Investment, Logging and Environmentalism in Developing Countries: Implications of Stone Container Corporation's Experience in Honduras', *Harvard International Law Journal*, 35(2): 499-533.

Fuller, W. A. (1976) *Introduction to Statistical Time Series*, New York, Wiley.

GRH (Gobierno de la República de Honduras) (1994) Las Medidas Económicas y su Relación con la Política de Desarrollo Sostenible y Equitativo del Gobierno de Honduras, Tegucigalpa.

Hendry, D. F. and Doornik, J. A. (1996) *Empirical Econometric Modelling Using PcGive for Windows*, London: International Thomson Business Press.

IADB (Inter American Development Bank) (1997) *Latin American Economic Policies*, No. 1.

IADB (1992) Contrato de Préstamo entre la República de Honduras y el Banco Interamericano de Desarrollo, Préstamo No. 645/OC-HO, Mimeo.

Ibrahim, I. B, and Hurst, C. (1990) 'Estimating Energy and Oil Demand Functions: A Study of Thirteen Developing Countries', *Energy Economics*, 12(2):93-102.

La Tribuna. Various issues.

Lindarte, E. And Benito, C. (1991) 'Instituciones, Tecnología y Políticas en la Agricultura Sostenible de Laderas en América Central', *Agricultura Sostenible en las Laderas Centroamericanas: Oportunidades de Colaboración Interinstitucional*, IICA, San José.

Mausollf, C. And Farber, S. (1995) 'An Economic Analysis of Ecological Agricultural Technologies among Peasant Farmers in Honduras', *Ecological Economics*, 12:237-48.

Meyer, H. K., Meyer, J. H. (1994) *Historical Dictionary of Honduras*, Scarecrow Press, Metuchen, New Jersey.

Mimeo (1995) Antecedentes de la Crisis Energética de Honduras en al Año 1994, Mimeo, Tegucigalpa.

Munasinghe, M. (1994) 'Sustainable Power for Latin America and the Caribbean: Pricing Policy and Related Options', *The Journal of Energy and Development*, 18(1).

Patuca River Campaign. http://www.ben2.ucla.edu/~alexagui/patuca/index.html (accessed 10 July 1998).

PNUD (Programa de las Naciones Unidas para el Desarrollo) (1994) *Informe sobre Desarrollo Humano 1994*, Fondo de Cultura Económico, Mexico D. F.

Pourgerami, A. And von Hirschhausen, C. R. (1991) 'Aggregate Demand for Energy and Dynamics of Energy Demand Elasticities in Non-Oil-Developing Countries', *The Journal of Energy and Development*, 14(2):237-252.

Sargan, J. D. and Bhargava, A. (1983) 'Testing Residuals from Least Squares Regression for being Generated by the Gaussian Random Walk', *Econometrica*, 51:153-74.

Schulz, D. E, Schulz, D. S. (1994) *The United States, Honduras, and the Crisis in Central America*, Westview, Colorado.

SECPLAN (1996) Hacia el Aprovechamiento Racional de los Recursos: Estrategia de Política para el Desarrollo Sostenido del Sector Energético Nacional, Mimeo, Tegucigalpa.

SECPLAN (1995) Generación y Cierre de Empleos en el Sector Moderno Durante 1993,

Proyecto HON/94/PO2 Política Social: Población, Genero y Empleo, Mimeo, Tegucigalpa.

Szekely, F. (Ed.), (1983) *Energy Alternatives in Latin America*, Tycooly International Publishing Ltd, Dublin.

Thorpe, A. T. (1996a) 'Honduras: Hybrid NEMs and Poverty', *The New Economic Model and its Impact on Poverty and Income Distribution in Latin America*, Bulmer-Thomas, V. (Ed), ILAS/MacMillan, London.

Thorpe, A. T. (1996b) Macro-Economic Conditions for Sustainable Agriculture in Central America, Department of Economics Discussion Paper No. 65, University of Portsmouth.

UDAPE (Unidad de Análisis de Políticas Económicas) (1995) Análisis de la Situación Financiera de la Empresa Nacional de Energia Eléctrica Periodo 1995-2000, Mimeo, Tegucigalpa.

UDAPE (1994) Impacto de la Crisis de Energía Eléctrica en la Economía, Mimeo, Tegucigalpa.

UNDP (United Nations Development Programme) (1994) Cooperación para el Desarrollo, FRINSA, Tegucigalpa.

Vickers, J. And Yarrow, G. (1991) 'The British Electricity Experiment', *Economic Policy*, No 12: 188-232.

Westley, G. D. (1992) *New Directions in Econometric Modelling of Energy Demand: With Applications to Latin America*, Inter American Development Bank, Washington, DC.

World Bank (1996) Programa de Ajuste del Sector Energía, Banco Mundial: Informe de Finalización de Implementación de Proyecto Crédito 2306-HO, Mimeo, Tegucigalpa.

NOTES

1. The Human Development Index is a UN construct devised to measure a country's socio-economic progress. It aggregates income per head, life expectancy and educational attainment (based on national literacy rates and average years of schooling) into an index, thereby permitting international as well as intertemporal comparisons to be made. Canada currently tops the rankings with a HDI score of 0.932, the African republic of Guinea trailing in last, 172 places behind, with a HDI score of 0.191 (PNUD, 1994).

2. This has, however, been questioned by some researchers. See Cheng (1997) for a recent review of the issues.

3. The Honduran government identifies three other regions (Copán, northern Olancho and Yuscarán in El Paraíso) where limited coal-mining activities are presently undertaken (SECPLAN, 1996).

4. Meyer and Meyer (1994:93) suggest the project cost more than $100 million, while Hernández (1987:183) calculates that it absorbed over 66.2% of total external aid inflows in 1984 alone.

5. In 1950, 69% of the population could be encountered in rural areas, just 20% in towns of 2,000+ people. Ten years later, only five cities had populations that surpassed 10,000. Prior to 1940, the majority of industrial enterprises, with the exception of the banana enclaves on the Northern coast and a handful of other brewing, tobacco, leather and food enterprises, employed less than five people (Meyer and Meyer, 1994:652, Blutstein et al, 1971:150).

6. Only Guatemala and Haiti have lower energy consumption per capita figures in Latin America.

7. This section discusses historic trends over the period 1971-1990, the post-1990 figures are examined in Section 3 where the focus is upon the more recent energy position.

8. A very basic electric cooker presently costs around 500 lempiras (US$43).

9. Population increased by 3.1% per annum and GDP by 3.4% per annum over the 1990-95 period.

10. Poor households generally improvise, illicitly connecting themselves to local ENEE cables. Theft among large industrial users can be more systematic as the experience of a British manager of a large multinational company close to San Pedro Sula proved. Within days of arriving in the country, he was approached by an individual who offered, for a fee, to bypass the ENEE meter installed on the company's premises. The offer was rejected - notwithstanding the fact that it had been made by an ENEE employee!! (personal interview, November 1994).

11. Despite ENEE billing on a monthly basis, the average settlement period was around 70 days by the end of 1995 (ENEE, 1996:11).

12. The most controversial was the suspension of tariffs on cars imported by congressional deputies during the Callejas administration (1990-4). This suspension, which has never been quashed, has proved a profitable loophole for some deputies.

13. As water levels fell from 268.15 metres (1992) to 247.55 metres (1994), *Cajón's* computed energy reserves fell from 585.99GWh to 395.27GWh (ENEE, 1997). The shut-down point is 220m. Thermal production recommenced in 1991 (3GWh). It then grew to 127GWh (1992), 231GWh (1993) reaching 493GWh in 1994. Net imports in 1993 totalled 51GWh (UDAPE, 1994:5/6).

14. This initial loan was followed by furthers loans, $32.5 million in 1992 and $33.4 million in 1993.

15. By this we do not necessarily mean rationing. Rationing could have been avoided by a combination of measures - dramatic price rises, paralysation of ENEE's electrification projects, increased run-down of water reserves at the country's HEP complexes and/or increased energy imports. Each of these solutions are not costless, however, and would have repercussions upon living standards (price rises, halting of electrification projects), foreign currency reserves (increased imports) and local eco-systems (increased water run-off).

16. The reason for its unpopularity stems from the sharp increase in food prices (78.4%) and the decline in the lempira's purchasing power (51.5%) over the period 1989-1992 (CHE, 1993:10/1). More comprehensive details on the Honduran economic and political environment in the 1990s can be found in Thorpe (1996a) and Schulz and Schulz (1994).

17. The UK Office of Electricity Regulation (OFFER) was created in the UK when the Electricity Supply Industry was privatised in 1990. It is responsible for the economic regulation of the generation, transmission distribution and supply aspects of the industry (see Vickers and Yarrow, 1981).

18. *Petróleos de Tela* ('Petrotela', licensed by Decree 112-90, September 1990) imported refined products through the Caribbean port of Tela between 1992-5. *Petróleos del Sur* ('Petrosur'), a subsidiary of Petrotela commenced importing through the Pacific port of San Lorenzo on 26 December 1993. Shell Hondura and Esso Standard (licensed by *Acuerdo Ejecutivo* 378-92, October 1992) both started operations in 1995, sub-contracting storage capacity from REFTEXSA. In 1996, REFTEXSA imported 57% of Honduran fuel oil requirements, Petrosur 29%, Shell 11% and Esso Standard 3% (SECPLAN, 1996:10ff). The main beneficiary of liberalisation was probably Henry Arevalo. This Honduran entrepreneur, linked to the Nationalist party, controlled Petrotela, channelling the profits into the newly promoted soccer team (Tela) in a vain attempt to clinch the National Soccer championship.

19. The IADB loan, for example, had specified that tariffs should be increased so that the average tariff covered 90% of such costs. With the exception of low-consuming residential customers (under 300KWh per month), all other tariffs were expected to cover 80% of costs (IADB, 1992:5). Yet, in September 1993, tariffs were reduced by 23% [consumers using less than 60KWh per month], 24.5% [60-100], 22.1% [101-300], 36.9% [301-500] and 1.9% [500+KWh] (World Bank, 1996:7).

20. The Honduras Electric Company (HECO) shareholders were Northern industrial

enterprises (including *maquila* companies). They were entitled to purchase the greater of either : (i) 0.5MW pm (increasing by 0.5MW per annum thereafter) or the (ii) average HECO monthly requirement, from ELCOSA.

21. The fund was to be capitalised by: (i) an annual 10 million lempira transfer from Central Government and (ii) a 15% profit tax levied upon electrical companies - including ENEE. Energy emanating from renewable resource use was to be taxed at 5%, the proceeds being destined for reafforestation projects run by Non-Government Organisations (Art 62).

22. ENEE (1996) suggests that 75.8% of its 1,947.8 million lempira deficit in the fourth quarter of 1996 was attributable to exchange-translation losses. At 31 December 1996, the company's external debt stood at US$601,667,989.22.

23. A joint IADB/World Bank Mission (August/September 1994) elaborated a 1994-7 Action Plan for Loss Reduction. While key elements (distinction of physical losses from fraudulent losses, introduction of new meter seals and contracting out debt collection to private agents) are still at the design stage, a meter revision programme (27,256 revisions led to a net upward adjustment in meter readings of 2,115,893KWh in 1996) is ongoing (ENEE, 1996). Recent plans favour contracting-out administrative and commercial operations (including billing), a plan expected to realise cost-savings of 90 million lempiras *(La Tribuna*, 15 January 1998).

24. The average marginal cost of generation over a five year period is used to establish a *Tarifa en Barra*. This is revised annually - unless an accompanying adjustment formula, designed to incorporate the impact of changing oil and exchange-rates, exceeds the current *Tarifa* by 5%. In this case, a new tariff is set (Articles 47, 49). The total supply cost includes the *Tarifa en Barra*, transmission costs and a mark-up corresponding to the rate of return expected by a 'model' supplier (Articles 51, 52).

25. The tariff is set at 110% of total cost for consumers of 500+KWh per month. Other rates are 100% (consumers of 301-500KWh pm), 80% (61-100KWh) and 45% (under 60KWh).

26. The contract: (i) transferred the Ceiba and Cortés installations to EMCE for the duration of the contract and (ii) terminated all current employment contracts at the transfer date. EMCE, unlike ELCOSA, was only permitted to supply electricity to ENEE however.

27. While regional transmission lines existed between Honduras and Nicaragua (1976) and Costa Rica (1982), these were isolated from the Guatemala-El Salvador link-up to the North. The SIEPAC project integrates the two systems, permitting the establishment and development of a competitive regional electricity market in accord with the *Tratado Marco del Mercado Eléctrico de América Central* signed by the region's presidents in Guatemala in December 1996.

28. A time series of relative Honduran energy prices is, as far as we know, not available hence the need to use the international oil price as a proxy.

29. The real international oil price is assumed to be constant over the forecast period.

30. If the IADB's projection of 4½% per annum growth for GDP is taken, our equations predict growth in electricity, petroleum and total energy of 7.3%, 6.6% and 3.6% per annum

respectively.

31. This could result in a total cost in excess of $5m under certain assumptions.

32. All equations were estimated using PcGive version 9.00, see Hendry and Doornik (1996).

33. A time series of relative Honduran energy prices is, as far as we know, not available hence the need to use the international oil price as a proxy.

34. Preliminary data analysis suggests that all variables used in the estimation work can be regarded as integrated of order one.

35. Various long-run specifications were considered. The preferred specifications are given in Table A1.