

Energy Subsidies versus Economic Efficiency: Practical and Theoretical Issues in the Case of Brunei Darussalam

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Abstract

Energy prices in Brunei are highly subsidised and have not changed for over twenty years. Electricity is priced at approximately B\$0.06 (US\$0.044) per kWh and petrol (gasoline) varies from B\$0.36 (US\$0.26) per litre for regular to a maximum of B\$0.53 (US\$0.38) per litre for premium unleaded. With oil and natural gas prices at relatively high historical levels and the government attempting to reduce its influence on the economy and promote privatisation, the increasing size of the subsidies has come to the attention of policy makers. This paper considers likely market prices for energy in Brunei given current institutions and infrastructure and discusses issues associated with removal of the subsidies in this unique economy.

Keywords: Energy, Subsidies, Tariffs, Efficiency, Conservation, Brunei

1. Introduction

Brunei is a small Sultanate on the North-West corner of the island of Borneo, which it shares with the Malaysian states of Sabah and Sarawak, and the Indonesian state of Kalimantan. In 2007 its population was estimated at approximately 390 000 (JPKE, 2007a) of whom approximately 100 000 are temporary residents (people on short-term work permits and their dependents). The vast majority of temporary residents work in the private sector with the public sector dominated by citizens and permanent residents.

The Brunei economy is largely dependent on oil and gas, which account for more than 90 per cent of both exports and government revenue. Oil was first discovered in Brunei in 1929 onshore but the more productive offshore reserves were discovered in 1963 and their development coincided with the high oil prices of the 1970s and early 1980s. Since this time Brunei has been planning its economic diversification away from oil and gas through a series of National Development Plans but without a great deal of success. Relatively high wages and low productivity make manufacturing and other private sector activities uncompetitive in the international market and reinforce the dominance of the public sector. Hence the economy has become almost entirely dependent on the public sector and on the oil and gas industry itself, which is highly capital intensive and not a large employer. That, of course, is the “curse” faced by resource dependent nations. On the other hand, the “blessing” from oil and gas is the wealth and all it brings: good infrastructure, free, high quality health care and education, no personal income tax or sales taxes, heavily subsidised retail prices for petrol, diesel, electricity, rice and sugar that have not changed for many years, and a relatively high material standard of living for the countries’ citizens. Despite this apparent welfare state, there is no formal welfare system, although there is a system of Zakat, a community/religious-based system of welfare whereby all members of the community pay a specified amount to a fund administered by the religious authorities, which is used to look after the needy. See Lawrey (2008) for a review of current developments in the economy of Brunei.

In 2008, reserve production ratios appear to be falling and the debates about what should be done have intensified. The role of the private sector and the possibility of the reduction or removal of subsidies have now been put on the agenda. The 2007 Long-Term Development Plan states two thrusts of economic strategy as “promoting national economic competitiveness through policies that encourage productivity, economic openness and competition” and “privatising those services currently provided by the public sector that are best undertaken by the private sector” (Department of Economic Planning and Development (JPKE), 2008a).

As international energy prices have increased over the last few years (see Figure 1), so too have the value of subsidies. Given this background, this paper considers likely market prices for energy in Brunei if subsidies were to be removed or reduced given current institutions and infrastructure. It also discusses other issues associated with removal of the subsidies in this unique economy. The paper is organised as follows: Section 2 discusses theoretical issues. Section 3 discusses electricity and uses a cost-of-service methodology to estimate what prices would be under various fuel cost options. Section 4 concerns retail petroleum and the extent of subsidies. Section 5 deals with policy issues and concluding remarks.

2. Electricity subsidies and pricing: theoretical Issues

There has recently been considerable discussion about the traditional view that inefficiencies result from subsidized energy prices. Economic theory suggests that subsidies are inefficient because, in the absence of market imperfections and with convex indifference curves, the value of the subsidy to the consumer will be less than its cost to the government (see Katz & Rosen, 1994). In other words, consumers use resources frivolously at the margin. If prices were increased to reflect commercial costs and the subsidy was returned to consumers in cash, they would be on a higher indifference curve, would be consuming less electricity and petrol (because relative prices have changed) and more of other, normal, goods. Economists argue that income transfers are superior to subsidies and reduce inefficiencies, as the former do not create the deadweight loss associated with subsidies and maximise welfare.

This theoretical view may not be always valid. In intra-household mechanisms in developing countries with a head of household distributing the cash within the household, studies have noted that well targeted subsidies tend to be superior to cash transfers in improving welfare. Subsidies for particular products may be a more efficient way to guarantee that benefits are shared within the household (see, e.g., Ross, 1991; Grogan, 2004). Ross states that “when a government directs resources to a deserving family in which all consumption decisions are made by the head of the household, an agency problem arises. The head, as the government's agent, may not allocate resources in the way the government, or the family, would wish. By constraining the transfer using subsidies or in-kind gifts, the government may be able to influence the intra-family allocations in a desired way”. For instance, the head of the household may not act in an unbiased or altruistic way and may selfishly allocate all or most cash transfer to himself. It should also be noted that just as energy prices have not changed for many years, neither have government salaries, while imported inflation, in particular, has eroded real salaries. Moreover, unskilled private sector wages are low, by any standards, but life has been reasonably comfortable for the vast majority of Bruneians largely because of the subsidised food, energy, education and health care. Removal of these subsidies could have important distributional consequences, as policy makers are aware (see, e.g., Dufty, 2007; Filipović and Tanić, 2009).

3. Electricity Usage and Subsidies

Installed capacity in Brunei is currently reported as 690.5 MW with peak demand at 454.1 MW and 2006 production of 2,948.3 GWH (JPKE, 2007b). The vast majority of consumption (almost 70 per cent in 2006) is for domestic and government lighting and power. There are two electrical utilities, the Department of Electrical Services (DES), which has an installed capacity of 424.5 MW and an independent power producer, the Berakas Power Company (BPC), which has 266MW and sells the majority of its output to the DES (Energy Division, 2007). There are currently seven operating power stations and although a combined cycle plant (where exhaust gasses are utilised to power a steam turbine) has recently been commissioned, the majority of power is produced by relatively inefficient open cycle gas turbines.

Electricity is subsidised by the generators paying a highly-subsidized price for natural gas to the producer, Brunei Shell Petroleum (BSP). This figure has been fixed for many years and is currently below production costs, which are estimated at approximately US\$1.00/MMBtu. The opportunity cost of using the gas in this way is the forgone revenue that could have been earned in the well-established LNG trade. Brunei exports the vast majority of its natural gas production to Japan and Korea under long-term contracts. LNG prices are less volatile than oil prices and over the period 2005, 2006 and the first six months of 2007 the price received for LNG averaged US\$5.82/MMBtu (JPKE 2007a). Liquefaction and shipping costs are estimated at US\$1.50/MMBtu (Sleeman

Consulting 2005) so the net revenue forgone by selling the gas domestically is US\$4.32/MMBtu (B\$6.05/MMBtu). Volumes are not trivial with approximately 10 per cent of gas production going to power generation (Energy Division, 2007).

Not only is fuel price fixed, residential and commercial tariffs have been unchanged since 1969. Both residential and commercial post-paid (credit) tariffs are based on a declining block system (DES 2008). The residential tariff specifies the first 10 kWh per month at 25 cents per kWh, the next 60 kWh at 15 cents per kWh, the next 100 kWh at 10 cents per kWh and the remainder at 5 cents per kWh. The commercial tariff is similarly structured, but also attempts to factor in the KVA maximum demand component; the first 10 KVA at 20 cents, the next 100KVA at 7 cents, the next 100KVA at 6 cents and the remaining units at 5 cents.

The declining average and marginal prices do not, in themselves result in over-consumption of electricity; they are the classic second degree price discrimination that can result in output closer to the optimal quantity where marginal cost equals marginal revenue but at the expense of producers capturing some consumer surplus. It is the fact that marginal price is below marginal (opportunity) cost that causes over-consumption.

Declining block tariffs imply that the larger and arguably more affluent users pay less per unit than those less fortunate. Consequently declining block tariffs could be considered inappropriate, both in terms of structure and price, under the prevailing economic circumstances in Brunei. In fact the block decline in Brunei is so steep that for many households the average tariff would be approaching 5 cents per kWh. Industry analysis has previously indicated that across all sectors the average tariff received by DES was just 5.8 Brunei cents per kWh (Newton, 2001). There is currently also a pre-paid scheme at a flat rate of 6 cents per kWh. For reference, the Singapore residential tariff in October 2010 is 23.34 Brunei cents per kWh (Singapore Power, 2010) and Malaysia has an increasing rate block ranging from 21.8 sen per kWh (9.5 Brunei cents) for less than 200 kWh to 44.6 sen per kWh (19.4 Brunei cents) for greater than 901 kWh (Tenaga Nasional Berhad 2010). There is no formal rationale for the highly subsidized price of electricity in Brunei. It could be argued that cheap energy is a good incentive to attract foreign direct investment but there is no high energy industry in Brunei at the present time and potential investments in aluminium smelting and other heavy industry have typically involved individual negotiations over energy prices. A more likely rationale is that it was originally conceived as simply a method by which to share the oil and gas wealth with the country's citizens.

3.1 Estimated commercial prices

This section uses a cost-of-service methodology to estimate the prices of electricity using both the production cost of gas and its opportunity cost (see Lawrey, Pillarisetti & Siddiqui, 2006). The cost-of-service method uses the summation of operating and maintenance costs, depreciation, corporate and property taxes if appropriate, and an allowed rate of return on an approved rate base of depreciated capital. These costs are then divided by annual output in order to calculate costs per kilowatt-hour as shown in equation (1):

$$COS = \frac{O+T+D+rK}{V} + \frac{F}{e} \quad (1)$$

Where O is operating and maintenance cost; T is corporate and property tax, if applicable; D is depreciation; r is the allowed return on rate base; K is the rate base of depreciated capital; V is volume of output in kilowatt-hours; F is fuel cost per kilowatt-hour; and e is a thermodynamic efficiency coefficient. One kWh of electricity is equal to 3.6 megajoules of energy so if there were no thermodynamic conversion losses the fuel cost of one kWh would be the cost of 3.6 megajoules of natural gas. In fact, the DES thermodynamic efficiency is estimated at approximately 23 per cent so fuel cost per kWh is:

$$(0.0036F_{GJ}/0.23)$$

where F_{GJ} is Fuel cost per gigajoule.

The data are from a variety of sources. The Brunei Department of Economic Planning and Development gives output figures for total electricity production in Brunei but capital and labour figures are only available for the DES. The depreciated capital base and labour costs are Brunei Treasury Statistics reported in Omar (2002). Repairs, maintenance and consumables, DES output, fuel costs and generation efficiency are from Newton (2001) adjusted for inflation. The DES provides a bundled service and does not track the unbundled costs of generation, transmission and distribution. A return of 8 percent on the depreciated capital base is allowed, representing the opportunity cost of capital, and fuel efficiency is the actual, estimated DES figure of 23 percent (Newton, 2001).

Because of the uncertainty regarding input data, results are, perforce, indicative. The estimated cost-of-service tariffs are 8 cents/kWh in the base case using the current subsidized gas price, indicating that the current tariff

structure is not even covering the cost of generation. When the production cost for gas is used, estimated cost of service is 9.47 cents/kWh and opportunity cost for gas results in a cost of service of 16.75 cents/kWh indicating a subsidy of approximately 10.75 cents/kWh. (Note 1) With consumption at 2656GWH in 2006, this results in a total subsidy of approximately B\$286 million per annum, which is approximately 1.6 per cent of 2007 GDP of B\$18.148 billion (JPKE, 2007a).

The most obvious implication of the subsidy and declining block tariff price structure is over-consumption of electricity, with per capita use double the world average and 80 per cent of the 32 high income countries (UNDP); and this is in a country with very little industry and temperatures of 24-34 degrees all year (see Figure 2). Another effect of the tariff is the forgone revenue that could have been used for other socially beneficial programmes. In addition, although the opportunity cost argument holds even when the source of electricity is renewable, like hydro-electricity, benefit forgone becomes more obvious with a depleting resource like natural gas. A further issue relates to the contribution to global warming of over-consumption of gas-fired electricity.

The issue of revising tariffs is inextricably linked to the ownership of the utility. Although the government is investigating the possibility of privatisation, in general, the possibility for competition in Brunei is more limited than in most other markets. The possibility of a competitive market developing can be considered by looking at technical and institutional factors. The extent of scale economies in electricity generation means that the approximately 700 MW of currently installed capacity in Brunei could theoretically be met with just 2 or 3 gas turbines operating at minimum efficient scale (EIA, 2008a). According to the EIA, it is only in the non-conventional areas such as solar thermal, biomass, wind photovoltaic etc. that less scale economies allow for minimum efficient scale (MES) to be achieved with less capacity but with higher capital cost. In Brunei at the present time the DES makes use of industrial frame type machines whereas the BPC has 14 aero-derivative gas turbines, site rated at 19MW. Theoretically, a generating company could operate with as little as three of these aero-derivative machines allowing for the possibility of some competition in generation. However, although these machines are small by conventional standards, the possibility of competing generators bidding in a wholesale electricity market seems somewhat too ambitious in a market with just some 50,000 households (JPKE, 2005).

Barriers to entry in the Brunei electricity market also exist because of the uncertainty that still exists about the government's approach to foreign direct investment and delays in obtaining regulatory approval. Entry by new local players is hindered by the underdeveloped capital market, lack of technical expertise and the inherent uncertainty because of long lead times associated with power station construction and commissioning. Uncertainty about the government's regulatory approach and electricity tariffs post privatisation reinforces these barriers (see Kwoka, 2008 for a discussion of barriers to entry in electricity generation in the United States).

The first, and possibly last, stage of the deregulation process in electricity is likely to be estimating true costs of production, especially for the government DES, and ascertaining the depreciated asset base of the two producers, which could then form the basis for cost-of-service type calculations or some sort of leasing arrangement with the private sector, or both. One advantage for Brunei is that the Berakas Power Company (BPC) and the DES currently operate completely segregated networks on an entirely different basis. While the DES is a government department, BPC is owned by the Brunei Investment Agency (BIA), operates as a private company and reports to a Board of Directors. Although its mandate is to provide reliable supply of electricity rather than maximise profit, it does appear to be operating on a commercial basis, given the subsidized gas and that it sells the majority of its output to the DES at an agreed price.

4. Petrol usage and subsidies

The oil and gas industry in Brunei is dominated by Brunei Shell Petroleum Sdn. Bhd. (BSP), which is owned 50% by the Brunei government and 50% by Shell International. Until recently it was the only producer of oil and gas in Brunei. Other related companies with the same ownership are Brunei Shell Tankers (BST), which transports the LNG to overseas markets, and Brunei Shell Marketing (BSM), which sells petroleum products at petrol stations in Brunei. Brunei Liquefied Natural Gas (BLNG), which liquefies the gas produced by BSP, is owned 50% by the Brunei government, 25% by Shell International and 25% by Mitsubishi Corp. Brunei Gas Carriers (BGC) was formed in 1998 to build and manage LNG vessels. It is owned 80% by the Brunei government 10% by Shell International and 10% by Mitsubishi Corp.

The only other oil company with production in Brunei is Total S.A. which operates the Maharaja Lela/Jamalulalam field which produced gas equivalent to 28,500 barrels of oil per day in 2007. The gas is sold to BLNG for liquefaction and export.

Companies involved in exploration include Total S.A., BHP Billiton and Amerada Hess on offshore Block J. A production sharing agreement for this Block was signed in March 2003 but exploration activities have been suspended since May 2003, awaiting the resolution of a border dispute with Malaysia. The Block K group consists of Shell, Conoco and Mitsubishi. Two onshore blocks L and M are also being explored. Block L is operated by Nation's Petroleum in a consortium including Loon Brunei Ltd and QAF Brunei Sdn Bhd. Block M is operated by TAP Oil. Survey work started on Blocks L and M in 2008 (PetroleumBRUNEI, 2008).

Retail petrol prices are highly subsidized with Regular (RON 85) petrol priced at 36 Brunei cents/litre (US\$0.26), Super (RON 92) at 51 cents/litre (US\$0.36) and Premium (RON 97) at 53 cents/litre (US\$0.38). Diesel is 31 cents/litre. Brunei Shell Marketing (BSM) is the only retailer of petrol in Brunei although some of its stations are operated by independent operators or franchises. The cost of petrol delivered to the stations is fixed, as are margins and final prices. This arrangement and the retail prices have been in place for many years. Retail prices are the same now, in 2010, as they were when the weighted average price of crude oil received by Brunei was US\$13.43 in 1998 (JPKE, personal communication).

There is one small refinery in Brunei but petroleum products are also imported and have increased in value recently from B\$5 million in 2002 to B\$37 million in 2006 (JPKE, 2007b). "Back-of-the-envelope" market prices can be estimated using the Energy Information Administration (EIA, 2008) breakdown of pump prices. At US\$80/bbl and 159 litres per barrel the crude cost of one litre of crude oil is US\$0.50. To this is added refining cost of US\$0.13/litre (maintained at the 2007 figure) and distribution costs of US\$0.04/litre. Brunei is a small country so the distribution figure is half that used by the EIA for the United States, although the refining figure is kept the same. There are no sales or other taxes on petrol in Brunei so these three components give a market price of US\$0.67/ltr (B\$0.94/ltr) and a subsidy of B\$0.41/litre for Premium petrol and B\$0.63 cents for diesel. Note 2 Working backwards, if refinery and distribution costs are deducted from the retail price, the residual amount is the price of crude. A retail price of B\$0.53/litre equates to a crude price of approximately US\$34/bbl. At world prices below US\$34/bbl the Brunei government is accumulating a surplus but at the current time it is providing a large subsidy. Approximately 44 per cent of automotive fuel sales is diesel with Premium petrol at 39 per cent. Refinery output in 2006 was approximately 800 M. Ton/day of which approximately 300 M. Tons was gasoline and 200 M. Tons was diesel. The estimated total values of subsidies are shown in Table 1.

With sales of petrol and diesel of 3 130 000 barrels (498 million litres) in 2006 (JPKE, 2007a), a crude estimate of the subsidy to automotive fuel amounts to approximately B\$262 million per annum, or 1.5 per cent of GDP.

The recent extreme volatility in oil, and to a lesser extent, natural gas prices highlights the difficulty in calculating subsidies. Since the OPEC average monthly basket price of crude oil peaked at US\$131.22/bbl in July 2008, it has declined to US\$41.41 in February 2009 and subsequently recovered to US\$81 in October 2010 (oil-price.net 2010). Market prices for commercially produced electricity have reflected these changes. But it is questionable to what extent these price changes have reflected the economic ideal of marginal social costs (comprising marginal extraction cost plus marginal user cost plus marginal external cost, see Pearce and Turner, 1990; Lawrey 1999).

5. Policy issues and concluding comments

The impact of energy subsidies and declining block tariffs in Brunei can be seen in the way society has become dependent on electricity. Buildings tend to be designed to use air conditioning and to limit natural light, since sunshine will make the air conditioning work less efficiently. Accordingly, artificial lighting goes hand in hand with air conditioning.

Regarding petrol, there are very few bicycles or motorcycles in Brunei and car ownership is one of the highest in the world at approximately 550 registered vehicles for every 1000 people in 2002 (Energy Division, 2007). Moreover, in 2002 approximately 74 000 of the population were temporary residents working in the private sector, who are less likely to own their own cars, thereby increasing the degree of motorisation among Brunei citizens and permanent residents (JPKE, 2002a). Nevertheless, a significant proportion of the working class population appears to live on low incomes with reported average hourly earnings in 2006 at just B\$2.62 for a labourer, B\$3.49 for a carpenter and \$6.34 for an electrician (JPKE, 2006). Average hours worked per week are approximately 50 in these occupations. This part of society would be greatly affected by increases in electricity prices.

We can consider two primary issues associated with the removal of subsidies. One is the implication for efficiency and welfare. The second concerns the possible institutional arrangements in a deregulated market. The efficiency argument against subsidies is that pricing below marginal cost results in a deadweight loss. Consumers are not faced with the true opportunity cost of energy production and have little incentive to conserve.

Pricing even below production cost – as in the case of gas as fuel for electricity generation - gives producers no incentive to explore for and develop new gas reserves either, although the majority of production is exported at world price. Moreover, since natural gas and oil are physically finite, their current over-consumption has consequences for sustainability of the economy. However, while forgone benefits in terms of social programmes have been mentioned by government officials, the possibility of returning the subsidy to consumers in cash has not been raised. Given the socio-economic conditions in Brunei, removing the subsidies even with a compensating cash transfer may not unambiguously improve welfare. Besides, cash transfer programs require appropriate institutions which are often not present in many developing countries including Brunei. In the absence of an actual Pareto improvement, welfare economics has difficulty in making prescriptive policy recommendations. (see UNEP, 2002; EEA, 2004; Lawrey, 2003).

Given that the complete removal of subsidies is not a straightforward issue, we put forth several policy recommendations to lessen fiscal burden and to reduce the energy footprint of Brunei.

- i. The declining block tariff structure should be replaced with either a flat rate or increasing block tariffs, off peak water heating and possibly air conditioning, and time-of-day pricing. This would allow the lower income groups to meet their basic needs while encouraging conservation where discretionary use of electricity is involved (see, e.g., Hadi, 2008). This will affect building design towards efficiency in energy use.
- ii. Thermal efficiency in generation must be improved for the current estimate of only 23 per cent. While subsidised prices protect consumers from high market prices they also give no incentive for the generator to improve efficiency. Cost-based pricing will only result in efficient outcomes when the costs themselves reflect least-cost production.
- iii. Alternative renewable energy sources should be developed aggressively and incentives to switch be provided for solar water heating and others. Brunei has significant potential for solar energy development.
- iv. Regarding petrol, there is substantial scope for increasing the availability, quality and acceptance level of public transport, car pooling or other innovations.
- v. Compared to the international target of approximately 10–12%, the Bruneian electricity supply industry shows high system losses of about 20%. One of the targets of the Power Development Policy entails “to plan, design and commission low loss transmission and distribution system”. Significant savings in energy consumption can be achieved through reduction of system losses (Asia Pacific Energy Research Centre (APEREC) (2008), Brunei Energy, 2008).
- vi. Finally, Brunei is a small and well integrated society where education and other extension programs have significant potential in enhancing voluntary reduction of energy use. Increased awareness of the high opportunity cost of subsidies and adverse environmental consequences of over consumption of energy may motivate people to voluntarily reduce consumption. One of the goals of the DES is: “Promoting energy conservation and clean environment”. The Brunei Energy Association (BEnA), established in 2002, plays a major role in the development of the energy industry and in promoting energy conservation and efficiency. The Energy Efficiency Conservation Committee (EECC) aims to promote public awareness on the importance of energy efficiency and conservation.

The nature of the Brunei economy and society is that the wealth from oil and gas has been shared with the population through a variety of subsidies. However, the extent of the subsidies and the drive for efficiency and commercialisation has recently raised the issue of their reduction or removal. The issue is complicated by the fact that the vast majority of Bruneians work in the public sector where benefits are very good but salaries have not increased for many years. Removing subsidies would hurt all consumers but would be particularly painful for the lower paid especially with no formal welfare system in Brunei.

The issue is one of sequencing policy changes. A change in policy to promote efficiency must be considered as part of a change in the nature of the economic system and incentives, possibly to include a comprehensive welfare safety net, not taken as an *ad hoc* measure without explicitly considering the nature of the society in which these changes are occurring. As Stiglitz (2003) has argued, it is often the sequencing of policies and the particular circumstances of the country concerned that are critical for successful development rather than the merits of an individual policy seen in isolation.

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Notes

Note 1. One reason this is below current tariffs in regional neighbours such as Singapore and Malaysia is that this calculation used an average of contract gas prices received by Brunei from 2005-2007 rather than 2008 oil or gas prices.

Note 2. For simplicity this assumes refining and transportation costs are the same for premium gasoline and diesel.

Note 3. In January 2008, when oil was trading at approximately US\$100/bbl, it was reported that the Brunei government had estimated costs of production of approximately B\$1.12/ltr for diesel and B\$1.13/ltr for Premium (see Hadi, 2008).

Table 1. Estimated subsidies on automotive fuels (Note 3)

Product	Regulated Price (B\$/ltr)	Estimated cost (B\$/ltr)	Subsidy (B\$/ltr)	Consumption (thousand litre, 2006)	Annual subsidy (B\$ millions)
Premium	\$0.53	\$1.29	\$0.41	194 775	\$80
Super	\$0.51	\$1.29	\$0.43	30 369	\$13
Regular	\$0.36	\$1.29	\$0.58	54 060	\$31
Diesel	\$0.31	\$1.29	\$0.63	218 466	\$138
Total				497 670	\$262

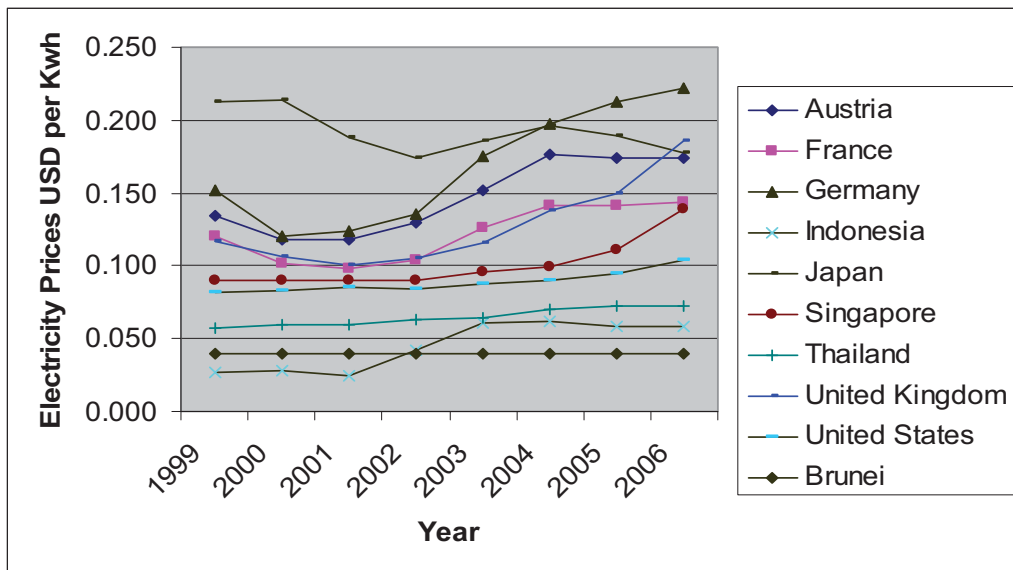


Figure 1. Electricity Prices

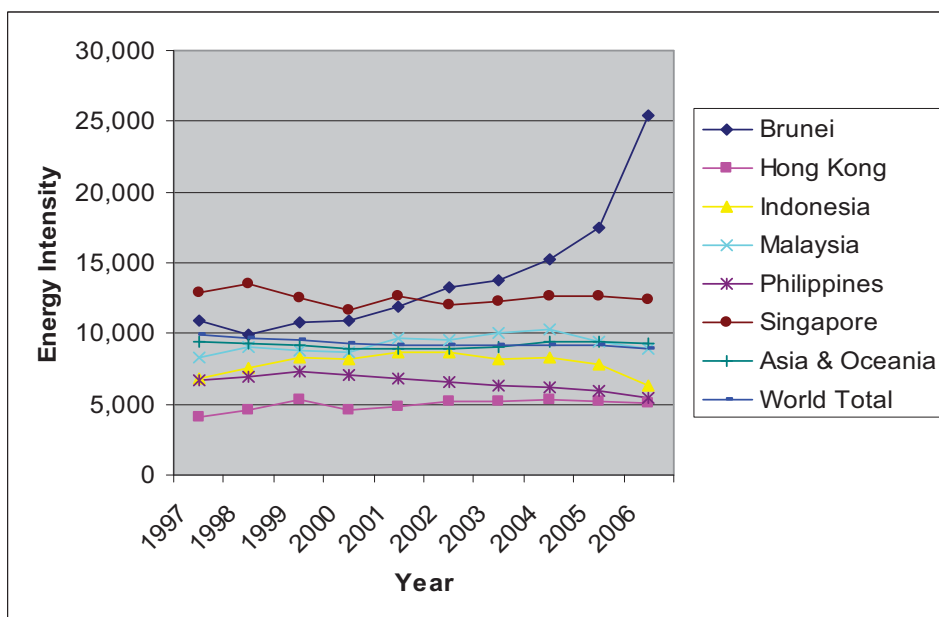


Figure 2. Energy Intensity