Energy Use and Efficiency in Fiji: Is Price Policy Effective?

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Abstract

Energy security is a major issue for policy makers, particularly in small energy dependent developing countries which source most of their energy requirements externally. Fiji relies heavily on non-renewable sources for energy supply despite government's continued efforts to increase energy sourced from renewable energy technologies. We note that only 31% of energy in Fiji has been sourced from renewable energy technologies; this falls far short of the desired renewable energy target of 90%. This paper examines Fiji's performance in using price policy to change the energy use behavior.

Introduction

Energy is one of the most important and critical elements of development of any society. It is the basic building block of economic development, linking all sectors of the economy. Economists have, thus, examined causal relationships between energy consumption and economic growth (Kraft and Kraft, 1978; Beenstock and Willcocks, 1981; Samouilidis and Mitropopulous, 1984; Yu and Choi, 1985; Erol and Yu, 1987; Cheng and Lai, 1997; Yang, 2000; Stern, 2000; and Adjaye, 2000).

Energy has further established its critical importance given the world wide transformation of economy towards IT based production systems. These systems are heavily energy dependent; absence or temporary shutdown of supply creates chaos in the economy. Furthermore, with the increasing world population and the growth of conventional energy dependent manufacturing and industrial sector, the demand for energy in the world is steadily increasing.

Among various energy products, electricity is the leading high-

quality energy, forming the material base of industrial production and people's lives. It is the most flexible form of energy that constitutes one of the vital infrastructural inputs in socio-economic development.

Given the rise in demand for energy products amidst limited supply, escalating prices and negative environmental issues arising out of the use of conventional energy sources, countries have begun seeking alternative sources for energy (in particular, renewable energy products), finding more energy efficient ways of doing things (for example switching to utilization of energy efficient appliances and machinery), and making behavioral and life style changes to conserve as well as improve energy efficiency.

Renewable energy supply requires massive upfront investment in capital equipment. This is a major constraint for small developing countries. Amid various other limitations, including fiscal constraints, allocation of funds for investment in renewable energy technologies which will provide returns in the medium to longer run is not an easy decision for policy makers. Switching from the use of older energy intensive appliances and machinery to more energy efficient ones are also not something that can be undertaken in the short term. Options require a long term strategy.

Lifestyle and behavioral changes towards energy efficiency is easier to achieve with significant use of price policies. The responsibility for the generation and supply of electricity rests largely with Fiji Electricity Authority (FEA). Over the last decade, the FEA has repeatedly asked for increases in tariff rates claiming that low tariff rates not only inhibits it from making investments into renewable energy projects but also may produce a bleak future for the company. On the other hand, consumer advocates have been asking for reduction in tariff rates arguing that people cannot afford to pay higher rates. In this paper, we assess the impact of tariff changes on energy consumption and efficiency.

Energy and Electricity Demand in Fiji

Over the past few decades significant changes have taken place in the energy sector in Fiji. Current data is unavailable; data available shows that only 31% of energy is obtained from renewable energy sources while the remaining is obtained from mineral fuel imports (see Table 1).

Table 1: Energy Source and Use, 2000-2004

Variable	2000	2001	2002	2003	2004	2004(%)
Energy Supply/ Source						
Fuelwood (TJ)	7,110	7,279	7,051	6,811	6,866	*12.1*
Baggase (TJ)	8,301	6,235	7,477	5,897	6,913	*12.1*
Hydro (TJ)	4,517	5,046	4,907	3,747	3,944	*6.9*
Solar (TJ)	0.04	0.05	0.04	0.03	0.02	*0*
Coal (TJ)	1.3	289	362	366	1	*0*
Petroleum (TJ)	16,938	34,046	36,226	35,864	39,252	*68.9*
Total Energy Use	*36,867*	*52,895*	*56,023*	*52,685*	*56,976*	*100*
Energy use by Sector (%)						
Industrial	1.0	1.0	1.0	13.0	14.0	n.a
Commercial	25.0	24.0	26.0	19.0	22.0	n.a
Residential	16.0	15.0	16.0	12.0	14.0	n.a
Transport	49.0	48.0	47.0	38.0	42.0	n.a
Agriculture	9.0	8.0	8.0	15.0	8.0	n.a
Government	0.5	0.5	0.5	0.4	0.5	n.a
Non Energy	0.0	3.0	3.0	3.0	0.0	n.a

(Source: Department of Energy's unpublished Energy Statistics yearbook, 2000-2004)

The sector using the most energy is transportation followed by Commercial/Industrial. The transportation sector, which consumes 42% of the total energy, uses mineral fuel only; hence contributes to major import dependence single handedly.

Post 2004, there have been few major renewable energy projects that have been commissioned which would add to raising renewable energy base for Fiji, while reducing mineral fuel use. However, the level of mineral fuel imports use and imports are still very high.

Over the period 1980-2009 the total electricity consumption in Fiji grew from 202.8m KWh to 715.3mKWh, an increase of 253% with an annual rate of growth of 8.4%. Mineral fuel consumption also grew, but at a much lower growth rate. In 1980, mineral fuel energy consumed was 85.3 million litres, which grew to 91.4 million litres in 2009; an increase of 7% with an annual growth rate of 0.23%.

While increase in energy consumption is a normal and good sign of a growing economy, its impact on the country's foreign reserve position is what concerns policy makers. In 2000, the total mineral fuel import bill

stood at F$1,822m, which amounted to 18.7% of the total export bill. This has now increased four-fold and comprises around 33% of total imports (Table 2). In terms of exports, we are paying more on imports of minerals fuels alone than the entire visible export earnings (118%).

Table 2: Mineral Fuel Import, 2000-2011 (F$,000)

Year	Mineral Fuels Import	Total Import	MFI as % of Tot. Imp	MFI as % of Tot. Exp
2000	339,995	1,822,222	18.66	34.14
2001	449,118	2,017,051	22.27	45.33
2002	441,388	1,970,000	22.41	50.50
2003	470,534	2,284,730	20.59	49.10
2004	596,086	2,501,639	23.83	62.70
2005	802,607	2,722,787	29.48	94.69
2006	1,043,453	3,124,342	33.40	125.07
2007	976,998	2,890,072	33.81	117.88
2008	1,252,068	3,601,404	34.77	127.40
2009	743,070	2,807,950	26.46	83.04
2010	1,130,356	3,464,614	32.63	106.78
2011	1,189,581	3,911,252	30.41	118.02

Note: Mineral Fuel includes motor spirits, aviation turbine fuel and gas (diesel) oil.
(Source: Bureau of Statistics Key Statistics, December 2012 and December 2005)

The substantial loss of income to imports of mineral fuels alone makes the Fijian economy rely heavily on the non-visible export sector such as tourism and remittances to help sustain the flow-in of imports. In the longer run, with income volatility in the external economies, this scenario could make our economy quite vulnerable.

Tariff Change and Consumption: Did Electricity Price Policy Work?

Electricity Generation and Renewable/Non Renewable Mix

Given the fact that 38% of the total electricity is generated from imported mineral fuels (Table 3), policy makers and regulators have been questioning whether electricity in Fiji is correctly priced. Incorrect pricing of electricity, in this case, a price below the market price, would result in excessive and inefficient consumption of electricity, high importation

of minerals fuels thus contributing to worsening foreign reserve position and negative environmental implications arising out of mineral fuel use, inability of FEA to create surplus and make forward looking investment to raise renewable energy production; and, inability of government to attract private investors into producing electricity via renewable energy technologies.

Table 3: Total Electricity Generated (GWh) in Fiji, 2008-2015

Year	2008	2009	2010	2011	2012*	2013*	2014*	2015*
Total Generation	797	798	854	837.2	822.8	838.4	855.1	872.3
Wailoa (FEA)	463	436	383	424.8	466.8	350	400	400
Nagado (FEA)	13	8	11	10.3	8.9	11	11	11
Wainikasou (FEA)	18	16	19	19.4	18.7	18	24	24
Waniqeu (FEA)	1	0	1	2	1	1.5	1.5	1.5
Butoni Wind (FEA)	5	7	6	5	6.8	6	6	6
FSC Lautoka (IPP)	12	7	10	13.5	9.9	15	15	15
FSC Labasa (IPP)	7	10	4	4.8	4.6	7.6	15.1	15.1
Tropik Drasa (IPP)	9	4	5	17.6	4.9	5	5	5
Nadarivatu (FEA)	0	0	0	0	29.9	100	100	100
Vuda Biomass (IPP)	0	0	0	0	0	0	0	100
Delta Nausori (New IPP)						1.4	24.8	37.3
Delta Nadi (New IPP)						2.8	24.8	37.3
Diesel & HFO (FEA)	269	310	415	339.8	271.3	320.3	227.8	120.2
Tot: Renewable Energy	528	488	439	497.4	551.5	518.1	627.3	752.1
Tot: Non Renewable En.	269	310	415	339.8	271.3	320.3	227.8	120.2
% Renewable Energy	66.2	61.2	51.4	59.4	67.0	61.8	73.4	86.2

(Note: * are projected figures)
(Source: Fiji Electricity Authority)

Electricity Tariff Rates: Fiji and the PICs

In light of the above concern, and based on a submission from FEA, the Commerce Commission undertook a study to examine the appropriate level of electricity tariff Fiji should have which, while discouraging inefficient energy usage, will also provide a reasonable degree of surplus which FEA could use to improve its current infrastructure and also, invest in new renewable energy sources.

In this exercise, the Commission utilized two approaches. Firstly, it

examined the cost structure of electricity production, distribution and retailing with a view to provide FEA a tariff rate which will have a market based mark-up. Based on a cost modeling exercise using FEA's data, the Commission noted that given the energy prices prevailing in October 2011, and the renewable and non-renewable energy mix, the unit cost of electricity provided by FEA stood at 31.8 cents per KwH (Table 4).

Table 4: FEA's Unit Cost of Retailing Electricity, October 2011

Energy Type	**Unit Cost Generation (c/KwH)**	**% of total Energy**	**Weighted Average Cost**
Mineral Fuel Electricity	34.2	33	11.3
Hydro Electricity	11.2	67	7.5
Weighted Average Unit Cost of Generation (G) (cents/KwH).			18.8
Overhead: Unit Cost of Transmission (T)/Distribution (D) and Retailing (R)			13.0
Total Unit Cost of GTDR, cents/KwH.			31.8

(Data: FEA, 2011).

Secondly, to safeguard against providing mark-up on a unit cost derived out of an inefficient production, distribution and retail cost structure benchmarking data was obtained. The benchmarking data for different countries are only available at the retail level. The tariff structure of Fiji along with other countries in the PICs are provided in Table 5.

Table 5: Average Electricity Tariff rates in the PICs

Country	**Tariff Rate (F$/kWh) as at *01/04/2010***
Kiribati	0.62
Niue	0.84
Palau	0.43
Cook Islands	0.94
Tonga	0.89
PNG	0.60
Tuvalu	0.69
New Caledonia	0.61
Samoa	0.59
Solomon Islands	1.48
New Zealand	0.48
Australia	0.42
Fiji	***0.26***

(Source: Various country sources; tariff rates converted to FJD equivalent using exchange rates at the prevailing date.)

While the members of the public and business houses in particular complained about the tariff rise and its impact on the business cost structure, the data presented in Table 4 shows that the tariff rates charged in Fiji is the lowest in the entire Pacific Island Countries.

Electricity Consumption: Aggregate and Sectoral

Following the change in tariff rates in November 2011 and April 2012, it would be of interests to all stakeholders to examine the impact it had, if any, on consumption levels over time as well as across sectors.

A perusal of electricity consumption data over the last 4 years reveals, as shown in Table 6, that total electricity consumption fell between 2010-2012. This fall in consumption is prima facie evidence that the use of price policy to address issues of consumption of natural resources can be effective.

Table 6: Aggregate Electricity Consumption, 2009-12 (Million GWh)

Month	**2009**	**2010**	**2011**	**2012**
January	52.158	60.554	63.744	63.197
February	61.369	61.879	59.348	59.685
March	60.403	65.310	63.702	64.121
April	59.130	63.509	63.494	57.979
May	59.880	64.965	63.289	61.586
June	56.629	58.511	61.094	58.877
July	58.946	61.332	58.405	58.328
August	57.796	61.332	59.300	59.204
September	56.552	62.323	57.943	59.568
October	59.621	62.041	60.214	63.252
November	61.174	59.708	61.455	61.997
December	59.476	61.913	61.945	59.985*
Total Consumption	703.133	743.377	733.934	727.779

* A large proportion of FEA power lines/transmission was knocked down from 17 Dec 2012 to mid-January 2013 due to Cyclone Evans.

(Source: Data obtained from Fiji Electricity Authority)

Real output during 2009-2012 increased by 4.5% (Table 7). Correspondingly, during the same period, electricity consumption in commercial and industrial sectors increased by 5% and 10.8%, respectively. But the institutional and household sectors saw reductions in energy consumption. This provides prima facie case of price policy's impact on reducing inefficiency of energy usage. Data from other sectors need to be collected over a longer period, as these sectors, particularly industrial and commercial, would be sticky to the status quo if alternatives are perceived to have large risks.

Table 7: Sectoral Electricity Consumption, 2009-2013 (M GWh)

Sector	**2009**	**2010**	**2011**	**2012**	**% Change 2009-12**
Residential	204.599	205.009	197.264	193.885	-5.2
Monthly Avg	17.050	17.084	16.439	16.157	
Commercial	313.848	336.156	331.985	329.571	5.0
Monthly Avg	26.154	28.013	27.665	27.464	
Street Lights	4.094	4.055	4.183	5.617	37.2
Monthly Avg	0.341	0.338	0.349	0.468	
Industrial	172.991	189.887	192.994	191.677	10.8
Monthly Avg	14.416	15.824	16.083	15.973	
Institutions	7.611	8.281	7.519	7.039	-7.5
Monthly Avg	0.634	0.690	0.627	0.587	
Total Electricity	703.143	743.387	733.944	727.789	3.5
Real GDP (F$m)	4,357.30	4,363.70	4,445.30	4,554.40	4.5

(Source: Data obtained from Fiji Electricity Authority)

Renewable Energy: Initiatives and Impediments

Government is seriously exploring ways in which it could increase Fiji's share of renewable energy source. In its 2011 budget address, the Prime Minister and Minister for Finance noted:

> ….Government will continue with its focus on renewable energy. Its incentives for investment in this area will continue. The new FEA tariff rates have also now enabled investors in the renewable energy sector to get viable returns on their investment by supplying to the national grid operated by the FEA. The inclusion of renewable energy as a sector to benefit from the RBF import substitution and export finance facility is an added incentive to invest in this area. There are other additional revenue measures that will reinforce Government commitment to reducing our energy consumption. It is imperative that we protect our environment and become more conscious and proactive in waste disposal and management (Minister for Finance, 2010: 32).

A number of initiatives have been undertaken by the government; these include:

1. Duty waiver on all importation of plant, machinery and equipment for bio-fuel projects;
2. Duty-free importation of renewable energy goods such as wind, solar, hydro, geothermal, biomass (turbines, panels, batteries, cogeneration plants);
3. An allocation of $2.7 million in 2011 budget for biodiesel projects;
4. $4 million allocation, through Japanese aid, for installation of solar home systems in rural homes and schools;
5. An allocation of $300,000 for renewable energy projects;
6. Diesel that is used for blending with biodiesel, attracts a duty concession of $0.13/L, from a duty of $0.18/L to $0.05/L;
7. Availability of a 10-year tax holiday for taxpayers undertaking new activities in processing agricultural commodities into bio-fuels as approved by the Commissioner from 1 January 2009 to 31 December 2014.

Despite the initiatives listed above, however, renewable energy contribution remains low. A critical examination of the above reveals several shortcomings in the approach. These include:

a) Less emphasis on the transportation sector: There is considerable emphasis on renewable electricity generation to reduce electricity generation via crude oil. However, there is not much emphasis on reducing mineral oil used in the transportation sector. In Fiji, only 30% of total energy use is accounted for by electricity, while 60% is accounted by mineral fuel use.

b) Lack of detailed Study on Energy Substitution: There is a lack of any detailed primary study on the level and degree of substitutability of the various energy products sector wise. Thus clear targets cannot be set and strategies and activities/investments lined up to achieve those targets. At the aggregate sector level, Reddy and Yanagida (1998) examine the degree of substitutability between sectors. Reddy (1998) examined the level of energy efficiency in the different sectors of the economy. While these studies provide evidence for substitution possibilities, they are based on secondary data. There remains the need for primary study on individual industries and on how these substitutions can be achieved.

c) Duty Exemptions pass-through effect: One of the reasons for low uptake of renewable products by users is the high capital cost of these products, duty exemptions notwithstanding.

Reforming of the Electricity Sector

The government is currently working on reforming the FEA. Electricity, like telecommunications, is supplied through extensive and very expensive grids. These require heavy capital investments – a factor which tends to give rise to natural monopolies. The grids are strategic assets which allow their owners to control the industry as a whole. In small markets, new players will not enter a market that is already nominated by a large player with an extensive grid. This eliminates competition in the industry. But without competition, it will be difficult to obtain price, volume and quality optimality.

Competition can be introduced in this industry if the grids can be organized under a 'common-carrier' regime, where the owner of the grid would be required to provide everyone with open and equal access to his strategic asset (see Reddy, forthcoming). The ownership rights and control over the grid need to be regulated in such a way that provides competition in both the source market as well as the retail end. It will allow electricity producers to sell their energy at a competitive price to the grid, and the retailer to retail the same in a competitive market. One cannot accommodate meaningful competition in generation with-out opening the grids to new generators.

The lack of an arms-length owner of a grid is one of the reasons for the low number of IPPs operating in Fiji. The FEA cannot be entrusted to examine IPP applications given its conflict of interest. Until such time the FEA is divided into three arms-length entities dealing with generation, distribution and retailing, IIP application processing and approval need to be done by an independent entity, possibly the Department of Energy.

Reforms of the above nature are not new across the globe. In the mid-to-late 1990s, several countries in the ASEAN region initiated wide-ranging programmes to reform their electricity sectors. These programmes were expected to result in fully competitive electricity markets encompassing independent and competitive generation and retail, commercially-focused monopoly networks and market-oriented governance arrangements. Large segments of these industries were privatized, with the governments assuming non-partisan roles, ensuring that the electricity business was conducted in accordance with the new market rules. Such reforms resulted in, albeit to different degrees and levels and at different rates for different countries, attraction of much needed foreign capital into these industries, improving their productivities and contributing to economic prosperity of these nations (Sharma, 2005). Due to lack of investi-

ble capital, Fiji has one main distribution grid from the major hydro power plants which, when damaged by floods or cyclones, cause major black outs and halt in plant operations. Such vulnerability needs to be dealt with immediately.

Summary and Conclusion

This study examined the energy consumption status in Fiji and identified some of the impediments to raising energy efficiency and renewable energy sources. The study shows that Fiji relies heavily on non-renewable sources for energy supply despite governments continued efforts to increase the renewable energy commitments. In 2004, only 31% of energy in Fiji was sourced from renewable energy technologies. This figure has is expected to have increased since then, as some major renewable energy projects have been commissioned since 2004.

However, despite these new projects, the bulk of the energy in Fiji is still sourced from non-renewable sources, in particular, from imported mineral fuels. The sector that continues to consume most of the energy is transportation (42%) followed by industrial/commercial (36%). In 2011, mineral fuel imports stood at $3.9 billion, which was equivalent to 30% of total imports and 118% of total exports.

Government attempted, through the Commerce Commission, to utilize a price policy to achieve efficiency gains in the electricity user sectors. This showed some positive impacts in the household and institutional sectors. But other sectors did not show much change. Data from industrial and commercial sectors needs to be collected over a longer period, as these sectors would be sticky to the status quo if alternatives are perceived to have large risks to their profitabilities.

Finally, the paper examined government initiatives in energy substitution. It, however, notes the negligible impact of the incentive policies. The paper proposes that a major breakthrough in getting independent power producers supplying electricity in Fiji can be achieved through reforming the FEA whereby the electricity grid and retailing functions are separated from the FEA, managed independently, and empowered thorough policy support to purchase energy supplied from non-traditional suppliers utilizing renewable resources.

Appendix 1: Electricity Tariff Change, Fiji, 2008-2011

Tariff Categories	Aug-2008	Sep-2009	Jun-2010	Nov-2010	Apr-2011
Domestic Category (c/kWh)					
Less than or equal to 250kWh/month average over a max 6-month rolling period	20.59	20.59	No longer applicable		
Greater than 250kWh / month average over a max 6-month rolling period	22.63	26.02	No longer applicable		
Less than or equal to 130kWh per month	New tariff band	20.59	17.2	34.84*	34.84*
Greater than 130kWh per month	New tariff band	26.02	34.84	34.84	34.84
Commercial and Industrial Category					
Up to 14999 kWh per month, c/kWh	24.91	28.65	37.47	39.34	42
In excess of 14999 kWh per month, c/kWh	24.06	27.67	39.47	41.44	44
Maximum Demand Tariff					
(i) Demands over 1000kW: per kWh/Month					
Demand Charge ($)	22.08	25.39	27.59	33.11	40.2
Energy Charge (cents)	14.44	16.61	18.81	24.92	33.5
(ii) Demands between 500kW to 1000kW: per kWh/Month					
Demand Charge ($)	22.08	25.39	27.59	31.73	38.5
Energy Charge (cents)	16.24	18.68	20.88	25.06	31
(iii) Demands between 75kW to 500kW: per kWh/Month					
Demand Charge ($)	22.08	25.39	27.59	31.73	36.2
Energy Charge (cents)	16.85	19.38	21.58	24.82	28.5
Excess Reactive Energy c/kWh					
Penalty Fee	17.08	19.64	19.64	44	44
Institution Tariff c/kWh	20.59	20.59	20.59	34.84	34.84
Street Light Tariff c/kWh	17.98	17.98	34.84	34.84	34.84

***** For units less than or equal to 75kWh per month, the customer will pay only 17.20 cents/unit and the rest will be subsidized. From November 2010, for Maximum Demand and Commercial & Industrial consumers who elect to take a power supply directly at the high voltage, a discount of 4% is allowed.

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