Energy Economics in Small Pacific Island Countries: Some Issues

Sunil Kumar
Hong Chen

Abstract

Development of renewable energy is now on the global agenda due to looming energy crisis and climate change impacts of fossil fuel emissions. While the science of renewable energy is necessary, understanding the economics of new forms of energies is equally urgent. Generally, the scientific knowledge and issues pertaining to the production and use of new energy forms may be universal but the economics of different forms of energies vary between countries and regions. The Pacific Island countries (PICs) are faced with a number of energy constraints and associated problems that are unique. This paper provides evidence of increasing energy bills for the PICs to establish a case for domestic alternatives.

Introduction

Production and consumption of commodities occur in the market only when they make economic sense. The law of economics, therefore, also applies to production and use of renewable energies. Even when the climatic agenda is so urgent and well-known, no production and consumption of renewable energy can occur in the market if its production and consumption does not make economic sense. No matter how environmentally friendly or scientifically proven the production and consumption of renewable energy is, at the end of day the production and use of that energy must be economically sound. For instance, commercial production and use of wind power at large scale can occur only when its costs are relatively lower than that of conventional energy. Similarly, solar electricity is a widely considered option in most tropical countries, but

economically, it is quite restrictive. Hydropower is in use on a large scale because it is economically viable. This option could be easily replicated because hydropower technology is available at reasonable cost and is environmentally friendlier than fossil fuel generators. Geothermal and wave energies are also viable options for many countries. Countries with technological know-how also opt for nuclear power; this, however, is not an option for PICs.

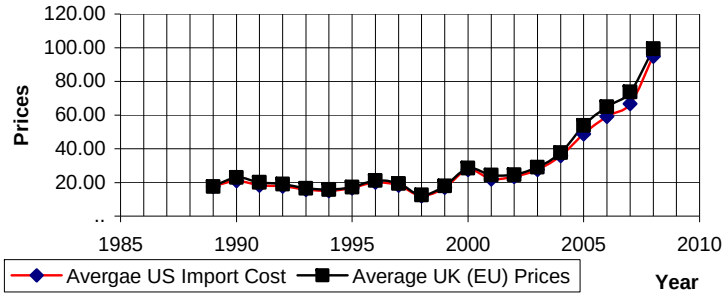
For the Pacific Island Countries, the choice of alternative energies is narrower since options such as nuclear power is technically too challenging, while options such as geothermal energy are minimal as of now (Marconnet, 2007). The economics of renewable energy in the Pacific Islands is determined by three key factors. First, the price of fossil fuel in the global market determines the opportunity cost of alternative energies. The associated political economies of imports of fossil fuel are also overbearing. The PIC governments collect significant tax revenues from imports of fuel to finance their expenditures. In addition, taxes are levied on the transport sector, which benefit government revenues. The second key factor is the cost of production of renewable energy. This has implications on the price at which renewable energy could be marketed domestically. The nature of available technologies determines this component of production cost. In the case of PICs, options are limited due to lack of investments and government support. In addition to the nature of technologies to produce new energies, the cost per unit also depends on the scale of production. Most PIC economies are very small, thus the scales of production are relatively limited, diminishing any possibility of exploiting economies of scale. The third factor is the nature and degree of environmental concerns among the PICs. Currently, the level of environmental concern among the PICs is high due to the economic and human costs of rising sea level and extreme climatic events like droughts, floods, and cyclones (see Nukuro, 2000).

Global Prices of Fossil Fuel: Impact on Renewable Energy

The global price of fossil fuel has generally not only been rising, but also rising much faster in recent years than it used to in the past. Figure 1 and Table 1 show that fossil fuel prices declined by about 9-10 percent on average in the period 1994-1998 against the average price in the period 1989-1993. During the period 1999-2003, the prices rose by approximately 45% and in the period 2004-2008, the prices rose by more than 160%. Global data shows that fuel prices increased much faster than the

non-fuel prices during these periods.[1]

Figure 1: Average Prices in Respective Currencies



Source: International Energy Agency, Database (2009)

Table 1: Five-yearly Average Prices of Fuel

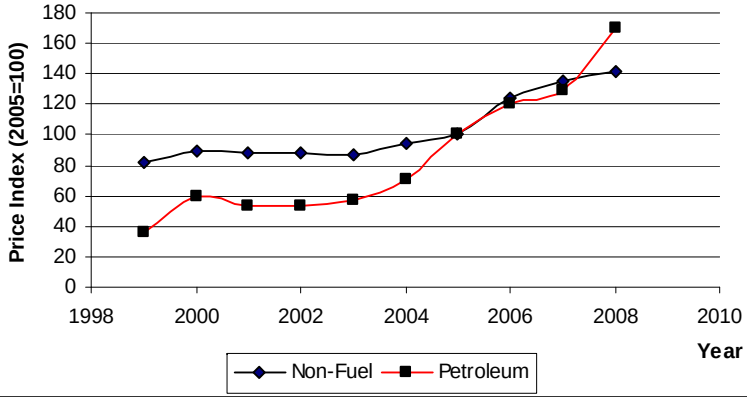
5-yearly Average	*Average US Import Cost*	*Average UK (EU) Prices*	*Rate of Change (US)*	*Rate of Change (UK)*
1989-1993	18.08	19.25	-	-
1994-1998	16.464	17.232	-8.9%	-10.5%
1999-2003	23.57	24.924	43.2%	44.6%
2004-2008	61.114	65.936	159.3%	164.5%

Source: International Energy Agency, Database (2009)

Data analyses in Table 2 and Figure 2 show that fuel price indices have increased at a much higher rate than non-fuel price indices.

[1] The non-fuel commodities comprise of food products and fuel consists of regular petroleum prices. The prices in Figure 1 are depicted by price indices.

Figure 2: Fuel and Non-fuel Price Indices (Trends)



Source: International Monetary Fund, Database (2009)

Table 2: Three-yearly Average Price Indices for Fuel and Non-fuel Commodities

Years	*Non-Fuel*	*Petroleum*	*Rate of Change Non-Fuel*	*Rate of Change Petroleum*
1999-2001	86.6	49.5	-	-
2002-2004	89.5	60.4	3.4%	21.9%
2005-2008	125.15	129.925	39.8%	115.2%

Source: International Monetary Fund, Database (2009)

There are two fundamental reasons why fuel prices increase faster than that of other commodities. First, the demand for fuel has continued to increase due to the expanding world economy, particularly growth in China, India and other Asian economies. This increase in demand of fuel puts pressure on energy resources globally. As household incomes increase, consumption of fuel increases considerably since energy often facilitates consumption of luxury goods. However, there is no clear consensus on GDP and energy consumption (Payne, 2010 and Hannesson, 2009). The unprecedented economic growth in Asia, particularly in China and India is putting intensive demand pressure on fuel markets (Lui and Jiang, 2009). Similar trends exist in other parts of the world that discernibly render global energy consumption unsustainable (Malyshev, 2009).

Scarcity, due to depletion of world reserves and higher cost of ex-

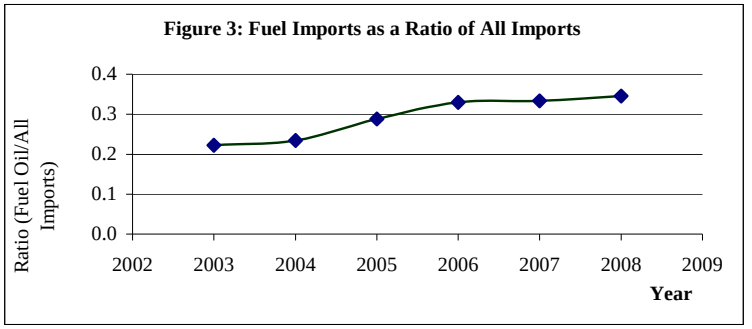
traction, would remain a problem. Although, new fields may be found by utilising better sensing technologies, the cost of extraction of those hidden reserves are likely to be much higher.

The effects of increase in price of fossil fuel on renewable energy resources are likely to be positive. As fossil fuel prices increase, the production of renewable energy sources would become relatively cheaper and thus, economically viable. Some examples of these are shown in the analysis later.

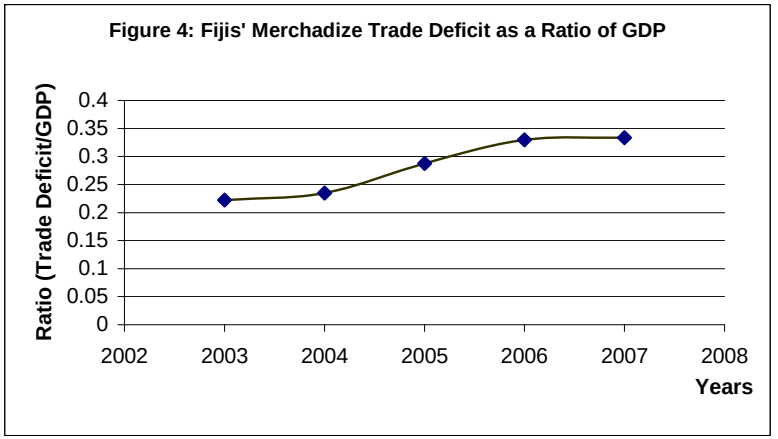
Pacific Islands Energy Consumption Trends and Issues

The Pacific Island countries are energy dependent small developing economies. They are prone to external economic shocks and have least ability to cope with such shocks in the short run. It is quite obvious that PICs do not have the capacity to escape surges in fuel prices. Fiji, for instance, suffers from huge balance of trade deficit, reaching unsustainable levels recently, prompting a devaluation of the currency in April 2009. A large part of the current account deficit arose from fuel imports, which has risen substantially in the last 5 years. Figure 3 shows that the ratio of fossil fuels to all other imports in Fiji has increased by approximately 13% points, from around 22% in 2003 to 35% in 2008. Combined with declining exports and increasing fuel bill, the deficit is likely to worsen. This scenario could lead to worsening economic conditions in Fiji. With the current trends, commodity trade deficit for Fiji could worsen substantially. The merchandise trade deficit as a ratio of GDP has been, as shown in Figure 4, increasing.

Similar trends exist in Samoa, Vanuatu, Solomon Islands and Tonga. Tables 3-6 show the fuel import bill for these countries. The trend shows increasing trade deficit for all the PICs; they also show that the fuel component of the deficits have been increasing. The increasing trade deficits are due to a combination of factors. Data shows that fuel as a component of imports has increased in all these PICs. While in Samoa and Vanuatu this increase has been low, in Fiji, Tonga and Solomon Islands the increases have been substantially higher. Tables 3, 4, 5 and 6 provide the details for the four PICs.



Source: FIBOS (2008)



Source: FIBOS (2008)

Table 3: Fuel Imports for Samoa (in Samoan '000s of Tala)

Year	Total Imports	Fuel Imports	Fuel Imports (as % of Imports)	GDP (in Current Prices)	Merchandize Trade Deficit	Deficit as % of GDP
2001	472,759	58,996	12.5%	836,601	-255,214	-30.5%
2002	447,465	58,221	13.0%	885,271	-207,335	-23.4%
2003	450,291	60,818	13.5%	948,164	-189,759	-20.0%
2004	583,264	83,222	14.3%	1,047,506	-346,096	-33.0%
2005	647,401	99,914	15.4%	1,129,520	-411,073	-36.4%

Source: Samoa Department of Statistics (2006)

Table 4: Fuel Imports for Vanuatu (in '000s of Vatu)

Year	Total Imports	Fuel Imports	Fuel Imports as % of Total	GDP (in Current Prices)	Merchandise Trade Deficit	Deficit as % of GDP	Fuel Import as % of Deficit
2001	13118	1859	14.2%	34125	-10223	-30.0%	-18.2%
2002	12433	1441	11.6%	32957	-9843	-29.9%	-14.6%
2003	12703	1846	14.5%	34185	-9450	-27.6%	-19.5%
2004	14306	1871	13.1%	36863	-10138	-27.5%	-18.5%
2005	16315	1837	11.3%	40387	-12189	-30.2%	-15.1%
2006	17744	2098	11.8%	45944	-13665	-29.7%	-15.4%
2007	20578	3722	18.1%	51980	-17541	-33.7%	-21.2%
2008	29021	4818	16.6%	NA	-17541	NA	-27.5%

Source: Vanuatu Department of Statistics (2009)

Table 5: Fuel Imports for Solomon Island (in '000s of SBD)

Year	*Total Imports*	*Fuel Imports*	*Fuel Imports as% of Total*	*GDP (in Current Prices)*	*Merchandise Trade Deficit*	*Deficit as % of GDP*
2001	450,430	74,353	16.5%	NA	-210,604	NA
2002	466,563	111815	24.0%	NA	-130,080	NA
2003	704,407	199406	28.3%	2,497,000	-204,312	-8.2%
2004	908,738	175640	19.3%	2,807,000	-267,724	-9.5%
2005	1,393,700	324574	23.3%	3,117,000	-604,890	-19.4%
2006	1,650,144	427225	25.9%	3,475,000	-724,812	-20.9%

Source: Solomon Islands Department of Statistics (2008)

Table 6: Fuel Imports for Tonga (in '000s of Pa'anga)

Year	*Total Imports*	*Fuel Imports*	*Fuel Imports (as % of Total)*	*GDP (in Current Prices)*	*Merchandize Trade Deficit*	*Deficit as % of GDP*
2000	123,145	21,531	17.48%	352,200	-107,321	-30.47%
2001	155,094	24,522	15.81%	396,900	-140,718	-35.45%
2002	195,130	25,696	13.17%	444,700	-164,697	-37.04%
2003	199,214	38,282	19.22%	470,900	-164,692	-34.97%
2004	206,381	40,865	19.80%	503,400	-175,826	-34.93%
2005	234,512	54,228	23.12%	577,300	-215,178	-37.27%
2006	235,692	65,344	27.72%	598,000	-216,675	-36.23%
2007	281,032	74,392	26.47%	649,200	-265,263	-40.86%

Source: Tonga Department of Statistics (2008)

The increase in fuel import bill, demonstrated by the data given above, leads to a common desire among the PICs to turn to renewable energy resources. This not only serves the domestic economic agenda but also contributes well to the global agenda on environmental degradation and climate change. However, the governments of the PICs need to take decisive action towards renewable energy options. For many of these countries, the decision regarding renewable energies could be a political one since these decisions entail resource commitment and investment support for producers and possibly consumers. Apart from changing the laws to permit mandatory implementation of such policies, many important policy changes would be necessary. For example, change to ethanol mix in the transport sector can be quite problematic. Such policy measures require appropriate change in the governing laws; the implementation of such laws could pose numerous logistical problems. PICs need international support to successfully implement such revolutionary development policies.

These policies also need closer coordination, and applied in consonance with the broader development policies. For instance, facilitation of production facilities for renewable energies (such as ethanol) and change of consumption laws need to be simultaneously put in place. Identifying investors domestically or globally to invest in PICs is fraught with problems. Even importing firms may need government support; establishing domestic capacities would be a huge challenge. Comprehensive investment policies may be needed to attract foreign investors in tiny PIC economies such as Kiribati, Tuvalu and Tonga. The bio-fuel sector in Fiji or other PICs would be far more challenging. The government of Fiji for instance, has already made moves to attract investors in the bio-fuel sector, though so far success has been limited (see Government of Fiji, 2009).

GDP Growth and Energy Consumption: An Econometric Analysis

In addition to the evidence for increasing energy bill for the PICs and the need for domestic alternatives to ease the currency pressure, in general, developing countries need substantive change in the pattern of energy consumption.

A preliminary econometric analysis of penal data for 35 countries for the years 2002-2007 show quite startling results. The analysis shows that developing countries as against OECD countries consume more en-

ergy per unit of total consumption.[2] By a crude implication, this establishes the point that there is a need for developing countries to become more energy efficient. This implies that as economies grow their energy consumption per unit of GDP should decline.

The analysis suggests that fuel price increases will cause greater proportional change in the ratio of fossil fuel energy consumption to total consumption. The ratio of fossil fuel energy consumption to total consumption in high income countries (OECD countries) is lower than that in relatively low income countries (middle income countries) sampled in the data. The coefficient for the OECD dummy is negative. So it can be implied that energy consumption dependence is higher for developing countries compared to high income countries. GDP and growth of industrial output are two other significant factors playing important roles in determining fossil fuel energy consumption. It means that macroeconomic imbalance with the rest of the world is increasing. As is the case for PICs, there is a need to improve their trade balance by either increasing their exports or by reducing imports, notably the consumption of imported fuel. Imports can be reduced by reducing fossil fuel consumption since the fuel bill for PICs is increasing at a disproportionately higher rate. But the question is how the consumption of fuel can be reduced if PICs were to attain higher levels of consumption. That is, reduce fuel consumption and yet grow economically. The answer may be that PICs need to find other forms of fuel that can be produced domestically.

This question of cheaper and environmentally friendly sources of energies is a global issue and needs global responses. This is where the renewable energies feature in our list of options. That is, while fossil fuel consumption is reduced, the overall consumption could be maintained if the production and use of renewable energies are introduced and enhanced. Their economic viability, however, remains questionable.

[2] The details are as follows:

$$FUELCONS_{i,t} = 1.35 - 1.08PRICE_t - 0.97OECD_{i,t} + 0.12GDP_{i,t} + 0.04INDUS_{i,t}$$

$$t-stat = (1.03)\ (-6.48)\qquad (-2.66)\qquad (2.26)\qquad (2.27)$$

$$R^2 = 0.09$$

$$n = 210 \text{ (35 countries, period: 2002-2007)}$$

where, FUELCONS = Fossil fuel energy consumption/total consumption;
PRICE = Natural Log of crude oil price;
OECD = dummy variable to distinguish OECD countries from the rest
GDP = Natural Logarithm of GDP;
INDUS = Growth rate of industrial value-added output.

Concluding Remark

With increasing fuel import bill and little or no prospect for domestic source of fossil fuels, PICs need constructive policies to deal with increasing trade deficits and stagnant growth. The challenge for PICs is not just reduction of fossil fuel consumption but to simultaneously realise economic growth and sustain overall consumption. For such outcomes policy makers need constructive or perhaps some revolutionary solutions to attain energy efficiency by adopting new and better technologies. These include well-structured energy policies that influence and motivate both the producers and consumers to adopt new technologies and energy forms that bring about energy efficiencies and enhance output. Forward looking strategies should have specific sector focus. For instance, in the case of Fiji, ethanol production and consumption may be a way to go (see Stuavermann and Kumar 2009). For other PICs such as Samoa, Tonga, Kiribati, Tuvalu and Micronesia, solar energy options may be more workable. Solomon Islands and Vanuatu have more natural options such as hydro, wind and solar power (see Wooldruff 2007 for more details).

References

FIBOS (2008) Key Economic Statistics, Fiji Islands Bureau of Statistics, Government Building Suva. Government of Fiji (2009) Supplement to the Fiji Budget Estimates 2010, Ministry of Finance, Government Building, Suva.

Hannesson, R. (2009) "Energy and GDP Growth" International Journal of Energy Sector Management, Vol. 3 No. 2, pp.157-170.

International Energy Agency (2009) Database, http://www.iea.org/textbase/nppdf/free/ 2009/key_stats_2009.pdf

Liu, X. and Jiang, X. (2009) "China's Energy Security Situation and Countermeasures" *International Journal of Energy Sector Management*, Vol. 3 No. 1, pp.83-92.

Malyshev, T. (2009) "Looking Ahead: Energy, Climate Change and Pro-poor Responses", *Foresight*, Vol. 11, No. 4, pp.33-50.

Marconnet, M. (2007) "Integrating Renewable Energy in the Pacific Islands Countries" A thesis submitted to the Victoria University of Wellington in fulfilment of the requirements for the degree of Master of Commerce and Administration in Economics, Victoria University of Wellington (Library database).

Nukuro, E. (2000) A Glimpse at the Pacific Island Countries' Population, Development and Environmental Issues, PAIEC Adviser, Suva Sub-Regional Office. http://www.spc.int/popadvocacy/A%20GLIMPSE%20AT%20THE%20PICS%20(PAPER).SVP.doc.

Payne, J.E. (2010) "Survey of the International Evidence on the Causal Relationship between Energy Consumption and Growth", *Journal of Economic Studies*, Vol.

37 No. 1, pp.53-95.
Samoa Department of Statistics (2006) Key Economic Statistics, South Pacific Commission (Prism Database), Noumea, New Caledonia.
Solomon Islands Department of Statistics (2008) Key Economic Statistics, South Pacific Commission (Prism Database), Noumea, New Caledonia.
SOPAC (2009) Potential for Liquid Bio-fuels in Fiji, Miscellaneous Report 677, Community Lifelines Program, Secretariat of the Pacific Islands Applied Geoscience Commission, Suva.
Stauvermann, P. and S. Kumar (2009) 'Can the Fiji economy be Saved by Ethanol Production', *Pacific Economic Bul*letin, Vol. 24, No. 3
Tonga Department of Statistics (2008) Key Economic Statistics, South Pacific Commission (Prism Database), Noumea, New Caledonia.
Vanuatu Department of Statistics (2009) Key Economic Statistics, South Pacific Commission (Prism Database), Noumea, New Caledonia.
Wooldruff (2007) "The Potential for Renewable Energy to Promote Sustainable Development in Pacific Island Countries", SOPAC, paper presented at 30th Conference of the International Association for Energy Economics, (Wellington, New Zealand, 17-22nd February 2007).

Authors:

Sunil Kumar and Hong Chen teach economics and statistics in the School of Economics at the University of the South Pacific, Laucala Campus, Suva, Fiji. Corresponding author: kumar_ss@usp.ac.fj