ADB

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Taking Control of Oil

Managing Dependence on Petroleum Fuels in the Pacific

Asian Development Bank

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6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

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Abbreviations and Acronyms

AAGR	annual average growth rate
ADB	Asian Development Bank
CO_2	carbon dioxide
CDM	clean development mechanism
CER	certified emission reduction
CFL	compact fluorescent light
CROP	Council of Regional Organizations of the Pacific
FEA	Fiji Electricity Authority
FSM	Federated States of Micronesia
GEF	Global Environment Fund
GHG	greenhouse gas
GWh	gigawatt-hour
IEA	International Energy Agency
IMF	International Monetary Fund
kW	kilowatt
kWh	kilowatt-hour
MDG	Millennium Development Goal
MEC	Marshalls Energy Company
MEECE	marginal effective electricity capacity expansion
MEPS	minimum energy performance standard
MW	megawatt
OED	Operations Evaluation Department
PDMC	Pacific Developing Member Country
PIEPP	Pacific Islands Energy Policy and Plan
PIEPSAP	Pacific Island Energy Policies and Strategic Action Planning
PIREP	Pacific Islands Renewable Energy Project
PNG	Papua New Guinea
PPA	Pacific Power Association
PREA	Pacific Regional Energy Assessment
PV	photovoltaic
RMI	Republic of the Marshall Islands
SOPAC	Pacific Islands Applied Geoscience Commission
SPREP	Secretariat of the Pacific Regional Environment Programme
UNDP	United Nations Development Programme
UNELCO	Union Electrique du Vanuatu Limited
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNEP	United Nations Environment Programme

FOREWORD

A reliable, secure and competitively priced energy supply is vital for promoting long-term economic growth and human development in the Pacific. World oil market developments in recent years have resulted in many Pacific Developing Member Countries (PDMCs) evaluating their heavy dependence on oil for meeting their energy needs.

Although oil prices fell sharply with the onset of the global financial crisis, prices have again begun to rise in response to signs of global economic recovery. This has considerable implications for PDMCs in terms of rising production and transportation costs being passed on in the form of more expensive goods and services, resulting in reduced economic activity. For example, higher air travel costs have the potential to adversely affect many PDMC economies by reducing the competitiveness of the tourism sectors of these countries.

Taking Control of Oil proposes a path for diversifying the energy mix in PDMCs. The report provides a comprehensive assessment of recent global oil prices trends, the exposure of PDMCs to oil price increases and its implications for social and economic development in the region. It also offers a number of policy options for managing risks associated with heavy dependence on oil imports.

This report was prepared as part of the output of the Asian Development Bank (ADB) regional technical assistance project (TA 6477 REG): Preparing a Response in the Pacific to High Prices, which was jointly funded by the ADB, the Australian Agency for International Development (AusAID), and the New Zealand's International Aid and Development Agency (NZAID). The goal of the project was to identify, develop and implement short-, medium-, and long-term response plans to commodity price increases in PDMCs in order to promote sustainable development in the region. In order to achieve this, the report is expected to contribute to improved energy planning and policy-making in PDMCs.

The publication was prepared by the Pacific Department under the supervision of Sungsup Ra, Director, Pacific Strategy and Special Operations. Allison Woodruff, Young Professional (Economics), led the preparation and publication which was supported by all other Pacific Department professional staff including, Craig Sugden, Senior Economist, and Anthony Maxwell, Energy Specialist. Consultants Scott Hook, Peter Johnston, and Rommel Rabanal assisted in preparing the initial draft. Wickie Baguisi and Frix del Rosario edited the publication. Ophie Iriberri provided editorial inputs and Cecil Caparas coordinated the publication process.

S. Hafeez Rahman
Director General
Pacific Department
Asian Development Bank

EXECUTIVE SUMMARY

Oil plays a vital role in the economic development and macroeconomic stability of Pacific developing member countries (PDMCs). It provides an essential input into economic production, predominately through transport and electricity services. It also affects wider community welfare through the price of fuels for cooking; the cost of goods delivered and access to local and overseas markets; and expenditures for fuel and fertilizer inputs for agriculture, forestry, and fisheries.

PDMCs are extraordinarily dependent on oil, particularly diesel, which makes them highly vulnerable to rising oil prices. Although gross oil consumption is low relative to that of other regions, intensity of oil use is high, with countries such as Cook Islands, Kiribati, Nauru, Solomon Islands, and Tonga, relying almost exclusively on petroleum for their commercial energy requirements. High oil prices are of concern to PDMCs since they represent a supply shock and can significantly weaken sound macroeconomic policy management through increasing inflation, reducing growth, and weakening balance of payments. Households are affected by high oil prices directly through rising fuel costs, such as kerosene used for lighting and cooking, and indirectly through increased imported food and transport costs, particularly in the outer islands.

Although the price of oil fell with the onset of a global economic slowdown, oil prices have once again begun to rise, reaching $70 per barrel in June 2009. This is because underlying structural factors that have contributed to rising oil prices in recent years—particularly rising demand due to economic transformations occurring in the People's Republic of China and India—remain unchanged. PDMCs will, therefore, remain highly exposed to oil price shocks over the medium to long term.

PDMC government responses to oil price shocks over the years have tended to be shortsighted and reactive due to a lack of guiding energy policy frameworks as well as capacity to carry out strategic energy planning activities. In addition, the availability of reliable up-to-date information on energy for informed decision making has been a major challenge.

Strategic energy policies are needed to reduce dependence on oil in the region over the medium to long term. First, governments have a role in ensuring that energy markets function properly by correcting market failures, such as removing distortionary and regulatory policies that discourage efficient energy use, and addressing information gaps in terms of public awareness of energy efficient and clean energy technologies. Another role of governments is to ensure macroeconomic stability since rising oil prices put pressure on price levels and the balance of payments. Finally, governments have a role in balancing efficiency considerations with equity in access to energy services. However, policies designed to address equity must be based on sound analysis to ensure that the least-cost means of achieving a particular aim is used. Also, it is important to ensure that public investments in the energy sector, particularly in countries with low levels of development, are not made at the expense of alternative investments in other sectors, such as transport and health, which could potentially yield higher returns to the country.

Over the years, a range of energy policy development initiatives have been supported by development partner and regional agencies to address PDMC energy planning capacity gaps primarily through the national energy offices. The results, however, have tended to be generic, with little sense of priorities or costs, poor links to national planning efforts, often limited apparent national ownership, and generally unconnected to the national budgeting process.

The key to energy security and reduced vulnerability is to diversify energy supply, and to include a balance between demand-side management, increases in the efficiency of existing energy supplies, and the development of new fuel and electricity sources that use cheaper fossil fuels or are renewable. Some initiatives that have been effective in the larger developing member countries of the Asian Development Bank may be inappropriate in very small countries with limited skilled human resources, tiny markets, and limited natural resource endowments. Other options may be more attractive in small, remote countries where oil prices are even higher and where reliable fuel supplies are absent. The combination of measures to use supply-side and demand-side improvements is important. No one option will provide all the benefits for the Pacific. A range of possible options for PDMCs include

- procurement of petroleum fuels at a price lower than existing contractual terms;
- possible replacement of diesel fuel for power generation with lower-cost heavy oils and/or biofuels;
- energy efficiency improvements within power utilities and transport;
- energy efficiency improvements for consumers;
- investments in urban renewable energy systems;
- possible substitution of high quality diesel fuel with less expensive, high-sulfur diesel and/or biofuels in the ground transport sector; and
- development of appropriate institutions, policies, plans, regulations, and incentives to support the above opportunities.

Strengthened energy policy making in the region must be underpinned by sound evaluation of the available options. For example, marginal effective electricity capacity expansion curves can be used to identify effective and efficient programs to provide an adequate supply of electricity in the region while reducing vulnerability to oil price shocks. Similar curves can be used to analyze the marginal costs of abatement from various greenhouse gas mitigation activities, to assess the resulting carbon dioxide reductions from a particular activity, as well as the associated cost per ton of carbon dioxide reduction.

The first chapter of this study provides an overview of the current energy situation in PDMCs, including recent fuel price trends, the exposure of countries to oil price increases, intensity of oil use, and the effects of high oil prices both at the macro and micro levels in PDMCs. Chapter 2 examines the role of government in the energy sector, assesses weaknesses in PDMC government energy policy making, reviews past development partner energy sector assistance in the region, and identifies areas where such assistance could be strengthened. Finally, Chapter 3 presents the various options for strengthening PDMC energy policy making and reducing oil dependence in the region.

INTRODUCTION

Background

The focus of this paper is to reflect on how Pacific developing member countries (PDMCs) can better manage oil consumption, rather than simply trying to replace the use of oil with alternative fuels or energy sources such as renewable energy, which has been the objective of most countries in the region for some years.[1] As the Asian Development Bank (ADB) has stated in its 2009 Energy Policy paper, while "energy independence is not likely, long-term cooperative options need to be explored at the international level to ensure production and use of energy stay within reasonable costs and in a sustainable manner".[2] This paper seeks to provide a clear approach in moving ahead in engaging different energy strategies for PDMCs but not at the cost of efficiency or reliability.

The onset of the current world financial crisis was accompanied by a fall in several commodity prices resulting in the rapid fall in the price of oil. However, oil and other commodity prices have begun to rise again following signs of global economic recovery, with the price of a barrel of oil reaching $70 in June 2009. The global outlook forecast is for the price of a barrel of oil to average $62 in 2009 and $74 for 2010.[3] Despite lower oil prices, the underlying imbalance between the supply and demand for oil remains since inadequate oil refining capacity will not be resolved for several years. In addition, continuing demand for oil is expected to remain relatively strong in

1 This study is intended to build on several recent reports that have examined the region's economic vulnerability to high oil prices, including (i) a 2007 United Nations Development Programme study, 'Overcoming Vulnerability to Rising Oil Prices: Options for Asia and the Pacific,' found that six of the seven countries in the Asia and Pacific region most vulnerable to rising oil prices were Pacific island countries; and (ii) a June 2008 report by the International Monetary Fund (IMF2008b) of more than 50 low- and medium-income countries included Fiji Islands and Tonga among those that could potentially experience extremely severe economic impacts from both a large balance of payments deficit and a serious decline in foreign exchange reserves. Generally, island countries were highly represented among those likely to be most seriously affected.

2 ADB. 2009b. *Energy Policy*. Working Paper.

3 Economist Intelligence Unit Global Forecast Outlook, September 2009.

emerging economies, such as Brazil, the People's Republic of China, and India, and supply reductions have been announced by major oil producers. As a result, oil prices are expected to rebound and remain at levels higher than those in the previous decade over the next 5 years. In addition, the current market's volatility is likely to increase uncertainty about future prices and the type of investments to be made by PDMCs for transport and electricity generation. This situation provides an opportunity for ADB to assess both immediate means of ameliorating the Pacific region's vulnerability to high oil prices and to consider practical medium-term policy issues and initiatives that might be considered by PDMC governments and others to take increased control of their demand for oil.

Excluding biomass for cooking, most PDMCs depend almost entirely on petroleum for their energy needs.[4] Oil powers the Pacific, and the region's dependence on this input is not going to change overnight or even over the next 12 months. Seeking a greater level of control of oil expenditures will require input from all social and economic sectors, and a solution will not be provided by any single initiative or external agency but a combination to provide the right signals. Government policy and business investment choices for conventional, renewable energy, energy efficiency, and associated matters, such as building design, are all intertwined. Shortsighted reactive responses to fuel price increases are likely to lead to ineffective policies (for example, reductions in excise taxes that reduce fiscal revenue and undermine the financial strategies of governments) with little actual long-term diversification of the sources of energy. Similarly, to make decisions about energy alternatives, governments require sound information about the capital, operational, and maintenance costs associated with alternatives. This involves both good technical and sound policy advice about the most appropriate strategies for improving energy diversification that will suit the local economy and institutional capacity.

Oil plays an important role in PDMCs' economic development and macroeconomic stability. It provides an essential input into economic production, predominately through transport and electricity services. It also affects wider community welfare through the price of fuels for cooking; the cost of goods delivered and access to local and overseas markets; and expenditures for fuel and fertilizer inputs for agriculture, forestry, and fisheries. High oil prices can significantly weaken sound macroeconomic policy management through increasing inflation, reducing growth, and weakening balance of payments.

PDMCs have many features in common, such as small size, remoteness, distance to major markets, and susceptibility to natural disasters. PDMCs differ in terms of size, population, resources, income, and energy usage. Similarly, parts of the Pacific face increasing pressure from growing population in the

4 See regional overview report of the Pacific Islands Renewable Energy Project (SPREP, 2005) for estimates of oil dependence for each country.

coming years, which is likely to place additional demands for oil for transport and electricity. The constraints that the region faces have been widely discussed and analyzed in previous ADB reports. It is sufficient to highlight that these have acted as constraints to economic growth and poverty reduction. However, the sorts of disadvantages the Pacific faces are common to other small island states around the globe, and ADB has characterized economic growth in the region as being generally disappointing compared to other island regions. In a midterm review of the Pacific Strategy, ADB (2008a) identified that the "Pacific region continued to display the symptoms of a fragile development process." This has meant the Pacific continues to lag on the poverty alleviation and the achievement of its Millennium Development Goals. High oil prices have only made this task more difficult (Box 1).

Oil Price Increases 2002–2008

The rise in oil prices since 2002 and the acceleration until mid-2008 raised concerns for numerous nations. The steady upward movement since 2002 has not had the same immediate effect as previous oil price shocks in the last 35 years. They have, nonetheless, affected sectors directly dependent on oil as a

Box 1. Transport and Oil Price increases

Throughout the Pacific, transport is a major user of fuel and an important means by which Pacific developing member countries (PDMCs) remain connected across the vast distances of their nations and with the world.

Transport in PDMCs has been affected by the impact of oil price increases through the following:

- Decrease in vehicle usage, vessel usage, and airplane usage.
- Less and more costly transport has led to reductions in economic opportunities and loss of output by businesses and income for households.
- Reduced disposable income as the proportion of fuel costs has increased.

Several countermeasures, most of which are oriented to road transport, can be considered when reviewing transport:

- Demand management—these can include changes in individual actions (such as changing current travel plans); regulation to discourage road users (through higher road charge or restrictions); and urban planning (such as developing better public transport and alternatives, including pedestrian and cycling).
- Supply management—these include subsidies to fuel (a temporary measure), assistance to the introduction of biofuels (coconut oil appears to be a possible option), and better management of road assets to increase fuel efficiency.
- Behavior management—driving slower and encouraging better maintenance.

The key aspects are changing attitudes, using available technology, and improving efficiency.

major input, such as agriculture, electricity, and transport, and a range of other sectors indirectly through higher input costs. Figure 1 shows the rise in the price of petroleum products between 2006 and 2009. It is important to note that the price of oil increased by more than 200% during the period.

The rise in the price of oil has been a cause for concern for all oil-importing countries. The International Energy Agency (IEA), working with the International Monetary Fund, has estimated that a $10 per barrel increase in oil price reduces global gross domestic product by about 0.5% the following year, and increases consumer prices by a slightly larger amount (IEA 2004). As an economy's vulnerability to oil prices increases, the negative effects on growth and inflation become more acute.

The fall in the price of oil in 2008 appears to represent a cyclical change due to deterioration in world economic conditions rather than a structural shift. In addition, actions by the Organization of the Petroleum Exporting Countries to reduce production will reinforce the structural imbalance in oil demand and supply. This is because the fundamental factor that was driving oil price increases is the imbalance between demand and supply. In particular, growing demand for oil resulting from the transformations occurring in the People's Republic of China and India are structural. In addition, IEA highlights that a large refining under-capacity remains, so that changes in crude oil production do not necessarily result in changes in petroleum-based fuel prices. Oil supply security also remains a problem due to possible acts of terrorism and adverse weather conditions that substantially affect production and refinement capacity.[5] Although cyclical factors resulted in falling world oil prices in 2008, given that underlying structural factors remain unchanged, it is likely that lower oil prices are a temporary phenomenon. This can be demonstrated by the fact that after falling to $30 per barrel at the end of December 2008, oil prices began to recover in 2009.

In the Pacific, price of petroleum fuels rose rapidly during the first two quarters of 2008 before falling in the third and fourth quarters as shown in Figure 1. The relationship between the world price of crude oil and local retail prices of fuels refined from oil is shown in Figure 2. The retail price is influenced by refining, distribution, and marketing costs, as well as taxes, duties, and price control mechanisms, but crude oil still accounts for a very large part of the retail fuel price. The figure includes retail price data for petroleum and diesel in several PDMCs during June 2009. The Mean of Platt Singapore (MOPS) price of oil is used as a benchmark (at $70 a barrel, or $0.44 per liter, indicated by the dotted line).

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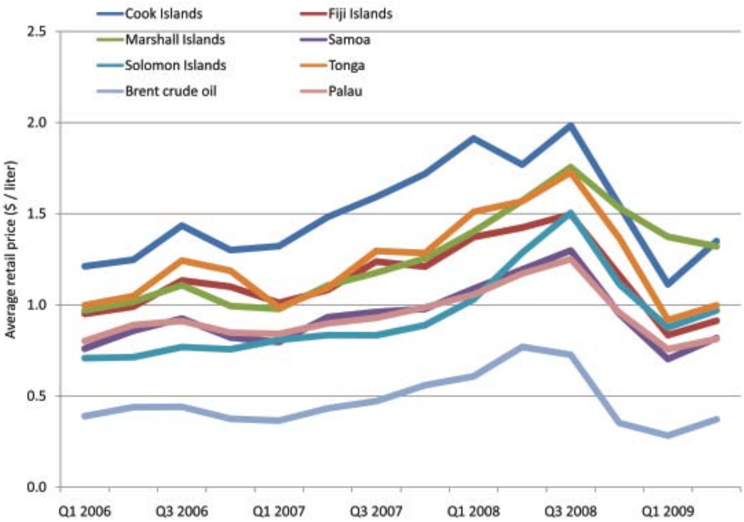
5 In 2005, hurricane Katrina reduced production and refining capacity in the United States. In 2006, a terrorist attack on oil production in Saudi Arabia was thwarted. In late 2008, an oil tanker was seized in the waters off Somalia.

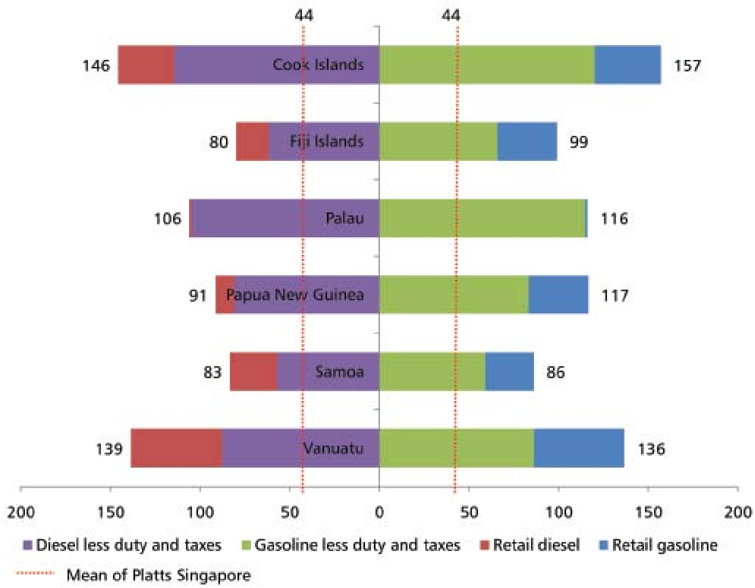
Fuel to the region, except for Australia, New Zealand, and Papua New Guinea (PNG), is shipped from Singapore through entrepots in Fiji Islands and Guam. High shipping costs, intensive multiple handling through island primary ports, and small suboptimal shipment sizes all contribute to higher fuel prices in the Pacific. Fuel prices in smaller markets, such as Cook Islands are significantly higher compared with larger countries in the region (Figure 2). However, it is interesting to note from Figure 2 that even though Samoa's fuel comes through the Fiji Islands and that it has a much smaller market than the Fiji Islands, gasoline prices are actually lower in Samoa. This partly relates to Samoa owning its own fuel storage facilities and thus is able to negotiate better prices than Fiji Islands. PNG's high prices could possibly reflect poor levels of negotiated contracts and inefficiencies related to the protection of the "inter-oil" refinery.

Figure 1: Retail Price of Gasoline in the Pacific Region (Quarterly averages, 2006–2009)



Source: Cook Islands Statistics Office; Fiji Islands Bureau of Statistics; Republic of the Marshall Islands Economic Policy, Planning, and Statistical Office; Palau Office of Planning and Statistics; Samoa Ministry of Finance; Solomon Islands National Statistics Office; SOPAC Fuel Price Database; Tonga Department of Statistics; and World Bank's Commodity Price Data (Pink Sheet), various years.

Figure 2: Retail Fuel Prices in PDMCs (June 2009, US cents per liter)



PDMC = Pacific developing member country.
Source: ADB resident missions; national press reports; SOPAC fuel price database.

The Vulnerability of the Pacific to Oil Price Increases

PDMCs are extraordinarily dependent on oil, particularly diesel. Except for hydroelectric power in several countries (Fiji Islands, PNG, and Samoa),[6] geothermal and gas in one (PNG), as well as wind in another (Fiji Islands), and limited use of coconut oil biofuel in at least two countries (Samoa and Vanuatu), commercial energy in the Pacific region is synonymous with petroleum. Intensity of oil use is more than 80% in the Pacific, with countries, such as Cook Islands, Kiribati, Nauru, Solomon Islands, and Tonga, relying almost exclusively on petroleum for their commercial energy requirements.

Petroleum Use

Accurate and up-to-date data on fuel imports and usage by sector for the region are difficult to obtain. The most recent assessment of regional energy issues in the Pacific is the Global Environmental Facility/Pacific Islands Renewable Energy Project series published by the South Pacific Regional Environment Programme in 2005, but based mainly on data through 2003. At that time, PDMCs consumed about 1,600 million liters of petroleum fuel (i.e., excluding

6 There are also smaller-scale hydropower generation in Vanuatu (600 kilowatts) and Solomon Islands at least 300 kilowatts).

reexports and bunkers). In comparative terms, this is equivalent to only 30,000 barrels/day, which is a very small volume compared with that of other regions of the world. It is important to note that the intensity of oil use in PDMCs is very high (as discussed in the following section).[7]

Petroleum fuel use varies considerably among the Pacific countries as shown in Table 1. This partly reflects the differences in energy usage and the coverage of electricity in various countries. In 2003, four PDMCs used 200 liters or less per capita of petroleum fuel per year (Kiribati, PNG, Solomon Islands, and Vanuatu); most were in the 300–700 liter range (Fiji Islands, Federated States of Micronesia, Samoa, Tonga, and Tuvalu); and several consumed 1,000 liters or more (Cook Islands, Marshall Islands, Nauru, and Niue), with Palau having by far the highest consumption at about 5,800 liters/person.[8] Because of the unreliability of data or lack of disaggregated data, no comparisons were available on petroleum fuel consumption for power, transport, or other sectoral use.

An earlier study using data from the 1992 Pacific Regional Energy Assessment (PREA; World Bank/United Nations/ADB) did attempt to disaggregate fuel use by sector. Table 2 shows that at that time, more than 48% of imported fuel was used for transportation and almost 37% for power generation (World Bank 1992). Biomass energy in the form of fuelwood and agricultural residues accounted for about 50% of total energy use in the region. Of this, some two-thirds was used in households for domestic cooking and one third by industry for processing heat and electricity (Institute of Natural Resources 1994).

For most individual countries, however, the actual share of transport is higher since PNG, by far the largest petroleum consumer in the region, skewed the average (weighted by volume). For 7 of the 12 countries studied, transport accounted for more than 70% of petroleum fuel consumption, including reexports and bunkers. Electricity typically accounted for a third or so of energy consumption, and direct use by commerce and industry most of the rest.

The requirements for transport—and the balance among land, sea, and air—depend strongly on population distribution, geography, terrain, distance between islands, national and rural income levels, and the location of hubs for regional or international air links. Therefore, it is unsurprising that transport fuel use varies widely from country to country. Typically (i.e., again excluding PNG), 44% was for road travel, 23% for sea, and 33% for air. If reexports (mostly for international airlines) and bunkering (foreign fishing fleets) are excluded, the typical pattern in fuel for road travel in the early 1990s made up 65% of total consumption, with sea accounting for 28% and air, 7%.

7 1,600 million liters / 159 liters/barrel / 330 refinery days/year = 30,500 barrels/day of refined products, which would require considerably more than 30,000 barrels of crude oil.

8 Assuming more waste with high levels of consumption, Cook Islands, Marshall Islands, Nauru, and Palau might be suitable for initial efforts at fast-tracking demand-side management energy efficiency improvements. (Niue is not a PDMC.)

Table 1: PDMC Petroleum Fuel Use in 2003 and Recent Growth Rates

Country	Volume		Year	Comments
	ML	L / capita		
Cook Islands	19	~ 1,000	2003	Data appear to be inconsistent; growth trends uncertain.
Federated States of Micronesia	~ 60	~ 600	2003	Very poor data; none at all by volume and dollar values of imports appear inconsistent.
Fiji Islands	> 320	~ 400	2000	Inconsistent 2000 data from 1999–2003; 250 ML in 1990.
Kiribati	16	~ 200	2003	AAGR is from 1990–2003.
Marshall Islands	127	~ 2,300	2003	Includes substantial reexports; no data for 1995–2002
Nauru	~ 15	~ 1,500	2003	Large year-to-year variation; no trend visible.
Niue	1.6	~1,000	2002/2003	AAGR for past 4 years.
Palau	~ 111	~ 5,800	2002	AAGR for 1999–2002 is very high but no clear reason found.
Papua New Guinea	~ 780	~ 150	2000	Poor time series data; considerable annual fluctuation.
Samoa	78	~ 400	2003	AAGR 1998–2003.
Solomon Islands	72	~ 150	2002	AAGR 1990–2002 (sharp decline during civil conflicts).
Tonga	~40	~ 400	2000	AAGR for 1990–2000 but data are unreliable.
Tuvalu	3.8	~ 400	2003	Data before 2001 are unreliable.
Vanuatu	41	~ 200	2003	AAGR 1994–2003, with considerable annual fluctuation.
Total (approx.)	1,650	NA	NA	

AAGR = annual average growth rate, L = liters, ML = million liters, NA = not available.
Source: National PIREP reports (SPREP, 2005).

[7] 1,600 million liters / 159 liters/barrel / 330 refinery days/year = 30,500 barrels/day of refined products, which would require considerably more than 30,000 barrels of crude oil.

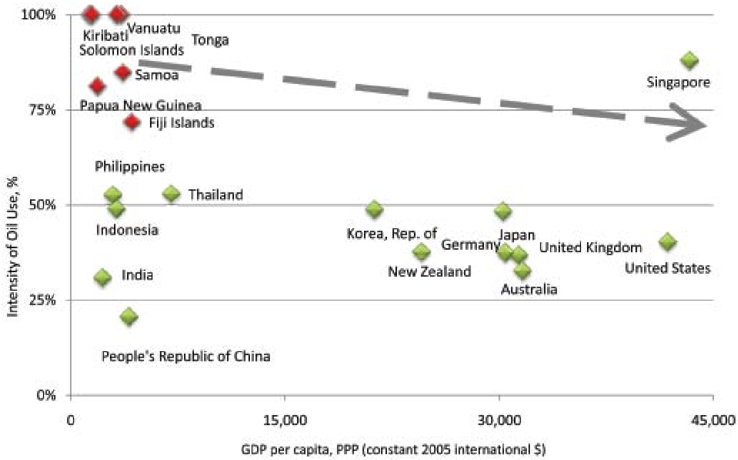
[8] Assuming more waste with high levels of consumption, Cook Islands, Marshall Islands, Nauru, and Palau might be suitable for initial efforts at fast-tracking demand-side management (DSM) energy efficiency improvements. (Niue is not a PDMC.)

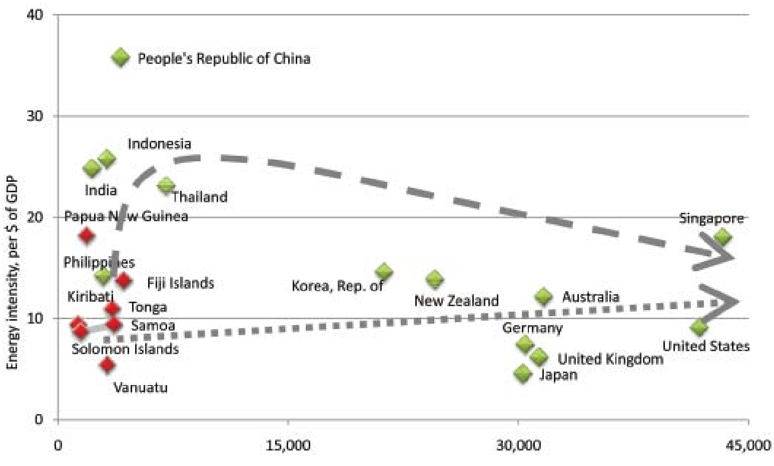
Table 2: Gross Petroleum Demand by Sector (Percentages; 1990)

Country	Transport	Electricity	Households	Government/ Industry and Commerce	Others
Cook Islands	70.6	26.2	3.1	NA	NA
Federated States of Micronesia	62.0	36.0	2.0	NA	NA
Fiji Islands	75.8	4.4	7.2	12.5	0.0
Kiribati	71.0	19.4	9.7	NA	NA
Marshall Islands	40.7	53.4	1.4	3.8	0.7
Palau	53.1	39.4	0.7	6.8	0.0
Papua New Guinea	34.4	52.6	1.5	11.5	0.0
Solomon Islands	26.5	17.1	3.4	47.9	5.1
Tonga	72.0	23.1	4.9	NA	NA
Tuvalu	74.0	18.5	7.5	0.0	0.0
Vanuatu	70.9	23.2	5.8	NA	NA
Western Samoa	79.9	15.7	4.5	NA	NA
Weighted Average	48.3	36.7	3.2	11.7	0.2

NA = not available.
Note: Industry includes agro-industry.
Source: *PREA Volume 1: Overview Report,* Table 1.4 (World Bank, ADB et. al., 31 August 1992).

Figure 3: Dependence on Oil and Energy Efficiency, 2005 (Relative to per-capita income levels)





GDP = gross domestic product, PPP = purchasing power parity.

Note:

1. Dependence on oil is measured by the intensity of oil use, or the proportion of petroleum consumption to total primary energy consumption (i.e., use of petroleum, natural gas, coal, and electricity). Energy efficiency, or energy intensity, is defined as total primary energy consumption (in quintillion British thermal units) per $ of GDP (in 2000 $, using market exchange rates).
2. Dashed lines are stylized long-term paths of oil dependence and energy intensity of Pacific developing member countries. In the bottom panel, the thick curved line represents the stylized long-term path of energy intensity for Fiji Islands and Papua New Guinea . The thinner straight line corresponds to the other Pacific developing member countries that may skip any industrialization phase.

Source: Energy Information Administration website: www.eia.doe.gov/ and the World Bank's World Development Indicators online database.

No doubt, energy-use patterns have changed considerably since the 1990s but there are no available estimates of more recent patterns of fuel use. This information would be useful for estimating the potential for cost-effective savings through different measures. The benefits from gains in efficiency in transport fuel use are predominately related to the use of better maintained equipment or the use of new equipment. As a result, much of the discussion in the following sections is on policy issues related to stationary electricity and the diversification of different fuel sources.

Intensity of Oil Use

The top panel of Figure 3 illustrates the evolution of oil dependence across the different levels of development. Dependence on oil is measured by the share of petroleum in total primary energy consumption. On average, as per-capita incomes rise, a country's dependence on oil is expected to decline as alternative sources of energy become more viable and consumption efficiency improves. Development allows for the adoption of more costly—but more efficient—technologies for producing energy, and these alternative sources also become increasingly necessary for supplying the escalating energy requirements of expanding economies. Thus, the share of oil in primary energy consumption should typically decline as an economy matures and develops.

In the Pacific, however, oil dependence may continue to be high even in the medium to long term as exemplified by the experience of another island nation—Singapore. Energy consumption in Singapore is still almost 90% petroleum-based (mostly imported) due to its very limited options for local energy production. This provides an indication that countries in the Pacific may continue to be highly dependent on oil even as they become more developed precisely because of the island-economy characteristics they share with the Southeast Asian city-state. Nevertheless, PDMCs can still reduce their long-term dependence on oil by properly harnessing more promising potentials in renewable energy such as hydropower, wind power, and solar energy that exist in the region.

On the other hand, in terms of total energy usage, economic activity in the Pacific has yet to be highly energy-intensive given the generally low state of industrial development in the region. Energy intensity of the gross domestic product is defined as the amount of energy (usually in British thermal units) required to produce a unit of output (in monetary or dollar terms). Following from the theory of structural transformation, energy intensity must be low at the initial phases of development as subsistence agriculture, the least energy-intensive sector, dominates the economy. As industrialization proceeds, the heavy energy requirements of the industry sector cause a significant rise in an economy's overall energy intensity. This then declines with the emergence of a more energy-efficient services sector upon the completion of structural transformation. In general, therefore, an "inverted-U" pattern characterizes the relationship between energy intensity and per-capita incomes (Figure 3 bottom panel). In higher-income PDMCs, such as Palau and Cook Islands, energy use is already at relatively high levels, similar to several non-PDMCs, such as Guam, French Polynesia, and New Caledonia.

Energy intensity in the region is expected to increase in the medium term as Pacific economies proceed with structural transformation and modernization. Nascent industry and services sectors will drive an increasing demand for energy to sustain economic expansion. The increase in energy intensity will be more pronounced in the Fiji Islands and PNG, where some degree of industrialization is already being achieved. For most of PDMCs that are unlikely to industrialize, rising energy intensities will be driven by expansion of the services sector, particularly tourism. Increases in energy intensity for these countries may be less substantial compared with that for PNG and Fiji Islands. Also, the path of energy intensity for economies that skip the industrialization phase may not necessarily follow an "inverted-U" pattern and instead exhibit a gradual upward sloping trend driven primarily by increasing electricity demand from the direct shift from agriculture to services.

With the expected increase in energy requirements even in the medium term, the need for measures to enhance energy security in the region is highlighted. The prevailing structure of energy consumption in the Pacific implies an escalating demand for oil henceforth, which is no longer sustainable as the era of cheap oil has apparently come to an end. Failure to address current dependence on oil will not only result in continued exposure to adverse external shocks from a volatile world oil market but will also inhibit prospects for sustained economic growth and development in the Pacific region.

As a result, recent fall in crude oil prices will possibly only be a temporary respite. The dependence on oil in these economies remains. In 2007, the United Nations Development Programme (UNDP) developed an Oil Price Vulnerability Index to draw together various local factors that affected a nation's exposure and vulnerability to oil. This involved calculating the national economic strength (such as economic growth); economic resistance to reflect local petroleum resources and intensity of oil use.[9] The UNDP dataset has been widened by ADB to include more Pacific states. The original analysis by UNDP included Fiji Islands, PNG, Samoa, Solomon Islands, and Vanuatu. Work undertaken by ADB for this paper extended coverage to include Kiribati and Tonga (outlined in Table 3).

9 This is a composite of selected indicators that reflects not just a country's economic performance and the resilience of its economy, but also the extent to which it depends on imported oil.

Table 3: Oil Price Vulnerability Index for Selected Pacific Countries

Country	OPVI	Rank
Fiji Islands	0.79	3
Kiribati	1.00	1
Papua New Guinea	0.66	7
Samoa	0.73	6
Solomon Islands	0.74	5
Tonga	0.80	2
Vanuatu	0.76	4

OPVI = oil price vulnerability index.
Source: ADB calculations.

Kiribati and Tonga are the most vulnerable to changes in oil prices among the seven Pacific nations with sufficient data for the analysis (Table 3). Overall, when compared to 39 other developing countries, all seven Pacific nations were among the 10 most vulnerable. Other island states, such as Maldives and Sri Lanka, also had a high level of vulnerability. Earlier analysis from UNDP found the same relative order for the Pacific states except for Fiji Islands. The more recent data used by ADB indicated that Fiji Islands was far more exposed to changes in oil prices than UNDP had estimated. The relevance of this information is that it helps policy makers to focus beyond the recent falls in crude oil prices, illustrating that the region remains highly exposed to crude oil supply in the long term.

The Effects of Oil Price Rises on the Pacific

The Pacific is a net importer of energy[10] and, except for PNG and Timor-Leste, there is an absence of known oil resources.[11] As a result, the sharp increase in oil prices has had significant effects on the Pacific, putting upward pressure on inflation rates and lowering economic activity. These price increases represent a supply shock, where the effects on activity arise because higher oil prices increase the costs of production across the economy, representing a reduction in the aggregate supply of goods and services that can be sustained at any given price level.

In addition, the rise in oil prices represents a loss of real income to fuel consumers, which implies that aggregate demand in net oil-consuming countries will be weaker than otherwise. This income is transferred to oil

10 It is interesting to note that in the 19th century, the Pacific was a net exporter of energy in the form of whale oil, which was widely used as a lighting fuel.

11 Note that PNG and Timor-Leste are now petroleum producers. PNG has a refinery with some export potential and considerable natural gas reserves. Timor-Leste exports millions of dollars of crude oil. In most other PDMCs, there has been almost no exploration or drilling, so potential is not known.

producers (and oil companies) and if there is no equivalent boost to aggregate demand in those countries, there will be a net negative effect on economic growth. Table 4 reviews the sectors that are major users of fuel and also highlights the specific needs of the poor. The use of fuel for lighting and cooking is predominately among the poor and non-urban population who are not connected to the grid.

Oil price changes take about 2 months to impact on the economy as it increases production input costs and final consumer prices of retail fuel, among other consumables. These increases have the potential to temporarily increase the headline inflation rate; if they become ingrained in price and wage settings behavior, then it could translate to continuing inflation. Oil price shocks are also usually associated with a slowing domestic economy, weaker household consumption and private investment, and rising unemployment rates. The price of crude oil had been increasing fairly steadily since 2001 and peaked in July 2008 before declining sharply.

Table 4: Major Uses of Fuels in the Pacific

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Item	Diesel	Kerosene	Gasoline
Major Sector Users	Transportation (vehicle and shipping) Agriculture Electricity generation	Households for lighting and cooking	Transportation (private cars and small commercial vehicles)
Relevance for Low-Income Communities	Used directly by low-income farmers and transport used by low-income households	Important for lighting in non-electrified households. Used for cooking.	Transportation*

Note: Aviation fuel is not included.
* Most low-income households depend on public transport and trucks that usually use diesel.
Source: UNDP 2008, with adjustments made by authors.

The key channel of transmission through to domestic economic activity is from lower consumer and investment spending. Increases in retail fuel prices act as a "surcharge" on household income-reducing discretionary income and the volume of household consumption expenditure. Businesses experience rising input costs, but since consumer prices often remain sticky in the short run, full cost increases cannot be passed onto final prices. Businesses must rationalize spending to maximize profitability (or reduce costs), and the sacrifice in such occasions is usually investment spending and even routine maintenance, although this happens with a lag. This effect is worsened for those parts of the economy that face regulated prices, such as electricity tariffs and bus and taxi fares, providing additional financial pressures for these businesses. There will be further negative impacts on economic growth through reduced exports to the extent that growth in major trading partners is reduced.

Figure 4: Inflation in PDMCs and the World Price of Oil

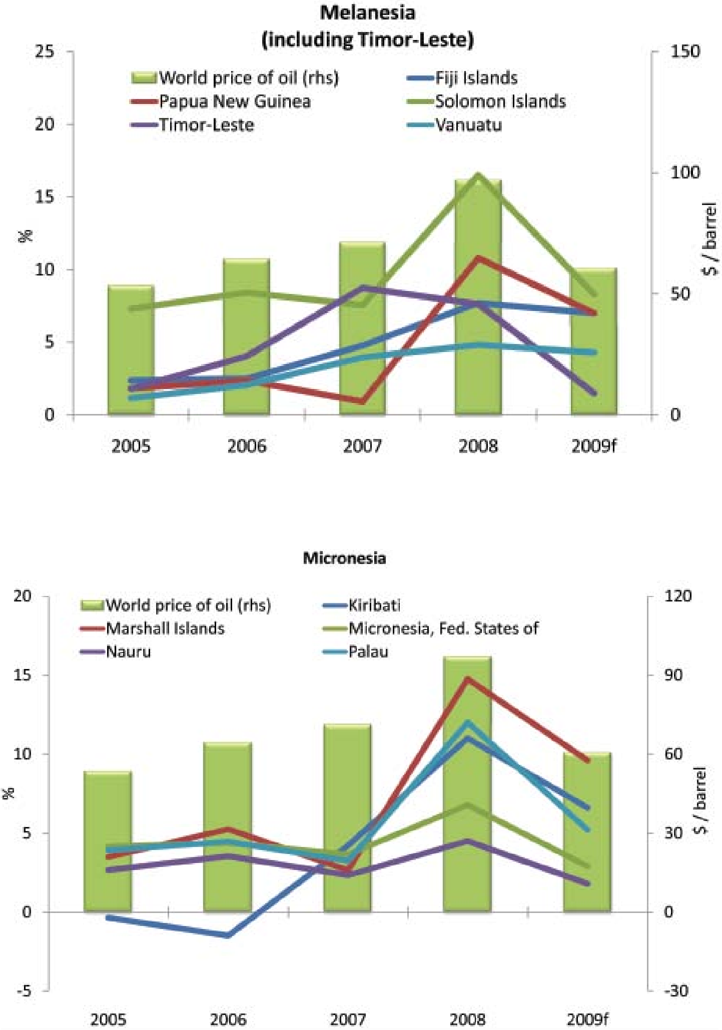
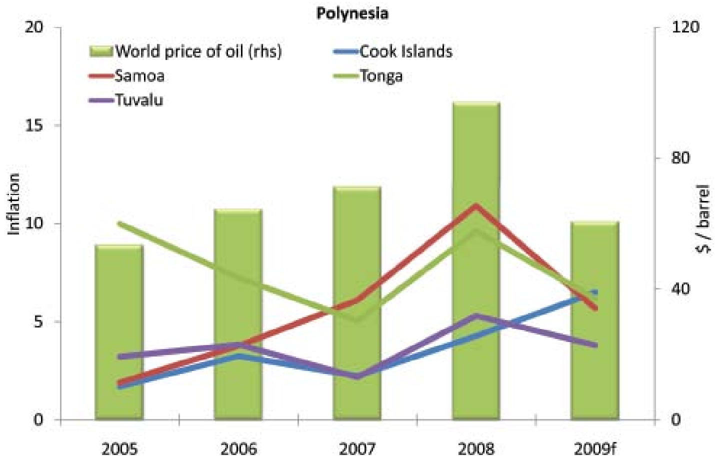


Figure 4: Inflation in PDMCs and the World Price of Oil (*continued*)



PDMC = Pacific developing member country.
Note: The world price of oil is an average of UK Brent, Dubai, and West Texas Intermediate crude oil prices, in $ per barrel; inflation is the annual percentage change in the consumer price index of each country.
Source: Asian Development Outlook, various years; and World Economic Outlook.

A review of inflation rates in PDMCs over the last several years suggests a moderate pass-through effect of higher oil prices, at least at the aggregate level. However, weak data integrity due to dated consumer price index baskets and often poor survey coverage, including the lagged effect of any price increases, means that oil price increases may take some time to flow through. The effect of high energy prices on Pacific communities has been discussed widely. In the Marshall Islands, concerns about the effect of rising fuel prices led to a declaration of an economic state of emergency in 2008 by the Marshall Islands president. Figure 4 shows the relationship between inflation and oil prices in selected PDMCs, divided by geographical area. Spikes in inflation can be observed in the Marshall Islands, PNG, and much of Polynesia, and Solomon Islands during 2008, which subsequently eased in 2009 along with the decline in world oil prices.

From the capital city to remote communities, given the dependence of most PDMCs on oil imports required to support economic activity, high oil prices reduce aggregate outputs. In addition, the impact is expected to fall especially on disadvantaged groups that depend on fuels, such as kerosene for cooking and lighting, and the flow-on effect of higher transportation costs, reducing contacts with urban and regional markets.

Furthermore, the price of all imported basic goods will also increase as a result of higher transportation costs. The region's population has become increasingly reliant on imported staple foods, particularly in atoll countries where limited land and water, and poor soils make it more difficult to grow staple crops. In addition, it is generally the lowest-income groups that spend more of their income on food. For example, in the Fiji Islands, households at the bottom income decile spend 48%–64% of their income on food compared with households at the top decile, which spend less than 20% on food. Transport costs cascade with each movement to more remote communities that require additional transport. Table 5 draws on household expenditure data for urban and rural communities in several PDMC economies. The data for Marshall Islands and Tuvalu indicate that there is a substantially greater share of rural income spent on fuel, electricity, and transportation and, thus these areas have a greater exposure to high oil prices. It should also be noted that these studies predate the oil price increases in 2007 and 2008 and that the shares might be higher and the urban/rural disparity even greater. Box 2 provides a brief summary of the challenges that high oil costs pose for the achievement of the United Nations Millennium Development Goals.

Table 5: Share of Fuel, Electricity, and Transportation Costs in Household Expenditures
(Selected PDMCs, %)

Pacific Developing Member Country	Urban	Rural
Federated States of Micronesia (FSM)*	13.7	16.3
Palau*	9.0	9.0
Republic of the Marshall Islands (RMI)	5.6	19.7
Samoa	13.5	11.6
Timor-Leste*	3.2	2.9
Tuvalu	3.2	10.0

PDMC = Pacific developing member country.
Note:
1. Figures presented above generally capture household expenditures on domestic fuels (i.e., for cooking, generators, etc.); electricity charges; and fuel for personal transport, as well as fares for public transport.
2. Estimated shares for countries marked with "*" are slightly overstated due to the inclusion of non-oil related expenditures in aggregate Household Income and Expenditure Surveys accounts (i.e., water bills, telephone, and postage charges in FSM; expenditures on water and other utilities in Palau; and airline, parking fees, and other transport costs in Timor-Leste).
3. Urban areas are defined as follows: FSM–Chuuk and Pohnpei; Palau–Airai and Koror; RMI–Majuro and Ebeye; Samoa–Apia; Timor-Leste–Dili, Baucau, plus other urban areas; Tuvalu–Funafuti. The remaining areas in each country are, therefore, classified as rural.
Source: Estimates based on the results of latest available Household Income and Expenditure Surveys of included countries, i.e., FSM (2005), Palau (2006), RMI (2002), Samoa (2002), Timor-Leste (2001), and Tuvalu (2004–2005).

As oil-producing countries, Timor-Leste and PNG face a different set of challenges associated with rising oil prices. Appropriate management of revenues mainly in the form of government tax receipts and ensuring macroeconomic stability will be required when the price of oil increases. Oil revenues provide a significant opportunity to make productive investments in physical infrastructure, such as roads and ports, and social spending on education and education to support development. However, often during resource booms, such as in the case of PNG in the 1990s, governments engage in wasteful spending on consumption, subsidies, and poor investments. Rising export revenues also put pressure on exchange rates leading to currency appreciation which can result in what is known as "Dutch disease". In such a situation, non-oil export sectors, such as agriculture, contract as a result of the reduction in export competitiveness. Oil wealth in recent years has been managed more prudently by PNG with the creation of a trust fund for priority investments. Similarly, Timor-Leste has established a petroleum fund to invest oil revenues where interest accrued is used to finance government spending.

Box 2. High Oil Prices—Implications for the Millennium Development Goals

The United Nations Development Programme (2007) sought to assess the link between high oil prices and the Millennium Development Goals (MDGs). While the relationship is complex, some of the conclusions included

MDG 1: Eradicate extreme poverty and hunger–higher retail prices of fuels and petroleum products can have economy-wide inflation and/or recessionary impacts.

MDG 2: Achieve universal primary education–education costs will rise if the rate of inflation increases. Higher costs will affect the ability of poor children to attend school. Increased transport costs will affect the access of non-urban children to schooling.

MDG 3: Promote gender equality and empower women–households forced to switch back to traditional biomass fuels may lead to additional time demands on women and children for fuel collection. Financial pressures for families may lead to the withdrawal of girls from school. However, the movement of non-working women into work may increase gender equality.

MDG 4: Reduce child mortality–use of inefficient wood and coal-burning stoves will raise pollution within homes to the detriment of infants. Health care costs will increase due to general inflation.

MDG 5: Improve maternal health–higher medical and travel costs may prevent poor women from obtaining proper pre-and postnatal care.

MDG 6: Combat HIV/AIDS and other communicable diseases—higher transport and health service costs can slow efforts to prevent the occurrence of epidemics and other communicable diseases.

MDG 7: Ensure environmental sustainability–to reduce oil dependence, there will need to be significant increases in investment in renewable energy and energy efficiency.

MDG 8: Develop a global partnership for growth–the expansion of markets for renewable energy and energy efficiency will allow for new opportunities for international cooperation.

Source: UNDP 2008, Overcoming Vulnerability to Rising Oil Prices, summarized by ADB staff.

A FRAMEWORK FOR OIL POLICY

Oil plays a vital role in contributing to development in the Pacific region. It is a fundamental input to most economic and social activity and a prerequisite for development in other sectors, such as education, health, and communication. Energy policy and national economic strategies seek to manage current and future energy demands in a dynamic economic environment that attempts to balance the exploitation of national resources, the flows of investment, the integration of technology and adaptation to technical change, environmental challenges, and institutional structures. Responding to the demands of oil and associated energy issues within the context of sustainable development involves balancing many complex and independent factors addressed in national, regional, and international statements, policies, and strategies. In framing energy policy, Pacific developing member countries (PDMCs) face a unique and challenging situation, for example:

- Demographics, incomes, and levels of development vary but a common attribute is the predominance of small and isolated population centers.
- Markets are thin and difficult to serve. The lumpy nature of infrastructure means that PDMCs often face large overcapacity, reducing opportunities to increase efficiency.
- Access to electricity varies in PDMCs: in some cases, there are rates of 100% (such as Marshall Islands, Palau, and Samoa); and in some states, the rates are nearly 10% (such as Papua New Guinea [PNG], Solomon Islands, and Timor-Leste). This also varies within states—between urban and rural areas—thus, energy strategies will differ even for different communities in the same country;

- Issues with land and access to capital and the lack of skilled labor means that operational and maintenance costs are often higher than in case studies of countries in other regions and that additional risks increase the required returns for new projects.
- With the absence of indigenous petroleum resources or the opportunity for reliable renewable energy sources, such as hydro, many states have limited energy alternatives, which can be complicated and higher cost. This also exposes the region to newly emerging technologies. For example, a report for ADB (2008b) suggested that far higher costs of infrastructure development occur in PDMCs compared to similar projects in Asia—up to 50% in some projects.

The rise in oil prices and the effect this has had on national economies and households in the Pacific in 2007 and 2008 led many PDMC governments to discuss a range of remedies to the adverse effects. Beyond the short-term reduction in taxes or the extension of subsidies, there has also been discussion of longer-term solutions to dependence on oil. The Forum Economic Ministers Meeting in October 2008 stressed the need for action and reported that PDMCs need to maintain their momentum and adjustment efforts. In particular, the ministers stated that "alternative energy options are seriously being pursued and energy efficiency initiatives are in train." Thus, having clear incentives and a stable policy environment are important to progressing these objectives.

The issues arising from high oil prices are not new to the Pacific region. Since the early 1980s, most of the PDMCs have established a range of institutional mechanisms—including energy positions within planning offices, energy offices and departments, and energy ministries—specifically in response to the high petroleum prices that have occurred periodically since the 1970s and the integration of energy as an important component of development.

To understand the problems related to the cost of oil, it is important to document and discuss the delivery of oil and understand that the costs commence well beyond the borders of PDMCs. As a result, the range of government policies discussed in this study can be beyond the immediate focus of transport and stationary electricity and stretch to purchase and shipping arrangements and policy for renewable energy technologies. The following section reviews the role of government by assessing previous approaches and the role of development partners, regional bodies, and international organizations in influencing energy policy and choices made by states.

In times when the public calls for government to respond and "do something," many states require a clear rationale of the nature of the current problem and if the current circumstances require government action. However, there has been a poor history of confronting these issues from past crises especially in the Pacific.

The Role of Government in the Energy Sector

The role of government in the energy sector revolves around four main areas of intervention to achieve the following goals:

- **Allocative efficiency**. Correction of market failures, including monopoly power in the energy sector and externalities, such as pollution, to ensure that the allocation of resources maximizes economic welfare.
- **Distributional equity**. The government seeks to maintain a balance between the goals of allocative efficiency and equity of access to energy among different members of society, e.g., subsidies in the form of lifeline tariffs.
- **Macro stability**. Using fiscal, monetary, and other economic policy interventions to manage balance of payments and inflation.
- **Regulatory role**. The government legislates and enforces laws of contract, consumer protection, justice, and so on to ensure that energy markets function.

Market Failures

The economic rationale for public policy interventions in energy issues generally relates to the existence of market failures and barriers that inhibit socially optimal levels of investment in the energy sector. To effectively design policies that address market failure, the nature of the "failure" has to be carefully considered. Market failures can be caused by a number of factors, including

Distortionary fiscal and regulatory policies. Government interventions may prevent prices from sending the correct signals to electricity consumers and suppliers. For example, where national utilities are required to adopt uniform pricing policies, if the marginal cost of electricity production in rural areas exceeds tariff levels, as in the case of PNG, there will be underinvestment in expanding the electricity supply beyond urban areas even when the willingness to pay for electricity among rural populations exceeds regulated tariff rates, resulting in a socially inefficient level of electricity supply. Ironically, such policies, which are justified on the basis of ensuring adequate access to electricity in rural areas, have resulted in the opposite effect.

Positive and negative externalities. Positive or negative spillovers occur due to incomplete markets and, as a result, either costs are not fully borne by an individual in the case of negative externalities, or benefits cannot be fully captured in the case of positive externalities. For example, although the combustion of fossil fuels imposes social costs in terms of air pollution and climate change, these costs are not fully internalized by the individual polluters; as a result, pollution will be higher than the social optimum. In the case of technological advancements in clean energy, since private individuals cannot capture the full benefits associated with their investments due to knowledge spillovers, which can be considered as public goods, individuals will underinvest in research and development.

Insufficient and incorrect information. A lack of information may slow down adoption of new technologies. For example, consumers may opt to continue to use conventional, mature fossil fuel-based technologies rather than renewable energy systems (even when the life-cycle costs of the latter are lower) due to insufficient or incorrect information about these new technologies.

Imperfect competition. There are two types of monopolies in the energy sector. First, natural monopolies may exist when production by more than one firm is technically impractical or would lead to wasteful duplication on a large scale, as in the case of an electrical grid. Alternatively, artificial monopolies exist when a dominant firm creates barriers to entry to inhibit competition from rivals. Imperfect competition can be seen as inefficient since a producer can restrict output and set prices above marginal costs, resulting in above-normal profits.

Misplaced incentives. These result from the principal agent problem, which occurs when an agent has the authority to act on a consumer's behalf, but does not fully reflect the consumer's best interests. For example, limited investment in energy-saving technologies, e.g., energy-efficient appliances, may occur if the agent is responsible for investment decisions but benefits from energy savings accrue to the energy user. Such relationships between principal and agent may skew incentives away from technologies with the lowest life-cycle costs in favor of technologies with low initial capital costs. For example, under Fiji Islands' current rural electrification policy, the government funds 90% of total capital costs associated with equipment purchase and installation (as well as maintenance and repairs for the first 3 years of the scheme) for village electrification projects, while communities are responsible for funding ongoing operation costs. Although communities are free to choose between technologies, diesel-based supply is the most commonly adopted technology. This situation may arise due to a government preference for the installation of conventional diesel generators versus other renewable energy technologies given that capital costs associated with the former are lower compared with the latter, while ongoing maintenance costs in terms of fuel inputs are significantly higher (however, such a situation could also arise due to a lack of information or experience with renewable energy technologies in communities, resulting in a preference for conventional diesel-based technologies).

Government intervention may seek to correct for the distortions created by market failure and to improve the efficiency in the way that markets operate in a variety of ways, including

- pollution taxes to correct for negative externalities, e.g., carbon tax;
- direct provision or subsidies for public goods (e.g., research on clean energy development);
- regulation of monopolies (regulatory control of prices, output, rate of return);
- policies to introduce competition into markets (reduced barriers to entry, e.g., unbundling of utility services);
- introduction of energy standards, e.g., minimum efficiency performance standards; and
- policies to promote public awareness and/or provide incentives for producers and/or consumers to adopt new technologies.

Given the complexity of certain market failures, PDMC governments need to balance the costs of market failure with the costs of failure in regulation. In many instances, feasible, low-cost policies can be implemented that either eliminate or compensate for market imperfections and barriers, enabling markets to operate more efficiently to the benefit of society. In other instances, however, policies may not be feasible, they may not fully eliminate the targeted barrier or imperfection, or they may do so at costs that exceed the benefits.

Stabilization

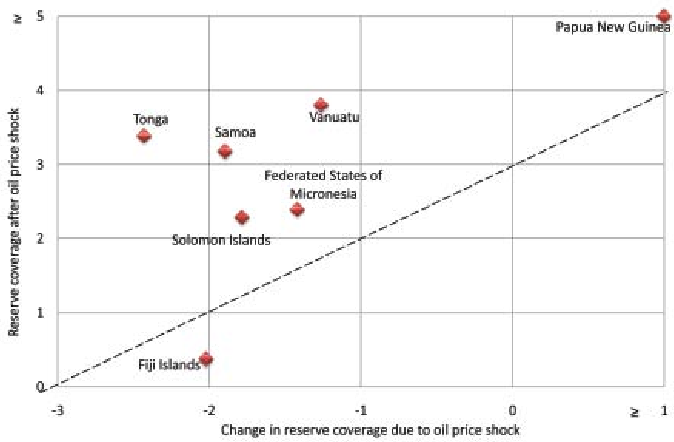
The combined effect of the rise in oil and food prices in recent years has meant that many governments have had to act to ensure the maintenance of price and balance of payments stability. The possible external effects of higher oil prices are drawn out in Figure 5. This is a reproduction of a table produced by the International Monetary Fund (IMF 2008b).[12]

Most PDMCs that have their own currencies maintain fixed exchange rate regimes, which mean that currency depreciations cannot be used to soften the impact of higher oil and other commodity prices. As a result, oil price shocks must be accommodated by reducing foreign exchange reserves. Similar to the IMF conclusions, Fiji appears to be most at risk from any sustained rises in hypothetical oil prices (anything less than 3 months is considered to be of concern). On the other hand, reserves appear to be healthy in Vanuatu due to increased earnings from tourism and rising inflows of aid and foreign investment.

Stabilization options are limited for countries that do not have their own currencies, such as in the Federated States of Micronesia, since depreciation or foreign exchange reserves cannot be used to address oil price shocks. As a result, remittances and aid flows, as well as borrowing in the short term and reducing holdings of foreign assets, are the remaining options for adjusting to oil price shocks (Levantis, Groeger, and McNamara 2006).

12 The field has been widened to include more information on PDMCs.

Figure 5: Impact of an Oil Price Shock on Reserve Coverage in the Pacific[a] (in months of imports)



Note: The diagonal line indicates reserve coverage of 3 months prior to an oil price shock.
a An "oil price shock" is defined here as a sharp rise in the world price of Brent crude oil equivalent to the increase from its average price in 2007—$72.7 per barrel—to its current average price from January to October 2008—$107.7 per barrel (average prices are from the World Bank Commodity Price Data Pink Sheet, November 2008 edition). Export and import values from 2008, and latest available gross international reserves data for 2009 are used to determine the effect of such a price increase on reserve coverage in Pacific countries (except for the Federated States of Micronesia, which uses 2007 trade data). The following simplifying assumptions are also made: (i) inelasticity of trade volumes to changes in the price of oil, (ii) any deterioration or improvement in the trade balance automatically translates into a corresponding drawdown or accumulation of reserves, and (iii) abstraction from exchange rate fluctuations.
Source: Estimates based on data from Asian Development Outlook 2009; Reserve Bank of Fiji; Federated States of Micronesia Division of Statistics; Bank of Papua New Guinea; Central Bank of Solomon Islands; Samoa Ministry of Finance; National Reserve Bank of Tonga; and Reserve Bank of Vanuatu.

Equity

A further rationale for government intervention in the energy sector is to promote equity in access to energy among lower-income groups or across geographical areas. For example, under the Pacific Plan, PDMCs have committed to increasing access to affordable and reliable energy services in the region. Recently, many governments have sought to shield consumers from the effects of commodity and oil price increases through a series of pricing measures that have aimed to "regulate" and limit the pass-through of high prices. These include

- Subsidies: Most often hidden in electricity and transport prices through regulation;
- Tax adjustment: Reduction in fuel taxes;

- Price restraint: Such as preventing the increase in general prices or taxi and bus fares; and
- Compensation schemes: Such as lifeline tariffs for low-income households.

In many PDMCs (Fiji Islands, PNG, Samoa, and Solomon Islands), utilities are required to apply uniform national tariffs, which results in high levels of cross-subsidies from main urban areas to outer islands. The Cook Islands, PNG, Palau, and Samoa have introduced lifeline tariffs as a means of providing low-income households with electricity at subsidized rates. Except for privately owned utilities, e.g., UNELCO in Vanuatu, electricity charges are generally insufficient to cover the actual costs of supply, which must be subsidized by the government or development partners. This situation has resulted in a lack of funds to invest in maintenance and expansion, leading to high generation and transmission losses, low coverage, and poor service to rural areas. Although equity is a social rather than economic goal, economic analysis of various policy options can ensure that equity goals are achieved at the lowest possible cost.

Related to issues of distributional equity, rural electrification has often been stated as an explicit government policy for promoting equity in standards of and growth between rural and urban areas. This is because expanding access to energy in the rural areas is often regarded as an important catalyst for promoting economic development and raising rural incomes through agricultural, industrial, and commercial development activities, which often justifies heavy subsidization of this sector. Access to electricity can also lead to lower spending on energy by replacing batteries and kerosene, improving the quality of lighting, using time savings through the use of household appliances, and getting affordable entertainment and information through radios and televisions. However, many assessments of rural electrification projects find that the ex ante projections of energy demand are usually overoptimistic and that the projects do not generally yield the expected level of benefits, particularly in terms of productive uses of electricity (Schramm 1993, World Bank OED 1995). According to a study by the World Bank (2008), 80% of electricity consumption in areas with low levels of development is used for lighting and television. As a result, it could be argued that electrification should follow, rather than lead, economic development so that electricity should be supplied only to areas where demand for electricity services already exists. Although access to electricity yields important household benefits in terms of improving the quality of life, supply alone cannot be expected to generate economic development, which must be supported by complementary investments in transport, health, and education.

This can be demonstrated by the case of PNG, a PDMC in early stages of development. In its medium-term development strategy, the government has prioritized investments in basic social services, such as health, education, law and order, and transport infrastructure, rather than electricity (Government of Papua New Guinea 2004). As a result, electricity is expected to be funded by user-charges, while budget resources will be used to fund essential services that would otherwise not receive adequate levels of investment. Provision of these basic services is intended to create the income, which will result in increased demand, as well as willingness and capacity to pay for electricity services. This situation can be contrasted by the example of Timor-Leste, a country with similar levels of development. In 2008, the government of Timor Leste signed contract to purchase 3 electrical generating stations, 10 sub-station and more than 600 km of high voltage transmission lines at a cost of around $400 million. The proposed project will increase the country's electricity generation capacity in the next few years from the current installed capacity of 44MW to 180MW to electrify urban followed by rural areas. Currently peak electricity usage in Timor Leste is less than 30 MW. Given limited budgetary resources in PDMCs, investment in the energy sector may carry high opportunity costs given the potentially large economic rates of return from investment in alternative priority sectors, such as transport.

Approaching Energy Policy

Effective policy requires the careful examination of underlying economic problems that justify government intervention in the market, the development of a baseline to measure the benefits of any intervention, and the transaction costs of intervention and program administration. The purpose of reducing vulnerability to oil is to give nations a threefold benefit:

- Improvements in national energy planning and strategy;
- Reductions in balance of payments and budgetary costs of oil; and
- Higher level of national welfare from improvements in energy efficiency and productivity.

There can also be some tension among the roles. In particular, attempts to reduce fuel taxes can also result in pressure on local budgets. Likewise, the adoption of reforms to state-owned utilities to provide better price signals to business and households can result in an increase in inflation and reduced household welfare in the short run.

A clear indication of some market failure is required before the government could intervene in any sector of the economy. However, the government needs to be similarly prepared for its own policy failure if it intervenes in a market without first appraising the objective and associated expected outcomes. For example, in the Pacific, one key problem in making good decisions regarding investment is the absence of clear data that will help the government decide on the energy option that would ensure the improved functioning of the energy market.

Investment in energy infrastructure—whether for stationary electricity or transport—is lumpy by nature particularly for generation using fossil fuels. In effect, there are large capital costs that result in often large outputs that are often beyond the immediate needs of the population served. This provides challenges in many small island states that often require large outlays for new infrastructure and then face the problem of high average running costs and generally inefficient production.

In many PDMCs, strategic analysis of national energy issues to effectively deal with pressing energy challenges has been lacking due to weaknesses in national energy planning capacity. As a result, energy sector investments have generally not been prioritized based on economic rate of return. This has been compounded by the lack of reliable up-to-date energy data to support energy planning.

Box 3. Factors Affecting the Effective Development of National Energy Policy

No overall energy (or petroleum) responsibility within governments. There is no single agency in any Pacific developing member country (PDMC) with overall responsibility for energy, and realistically there cannot be, as energy use permeates all aspects of human activity and all aspects of national development. In the majority of PDMCs, petroleum accounts for well over 90% of non-biomass energy use (i.e., commercial energy use) but there are no clear mechanisms within governments—or appropriate signals to the private sector—for sourcing it competitively, using it efficiently, or seeking economically viable alternatives. Efforts tend to be ad hoc.

Weak coordination within governments. Although every activity requires energy, there is limited coordination between PDMC energy departments and other government or private agencies. Some PDMC climate change policies have no links to, or consistency with, national energy policies, even where both have cabinet endorsement. Integration of regulation and implementation. In some PDMCs, the office that has regulatory responsibility for energy also implements projects. Power utilities are generally self-regulating, and this can effectively limit independent (private) power production both for feeding into island grids and for rural electricity supply.

Integration of project design and implementation. In general, the office that prepares proposals and designs energy projects also expects to implement it, although the required skills for each task are different. With no separation between the roles of project conception and implementation, internal critical evaluation of the success or failure of either specific projects or the overall approach tends to be limited.

Source: Author

Previous Development Partner Assistance to Deal with Oil Pressures

In reaction to the weakness shown at the national level, international donors and international financial organizations have all sought to support and assist national energy policy development and implementation. Some of the participants involved in the Pacific include

- international financial institutions, including the World Bank and ADB;
- international organizations, including United Nations Development Programme (UNDP);
- regional organizations, such as the Pacific Islands Applied Geoscience Commission (SOPAC), Pacific Power Association, Secretariat of the Pacific Community, and Secretariat of the Pacific Regional Environmental Programme; and
- nongovernment organizations, including Greenpeace Pacific and the International Conservation Union.

ADB and other organizations have provided international energy advisors for several years to a number of PDMCs. In the 1970s, the forerunner to the Pacific Islands Forum Secretariat was established, an energy section was developed, and development partners worked with regional organizations to assess key national energy issues and developed a range of responses.

During the past quarter century, investment in the energy sector within PDMCs have been significant. ADB and others have updated, refined, and expanded the coverage of the early analyses;[13] a small core of Pacific island professionals now manage the national energy offices and the energy activities of the region's Council of Regional Organizations in the Pacific (CROP) agencies;[14] several national oil companies or nationally owned oil storage facilities have been established; and numerous electric power facilities have evolved from government public works departments, with many slowly corporatized. An Energy Working Group within the CROP umbrella has developed a regional energy policy (Box 4), which is meant to guide CROP energy-sector activities, provide mechanisms for a degree of interagency cooperation, and provide a

13 These include the 1992 *Pacific Regional Energy Assessment* (PREA; World Bank Energy Sector Management Assistance Program; 1992) prepared by the World Bank, ADB, and UNDP with 12 national reports and a regional overview; and the 2005 *Pacific Islands Renewable Energy Project* (PIREP), a UNDP/Global Environment Fund-funded effort (15 national reports, regional overview) prepared by the Secretariat of the Pacific Regional Environment Programme (SPREP).

14 The CROP agencies with active energy programs include the South Pacific Applied Geoscience Commission (SOPAC, which is the lead energy agency within CROP, but is soon to be absorbed into other agencies); SPREP; and the Pacific Power Association, which represents more than 20 Pacific electric power utilities and, to a lesser extent, the electricity industry.

framework for national energy policies that are consistent across the region.[15] Overall, there has been progress within the region in understanding energy issues and technologies. Development partners have continued to support energy sector development throughout the past three decades, although funding levels and areas of emphasis have waxed and waned considerably. However, investment from local sources within the energy sector has remained low in many countries, with a high degree of dependence on grant finance continuing.[16]

The oil price shocks in the 1970s and 1980s had posed serious macroeconomic problems, including decline in growth and rising inflation for the region. Since the early 1980s, there have been several initiatives to produce national and regional overview reports on key energy sector issues for PDMCs, including

a. *Pacific Energy Program* series of 1982 led by the Australian National University and UNDP for eight PDMCs;
b. Reports on *Issues and Options in the Energy Sector* for four PDMCs prepared by the World Bank (early 1980s);
c. The *1992 Pacific Regional Energy Assessment* (PREA) series by the World Bank, UNDP, and ADB, which covered 12 PDMCs; and
d. The *2005 Pacific Islands Renewable Energy Project* (PIREP), a UNDP/GEF–SPREP effort covering 15 Pacific island countries, which assessed renewable energy within a wider context.

15 The Energy Working Group consists of representatives from CROP agencies with energy sector activities, several nongovernment organizations, and donors, with UNDP, Australia, and New Zealand typically attending/observing. The group is supposed to ensure coordination among members and provide advice to CROP on energy matters but has a mixed record in doing so. It reports to energy ministers of Forum Secretariat member states.

16 The Micronesian countries (Marshall Islands, Federated States of Micronesia, Palau) have long relied on US Compact funds for capital investment in the energy sector. For many years, even the fuel for power production was purchased or highly subsidized by the United States; Australia; New Zealand; Taipei,China; and Japan have provided grants for the power sector in many of the smaller countries (Kiribati, Tuvalu). Even in 2008, several PDMCs (such as Tuvalu) had received funds from Japan, which provided up to $1 million for fuel purchases.

Box 4. Pacific Islands Energy Policy and Plan

Adopted at the 2004 Regional Energy Ministers Meeting in Madang, Papua New Guinea, the Pacific Islands Energy Policy and Plan (PIEPP) was developed to provide a regional consensus on energy issues and as a means of coordinating the energy programs in regional organizations and with development partners. The vision of the PIEPP is the increased availability of "reliable, affordable, and environmentally sound energy for the sustainable development of all Pacific Island communities". It is also intended to offer guidelines for the adaptation to the circumstances of Pacific island countries and territories in the development of their National Energy Policies and Strategic Action Plans and to assist Pacific island countries toward achieving the Millennium Development Goals.

For planning and policy development purposes, under the PIEPP, the energy sector is organized and analyzed according to the following six themes, which have become the standard classifications for integrated energy planning: (i) regional energy sector coordination, (ii) energy policy and planning, (iii) petroleum, (iv) renewable energy, (v) electric power, and (vi) energy use in transport. Four crosscutting issues, which apply equally to all themes, have been identified: energy for rural areas and remote islands, environmental aspects of energy use, energy efficiency and conservation, and human and institutional capacity development in the energy sector. The PIEPP is structured around 10 sections, based on each of the identified themes, with the following goals in each area:

- **Regional Energy Sector Coordination**: A cooperative approach to sector coordination that maximizes the impact of regional resources and capabilities
- **Policies and Planning**: Open and consultative cross-sectoral policy development and integrated planning to achieve sustainable supply and use of energy
- **Power**: Reliable, safe, and affordable access to efficient power for all Pacific islanders in both rural and urban parts of the region
- **Transportation**: Environmentally clean, energy-efficient, and cost-effective transportation within the region
- **Renewable Energy**: An increased share of renewable energy in the region's energy supply
- **Petroleum**: Safe, reliable, and affordable supplies of petroleum products to all areas of the Pacific, including rural and remote islands
- **Rural and Remote Islands**: Reliable, affordable, and sustainable energy supplies for the social and economic development of rural and remote islands
- **Environment**: Environmentally sustainable development of energy sources and use of energy within the region
- **Efficiency and Conservation**: Optimized energy consumption in all sectors of the regional economy and society
- **Human and Institutional Capacity**: Adequate human and institutional capacity to plan, manage, and develop the Pacific energy sector

Source: Pacific Islands Forum Secretariat 2002.

A more detailed outline of the various capacity programs and reports for the Pacific is outlined in Table 6.

There have been development partner-supported efforts dealing with overall energy policy, the most recent of which is the Pacific Islands Energy Policies and Strategic Action Planning (PIEPSAP) project. The project, completed in August 2008, was a 30-month effort to prepare practical national energy policies and investment plans through a Danish-funded program at the SOPAC.[17] The PIEPSAP project aimed to improve the capacity of Pacific island countries to develop practical national energy policies, and the strategic action plans to implement the policies. Activities undertaken under the PIEPSAP project included the preparation of national energy policies, strategic energy plans and energy legislation, support to regulatory activities, tariff and pricing studies for electricity, implementation of management information systems for power utilities, feasibility and project studies, as well as support to the development of practical energy sector management mechanisms. Reviewing these previous reports and understanding the recommendations is an important part of determining how energy policy making and planning in the region can be strengthened.

Efforts to improve energy efficiency through demand-side and supply-side management initiatives have been made. Since the 1980s, hundreds of audits have been carried out in the region for buildings, hospital boilers, water pumping stations, businesses, factories, and transport (Wade et al., 2005).[18] The Pacific Power Association has been engaged in working with utilities in various Pacific island countries to improve supply-side efficiencies in the production and distribution of electricity. Most recently, the European Union has approved a €1.2 million project of the association, which will focus on energy efficiency and capacity building. The Government of Australia has also committed A$1.5 million through the Renewable Energy and Energy Efficiency Partnership for the Pacific for renewable energy and energy efficiency initiatives in the Pacific.

Despite these initiatives, support for energy efficiency has been minor. To some extent, this is understandable: effective energy efficiency is very labor and skill-intensive; efficiency is not a single market, but constitutes a diverse range of end-users, equipment, and technologies, and large numbers of small, dispersed projects. Nevertheless, energy efficiency measures could offer significant potential for reducing dependence on oil in the region. For example, energy-efficient measures account for more than 65% of energy-re-

17 Earlier initiatives to support energy policy in the region were implemented through the Forum Secretariat in1980s–1990s, the United Nations' Pacific Energy Development Programme 1983–1992.

18 These various energy efficiency measures have been funded under the Commonwealth Heads of Government Regional Meeting energy program for Commonwealth island countries funded by the Government of Australia, the US Department of Energy and Department of Interior, the UNDP Pacific Energy Development Programme, and the European Union under the Lome II Pacific Regional Energy Programme and Lome III.

lated emissions savings up to 2030 (under the IEA's 2006 Alternative Policy Scenario), far more than the 22% savings expected from switching to nuclear and renewable energy.[19] Energy efficiency has generally not been a priority of PDMC governments for new energy investments, and its potential is poorly appreciated or understood within the region.

Table 6: Pacific Energy Capacity Building and Reports

Program	Operational/ Reporting Period	Comments
Pacific Energy Program (PEP)	1982	A report of eight Pacific developing member countries (PDMCs), which was the first attempt to develop data and understand the energy issues facing the region. It was an important input in later programs of the European Union and the United Nations Development Programme (UNDP).
Pacific Energy Development Program (PEDP)	1983–1992	Provided energy advice and capacity building for 13 PDMCs. Funded by UNDP through the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).
South Pacific Institute for Renewable Energy (SPIRE, Tahiti)	1984–1996	Developed technical designs, created and managed pilot demonstration projects, and tested renewable energy components for the Pacific. Funded by the French and French territory governments.
Pacific Regional Energy Assessment (PREA)	1992	This series of reports covered 12 PDMCs and was a joint effort by the World Bank, Asian Development Bank (ADB), UNDP, and the Pacific Islands Forum Secretariat. It covered broad energy sector issues.
EC Lomé 2 Regional Energy Program	1994–1998	Provided a large number of small renewable energy projects to Pacific states mainly focused at national energy offices.
Forum Secretariat (initially the South Pacific Bureau for Economic Cooperation and later the Pacific Islands Forum Secretariat)	1982–1995	Interface with regional development partners for project development and implementation. Provided some advice and capacity development. Many functions moved to the Pacific Islands Applied Geoscience Commission (SOPAC) in the late 1990s.
Renewable Energy and Efficiency Program (REEP)	2004–2006	An ADB technical assistance study on practical and affordable investments in renewable energy and improved energy efficiency in Fiji Islands and Samoa. The focus was on private sector involvement and rural area development.
Pacific Islands Renewable Energy Project (PIREP)	2003–2005	This was a UNDP/Global Environment Fund/ Secretariat of the Pacific Regional Environment Programme (SPREP) effort covering 13 PDMCs. It focused on assessing issues, options, opportunities, and constraints to the development of renewable energy.
Pacific Islands Applied Geoscience Commission (SOPAC)	Ongoing	A range of advisory and capacity development functions. Managed a range of urban and rural energy projects, especially small-scale renewable energy programs.
The Secretariat of the Pacific Regional Environmental Programme (SPREP)	Ongoing	SPREP has administered a range of environmental capacity-building projects, which include energy, particularly those involving climate change programs that seek to build renewable energy capacity.
Pacific Islands Energy Policy and Strategic Action Planning Project (PIEPSAP)	2006–2008	A Danish-funded SOPAC project aimed at strategic planning, national energy policy, and regulatory development.
Pacific Power Association (PPA)	1992–present	Council of Regional Organizations of the Pacific agency with membership of over 20 Pacific electricity utilities and the power industry. In recent years, PPA has become active in both renewable energy (mostly solar PV) and energy efficiency (mainly demand

Source: Author

19 This is from Global Trends in Sustainable Energy Investment 2008: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency (UNEP, July 2008).

Some of the key responses suggested by the various studies conducted in the region have included the following.

- Indigenous resource options should be assessed and, where appropriate, developed.
- Price surveillance of petroleum fuels, including wholesale and retail markups, should be improved.
- A region-wide bulk petroleum purchase arrangement to improve prices should be developed.
- Improvement in supply-side and demand-side energy efficiency should be a priority in policy development and implementation.
- Governments should move toward a regulatory and/or policy role in energy rather than being a direct participant in the supply of electricity and transport services.

Strengthening Assistance to PDMC Energy Sectors

Despite the significant amount of international development partner and regional assistance to PDMCs to support energy policy development and address the region's heavy dependence of oil, the effectiveness of this assistance has been limited due to a number of factors.

The focus by governments and development partners on possible solutions to offset the increased price of oil has been alternative sources of energy, including renewable energy technologies. Often, assistance is linked to the preferences of particular development partners or nongovernment organizations that seek to highlight a particular alternative energy source particularly for small-scale remote projects. Imposed constraints, such as this, can have an overall welfare-reducing effect since there are potential alternative energy investments for reducing dependence on oil, such as demand-side management measures for promoting energy efficiency, that offer better returns on investment.

Development partners could place more emphasis on gaining better understanding of high-priority needs in the energy sector to ensure that limited funds are better targeted. The PDMC governments often only respond to crises or opportunities instead of planning in advance or coordinating internally. If an opportunity arises for energy assistance, the energy offices tend to concentrate on, and request assistance for, what they know and understand (small-scale renewable energy) or some topical issue (e.g., biofuel) and often approved uncritically through a national aid coordinating mechanism.

Bulk fuel purchase, energy efficiency, and renewable energy sources have been highlighted as priority areas for assistance, but implementation in these areas has been weak. This has been partly because of a lack of understanding of local capacity and capabilities. For example, most of the funding for energy policy has traditionally focused on specific items of infrastructure or training as opposed to the development of policy capacity and financial and regulatory mechanisms for successful energy policy implementation. Institutions provide the structure within which both formal and informal arrangements are made. They are important means of providing signals to both businesses and households, which affects the level of investment and expenditure. However, PDMC energy departments remain little more than bodies seeking and directing development partner project funding.

In summary, government plays a key role in the development and implementation of energy policy. If a clear policy and strategy is developed, then electrification can deliver major benefits to a community and to the country, as a whole, in terms of economic growth, poverty reduction, and social benefits. Such benefits, however, depend on the provision of services that respond effectively to demand and do so efficiently.

There appears to be little analysis conducted by PDMC governments or development partners on what the really important energy issues are (and constraints and possibilities) for national development, and the niches where a regional approach might make some significant difference. In particular, there is no apparent "vision" of the key changes required within the region to shift toward more sustainable energy use and how the region's institutions can best assist. As a result, almost by default, oil appears entrenched by a combination of weak policy and a lack of demand for real alternatives.

Box 5. Case Study: Addressing High Oil Prices in the Marshall Islands

The Republic of the Marshall Islands (RMI), with a population below 60,000 people, consists of two groups of isolated atolls and islands extending 1,150 kilometers (km) north–south and 1,300 km east–west. About 70% of the population lives on two atolls, with about 50% on Majuro, the national capital. RMI is overwhelmingly dependent on imported petroleum fuel, which accounted for about 90% of gross energy supply in 2003, the remainder being biomass used primarily for rural cooking. Over the last decade or more, Majuro has had a reliable power supply. Residential consumption, at 550 kilowatt-hour (kWh) per household per month in early 2008, is nearly the highest among PDMCs.

A 1987–2003 Compact of Free Association with the United States included an allocation for "a contribution to efforts aimed at achieving increased self-sufficiency in energy production" that provided $2 million annually to the government. The funds were used, in part, for a bond issue in the early 1990s and as security for construction of the Marshall Islands Electricity Company's (MEC) power plant. After the bond was cleared in 2001, a significant portion of the funds was used to subsidize electricity tariffs on Majuro. The government-owned storage facilities (23 million liters) are the largest within about 1,500 km and, until recently, MEC has reexported half or more of diesel fuel imports. In recent years, Majuro's electricity tariffs have been subsidized from the profits—typically $1.5 million–$2.5 million/year—from MEC fuel sales, primarily bunker sales to tuna fishing fleets.

A "State of Economic Emergency"

A dispute with Mobil over fuel supply terms followed by the imposition in December 2006 of import duties and taxes on diesel fuel sales, reduced MEC's competitiveness as a reexporter of fuel. With the rapid increase in fuel prices from 2007–2008, and the inability to earn significant profits from bunkering, MEC increased its average charge for electricity from $0.13/kWh in 2006 to $0.45/kWh in mid-2008. Nonetheless, MEC was in serious financial difficulties when President Litokwa Tomeing and his cabinet declared a State of Economic Emergency on 3 July 2008 to address problems caused by soaring inflation—projected at 22.8% for 2008—arising from increased food and commodity prices. Beyond the immediate efforts to relieve cost pressures, such as reduced duties, a specific objective of the declaration was to fast-track a reduction in energy use and, hence, the demand for imported oil. In particular, the government sought to update the National Energy Policy and develop an action plan with measurable objectives to guarantee national energy security and sustainability over the long term, to reduce the nation's high dependency on imported fossil fuels and to counteract the impact of high fuel prices on the cost of living.

The ADB Energy Assessment

In August 2008, the Government requested ADB's assistance in dealing with the crisis. Among other responses, ADB carried out a 2-week rapid energy assessment in September 2008 to advise on practical short- to medium-term government responses.

The assessment looked primarily at a range of opportunities to reduce the net cost of petroleum fuels for electricity generation on Majuro atoll, with an emphasis on improved energy efficiency and grid-connected renewable energy and also some coverage of petroleum procurement and policy initiatives to reduce the impact of high prices on low-income residents of RMI. Because of time constraints, data limitations, and uncertainty over future oil prices, the impacts of various investments are only indicative. Regardless of whether crude oil sells for $70 or $150 per barrel, the conclusions nonetheless remain broadly unchanged, although the magnitude of savings will vary. The figure below shows indicative savings to MEC in percentage, based on August 2008 fuel costs. It suggests that improvements in energy efficiency for the consumer (columns 1–2) and by the utility (columns 3–4) will provide the most short- to medium-term savings.

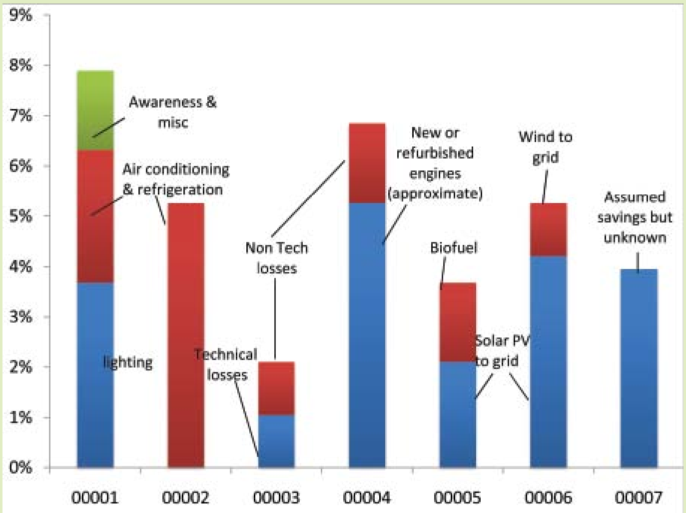
A quick assessment of this sort inevitably comes with several observations:

- Majuro has a history of very inefficient electricity use due to several decades of high subsidies but there are no reliable data on lighting and air-conditioning use. Nonetheless, even a quick study with limited data can demonstrate that simple, practical, and cost-effective investments justify an efficiency program targeting lighting and air conditioning and/or cooling as a priority.
- There could be substantial, but at this point unknown, savings from new bulk fuel procurement arrangements endorsed by the Pacific Islands Forum in 2008.
- New or refurbished engines at MEC would increase fuel efficiency considerably, but at this stage, the cost of this and other "supply-side" improvements are unknown.
- Not shown is the potential of switching power generation from diesel fuel to cheaper heavy fuel oil, which is used in Fiji Islands, Guam, and elsewhere. Preliminary claims in the RMI range from savings of 40% or more in fuel costs to quite substantial losses. There are supply and technical issues

that could not be resolved during the assessment; data obtained, however, suggest that these issues should be assessed in more detail.

- MEC could again earn profits from fuel sales, but this would require the removal of import duty and taxes on fuel reexported. To do so would require the arrangement of a loan during a period of low cash flow to enable MEC to again import sufficient fuel for both power use and reexports.

Possible Savings for the MEC



Energy Use Efficiency 1-2 yrs 3-5 yrs | Energy Supply Efficiency 1-2 yrs 3-6 yrs | Renewable Energy 1-2 yrs 5-10 yrs | Fuel Contracts 1-2 yrs

Note: Savings are expressed in percentage of fuel use based on $19 million of imports.

Many efforts for reductions in the vulnerability to oil rely on an increasing role for renewable alternatives. Opportunities from renewable energy were restricted to those that are commercially available, relatively easy to operate and maintain, and proven in PDMCs or similar conditions. However, the costs and outputs of renewable energy systems are very site-specific; hence, findings for the RMI cannot be simply transferred to other PDMCs:

- Grid-connected solar photovoltaics (PV) are technically proven, and the costs and energy outputs are well known. For technical and cost reasons, for Majuro, the maximum size in peak megawatt (MW) was restricted to 25% of the noon load. Capital costs are very high, at about $25 million, for a 2.5-MW peak system. In Majuro, solar PV is technically appropriate and has very low operating and maintenance costs—several cents per kWh—but financial viability depends on the availability of at least partial grant funding with low opportunity costs.
- A wind energy system similar in size to the solar PV system looks far less attractive in terms of net savings to MEC because installation costs for an atoll environment could well be double those in mainland Asia or Europe, operational and maintenance costs would be very high in the harsh salty

environment, and the output is not reliably known as there has been no wind energy assessment. In the RMI, wind appears to be much less attractive than solar.

- Coconut oil is produced in the RMI, costs and energy value are known, and blending a small amount (5% or so) should pose no technical problems. However, the net savings to MEC could be nil, as imported diesel fuel is replaced by a locally produced fuel of similar cost. The benefits of a larger long-term program would mainly be rural employment.

Better Communication Between Development Partners is Required

An important element of the assessment has been that improved donor cooperation and coordination for follow-up activities is needed. To improve communication, ADB is sharing information with the Australian Agency for International Development, which is providing funding for a national energy advisor; the European Community, has used the rapid assessment as the basis for a national energy plan and action program; and the Pacific Power Association, is advising MEC further on efficiency improvements in electricity supply.

Lessons for other states from RMI's experience include the following:

- Changes in policy require a strategy. Without an updated energy strategy, RMI is unable to develop a comprehensive approach to reducing oil dependence;
- Good policy is informed by sound estimates of the costs and benefits of various options. This requires rigorous analysis to reflect local circumstances. Alternative options, especially renewables, are site-specific and non-tested new technologies might be promising but are likely to be costly; and
- Businesses and households need clear incentives to conserve electricity through better pricing to reflect the cost of inputs, production, and losses. Poor pricing leads to excess consumption, energy inefficiency, and poor construction practices.

Source:
2008 data: RMI government data and ADB estimates.
2003 and earlier data: Marshall Islands National Report, Pacific Islands Renewable Energy Program (GEF/UNDP SPREP; 2005);
Asian Development Outlook 2008 Update (ADB, September 2008).

APPLICATIONS FOR THE PACIFIC

Pacific island countries are largely reliant on imported fossil fuels to meet their energy supply demands, and although alternatives to oil may be a sound long-term choice for electricity and transportation, local infrastructure remains tied to oil.[20] As a result of a combination of few local fuel sources and the distance of island states from the major international energy markets, fossil fuel will remain a heavy burden for their financial budgets. However, the rise in crude oil prices during 2007 and 2008 again revealed the region's exposure to a single type of energy. But any change to diversify the energy mix requires finance, planning, better data, improved policy development, and sound implementation and follow through.

Most Pacific nations do not have indigenous fossil fuels[21] and rely on imports of petroleum products from a long distance by sea for their energy supply. The demand for crude oil and its derivatives is predominately a derived demand for the services provided by electricity and transportation. These are two important goods and services that are the basis of sound economic growth. The opportunities to substantially reduce fuel usage for transportation in the short term are limited; as a result, this paper focuses on electricity and reviews wider policy issues, such as energy efficiency and renewable energy. In the longer term, the use of highly efficient vehicles, improved maintenance, and better reading systems could reduce fuel use per kilometer traveled quite significantly.

20 It is widely available, easily transported, has high energy content per unit volume, and the technology to use is very well developed. There are good guarantees of performance, initial costs are low, operational and maintenance costs are well known, and PDMC utility staff know how to operate and maintain the systems.

21 The only known exceptions are Timor-Leste and Papua New Guinea, both with a significant oil resource.

Electricity itself is a peculiar commodity that requires somewhat different understanding and assessment than other private goods and services. Electricity is required for a range of economic and non-economic activities—from cooking to powering household appliances, to supporting education and health facilities and powering business activity dependent on electrical power. These economic, social, and community welfare uses (that can reduce poverty and improve living standards) mean that the economic value of reliable energy supply will not be reflected in the cents per kilowatt-hour required to purchase, generate, and operate and maintain that supply but rather in the value of the service provided[22] by the appliances and equipment that use electricity. Similarly, with wide community-based benefits from the generation of electricity not being captured by each individual household, individuals will only be willing to pay for costs related to their own electricity use rather than the wider security and regulatory costs associated with the development of an energy policy, security of supply, and regulatory supervision of energy suppliers. The rise in crude oil prices during 2008 and the resulting economic problems that several states found they were facing revealed the importance that communities in the Pacific attach to the outputs that rely on oil and, thus, the importance of linking wider policy matters discussed in this paper on the demand, supply, and use of oil for transport and electricity.

The Options Available are Numerous

There are many alternatives for reducing oil dependence in Pacific developing member countries (PDMCs). On the supply side, this includes other sources of energy, such as natural gas, different grades of oil, and renewable energy; and improvement in generation efficiency and reductions in transmission and distribution losses. On the demand side, options include improved demand efficiency by large energy users and the integration of local energy production by independent producers, such as timber processing, mines, and sugar production.

However, decisions on alternatives require long-term government commitments to new infrastructure and complementary policy and regulatory environments. Incentives and sanctions must be a combination of top-down and bottom-up actions to encourage voluntary actions in terms of house design and purchase of appliances and, in some cases, to possibly prohibit particular activities. These might include either lower import duties, lower corporate taxes, or reduced import duty on energy-efficient appliances (for example, compact fluorescent lights), and higher annual vehicle taxes on large vehicles. PDMC governments could also prohibit any technology that is not commercially proven.

22 For example, provision of lighting through solar systems in remote areas may have a cost of $1.00/kWh or more but can be cheaper—and provide a far better service—than the alternative kerosene- or petrol-fueled lighting.

Energy Efficiency Improvements

Energy conservation refers to steps taken to reduce overall energy consumption levels, such as making investments in energy-efficient appliances or changing energy consumption behavior. On the other hand, demand-side management refers to the planning, implementation, and monitoring of activities designed to influence consumer's use of electricity in ways that will produce desired changes in a utility's load shape.

Box 6. Why Are Some Strategies More Favored Than Others?

Being financially and economically viable does not result in the adoption of a new technology. Some of the possible reasons related to low voluntary adoption and information failures include the following:

1. Energy users are unaware of the magnitude of savings available.
2. There is a lack of confidence in the claims of technology providers or energy auditors.
3. There is uncertainty about the future risks posed by a carbon-constrained economy and, therefore, the potential benefits from particular energy strategies.
4. The absence of systems in place to monitor the energy performance or improvement impacts in some parts of their operations.

Most of the easier, short-term, and cost-effective opportunities for reducing energy use in PDMCs involve energy conservation measures, such as promoting the use of compact fluorescent lights (CFLs; Box 7) and solar water-heating systems, as well as the introduction of energy efficiency standards and labeling of household appliances (Box 8). Other measures include energy audits of major government buildings, which are generally the most wasteful energy users, as well as other major infrastructure.

Source: Author

Supply-side measures are also critical for improving energy efficiency in PDMCs. For example, electrical losses (technical and nontechnical, including unmetered sales) of the Pacific island utilities averaged 13.8% compared to a desirable target of about 10% or lower (World Bank 1992). This has apparently improved in recent years although PPA benchmarking studies suggest it is still far too high.

Box 7. Energy Efficiency—Potentially Large Gains at Small Costs

The following two examples look at the experience of Fiji Islands and Timor-Leste in increasing the use of compact fluorescent lights (CFLs):

Fiji Islands. In mid-2005, during the consultancy to develop the ADB Renewable Energy and Energy Efficiency Program, estimates were provided to the Fiji Electricity Authority (FEA) on costs and benefits of a program to provide 150,000 CFLs to 50,000 households. It was assumed that FEA would bear the full costs, with consumers exchanging vouchers attached to their electricity bills for free CFLs at designated retail outlets. Even with very conservative assumptions regarding high unit costs of CFLs and management costs, electricity consumption over the program would decrease by 10 megawatt-hours and the evening peak demand would decrease by 7 megawatts (MW), representing a savings of F$2 million (then $1.2 million) for consumers and F$1 million ($0.6 million) for FEA in generation expenses. Typical household lighting costs would drop from F$70 to F$40 per year. The estimated gross payback for FEA was under 2 years, and fuel consumption would drop by 1,600 tons, saving F$1 million.

FEA developed an alternative program that would provide less savings but a far quicker payback period of 0.9 months. Working with importers and retailers, who agreed to share costs and benefits, FEA carried out the "Buy 1 and Get 1 Free Program" to provide 80,000 Philips CFLs over 2 years, reduce the evening peak demand by 3.9 MW, and save FEA about F$0.5 million. Consumer savings would vary, depending on the number and wattage of CFLs purchased. A consumer replacing two 75-watt lights with two 15-watt CFLs would reduce lighting costs from F$154 to F$31 over the estimated 5,000-hour life of the CFL with slightly lower net savings.

In fact, only about 40,000 lights were replaced by CFLs. FEA has not assessed overall costs and benefits as the program was managed by a private company but estimates about 1.4 gigawatt-hours per year of reduced consumption. In late 2008, FEA was considering a new program to respond to high consumer demand, with CFLs available from a wider range of retailers to encourage competition, and paid through their electricity bills.

Some of the particular lessons from the experience include

- having the support of the utility—it needs to be in their interest;
- using technically appropriate technology to reflect some of the problems of local electricity supply.

Timor-Leste. In Timor-Leste, a World Bank Power Sector Priority Investment Project distributed 27,000 free CFLs to low-income customers with pre-payment meters, reducing monthly bills from $15 to $11. For a scaled-up program, the World Bank conservatively estimates an economic rate of return of 125% and a payback period of under 1 year. Including the benefits of reducing the peak load by 1 MW, and the related avoided capital cost of power generation and the global environmental benefits from energy savings, the payback period is only 3 months, even if the consumers have to purchase replacement CFLs.

Source: Personal communication, Subhash Morris, DSM officer, Fiji Electricity Authority, 20 October 2008; 2005 working papers from ADB Pacific Subregional Renewable Energy and Energy Efficiency Program (REEP; RETA-6102); Project Paper for Proposed Grant to Republic of Timor-Leste for Energy Services Delivery Project (World Bank, June 2007).

Box 8. Proposed Fiji Standards and Labelling Program

The Fiji Department of Energy has proposed the introduction of standards for all new household refrigerators and freezers, which would see Australian and New Zealand standards adopted for appliances sold in the Fiji Islands. These standards would consist of two mandatory requirements:

(i) Energy labeling: Requires all household refrigerating appliances for sale in the Fiji Islands to have been tested under standard conditions, labeled with predicted annual energy consumption, and comparatively ranked on a 6-star scale. This provides buyers with consistent, reliable information, enabling consumers to take running costs into account when they purchase a new appliance. In this way, it can increase energy efficiency of the refrigerator and/or freezer market through better information.
(ii) Minimum Energy Performance Standards (MEPS): MEPS set a legally enforceable minimum level of energy efficiency for sale of appliances on the Fiji market, and so directly force suppliers to introduce more energy-efficient products and/or to remove the less efficient ones from the market. Thus, energy savings are guaranteed provided the program is well enforced.

It is estimated that if implemented by 2008, MEPS would reduce total electricity use by household refrigerators and freezers by about 8% below business as usual by 2010 and 20% (or 35 gigawatt-hour per year) below business as usual by 2020.

A cost–benefit analysis carried out for the Australian Greenhouse Office found that, assuming that costs associated with product price increases would reach a maximum of 10%* it was anticipated that although households in the Fiji Islands would spend an extra $10.9 million on refrigerators from 2008 to 2020, households would be saving approximately $91.6 million on electricity bills as a result of purchasing new, more efficient refrigerators. This figure is based on the current lifeline tariff. Using a discount rate of 10%, the benefit–cost ratio was estimated to be 4.2, assuming maximum price increases. Significant greenhouse gas emission reductions would also result from reduced use of diesel fuel.

* However increases may be much lower, as was observed in difference between predicted and actual costs in the Australian experience.
Source: Wikenfield (2006).

There are significant opportunities for improving energy efficiency in the ground transport fuel use in PDMCs. Studies conducted in countries, including Japan and the United States, have demonstrated that the most efficient cars typically use less than one-third of the fuel used by least efficient cars of comparable size. Further fuel savings can be gained through improved maintenance schedules since dirty air filters can increase fuel use up to 20%, while underinflated tires can increase fuel use by 10% (Wade et al., 2005). Given the large potential for fuel savings in the ground transport sector, PDMCs may consider implementing the following measures:

- Better vehicle maintenance (tune-ups, filters, tire pressure, etc.) for buses, taxis, and private vehicles, which can greatly improve vehicle efficiency;
- Lower import duties for smaller, more efficient vehicles (and/or higher annual vehicle road taxes for less efficient vehicles); and
- Mandatory annual vehicle inspections, and frequent road inspections, including efficiency (as shown by vehicle exhausts).

Generally, demand-side and supply-side measures, although skill-intensive to implement, are the most economically efficient means of reducing demand for oil compared with expanding renewable energy supplies.

Renewable Energy Technologies

There is a large potential for the widespread use of renewable energy technologies in PDMCs However, except for large hydropower systems in Fiji Islands and PNG, to date, most renewable energy projects have been small in scale focusing on the use of renewable energy technologies, particularly solar home systems, to provide basic energy services to rural households. However, in recent years, there have been efforts to incorporate renewable energy systems into urban electrical grids, such as the Butoni Wind Farm in Fiji Islands, which produces a total of 10 MW of power or 12 GWh per year when fully operational, or the installation of a 100 kilowatt-peak grid-connected photovoltaic (PV) system in Palau.

There has also been growing interest in the use of coconut oil as a substitute for diesel fuel in the Pacific in recent years. A number of countries are currently experimenting with the use of coconut oil biofuel. For example, the Fiji Department of Energy has installed biofuel generators, which are designed to run on locally produced coconut oil, in two rural communities on the islands of Vanua Balavu and Taveuni. The feasibility of installing a biofuel generator in a third community is being assessed. In Samoa, the power utility, Electric Power Corporation, has been considering the feasibility of using coconut oil as a fuel for power generation. Private-sector initiatives in biofuel development are also widespread in the Pacific. In the Marshall Islands, the Tobolar copra mill is retailing 50/50 filtered coconut oil and diesel blend below the price of regular diesel, and a number of vehicles are being operated using this fuel. In addition, the power utility in Vanuatu, UNELCO, has embarked on "industrializing" the production of fuel-grade coconut oil and using it in its generators in a blend of 10% coconut oil. This endeavor is expected to support the local industry as well as help reduce emissions.

Overall, renewable energy technologies are based on resources that are capable of sustainably being regenerated if used wisely. However, it is not clear whether renewable energy technologies are superior to conventional energy in terms of their environmental impacts[23] since both renewable and conventional energy technologies have some adverse environmental effects. When properly managed, however, renewable energy technologies are compatible with environmental protection and the concept of sustainable development (Wardrop 1994).

Reexamination of Fuel Supply Arrangements

The small and fragmented nature of Pacific island economies, combined with the little competition between oil companies in petroleum supply, means that petroleum prices in the region tend to be high. The Pacific Islands Forum Secretariat has been involved in establishing a bulk fuel procurement agreement between countries in the region as a means of increasing economies of scale and bargaining power, which could result in PDMCs negotiating lower fuel prices (Box 9).

Although natural constraints, such as remoteness and small size, mean that oil-based fuel prices will always remain higher than average in PDMCs, Samoa has been successful in achieving the lowest fuel prices in the region through the introduction of an "ownership, competition, and regulation model". Using competitive tendering arrangements, multinational oil companies tender every 3–5 years for the right to supply fuel to the country. In addition, rigorously enforced formula-based fuel price reviews are applied every month. Such arrangements are possible in Samoa where fuel import terminals are publicly owned; it would be more difficult for other PDMCs to adopt a similar model where fuel infrastructure is owned by fuel suppliers (Sanghi and Bartmanovich 2007).[24]

23 For example, some proposed biofuel projects (e.g., ethanol from cassava in Fiji Islands) in the region will have a prodigious appetite for water. Oil palm plantations may also discharge effluents, resulting in marine pollution. A poorly designed rural solar PV system can result in the improper disposal of toxic batteries. Hydroelectric systems exceeding 10 MW, if poorly planned, have the potential to cause serious downstream effects.

24 Similar arrangements are being considered in the Cook Islands under the proposed Fuel Farm Initiative.

Box 9. Case Study: Bulk Fuel Purchase

The memorandum of understanding that was reached in Auckland in October 2008 on the bulk purchase of oil was hailed as an important step in reducing some of the inefficiencies associated with the various small markets in the Pacific and the additional costs for the small fuel loads that face higher transport, storage, and distribution costs in the region. For instance, transport costs add 5%–10% to the cost of fossil fuels to main distribution centers in Fiji Islands and Papua New Guinea, and 27%–40% to smaller secondary distribution points (Rizer and Hansen 1992).

The idea of bulk purchasing among Pacific countries has been around for some time. For example, the World Bank suggested the concept in a report back in 1982 and the United Nation's Pacific Energy Development Program prepared a paper for energy ministers on likely costs and benefits in the mid-1980s.

The current proposal seeks to coordinate the purchase, transport, and storage of fuel in region. So far the Cook Islands, Nauru, Niue, and Tuvalu have committed to the regional bulk purchase scheme.

A number of administrative, policy, and regulatory issues first need to be developed and agreed upon before the proposal can be realized and implemented. The key matters of agreement cover the following.

- **Fuel**: States that are a party to the agreement must have the same quality of fuel. There is some opportunity for countries in the region to review the type of fuel that is being purchased. The current fuel is often the higher-quality EU-4 standard, but there is a possibility to use lower-quality, high-sulfur fuels.
- **Storage**: States must have greater fuel storage capacity especially in designated regional fuel centers. This will involve new investment in infrastructure by members of the group. However, the way in which these facilities will be financed and recovery of any loans will be an issue. Similarly, the scale of the facilities will require some careful thought. In particular, the life of these facilities (when maintained) can extend over 30 years. It is possible that the role of oil and cost of alternatives may make such an investment uneconomic, leaving the country that builds this asset with a stranded asset for some time.
- **Administrative Training**: To be able to benefit from the bulk purchase agreement, states will need training or assistance in the future market as greater gains can be made by purchasing in the forward market rather than in the spot market. Member states will require an understanding of future contracts, options, and the role of hedging in diversifying risk. At the moment, most fuel purchases are in the spot market, and this led to the problems faced during the recent rise in the price of oil.

The initiative also exposes the initial members to a "free rider" problem as other states may simply wait until the process is established and operating before joining to avoid the upfront "buy-in" costs associated with the points raised.

Source: PIFS 2008.

Box 10: The Development of Options: Technology Increases Choices

There are specific technical issues related to the use of energy. They are driven by geographical factors; the actual capability to develop, operate, and maintain specific infrastructure; and the appropriateness of the solution. The rapid pace of development in energy ideas and innovations is providing various new ways of delivering energy services. These alternatives do not only encompass new technology but also point to solutions that will improve the performance of existing technologies. Some of the alternatives that can be considered at various time periods include the following:

Immediately Available (up to 2 years)

- Energy efficiency—such as use of compact fluorescent lights (CFLs) for private and public lighting
- Solar water heating—especially important for the hotel industry and commercial buildings
- Energy audits of major government buildings and infrastructure—PDMC government agencies are often the most wasteful energy users
- Regulation of household building design—including improved ventilation and insulation
- Energy efficiency standards and labeling for household appliances
- Local renewable energy technologies—such as solar, wind, and hydro, which are often cost effective for remote areas
- Replacement of existing transportation stock with energy-efficient vehicles
- Improvements in energy efficiency by producers (supply-side)—including reductions in transmission and distribution losses
- Biofuels—use of coconut oil and other agricultural materials as an economical supplement to diesel fuel

Near Term (next 3–10 years)

- Replacement of light diesel fuel with heavy oil fuels for electricity generation—new transport and storage infrastructure required
- New procurement and contracting arrangements to improve the purchase price of fuels
- National renewable energy options—such as solar, wind, and hydro, which may be cost effective for larger-scale urban use
- Development of supporting institutional and regulatory structures to provide clear policy and commercial incentives to energy suppliers and users

Beyond 15 years

- Ocean and tidal technology
- Algae-based biofuels
- Fuel cells
- Carbon capture and storage technology

These do not reflect the possible cost of various initiatives especially those items that are immediately available. The net benefits and practicality will also vary very substantially from location to location.

Source: Author

A further option to reduce the costs of imported fuel in PDMCs is to import lower-cost and lower-quality, high-sulfur diesel fuel. Sulfur is a naturally occurring component of crude oil and is found in both gasoline and diesel. When these fuels are burned, sulfur is emitted as sulfur dioxide (SO_2) or sulfate particulate matter. Although the use of high-sulfur diesel fuel would result in increased pollution levels, given small overall emissions in most PDMCs, this would not significantly affect the air quality. However, newer fuel-efficient designs of vehicles generally require low-sulfur fuels. As a result, there may be a trade-off between fuel efficiency and cost considerations.

Factoring Climate Change into Energy Policy Making

Climate change, linked to by fossil fuel emissions in the transport and electricity sectors, is another reason for addressing the region's heavy dependence on oil. While they are small contributors to overall global greenhouse gas (GHG) emissions, PDMCs are highly vulnerable to the effects of climate change, such as sea-level rise and the increasing frequency and intensity of natural hazard events. Mitigation efforts in the region will not only contribute to a global reduction in GHG emissions but, more importantly, will address the region's vulnerability to high oil prices.

The Kyoto Protocol, which sets mandatory targets for industrialized countries to limit or reduce GHG emissions to the agreed target levels, was developed by the international community as a means of overcoming the collective action problem associated with climate change. Under the Agreement, the clean development mechanism (CDM) was developed to give industrialized countries (Annex I countries) some flexibility in achieving their emission reduction targets by allowing them to pay for projects that reduce GHG emissions in developing countries (non-Annex I countries) to minimize the costs of abatement and collect certified emission reduction credits in return, which can be applied against meeting emission reduction targets.

Box 11. The Cost of Carbon: Increasing Opportunities

The threat of global warming and associated issues related to climate change also highlight the need for solutions to problems that cross over and seek to solve both energy and environmental problems. As a result, dealing with the effects of climate change has led to innovative approaches. One of the key market-based responses has been the development of a global carbon market. The development in carbon trading and measures, such as the clean development mechanism (CDM), provides opportunities for the development of various programs in the Pacific to diversify energy supplies. In October 2009, 1 ton of carbon abatement in certified emission reductions (CER) in the secondary-market price for December 09 futures contracts was €12. In the primary market, for future CER flows from projects, prices for delivery up to the end of 2012 were in the range of €8 to €11. While this does not purport to be an accurate measure of the negative externalities that arise from the production of harmful greenhouse gases, it does allow some increase in the cost/benefits of some Pacific-based projects. For example,

- In the Fiji Islands, a proposed biogas/methane capture project has the opportunity to reduce the equivalent of 10,000 tons of carbon dioxide per year and could be used to generate electricity.
- A grid-connected solar PV input to the current diesel system (in the Marshall Islands) would generate 2.5 MW, with an annual electricity production of about 3.5 GWH per year. Reductions in greenhouse gases would be about 2,300 tons.

Source: ADB estimates.

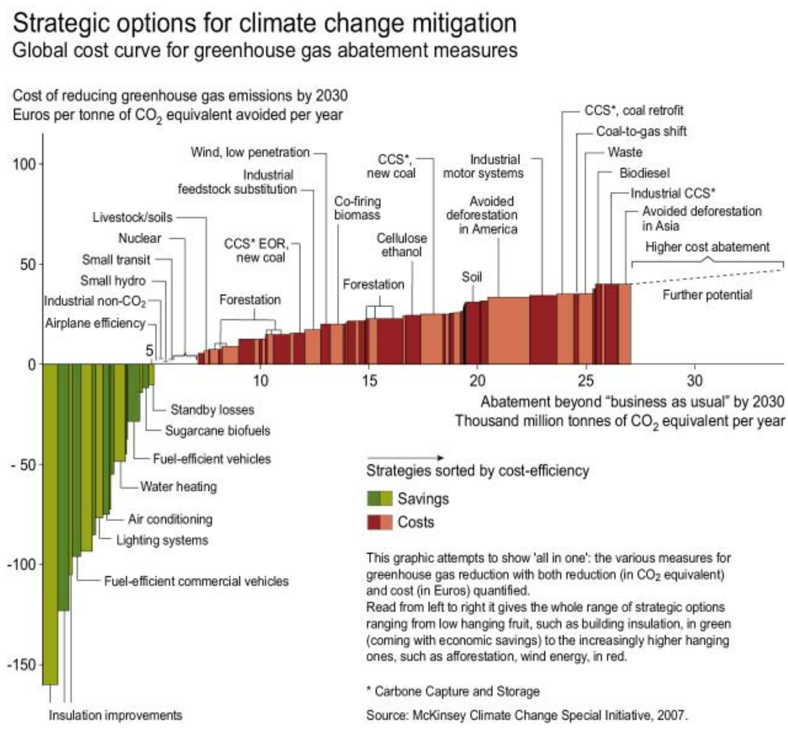
CDM provides PDMCs the opportunity to reduce their dependence on oil through investments in energy efficiency and renewable energy technologies in projects, which result in GHG abatement that are "additional to any that would occur in the absence of such activities" (UNFCCC, 1998, paragraph 5c, Article 12).[25] Currently, there are two CDM projects in the Pacific: a micro-hydro project in Fiji Islands and a geothermal project in PNG.[26]

25 This statement has been open to different interpretations. On the one hand, "environmental additionality" has been interpreted as the requirement, which means that a project is additional if the emissions from the project are lower than the baseline. The second interpretation of "project additionality" means that the project must not have happened without the CDM, i.e., that CERs are required to make the project economically viable. At present, the CDM executive board deems a project additional if its proponents can document that realistic alternative scenarios to the proposed project would be more economically attractive or that the project faces barriers that CDM helps it overcome.

26 Fiji Islands—Wainikasaou and Vaturu Small Hydro Plants, Viti Levu: These two plants of 6.5 MW and 3 MW capacities, respectively, were developed by FEA/Pacific hydro as a CDM project in 2004–2005. This project is being implemented, with UK's Accord Energy purchasing 100% CERs through ABN-AMRO bank. The two projects are estimated to help reduce GHG emissions by 24,928 tons of CO^2 equivalent annually. PNG—Lihir Geothermal Power project: This project started in 2003 with a 6-MW pilot plant and a capacity of 55 MW when fully commissioned. It will produce 422 GWh annually and displace 278,904 tons of CO_2 equivalent per year. There is no Annex 1 country partner in this project, and the registration allows Lihir Gold Company to accumulate CERs for 10 years.

To ensure that investments in clean energy or energy efficiency projects are cost effective, countries need to consider the marginal costs of abatement associated with various GHG mitigation activities. Energy planning can be strengthened by the use of marginal cost of abatement curves (Figure 6) that provide an assessment of the level of emission reduction, which a range of measures could achieve at a given point in time against a projected baseline level of emissions. These curves demonstrate resulting carbon dioxide reductions from each measure, as well as the associated cost per ton of carbon dioxide reduction.

Figure 6: Marginal Cost of Carbon Dioxide Abatement Curve



BAU= Business as usual, CCS= carbon capture and storage, CO_2= Carbon dioxide, EOR= Enhanced Oil Recovery, EUR= euro, Gton= Gigaton, t= ton, tCO_2e= tons of carbon dioxide equivalent.

Source: United Nations Environment Programme/GRID-Arendal.

Replacing Intuition with Sound Data and Analysis

One of the clear important ingredients of better policy, implementation, and evaluation is data and information. For example, considering some of the alternatives on the supply side, there are technical limitations and financial costs associated with the use of different petroleum types. Other alternatives include renewable energy sources, such as biomass, liquid biofuels, solar and wind power, and hydropower. The applicability of various energy supply technologies is dependent on capital and operational costs associated with the energy source, the ability to work effectively with existing energy systems, and the ability to cope with adverse climatic conditions in the region. The use of estimates based in Asian, North American, or European studies is insufficient. The rest of the section develops some of the key points to enable nations to take better control of oil.

Many characteristics of energy generation, such as remote locations, small demand, and the high cost of fossil fuel imports, are specific to the region. To reflect these differences from other parts of the world and make the discussed framework match more with realistic situations in the Pacific region, the case of energy decision making in Palau (Box 13) and the Marshall Islands[27] (Box 5) have been presented as case studies in this document. More studies of a similar nature are required to document how various PDMCs are seeking to confront their energy problems and document their progress and lessons in diversifying energy supplies to urban and remote locations by developing different approaches.

Data remains a challenge for sound policy making and recommendations. Under the limitations of socioeconomic, industrial, and human resource development, energy database building and maintenance remains at an early stage in the Pacific region. Due to the lack of a comprehensive energy database for the entire region or any individual country, many issues regarding energy supply and consumption have not been well quantified to date. The conventional framework for energy policy making relies very much on quantified information for energy hardware. As a result, PDMC energy policy making needs to develop a good time series of basic data and necessary qualitative analysis on the use and sources of energy.

Without an adequate database of energy costs over time, there is a strong likelihood that advice can be overly influenced by "one-off" observations, personal biases, or estimates that could provide the wrong sort of signals. Among the important issues that need to be better researched are the appropriate size and use of subsidies and taxes that are currently being provided to or levied on energy producers and consumers.

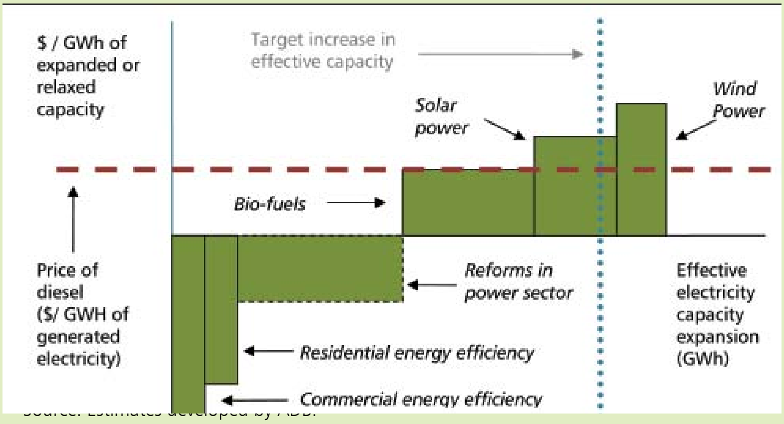
27 Palau does not have a formal national energy policy although one is to be developed during 2009. It does have an energy efficiency policy and action plan for the government. The Marshall Islands is currently developing an energy policy with European Union support. It is expected to go to cabinet in mid-2009.

Evaluation of various measures to reduce vulnerability to oil and improve energy security in the Pacific region can be undertaken by using an approach similar to the marginal abatement cost curve commonly used in the analysis of greenhouse gas mitigation measures. As the primary objective is to identify effective and efficient programs aimed at providing an adequate supply of electricity in the region while reducing vulnerability to oil price shocks, the interventions to be considered focus on alternative energy and the internal efficiency of power utilities on the supply side, and consumer energy efficiency on the demand side. Benefits are measured in terms of the effective expansion of electricity generation capacity resulting from the use of alternative energy, increased efficiency of suppliers, and the reduction in demand due to energy-saving interventions. Thus, a marginal effective electricity capacity expansion (MEECE) cost curve has been constructed to aid in the evaluation of various options for improving energy security in the region. An example of a MEECE cost curve is presented in Box 12.

For PDMCs, an alternative decision criterion for choosing good projects should perhaps involve the use of the price of diesel fuel as a cost benchmark. As the region is heavily dependent on diesel to power its electricity needs, any measure that can generate a given level of electric power output, or reduce demand by an equivalent amount at an overall cost lower than the prevailing payments for diesel, can be considered cost effective. The cost of diesel can change to reflect the cost of diesel at different sites.

Governments and development partners should focus on developing and implementing measures that have lower associated costs than their current primary power source (i.e., diesel) and disregard, at least for the time being, other alternatives that are likely to be more expensive. In the illustrative MEECE cost curve in Box 12, solar photovoltaic power can be considered cost effective using the target level of effective electricity capacity expansion. However, using the price of diesel benchmark, wind can no longer be deemed cost effective, leaving energy efficiency, power sector reforms, and biofuels as the remaining viable options for enhancing energy security. This is, of course, only illustrative; the relative benefits/costs of actual hydro, biofuels, etc. investments will vary from country to country and location to location.

Box 12. An Illustrative Example of a MEECE Cost Curve[28]



There is a range of possible issues in the use of a marginal effective electricity capacity expansion (MEECE) cost curve approach for the Pacific region. Outlined below are some of the related issues:

- **Remoteness and/or island economy issues**

a. Need to account for possible additional costs to expanding electricity grids due to dispersion (and remoteness for some) of target areas;
b. Possible consideration of autonomous stand-alone systems as part of the options for electrification of remote areas that may not be practically connected to electric power grids; and
c. Access costs in terms of technological readiness of targets of intervention (i.e., some interventions may require substantial "technological leaps" given the current state of development and existing technologies in the Pacific).

- **Valuation of costs and benefits**

a. Accounting for existing price distortions due to either government policy, market imperfections, or both;
b. Proper valuation of the opportunity costs involved in producing biofuels, taking into account the potential loss in export revenues (i.e., from exporting agricultural products that are being used as biofuels);
c. Measuring reductions in deadweight losses due to increased efficiency of power utilities with the introduction of reforms; and
d. Inclusion of broad social, environmental, and economic costs of each option.

- **Setting of appropriate targets and time frames**–Feasibility of interventions to be considered depends upon the time horizon prescribed for achieving the set target. Appropriateness of the target, on the other hand, affects the determination of the relative cost effectiveness of alternative interventions

28 The relative magnitudes of benefits and costs (except for the "reforms in the power sector" intervention) approximated here are based on several marginal abatement cost (MAC) curves presented in recent studies. However, since those MAC curves were constructed for other countries and/or regions, adjustments have to be made in deriving the associated costs and benefits for such measures when implemented in the Pacific. Also, the illustration only presents general categories of interventions. An actual MEECE cost curve will individually evaluate specific measures, such as energy-efficient lighting versus energy-efficient air-conditioning and insulation, wind power in ideal sites versus wind power in average sites, solar-powered grids versus stand-alone solar power systems, among others.

Box 13. Case Study: Developing a Cost Curve—The Experience of Palau

Palau, located about 1,300 kilometers southeast of Manila, has only 21,000 people, 80% of whom live on or near densely populated Koror. About 99% of households and businesses are connected to the electricity grid, and residential consumption in 2006 averaged 450 kilowatt-hour/household/month, among the highest in the PDMCs. High and wasteful levels of electricity use are a legacy of several decades of subsidized electricity prices.

In 2005, Palau's president promulgated Executive Order 234 mandating a 10% reduction in electricity consumption and vehicle fuel use for the executive branches of government. In mid-2006, the government requested assistance from Pacific Islands Applied Geoscience Commission (SOPAC) to help develop an energy conservation strategy to achieve the mandated targets. SOPAC worked with the national energy office to develop

a) an overall strategy,
b) a methodology for allocating electricity costs (and reduction targets) among ministries,
c) a methodology for prioritizing energy efficiency investments, and
d) simple procedures for monitoring and evaluation.

An energy audit was carried out on the government complex and Bureau of Public Works, and a number energy audit kits were provided for future audits. Vehicle and electrical appliance procurement procedures were drafted with specified energy efficiency criteria, with rules and allowances for exceptions. Vehicle maintenance procedures and schedules were drafted to improve vehicle fuel efficiency.

The estimated annual savings and initial costs of various options assessed for energy supply and improved efficiency are summarized in the table below. The table is illustrative, based in part on SOPAC, European Union, and Japan International Cooperation Agency studies. Although actual results will vary, the table and the following figure provide a reasonable estimate of the value to Palau of various energy sector investments.

The table also shows the net present value for the above investments discounted at 5% and approximate reductions (or increases) in greenhouse gas emissions. The benefits vary somewhat each year depending on the implementation period. Some benefits are assumed to drop slightly each year as people become careless in operations or maintenance. Benefits are only fuel savings, except electricity savings energy-efficient homes and solar water heating for the tourism sector.

In terms of the initiatives evaluated, some high-value investments (compact fluorescent lighting, solar water heating for the tourism sector, and a range of government and private efficiency measures) are worth implementing immediately even at a crude oil price of $60 per barrel. Some are uneconomic (a high-cost solar PV demonstration, a small hydroelectric system); one is very high value and well worth assessing in more detail, even though initial costs are not accurately known (switching from diesel fuel to heavy fuel oil); and one has such large potential benefits that analysis of implementation costs would be worthwhile (water and sewerage pumping efficiency). These sorts of investments are very site specific and are not necessarily applicable to other PDMCs. In general, energy efficiency investments appear likely to be far more attractive than renewable energy. If there are large grants, with little opportunity costs, available to develop urban renewable energy systems, the conclusions could change. The following figure provides a graphical demonstration of the net benefits of the various options.

NPV ($'000) and GHG Emission Changes for Palau Investments

Investment	Initial cost ($'000)	NPV for oil price of			Discount period (years)	GHG change (tons of CO_2 equivalent / year)
		$60	$80	$100		
CFL (households)	40	1,141	1,589	1,968	5	(1,500)
Capital complex efficiency	28	250	341	434	5	(350)
Government miscellaneous efficiency	57.5	82	125	171	5	(180)
Government lighting efficiency	40	16	40	60	5	(70)
Public Works efficiency	9.2	3	8	12	5	(14)
Solar water heating		684	1,086	1,443		(900)
Outlying islands awareness	15	(2)	3	8	5	(15)
Energy-efficient homes	300	0	102	200	15	(240)
Solar PV (3.2 MW peak)	27,200	(11,686)	(8,321)	(4,956)	20	(4,050)
Solar PV (0.1 MW peak)	1,350	(1,052)	(965)	(879)	20	(100)
Small hydro (200 kW)		(2,474)	(1,950)	(1,506)		- 570
Switch from ADO to HFO	22,000	?	?	43 m	10	+ 28,800

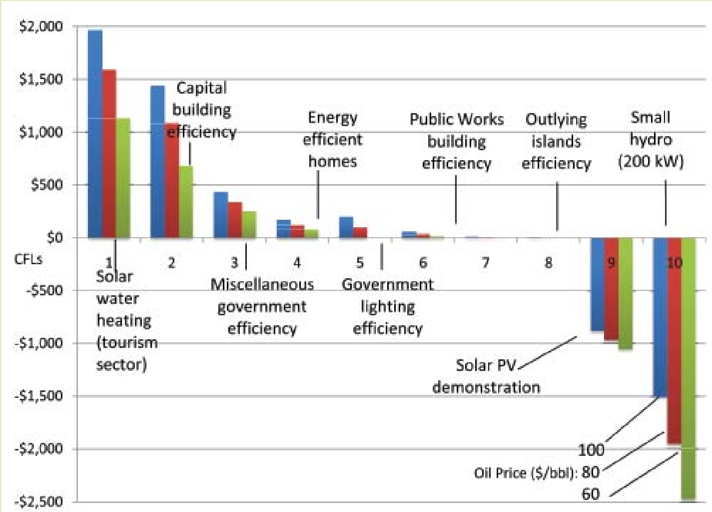
? = data not available, ( ) = negative value, ADO= automotive diesel, CFL= compact fluorescent lighting, CO_2= carbon dioxide, GHG= greenhouse gas, HFO= heavy fuel oil, kW= kilowatt, MW= megawatt, NPV= net present value, PV= photovoltaic.

Note: Only benefits considered are fuel savings except energy-efficient homes (electricity savings).

Lessons for other states from Palau's experience include

- changes in policy require a clear strategy;
- good policy is informed by sound estimates of the costs and benefits of various options. This requires rigorous analysis to reflect local circumstances; and
- the development of datasets and procedures will ensure that monitoring and evaluation of the changes in the policy are undertaken.

Net Present Value in $'000 of Palau Energy Investments (5% discount rate)



High Net Benefits High Net Costs

bbl= barrel, CFL= compact fluorescent lighting, kW=kilowatt, PV= photovoltaic.

Source:

Palau Energy Conservation Strategy: Final Report (SOPAC, September 2007)
Republic of Palau: Energy Efficiency Action Plan (Government of Palau, February 2008)
Palau submission to the Government of Italy for energy efficiency funding (2008)
Master Plan for Upgrading Palau Electricity Supply (2 volumes: final draft, May 2008)
AGO Factors and Methods Workbook version 3 (Australian Greenhouse Office; March 2003)
Discussions with Philippe McCracken; EC REP-5 energy adviser (Suva).

Conclusions and Recommendations

This report has reviewed the region's exposure to the high and volatile price of oil, the dominance of oil for much of the Pacific, and the range of opportunities for reducing the costs of petroleum fuels in PDMCs from both regional and national perspectives. It has not been about the provision of energy services, whether cooking or lighting or direct electricity or fuel for small, remote rural communities and, therefore, has not discussed, for example, small stand-alone home solar PV systems, which are increasingly popular, and (if carefully managed) cost effective for remote communities.[29]

29 In the Marshall Islands, for example, with a sizeable rural solar PV program, 70% of the population lives on urbanized Majuro and Kwajalein atolls. In Palau, 90% of the population lives within one single reef system. In Fiji Islands, 87% of the population lives on the two main islands of Viti Levu and Vanua Levu, though many of the households are rural. In Kiribati, nearly half of the national population lives in the sole urban center of South Tarawa.

During the past quarter century, there have been numerous efforts to reduce PDMCs' dependency on petroleum fuels. In the medium-larger countries with hydro and/or geothermal resources, there has been development of those resources for electric power,[30] where they are close to load centers. For the most part, however, PDMCs remain overwhelmingly and will continue to be highly dependent on petroleum fuels. The work on oil price vulnerability index (Table 3) indicates that this is likely to remain an issue for some time, which requires further consideration.

This report has sought to emphasize the practical and proven opportunities, whether related to technologies or policies on the demand side and/or supply side. Some initiatives that have been effective in larger ADB DMCs may be inappropriate in very small countries with limited skilled human resources, tiny markets, and limited natural resource endowments.[31] Other options may be more attractive in small, remote countries where oil prices are even higher and where reliable fuel supplies are absent. However, PDMCs are all distinctive with their own individual resource endowments; thus, no generic solution will suit them all. Nonetheless, in general, there are opportunities for the following in the short, medium, and long terms; in particular, these include

- procurement of petroleum fuels at a price lower than existing contractual terms;
- possible replacement of diesel fuel for power generation with lower-cost heavy oils and/or biofuels;[32]
- energy efficiency improvements within power utilities and transport (supply-side management);
- energy efficiency improvements for consumers (demand-side management);
- investments in urban renewable energy systems (improvements in transport efficiency and usage, and use of direct combustion from local materials);
- possible substitution of high quality diesel fuel with less expensive, high-sulfur diesel and/or biofuels in the ground transport sector; and
- development of appropriate institutions, policies, plans, regulations, and incentives to support the above opportunities.

The key to energy security and a reduction in vulnerability is diversification of energy supply and should include a balance between demand-side management, increases in the efficiency of existing energy supplies, and the development

30 Relatively large hydro in PNG and Fiji Islands, smaller hydro in Samoa, Vanuatu, and possibly for the Solomon Islands. Geothermal at a mine in PNG.

31 For most individual countries (other than Fiji Islands and PNG), this probably includes EESCOs.

32 And other fuel switching opportunity is electricity to liquefied petroleum gas (LPG) and kerosene to LPG.

of new fuel and electricity sources that use cheaper fossil fuels or are renewable. For example, the wide-scale utilization of energy-efficient lighting is an innovation that is available now, does not require large outlays in expenditure by PDMCs, and provides proven gains in reduced energy costs with the same service.

Focusing on consumption and energy practices to develop behavioral changes can yield sustainable low-cost gains for PDMCs. The combination of measures to utilize supply- and demand-side improvements is important. No one option will provide all the benefits for the Pacific. Box 10 reviews some of the options and indicative time periods involved.

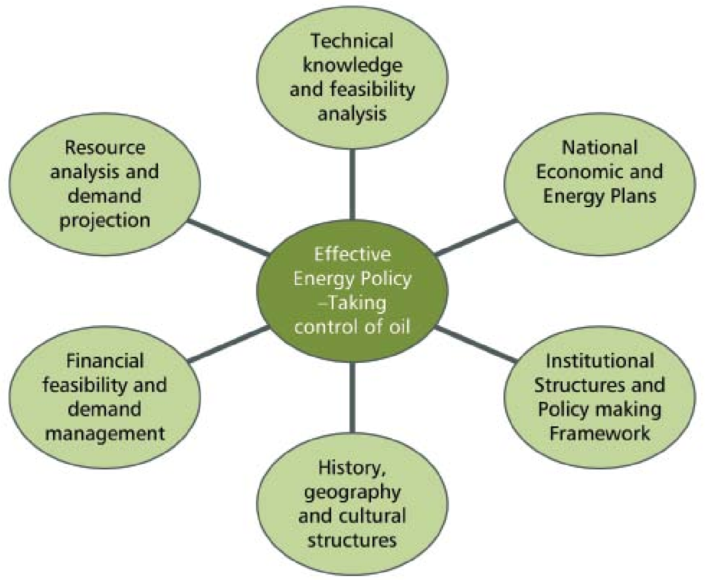
To improve the effectiveness of energy policy making, and encourage practical and cost-effective renewable energy and energy efficiency in the Pacific region, a policy-making framework is required. While there has been some development of regional guidelines for energy policy making through efforts by SOPAC at the national level, there does not appear to be an appropriate framework available for successful energy policy making. In the work to date, too much emphasis has been placed on idealized and theoretical energy policy-making problems using data that do not reflect local capital costs or operations and maintenance expenses that reflect local land ownership issues and weather conditions. Yu et al. (1998) identified some of the main lessons learned from recent failures of approaches to energy policy in less-developed countries, including the following:

- Lack of attention to social and political issues. For policy analysis, not only technical and economic factors, but also political, social, cultural, institutional, and environmental issues need to be considered (Meier and Munasinghe 1994).
- Lack of understanding of local decision making processes. Too often, proposals do not consider their actual use in solving real policy-making problems. Not surprisingly, when decision makers receive the results of modeling studies, they often find the conclusions and recommendations to be naive, not reflecting the real situation in developing countries, and not politically acceptable (Biswas 1990).
- Local experience, knowledge, and judgment are often ignored.

Energy is an integral part of economic growth and development policy. Hence, PDMCs should not develop separate programs for renewable energy, energy efficiency, transport energy, or climate change in isolation. Instead, they should try to develop a least-cost approach that incorporates a judicious mix of supply and efficiency options. No one option will reduce the region's dependence on oil, and no one technology will deliver an escape. The lesson from previous experience of policy implementation in the Pacific is that once a policy is developed, it requires continued support in the implementation and the follow through in coming years. The support and advice by donors, regional organizations, and international financial institutions remain important.

Figure 7 demonstrates the range of issues that input into effective energy decision making in the Pacific and seeks to provide a guide to policy makers.

Figure 7: Developing a Framework for Energy Policy in the Pacific



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