Chapter 6 A framework for energy policymaking in the region*

6.1 Introduction

It has been suggested that most of the Pacific Island nations would benefit from adopting sustainable energy policies (Abdalla 1994; Goldemberg & Johansson 1995; Wardrop 1994). However, there does not yet appear to be an appropriate framework available for successful energy policymaking. In recent years, a modelling approach has been an important tool in energy policymaking, planning and management (Lavergne 1994). Little work, however, has been done on this in the Pacific Island region. In the work to date, too much emphasis has been placed on idealised and theoretical energy policymaking problems in both developed and developing countries (Biswas 1990). The main lessons learnt from recent failures of modelling approaches are:

(i) 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 & Munasinghe 1994). In particular, many modellers in developed countries do not appreciate the reality in developing countries (Biswas 1990).

(ii) Lack of understanding of decisionmaking processes. Many modellers have no experience in decisionmaking. Too often model development does not consider who is going to use the model, its potential application and actual use in solving real policymaking problems. Not surprisingly, when decisionmakers receive the results of modelling studies, they often find the conclusions and recommendations to be naive, not reflect the real situation in developing countries and not be politically acceptable (Biswas 1990).

(iii) Too much emphasis is given to the development of more complex models that use increasingly sophisticated mathematical techniques and computer technology. Necessary experience, knowledge and judgement, however, are often ignored. Also, more complicated methods mean more time and financial consumption (Biswas 1990; Lapillone et al. 1994).

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* Sections of Chapter 6 has been published in the paper: Yu et al. (1997b).

These issues need to be addressed by energy policymakers in attempts to establish an applicable framework for energy policymaking. One of the important objectives in building the present framework is to provide a tool that will be useful to energy policymakers in the Pacific Islands when evaluating energy options, formulating energy policy and carrying out energy planning. International organisations and foreign donors deciding on support for energy projects should also find the approach useful.

Many characteristics of energy generation conditions such as remote locations, small demand and the high cost of fossil fuel imports are unique to the Pacific Island region. There is a need, therefore, to reflect these differences from other parts of the world and make the framework more realistic in the Pacific Island region. The case of energy policymaking in Kiribati is used as an example of the application of the framework. This is not only because Kiribati has many of the unique characteristics of the region, also it is a country with the lowest GDP in the region (Poirine 1995). More importantly, Kiribati has achieved great progress by providing energy to rural and remote islands by developing solar energy (Yu et al. 1996).

The very common, conventional framework for energy policymaking, relies on quantified information. As a result, this energy policymaking approach needs massive data and necessary qualitative analysis is neglected. Under the limitations of socio-economic, industrial and human resource development, energy database building is at an early stage in the Pacific Island region. Due to the lack of a comprehensive energy database for the entire region, many issues regarding energy supply and consumption have not been quantified to date. Even if in the future, the database for energy issues is well built, qualitative analysis will still be a useful method. This is because the use of qualitative analysis will clarify information that needs to be quantified. In the framework presented here, thus, a balance is given to both quantitative and qualitative methods.

6.2 Concepts

A number of concepts were employed in developing the framework, which are briefly explained as follows:

Purpose and general character. Building this framework is mainly for management purposes, not for pure academic discussion. Environmental protection and ecosystem conservation

should be integrated into the energy policymaking processes, although their value have not been well determined in terms of market systems and many effects cannot been quantified to date. Also, energy policymaking should consider broad political, socio-economic, cultural, and technical issues. The framework should easily be understood and be able to be applied by energy policymakers in the region. It, therefore, should be as simple as possible in terms of its structure, economic analysis, mathematical and computing tools.

Capability for broad adaptation. There are 22 countries and territories in the Pacific Island region as a whole. They exhibit wide diversity in respect of social, political and natural environments. Also, they have different indigenous energy resources. The framework should have a broad capability to address energy policy needs under various socio-economic, cultural and environmental situations.

Uncertainty. Uncertainty related to energy issues exists with respect to energy demand, energy resources, technologies, economic performance, the international energy market, governmental policy, people's lifestyles, and environmental effects. Although uncertainty related to energy issues cannot be accurately estimated, we do know that the uncertainty will be reduced with the development of human knowledge. For the sake the discussion in the chapter, a hypothetical range of $\pm$ 5% of uncertainty is assumed for the framework.

Renewable energy and energy conservation. Renewable energy technologies are based on resources that are capable of regeneration. They are more sustainable than conventional technologies that are based on depletable fossil fuels. In general, renewable energy technologies are superior to conventional energy in terms of their environmental impacts, although 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). Most Pacific Island countries, however, are reliant on imported fossil fuels to meet their energy supply demands. As the island states are located far from the major international energy markets, fossil fuel supply is a heavy burden on their financial budgets. The development of renewable energy could relieve this burden. Therefore, in the framework, a special consideration is given to renewable energy. Efficient usage of energy is another important issue for energy policymaking. For example, electrical losses (technical and non-

technical, including unmetered sales) of the Pacific Island utilities average 13.8 percent (17 percent in Kiribati) compared to a desirable target of about 10 percent or lower (World Bank 1992).

Qualitative and quantitative analysis. There are many limitations in energy policymaking, such as data unavailability, a lack of knowledge regarding social and environmental matters, and a poor knowledge of existing market systems. At the moment, not all effects related to energy issues can be quantified even if qualified. In the framework, both quantitative and qualitative analysis is encouraged (Lapillone et al. 1994).

The assumption of scenarios and selection of parameters. In projecting energy demand, a demand increase at exponential growth is assumed. Also, three scenarios, that is high, base and low energy demand are assumed. Base energy demand refers to the energy demand at current growth rate and assumes that this growth rate will not change into the future. The exponential growth model is largely used to estimate energy demand by nations and international organisations.

Recently, this model has been challenged because with adoptation of energy efficiency measures, energy demand appears constant in many member countries of OECD. They are most advanced developed countries in terms of technology, capital, human resources development and management.

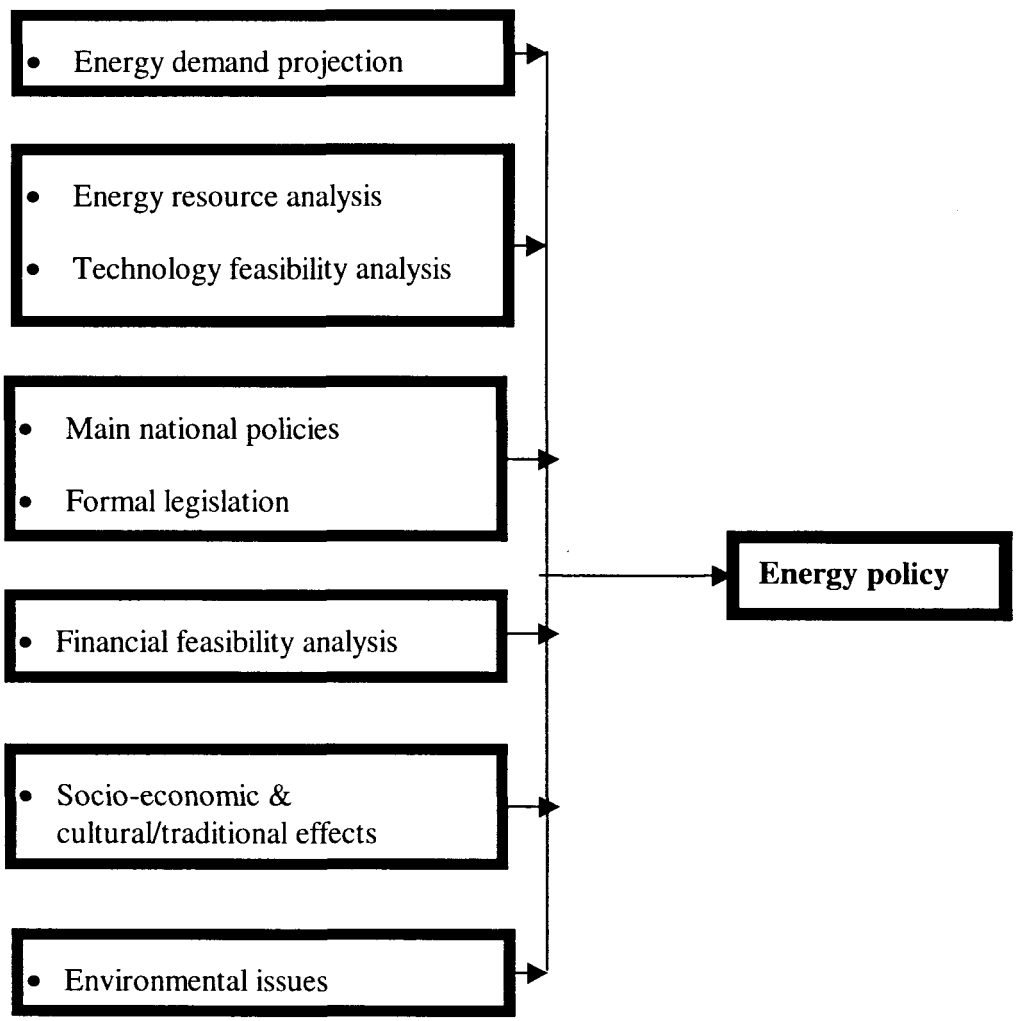
In many Pacific Island nations, however, the development of energy sector is still in its very early stages. Due to limitations on technology, finance, human resources development and institutions, their energy demand will continue to grow with the economic development. This trend will not change in the short term because their problems as mentioned above cannot quickly be overcome. Therefore, the use of the exponential growth model to project energy demand in the Pacific Island region could be reasonable. Furthermore, the importance of renewable energy and energy efficiency will be significantly highlighted under exponential growth projections.

To estimate the penetration of renewable energy and fossil fuel savings, three assumptions are considered. That is, 10 percent, 30 percent and 50 percent of total energy demand are sourced by renewable energy; and 10 percent, 20 percent and 30 percent of fossil fuel is saved by

energy conservation. The projected period used in the research is fifteen years, which is between 1995 and 2010. The selection of parameters or data is based on the situation in the Pacific Islands. Parallel comparative data from Europe, North America and other developed countries must be very carefully and sceptically used, because there is a large gap between the Pacific Island nations and developed countries in socio-economic, cultural, technological, and industrial backgrounds.

Unproven energy technologies. Some renewable energy technologies, such as wave and OTEC have not yet been proven at this stage (Wardrop 1994). As a consequence, these technologies are not evaluated.

Figure 6.1 Framework for energy policymaking in the Pacific Islands



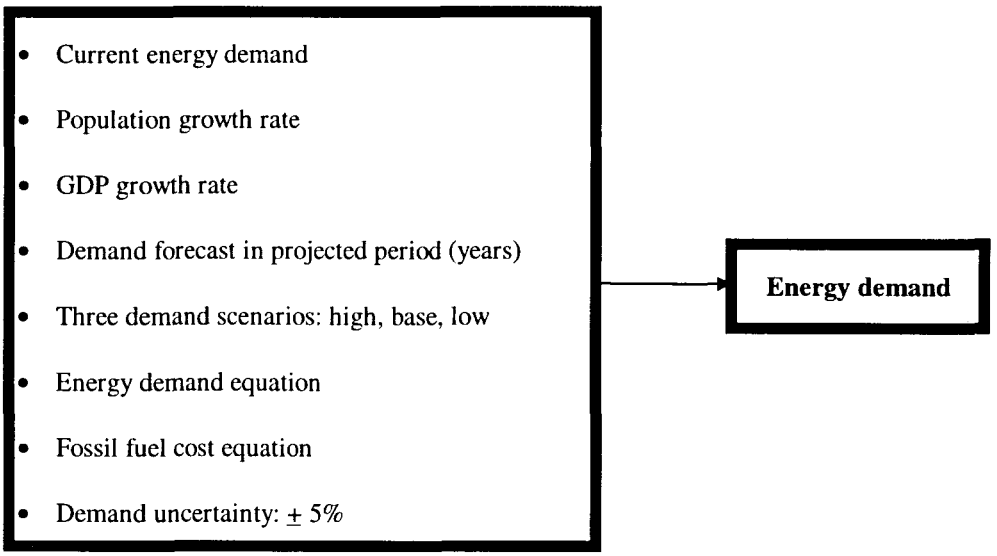
6.3 Description of the framework

In Figure 6.1, a suggested framework for energy policymaking in the Pacific Islands includes six main components: (i) energy demand projection; (ii) analysis of energy resources and technology feasibility; (iii) the main national policies and legislation; (iv) financial analysis; (v) socio-economic and cultural effects; and (vi) environmental issues.

6.3.1 Energy demand projection

In order to estimate energy demand, an energy demand sub-model (see Figure 6.2) with an exponential growth energy demand equation and an imported fossil fuel cost model is used:

Figure 6.2 Sub-model 1: Energy demand projection



Energy demand equation $E_t = E_o(1+\lambda)^{t-t_o}$ **(1)**

Where:

E_t---projected energy demand in year t (kilolitres);

E_o---current (or year zero) energy demand (kilolitres);

λ---energy demand compounding rate (% expressed as a decimal, and $\lambda>0$);

$t-t_o$--projected time period (years);

t_o---initial year;

t---year of estimate.

Fossil fuel cost equation $C_t = E_t \times P_t$ (2)

Where:

C_t---total imported fossil fuel cost in year t (US$M);

E_t---projected energy demand in year t (kilolitre);

P_t---unit cost of fossil fuel in year t (US$/litre).

6.3.2 Energy resources and technology feasibility

In the process of energy policymaking, the availability of potential energy resources and the feasibility of different energy technologies need to be assessed. In the Pacific Islands, some countries have hydro resources for generating electricity, such as Fiji and Western Samoa. However, in some countries with low altitudes above sea level, such as Kiribati, solar or biomass could be the main indigenous resources for energy usage.

6.3.3 National policies and legislation

National policies and formal legislation are important bases to start with when considering energy options; energy policy should not conflict with established national policies. Since the early 1980s, for example, some entrepreneurs attempted to invest in power production from the combustion of hazardous wastes in the Pacific Island region. They have made proposals to a number of Pacific Island governments, such as Kiribati, the Marshall Islands, Palau, Tonga and Western Samoa. In order to protect the fragile island environments from toxic air pollution, the island governments have rejected all such offers (World Bank 1992).

6.3.4 Financial analysis

The financial resources available for energy projects need to be properly estimated as an important first step in the process. As issues need to be considered such as government and potential private funding, international aid, consumer investment, tariff management, and potential fossil fuel savings delivered by the proposed alternative energy resources and energy conservation strategies. It should always be taken into account that the fiscal capability (i.e. budget & revenue collections) of governments is very limited in many Pacific Island countries.

Also at present, in many Pacific Island countries, "electricity is not priced on the basis of full cost recovery, and either explicit or implicit electricity subsidies exist" (Wardrop 1994, p10). For instance, the Kiribati Government gives a subsidy of US$88,000 each year to a diesel

power utility for power used in delivering water and sewage services (Tonako, for Secretary, Ministry of Works & Energy, Kiribati, 1995, pers. comm. 25 September). Reducing subsidies for energy supply and utilisation could be an important goal of energy policymaking in the region. In carrying out financial analysis, an energy budget function can be employed.

Energy budget function $\mathbf{B_e = \sum_{i=1}^{7} f(x_i)}$ **(3)**

Where:

B_e---energy finance budget (US$M);

x_1---government funding (US$M);

x_2---private funding (US$M);

x_3---consumer investment (US$M);

x_4---international aid (US$M);

x_5---fossil fuel savings by renewable energy and energy conservation (US$M);

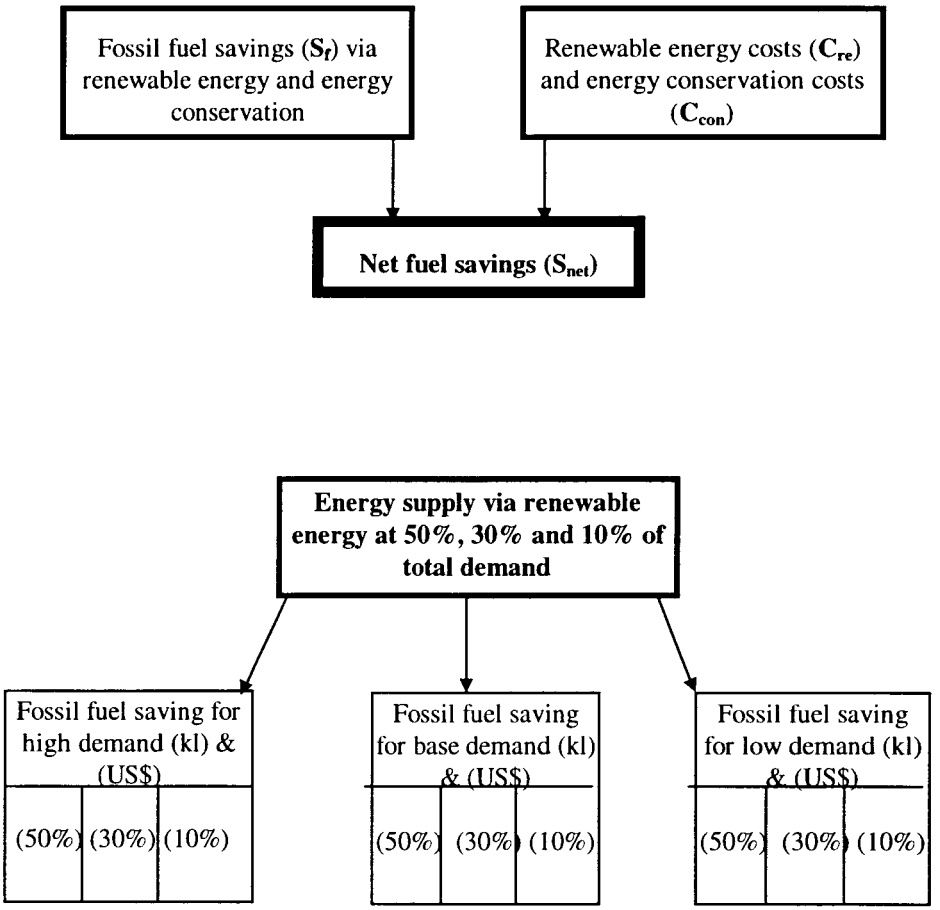
x_6---projected tariff (US$M); and

x_7---others.

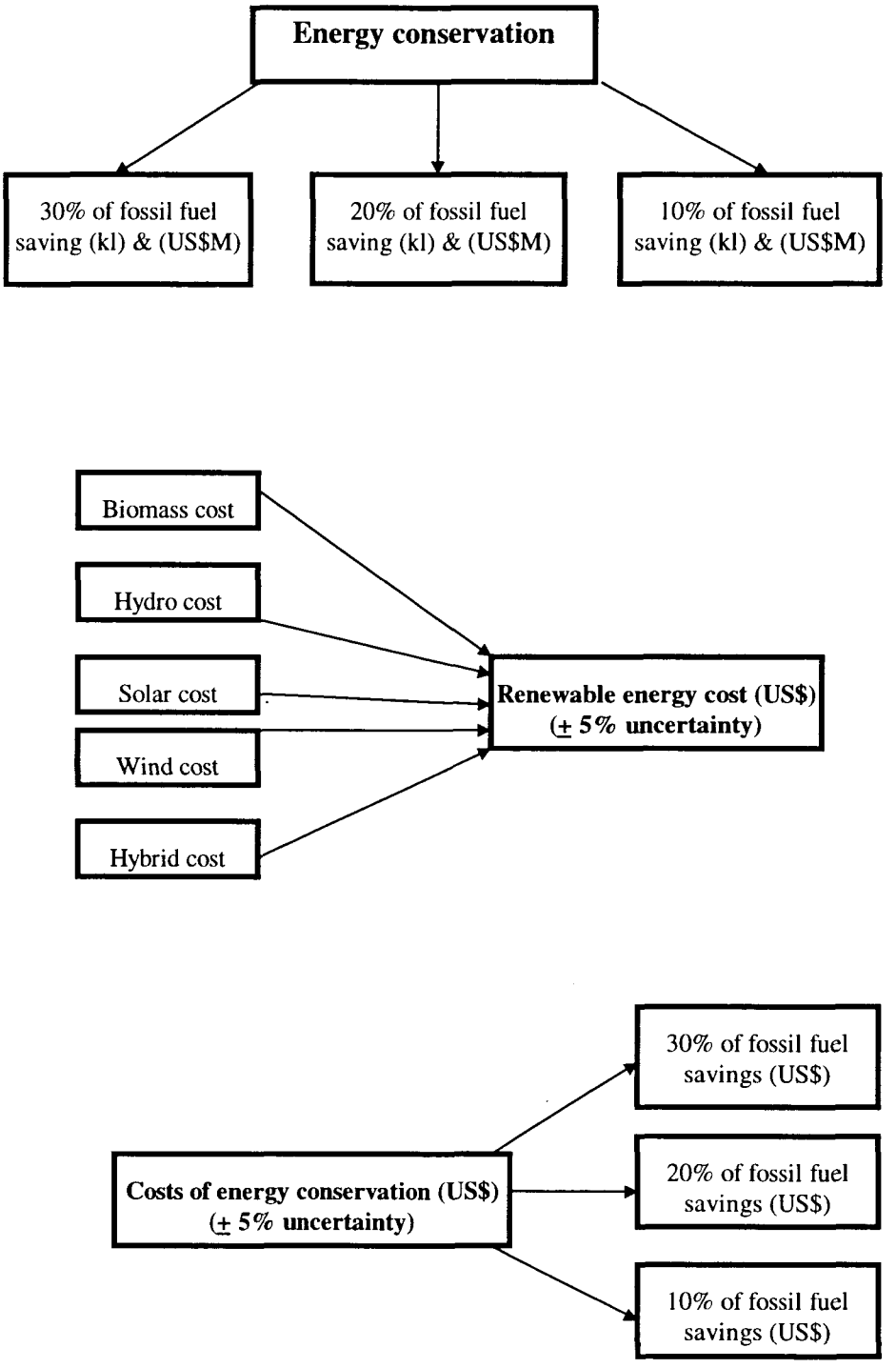
While fossil fuel energy still plays the major role in energy supply for the region, the Pacific Island nations can greatly benefit from energy conservation programs both on the energy supply and demand sides (World Bank 1992). In the region at present a large amount of electricity is wasted due to inefficient appliances and excessive air conditioning (World Bank 1992). A considerable potential for energy conservation exists through proper maintenance and operation, as well as by using efficient appliances. Even simple conservation measures such as de-icing refrigerators and freezers could achieve important savings, or deliver more services for the same amount of energy consumed (World Bank 1992). In the Cook Islands, the Mitiaro Island Energy Saving Light Bulb Project is an example which is mentioned in Chapter 5.

In the financial analysis, a net fossil fuel saving sub-model is used for discussing the contribution of renewable energy and energy conservation with a net fossil fuel saving equation.

Figure 6.3 Sub-model 2: Net fuel savings



continued Figure 6.3



Net fuel saving equation $S_{net} = S_f - C_{re} - C_{con}$ (4)

Where:

S_{net}---net energy saving in year t (US$000);

S_f----fossil fuel saving (US$000);

C_{re}---cost of renewable energy (US$000);

C_{con}--cost of energy conservation (US$000).

6.3.5 Socio-economic and cultural/traditional effects

Energy projects could have positive or negative effects socially, economically and culturally in both direct and indirect ways. In the region, culture and tradition, including customary law and religion, have a major influence on energy projects and other issues. In the process of energy policymaking, social, economic, and cultural and traditional factors should be decisive factors for selecting energy options. The framework includes a sub-model for evaluating benefits and costs of social, economic and cultural/traditional effects regarding energy issues.

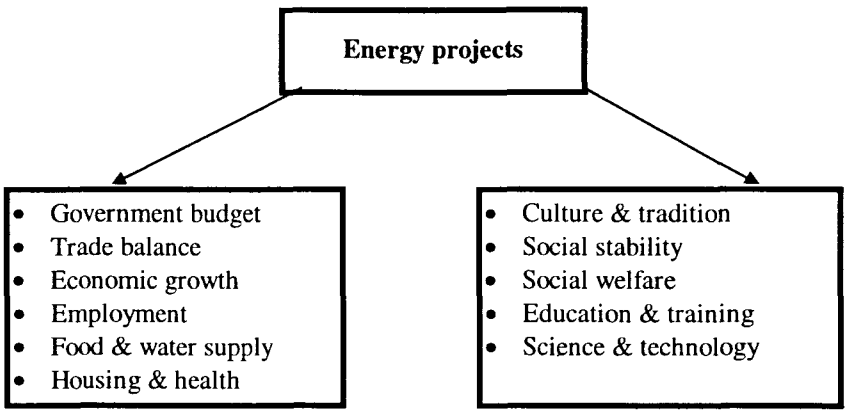
According to this sub-model, government budget, trade balance and economic growth resulted from planning energy projects should be quantified. Also, improvements in employment, food and water supply as well as housing and health need to be analysed. Due to many reasons (for example, cost of technology), many people are excluded from these projects. In this situation, these projects could create some social gaps, for example, between people in a village, which is not good for maintaining friendship between villagers; this could result in social instability. The effects of any energy project in promotion of social welfare, education, training, science and technology need to be evaluated.

An important issue for energy policymaking is that customary land and sea tenure could have a significant role on the development of sustainable energy in the Pacific Islands (World Bank 1992). In all independent Pacific Island nations except Tonga, a large degree of communal control is retained over land use and the exploitation of natural resources. In some countries, negotiations with respect to land use are not undertaken through national or provincial governments, but directly between developers and the customary landowners. The on-site

control of governments, in practice, has been quite restricted. In some nations, where the authority of chiefs has been eroded, energy projects and environmental conservation programs are either no longer fully applied or not enforced (South Pacific Regional Environment Program 1992a).

Additionally, the current means of dealing with compensation claims are largely ineffective (World Bank 1992). Often the rights of the state and landowners are not clearly delineated. Even where the rights are clearly defined in formal legal terms, they are not necessarily understood or compatible with customary law (World Bank 1992). The Komarindi hydro project in the Solomon Islands, the Rouna hydro-electric project in Papua New Guinea and Bukuya hydro power scheme in Fiji, have highlighted land tenure and compensation claims as among the key issues to be resolved before these energy projects could proceed (Department of Energy of Fiji 1994a; World Bank 1992).

Figure 6.4 Sub-model 3: Socio-economic and cultural/traditional issues of energy projects



6.3.6 Environmental issues

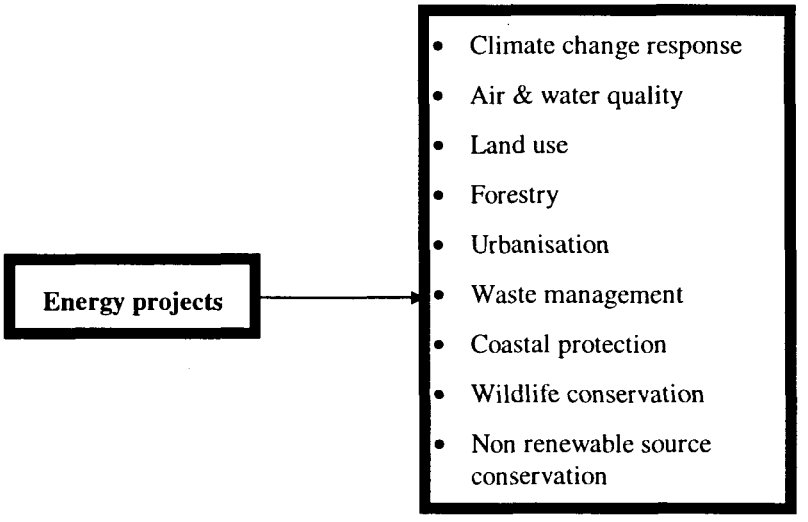
Energy production and consumption may result in serious impacts on the environment. For example, supply and usage of fossil fuels can pollute global and local environments (eg atmosphere and water pollution). Renewable energy uses such solar, small hydro electricity and wind power will save fossil fuels and reduce pollution. Also, these renewable energy technologies will benefit forestry, coastal protection and wildlife conservation. More

significantly in the Pacific Island region, renewable energy could provide most people in remote areas with electricity. This could reduce migrants from out islands to big islands. As a result, it will discourage urbanisation and improve waste management.

Also, renewable energy can cause some environmental problems (Jackson 1992). In densely populated areas, for instance, firewood supplies are becoming scarce. This is contributing to deforestation, land and coastal degradation (SPREP 1992a). Hydropower projects can have some adverse downstream effects. Even small-scale household solar PV systems can result in some significant environmental problems with the disposal of used solar PV batteries. Also, energy projects can have some negative environmental impacts on wildlife conservation (eg large hydroelectric schemes might reduce fish stocks).

Some people have said it is difficult to see how these issues can be left to a market approach, even in principle; and have questioned how we can put a fair price on an endangered species or an ecosystem threatened by human activity (Cairncross 1992; Lowe 1994b). In order to avoid the impacts of energy projects on the environment, these issues need to be adequately considered at the early stages in energy policymaking through environmental impact analysis. Environmental concerns should be pro-actively incorporated into energy investment planning and decisionmaking. Simply reacting to environmental problems after they occur is not acceptable (Meier & Munasinghe 1994). At the moment, some effects can be quantified and some cannot. Therefore, both quantitative and qualitative analyses are necessary.

Figure 6.5 Sub-model 4: Environmental issues related to energy projects



6.4 Case study: energy policymaking in Kiribati

The Republic of Kiribati occupies an Exclusive Economic Zone of 3.5 million km^2 in the Central Pacific. The 33 islands and reefs have a total land area of approximately 820 km^2, which results in a sea to land ratio of 4,000:1 (Wilson 1994). Socio-economic indicators for Kiribati in 1993 are shown in Table 6.1.

Kiribati is a fossil fuel importing country. In 1994, its fuel imports totalled 8,500 kilolitres. The consumption of imported fuel for electricity generation, cooking, lighting, heating, water and sewage pumping was 3,500 kilolitres (Table 6.2). The nation's main electricity supply is diesel-generating power. As for renewable energy, only solar PV has made a small contribution to electricity supply. In 1994, diesel-generating electricity was 9,083 MWh and solar PV electricity was about 25 MWh (Tonako, for Secretary, Ministry of Works & Energy, Kiribati, 1995, pers. comm. 25 September). With the current power-generating set-up in Kiribati, fuel efficiency was 3 kWh per litre of diesel. The equivalent diesel fuel demand for generating electricity in 1994 was about 3,036 kilolitres (Tonako, for Secretary, Ministry of Works & Energy, Kiribati, 1995, pers. comm. 25 September).

Table 6.1 Kiribati: Socio-economic indicators (1993)

Population	77,100
GDP (US$M)	32
GNP per capita (US$)	710
Share of agriculture & fisheries in GDP (%)	25
Share of service activities in GDP (%)	25
Share of manufacture in GDP (%)	limited

Sources: United Nations (1997); World Bank (1995a).

Table 6.2 Petroleum imports and consumption in Kiribati (1994)

Imports (kilolitre)	Import value (US$M)	Percentage of total imports (%)	Percentage of total exports (%)	Consumption* (kilolitre)
8,500	2.6	9.3	47.8	3,500

Sources: Tonako (for Secretary, Ministry of Works & Energy, Kiribati, 1995, pers. comm. 25 September); Akura (General Manager, the Solar Energy Company, Kiribati, 1996, pers. comm. 27 June).

*This excluded the consumption of transport sector.

In order to simplify the analysis of issues for energy policymaking in Kiribati, only electricity generation was focused on. In appraising the diesel cost for generating electricity, only the diesel fuel cost was considered in this research. Other costs such as diesel power capital costs, operation and maintenance costs and social and environmental costs were not taken into account owing to information being unavailable.

The Pacific Regional Energy Assessment carried out by the World Bank projected that, over the period 1990-2000 in Kiribati, diesel fuel demand would increase at an average rate of 4.9 percent (World Bank 1992). For the projected total diesel demand for electricity by 2010, thus, three scenarios were assumed: low growth demand ($\lambda = 3\%$); base growth demand ($\lambda = 5\%$); and high growth demand ($\lambda = 7\%$).

Under the three scenarios, using energy demand equation (1) and an uncertainty of $\pm$ 5% of values, the annual diesel demand for generating electricity in Kiribati by the year 2010 will reach levels of 4,872 $\pm$ 244, 6,628 $\pm$ 331, and 8,963 $\pm$ 448 kilolitres respectively (Table 6.3).

Based on the world crude oil price estimations by the International Energy Agency (1995), the diesel price P_t was projected (Table 6.3). According to the fossil fuel cost equation (2) and under the base growth scenario, in 1995, Kiribati's diesel fuel cost for generating electricity was about US$1.28 $\pm$ 0.06 million dollars. By the year 2010, an annual diesel demand of 6,628 $\pm$ 331 kilolitres, would cost the Kiribati Government about US$4.11 $\pm$ 0.2 million (1995 dollars) (Table 6.3).

In Kiribati, there are no hydropower resources. Wind, wave, tidal, and OTEC resources have not been identified as energy resources (Ministry of Finance and Economic Planning of Kiribati 1992). Also, biomass has very little potential for electricity generation. This is because Kiribati has a very small land surface area and hence no substantial forest resources to meet firewood and other biomass fuel needs for its energy demands (Ministry of Finance and Economic Planning of Kiribati 1992). Also, the limited biomass resources that are available could play an important role in resisting sea level rise and in protecting potable water. However, Kiribati is near the equator and has abundant solar energy resources. Its annual mean daily insolation value is 24 MJ/ m^2/day and annual sunshine hours are about 2,500 (7 hours of sunshine per day on the average) (Prasad 1991).

Solar PV systems appear to offer an economic alternative to diesel generation for the electrification of remote rural areas. At current costs, solar PV systems can be competitive with small diesel based electric power systems for remote island communities. In rural areas with mainly house lighting loads, individual solar PV systems may be cheaper than small diesel systems for electrification where there is a low load density (World Bank 1992). To date, there are more than 310 small-scale stand-alone household solar PV systems, which are installed in Kiribati. Accordingly, solar energy is the most likely appropriate renewable energy resource in Kiribati for the future.

Since the 1980s, the Kiribati Government has encouraged the use of indigenous energy resources by means of implementing policy, legislation and institution building. In 1984, a solar energy company was established under the Ministry of Works and Energy. In order to speed up the penetration of renewable energy, the company was privatised in 1993 (Yu et al. 1996). Due to the fact the solar PV systems used in Kiribati are mostly individual household systems whereas diesel generators usually supply a group of houses, households prefer to have the PV systems. The customary land tenure for installing small household solar PV systems does not seem to be a serious issue here.

Financial resource aspects. The next step is financial resource analysis. In order to clearly explain the methods, only the scenario of base growth demand ($\lambda = 5\%$) is discussed. Firstly, the net diesel fuel savings are estimated by using sub-model 2. For doing this, diesel fuel savings via renewable energy, and energy conservation as well as their costs for saving such

amounts of diesel fuel, need to be calculated (see Table 6.4~6.7 and Figure 6.6). Then, using equation (4), the net diesel fuel savings are shown in Table 6.8 and Figure 6.7.

Table 6.3 Projected diesel demand and cost for electricity in Kiribati by 2010

Scenarios	1995	2000	2005	2010
Diesel price projection Pt (US$/l)*	0.4**	0.49	0.62	0.62
Low growth demand in kl ($\lambda = 3\%$)#	3,127±156	3,625±181	4,202±210	4,872±244
Total low growth demand cost (US$M)#	1.25±0.06	1.78±0.09	2.60±0.13	3.02±0.15
Base growth demand in kl ($\lambda = 5\%$)#	3,188±159	4,069±203	5,193±260	6,628±331
Total base growth demand cost (US$M)#	1.28±0.06	1.99±0.10	3.22±0.16	4.11±0.2
High growth demand in kl ($\lambda = 7\%$)#	3,249±162	4,557±228	6,391±320	8,963±448
Total high growth demand cost (US$M)#	1.30±0.07	2.23±0.11	3.96±0.20	5.56±0.28

* The estimate is based on *The Crude Oil Price Assumptions* (International Energy Agency 1995).

**This is wholesale price in Kiribati in 1994. The local electricity utility bought the fuel at wholesale price.

With a ± 5% of uncertainty.

Table 6.4 Diesel fuel savings via renewable energy and conservation by 2010*

Scenarios	1995	2000	2005	2010
Base growth demand (kl) (λ = 5%)	3,188±159	4,069±203	5,193±260	6,628±331
Total base growth demand cost (US$M)	1.28±0.06	1.99±0.10	3.22±0.16	4.11±0.2
Saving via solar PV (kl) (50% of demand)	1,594±80	2,035±102	2,597±130	3,314±166
Saving via solar PV (kl) (30% of demand)	956±48	1,221±61	1,557±78	1,988±99
Saving via solar PV (kl) (10% of demand)	319±16	407±20	519±26	663±33
Saving via conservation (kl) (10% of demand)	319±16	407±21	520±26	663±33
Total diesel fuel savings (kl)				
50% via solar + 10% via conservation	1,913±96	2,442±122	3,116±156	3,977±199
30% via solar + 10% via conservation	1,275±64	1,628±81	2,076±104	2,651±132
10% via solar + 10% via conservation	638±32	814±40	1,038±52	1,326±66
Total diesel fuel savings (US$M)				
50% via solar + 10% via conservation	0.77±0.04	1.2±0.06	1.93±0.1	2.46±0.12
30% via solar + 10% via conservation	0.51±0.03	0.8±0.04	1.29±0.06	1.64±0.08
10% via solar + 10% via conservation	0.26±0.01	0.4±0.02	0.64±0.03	0.82±0.04

*With a ± 5% of uncertainty.

With the usage of renewable energy and the promotion of energy conservation, the energy demand and total costs of diesel fuel for power generation in Kiribati will be massively reduced. For instance, based on the assumption that electrical demand is reduced 30 percent via solar PV and 10 percent via energy conservation, the diesel fuel demand could drop from 6,628 $\pm$ 331 kl to 3,977 $\pm$ 199 kl by 2010 (Figure 6.8). Total diesel import bills could be reduced from US$4.11 $\pm$ 0.2 million to US$2.47 $\pm$ 0.12 million (Figure 6.9).

After the net fossil fuel savings are estimated, function (3) can be used to estimate the energy budget. Under the base growth demand (λ = 5%), and assuming 30 percent of energy demand is reduced via solar PV and another 10 percent via energy conservation, the diesel fuel demand could drop from 4,069 $\pm$ 203 kl to 2,441 $\pm$ 122 kl in the year 2000 (Figure 6.8). The diesel fuel costs could drop from US$1.99 $\pm$ 0.1 million to US$1.19 $\pm$ 0.06 million (Figure 6.9).

The Kiribati energy budget can then be estimated and is shown in Table 6.9. International aid, private investment and the government contributions are the three main financial sources for energy sources (see Table 9). With economic growth, improvements in the use of renewable energy technology and energy efficiency, as well as reduction of energy subsidies in Kiribati, this ratio could be changed. For instance, net fuel savings could be one of the main financial sources.

Table 6.5 Costs of solar PV in Kiribati by 2010 (1990 US$)

(Base growth projection $\lambda = 5\%$)

Scenarios	1995	2000	2005	2010
Solar PV cost projection (US$/kWh)*	0.25 ~ 0.28	0.21 ~ 0.24	0.17 ~ 0.20	0.13 ~ 0.16
Saving via solar PV (kl) (50% of demand)	1,594±80	2,035±102	2,597±130	3,314±166
Saving via solar PV (kl) (30% of demand)	956±48	1,221±61	1,557±78	1,988±99
Saving via solar PV (kl) (10% of demand)	319±16	407±20	519±26	663±33
Equivalent power output (MWh) (50% of demand)**	~48	~61	~78	~99
Equivalent power output (MWh) (30% of demand)**	~29	~37	~47	~60
Equivalent power output (MWh) (10% of demand)**	~10	~12	~16	~20
Solar PV cost in US$000 (with ± 5% uncertainty)				
50% of demand	11.4 ~ 14.1	12.2 ~ 15.3	12.6 ~ 16.4	12.5 ~ 16.6
30% of demand	6.9 ~ 8.5	7.4 ~ 9.3	7.6 ~ 9.9	7.4 ~ 10.1
10% of demand	2.4 ~ 2.9	2.4 ~ 3.0	2.6 ~ 3.4	2.5 ~ 3.4

*The estimate is based on *Solar Technology Status by 2020* without storage cost (World Energy Council 1994).

**At the moment, the fuel efficiency is 3 kWh per litre of diesel in Kiribati. It is assumed that a value of 3 kWh solar PV power is equivalently generated if a litre of diesel fuel is saved by using solar PV.

Table 6.6 Costs of energy conservation in Kiribati by 2010[#]

(Base growth projection $\lambda = 5\%$)

Scenarios	1995	2000	2005	2010
Saving via energy conservation (kl) (10% of demand)	319±16	407±21	520±26	663±33
Equivalent power generation (MWh)* (10% of diesel demand saving)	9.6±0.48	12.2±0.63	15.6±0.78	19.9±0.99
Costs of energy conservation (US$)**	887±44	1,127±58	1,441±72	1,838±91

*In 1994, the fuel efficiency was 3 kWh per litre of diesel in Kiribati (Tonako, for Secretary, Ministry of Works & Energy, Kiribati, 1995, pers. comm. 25 September).

**The cost of energy conservation in Kiribati is about US$92.34/MWh, which includes the fuel and operating costs associated with the generation of that MWh (SRC International Pty 1995).

[#]With a ± 5% of uncertainty.

Table 6.7 Costs of renewable energy and conservation for fuel saving by 2010*

(Base growth projection $\lambda = 5\%$)

Scenarios	1995	2000	2005	2010
50% via solar + 10% via conservation (US$000)	12.2 ~ 15.0	13.3 ~16.5	14.0 ~ 17.9	14.2 ~ 18.5
30% via solar + 10% via conservation (US$000)	7.7 ~ 9.4	8.5 ~ 10.5	9.0 ~11.4	9.1 ~ 12.0
10% via solar + 10% via conservation (US$000)	3.2 ~ 3.8	3.5 ~ 4.2	4.0 ~ 4.9	4.2 ~ 5.3

*With a ± 5% of uncertainty.

Table 6.8 Net fuel savings via renewable energy and conservation by 2010*

(Base growth projection $\lambda = 5\%$)

Scenarios	1995	2000	2005	2010
50% via solar + 10% via conservation (US$000)	717.8 ~ 795	1,127 ~1,244	1,816 ~ 2,012	2,326 ~ 2,562
30% via solar + 10% via conservation (US$000)	472 ~ 531	752 ~ 830	1,221 ~1,339	1,551 ~ 1,708
10% via solar + 10% via conservation (US$000)	247 ~ 266	377 ~ 416	606 ~ 665	776 ~ 855

*With a $\pm$ 5% of uncertainty.

Figure 6.6 Diesel fuel savings for Kiribati by 2010

(Base growth projection with $\pm$ 5% uncertainty)

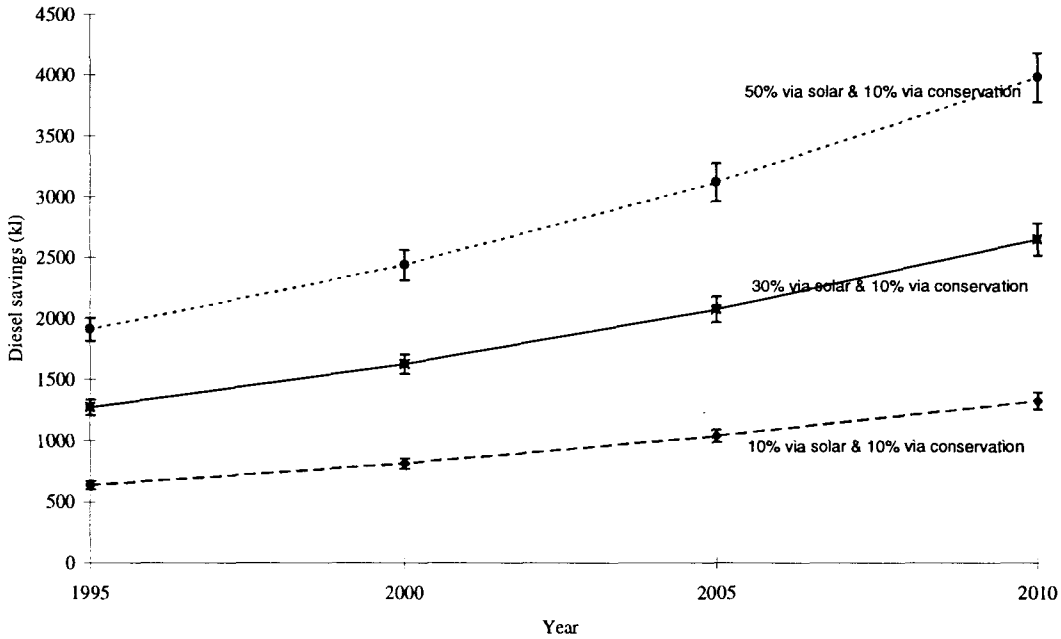


Figure 6.7 Net fuel savings via renewable energy and conservation by 2000

(Base growth projection with ± 5% uncertainty)

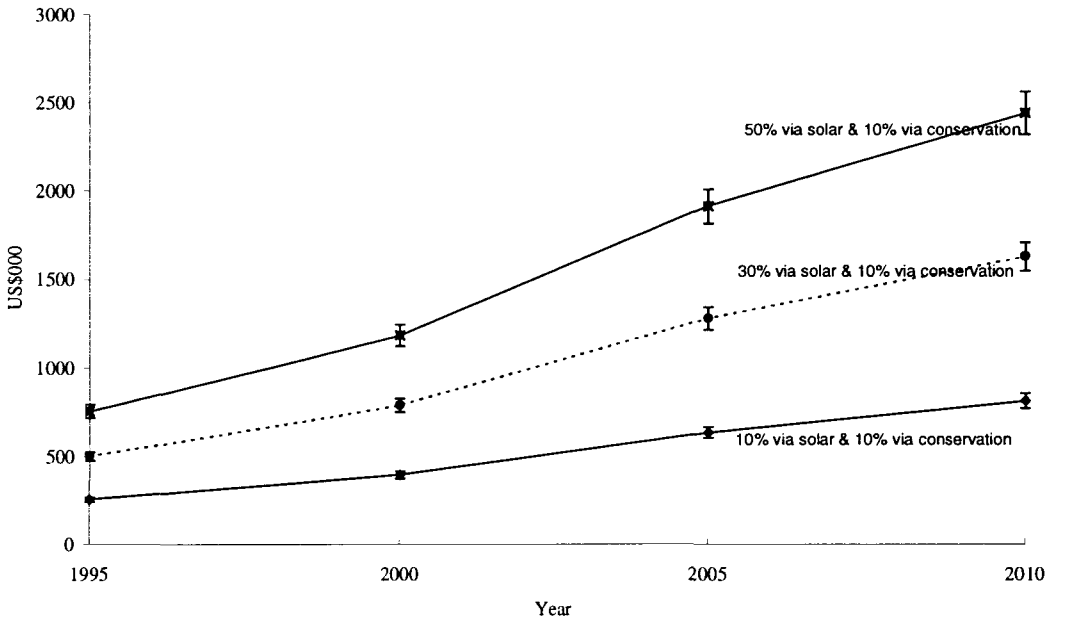


Figure 6.8 Comparisons of diesel fuel demand for power generation by 2010

(Base growth demand with ± 5% uncertainty)

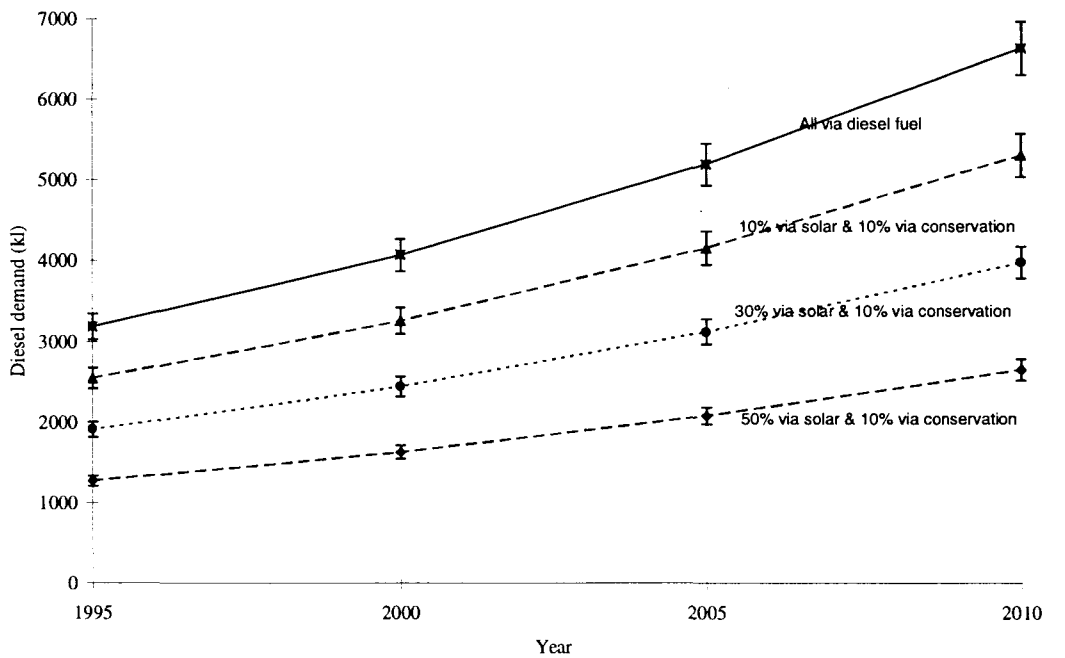


Figure 6.9 Comparisons of diesel fuel costs for power generation by 2010

(Base growth demand with ± 5% uncertainty)

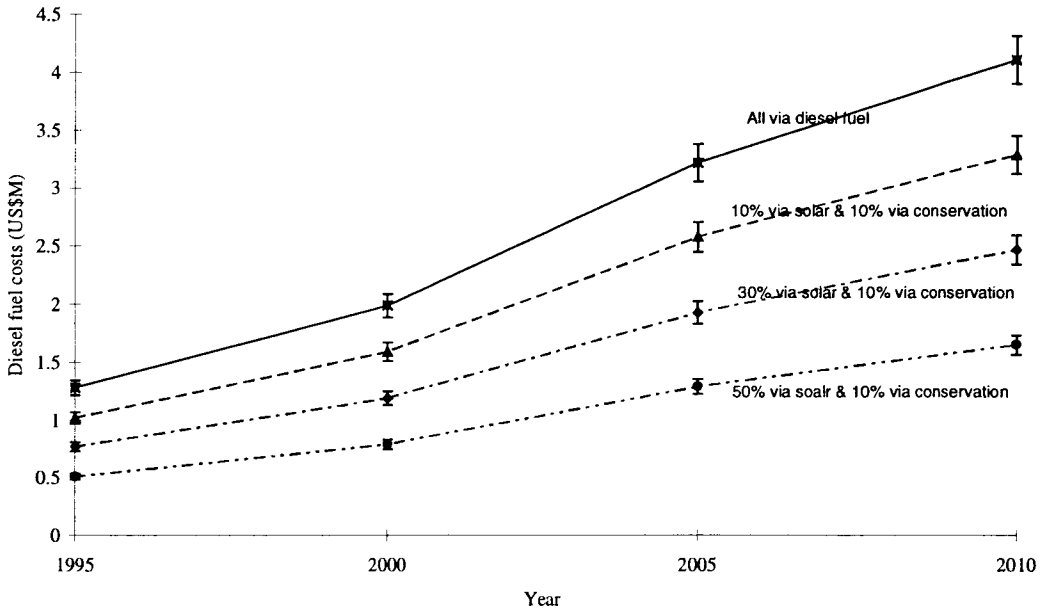


Table 6.9 Energy budget in Kiribati in year 2000*

(Base growth projection $\lambda = 5\%$)

Financial sources	Value (US$000)	Share (%)
Foreign aid	357 ± 18	30
Private	297.5 ± 15	25
Government	238 ± 12	20
Net fossil fuel savings**	119 ± 6	10
Customers	119 ± 6	10
Tariff	47.6 ± 2.4	4
Others	11.9 ± 0.6	1
Total	1,190 ± 60	100

*With a ± 5% of uncertainty.

**30% of energy supply via solar & 10% of energy supply via energy conservation.

According to sub-model 3 and sub-model 4, with the penetration of solar PV systems and improvement of energy efficiency, a range of socio-economic, cultural/traditional and environmental benefits could be achieved in Kiribati. They are briefly discussed as follows:

Social-economic and cultural/traditional aspect. Table 6.10 shows that in 1996 the Kiribati Government Development Budget allocations for industry, tourism, and agriculture was US$59,600, US$143,800 and US$745,000 respectively. However, if 30 percent of energy supply was provided by solar PV and another 10 percent of energy supply by energy conservation, at least, a value of US$(0.47~0.53) million net fuel savings could have been reached in 1996 (Table 6.8). This net saving could have been used for industrial, tourist and agricultural development. Also, with a decrease in imports of fuel, the country's trade balance could have been helped. In rural and remote areas, the local people could have greatly benefited in employment, education, food processing, water supply and medical conditions from the usage of solar PV. For example, some researchers have reported that there is a five percent improvement in life expectancy, literacy rates and GDP per capita for households with newly installed PV lighting (Institute of Natural resources 1994).

Environmental aspects. A clear benefit is non-renewable resource conservation. In 2010, for instance, if solar PV could replace 30 percent of the energy supply, and energy conservation could reduce 10 percent of fossil fuel consumption, then a total of 2,651$\pm$ 132 kl diesel fuel (the value US$1.64 $\pm$ 0.08 million) could be saved (Table 6.4). The savings of fuel could help to promote the country's capability for adapting to climate change. In addition, the reduction of diesel fuel consumption will improve local air and water quality.

It could have some positive effects on marine wildlife species by reducing pollution risks from oil leakage. There might be some associated negative effects of renewable energy, such as the toxic chemicals of wasted solar batteries contaminating soil and drinking water. These bring risks to human beings and environments. During the development of solar energy, effective measures for the management of these wasted batteries need to be employed. For instance, there should be trained people to collect and store these used batteries. Also, if it is possible, island countries may negotiate with their suppliers in developed countries to recycle batteries.

Table 6.10 Kiribati Government Development Budget for 1996

(US$000)

Sector		Budget
Agriculture		745
Fisheries		953.6
Tourism		143.8
Industry		59.6
Transportation		618.4
Education		8,269.5
Health and Social welfare		4,991.5
Energy		85.7
	renewable	0.745
	non-renewable	84.93

Source: Ministry of Finance and Economic Planning of Kiribati (1995).

6.5 Concluding comments

In this research, only energy policymaking with respect to electricity generation has been discussed. The framework, however, can be easily adopted to analyse other energy issues such as transportation energy demand and biomass energy demand for cooking and heating. Based on the situation in Kiribati, solar PV as the main renewable energy source was discussed. Hydro power energy in Papua New Guinea, Fiji, Western Samoa, the Solomon Islands and French Polynesia, wind energy in the Cook Islands, and hybrid energy systems in Nauru, the Republic of Marshall Islands and many other island countries, could be analysed by using the framework. In principle, this framework can be also used in energy planning for oil, gas or other energy supply and consumption issues.

For the purpose of framework simplification, some assumptions have been made, such as selection of three scenarios (low, base and high-energy demand) and a $\pm$ 5% uncertainty. All of these can be changed depending on the requirements of energy planning and management. For

example, discount rates were not mentioned and scenarios and assumptions were not fully analysed in the energy demand and financial resource discussion. This is because, via the case study in this chapter, a methodology was intended to be introduced here, rather than an exacting policymaking exercise carried out. In a real world of policymaking evaluation, the appropriate energy demand growth scenarios, the contributions of renewable energy and energy conservation, uncertainty, the projection period of energy policy, and other factors (eg. discount rate) need to be selected according to actual situations.

A lack of a database regarding energy issues is a recurrent problem in the Pacific Island region. For instance, in order to compare per kWh generating costs between diesel fuel and solar PV energy, estimates of the costs for solar PV systems in Kiribati could not be found, even in the Energy Division of the SPF Secretariat. To select energy options, more effort needs to be made towards enhancing the development of research on energy resources, energy technologies and energy economics in the future.

Renewable energy in some cases is already commercially competitive in the region (Liebenthal et al. 1994; Wardrop 1994). Further development of renewable energy and promotion of energy efficiency will require a considerable amount of assistance in finance, research, development, technologies and industrial infrastructure. Many Pacific Island countries lack the necessary capabilities to provide these basic needs due to limitations in their socio-economic development. Overcoming the financial problems associated with renewable energy will ultimately rely on financial capability building in these countries and a decline in the capital cost of renewable energy technologies. However, financial capability building and cost reduction will not significantly take place over a short period of time. Table 6.9 shows that if foreign aid can support 30 percent or more of the energy costs in Kiribati, it could be very useful in financing renewable energy and energy conservation.

Chapter 7 International aid for renewable energy in the region since the 1970s*

7.1 Introduction

Since the late 1970s, many foreign donors and international organisations have made contributions to the development of renewable energy in the Pacific Island region. However, international aid could do much more towards developing alternative energy sources than it has achieved to date. Reviewing the actions of foreign donors and international organisations, with regard to the encouragement of renewable energy in the region, should give some indication of the level of progress of the renewable energy industry to date and indicate future potential. Little assessment, however, has been done with regard to the impact of international aid in development of renewable energy in the region.

In order to review international aid being given for renewable energy in the region, a survey was carried out between November 1995 and May 1996 as a part of this research. The basic aim of the survey was to acquire qualitative and quantitative information by analysing different donors' actions in promoting renewable energy in the region. The results of the survey are useful in indicating the trends of international aid to the region. The results are also useful in discussing possible future approaches taken by bilateral and multilateral aid organisations in encouraging renewable energy development in the Pacific Island region.

Via the survey, 13 donor countries and 13 international and regional organisations were examined. The 13 donor countries were Australia, Belgium, Canada, China, Denmark, France, Germany, Japan, the Netherlands, New Zealand, Norway, the UK and the USA.

The 13 regional and international organisations included the Asian Development Bank (ADB), the Commonwealth Heads of Regional Government Meeting (CHORGM), the Commonwealth Fund for Technical Cooperation (CFTC), the European Investment Bank (EIB), the European Union (EU), the South Pacific Forum Secretariat (SPFS), the South Pacific Commission (SPC), the South Pacific Applied Geosciences Commission (SOPAC), the United Nations

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* Sections of Chapter 7 have been published in the paper: Yu & Taplin (1997b).

Development Program (UNDP), the United Nations Industrial Development Organisation (UNIDO), the United Nations Fund for Technology and Science Development (UNFTSD), the United Nations Pacific Energy Development Programme (UNPEDP) and the World Bank.

7.2 Survey methods

The survey involved both directly approaching the organisations and documentary research. The direct approach involved asking donor countries and international organisations, and their embassies or branches in Australia, for help in accessing the necessary information. Documentary research included searching publications, reports, government documents and unpublished papers. To carry out the survey, fax letters, e-mails, and telephone calls were used. Due to the difficulty in accessing recorded information for most of the Pacific Island countries, the survey was mainly directed towards major donors to the Pacific Islands.

According to previous experience (Wadsworth 1997) in survey research, a questionnaire needs to be concise and have focus. Also, the questionnaire designed should be aware that the organisations being surveyed carry out many duties. Providing information is extra work. Reducing inessential questions can encourage quick responses from aid agencies. Taking into account the respondents' time available and limiting questions to the most vital information, a relatively straightforward table for respondents to complete was designed as shown in the Appendix 1.

Even though this is a very basic survey form, some aid organisations still found it was not easy to provide information as requested. This is because some aid agencies record their aid projects in different ways. Quite often, for example, JICA records its renewable energy projects within a broader energy category. Thus, it mixes up renewables with conventional energy projects and JICA found very hard to tell how much of its energy funding went to renewables. In this case, the recipient countries had to be asked to identify them.

The focus of the survey was limited to the implementation of international aid in the Pacific Islands in the 1990s. Considering that official government aid is the major form of aid to the Pacific Islands, donor government organisations, such as the Australian Agency for International Development (AusAID), the Japanese International Cooperation Agency (JICA), and the United States Agency for International Development (USAID), were key respondents for the survey.

Throughout the survey, often for the same project or program, there was great variation in information supplied from different information sources. For instance, according to the European Union's statement (Osborne, Adviser, Delegation of the European Commission to Australia and New Zealand, 1996, pers. comm. Fax letter, 8 March), since 1984 to 1995, under the Lome Convention III, the European Union (EU) has given US$4.87 million dollars to the Pacific Island region for renewable energy. However, the Institute of Natural Resources in the University of the South Pacific (1994) pointed out that from 1982 to early 1994, the EU has provided only US$4.09 million dollars of the original US$4.87 million dollars promised for Lome Convention II projects. Nick Wardrop (former Energy Officer, Renewables, Energy Division in the Forum Secretariat, 1996, pers. comm. Telephone call, 8 May) clarified that EU's Lome Convention II covered a range of energy projects and that it provided a total value of US$4.87 million aid to the region. The funding for renewable energy is only a part of this program[1].

To increase the reliability of information, uncertain information such as this was sent back to the related donors or island countries for confirmation. It was difficult to check the reliability of some information, and therefore some had to be left out from the final results of the survey. The survey proved to be a major undertaking. Time was a constraint and further information may have become available if further allocation of time had been possible. Many donors mentioned that they provided information for only some of their aid projects because they found it difficult to trace all their renewable energy project records. It, therefore, should be noted that the survey does not exhaustively cover all aspects of international aid for renewable energy in the region.

An additional complexity was that many donors provided their funding information in different foreign currencies such as French Francs, Japanese Yen, European Currency Units, Pounds Sterling and Fijian Dollars. In order to make comparison easier, all currency units were

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[1] Lome Convention II (between 1979 and 1994) and Lome Convention III (since 1984) are the European Union's Environment and Development Aid Programs in Africa, the Caribbean and the Pacific region (Johnson and Corcelle 1995). In the Pacific Island region, under Lome Conventions II and III, the regional energy programs were administered by the Forum Secretariat (World Bank 1992). The energy projects have been implemented in eight Pacific Island countries including Fiji, Kiribati, Papua New Guinea, the Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa (Osborne, Adviser, Delegation of the European Commission to Australia and New Zealand, 1996, pers. comm. fax letter, 8 March).

converted to US dollars in the survey according to the relevant year's foreign currency exchange rates.

Appendix 2 comprehensively documents the international aid given for renewable energy in the Pacific Island region from the 1970s to 1996; Table 7.1 provides a general picture of the UK international aid for renewable energy worldwide since 1987; in Table 7.2, the Australian contributions to renewable energy in Asia and the Pacific Islands are shown from 1984 to 1998; in Table 7.3, the World Bank's renewable energy projects in South East Asia and the Pacific Islands (1987-1997) are listed; and Appendix 3 shows the main energy projects carried out by the Asian Development Bank in the Pacific Islands between 1989 and 1996.

7.3 Findings

7.3.1 General description

Over the last two decades, international aid for renewable energy in the Pacific Island region has been in many and varying forms. Donors have come from Europe, North America, Asia, and Oceania (see Appendix 2). Most bilateral donors have come from developed countries; however, some donors have come from developing countries, such as China. Multilateral donors have included international organisations and regional organisations. Some regional organisations are recipients, as well as donors, for example, the SPF Secretariat, the South Pacific Commission (SPC) and the South Pacific Applied Geosciences Commission (SOPAC).

Aid programs and projects cover diverse areas of activity. They include capital investment, technical assistance, energy resource monitoring, and construction of hydro power stations, energy system installation, training, planning, project demonstration, review of programs and projects, and strengthening of institutions.

Aid to date, for renewable energy, has focused on four renewable energy technologies: that is, solar, hydro, biomass and wind. The funding forms are mainly of two types: grant and loan. Some aid also has been provided in the form of: cooperation in research, in kind[2], expert advice and joint venture.

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[2] In goods or other forms, instead of money.

7.3.2 Lack of aid for renewable energy in the region

In the 1980s, many developed countries and international organisations were interested in developing renewable energy resources in the Pacific Island region. Since 1990, however, their interests have shifted to other foci and other regions. In the 1980s, for instance, Norway supported a wave energy-monitoring project in Fiji, Tonga, Vanuatu and Western Samoa (Institute of Natural Resources 1994). In the 1990s, the Norwegians have discontinued all bilateral aid for the region. This is because the Pacific Islands have been deemed outside the field of Norwegian Development Cooperation (Tveite, Head Office, Norwegian Agency for Development Cooperation, 1996, pers. comm. fax letter, 28 March).

Like Norway, the UK had some renewable energy projects in the region in the early 1980s. Although the UK has supported a number of renewable energy projects worldwide between 1987 and 1996 (see Table 7.1), only one UK assisted energy project has been implemented in the Pacific Island region. This was an institutional strengthening project for the Fijian Energy Department from 1992 to 1996. The project involved both renewable energy and conventional energy foci (Martin, Energy Adviser, British Overseas Development Administration, pers. comm. fax letters, 29 November 1995 & 9 May, 1996).

The survey also shows that some donors in the 1990s have limited their aid projects for renewable energy to Asian countries rather than to Pacific Island countries. For example, since 1990, Australia has had only about three renewable energy projects in the Pacific Island region (Table 7.2). Another example of this, is the World Bank that, in 1987, gave aid to the Afulilo Hydro Power Project in Western Samoa. Since then, no renewable energy projects in the region have received assistance from the World Bank (Table 7.3).

It is also interesting to note that Belgium, Denmark and the Netherlands Governments have not given any bilateral aid to the Pacific Islands with respect to renewable energy. These governments appear to perceive the Pacific Island region is not the main region in need of international aid. For instance, the Danish Government considers the GNPs in the Pacific Island region to be above the level that is chosen as a standard for Danish aid (Frederiksen, Environmental Division of Royal Danish Ministry of Foreign Affairs, 1995, pers. comm. Fax letter, 5 December).

Table 7.1 UK international aid for renewable energy globally (1987-1996)

Project title	Recipient country	Project title	Recipient country
Solar, wind, and hybrid energy		Geothermal energy	
Measure wind and solar resources	Zimbabwe	Geothermal energy	Kenya
Assessment of a wind/solar pumping system	Egypt	Miravalles geothermal project	Costa Rica
Participation in an IEA photovoltaic project	Global	Hydro energy	
Investigate photovoltaic reverse osmosis	Global	3 hydro power projects	Peru
Solar timber drying kilns	Global	2 mini hydro projects	Indonesia
Alternative energy study	St. Helena	Micro hydro projects	Nepal
Wind turbine	St. Helena	Mini hydro project	Sri Lanka
Use of wind energy study	China	Mini hydro project	Thailand
Wind/diesel generators	China	Micro hydro induction generators	Nepal/Peru
Wind/diesel systems	Global	3 hydro projects	India
Kijito wind pumps	Africa	3 hydro projects	Kenya
Wind pump market survey	Global	3 hydro studies	Malaysia
Wind pump development	Global	2 hydro projects	Sri Lanka
Wind pump regional network	Asia	Owen Falls rehabilitation	Uganda
Wind energy survey	Caribbean	Kariba South Power	Zimbabwe
Biomass energy		General	
Biogas technology study	Global	Renewable/energy efficiency survey	Egypt
Biogas study	Mauritius	Study for renewable programs	Global
Biomass compaction equipment study	Global	Energy department strengthening	Fiji

Source: Martin (Energy Adviser, British Overseas Development Administration, fax letters, 29 November, 1995 & 9 May, 1996).

Table 7.2 Australian renewable energy projects in Asia and the Pacific Islands (1984-1998)

Year	Country	Program	Description	Funding (US$000)
1984	Fiji	Small activities scheme	Mini hydro scheme for Wairiki Catholic Mission	9.0
1990	Fiji	Small activities scheme	Solar lighting for Kiuva Community hall	9.4
since 1988	Forum Secretariat	Small energy projects for renewable energy	Annual grant	71.1
1990	Tuvalu	Small activities scheme	Solar lighting for police stations and quarters on outer islands	7.3
1984-85	India	Direct aid program	Contribution for installation of four solar energy heating systems in medical centre	1.3
1992-93	India	Small activities scheme	Trials of non-conventional energy products	47.8
1989-91	Sri Lanka	Commercial in confidence	Solar domestic lighting for 1,000 households in Pansiyagama	47.5
1991-96	Nepal	Bilateral	Community Forestry Program including 20,000 ha plantations	7,791
1993	Cambodia	Small activities scheme	Save the Children Fund Australia project: 2 solar pumps and 2 solar powered vaccine fridges	23.1
1994-96	Cambodia	Bilateral (NGO)	Solar powered laboratory for Australia Red Cross Hospital	component of project-total US$0.18M
n.a.	Cambodia	Direct aid program	Save the Children Fund Australia project: solar lighting systems for a clinic and meeting room	4.2
1994-95	Laos	Bilateral	20 solar lighting systems and 20 solar refrigeration systems in 20 clinics	150
1994-98	Vietnam	Bilateral (NGO)	Solar food dryers and fuel efficient energy conversion systems for cooking and food processing	component of project-total US$0.66M
n.a.	Indonesia	Small activities scheme	Micro-hydro electricity project at Bokondini	43.8 (est)
n.a.	Thailand	Direct aid program	Solar water treatment unit	under consideration
n.a.	Thailand	Small activities scheme	Solar energy fruit drier factory	under consideration
1989-94	regional	ASEAN-AAECP phase 2 project	Energy efficiency and renewable energy projects	3,890
1994-98	regional	South East Asia AAECP phase 3 project	Project to assist in the development of FBC technologies for the production of combined heat and power utilising available biomass residues supplemented by low-grade fuels available in the countries.	2,200
n.a.	Maldives	Food aid	49 aluminium towers for mounting solar beacons	467.1

Sources: Davis (Deputy Director General, Pacific and International Programs Division in AusAID, 1995, letter, 15 December); Institute of Natural Resources (1994).

Table 7.3 World Bank renewable energy projects in South East Asia and the Pacific Islands (1987-1997)

Country	Year	Project	Loan (US$M)	Status*	Co-finance
Indonesia	n.a.	Hybrid (PV, wind, diesel hybrids) for remote applications	n.a.	concept	not known
Indonesia	1997	PV, biomass, wind, mini-hydro and mini-geothermal energy development	~ 185	pipeline	not known
Indonesia	1995	2nd rural electrification project (mini-hydro and mini-geothermal energy)	398	approved	none
Philippines	1994	Leyte-Cebu geothermal power project	211	on-going	commercial
Philippines	1994	Leyte-Luzon geothermal power project	227	on-going	commercial
Philippines	1990	Philippines Energy sector loan for geothermal power project	390	on-going	multilateral and bilateral
Philippines	1988	Bacon Manito geothermal power	100	on-going	bilateral
W. Samoa	1987	4 MW small hydro power project	4	on-going	bilateral and commercial

Sources: Young (Research Analyst, Industry and Energy Department of the World Bank Group, 1995, pers. comm. fax letter, November 9); World Bank (1993).

* 'concept' and 'pipeline' imply that the projects are still pending board approval.

7.3.3 Small proportion of aid sources for renewable energy

During the 1990s, the priority of some donors' aid policies has not been on renewable energy. Rather their energy assisted programs and projects have favoured conventional energy sectors. For example, the European Union's Lome III regional energy program with total funding of US$5.21 million, administered by the SPF Secretariat, is the largest single regional energy assistant project. The financing agreement for Lome III was signed on 18 February 1994 (Institute of Natural Resources 1994). Of the total funding of US$5.21 million, US$1.14 million was indicated for skilled personnel development and training for conventional energy systems; US$1.58 million for the diesel generating power sector; US$1.58 million for energy conservation, policy and planning, and US$0.79 million for administrative support and

overheads. Only around US$0.12 million was projected to be spent on training in the renewable sector (Institute of Natural Resources 1994).

The Asian Development Bank (ADB) is the main donor for the energy sector in the Pacific Island region. From 1989 to 1996, however, only two renewable energy projects were funded by the ADB (see Appendix 3). One was in 1989, where the ADB provided a loan of US$8.43 million to the Divune Hydro Project in Papua New Guinea (ADB 1990). Another was in 1990, based on a grant of US$1.3 million, where the ADB offered the technical assistance to a detailed design study of the Komarindi Hydro Power Projects in the Solomon Islands (ADB 1991). Scanning the ADB's energy projects between 1989 and 1996 (Appendix 3), shows a clear trend that in the 1990s the focus of the ADB's energy aid programs in the region was the development of diesel power systems and other conventional energy systems. In other regions, a study by Aid/Watch revealed that the majority of ADB funding is going to traditional power projects, such as coal, hydrocarbons and large-scale hydropower rather than renewable energy and demand side management (Aid/Watch 1996).

7.3.4 Lack of institutional strengthening for renewable energy

Strengthening energy institutions is the most fundamental area of need for enhancing renewable energy usage in the region. Institutional strengthening can have the benefits of: energy policy formulation and implementation; energy supply planning; energy research and development; organisation of projects; skilled human resource development; customer services; economic management of energy; and efficient use of international aid. During the last two decades, there have been very few donors who have paid attention to improvement of energy institutions. As Dawson (former Director of Energy Division, the SPF Secretariat, 1994, pers. comm. fax letter, 31 October) has commented:

> It is unfortunate that so many donors, including Australian international aid organisations, have focused on the provision of renewable energy equipment and technologies, rather than on increasing the institutional capacity of the countries to effectively plan and manage their energy sectors. ... Until such time as appropriate policy and institutional arrangements are put in place the prospects for renewable energy technologies as a means of supplying energy will remain quite poor. ...

7.3.5 Aid projects and donors' interests

Different aid donors have different project interests in the region. China and the US seem to be interested in the building and upgrading of hydro power plants. France favours installing solar PV energy systems in French Polynesia, New Caledonia and other states in the region. For instance, the French Government provided a US$1.24 million loan to the Cook Islands for the Pukapuka Solar Electrification project in 1991 (Tereapii 1995).

Other donors including the United Nations Development Program, the Pacific Energy Development Program, Japan and the South Pacific Applied Geosciences Commission mainly provide aid for technical assistance. This includes feasibility studies of energy projects, technique training courses, and surveys and assessments of energy resources. Since 1982, under the Lome Convention II and III Regional Energy Program, the European Union has supported twenty-two pilot and demonstration operations for using solar, biomass and micro hydro power resources (Osborne, Adviser, Delegation of the European Commission to Australia and New Zealand, 1996, pers. comm. fax letter, 8 March). German international aid in the region appears to be directed more towards biomass energy projects such as wood stoves and fuelwood projects.

7.4 Policy responses

7.4.1 International aid for the region

The survey raises several issues with respect to international assistance for renewable energy. Since 1990, for instance, many bilateral and multilateral donors have significantly reduced their aid for renewable energy development in the Pacific Island region. Some developed countries did not give any aid to the region as they thought the GNP in the region had exceeded the level, which is used to decide necessity for assistance.

Although per capita GNP (or GDP) is considerably higher in the Pacific Island region than in many other developing countries, the region still retains many social and economic problems. Most of these nations experience shortages of skilled human resources and natural resources and are long distances from international markets. In fact, their GNP (or GDP) has largely relied on foreign aid, loans from outside the region, and remittances from their citizens working overseas.

An argument, therefore, is that their GNP (or GDP) should not be the sole factor taken into account by donors when selecting recipients. Developed nations and international organisations still need to pay attention to the problems of the region. In the area of renewable energy, Denmark and the Netherlands have a good technological base and experience in developing wind energy. They could make a great contribution in assisting exploitation of the Pacific Island region's wind energy resources.

7.4.2 Renewable and energy funding

Another important issue is that donors' energy funding sources are largely pumped into the conventional energy sectors. For example, the Asian Development Bank's energy projects mainly favour diesel generating electricity supply. The importance of energy conservation in the region cannot be denied because renewable energy products continue to be high in capital costs. However, boosting the renewable energy industries should become a benchmark of international aid when dealing with energy issues in the region. There is a need for a balance between funding renewable and conventional energy. Unfortunately, encouraging diesel generation and distribution in the region will most likely have an adverse impact on the expansion of renewable energy and slow the progress of the establishment of a sustainable energy industry.

There are several ways that the use of renewable energy systems can be encouraged. Some international and regional organisations such as the International Energy Agency (IEA), the UNEP and the SPREP could potentially institute more actions to support renewable energy. In addition, some international organisations (for example, the World Health Organisation and the Food and Agriculture Organisation of the United Nations) could assist the use of renewable energy through their aid programs. They could encourage using renewable energy for food processing, potable water supply, sewage treatment and disposal, rather than encouraging the use of diesel generating power. For instance, the World Health Organisation has supported the Cook Islands use of solar water pumping systems for the disposal of sewage. This has prevented pollution of the coastal environment and reduced the risk to public health (Wichman, Acting Director of the Renewable Energy Directorate, the Cook Islands, 1995, pers. comm. 13 April).

7.4.3 Renewable energy and institution development

Institutional development for enhancing renewable energy is another challenging issue. Kiribati and Tuvalu have been successful in developing rural solar PV electrifications. Their success appears to be independent of the public sector, and involves good maintenance, and a good rate of fee collection, continuing training and available external technical support (Liebenthal et al. 1994). In the future, international aid for institutional strengthening should assist the Pacific Island countries to restructure their energy institutions, formulate and implement energy policies, and plan for future energy supply. Aid should help the management of energy projects, energy market research, improved technical training and education, as well as increasing capabilities for more efficient use of foreign aid.

Assistance should also be available for maintenance, fee collection and management, spare parts supply and technical assistance. Some international aid organisations have worked on institutional strengthening for the conventional energy sector. Aid for energy institution strengthening is necessary to reduce the demand for fossil fuel consumption through the improvement of energy planning and management, but it cannot replace the institutional strengthening of renewable energy sectors.

7.5 Conclusion

International aid can play an important role in promoting the use of sustainable energy systems in the Pacific Island region. However, the survey results have shown lack of aid for renewable energy in the region is a general picture. Two major issues are involved: one is the small proportion of aid sources directed towards renewable energy and, a second is the lack aid for institutional strengthening programs for renewable energy.

Chapter 8 Australian foreign aid and related domestic issues*

8.1 Introduction

The allocation of Australian foreign aid is significantly affected by Australia's relationships with other nations and commercial interests. Also, domestic issues largely influence foreign aid policies and activities. By way of further exploring international assistance for renewable energy in the Pacific Island region, some Australian foreign aid and domestic issues associated with the development of renewable energy are closely examined in this chapter.

8.2 Australian international aid

8.2.1 Australian international aid organisations

The Australian Agency for International Development (AusAID) is the main government aid agency and has management autonomy from the Department of Foreign Affairs and Trade (DFAT). This agency is responsible to the Minister for Development, Cooperation and Pacific Island Affairs for the administration of A$1.43 billion official overseas aid (or development cooperation) program, and to the Minister for Foreign Affairs and Trade as the portfolio minister (Commonwealth of Australia 1997). Currently, the Agency consists of 540 staff including 60 posted in Australian overseas missions and 35 in state offices throughout Australia (Commonwealth of Australia 1997). It should also be noted that Australian non-government organisations and Australian educational institutions have given contributions to poverty relief, socio-economic development and the training of personnel from developing countries (AusAID 1995).

8.2.2 A summary of Australian aid since World War II

Australia's development assistance program had its beginnings in the pre-war years in Papua New Guinea. After World War II, Australia made efforts towards international reconstruction by supporting United Nations relief agencies and joining the World Bank. The Colombo Plan was an important milestone of Australian international development cooperation. In 1950, seven Commonwealth countries (Australia, Britain, Canada, India, New Zealand, Pakistan and Sri Lanka) launched the Colombo Plan in Colombo, Sri Lanka for the Asia-Pacific region's development

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* Sections of Chapter 8 have been published in the papers: Yu et al. (1997c).

cooperation. Providing food, training and education to developing countries were important aspects of the Colombo Plan. Under the Plan, Australia and other donor countries gave urgent financial, food and technical assistance to developing countries. The Colombo Plan quickly attracted new recipient members from Asia and the Pacific Islands (AIDAB 1992b).

There was a steady growth in overseas aid from Australia throughout the 1950s and 1960s. It reached a high point during the Prime Ministership of Sir Robert Menzies (Fraser 1991). In 1970, Australia contributed about 0.52 percent of its GNP to official development assistance (ODA) disbursements (Commonwealth of Australia 1996a). In the 1980s, with economic and unemployment problems and budget deficits in Australia, the cry, "Charity begins at home! Foreign aid is not a free lunch!" was apparently difficult for politicians to ignore (Remenyi 1991, p3). They seemed to think that there were no votes in foreign aid. As a result of the domestic economy and politics, Australian ODA has declined.

In 1996-97, Australia will provide A$1,450.1 million as its official development assistance (ODA). This will be a decline of 10 percent of that in the previous year. The current Australian government believes the fact that Australia must put its own economic house in order first, this is not withstanding that Australia still supports the United Nations goal of about 0.7 percent of GNP as aid although not complying with it (Commonwealth of Australia 1996a). Table 8.1 indicates Australian trends in ODA.

After World War Two, the Pacific Island region was Australia's main defence security zone and the island nations became trading partners. With the Cold War over, the focus of Australia's international relationships has shifted from the Pacific Island region to Asian countries in the hope of making more money there than in the Pacific Islands (McCall 1991). It makes sense to consider that ODA should be of benefit to the donor and the recipient. In Australia's case, however, the orientation towards ODA being for Australia's own benefit is so overwhelming that the countries to which Australia gives aid tend to be only those that import Australian goods. As described by Remenyi (1991, p4) "For Australia, ODA is a trade promoting boomerang!".

Table 8.1 Australia's official development assistance (1945-1997)

Year ending 30 June	Current price (A$M)	Real change over previous year (%)	ODA/GNP ratio (%)
1945-46	13	n.a.	0.39
1964-65	98	n.a.	0.51
1971-72	200.5	3.9	0.52
1977-78	426.1	2.1	0.46
1983-84	931.8	0.7	0.50
1984-85	1,011.4	2.5	0.49
1985-86	1,031.0	-5.1	0.45
1986-87	975.6	-11.8	0.38
1987-88	1,019.6	-2.1	0.36
1988-89	1,194.6	7.9	0.37
1989-90	1,173.8	-7.5	0.33
1990-91	1,261.0	3.1	0.35
1991-92	1,330.3	3.5	0.36
1992-93	1,386.0	3.3	0.36
1993-94	1,410.8	0.6	0.34
1994-95	1,480.2	2.8	0.34
1995-96	1,564.5	1.9	0.34
1996-97	1,450.1	-10.0	0.29

Sources: Remenyi (1991); Commonwealth of Australia (1996a).

In the 1990s, Australia has continuously given high priority to the Pacific Island countries in terms of foreign aid. From 1990-1991 to 1995-1996, a total of A$2.73 billion of Australian foreign aid flowed from Australia into the Pacific Island region through country programs, multi-country activities and regional organisations as shown in Table 8.2 (AIDAB 1994; Commonwealth of Australia 1996a). In the region, Australian aid has focused on human resource development, institutional strengthening, health, population and family planning, the environment, and private sector development (Bilney 1993; Commonwealth of Australia 1994).

In 1991, the Australian Government formalised a new international aid policy which has three main foci: sustainable economic growth; investment in human resources through education, health, capacity building and social sector development; and safety nets and poverty targeting which includes emergency relief (Bilney 1993).

The sustainable economic growth strand includes support for infrastructure, agriculture, mining, industry, environmental management and institutional strengthening. Capacity building focuses on human resource development and economic policy formulation. The third strand includes emergency humanitarian transfers and relief for refugees and the victims of famine, wars and disasters. It also provides aid to meet the basic needs of people, such as water and sanitation (Bilney 1993). In addition, the Australian Government prioritises its aid in other areas, for example: the equal participation of woman in development, the environment, population and family planning, and human rights (Bilney 1993).

In 1993, the Hon Gordon Bilney MP, then Minister for Development Cooperation and Pacific Island Affairs, explained that while humanitarian concerns are central, aid is also an important instrument of foreign policy and commercial interests. Bilney (1993) emphasised that Australia aims to maximise both effective aid and commercial returns to Australia through its aid programs while also acknowledging that poverty alleviation is intrinsic to the objective of aid.

AusAID implemented its policies through developing and implementing projects and other assistance on a country-by-country basis. Additional support is provided through regional organisations and via multi-country activities. Globally, Australia provides assistance to international organisations such as the World Bank, the United Nations and Commonwealth agencies. Supporting international organisations is considered to be part of Australia's

obligation as a good international citizen and as a serious and concerned development partner (AusAID 1995).

Country programs match recipient country needs with Australia's objectives and capability to assist. AusAID forms agreements with the recipient countries with regard to long term strategies for development cooperation. In order to manage aid projects and activities, AusAID follows the four main steps; that is, identification, development, implementation and completion. This process includes careful screening to ensure that projects are environmentally sustainable and equally benefit men and women in developing countries (AusAID 1995).

In keeping with Australia's interests in the region, the official assistance programs focus on the countries of the Pacific Islands and East Asia. These aid programs have advanced Australia's commercial interests by improving regional trade, economic development, the creation of export opportunities for Australian companies, and through the direct purchase of Australian goods and services (AusAID 1995).

8.3 Australian foreign aid for renewable energy in the Pacific Islands

Although sustainable economic growth has been stated as one of the goals of the Australian aid policy, there remains a significant gap between policy and implementation (Australian Council for Overseas Aid 1992). For instance, there is no aid policy directed towards implementing renewable energy systems in the Pacific Island region by AusAID. Rhiannon (1995) argued:

> If logic and true commitment to ecological sustainablility were the basis of Australia's overseas aid program, coal projects would not be a major feature of our development assistance to Third World countries. This is particularly so now that coal is recognised as one of the major culprits in the production of greenhouse gas emissions.
>
> However, every time Australia provides money to a developing nation either directly or via the World Bank for a coal related project, we are effectively creating future markets for Australian coal.
>
> Our overseas aid programs should be working to reduce developing countries dependency on fossil fuels and promoting the many renewable energy sources that are now commercially viable.

Table 8.2 Total Australian aid flows in the Pacific Islands from 1990/91 to 1995/96 (A$M)

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97*
Papua New Guinea	333.1	335.0	333.7	339.0	319.2	337.1	319.5
Fiji	13.8	14.3	24.0	23.4	21.6	20.3	19.1
Vanuatu	10.3	10.6	13.8	16.2	14.0	13.9	12.8
Solomon Islands	10.2	10.1	14.1	13.9	14.2	11.6	11.5
Western Samoa	8.8	11.4	12.0	12.0	12.0	11.8	11.6
Tonga	7.7	8.1	10.9	10.8	11.0	10.5	10.4
Kiribati	2.4	3.5	5.4	7.1	6.6	6.2	6.3
Nauru	n.a.	n.a.	0.2	2.8	2.9	3.0	3.0
Tuvalu	1.9	2.3	2.3	2.8	3.4	3.9	2.3
FSM	1.3	1.0	1.4	1.6	1.7	1.6	2.1
Cook Islands	1.1	1.1	2.3	2.4	1.9	1.8	1.7
New Caledonia	0.2	0.4	1.5	1.3	1.3	1.2	1.3
Marshall Islands	n.a.	n.a.	0.0	0.8	0.6	0.6	0.2
Niue & Tokelau	0.5	0.7	1.0	0.8	0.8	0.8	0.9
French Polynesia	n.a.	n.a.	0.1	0.2	0.4	0.5	0.4
Other & Regional	29.7	27.3	29.5	29.2	34.8	44.4	45.5
Total	442.8	453.6	452.7	464.5	446.8	469.7	448.6

Sources: Commonwealth of Australia (1994 & 1996a).

*Estimated expenditure by AusAID.

In the 1980s, Australia contributed to the development of renewable energy systems in the Pacific Island region. However, since 1990, Australia has given little support to the Pacific Island region for developing renewable energy through bilateral aid programs. In Canberra, an officer of AusAID explained that this is because Australia perceives that the Pacific Island countries do not want renewable energy systems (Vardor, Director of Pacific Islands II Section of AusAID, 1994, pers. comm. 13 September).

Another AusAID official, working in Western Samoa, said:

> It is true we have not supported any sort of project since 1990. But, local governments never asked us for support. If local governments had a proposal for a renewable energy project, we may agree with them (1995, pers. comm. 4th April)

In 1994, however, Fiji did ask Australia for funding for renewable energy projects but the proposed projects were rejected by Australian International Development Assistance Bureau (AIDAB). The reply from AIDAB was:

> With regard to AIDAB [the former name of AusAID] funding, as I pointed out in our meeting, [renewable] energy has not been identified as a priority area for bilateral aid assistance. We tend to leave activities in this sector to the larger multilateral banks such as the World Bank and the Asian Development Bank as the energy sector does have a greater inherent capacity to operate on a commercial or semi-commercial basis.[1]

It appears that recent Australian bilateral aid policy has rejected any renewable energy project in the Pacific Island region. This is notwithstanding the fact that development of renewable energy in the region could benefit the Australian renewable energy technology industry in terms of sales of equipment if aid were given.

In recent years there has been a tendency for Australian bilateral aid to move from the Pacific Island region to South East Asia for economic, self-interested reasons. Lack of interest in support of renewable energy development in the Pacific Islands perhaps also reflects the Australian Government's energy export strategy. Australia is a very large conventional energy resources producer. Export of coal and petroleum products is extremely important in Australian international trade with Australia being the world's largest coal exporter. Although the market is small, Australia is a major conventional energy provider in the Pacific Island region.

Australia's lack of aid support for renewable energy systems in the region compares unfavourably with other donor countries. This has caused Australian renewable energy industries to lose many opportunities for exporting their products. Arguably this has had the effect of diminishing the expansion of the Australian domestic market for renewable energy

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[1] Source: Department of Energy, Fiji (It was a letter from AIDAB to the Department of Energy, July 1994).

systems, as more overseas sales would make production more viable and thus lower capital costs. Australian companies could easily have taken advantage of the opportunity of setting up joint businesses in any of the Pacific Island countries. An example of such a venture is the Solar Energy Company in Kiribati, which has been established as a joint French/Kiribati venture. This company markets its products to many other Pacific Island nations. Joint ventures between developed countries and the Pacific Island nations could have other advantages, such as technology transfer and low labour costs. Therefore, joint ventures could promote the market penetration for renewable energy products.

This situation has resulted in an expression of serious concern by Australian renewable industries (eg BP Solar Australia Pty) and overseas Australians. They see other trade blocks, such as the EU and the US, assisting their own renewable energy industries to gain a foothold in the region. They say they cannot really understand the Australian Government's rationale. They hope that the Australian Government will rapidly adjust its international aid policy to contribute to the development of renewable energy systems in the region.

Australia has an internationally respected renewable energy industry and a number of high calibre renewable energy research institutes. Australian scientists, technologists and manufacturers are leaders in many relevant fields. They should be given every encouragement to implement their technologies at home and to export them (Waddell 1993). As a developed country, and a member of the Pacific region, Australia could be expected to make a significant contribution to the development of renewable energy systems in the Pacific Islands.

There has even been some display of Australian Government interest in contributing renewable energy systems to the Pacific Island region. For example, in October 1994, the then Federal Environment Minister, John Faulkner, announced that Australia was interested, in relation to its commitments under the United Nations Framework Convention on Climate Change (FCCC), in facilitating Australian industry's involvement in small scale projects with Pacific Island governments, directed towards the replacement of fossil fuel power sources with renewable energy resources. However, although a small governmental financial base was established to encourage this, the alternative energy industry in Australia was not in a financial position to involve itself seeing little incentive for doing so (Brown, General Manager of BP Solar Australia Pty, 1995, pers. comm. 12 January).

8.4 Energy issues in Australia

Australian energy industries have been significantly important to Australian social and economic development over the last decade. For example, in 1985-1986 these energy industries contributed one in every eight dollars to tax revenues and represented 25 percent of total exports. Coal was the largest single export item and oil was the fifth largest in 1985-86. Energy produced by these industries was worth over A$18 billion; they provided seven percent of Australian GDP and employed over 200,000 Australians (Department of Primary Industries and Energy 1988).

In the 1994-95 financial year, earnings from energy exports totalled A$10,730 million dollars (McLennan 1996a). This accounted for 12.4 percent of Australia's total earnings from exports (A$86,730 million) (see Table 8.3). In 1995-96, Australia's energy exports were worth some A$12.2 billion, which was about 12.5 percent of the value of all exports of goods and services (Commonwealth of Australia 1996b). Of total energy exports, coal has the largest turnover with exports of A$8 billion in the 1995-96 financial year and direct employment of 25,000 people (Liberal Party of Australia 1996).

Both the Labor and Coalition Governments have a very strong export policy for fossil fuels. During the period of the Labor Government, a strategy for coal export suggested by the Department of Primary Industries and Energy (1988, p85) was "the need to continue to press overseas governments to restructure their industries and open up their markets to coal imports". The current Coalition Government advocates conventional energy export even more strongly. For instance, with regard to the coal industry, the Coalition Government stated that it will abolish any export controls on coal, and its policy will be "to enhance international competitiveness to maximise the returns to Australia from export" (Liberal Party of Australia 1996, p13). As for Australia's uranium industry, the Coalition Government criticised the Labor Government's 'three mines' policy that has restricted Australian production of uranium at the expense of Australian jobs and export income. The new Government, therefore, has abolished the 'three mines' policy and plans to approve new uranium mines to increase uranium exports (Liberal Party of Australia 1996).

Recently, the Federal Minister for Resources and Energy, Senator Parer, stated that there is enormous potential for the sale of Australian coal, natural gas and uranium with the growing Asian demand. He further emphasised that it is very important for Australia to remain

competitive against rivals through developing a long-term export strategy for its energy products (Mckenzie 1996).

Australia's production of primary fuels reached 9,036 PJ in 1993-94 (Bush et al. 1995). Black coal accounted for 53 percent of total energy production, and brown coal about five percent. Uranium contributed 14 percent, petroleum 12 percent, natural gas 12 percent and renewable energy resources 2.8 percent (Table 8.4).

As Table 8.5 demonstrates, Australia's total energy consumption by 2009-10 is projected to grow at an average annual rate of 1.7 percent and total 5,506 PJ. Table 8.5 shows that it is expected that there will be a reduction in the average annual growth rate of energy consumption, compared with a 2.4 percent overall growth rate over the last 20 years. This is due to factors such as the existing energy consumption level already being very high, improvements in energy efficiency, and enforcement of policies for greenhouse gas reduction (McLennan 1996b). By 2009-10, total energy production is predicted to reach 14,798 PJ, more than 60 percent above the 1993-94 level. Black coal production is expected to still be the dominant source (see Table 8.6).

In 1992, Australian energy-related CO_2 emissions amounted to 272.6 million tonnes, which was equal to 1.26 percent of world emissions (International Energy Agency 1994). Within the OECD nations, Australia is the fourth highest producer in terms of per capita emissions (15.55 tonnes per person) and the fifth highest in terms of emissions per unit of GDP (1.42 tonnes per US$1,000) (International Energy Agency 1994). Australia's energy intensity, 0.463 tonnes of oil equivalent (toe) per US$1,000, is higher than the OECD average of 0.395 toe per US$1,000 (International Energy Agency 1994).

According to the National Greenhouse Gas Inventory Committee (1996), Australian greenhouse gas emissions from all sources (in CO_2 equivalents) increased by 8.7 percent, over the period from 1988 to 1994, from 530 million tonnes to 576 million tonnes. In 1994, stationary sources in the energy sector[2] were the largest contributor to national emissions in Australia amounting to about 37 percent and the chief contribution to the rise in emissions was from electricity generation from power stations. With regard to individual greenhouse gases,

[2] Stationary sources include electricity generation, petroleum refining and fuel use in the industrial, commercial and residential sectors.

CO_2 made the highest contribution (71.2 percent) to total emissions in 1994 (National Greenhouse Gas Inventory Committee 1996). According to the Department of Foreign Affairs and Trade, Australia's CO_2 emissions in 2000 are expected to be nearly 25 percent higher than in 1990 (Bita 1996).

Table 8.3 Energy and economic data for Australia (1994-95)

Total GDP (A$M)	414,649
GDP from energy (A$M)	30,560
Share of GDP (%)	7.3
Total exports (A$M)	86,371
Energy exports (A$M)	10,730
Share of exports (%)	12.4

Source: McLennan (1996a).

Table 8.4 The production, demand, imports and exports of energy in Australia (1993-94)

Energy resources	Production (PJ)	Share (%)	Imports (PJ)	Exports (PJ)	Demand (PJ)	Share (%)
Black coal	4,787	53.0	-	3,684	1,197	28.7
Brown coal	487	5.4	-	-	487	11.7
Crude oil	1,061	11.7	787	365	1,502	36.0
Petroleum products	n.a.	n.a.	104	169	n.a.	n.a.
LPG	100	1.1	-	-	n.a.	n.a.
Natural gas	1,054	11.7	-	321	733	17.6
Uranium*	1,293	14.3	-	1,876	n.a.	n.a.
Renewable	254	2.8	-	-	255	6.1
Total	9,036	100.0	891	6,415	4,173	100

Source: Bush et al. (1995).

*Due to large stockpiles, exports outweighed production in the financial year of 1993-94.

Table 8.5 Projected energy consumption in Australia by 2009/10

Energy resource	Consumption (PJ)	Average annual growth (%)	Share in 1993/94 (%)	Share in 2009/10 (%)
Black coal	1,528.3	1.5	28.7	27.8
Brown coal	574.7	1.0	11.7	10.4
Natural gas	1,271.6	3.5	17.6	23.1
Crude oil	1,854.9	1.4	36.0	33.7
Renewables	276.8	0.5	6.1	5.0
Total	5,506.3	1.7	100.0	100.0

Source: McLennan (1996b).

Table 8.6 Projected energy production in Australia by 2009/10

Energy resource	Consumption (PJ)	Average annual growth 1993/94 -2009/10 (%)
Black coal	7,191.5	2.6
Brown coal	574.7	1.0
Uranium	3,760.0	6.9
Natural gas	2,218.2	4.8
Crude oil	646.3	-3.0
Petroleum products	130.9	1.7
Renewables	276.8	0.5
Total	14,798.4	3.1

Source: McLennan (1996b).

8.5 The Australian renewable energy industry

8.5.1 General situation of Australia's renewable energy industry

In Australia, the renewable energy industry consists of a small number of manufacturing companies and has the support of associated research institutions. The consumption of renewable energy achieved an annual growth rate of 1.3 percent over the period of 20 years between 1973-74 and 1993-94 (McLennan 1996b).

In 1993-94, renewable energy accounted for nearly 6.1 percent of the total energy demand in Australia (Table 8.4). This energy is mainly in the form of wood, bagasse and hydro-electricity. These energy forms' contribution to total energy demand was 2.5 percent, 1.7 percent and 1.4 percent respectively (Bush et al. 1995).

The State of Tasmania is well endowed with large scale, hydropower projects and the Snowy Mountains HydroPower Scheme is used in the States of New South Wales and Victoria. In Tasmania, hydro electricity makes up about three-quarters of the consumable renewable energy (Bush et al. 1995).

In Queensland, bagasse is the main renewable energy source for powering sugar refineries. Wood is consumed for home space heating as another renewable fuel (particularly in Tasmania). In 1994 about 18 percent of households used wood for space heating in Australia (McLennan 1996b).

Solar energy is used for heating water, drying crops and extracting salt. In 1994, for example, five percent of households in Australia used solar energy to heat their water (McLennan 1996b). The development of geothermal energy has also achieved some progress. A 120 kW demonstration plant is currently operating in Birdsville, Queensland. Geothermal energy is currently being used in Portland, Victoria for heating the local swimming pools, and for space heating at the hospital and police station (McLennan 1996b).

By 1992, there were five major solar water-heater manufacturers in Australia. The solar heating industry has annually produced about 25,000 to 35,000 systems. These systems have been exported to over 70 countries (Department of Primary Industries and Energy 1993; Dr Branford, Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

Australian photovoltaic cell manufacturers produce some 5.75 MW of solar PV cells annually. This is seven percent of world output (see Table 8.7). Telecom Australia is the largest solar PV user with over 8,000 systems. Other uses, such as for street lights and bus shelters, are increasing, while, in remote areas, solar PV is largely used in diesel (or petrol)-solar hybrid systems for power supply. The largest grid connected solar PV system (20 kW) is at Kalbarri, Australia. To date, research into solar thermal electricity has made very slow progress. The Australian National University has a demonstration unit. There is also a feasibility study for a 2 MW unit underway at Tennant Creek (Dr Branford, Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

In the wind energy industry, prior to 1993, two manufacturers of wind generators produced machines ranging from about 0.3 to 10 kW (Department of Primary Industries and Energy 1993). There is still a manufacturer of small wind generators operating (Westwind) based in Perth, Western Australia. To date, Australia has one wind farm with 15 turbines producing about 2.5 MW at Esperance, Western Australia. Non-electric water pumping windmills are widely used in many remote areas and have become an Australian 'icon' (Dr Branford, Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

The Australian biomass energy industry has been growing since the early 1970s. By 1992, it comprised more than 500 companies (Department of Primary Industries and Energy 1993). Branford estimated that the sugar industry generated 40 MW of electricity and 100-200 MW of heat from bagasse in 1995. Branford argues that: the sugar industry has the capacity to produce up to 400 MW electricity; 50 MW can be produced from cogeneration power from waste paper and garbage; and 5,000-10,000 MW of heat could be produced from wastes of timber, rice and other industries. Also Branford estimates about 65 MW of electricity is also now produced from landfill (1996, pers. comm. 16 October). Currently, Australian hydro electricity production is 15 TWh per year; this is around 11 percent of Australia's electricity needs (Dr. Branford, Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

In October 1996, Branford estimated that the Australian renewable energy industry, including products and services, had an annual turnover of around A$390 million in 1995, which is shown in Table 8.8 (pers. comm. 16 October). By the year 2009-10, the consumption and production of renewable energy is expected to increase at a rate of 0.5 percent annually (see Table 8.5 & 8.6).

Table 8.7 World and Australia solar PV production (1995)

	World	Australia
Production	72 MW	5.75 MW
Capacity	100 MW	10 MW
Increase rate	15-20%	n.d.
Siemens Solar	17.3 MW	n.a.
Solarex (International)	9.4 MW	2 MW
BP Solar (International)	7.2 MW	3.75 MW

Source: Dr Branford (Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

Table 8.8 Estimated sales of Australia's renewable energy (1995)

Item	Exports (A$M)	Total (A$M)
Solar water heaters	30	60
Solar PV panels and other equipment	30	60
Wood heaters	n.a.	140
Bagasse plants	*	30
Landfill gas plants	n.a.	40
Medium hydro	n.a.	30
Miscellaneous	n.a.	30
Biomass and hydro	40*	n.a.
Total	80-100	390

Source: Dr Branford (Energy Innovation Section, Department of Primary Industries and Energy, 1996, pers. comm. 16 October).

* Mainly consultancy earnings rather than plant and equipment sales.

8.5.2 The barriers for the Australian renewable energy industry

In Australia, existing conventional energy industries, market systems and economic structures are all impediments to expansion of domestic markets for renewable energy. Australia has an ample supply of energy from all sources, in particular coal. Most Australians are serviced by grid electricity whose generating 'cost' and consumer price are very low. For example, under the current energy market system, the cost of coal-fired electricity in Australia is about A$0.035-0.06/kWh (Diesendorf 1997). In comparison with the cost of solar PV electricity (A$0.28-0.30/kWh), coal-fired electricity is much 'cheaper'. This applies to most forms of renewable energy with the exception of hydro electricity in Tasmania (see Table 8.9) and the supply of electricity to remote areas.

According to a world industrial and commercial electricity price survey (National Utility Services 1995), the average price of Australian electricity was US$0.044/kWh in 1995, which is nearly four times cheaper than Germany's electricity which was about US$0.165/kWh for the same year (see Figure 8.1). This current energy situation in Australia has resulted in renewable energy being disadvantaged in domestic market competition. In addition, some people in rural

areas in Australia, which are the most viable regions for the expansion of use of renewable energy, are still concerned about the reliability of renewable energy supplies and are calling for grid based coal-fired electricity supplies. These factors are limitations to domestic market expansion for renewable energy.

Another difficulty for Australia's renewable energy industry is lack of funding for research, development and commercialisation. For instance, in 1992/93, research and development expenditure on Australia's energy supply was A$105 million. Of this, A$16 million (15.2 percent of the total funding) was spent on the renewable energy industry (McLennan 1996b). In 1994-95, the total funding for research and development of energy in Australia was A$331.4 million. However, only A$7.9 million (2.4 percent of the total funding) was for renewable energy. This is a significant decline in the funding for Australia's renewable energy industry development (McLennan 1996b).

Existing energy supply comes mostly from a few, large, centralised producers and utilities. However, many renewable energy companies in Australia are currently small in terms of financial and human resources as well as commercial capabilities. This has resulted in the following disadvantages to renewable energy development compared with conventional energy supply. For example, as Diesendorf (1997) pointed out, the barriers to renewable energy include:

- It is excluded from many of the incentives available to the large energy suppliers, such as tax deductions, infrastructure bounds and infrastructure development by government.

- Those who borrow money to purchase sustainable energy products have to pay higher interest rates and to accept shorter repayments periods.

- Large energy suppliers and large-scale industries have considerable political power to influence government decisions on power station projects and subsidies on the price of electricity.

- When a new power station is proposed, only a few parties are involved and it is organisationally simple. In comparison it would be very difficult for many fragmented

providers of renewable energy to cooperate to the extent of being able to make a collective bid to compete against the power station.

- Baying renewable energy products may involve several phone calls, arranging an energy audit and a visit to different shops and showrooms. This is much less convenient than using energy inefficiently and paying the increased bills.

There are also limitations on the potential for cooperation between these organisations, such as business confidentiality because they are competitors. It is not surprising that it is not possible for political lobbying, research, commercialisation and overseas market research to be carried out by small companies individually.

Lack of education, information and training is another barrier. For example, customers lack education and information about efficient energy use; also few tradespeople are trained in the installation and maintenance of renewable energy technologies.

The current restructuring of energy industries is also a factor. Both the electricity and gas industries in Australia are undergoing micro-economic restructuring. During the restructuring, some of the barriers to renewable energy are being enhanced, while some new barriers are being created. This is because the restructuring aimed to reduce electricity price. It encourages energy producers and customers to seek the cheapest unit price of electricity instead of the lowest energy bills. Under the existing electricity market system, unfortunately, the electricity cost of conventional energy is much cheaper than that of renewables.

8.6 Government policies for renewable energy in Australia

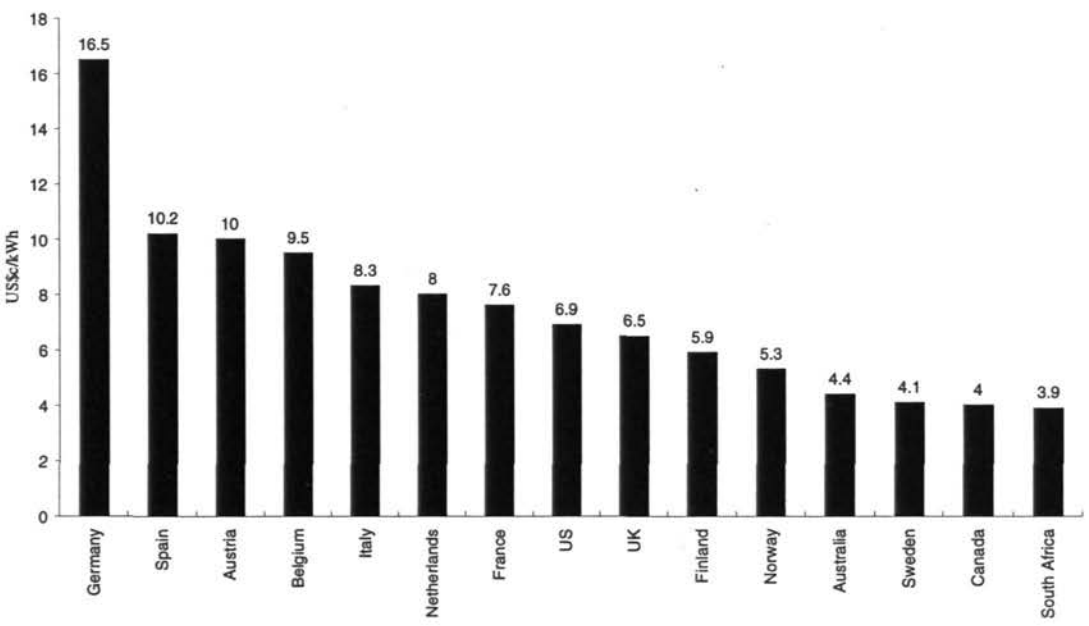
In order to reduce Australian dependence on fossil fuel energy, the development of renewable energy systems has been introduced. This has inevitably become an important political, economic and environmental issue in Australia. Federal and State Governments have provided support for the development and use of renewable energy through a wide variety of programs. For example, at the Federal Government level, the then National Energy Research, Development and Demonstration Program (NERDDP) was established in 1978 with the responsibility for developing and coordinating research on all forms of energy, including renewable energy.

Table 8.9 Electricity generating costs from new power plants

Power Plants	Cost (1991 Australian cents/kWh)
Coal--- NSW, QLD	3.5-4.0
Vic	5.5
WA	5.5-6.0
Natural gas---NSW and QLD	3.5-4.0
Wind---Denmark and California, best sites, 1991	6.5-7.0
Wind---Denmark and California, best sites, 2001	5.2-5.6
Hydro--Tasmania	8.0
Nuclear---Sizewell B, UK	12
Solar thermal--California, 1991	12.5
Australia, 2000	10?
Solar PV---flat plate, Australia, 1991	28-30
Trough concentrator, 2000	16?

Source: Diesendorf (1997).

Figure 8.1 International electricity prices (1995)



Source: Energy Digest, 1995, 24(3), pp.3-7.

Since July 1990, in order to achieve greater flexibility and responsiveness to industry needs, the NERDDP was replaced by the Energy Research and Development Corporation (ERDC) (Department of Primary Industries and Energy 1993). The ERDC was created under the *Primary Industries and Energy Research and Development Act* (1989). Since its establishment, the ERDC has committed A$65 million to investments in 219 energy innovation and research projects, the total cost being A$214 million (ERDC 1995). But only a fraction of this was devoted to renewable energy. Recently, ERDC has been shut down, apart from funding the existing projects to completion.

Funding has also been provided for the Perth International Centre for the Applications of Solar Energy (Fisher 1994). In the renewable energy area, the Federal Government had provided direct support of some A$41 million for solar, wind, biomass, hydro and geothermal energy projects by 1993 (Department of Primary Industries and Energy 1993). In 1996, the Cooperative Research Centre for Renewable Energy was established in Perth.

State Government initiatives in the area include provision of stand-alone power supply systems based on renewable energy technology. For instance, a remote area power supply assistance scheme has been in place in New South Wales (NSW) for many years (Fisher 1994). Recently, the NSW Government established the Sustainable Energy Fund (SEF) to support activities including demonstration and commercialisation of renewable energy technologies. This fund has been allocated a budget of A$65 million over its first three years which will be maintained depending on performance (Hemming, Manager, Research Funding and Technology, Department of Energy, NSW Government, 1996, pers. comm. letter, 1 March).

In December 1995, the NSW State Parliament passed three sustainable energy bills. One result of these bills is that electricity suppliers in NSW are to cut their greenhouse gas emissions by 20 percent by the year 2005 or to any level agreed to by the Council of Australian Governments in the interim. This made NSW the first state in Australia to set targets in its legislation for reducing greenhouse gas emissions (Sustainable Energy Industries Council of Australia 1996a).

Notwithstanding the fact that state and federal governments have made these efforts towards the development of renewable energy, significant growth in the renewable energy industry has

not been achieved in Australia. A senior officer of the Commonwealth Department of Primary Industries and Energy has indicated that growth in the use of renewable energy is not due to the quality of the technology but argues "Lack of public awareness is a problem with new technology..." (Fisher 1994, p.687). However, this argument fails to mention the dramatic decline in Federal funding for renewable energy since around 1980.

Environmental groups consider that the major barriers to the adoption of renewable energy are not technical barriers, but political and institutional ones, or arise from distorted markets and inappropriate accounting systems (Diesendorf 1994). These groups have also criticised failure in government policy, legislation and financial support for renewable energy. Mills (1994) has argued that the governments should immediately have a much larger national financing scheme funding all renewable measures, in all sectors, everywhere.

However, the former ALP Federal Government and the current Coalition Government in Canberra both have taken a similar stance on energy, and have indicated that the optimal way of allocating resources is through the competitive market. Renewable energy is expected to compete with fossil fuels in its development without significant assistance.

Leaving the development of renewables to the outcomes of market forces is an approach that has been strongly challenged by environmental groups, academic commentators and the renewable energy industries. They argue that the current energy market system does not take into account the broad social and environmental costs of energy supply and consumption. For example, Lowe (1994b, pp208-209) has argued:

> ... Fuel prices do not include any form of compensation to future generations for the depletion of resources, do not include the costs of such effects as acid rain or climate change, do not account for such social effects as the impact on patterns of social life, and do not include any form or provision for the impact of fuel use on such factors as our balance of trade, our self reliance and the strength of our currency. Further, in most of these cases there is no prospect of a convincing algorithm that would allow us to build these factors into the price structure. For that reason the market prices of fuels are not likely to reflect wider considerations, so market choices will also not reflect the wider issues that form part of the consideration of ecologically sustainable development.

In order to cut CO_2 emissions and strengthen renewable energy systems, environmental taxes, such as a carbon tax, have been proposed (Lowe 1994c; Sonneborn 1994; Common 1994).

The Business Council of Australia, the Australian Mining Industry Council and other Australian industry groups, however, are strongly against the introduction of a carbon tax. They stress: Australia is highly dependent on fossil fuels for its domestic energy use; the ability to reduce that dependence is very limited; and the export of fossil fuels is a very important contribution to the Australian economy. If a carbon tax were applied to exports of Australian fossil fuels, it would have serious impacts on Australia's exports of conventional energy and national economic growth (Business Council of Australia 1993).

In particular, the argument is often put that with significant cuts in CO_2 emissions, Australia could face significant economic losses in the short term (Business Council of Australia 1993; Taplin 1994b). It is not surprising, then, that the introduction of a small carbon tax on emissions was considered but rejected by the ALP Federal Government in 1995 and again by the new Coalition government in 1996 (State of the Environmental Advisory Council 1996; Macleay 1996).

In the publication, *Australia: State of the Environment 1996*, the State of the Environment Advisory Council (1996, p30) pointed out that "To date, Australia has made only limited progress towards stabilising greenhouse gas emissions." In the absence of strong action by all sectors, "Australia will not achieve even the more modest emission reduction foreshadowed in the Commonwealth's current policies and programs".

The Coalition's energy policy released during the election campaign in February 1996 declared that a Coalition Government would encourage research and use of renewable energy where practical. The Sustainable Energy Industries Council of Australia (1996a, p2) criticised their policy position by saying:

> The Coalition's policy consists mainly of vague statements broadly in favour of sustainable energy but offering no substance or specific implementation policies and no new funding for energy efficiency and renewable energy. In fact, A$8.8 million cuts across the energy portfolio are proposed.

The Coalition's energy policy highlights the intention to pursue the lowest possible energy costs in a competitive energy market. The intention has resulted in further interest group criticism because "low cost energy generally leads to decreased concern about energy efficiency and an

emphasis on increased sales". This is a serious contradiction within the policy (Sustainable Energy Industries Council of Australia 1996a, p2).

It can be seen then that development of the renewable energy industry in Australia is seriously restrained by the conventional energy industry, the existing market system and current economic structures. Its penetration in the domestic market has been very slow.

In assisting export for Australian renewable energy, the Development Import Finance Facility (DIFF) scheme has held a special position. The DIFF scheme has been a 'tied aid mixed credit' scheme. Financing for DIFF projects comes from two sources: one is the DIFF grant, provided by AusAID; another is export credit financing, provided by the Export Finance and Insurance Corporation (EFIC). These combined funds have been offered to recipient governments as a concessional loan.

The objective of DIFF has been to promote sustainable socio-economic development in developing countries, as well as to promote Australian foreign policy and commercial interests. The scheme has covered a variety of areas including manufacturing, waste management, communications, transport, energy and mining. In addition, projects in water supply, sanitation and rural electrification have been eligible (AusAID 1996a).

The scheme was introduced into the aid program in 1980, with the first project being approved in 1982. Between 1982 and 1994, 90 projects were financed with a total funding of A$643 million. DIFF expenditure grew to represent around eight percent of Australia's total annual aid budget (A$1.56 billion) (AusAID 1996a). In 1995-96, about A$120 million was allocated for DIFF projects (AusAID 1996a).

Recently, however, the Coalition Government terminated the DIFF scheme. The main reason given was that the Coalition Government "intends to reduce the fiscal deficit of A$8 billion and that requires cuts to programs" (AusAID 1996b, p1). Many Australian companies including renewable energy companies could be badly affected by this policy reversal and it may seriously slow the progress of the Australian renewable energy sector. The Government needs to rethink this issue from a long-term policy stance.

One example of the impact of the termination of the DIFF scheme is the cancellation of an Indonesian solar PV rural electrical project. In 1995, the Indonesian government requested that Australia support an A$38.69 million solar PV rural electrification project. This project aimed to provide energy to 20,000 homes located in eastern Indonesia by providing solar power systems to run radio and television broadcasts, and provide electric lighting (Business Corporation Section of AusAID, 1996, pers. comm. letter, 8 August). If the project had gone ahead under the DIFF scheme, Australian renewable energy industries would have benefited. However, now it is very unlikely that this project will proceed with Australian government assistance.

8.7 Summary

Its domestic issues and Australia's relationships largely influence Australian foreign aid policy with other nations. With respect to the development of renewable energy in the Pacific Island region, there are several major problems with Australian foreign aid and domestic policies:

(1) With the Cold War over and under the pressure of domestic economies, the focus of Australia's international relationships has shifted from the Pacific Islands to other regions. As one of its consequences, Australia has reduced aid to the Pacific Island region since the 1990s. In particular, Australia has stopped assisting renewable energy systems in the region via its bilateral aid program.

(2) Australian conventional energy industries, especially coal, are very important to Australian social and economic development. Both the former Labor and present Coalition Federal Governments have, thus, a very strong export policy on fossil fuels.

(3) Existing Australian energy and economic structures, market systems and government policies are all barriers to developing domestic markets for Australia's renewable energy industries.

(4) Australia's renewable energy industries are also limited by their small size in terms of financial and human resources as well as by their commercial capabilities.

Therefore, whether Australian international aid can play a role in the development of sustainable energy in the future will largely rely on Australian domestic issues and policies.

Chapter 9 Discussion and recommendations*

9.1 Introduction

In the previous chapters, the appropriateness of renewable energy, the role of foreign aid, and issues regarding international aid for renewable energy systems in the region have been discussed. Tackling these problems is challenging. The Pacific Island governments, developed countries and international organisations need to make a great deal of effort in seeking solutions to these problems. In most cases, these issues are not independent, but interact with each other. For example, exploring the potential for renewable energy resources involves government energy policy, energy institutions, skilled human resources, technology, and international aid for financing and expert assistance. It is evident that, in order to develop renewable energy in the region; a comprehensive policy approach is needed. Some possible solutions to these issues are discussed in this chapter from a policy perspective. In particular, special attention is paid to look at how aid agencies can more successfully assist sustainable energy through the further improvement of their aid policies and practices. Based on this discussion, the main recommendations of this research are proposed.

9.2 A driving force: the Pacific Island nations' sustainable energy policy

Pacific Island governments' policies will be a strong force for achieving sustainable development in these countries (Bilney 1993). Kanaley (1996, p2), Director General of AusAID, comments:

> If countries are to develop, they require a sound and stable policy framework; market based policies which encourage integration in the global economy; an emphasis on social development; enhanced participation by the local population, and notably by women; good governance, in the widest sense; policies and practices that are environmentally sustainable; and better means of preventing and resolving conflict and fostering reconciliation.

Foreign aid is about cooperation not imposition. As the head of USAID, Brian Atwood has said "aid is a facilitator and knowledge provider rather than simply a source of funds" (Kanaley 1996, p2). Foreign assistance is only a small part of the development equation and on its own

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* Sections of Chapter 9 have been published in the papers: Yu et al. (1996, 1997a, 1997b & 1997c); Yu & Taplin (1998, 1997a & 1997b).

can never fundamentally solve the problem of poverty. Success can only been achieved when the people and institutions of recipient countries make sustained efforts to help themselves.

Taking a long-term view, national energy policies for the Pacific Island countries that are socially acceptable, economically affordable, technologically appropriate and environmentally sound could benefit social and economic growth in these nations. However, without some initiative from these nations in establishing sustainable energy systems, the Pacific Island countries cannot expect donor countries and international organisations to have positive involvement in this sector. Any sustainable energy project that is successful in gaining foreign aid would need to be accompanied by a positive commitment from the recipient government.

Energy policy formulation and implementation is an important task for many Pacific Island governments. Energy policies should include clear statements about renewable energy and explicit energy targets, as well as short, middle and long term tasks and practical measures. In particular, the phasing out of subsidies for conventional energy consumption should be an essential component of these policies.

In these island countries, the true costs of electricity generation may be hidden by government subsidies for fuel, equipment, labour and other items (Wardrop 1994). The subsidies for electricity, by underpricing, encourage less than efficient consumption of imported fuels. These subsidies have resulted in curtailment of the development of other governmental sectors and services (Cairncross 1992). Also, renewable energy and energy conservation will not be greatly developed under a system of government subsidies for fossil fuel energy consumption (Wardrop 1994).

In Chapter 6, the tariff management issue is stressed. The general opinion expressed in the literature is that it is best to build a reasonable tariff to gradually cover the full costs of energy supply and consumption. This could be helpful in encouraging energy conservation and renewable energy. In turn, it could be useful in releasing Pacific Island governments' financial burdens. Although removing energy subsidies may be politically difficult for many small island countries, it is a necessary step to take. However, reducing energy subsidies should necessarily take care of the situation of low income consumers, who now benefit from these subsidies

(Goldemberg & Johansson 1995). In addition, these policies should assist in establishing efficient energy institutions, which may be in the public or private sector.

In policy dialogue with donor countries and international organisations, the development of renewable energy should be an important topic. A clear message regarding the need for renewable energy should be communicated to donor countries and international organisations, so that these donors can better rank their priorities for providing aid according to the Pacific Island nations' sustainable energy needs.

However, in developing renewable energy in many island countries, there has been considerable difficulty in obtaining support from the Pacific Island governments. Usually, the governments rely on foreign aid for funding their renewable energy (Institute of Natural Resources 1994; Rizer & Hansen 1992). Table 10 shows that the Kiribati Government Development Budget for renewable energy in 1996 was about US$745. It was only about 0.88 percent of the total energy budget (US$85,700). Although the Kiribati Solar Energy Company is privatised, the government's financial support is very important to the company's commercialisation in its early stages. Under the current financial situation in many small Pacific Island countries, working out a more reasonable balance in the energy budget between renewable and non-renewable energy is a significant challenge for energy policymaking in the region.

Seeking assistance from developed countries and international organisations is an important strategy for developing renewable energy to these island countries. At the same time, the Pacific Island governments need to further exploit their own financial potential for funding renewable energy, such as government budgeting, private investment and energy consumers' contributions. In particular, investment from the private sector and energy customer pool resources should be encouraged. Energy consumers need to be aware that the development of renewable energy is their own business and they cannot just leave it to governments or foreign aid.

In other regions of the world, one of the successful approaches to addressing capital shortages has been through private investment and customers making contributions to fund renewable energy. In China, for example, capital resources for small hydro schemes mainly come from

four financial sources, that is, central government, local government, private enterprise and local energy consumers (Zhu 1996).

Furthermore, in both China and India, the per capita GDP is far below that of the Pacific Islands. For instance, in 1992, the average per capita GDP in the Pacific Island countries was US$2,470, ranging from US$710 in the Solomon Islands to US$15,449 in French Polynesia (see Table 3.3) (Poirine 1995). However, in the same period, China's per capita GDP was US$368 and India's was only US$312 (International Monetary Fund 1996). This indicates that customer pool resources might be a possible capital resource for renewable energy in the Pacific Island region.

A number of developing countries in other regions, such as Brazil, Thailand, India and China have achieved considerable success in the process of developing their renewable energy industries. Although there are many differences between other regions and the Pacific Islands, their experiences and lessons would be useful to the Pacific Island governments in shaping national energy policy strategies.

Although fossil fuel use in China is growing at an extraordinary rate small hydropower systems have been markedly successful with respect to number and capacity since the early 1950s. By the end of 1993, a total of 48,284 small hydro power stations were operating. Their total installed capacity was 15,055 MW and annually generated electricity about 47,000 GWh (Zhu 1996). The Chinese success in small hydropower systems is greatly attributed to the nation's energy policies. For example, the development of small hydropower systems has followed a very flexible approach. They are mainly operated on a decentralised basis, with reliance on local governments, local communities and local people.

Also to formulate adequate policies, energy policymakers must be familiar with national policies, laws, and customary land and sea tenure. Energy policymakers also need to be aware of national socio-economic situations such as average household income, and the potential of international aid for energy development, for example, how much foreign aid will be available for projected energy projects. Accordingly, education of those in energy institutions in the Pacific Islands with regard to energy policymaking is necessary.

9.3 The priority of international aid

9.3.1 Aid and sustainable development

There are fundamental challenges faced in formulating the objectives of foreign aid. A basic aim of aid should be to strengthen developing countries' sustainable development. However, the current implementation of foreign aid has mainly been to alleviate poverty at the cost of undermining socially and economically sustainable development. Essentially, long term and sustained poverty reduction in Pacific Island countries will ultimately come from their own social and economic development.

Furthermore, their social and economic achievements will depend on the development of their social, economic, cultural and political systems, as well as their institutions, policies, infrastructures, natural and human resources. Poverty issues cannot be readily resolved in the Pacific Island countries without addressing sustainable development. Foreign aid can help to directly alleviate poverty in the short term, with provision of immediate needs like essential food, but it cannot eradicate poverty. A further important benefit of international aid is promotion of the capability of self-reliance.

This does not mean foreign aid is unnecessary. Foreign aid is needed to establish sustainable development in the Pacific Islands. If limited foreign aid resources are geared to build capability for sustainable development in recipient countries, this will have much greater effectiveness than the direct delivery of food, commercial goods and other activities. Foreign aid is also important in emergency poverty reduction.

Cassen (1994, p95) argues that "There is a broad and often neglected question of whether [aid] projects contribute to the economic self-reliance of the recipient country, that is, to the country's ability to do without aid in the future." Some less developed countries (LDCs) have experienced economic growth and have made the transition from recipient to donor status. For example, South Korea was expected in 1995 to join the OECD the following year. Singapore, Malaysia, and Thailand are also expected to become aid donors by the end of the century (Hook 1995). Therefore, Cassen (1994) emphasises that it is essential for all donors to pay much more attention to what aid is doing for long term self-reliance. The Pacific Island nations need assistance to promote their self-reliance.

For many years, the priority of Australian foreign assistance has been the provision of basic human needs for the poor and underprivileged communities, such as food and drinking water. Of course, this aid policy stance has validity. In the Pacific Island region, however, energy availability has seriously limited social and economic development and environmental protection. Renewable energy can play a vital role in improving the quality of life of people in the region, especially in rural areas. In the region, many people would benefit from energy produced to meet basic needs for water pumping, food processing and storage. If aid is only limited to food and water provision, poverty will never be eradicated. Conversely, if aid agencies can significantly reduce the region's dependence on imported energy, very significant financial resources could be saved, and these financial resources could be allocated to other sectors for social and economic development.

Although both the past Australian Federal Labor Government and the present Coalition Government have stated that their overseas aid encourages sustainable development and alleviates poverty, AusAID has not had any policy for assisting the development of sustainable energy systems in developing countries. The analysis of Kiribati energy policymaking in Chapter 6 shows that sustainable energy is a better option for providing electricity in many rural areas than diesel fuel energy. AusAID needs to pay significant attention, and develop a clear policy, to encourage the Pacific Island nations in developing sustainable energy systems. In this way, Australian foreign aid in the Pacific Islands and other regions could be more effective.

In these island countries, different energy strategies and requirements for international aid are needed than for other developing nations. This is due to differences between the societies, economies, cultures, natural environments, energy resources, and development levels of industry, technology and education. Thus, appropriate assistance needs to be given to these countries according to their individual situations.

9.3.2 Renewable energy and sustainable development

In the region, imported conventional energy is too expensive and not sustainable. In order to achieve socio-economic development, poverty alleviation and the improvement of the standard of living in Pacific Island developing countries, sustainable energy systems are a necessity.

Usage of renewable energy would reduce the island governments' expenditure on imported energy. This would allow for more financial resources to be allocated in other critical social and economic sectors and towards the implementation of sustainable development policies in general. Since Fiji's major hydro scheme (80 MW) at Monasava came into operation in 1982, its diesel imports have dropped by two thirds, thus saving up to US$220 million between 1983 and 1991 (World Conservation Union 1992 & 1994).

In 1995, the Kiribati Development Budget for the development of aquaculture fisheries resources, agriculture capacity building and sanitation/water supply totalled about US$0.3 million. In the same year, however, the Government spent US$1.2 million purchasing diesel fuel (Ministry of Finance and Economic Planning of Kiribati 1994). If using renewable energy can reduce consumption of imported diesel fuel, certain financial resources could be saved. This money could be redirected to fund the development of aquaculture fishery, agriculture and improved sanitation/water supplies.

With increases in energy supply, through renewable energy, employment opportunities and income could increase in the rural and outer islands in the region. In Kiribati, it has been suggested that during storms and in the evenings, many villagers could carry out family business activities, such as processing seafood, weaving mats and making local handicrafts under solar lights (Yonden Consultants 1994).

Before the introduction of micro-hydro electricity into villages in the Solomon Islands, many villagers felt compelled to allow the logging companies to exploit their forest resources in order to raise their income for various necessary expenditure such as paying tax, buying basic manufactured goods and fuels. Since the 1980s, the operation of hydro electricity has stimulated socio-economic development and enabled the villagers to pursue various cash-earning activities, such as making bread and furniture, drying copra, and storing fish and vegetables in cool rooms (APACE 1995).

Medical services are improved by electrification. An example of medical service assistance is the installation of solar PV systems in all island health centres of the Gilbert Group (17 islands) to provide electricity for vaccine refrigeration. Sanitary conditions in some countries in the region are also being improved by the provision of solar PV electricity especially with the major

health problem of clean drinking water in coastal areas being polluted by sewage effluent. In the Cook Islands, sewage effluent is being disposed of in suitable land areas using solar electrified pumps.

The supply of electricity could also greatly benefit education. In Lovoni village Ovalau, Fiji, an independent assessment by a school teacher confirmed that solar PV lighting in households improved the quality of school children's homework (Institute of Natural Resources 1994). In addition, the postulated improvement in the Human Development Index (HDI) for households with newly installed solar PV lighting is estimated at a rate of five percent improvement in life expectancy, literacy rate and GDP per capita (Institute of Natural Resources 1994).

Electrification is also making modern communication possible in the rural and outlying islands. Most Pacific Island nations are far from major international markets. With their economies gradually shifting to a market economy and with heavy reliance on international markets, modern communication is very important to the Pacific Islands' economic growth. Without a reliable electricity supply, modern levels of communication are impossible to achieve.

A range of environmental benefits has been obtained with the supply and usage of hydro electricity in rural areas. In the Solomon Islands, the rainforest has remained intact, which has significantly prevented soil erosion and silting up of reefs caused by logging. The local air and water pollution risk has been reduced by the replacement of fossil fuels with hydro electricity (APACE 1995). At the same time, there are increasing social and environmental benefits by reducing the urban population drift from villages and remote areas. The quality of life and socio-economic development opportunities have been improved in rural and remote areas by access to a successful electricity supply (Bryce et al. 1995).

As compared with conventional energy, renewable energy has other advantages. Firstly, electricity supplies by solar photovoltaic (PV) household systems are already practically and economically feasible in many outer islands and remote rural areas even without accounting for social and environmental costs (Liebenthal et al. 1994; Wardrop 1994; World Bank 1992). For example, solar PV systems are used in Tuvalu and Kiribati where there is no regular fossil fuel supply for electricity generation. In 1994, the World Bank completed research comparing solar PV and diesel systems. The research was based on life-cycle costs of providing the final services, such as household

electricity for lighting, refrigeration, television and video cassette recorders (VCR). The results of the research show that the life-cycle costs of solar PV systems are marginally lower than those of diesel systems for households in remote rural areas (Liebenthal et al. 1994). In the case of providing electricity to run lights and TV/VCR, for example, life-cycle costs of solar PV and diesel system per customer were US$4,015 and US$4,264 dollars respectively (see Table 9.1 & 9.2).

Secondly, the conventional approach to rural electrification-establishment of isolated diesel station has yielded disappointing results in the region. In many areas it is difficult and expensive to supply fuel, spare parts and maintenance personnel, and often not reliable. For example, on some islands in the Cook Islands, electricity supply is not regular, and limited to short periods, owing to uncertain shipping of diesel fuels (Tereapii 1995). Moreover, they are far below the standards required to stimulate economic development or even to meet the modest household needs of the consumers (Liebenthal et al. 1994).

Table 9.1 Life-cycle costs of solar PV systems per customer (US$)

Cost element	Lights only	Lights & TV/VCR	Lights & refrigerator
Customer appliance costs	265	1,208	1,784
Initial costs	132	732	1,332
Future costs	133	476	452
Generation equipment costs	984	2,670	5,897
Initial costs	741	2,216	4,436
Future costs	243	454	1,461
Operation & maintenance costs	137	137	137
Based on monthly cost	1.50	1.50	1.50
Total	1,386	4,015	7,818

Source: Liebenthal et al. (1994).

Note: Present discounted value of costs in constant dollars for 15 years at a 10 percent discount rate.

Table 9.2 Life-cycle costs of diesel systems per customer (US$)

Cost element	Lights only	Lights & TV/VCR	Lights & refrigerator
Customer appliance costs	72	858	1,228
Initial costs	51	551	953
Future costs	21	307	275
Generation equipment costs	939	2,151	2,347
Initial costs	750	1,719	1,875
Future costs	189	432	472
Operation & maintenance costs	593	1,255	4,335
Based on monthly cost	0.65	0.55	0.50
Total	1,604	4,264	7,910

Source: Liebenthal et al. (1994).

Note: Present discounted value of costs in constant dollars for 15 years at a 10 percent discount rate.

However, household PV systems have been used in the region for over 15 years. It has shown that with good reputable equipment, solar PV systems are generally more reliable than diesel generator systems (Wardrop 1994). To date, solar PV systems with battery storage are one of the most cost-effective options for small domestic and institutional power systems in many rural, non-grid connected areas in the region (Wardrop 1994).

Despite the capital costs of renewable energy are very high to date, the prospects for using renewable energy in the medium to long term are very good in the region. Wardrop (1994), an adviser for renewable energy in the Energy Division of the South Pacific Forum Secretariat, has commented:

> The region's renewable energy resources base is large relative to demand, particularly for solar and in some countries hydro and biomass. Renewables offer considerable potential for displacing conventional fossil fuel based energy systems and in some cases are already commercially competitive. With continued technical and economic improvements in many of the technologies , they will be able to contribute much more to Pacific Island countries' energy supplies and reduce the dependence on imported petroleum in the longer term.

9.4 The main measures for future international aid

9.4.1 Human resources and institutional development

Human resource development and further development of institutions in energy planning, system management project organisation and technologies are important factors in the development of successful renewable energy systems. Without such infrastructure support, installation of any renewable energy system would not be successful in the Pacific Island region, even if it involved excellent technology. A lack of energy policymakers, energy planners, project organisers, energy economists, energy managers, engineers and technicians is a perennial problem for these countries.

In Nauru, for instance, there is no national energy policy, plan or strategy. In Western Samoa, due to an insufficiency of qualified staff and an inappropriate energy institutional structure, the government energy authority is not capable of carrying out the policy formulation, planning, management, project design and technician training needed. Conversely, Kiribati and Tuvalu have been successful in developing rural solar PV electrifications. Their success appears to be independent of the public sector, and results from good maintenance, and a good rate of fee collection, continuing training and available external technical support (Liebenthal et al. 1994).

Promoting the capability of national institutions to plan, implement and manage technical training will be an important approach for developing renewable energy. In the future, international aid for institutional strengthening should assist the Pacific Island countries to restructure their energy institutions, formulate and implement energy policies, carry out energy projects and energy market research. Aid should also help these energy institutions to improve their technical training and education programs, as well as make more efficient use of foreign aid.

With regard to energy institution strengthening, the World Bank (1992) suggested that these island countries should have private companies to manage their energy sectors. The governments only need to formulate national energy policies and should not become involved in energy management. Which form of energy institution should be adopted, private or public? It depends on the individual country's situation. There is no easy answer. Privatisation might be suitable for some countries, but it may not be in others.

No matter whether private or public, appropriate government energy policies and legislation may be the most important factor. For example, if there is a private company established for dealing with renewable energy in a particular island nation, but the government still provides subsidies for fossil fuel energy supply and consumption, then under this situation, renewable energy could still be difficult to develop. Also, even though privatisition may be a main trend for dealing with energy issues in the Pacific Island region, there is a significant need to establish linkages between investment and capacity building. This is because private sector investments often fail due to a lack of human skills, strong institutions and conductive policy or legal frameworks (Sustainable Energy and Environment Division of UNDP n.d.).

Human resources and institutional development, however, is a long-term task. The Pacific Island governments, donor countries and international organisations should make constant efforts to enhance human resources and institution development. Aid providers, such as AusAID, need to be ready to provide long term investment in this area.

The primary purpose of human resource assistance should be focused towards institutional strengthening rather than the ongoing supply of outside experts to the island countries. Human resource development and institution strengthening not only needs basic education and training but also specialised education and training. Especially in school education programs, mathematics, physics, science and technical training should be encouraged. Assistance in training private sector personnel in the Pacific Island region should also be given consideration.

Some international aid organisations have worked on institutional strengthening for the conventional energy sector. Aid for energy institution strengthening is necessary to reduce the demand for fossil fuel consumption through the improvement of energy planning and

management. But it cannot replace the institutional strengthening of renewable energy sectors. This is because developing renewable energy will need new approaches and new technologies.

9.4.2 Financial assistance

The general situation in most of Pacific Island nations is that these nations have limited financial resources, and cannot use economic mechanisms, such as taxes and subsidies, as a means to raise revenue to purchase renewable energy systems. Also, the cost of renewable energy cannot be significantly reduced in the short term. This is because the development of renewable energy systems has not reached commercial stage worldwide. Conventional energy supply still dominates the international energy markets. Therefore, the World Energy Council (1994) suggested that bilateral and multilateral aid programs should increase the priority for funding of renewable energy projects in the developing countries. Providing sufficient financial support for the establishment of renewable energy systems, especially the initial capital investment, is essential. There are some prospects for creating financial assistance for renewable energy that can be considered:

Firstly, donors' energy funding sources are largely pumped into the conventional energy sectors. For example, the Asian Development Bank's energy projects mainly favour diesel generating electricity supplies (see Table 7.3). Encouraging diesel generation and distribution in the region is likely to have an adverse impact on the expansion of renewable energy, and slow the progress of establishment of a sustainable energy industry. Financial aid should be directly provided to the region for capital renewable energy through different aid means, such as grant, low interest loan, and in kind. Aid for energy conservation in the region should not be denied because renewable energy products continue to be high in capital costs. However, boosting renewable energy for rural electrification should become a benchmark of international aid when dealing with energy issues in the region. There needs to be a balance between funding renewable and conventional energy.

Secondly, donors need to further support these island countries in developing their national economies through strengthening productive sectors, such as agriculture, fishery and tourist industries; encouraging private business; improving taxation; maximising commercial profits; and reducing trade deficits.

Thirdly, to address the issues of global climate change by developing renewable energy, the Pacific Island countries should have access to the Global Environmental Facility (GEF)[3] and other international financial aid programs. Also, an opportunity for Pacific Island nations to further introduce renewable energy and move towards sustainable energy systems exists via the UN Framework Convention on Climate Change (FCCC) implementation mechanisms of joint implementation and technology transfer.

Fourthly, improving international trade could be an important approach for financing renewable energy in the region. Developed countries should amend their trade policy, and build fairer trade relationships with the Pacific Island countries by facilitating access of their goods into international markets at fair market prices, so that the Pacific Island countries can receive more earnings from international trade to increase their economic and financial capabilities.

Access fees for fishing in Pacific Island waters are also a source of revenue to the island nations. Each year, the vessels from distant water fishing nations (DWFNs), such as the US, Japan and Korea, pay little in access fees for offshore fishing in the waters of the Pacific Island region. In 1993 total access fees for the region were about US$56 million compared to a total catch valued at about US$1.2 billion (World Bank 1995a). The lowest access fee paid by Korea was only 2.2 percent of its catch value (World Bank 1995a). This is quite a low level of fees received by the Pacific Island nations. The World Bank (1995a) suggested that these island countries should increase access fees from the present level to about four percent of the total catch value.

Finally, the establishment of a favourable market for renewable energy has a long way to go, and this market is impossible to foster without the cooperation of developed countries. This is because developed countries are fortunate enough to have the technology and financial resources; the cutting edge of renewable energy development will be in the developed

[3] The Global Environment Facility (GEF) was initially set up in 1991 as a three year pilot program providing grants and low-interest loans to developing countries. It has now continued into a second phase with substantial funding. Currently a US$3.5 billion fund, it is jointly managed by the World Bank, the United Nations Development Program, and supports international environmental management and the transfer of environmentally benign technologies. The first projects began in 1991. Projects concentrate on: reducing and limiting greenhouse gas emissions; preserving biodiversity and maintaining natural habitats; and reducing further ozone depletion.

countries. The developed countries should boost their own renewable energy industries through research. This could largely reduce the costs of renewable energy (Foley 1992).

9.4.3 Appropriate technological transfer

With regard to technology transfer from developed countries to the Pacific Island region, it is necessary to make sure that the development strategies and types of technology suit the local conditions in a broad sense. Otherwise, these strategies and technologies will fail to meet the real needs of Pacific Island people in terms of energy and socio-economic development (APACE 1995). For a long period, there has been a misunderstanding about renewable energy technologies. Many people often imagine renewable energy technologies to be small and simple. Renewable energy can be simple and small. However, the practices in developing renewable energy in the region have taught the lesson that renewable energy does not necessarily mean simple.

Modern renewable energy systems can be fairly technologically intensive. For instance, during the 1980-1990 period, many new or improved technologies were introduced into the Pacific Island region. However, "few of these new technologies have been designed for the small island environment" (Rizer & Hansen 1992, p19). Moreover, there is a range of renewable technologies such as wave, tidal, OTEC, and biofuels that could have the potential for providing energy in the region. But they are either uneconomic at current energy market or are still in the technical improvement stages. Wardrop (1994, p8) argued that "it is unlikely that they will be suitable technologies for the region for some time".

The success of sustainable technology in the region also depends on the long-term commitment to supply quality equipment and maintenance. Unfortunately, many companies operating from outside the region are either unable or unwilling to support their technology and products once installed (Wardrop 1994). As a temporary strategy to hasten the use of renewable energy in the region, foreign experts should work in the Pacific Islands as technical advisers.

In the long term, in order to target problems related to technical issues, a regional centre for renewable energy technology and training should be established under the guidance of the following bodies: the Forum Secretariat; the South Pacific Regional Environment Program; the University of the South Pacific; and the South Pacific Institute of Renewable Energy

(SPIRE). The Centre should be a main technical base for developing renewable energy in the Pacific Island countries. As the Institute of Natural Resources in the University of the South Pacific reported (1994, p24):

> The only possibility that can be suggested to solve the above problem is to create a new infrastructure, a regional centre for renewable technology that would, in the long term, act as a replacement for the present reliance on imported knowledge and overseas consultants. Such a centre, would, in the short term, be a halfway house for international experts and assist the transfer of renewable technologies to the rest of the region. It could be staffed by a combination of local and international professionals and include a strong training component.

9.4.4 Local community involvement and joint ventures

In order to develop renewable energy industries in the region, broad cooperation between developed countries and the Pacific Islands needs to be fostered. This cooperation would include donors working with local government, communities and local energy companies in joint: planning; surveying of the potential of local renewable energy resources; and designing, manufacturing and management. The experience of Asia, the Pacific Islands and other regions has shown that the involvement of local communities and local companies could be an efficient way to transfer technology.

A successful aid project to be one that is maintained and upgraded by local materials and skills (Bryce 1995). APACE presented an important example during its assistance in developing rural hydro electricity in the Pacific Island region (Bryce 1995). This example shows that, given the right support, a rural community could successfully own, operate and maintain a micro-hydro scheme.

In Brazil, the joint US/Brazilian Renewable Energy Rural Electrification Pilot Project demonstrates solar PV, wind, and hybrid power systems in application. The project's objectives were to: establish technical, institutional, and economic confidence in using renewable energy; establish ongoing institutional, individual, and business relationships (US/Brazilian partnerships) that benefit both Brazil and the United States; and lay the groundwork for larger-scale rural electrification through distributed renewable energy systems in Brazil. The US Department of Energy shared up to 50 percent of project costs, Brazilian state-owned utilities covered the remaining part of the costs (US Department of Energy 1996).

This Brazilian project included two phases: (i) Phase 1 to provide solar PV lighting systems to about 350 homes in the State of Pernambuco; and to provide solar PV lighting systems to about 400 homes and 14 schools in the State of Ceara; (ii) Phase 2 to install a 50 kW solar PV/wind/battery hybrid system, to operate in parallel with existing diesel generators in the village of Joanes on the island of Marajo; and install a second 50 kW solar PV/wind/battery hybrid system, to operate in parallel with existing diesel generators in the village of Campinas in Amazonas. The system also has the option for 20 kW of wind generation. Phase 1 installation was completed in the summer of 1994, and Phase 2 installation was completed by late 1995 (US Department of Energy 1996).

Recent projects in India in development of renewable energy through joint ventures have been successful. TATA-BP Solar is a joint venture between the giant TATA group of Indian energy companies and BP Solar (International) owned by British Petroleum. The joint venture involves use of Australian-made solar PV cells from BP Solar Australia for a range of needs in India. The Joint Venture Company is now the biggest manufacturer of solar modules in India, producing around 1 MW a year. Solar PV cells (US$2.2 million worth), were sourced from Australia in 1995 (Zubrzycki 1996). Interestingly, following from this joint venture, most of the development for rural solar technology infrastructure manufacturing will take place in India for the entire BP Solar group.

The market for solar energy in India is growing at a rate of 30 percent to 40 percent a year. It has made India one of the fastest growing users of solar energy in the world (Zubrzycki 1996). In the last two years, more than 100 joint ventures in renewable energy have been established in India with foreign companies (Zubrzycki 1996). To date, there are more than 250,000 solar PV cells installed in India for an aggregate capacity of 17 MW, with 7 MW being added each year (Zubrzycki 1996). By 1997, India is expected to be the second biggest wind energy producer in the world after the US (Zubrzycki 1996).

Since 1992, a successful joint venture producing solar PV controllers in the Pacific Island region has been between a French renewable energy company and the Solar Energy Company of Kiribati (Akura, General Manager, Solar Energy Company of Kiribati, 1996, pers. comm. Telephone call, 16 May). The French company, as a joint venture originally designed the controllers, and the controllers have now been redesigned due to some technical problems.

They are inexpensive, reliable, easy to repair and more suitable for use in the region and in other developing countries.

Five years ago, the controller produced by the French company was costed at US$234 dollars per unit. After the joint venture, the cost dropped dramatically. Now, the cost is only US$70 dollars per unit. It is also US$11.1 dollars cheaper than the controllers made by the Australian BP Solar Company (Akura, General Manager, Solar Energy Company of Kiribati, 1996, pers. comm. Telephone call, 16 May). As a result, these products have been successfully exported to Fiji, Tonga, Tuvalu in the Pacific Island region and Bhutan in Asia. In 1996, a Melbourne based Australian Company has joined the venture with the Kiribati/French Solar Energy Company as a new partner (Akura, General Manager, Solar Energy Company of Kiribati, 1996, pers. comm. telephone call, 16 May).

Through joint ventures with the Pacific Island states, developed countries could increase their capital investment in the region. The capital costs of renewable energy products and technologies would be reduced because labour costs are lower in these countries. Moreover, it would help to reduce trade barriers and increase the export of renewable energy products between the region and other countries. In addition, the joint ventures could directly assist technology transfer from developed countries to the region and promote human resources and institutional development in these island countries. Therefore, international organisations and developed countries need to think seriously about joint ventures as a substantive form of assistance for renewable energy development in the region.

9.4.5 Bilateral and multilateral aid

In the past, the Pacific Island countries received bilateral and multilateral financial assistance from foreign donor countries and international organisations. Generally speaking, multilateral aid, such as World Bank aid, has been based on loans. Application procedures for loans are always time consuming and loans are hard to obtain. For example, many government officers in Fiji, Kiribati, Nauru, the Cook Islands and Western Samoa mentioned that the World Bank has interests in other regions as well as the Pacific Islands and in other sectors outside the renewable energy sector. The World Bank has very high expenditures on project administration, no matter whether the project is large or small. The World Bank, therefore,

tends to support very large-scale development projects. Moreover, in many cases, the World Bank's procedure for loans needs six years from project proposal to approval.

Most bilateral assistance is in the form of grants or aid in kind. The procedure of funding applications is shorter than that in multilateral aid. However, the amount is generally too small to run a project on an engineering scale, such as constructing a small hydro power plant or installing a small wind power station. Bilateral assistance can only support tiny projects, such as energy resource assessment, feasibility studies and short training courses.

Unfortunately, the Renewable Energy Sector of the SPC Secretariat is facing similar problems as the island countries in terms of assistance for renewables. Due to financial constraints, its staff positions and annual budget are limited. As a result, it can only deliver small ad-hoc programs for regional development of renewable energy systems. Moreover, bilateral aid is often tied to the donor's interests. For instance, if a donor provides funding for renewable energy projects, the recipient country has to buy energy equipment and other products from the donor who provides the funding.

In order to promote aid efficiency, bilateral aid could be a main channel for those donor countries that have the capabilities in terms of technology and finance, such as Japan, Germany, France and Australia. For some small projects such as demonstration projects and training courses, the present system of multilateral aid provided to the Renewable Energy Sector in the Forum Secretariat seems to work well.

At the same time, some countries in the region expect that bilateral donor countries should have a flexible aid policy, that is, their aid programs and projects should not be tied to conditions which are mainly concerned with the donor's interests. Without these conditions, recipient countries could purchase more suitable technologies and better energy products from any country. In this way, the Pacific Island countries could make more efficient use of foreign aid resources (Kumaran, Director of Energy Department, Fiji, 1995, pers. comm. 27 March; Wichman, Acting Director of the Renewable Energy Directorate, the Cook Islands, 1995, pers. comm. 13 April).

The multilateral banks, such as the World Bank, should develop special financial programs or policies to provide renewable energy systems for the Pacific Island region. Currently, in the

region, renewable energy mainly consists of small-scale systems and is mostly used for improving people's living standards. Using renewable energy as the main power source for industry and manufacturing, is a long way off. Therefore, the World Bank's support for large projects with a quick economic return policy needs to be questioned as an appropriate policy for providing renewable energy to the region. Although the World Bank's mission (World Bank 1994) is to help developing countries reduce poverty and promote sustainable development and environmental protection, the Bank has no detailed policy for renewable energy in the region and very few projects are carried out by the Bank in the Pacific Island countries.

In the future, the World Bank needs to work out an aid policy for supporting small-scale renewable energy in the Pacific Island region. Each year, at the least, multilateral banks should allocate financial resources to the Pacific Island region to help the small island countries enhance renewable energy. Recently, the World Bank set up an office in Suva; Fiji to facilitate the financing and operation of Pacific projects (Fraser 1996). It could be hoped and expected that more financial resources for renewable energy will be delivered into the region with the establishment of this facility.

9.4.6 Promotion of effective aid

From the result of the survey, which is discussed in Chapter 7, it can be seen that since the late 1970s, many donors have been involved in giving aid for renewable energy in the region. However, many donors do not have any plans for long term policies and programs for renewable energy in the region. It is quite often the case that some donors give recipient funding or equipment, but then they never go back. Some donor's funding is often such a small amount that the recipient country cannot do anything with the funding. Sometimes many donors give aid to the same country for the same project at the same time, while another island country is not getting any support. Therefore, more work could be done in promoting aid efficiency through cooperation between donors.

Co-aid from developed countries could be a practical method for funding renewable energy in the Pacific Island region. For instance, some Pacific Island states may seek assistance from Australia to exploit their wind energy resources. While Australia has difficulty in offering financial aid, its small wind energy technology has been commercialised. Japan, on the other

hand, has the capability to offer financial aid but does not have mature wind energy technology and products. In this case, Australia and Japan potentially could work together to co-aid Pacific Island countries' small wind energy projects given that there is a suitable wind potential.

In addition, to date many bilateral donors and international organisations have already worked in the region with broad aid programs, such as food and water supply, health, and other socio-economic development projects. If aid for renewable energy is wisely integrated into these aid programs; the aid would not only improve people's living conditions in terms of food, water and sanitary needs, but also provide them with greater access to useful forms of energy. As a result, the efficiency of international aid to the region could be improved.

For doing this, aid agencies could encourage using renewable energy for food processing, potable water supply, sewage treatment and disposal, rather than encouraging the use of diesel generating power. For instance, the World Health Organisation has supported the Cook Islands using solar water pumping systems for disposal of sewage effluent. This has prevented pollution of the coastal environment and reduced the risk to public health (Wichman, Acting Director of the Renewable Energy Directorate, the Cook Islands, 1995, pers. comm. 13 April). Also, capability building programs, such as education, human resource development and institutional improvement could assist in providing appropriate training to local energy policymakers, managers, planners, engineers, and technicians, as well as special education programs for local energy consumers.

9.4.7 Non-government organisations

Non-government organisations are playing a prominent role in foreign aid and development processes. In addressing economic and socio-cultural aspects of human development in the developing countries, they have a holistic approach. Their focus is on poor people, whether in rural villages or in urban slums (Australian Council for Overseas AID 1992). Particularly, their strengths lie in community development and grassroots activities. These are essential features of an effective aid program (Bilney 1995).

In Australia, non-government organisations raise some A$120 million a year in aid money from the Australian community (Australian Council for Overseas AID 1992). In the 1994/95 financial year, their funding collection was A$170 million. Also government aid funding via Australian NGOs

increased to A$113 million in the 1994/95 financial year. It represented 7.7 percent of the Australian official aid program (Bilney 1995). According to the Australian foreign aid budget, more than A$100 million assistance will be delivered through Australian NGOs in 1996/97 (Commonwealth of Australia 1996).

Normally, Australian NGOs work with local partner organisations and local communities overseas. Therefore, their responses to basic human needs and development in developing countries is often made from within the local context, by working with local people using local methods and local resources. They also have other strengths in delivering certain government aid programs. These include: (i) setting up programs in certain places where it is difficult for the government to deliver aid for political reasons; (ii) a greater capacity to deliver aid in some sectors than government agencies, such as in small scale rural electrification programs; and (iii) helping in emergencies where NGOs can help people more quickly and more efficiently than government assistance could. Also, most experts and staff from NGOs are volunteers. Therefore, NGOs expenditure on administration and living expenses is significantly less than that of government aid organisations.

Due to the fact that NGOs have the above advantages, they could play a more significant role in the delivery of assistance for renewable energy in the Pacific Island region. APACE's successful achievements in rural electrification using renewable energy has demonstrated that some NGOs have this capability and potential in carrying out international aid for renewable energy in the Pacific Islands and other region.

9.5 Reform of donors' domestic renewable energy policy

Developed countries could be important contributors in research and development with respect to renewable energy and in improving energy conservation techniques since they are fortunate to have the technologies and financial resources. As some comment "the cutting edge of renewable energy development will have to be in the developed countries. If nothing happens there, nothing will happen at all" (Foley 1992, p364). If developed countries increased their own renewable energy technologies and industries, this would contribute largely to reducing the costs of renewable energy technologies and products worldwide.

However, in Australia, the existing economy and energy industries heavily rely on conventional energy production and supply - predominantly coal mining and coal exports. The governments'

energy policies are biased towards fossil fuel energy industries. The renewable energy industry has received very little attention and little assistance from the Australian Government. Under the existing economic system and energy structures, Australia has neither encouraged sustainable energy industry domestically nor overseas. At the same time, the Australian Government has not been willing to formulate and implement effective legislation and policies to achieve the target for cutting greenhouse gas emissions according to the Framework Convention on Climate Change. In order to achieve significant development of renewable energy in Australia and the Pacific Island region, Australian Government policy should concentrate on the following areas:

Firstly, restructuring Australia's energy industry should be a fundamental priority of government, no matter whether Labor or Coalition. Australia's conventional energy industries should be reformed to become based on diversified sustainable energy systems. Although this type of reform is difficult, it is a necessary step to take. This is because it will lead to building and securing Australia's long term national economic interests and protecting the global environment.

Secondly, the Australian Government should increase assistance for research and development including market research directed towards commercialisation of the renewable energy industry. Development of renewable energy must link closely with commercialisation, marketing and pure research. Pure research, such as the research on solar PV cells, is important in reducing the cost of renewable energy. However, the solar PV cells are only part of the total cost of a solar PV installation. Costs for mounting, wires, switches, batteries, ballasts, refrigerators and other equipment can make up to 50 percent or more of the total cost of an installation (Foley 1992). Accordingly, these costs need to be evaluated together with other commercialisation and marketing issues. Also, governments need to develop special funding programs to encourage the use of renewable energy in domestic markets.

Thirdly, Australia should gradually increase the export of renewable energy technology and products from the energy industry. This could help the renewable energy industry and secure Australia's conventional energy market from a long-term point of view. It is not wise for us to only rely on fossil fuel exports without other choices when competing with other suppliers in the international energy market. Australia's export of fossil fuels could lose revenue because of

lower prices from overseas competitors. While Australia continuously provides cheap fossil fuels, particularly coal to international markets, other countries are encouraged to consume fossil fuels. Worldwide, as a result, it increases the depletion of non-renewable resources, retards the progress of sustainable energy and increases global environmental pollution.

In order to expand overseas markets for Australian renewable energy products, the Australian Government should encourage Australian renewable industries to invest money in the Pacific Island nations and elsewhere in developing countries in joint ventures. This should help reduce the cost of renewable energy products and increase the advantage of Australian renewable energy products in the marketplace. Further introduction of this form of cooperation could be a practical strategy for developing renewable energy in both Australia and the Pacific Island region.

Fourthly, the Business Council of Australia, the Australian Mining Industry Council and other Australian industry groups emphasises the importance of the conventional energy industry to Australian economic structures and current national interests. However, the Federal Government should not only consider current national interests, but also long term national interests. Attention should be paid to present day interests and the interests of future generations. Australia also has obligations to fulfil with respect to international laws for protecting the global environment.

Finally, the Australian Federal and State Governments should support research into the real costs of energy production and consumption, including social and environmental costs, and provide a database for energy planning in Australia. Such a database would shed light on the viability of subsidies for fossil fuels and new legal and economic measures, such as environmental taxes. Following the example of the NSW State Parliament, other states and the Commonwealth Government should set targets for cutting greenhouse gases via legislation rather than by policy documents (see, for example, Government of Australia 1992).

Under the current unfavourable energy market and government policy, the Australian renewable energy industry could adopt some positive strategies to develop Australia's renewable energy. There are two aspects that could be developed. These are:

Firstly, close cooperation between Australian renewable energy companies and Australian research institutes will be necessary. Currently, in Australia, many renewable energy companies

are small in terms of financial and human resources as well as in commercial capabilities. There are also barriers between these organisations in terms of cooperation as they are competitors. Such renewable energy organisations might be in a disadvantaged position when competing with conventional energy and in anticipating national energy policymaking because of its small size. In July 1996, in Melbourne, Mr Warwick Parer, the Federal Minister for Resources and Energy, convened the first meeting of the Business and Ministerial Round Table on Sustainable Energy Policies. Prior to the meeting, Minister Parer had refused a request by the Sustainable Energy Industries Council of Australia asking for full representation of the sustainable energy industry at the Round Table. Ten of the 11 representatives came from fossil fuel based industries (Sustainable Energy Industries Council of Australia 1996b).

However, if these small companies or institutes form a cooperative, Australia's renewable energy industries could become a very powerful organisation, in competition with conventional energy industries, and form a strong political lobby voice. This cooperative could help to concentrate limited financial and human resources, remove the various blocks between renewable companies or research institutes, strengthen task forces for technological and marketing research, and product commercialisation, as well as promote market penetration overseas and domestically. Australia's renewable energy industries (including companies and research institutes) really need to form a suitable organisation to assist them to develop notwithstanding the current unfavourable competitive systems and government policies.

Secondly, in Asia and the Pacific Island region, a significant proportion of the population in rural areas does not have access to any electricity supply. There is a huge potential market for Australian renewable energy technology, products and services. Moreover, in Asia and the Pacific Island region, the cost of labour is much cheaper than that in Australia. If Australian renewable energy companies participate in joint ventures with developing countries, the significant capital cost of renewable energy products can be reduced. This sort of venture could greatly enhance market penetration for the renewable energy industry both domestically and overseas. A joint venture could secure the overseas market for Australian renewable energy companies as well. Therefore, the Australian renewable energy industry needs to consider seriously the possibility of joint ventures as a new opportunity for development.

Chapter 10 Overview and outcomes of the research

This chapter draws together the major conclusions and recommendations of this study regarding international aid and energy sustainability in the Pacific Island region. In Chapter 1, the following hypotheses for this thesis were stated: renewable energy is the most appropriate energy source for the needs of Pacific Island nations; and international aid directed to the Pacific Island region can play an important role in promoting the use of sustainable energy systems. Also, the main purpose of this thesis was observed to be: to discuss the main socio-economic, political, cultural and environmental issues with respect to developing sustainable energy systems in the Pacific Island nations. Following from the hypotheses and purpose, the major objectives of this research were: (i) establish a framework for energy policymaking; (ii) review international aid in terms of the appropriateness of assistance; (iii) analyse donors' perspectives with regard to their domestic, social and economic conditions and their interests in renewable energy and energy sustainability; and (iv) identify the best means to assist development of sustainable energy in the Pacific Island region.

Overall, the energy problems of the Pacific Islands are seen as being embedded in wider economic, social, environmental, technological and educational issues. Undoubtedly, there will always be policy compromises and trade-offs. There is no single energy problem and there is no absolutely ideal strategy for the Pacific Island region as a whole. Any economic development plan, energy system and technology adopted needs to be appropriate to the physical, social and cultural environment, financial capabilities, and current state of education, science and technology. Appropriate energy supply systems should ideally support economic development and maintain environmental quality. On the other hand, inappropriate energy systems may limit socio-economic development and damage the environment.

10.1 Conclusions

In Chapter 2, the research presented highlights that international aid would be of fundamental assistance for developing sustainable energy in the region.

Chapter 3 demonstrates that renewable energy would be a suitable energy source in the Pacific Island region, in terms of natural conditions, culture, political independence, socio-economic development and environmental management. In Chapter 4, the appropriateness of renewable

energy for the Pacific Island region is further supported from three perspectives: energy resources, policymaking/planning and management.

Chapter 5 indicated that if renewable energy is really going to be the main energy source in the region, the barriers of financial resources, skilled human resources and energy institutions have to be removed.

In Chapter 6, the research emphasises that using a framework for formulation of energy policy could be a new approach for energy planning and management in the Pacific Island region. A comprehensive framework for energy policymaking in the region is proposed. The framework is designed for practical energy management purposes. It aims to facilitate integration of broad issues, such as socio-economic, cultural, political, legal, environmental, technological and foreign aid issues, into the energy policymaking process. The case study of energy policymaking in Kiribati shows the framework can be used as a useful tool for energy policymakers in the Pacific Islands in selecting energy options, formulating energy policy and energy planning. It could also be of use to international organisations and foreign donors in deciding which energy projects should be supported in the region.

In Chapter 7, the survey of aid donor countries and organisations documented indicates that the major issues affecting international aid for the enhancement of renewable energy systems in the region are as follows: sustainable energy has not been identified as a priority area for international assistance by many donors; there is a lack of human resource development and aid programs directed towards institutional strengthening for renewable energy development; donors are withdrawing aid from the Pacific Islands; the region has a small proportion of aid for renewable energy in comparison with aid resources for conventional energy; bilateral aid projects are strongly tied with donor's interests; and multilateral funding organisations, such as the World Bank, tend to support large scale development projects with quick economic returns rather than the small scale type of projects viable in the Pacific Island region.

The relationship between international aid and domestic issues of donor countries is discussed in Chapter 8. Donor countries' domestic issues, such as economic and industrial development, energy structures, and trade, foreign and environmental policies, significantly affect their implementation of foreign aid for sustainable energy systems in the Pacific Island region. For instance, as Australia's

economy and industries are heavily dependent on conventional energy, Australia is not currently willing to strongly support sustainable energy industries domestically or overseas. If international aid were expected to play an important role in the development of sustainable energy, improving the related domestic policies of donor countries from the viewpoint of energy sustainability would be a necessary prerequisite.

In Chapter 9, the following four major policy issues are discussed: Pacific Island nations' sustainable energy policy; the priority of international aid; the main measures for future international aid; and reform of donors' domestic energy policy.

The results of this research have indicated that renewable energy is the most appropriate energy source for the needs of Pacific Island nations in terms of being socially and culturally acceptable, environmentally sound, technologically suitable and economically feasible. Also, the research shows that international aid would potentially play an important role in promoting sustainable energy systems in the Pacific Island region. Accordingly, the hypotheses posed in Chapter 1 are supported by the research findings.

10.2 Major recommendations

In the future, the Pacific Island nations, developed countries and international organisations would be wise to consider the following policy approaches: (i) the Pacific Island nations should initially adopt ecologically sustainable energy policies; (ii) international aid needs to be refocused on promoting recipient's capabilities in terms of self-reliance and sustainable development including the promotion of sustainable energy systems; (iii) donor countries need to positively encourage sustainable energy industries by reforming their own economic and industrial structures through effective national legislation and policies; and (iv) it is vital that skilled human resource and institutional development, financial assistance, technology transfer, local community involvement, joint ventures, bilateral and multilateral assistance, aid efficiency, and the role of non-government organisations, be encouraged and instituted.