

FINAL DRAFT

EXPLORATORY REPORT

**PRELIMINARY ASSESSMENT OF CAPACITY BUILDING NEEDS
FOR SUSTAINABLE DEVELOPMENT/VULNERABILITY REDUCTION
IN TUVALU**

PREPARED BY

AL BINGER, PhD

SUBMITTED TO

**THE MINISTRY OF FINANCE
GOVERNMENT OF TUVALU**

March 2003

TABLE OF CONTENTS

Acknowledgements	ii
Abbreviations and Acronyms	iii
Tables and Figures	iv
1.0 BACKGROUND	1
2.0 INFORMATION ACQUISITION	2
3.0 NATIONAL OVERVIEW AND FINDINGS	2
3.1 National Overview	2
3.2 Findings	4
3.2.1 Energy Dependence	5
3.2.2 Limited Fresh Water Resources	7
3.2.3 Pollution from Waste	8
3.2.4 High Level of Food Dependence	8
3.2.5 Very Thin Economic Base and Associated Challenges	9
3.2.6 Climate Change and Sea Level Rise	10
3.2.7 Institutional Capacity	10
3.2.8 Geographic Location and Trade	12
4.0 ANALYSIS OF FINDINGS AND RECOMMENDATIONS	14
4.1 Possible Actions to Reduce Vulnerability	16
4.1.1 Reducing Energy Dependence	16
4.1.2 Increasing Water Supply and Availability	24
4.1.3 Increasing Food Security	27
4.1.4 Economic Diversification and Resilience Building	27
4.1.5 Adaptation to Climate Change and Sea Level Rise	29
5.0 CONCLUSION	30
REFERENCES	32
APPENDICES	34
<u>Appendix A</u>	
Capacity 2015 Partnership with Tuvalu on Sustainable Development Strategies and Local Level Capacities – Terms of Reference for Technical Assistance	34
<u>Appendix B</u>	
List of Persons Interviewed	36

ACKNOWLEDGEMENTS

ACRONYMS

AOSIS	Association of Small Island States
AusAID	Australia Agency for International Development
BPOA	Barbados Programme of Action
CC and SLR	Climate Change and Sea-Level Rise
CDI	Capacity Development Initiative of the GEF
COP	Conference of Parties
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization
GAR	Golder and Associate Report
GEF	Global Environment Facility
GHG	Greenhouse Gases
IFAD	International Fund for Agriculture and Development
IPCC	Intergovernmental Panel for Climate Change
IPR	Intellectual Property Rights)
KP	Koyoto Protocol
MEAs	Multilateral Environmental Agreements
OTEC	Ocean Energy Thermal energy Conversion
ODAs	Overseas Development Agencies
PICHTR	Pacific International Center for High Technology Research
SIDS	Small Island Developing States
SLR	Sea-level Rise
SPOCC	South Pacific Organizations Coordinating Committee
SPREP	South Pacific Regional Environmental Programme
TANGO	Tuvalu Association of Non-Governmental Organizations
TEC	Tuvalu Electric Corporation
TSECS	Tuvalu Solar Electricity Cooperative Society
TRIPS	Trade-related Aspects of Intellectual Property Rights
TWMP	Tuvalu Waste Management Programme
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environmental Programme
UNFCCC	UN Framework Convention on Climate Change
USP	University of South Pacific
UWICED	University of the West Indies, Center for Environment and Development
WTO	World Trade Organization
WCED	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development

TABLES

Table 1	International Electricity Prices for Household and Industry – - non-OECD Countries	6
Table 2	Global Energy Technology Options and Economics	17
Table 3	Growth of electricity peak load, demand, TEC staff, and cost	18

FIGURES

Figure 1	Sea level rise over time based on Global Climate Change	4
Figure 2	Annual budget and number of staff members for the past/future three years	7
Figure 3	Exchange Rates: Tuvaluan dollars or Australian dollars per US dollar - 1997-2002	15

EXPLORATORY REPORT

PRELIMINARY ASSESSMENT OF CAPACITY BUILDING NEEDS FOR SUSTAINABLE DEVELOPMENT/ VULNERABILITY REDUCTION IN TUVALU

1.0 BACKGROUND

As part of Tuvalu's commitment to the principles of Agenda 21 and the outcome of the WSSD 2002, the new Government of Tuvalu is committed to preparing a national sustainable development strategy. As part of the process of putting together this strategy, the government is planning a National Sustainable Development Summit sometime in 2003.

Having been aware of the dynamics of the Capacity 21 Project under the United Nations Development Programme (UNDP), and its significant contribution to the social and economic development and environmental protection in many developing countries, the Ministry of Finance, Planning and Industries of Tuvalu, made enquiries with the new Capacity 2015 Project, based in New York, for a possible partnership. On November 11, 2002, in response to Tuvalu's request, the UNDP engaged the services of a consultant to undertake an exploratory mission to Tuvalu, focused on helping the government to further develop its ideas for sustainable development, and in the process identify capacity needs. The consultant's terms of reference were as follows:

- (a) Meet and hold consultations with relevant stakeholders on Funafuti, the capital of Tuvalu – from Government, Local Government, NGOs and civil society and gauge local awareness and support for the need for local capacity building and national sustainable development strategies.
- (b) Consult with staff at the Economic Research and Policy Development Department in the Ministry of Finance, Planning and Industries on the National Sustainable Development Summit framework and make amendments as necessary to incorporate elements of the partnership with capacity 2015;
- (c) Prepare a Capacity 2015 Programme for the involvement in the National Sustainable Development Summit scheduled for mid-2003 and set out a broad framework for the implementation of a Partnership platform between Tuvalu and Capacity 2015 on local capacity building and sustainable development strategies.

This first draft of the report presents the findings of the exploratory visit, and makes a series of recommendations for consideration by the government. Based on the response from government and discussion with the UNDP Capacity 2015 programme, the report will be finalized. Part of that final report will be the proposed capacity building initiative to address vulnerability reduction/capacity building.

2.0 INFORMATION ACQUISITION

The information presented in this report is the product of an exploratory visit by the consultant during the period November 11th to 14th 2002. A list of persons interviewed is provided in Appendix A.

In addition to the interviews, national information sources reviewed included:

- *First National Communication Report to the Secretariat of the UNFCC*, Government of Tuvalu 2000.
- *Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid*, June 2002, Ministry of Environment, Energy and Tourism.
- *Tuvalu Waste Management Project Document – Australian Aid – Golder Associates*, June 2002.
- *Case Study: Water Management In Tuvalu with Special Emphasis on Rain Water Harvesting*, Filipino Taulima, Director, Public Works Department, Ministry of Public Works, Funafuti, Tuvalu, Pacific Regional Consultation on Water In Small Island Countries, Outrigger Hotel, Sigatoka, Fiji, 29th July –3rd August 2002.
- *Our Way Forward, Strategic Plan*, Tuvalu Association of Non-Governmental Organizations 2001-2004.

3.0 NATIONAL OVERVIEW AND FINDINGS

3.1 National Overview

Tuvalu consists of nine, low-lying small islands scattered over 500,000 square miles of the western Pacific, just south of the Equator. The islands include Niulakita, Nukulaelae, Funafuti, Nukufetau, Vaitupu, Nui, Niutao, Nanumaga (Nanumanga), and Nanumea. Tuvalu's highest point is just 16 feet above sea level, making it one of the lowest-lying nations in the world. The shoreline is surrounded by coral reefs and the atolls usually consist of a broken ribbon of land enclosed by a lagoon. The climate of Tuvalu is warm and humid throughout the year, with an average annual temperature of about 30° C (about 86° F) and average rainfall of about 3,000 millimetres. Tuvalu lies outside the conventionally defined major cyclone zone belt. However, during 1997, it experienced effects from three cyclones.

The country’s population is estimated at over 10,000 inhabitants who live predominantly on three, densely populated islands with sandy soils with limited plant nutrients. Typical of a low-lying tropical island, the country has limited fresh water resources. The vast majority of the population derives their potable water from rainwater by the use of rooftop water catchment system. There is no reticulated system of water distribution in the country. Distribution is via tanker trucks.

Two small desalination plants help to augment potable water supply. Wells are an important source of brackish water, but are vulnerable to pollution from surface debris and decaying organic matter as they are relatively shallow, generally six hundred millimeters in depth.

The major environmental problems are considered to be:

- sea level rise;
- poor and improper waste management;
- coastal erosion because of the use of sand for building materials, and;
- damage to coral reefs, including damage from the spread of the *Crown of Thorns* starfish.

The country has no known mineral resources and few exports. The basis of the national economy is primarily:

- Small industries: fishing, tourism, and agriculture – copra. In 1977, exports primarily to Sweden, Fiji, Iceland, Germany, and Greece earned AUS\$276,000 (fob). In 2000 exports mainly to Fiji and New Zealand earned some AU\$173,952 (fob).
- Remittances.
- Revenue from The Tuvalu International Trust Fund established in 1987 by Australia, NZ, and the UK and supported by Japan and South Korea.¹
- Revenue from Information and communication technology (dot com use of the “tv”. and international telephone).

The country’s GDP in 2000 was estimated at US\$1,100 per capita and an estimated labor force of 7,000 in 2001. The country’s major economic activities are:

- Subsistence farming (coconuts, taro) and fishing.
- Tourism - fewer than 1,000 tourists, on average, visit Tuvalu annually.
- Provision of off-shore and maritime crew.

The major sources of government revenue come largely from: the sale of stamps and coins and worker remittances; incomes from fishing agreements²; dividends from the Trust Fund, and; economic aid. The estimated government revenue in 2000 was AUS\$22.5 million which paid for AUS\$11.2 million of government expenditures and AUS\$7.2 million on the import of commodities: food, fuels, machinery, and manufactured goods.

The rate of economic growth and population growth in 2000 was estimated at 3 percent and 2.0 percent respectively. As with many developing countries, a major problem for the government is growing the economy at the required rate to create employment. As a result of this failure there is pressure for outward migration.

¹ As a result of wise investments and conservative withdrawals, this Fund has grown from an initial \$17 million to over \$35 million in 1999.

² The 1988 treaty on fisheries with the US government generated about \$9 million, a total that is expected to rise annually.

3.2 Findings

Tuvalu faces many challenges in its desire for sustainable development. From the standpoint of overall vulnerability, Tuvalu, the planets' second smallest nation, faces the world's most difficult challenges. Key among these challenges is its environmental and economic vulnerabilities. The small population base represents significant challenges related to economic scale. Consequently, there is currently very limited private sector capacity, leaving government with responsibilities usually allocated to the private sector in larger societies.

Sea level rise associated with global climate change is considered the reason for the ongoing loss of some of the country's atolls. Given the relatively low elevation of Tuvalu's land mass, significant rise in sea levels, as predicted in certain scenarios in the International Panel on Climate Change (IPCC) 2001 Report³ (see Figure 1), would significantly reduce the land surface of the country. A major consideration that has to be factored in planning for sustainable development of the country is the predicted increase in sea levels that could cause massive coastal erosion as well as swap much of the islands in the not too distant future (within the next fifty to a hundred years).

In 1997, the government adopted a strong stance on the need to control emissions of greenhouse gases in order to ensure the survival of low-lying island nations, which are threatened by rising sea levels.

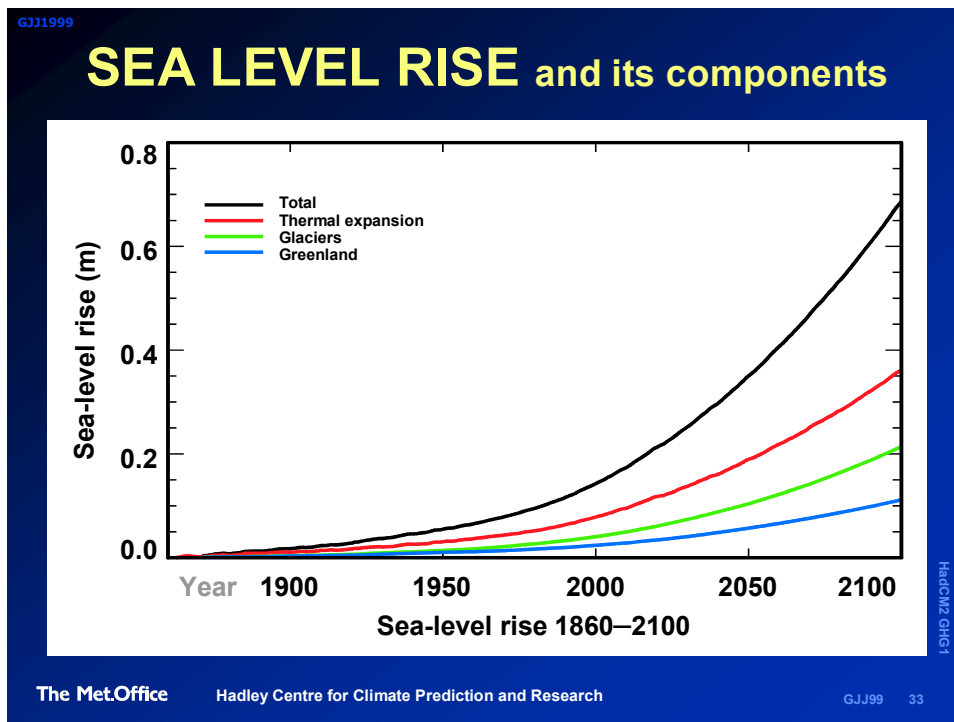


Figure 1 Sea level rise over time based on Global Climate Change (IPCC, Third Assessment Report, 2002).

³ The IPCC is an international group of scientist who are assessing the evolving consequences of the emission of greenhouse gases under the United Nations Framework Convention on Climate Change.

Based on the discussions during the exploratory mission, a number of key issues were identified as critical for the country to start reducing its growing level of overall vulnerability. Key aspects of the country's vulnerability, discussed during the visit, focused on the following areas:

- Energy Dependence
- Limited Fresh Water Resources and high dependence on rainfall
- High level of Food Dependence
- Very thin Economic Base
- Climate Change and Sea level rise
- Limited Institutional Capacity

3.2.1 Energy Dependence

One of the unique characteristics of Small Island Developing States is high energy cost, as shown in Table 1. High energy prices represent a constraint to the ability of SIDS to compete globally in the provision of goods and services. Prior to the establishment and coming into force of the World Trade Organization (WTO) and its new regime, SIDS, in recognition of these unique development challenges, received preferential treatment for their exports and were afforded tariff regimes that represented the fact that they were very open economies and had a very limited economic base to generate revenue for the government.

Combined with high interest rates, high electricity costs in SIDS is eroding the ability of many SIDS to compete in their local, regional and global markets. Failure to be competitive results in reduction of markets or worse, loss of markets. The loss of markets or inability to break into new markets because of high cost limits the opportunity for economic growth.

From the perspective of economic growth in SIDS, in a regime of increasing energy cost, is a very difficult challenge to overcome. A good example of this is the economy of Trinidad which dominates the manufacturing sector in the Caribbean region.⁴ Electricity prices in Trinidad are as low as US\$0.0040 per kilowatt-hour, whilst bigger populations like Jamaica continue to lose domestic and regional market share. Jamaica's energy costs are some three hundred percent (300%) higher than Trinidad. In the case of Tuvalu, where population size represents a major challenge to the development of successful economic ventures, high energy costs make that challenge even greater.

The life style that the populations of SIDS while differ in extent is similar to many aspects of that enjoyed by the developed countries, characterized principally by being highly dependent on petroleum based energy services for lighting, cooking, transportation, commercial and industry. However, the ability of populations in SIDS (like Tuvalu) to pay for energy is significantly less than the population in developed countries. Households in developed countries, despite utilizing significantly more electricity than those in SIDS, pay a significantly lower percentage of household income for energy services. This situation results from three factors - significantly

⁴ Trinidad has significant petroleum resources that comprise some 80 percent of its economy.

higher salaries, lower electricity rates, and more efficient use of energy. With lower incomes and higher cost for electricity, households in developing countries will be able to afford only limited amounts of electricity, thereby foregoing services like air conditioning and washing.

Table 1: International Electricity Prices for Household and Industry - - non-OECD Countries⁵

COUNTRY	HOUSEHOLD				INDUSTRIAL			
	1995	1996	1997	2000	1995	1996	1997	2000
Argentina	n.a.	0.111	0.139		n.a.	0.081	0.079	n.a.
Barbados	n.a.	0.151	0.167		n.a.	0.157	0.174	
Bolivia	n.a.	0.071	0.069		n.a.	0.080	0.077	
Brazil	0.142	0.146	n.a.		0.079	0.082	n.a.	
Chile	n.a.	0.133	0.121		n.a.	0.075	0.070	
Chinese Taipei (Taiwan)	0.096	0.093	0.089		0.076	0.073	0.069	
Colombia	n.a.	0.044	0.040		n.a.	0.088	0.080	
Costa Rica	n.a.	0.068	0.062		n.a.	0.095	0.089	
Cuba	n.a.	0.126	0.128		n.a.	0.079	0.072	
Dominican Republic	n.a.	0.084	0.082		n.a.	0.101	0.098	
Ecuador	n.a.	0.025	0.060		n.a.	0.055	0.065	
El Salvador	n.a.	0.082	0.082		n.a.	0.109	0.110	
Grenada	n.a.	0.193	0.193		n.a.	0.163	0.163	
Guatemala	n.a.	0.071	0.071		n.a.	0.096	0.097	
Guyana	n.a.	0.079	0.078		n.a.	0.105	0.104	
Haiti	n.a.	0.102	0.096		n.a.	0.098	0.103	
Honduras	n.a.	0.063	0.070		n.a.	0.084	0.089	
India	0.028	n.a.	n.a.		0.067	n.a.	n.a.	
Jamaica	n.a.	0.139	0.135		n.a.	0.106	0.105	
Nicaragua	n.a.	0.107	0.119		n.a.	0.101	0.107	
Panama	n.a.	0.121	0.121		n.a.	0.099	0.100	n.a.
Paraguay	n.a.	0.064	0.069		n.a.	0.052	0.040	
Peru	n.a.	0.146	0.138		n.a.	0.056	0.052	
Russia	n.a.	n.a.	n.a.		0.031	0.044	n.a.	
Slovak Republic (Slovakia)	0.031	0.031	0.029		0.052	0.052	0.052	
South Africa	0.050	0.045	n.a.		0.029	0.023	n.a.	
Suriname	n.a.	0.171	0.171		n.a.	0.131	0.131	
Thailand	0.084	0.086	0.074		0.068	0.074	0.061	
Trinidad and Tobago	n.a.	0.029	0.028		n.a.	0.024	0.023	
Uruguay	n.a.	0.154	0.157		n.a.	0.084	0.077	
Venezuela	0.031	0.017	n.a.		0.061	0.033	n.a.	

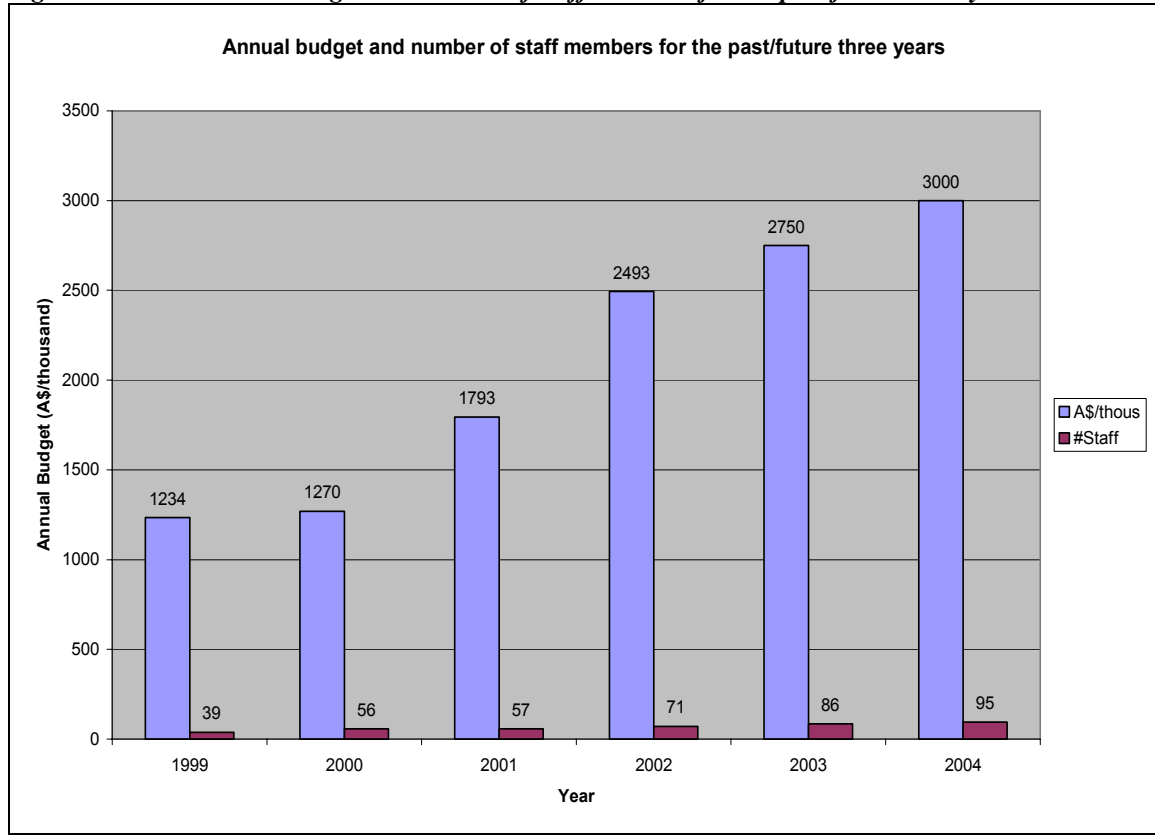
Like the vast number of SIDS, Tuvalu is dependent on importation of petroleum products for commercial and household services. Diesel and gasoline are imported for electricity generation and transportation. The small quantities and long transportation distances make for very costly energy services.

High fuel cost and the small scale of the electricity generation results in high electricity cost. Currently, electricity tariff is about AUS\$0.47/kwh for commercial customers and Aus\$0.30/kwh for residential customers. The significant difference in commercial tariffs represents in part, government subsidy. During 2002, subsidies to

⁵ Prices in U.S. Dollars per Kilowatt hour

Tuvalu’s Electric Corporation (TEC), the government-owned electric utility, was AUS\$1,200,000 (refer to Figure 2).

Figure 2 Annual budget and number of staff members for the past/future three years⁶



Approximately fifty-three (53%) percent of the cost of generating electricity is for fuel. The largest generating facility is located on the Island of Funafuti, with total available capacity of 1,139 kilowatts and current peak load of 700 Kilowatts. The importation of petroleum fuels represents the single largest foreign exchange recurring expenditure and consumes some 10 percent of the annual budget and an even greater percentage of the foreign exchange earnings. In 2001 the percentage of national budget that went to the importation of petroleum was 4.6 percent and the percentage of foreign exchange utilized was 25 percent.

3.2.2 Limited Fresh Water Resources

A major determinant of the quality of life for island populations is access to fresh water. Assessment of an island’s water resource is basis for efficient management and protection of this most important resource. Water supply on the various islands comes from a combination rainwater, well water and desalination of sea water.

Among the islands natural endowment is a very friendly climatic regime that brings fairly predictable and regular rainfall to the major islands. It is estimated that the

⁶ Source: The Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid, June 2002, Ministry of Environment, Energy and Tourism

island of Funafuti receives on average about 3000 mm of rainfall annually. There is no system of piped water distribution or wastewater collection. The absence of such wastewater collection systems and family scale production of livestock (pigs in particular) contribute to degraded ground water quality.

Water collection systems are at the household and institutional levels, however, government maintains capacity, including desalination facilities, to provide water to households and commercial facilities, especially during extended periods without rainfall (estimated about three to four weeks). There is a government recommendation for each household to have rainwater storage of about 9 to 10 cubic meters. Based on the 50 litres per person and four persons per household, such storage would be adequate enough for 20 to 25 days. Hence, three to four weeks without rain and water, availability problems begin. This situation is more frequent in the other two major islands that are further north and have less rainfall. As in the case of electricity, government also subsidizes the cost of water. Commercial operations are charged AUS\$44.00 per 5,000 litres and households are charged AUS\$15.90 for the same amount.

Based on the IPPC report, Tuvalu can expect changes in rainfall regime as a result of climate change that will further aggravate the existing water availability situation that is now considered a threat to public health and a constraint on economic development. Based on the cost of operating the current 10,000 litres per day desalination plant (electricity usage at the plant is about eight thousand five hundred kilowatts hour per month, costing about AUS\$4,000 and is one of the largest consumer of TEC), the country needs to make sure that it explores other options for providing fresh water.

3.2.3 Pollution from Waste

On the island of Funafuti, there are some 1000 households with an estimated consumption of 200 litres per day, which approximates to a daily usage of about 200,000 litres. Almost all of this wastewater is discharged into the ground water. The major societal impact of poor waste management is pollution of ground water resources. As with many small communities, awareness of the environment and health problems associated with improper waste management is bringing about changes, but there is still little enforcement of regulations. The overall responsibility for collection, in the case of Funafuti, is shared between the City Council and National Government.

3.2.4 High Level of Imported Food Dependence

Relatively high population density on the inhabited islands, low fertility, and poor water retention capacity of the sandy soils results in limited agricultural production and limited potential. The vast majority of agricultural activity is subsistence and focused on production of coconuts, taro and bananas. Local sources of protein come in the form of fish and pork.

All cereal (rice, wheat, etc) is imported, so too is the majority of dairy products and vegetables. All forms of bottled beverages, alcoholic and non-alcoholic, are imported. In 2002, it is estimated that AUS\$5,719,707 of food was imported to meet national needs. Importation of food is regulated by a 20-year-old statute that is now outdated

and provides loopholes for the importation of food that has expired shelf life or not meeting international standards.

The growing level of dependency on the importation of food and the difficulties the country has generating foreign exchange makes for increasing vulnerability of the country. The government of Tuvalu recently became a member of the United Nations Food and Agriculture Organization (FAO). As a member, the government can now seek technical support to help increase national agricultural production in order to reduce national vulnerability.

3.2.5 Very Thin Economic Base and Associated Challenges

Economies of scale prevent Tuvalu from having certain types of activities, as the local market is very small. Based on this, it is expected that the economy would be dominated by products from the natural resource base, in this case fisheries and the right for others to fish in the EEZ – which generates the major amount of revenue.

The remoteness of Tuvalu, in November 2002, is reflected in having only two international flights per week via Suva, Fiji. The two flights provide approximately 60 passenger seats per week, and if tourist arrival is to be increased there is need for improved airline transportation. The current airport and civil aviation capacity need to be upgraded. The current airport runway is structurally flawed and as a result is restricted to an aircraft load of 25 tons or less. There has been no Director of Civil Aviation for the past four years; this puts the country at a disadvantage in international negotiations.

With regards to maritime transportation, the Japanese government is providing assistance to Tuvalu to build a new wharf. The new wharf will facilitate a greater number of cruise ships, as well as general docking and inter-island traffic that is necessary to promote tourism development.

The national government is the main and predominant driving force for the economy, as the private sector is in its infancy. It is the single largest employer of labour (approximately forty percent of the annual recurrent budget goes for staff salary and benefits). The government also provides, at reduced cost or free, social services such as electricity, water, education, health care and drugs. The health services of the country are increasingly feeling the pressure of the limitations of available financial resources. Among the growing challenges that face the sector is coping with the:

- increasing rates of HIV/AIDS linked to Maritime activities, which is a major source of employment;
- increasing rates of Type 2 diabetes -- considered related to diets and the type and quality of food that is imported;
- increasing frequency of hypertension and heart disease -- also considered related to diets and the type and quality of food that is imported;
- increasing frequency of skin diseases, eg., elephantiasis (disease in which parts of the body, usually the legs, become greatly enlarged, caused by parasitic worms that block the flow of lymph) – resulting primarily from contact with the type of mosquito associated with poor waste management, and;

- difficulty retaining professional staff.

3.2.6 Climate Change and Sea Level Rise

“Providing us with capacity building, adaptation and other imaginative measures to mitigate climate change while refusing to institute domestic policy and political measures that will genuinely reduce global emissions is like treating us like the pig you fatten for slaughter at your eldest son's 21st birthday party.”⁷

Tuvalu's First National Communication Report established a range of adverse changes that are likely to be experienced in the future as a result of ongoing climate change resulting from the emissions of GHGs. Because of the government's very vocal position internationally, the majority of the individuals interviewed were aware of the issue. Most were able to identify the likely impacts of climate change in the future such as: more frequent tropical cyclones; more severe droughts; accelerating coastal erosion; salt water intrusion into soils and groundwater; more extensive tidal and storm surges; increasing sea level rise; bleaching of coral.

Based on the current state of the science, the increase in GHG concentration during the last century may, according to some scientific models, have set in motion an increase in sea level of about one meter over the next 50 to 100 years. Also of concern is the impact that rising seawater temperatures could have on the marine life, which is its principal commercial and subsistence resource. Temperature increases of 1-2 degrees Celsius would cause serious coral bleaching, substantially affecting the rich diversity of marine life that is the basis of their society.

As a low-lying group of island coral reefs, mangrove and sea grass play a critical roll in minimizing coastal erosion. This function will become of even greater importance with increasing sea level. In Tuvalu, as is the case with a number of SIDS, reefs, mangroves and sea grass beds are under pressure from pollution derived from the poor management of waste (solid and effluent).

Despite ongoing efforts such as demonstration of new techniques for managing the waste from the production of pigs (a popular subsistence activity), and the composting of waste material from plants to produce fertilizer, the country still has a long way to go in management of its waste in order to minimize damage to coastal defensive ecosystems. Systems that will be critically important are helping to address the erosive forces that will accompany sea level rise. Three islands have already disappeared, and flooding has become more frequent.

3.2.7 Institutional Capacity

“Our capacity to develop solutions to the chronic problems of basic infrastructures particularly for transportation, affordable energy, fresh water supply, health services, quality education as well as to improve institutional regulatory, financial and management frameworks, moreover, is highly limited due to the lack of financial and technical resources.”⁸

⁷ Tuvalu statement at the COP 6, The Netherlands, November 2000.

⁸ Tuvalu Statement at the WSSD, South Africa August/September 2002.

Capacity and Capacity Building

As pointed out in the UNDP/GEF CDI report “*Capacity Building in Small Island Developing States*,”⁹ there is limitation in capacity at the individual, institutional and systemic levels for the implementation of sustainable development. This is also the situation in Tuvalu. However, being the second smallest of the small islands among SIDS, the situation is even more pronounced. For example, in many areas, the size of the population makes it very difficult to retain certain types or levels of professional skills. Limited revenue limits the number of public sector employees. But, possibly most noticeable, as with nearly all developing countries, there is no framework for building the capacity for planning for sustainable development.

Regarding the nation’s education system - as with the vast majority of developing countries - the curriculum is biased towards white collar jobs covering mostly academic subjects. Under the proposed reforms from the National Education Forum, there is expected to be diversification of the curriculum and more emphasis will be placed on life skills. The education system consists of primary and secondary education. Tertiary education is pursued outside the country at the University of the Southern Pacific in Fiji, or elsewhere, based on scholarship availability. There is no strategic human resources development plan for training the professionals needed to address sustainable development in the country. The active recruitment of skilled professionals by the developed countries is impacting on the capacity of the country. Like many other SIDS, Tuvalu is experiencing significant brain drain.

The institutional capacity for sustainable development outside of the government lies with the Tuvalu Association of Non-Governmental Organizations (TANGO), an umbrella group comprised of a number of smaller NGOs located throughout the country. Although established in 1986, the activities of the organization, like so many of others in small countries, have been constrained by limited resources both financial and human and it has been within the last three years that activities have been ongoing. Many of the members of TANGO have little or no capacity. For example, Island Care, an environmental focused NGO established in 2001, needs physical space¹⁰.

The limited capacity of the NGOs in the environment area is such that frequently the NGOs have to depend on the government officer to provide technical advice. There is needed capacity to help develop new strategies as well as improve monitoring of the environmental conditions particularly on the other islands. A major challenge will be building capacity so that NGOs can become largely self-sufficient – this will require helping the NGO sector build capacity to generate income. Possibilities identified so far include production of dye from mangrove, production of compost, operations of community waste collection services, crafts and coral harvesting.

The major source of funding comes from AusAID and the European Union and support activities in school building, farming, and youth leadership. Based on its

⁹ Report Prepared for the UNDP by AI Binger, September 2000.

¹⁰ Given that the National Government will vacate a number of space when its new office building is complete Island Care may wish to dialog with government about availability of some of this space.

current activities, TANGO has identified a number of capacity building needs at the community level to support implementation of activities that include:

- Leadership training
- Monitoring and reporting
- Conducting and documenting outcome of meetings
- Research techniques
- Project management and proposal preparation.

3.2.8 Geography and Trade

The final elements of the nation's vulnerability are its geographical features and location. Among the features that results in vulnerability is the very low lying nature of the islands that makes for flooding from tidal action of a few meters in height, as well as from severe rainfall events. Poor soil fertility and limited land area represents other sources of vulnerability-related geographical features. Like a number of other Pacific countries, Tuvalu is isolated; this results in high transportation costs and limited access that adds to the vulnerability of the country.

The ongoing round of trade negotiations under the WTO and other regional regimes continue to benefit the larger countries and whilst being a disadvantage to the smaller ones. Totally dependent on global stability and trade, SIDS, including Tuvalu, need to work cooperatively with other small islands to ensure that their collective vested interests are protected, by specifically acting to:

- Preventing excessive tariff reduction – SIDS by nature of their economy, rely heavily on taxes on international trade to generate revenue. The WTO's effort to achieve extensive tariff reduction could, according to research by the UWICED research team, cause budget deficits. The WTO needs to be convinced of the necessity of granting more flexibility to SIDS, with regard to their tariff liberalization. In the forthcoming tariff negotiations, SIDS must not be required to make further commitments to reduce tariffs and to bind their tariffs beyond their trade, development and financial needs. Doing so would further increase economic stress and vulnerability.
- Lobby for holiday from the non-subsidy ruling in key sectors with new investment and the development of new industries to meet the internal needs in critical areas such as energy, potable water, fisheries and food processing. Justification of such a position would be based on the diseconomies of small scale, the dependence on imported technology and finance, the export concentration in single products and over-dependence on specific overseas markets, make the SIDS vulnerable to international trade shocks.

Large economies like the EU and US are allowed to keep subsidy schemes, based on arguing that it is necessary to protect the economically vulnerable workers (primarily in the agricultural sector). SIDS, being price-takers cannot influence the international prices of their exports to their advantage. They have to face wide fluctuation in prices accompanied by high inflation, volatile exchange rates and trade deficits. These contribute to massive losses of export earnings that are vital for their development. The export patterns of SIDS are so narrow in terms of

product coverage that their total value of exports remains insignificant in comparison with the total volume of exports of other countries hence they have little capacity to distort international trade. SIDS needs to maintain certain types of support measures that are crucial for them to pursue their economic and industrial development strategies.

- Special Market Access - In the forthcoming WTO negotiations on market access, SIDS need to seek more favorable treatment in terms of market access for the historical exports from the vast majority of SIDS. This special market access would remain until an agreed level of FDI is achieved. SIDS traditional trading partners should assist SIDS in ensuring that there is no further loss of preferential markets, and that mechanisms are established to help SIDS make the transition to other goods and services. Without this support there is a risk that not only these countries would be further marginalized, but also they may well jeopardize the multilateral trading system itself.
- Support for domestic industries – particularly those who are adding value to natural resources in an environmentally friendly manner and have the potential to provide sustained employment. Such industries are also most likely to be the ones on which future industries will develop helping diversification and minimizing vulnerability of SIDS economy although the WTO provides contingency measures to protect domestic industry in the event of emergency situation. These rules are complex, costly and law intensive and are therefore not easily utilized by SIDS. It is recommended that SIDS seek flexibility or policy space to be able to provide redress and/or support measures to industries important to their development strategies.
- State Trading Enterprises – SIDS are very active players in international trade depending on trade for food and most basic necessities. However, in some SIDS where domestic market size happens to be small, the private sector sometimes cannot be relied on for the import of basic commodities. Under such conditions government has to play this role. The WTO views this as trade distorting. As long as policies and laws do not exist to prevent private sector, such a ruling should not be applicable in the case of SIDS.
- TRIPS – the agreement for the protection of intellectual property imposes minimum but relatively high standards of protection and enforcement of intellectual property rights (IPR) which the SIDS must follow. The costs of adopting and implementing these IPR standards are extremely high for SIDS in financial and administrative terms. Further, the royalties on license fees, payable by SIDS, represent significant transfers to developed countries. It is recommended that SIDS be given assistance to strengthen their institutional and administrative capacities, both to implement their international obligations as well as to protect their own IPRs.
- International Transport – in view of their remoteness, geographical location and small size of transaction, international transportation constitutes significantly higher per unit cost than for larger countries. It is therefore recommended that the

international community develop special schemes and mechanisms to mitigate transport costs to these countries.

- Insurance and Re-insurance – based on their vulnerability to natural phenomena, the cost of insurance and re-insurance to producers/investors in SIDS tend to be relatively costly. It is recommended that the international community in partnership with SIDS explore options to mitigate the impact of these costs on the price of final goods and services.

4.0 ANALYSIS OF FINDINGS AND RECOMMENDATIONS

Tuvalu, which will celebrate twenty five years of independence on October 1, 2003, faces a diverse and formidable challenge to improving the quality of life for its estimated 12, 0000 inhabitants, as does any other country. The country is a group of nine coral atolls in the South Pacific Ocean, about one-half of the way from Hawaii to Australia. The country has no known mineral resources; the principal economic activities are subsistence fishing and farming.

Tuvalu's major natural resource is the ocean. Despite having only 24 kilometres of coastline, the country's exclusive economic zone (EEZ) is about 910,000 sq km (350,000 sq mi). The country's other major natural resource is renewable energy resources in the form of solar, ocean, and wind. Unfortunately, in the case of exploiting the ocean, the country has not yet developed its renewable energy resources and depends on diesel fuelled generators to provide electricity on Funafuti, and some of the outlying islands.

Each year, the country spends about fifty percent of its foreign exchange earning and grants on the importation of food and fuel, with exports only a fraction of merchandise imports (the country generates on average only 40 to 50 percent of foreign exchange requirement,¹¹ the remainder coming from grants, revenue from the Trust Fund¹², and remittances; the situation is described graphically in Figure 4.0, that shows the variation in the exchange rate for the last 6 years).

¹¹ In 2000, Tuvalu negotiated a contract leasing its Internet domain name ".tv" for \$50 million in royalties over the next dozen years.

¹² During the decade of the 1990s, based on the rapid expansion of the global economy, significant income was received from the trust fund established. Complemented by sound investments and conservative withdrawals, this Fund has grown from an initial \$17 million to over \$35 million in 1999. However, the down turn in the global economy will likely negatively impact the income to the government from the Trust Fund in the short to medium term. Additionally, and probably more worrying is that, demands on the funds for investments to address adaptation to global climate change and sea level rise will also minimize the fund's longer terms contribution to social services and investments.

Figure 3 Exchange Rates: Tuvaluan dollars or Australian dollars per US dollar - 1997-2002



The government is far and away the major employer, and employment opportunities are limited. However, in an effort to reduce its dependence on foreign aid, the government is pursuing public sector reforms, including privatization of some government functions and personnel cuts. Tuvalu is placed in a vulnerable situation when the pending impacts of sea level rise are added; this signals a need for urgent action.

Based on the success of other tropical islands, Tuvalu is also looking to Tourism to drive economic growth. To succeed, Tuvalu would have to attract significant foreign investment into improving international transportation access, increasing water availability, as well as in the development of tourism structures. Given the poor record developing countries have in attracting foreign investment¹³ and SIDS in particular that have attracted significantly less than 1 percent of FDI, this will represent a significant challenge and is unlikely to help in the short of medium term address the country's vulnerability. (The UNDP Human Development Report 2002, said that developing countries attracted FDI of 2.5% of GDP which was more than they get from Overseas Development Agencies {ODAs}).

Proposed project-based economic activities such as cereal milling will contribute to vulnerability reduction by improving food security, providing employment and reducing foreign exchange requirements. Development of projects to add value to coconut beyond copra could also make a positive contribution to reducing vulnerability through the production of other products including, feeds, energy and

¹³ Based on UNDP Human development Report 2002?? The vast majority of FDI went to less than twenty percent of developing countries.

fertilizer. The production of feeds and fertilizer would improve the potential of local agriculture. The energy provided would help reduce dependence on imports.

Overall, for the longer term, based on Figure 1, the greatest source of Tuvalu's vulnerability is climate change and sea level rise, associated with global climate change. The extent of the evolving threat raises the question as to whether under the projected weather regime and other likely consequences for the country from global climate change can a viable society exist beyond the next 50 to 100 years in the same geographic location? This report suggests strongly that the government consider this issue. This report strongly urges the government to adapt a strategy for economic development that is based on reducing vulnerability versus one driven by increasing the rate of GDP, in order to reverse the growing economic and environmental vulnerability not related to global climate change. All recommendations do, however, take into consideration climate change and sea level rise.

The key for vulnerability reduction is more effective and efficient use of Tuvalu's natural resource base through capacity building and partnerships to reduce the dependence on importation of energy sources and food, and to reverse degradation of its natural environment.

4.1 Possible Actions to Reduce Vulnerability

The remaining sections of the report list actions that are considered likely to reduce the vulnerabilities that now characterize the country. The recommended actions are organized by sectors, but in the majority of cases are inter-sectoral.

4.1.1 Reducing Energy Dependence

In the case of Tuvalu, a major requirement for reducing the country's vulnerability is getting the energy sector fully integrated into all sectors. Ongoing and planned projects such as the construction of a central office for all government entities in the capital, a new hospital and expanded wharfing facilities will increase the demand for electric energy. One of the most important decisions by the present government in this sector will be how it chooses to provide an estimated 1,690 kilowatts of new capacity over the next two to three years, and how this decision matches up with the country's desire to become less dependent on donor assistance.

As shown in Table 2, the different sources and technology used to generate electricity have significantly different costs and foreign exchange requirements and consequently the level of pressure on the natural resource base. The cost structures are also different for the production of energy. For example, diesel generators are relatively cheap in terms of capital investment, but uses very costly fuel hence electricity costs are higher. These options also vary in terms of scale and environmental impacts.

Based on the globalisation of financial markets and the withdrawal of major financing institutions such as the World Bank from power sector lending, one approach that will inevitably be recommended will be the privatisation of the TEC; after all, such an approach would be very consistent with reducing government employment, and attracting private investment. However, seen from the national goal of sustainable

development, or in other words vulnerability reduction (and the current situation with domestic subsidy and limited energy management capacity), this could be the worst option, given the experience with privatisation in small island states like Dominica, and St. Lucia. In these countries privatisation came ahead of capacity for utility regulations, thereby exposing these countries to increasing electricity costs.

Table 2 Global Energy Technology Options and Economics¹⁴

Technology	Percent growth per year	Operating Capacity end 1998, GW	Capacity factor, %	Energy production, 1998, TWh	Turnkey Investment Cost, US\$/kW	Current Energy cost of c/kWh	Potential energy cost, c/kWh	CO2 Emission Grams C/kWh
Biomass, Electrical	~3	40	25 - 80	160	900 – 3,000	5 - 15	4 - 10	
Biomass, Thermal	~3	>200	25 - 80	>700	250 – 750	1 - 5	1 - 5	
Wind, Electrical	~30	10	20 - 30	18	1,100 – 1,700	5 - 13	3 - 10	
Solar PV, Electrical	~ 30	0.5	8-20	0.5	5,000– 10,000	25 - 125	5 - 25	
Solar Thermal, Electrical	~5	0.4	20 - 35	1	3,000 – 4,000	12 - 18	4 - 10	
Large hydro	~2	640	35 - 60	2,510	1,000 – 3,500	2 - 8	2 - 8	
Small hydro	~3	23	20 - 70	90	1,200 – 3,000	4 - 10	3 - 10	
Natural Gas Combined Cycle, steam-turbine					445	2.91 – 3.24		91
Pulverised Coal, Flue Gas Desulphurization					1090	3.23 – 3.94		238

A more appropriate strategy could be based on private management with clear incentives for increasing efficiency of electricity generation and use, development of renewable energy sources, and co-generation

Despite significant renewable energy resource endowment, this resource is used primarily at the household level for cooking; the trend is, however, towards bottled

¹⁴ WEA 2000: Table 7.25, p. 266; Natural Gas & Coal from Table 8.4, p. 281; PWR: Ampere Commission, 1-7 and 1-9

LPG. A biogas project sponsored by AusAID, as part of the TWM, to help minimize pollution of ground water and threat to public health from waste generated during the domestic rearing of pigs, has the potential to demonstrate a technology that if socially accepted could make a major contribution to helping the country address aspects of its vulnerability resulting from its dependence on imported petroleum as well as disease and pollution resulting from poor management of waste.

Table 3 *Growth of electricity peak load, demand, TEC staff, and cost.*¹⁵

Year	Peak Load	Demand	# Staff	Cost (A\$/thousands)
1996	465	2,200,000		
1997	475	2,429,000		
1998	488	2,510,000		
1999	580	6,694,000	39	1,234
2000	633	2,829,000	56	1,270
2001	642	2,848,000	57	1,793

Biogas technology represents one of three energy production technologies that the Government needs to give serious consideration to as it formulates plans for reducing national dependence on imported petroleum as well as meeting its moral obligations under the UNFCC. The other two technologies are gasification of solid waste and coconut waste, and ocean thermal energy conversion (OTEC). Recommended actions by the government are as follows:

- **Increasing Efficiency: Undertake Energy Audit to Determine the Feasibility of National Demand Side Management Initiative**

Observations during the visit showed that there was significant opportunity for efficiency improvement in imported appliances and lighting. One component of the proposed energy efficiency program would consist of lighting focused on bringing about a transition from incandescent lighting to compact or regular fluorescent lighting. Implementing an efficient lighting program would reduce electricity generating requirement as well as reduce the amount of electricity used for lighting; for example, a household with five, seventy-watt incandescent bulbs that keeps them on for three hours per night would use about 34 kilowatt hours of electricity per month. Replacing the bulbs with 20-watt compact fluorescent, which gives the same amount of light, would reduce usage to about 10 kilowatt hours per month.

The other component would focus on the establishment of tariff structures so that importation of energy efficient appliances would be encouraged *vis a vis* energy inefficient appliances. The two proposed components of lighting and revised tariff structure on appliances would make significant impact on reducing electric energy consumption during the periods of peak electricity demand at around 2 pm and at 8 pm. In addition, this would help to reduce the 7 percent annual growth in electricity demand as well as meet obligations under the UNFCC convention. Possible sources of funding to plan and implement can come from the GEF small or medium size

¹⁵ Table prepared from The Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid, June 2002, Ministry of Environment, Energy and Tourism

grants, bi-lateral funding, UNDP energy partnership, UN Foundation, EU /SOPAC energy Partnership and private donor organizations.

An important benefit of increasing efficiency is that it will increase availability of present installed capacity, thereby extending the time before new installed capacity is needed. This would give the government additional time to make decisions.

- **Increasing Efficiency: Undertake Assessment of Co-generation for the Government Offices and Hospital**

The ongoing infrastructure development consisting of the government building, hospital and docks, as mentioned earlier, will create a demand for additional electricity for cooling, lighting, and motors. The cost at which lighting and cooling services are provided will depend on the primary source of energy chosen. If the primary energy source is petroleum, one option for meeting both types of energy services (electricity and cooling) based on petroleum fuel is co-generation technology. If the energy source is petroleum, then co-generation should be given first consideration.

Cogeneration is an energy system that generates electricity through the burning of fuel and then uses the waste heat to generate ice/cold water systems for central cooling. This technology would provide the cheapest means of providing electricity and cooling. In comparison, an electrical based cooling system uses electricity, not waste heat to generate cooling. As a result, larger power plants are needed and these facilities consume more fuel. The greater investment in the electricity generation and higher fuel consumption make for higher energy costs, compared to co-generation systems. For a comparative example, a combined energy demand of 8 megawatts consisting of 3 megawatts of electricity and 5 megawatts of cooling can be satisfied by either building a power plant of 8 megawatt capacity; or a cogeneration plant with an output of 3 megawatts of electricity and 5 megawatts of cooling using the waste heat from the 3 megawatts power plant as the principal energy sources.

- **Undertake evaluation of new energy technologies**

As pointed out earlier, in discussing the biogas technology, the following two technologies deserve serious evaluation by the Government as they have the potential to simultaneously address major contributors such as energy, water supply, environment protection and/or food security. Equally important they have the potential to reduce the foreign exchange requirement of the economy, while also creating employment.

- *Ocean Thermal Energy Conversion (OTEC), Wave, and Tidal*

The tropical ocean is one of the major resources of the small tropical island. The ocean provides many possibilities to provide energy for small islands that have yet to be commercialised despite the availability of very promising technology. The range of technologies developed makes possible the conversion wave motion, tidal action or current changes into electricity. One particular technology that seems worthy of considerations by Tuvalu is OTEC.

The OTEC technology has three basic systems classified as: Closed cycle; Open cycle and Hybrid-cycle. All three options require a coastal geography with sea shelves that have very steep gradients and reach a depth of a thousand meters with a few kilometres from shore. Through OTEC, energy in the form of electricity is generated by the thermal difference between the surface of the ocean and a depth of 1000 meters. Simply put, OTEC is the cycle in the air conditioner operating in reverse with an additional system to condense water. The key requirements for OTEC are the marine geography and constant surface temperature.

A 1987 survey of the Pacific islands for the potential for utilizing Ocean Energy, conducted by the International Center for High Technology Research (PICHTR), identified eight islands including Tonga as having potential¹⁶. Based on populations, economies, internal policies energy demands and projections and OTEC related cash-crop potential, it is quite likely therefore that Tuvalu could have similar potential, given the advance in technology that has happened in the last 16 years.

However, as pointed out in their report,¹⁷ OTEC technology remains unexploited despite its tremendous potential and a resource technology. OTEC hybrid systems technology developed by US and Japanese groups now provide the means to convert the solar energy stored in the ocean into a range of direct and indirect products such as fresh water, electricity, and protein. There are commercial companies that are actively seeking partnerships for the building of commercial plants in Small Islands.

To date, there is no commercial plant operating but, the government of Palau is proceeding with a plan to build three, small, 1 to 3 Megawatt plants within the next couple of years. The government of India is completing a 1 megawatt floating facility. Based on available technology in the mid-1990s, it is anticipated that a hybrid 1 megawatt system that also produces about 470 cubic meters per day of water, is enough to meet the demands of 20,000 people. The projected cost of electricity is between US\$ 0.11 to US\$ 0.19 per kilowatt-hour based on a thirty-year lifetime.

The source of energy from the ocean, whether through OTEC or other technologies such as tidal, wave or current, would significantly reduce the pressures on the economy arising from importation of petroleum. If the cost is equal or less than the current cost, it would help to improve Tuvalu's ability to compete in the global economy. Additionally, as it has no emissions it would help reduce the emissions of greenhouse gases, considered responsible for global climate change and sea level rise.

¹⁶ Vega, L.A., and Trenka A.A. A., Near markets potential for OTEC in the Pacific Islands, International Center for High Technology Research, Honolulu. Hawaii, 1989.

¹⁷ Takahashi, P ands Trenka, A. Ocean Thermal Energy Conversion, UNESCO. 1997

- **Gasification of Solid Waste**

Gasification is an elevated temperature process in which carbon rich material is converted from solid to gas. The actual technology system is relatively simple consisting of a metal vessel with a number of inlets and outlets, into which the material to be gasified is fed. To maximize the efficiency of the conversion of the material into energy, the metal vessel, called a reactor, is insulated to minimize heat loss. Within the reactor, the material is converted in a synthetic gas. Gasification technology is used in a number of countries in Europe, India, and the Philippines; Organizations such as the FAO and UNIDO are possible sources of assistance in assessing the appropriateness of this technology for Tuvalu.

This process makes it possible to convert a wide range of material into energy. In the case of Tuvalu, such a system could be utilized to convert plastics, rubber, paper and cardboards into energy such as hot water, electricity, and desalinating seawater. This technology would also be able to help address or provide an option for the disposal of certain types of hospital and hazardous waste such as used lubrications.

- **Solar, Wind Resources**

In order to determine the best future energy options for Tuvalu, there is need for assessment of the country's solar and wind resources. Until such an assessment is undertaken it will not be possible to make a judgement as to what would be the most ideal mix of energy sources and technologies that provide for security of supply and minimum contribution to economic or social vulnerability, in the future. Tuvalu's experience with solar and wind energy technologies is very limited. A previous attempt at a PV for lighting was unsuccessful. The Tuvalu Solar Electricity Cooperative Society (TSECS) implemented the project. The main reason given for failure of the project was related to the management capacity and the lack of skilled personnel in the area of solar energy. This poor management was further aggravated by the absence of a clear policy on renewable energy, which positioned the TSECS against strong competition from TEC.

• **Household energy**

The energy for cooking in households come primarily from biomass and bottled LPG. There are no viable options to biomass and LPG for cooking, however, the efficiency of use of the biomass resources could be improved; and currently, wasted material such as coconut shells and bows used as a supplement. This may require conversion to briquettes or charcoal.

Lighting services for household that have no access to electricity depend primarily on kerosene. Similar to cooking, there are no readily available options to kerosene. One option that could be considered is biogas systems such as that used by the Integrated Piggery Project, sponsored by AusAID. These systems generate a gas from the plant and animal waste that is used in many countries to cook and for lighting. As many households rear pigs as part of normal life, the waste from pigs along with garden waste is good raw material for use in the generation of biogas.

The high priority given to this technology by this report, although recently introduced into the country, lies at its scope. The biogas technology if accessed, to be appropriate and acceptable, this technology could make a major contribution to economic, social and environmental vulnerability reduction arising from the use of the natural resource base. Biogas technology which is used in many countries in Europe and Asia, all be it on a large scale, is considered as proven, and capacity to implement can be developed relatively easily compared to other renewable energy technologies.

The use of such systems on a community level would help to minimize environmental degradation and help protect fragile ecosystems. The government's best options for assessing and determining the applicability and contribution of this technology lies in the ongoing AusAID project that is now not being effectively monitored. This is based on its late implementation, which was related to issues relating to physical location of the plant. One of the main issues that need to be assessed is the cost versus the quantifiable benefits. The cost of the biogas systems for 100 pigs is estimated at AU\$20,000, however a significant portion of this cost is associated with the importation of skills and learning. This should not be interpreted as an indication that the technology is too expensive. Government needs to ensure that there is effective operations and monitoring as there are very important lessons to be learnt from this project.

The government should do its best to ensure that this project does not suffer the same fate as the pilot solar energy project, as this will give donors a negative attitude to assist the country with renewable energy projects which is the most abundant natural resource of the country. The Government also needs to ensure that capacity is built during the further implementation of this project. It may be worth considering having the members of TANGO more effectively involved in the project, as well as the National High School Science Curriculum.

- **Evaluate electric transportation**

Public demand for transportation is resulting in increasing numbers of motor vehicles. Given the small size of the islands, the country could pursue a transportation policy that makes the country a high per capita user of electric vehicles. The choice of electric vehicles (such as bikes and bicycles) would help to further reduce the nations vulnerability related to imported petroleum. In categories of motor vehicles such as motorcycles – battery powered¹⁸ motorcycles are equal in cost. As bikes are the major mode of transportation, a transition from one type of bike to another would make a significant contribution to reducing gasoline imports. Policy options such as differential tariffs on gasoline versus battery-powered cycles could be investigated for feasibility. Battery powered cycles would use electricity to charge batteries. Among the environmental benefits of battery-powered cycles are: they are silent; use no lubrication oil; and do not have any tailpipe exhaust.

Recommendations for Reducing Energy Related Vulnerability

Tuvalu's first significant decision, that will influence its level of future vulnerability, is the choice of energy systems to meet the increase in electricity supply that will

¹⁸ Battery made of nickel metal hydride can be recharged thousands of times before dying.

come about by the construction of new government offices, hospital and port. Based on the timetable, it is doubtful that it will be possible to do the assessments of the renewable energy resources to have a practical option to a petroleum fuelled facility. It is recommended that the government give priority consideration to co-generation systems.

For the future, best options for reducing its national vulnerability associated with dependence on importation of petroleum for essentially all energy services lies in capacity development, and where required technical assistance to assess and implementation actions in the following:

- Efficient Lighting Programme
- Demand Side Management Programme
- Development of renewable energy resources, particularly those that also address needs outside the energy sector should be given priority.

For the longer term, capacity needs to be built to help first evaluate the renewable energy resources to determine if this is a feasible option based on the current technology and the existing social and economic and political conditions. The guiding principles should be the integration of plans seeking to increase the availability of utilities and increase potential for food production. In this regard, the government of Tuvalu is urged to pursue options for the development of Ocean Energy Thermal energy Conversion (OTEC) with private sector companies in Japan and/or the USA.

- Ocean thermal energy conversion technology is able to utilize the low-grade thermal energy from the tropical ocean to generate electricity and desalinate water, without any environmental damage. This technology at the scale of 3-megawatt electricity plant would provide up to one million gallons a day of desalinated water. An OTEC plant of this size would meet all energy and water needs for Funafuti well into the future particularly if implemented in association with end-use efficiency programmes. This quantity of water would allow for significant increased shipping activity at the new port, as well as evaluating new areas for food production like hydroponics.
- The development of an OTEC plant could also be done so as to provide all the cooling requirement of the new hospital and the government building at a fraction of the cost of doing central or single unit electric powered cooling systems. Preliminary economic analysis show the total cost of fuel imports for electricity generation, appliances for cooling, the pending investment in an additional almost 2 megawatts of diesel turbines, and investments in additional desalination plant would pay off the full cost of a US\$25 million OTEC facility that would provide electricity, water and cooling in less than 10 years. An OTEC facility should have a lifetime in excess of thirty years.

There are various sources of funding that could be pursued to provide the resources to investigate the various recommendations these include: EU/SOPAC Energy Partnership; GEF, Bilateral Sources, Regional Development Banks, and UN agencies.

4.1.2 Increasing Water Supply and Availability

The country and Funafuti in particular, has a major water supply problem that requires urgent action by government. It is recommended that the following actions be considered:

- Complete an assessment of existing available water resources (quality and quantity), including identifying sources of likely or ongoing pollution including salt-water intrusion resulting from sea level rise. Assessment should also include the volume and condition of storage.¹⁹ This assessment will provide valuable data for planning better distribution of water during periods of water stress, as well as identifying areas where there is need for additional storage.
- Developing public education and outreach initiatives to support effective water conservation management, and to further promote proper waste management to minimize pollution and spread of diseases associated with contact with infected or polluted water.
- Feasibility of using the airport runway as a rainwater collector, both in its present situation and if upgraded for heavier traffic. This option is conditional upon a decision to upgrade the existing runway to take higher tonnage. As part of the design there will be the opportunity to evaluate the incorporation of storage areas.
- Develop capacity to facilitate the introduction of technologies on demonstration scale that would facilitate the following:
 - Water conservation programme – toilets and showers;
 - Feasibility of grey water from households as feed material for biogas community plants²⁰ ;
 - Production of medium-size plastic containers (9-10 cubic meters) to provide a locally affordable source.

Given the country's experience with desalination plants, which have proven to be operational and maintenance costly, it is recommended that prior to the government making any decision to add desalination plant capacity that thorough exploratory linkages and synergy with planned activities including the following be undertaken:

- Expansion and Upgrading of Port Facilities
- Increase in Tourist Arrival
- New Government Building
- New Hospital
- Installing Additional Electric Generation
- Upgrading of Airport Runway.

¹⁹ This would be expansion of the work done by Australian Agency for International Development for Funafuti Island to the other islands with the major islands first.

²⁰ One of the principal requirements for effective operation of biogas plant is adequate water.

- The population of Funafuti use and discharge more than 200,000 litres of waste water per day, that, along with effluent from pig rearing goes into the fragile ecosystem of the island polluting the sub-surface water and quite likely the coastal waters. Given this situation it is recommended that:
 - Government develop the institutional capacity to effectively monitor coastal water quality. This will require basic analytical capacity for microscopic examination, BOD analysis, and determination of elemental composition. This could be developed as part of the advanced science curriculum at The National High School.
 - Government undertake a technical assessment of the Piggery biogas project, sponsored by the Australian International Development Agency (AusAID). An assessment of the facility would help determine whether this technology has the potential to work at the community level, where it would provide an alternative approach to the use of septic tanks for the treatment of household effluent in a community. This facility could be used to build capacity for the development of a more advanced anaerobic treatment system of organic waste in order to minimize pollution. As discussed earlier, it is estimated that Funafuti produces more than 100,000 litres of waste water, this, combined with approximately 10 tons of plant organic waste could generate in excess of 20,000 cubic feet of biogas that could be used instead of diesel for electricity generation, as well as to desalinate sea water. In addition, about five tons of compost would be produced. Use of this material in farming would improve crop production by providing nutrients and increasing water holding capacity of the very porous sandy soils.
- Based on the June 2002 Golder and Associate Report on the Tuvalu Waste Management Programme (TWMP), it is estimated that on average, each household generates about 36 kg per week of solid waste. Of this, more than 70 percent was garden waste (biomass). One year into the implementation of the TWMP, there is marked improvement in the collection and disposal of solid waste. The Golder and Associate Report (GAR) list a number of successes and also lays out a series of recommendations²¹ for further improvements. In the majority of cases, the findings of this exploratory report support the recommendations, however, on the following issues there are other factors to consider that could lead to different approaches specifically:
 - Plastic material – the GAR report recommends the use of legislative tools, subsidies, and changes in import rules²² to address the waste disposal problem posed by plastics - this report suggests for government consideration the following, based on the reality that internationally, the use of plastics continues to increase. Tuvalu would find it very difficult to enforce any policy banning the use of any kind

²¹ See page 9 and 10 of the Golder Associates June 2002 report.

²² A principal suggestion is for imports to come in a larger container and then be repackaged in small containers made from reusable, recyclable material. Government would use tariffs to discourage importation of non-reusable or recyclable packing material.

of plastic. Plastics and other waste material derived from petroleum have very high per unit energy value. Partly as result of this there are a number of innovative technology ventures to develop products from used plastic material. A more simple option for Tuvalu may be to require, as in the case of garden waste, that plastics be placed into the non-biomass bin for collection and transport to the landfill. Upon arrival at the landfill, plastic material is removed for use as fuel, or recycling.

- Waste oil – there are two major sources of waste oil – the power stations, and motor vehicles – the volume of waste oil generated on Funafuti is about 420 litres per month consisting of 250 litres from the power company and 170 litres from motor vehicles primarily. The Golder Associates report recommends consideration of a dedicated oil waste burner linked to the power plant. Waste oil, like plastics, is also a petroleum-based product and also has high energy content. The suggestion for use of energy is supported, but the approach of linking it to the power plant should be reviewed within the larger context of a larger incinerator for disposal of the hospital waste that would require fuel, and no clear strategy for hazardous material disposal.
- Medical waste – based on the expansion to the hospital the GAR recommended that the present incinerator be used while putting in place plans for a larger incinerator in the next two to three years. The recommendation is very practical and logical; however, the government might want to consider gasification energy technology which provides an alternative to incineration when there is energy rich waste material available, as is the case with Tuvalu (for discussion of this technology and option see the section on energy).

These alternatives to the Golder Associates recommendations differ in that these recommendations seek to first, capture/recover the energy value of the waste material through the use of technology to provide products which in turn has the potential to be financially neutral or positive, compared to the disposal led approach that will continue to be financially negative requiring fees or government budgetary allocation. This difference is not surprising, for despite national commitment to sustainable development which is the basis of the alternatives recommended, problems are still approached and action(s) decided along predominantly sectoral lines.

- Sewage management is predominantly in the form of individual septic tanks, the vast majority of which were found to be not functioning effectively during the most recent audit.²³ Among the causes documented by the report are: absence of required inlet and outlet fixtures; capacity less than needed; improper discharge locations; poor construction and workmanship. The findings of the audit raises questions about the viability of this system as an effective means of protecting public health and the fragile ecosystem.

²³ Golder Associates Report, June 2002

This report supports the Golder Associates call for urgent action on the part of the Government to address the sanitation problems before there is a major public health problem that would seriously damage the fledging tourism development. Additionally, the Government needs to recognize that sea level rise is already affecting the country and that the principal defence against sea level rise and associated erosion is a healthy coastal ecosystem (reefs, mangroves, sea grass). The health of the coastal ecosystem is dependent on the quality of the environment; polluted ground water results in declining coastal environment quality, negatively impacting on the ecosystem. In the case of Tuvalu, degradation of coastal ecosystems will mean less coral reefs, mangroves, and sea grass that are the main protectors against coastal erosion.

4.1.3 Increasing Food Security

The changing life style and population growth are driving increased dependence on imported food products. The ability of Tuvalu to produce food is limited because of size and characteristics of the soils. Growing dependence on imported food represents a significant vulnerability for the country in two ways. First, is dependence on external production and generating the needed foreign exchange to pay for imports; second, the country is vulnerable to disruptions that could result in a range of factors from political unrest to unfavourable weather conditions in producing countries. It is recommended that government take necessary steps to develop individual and institutional capacity to use every square meter of land efficiently. This would include the following actions:

- Utilizing assistance from FAO and USP to build capacity and transfer technologies to use its agricultural resources more efficiently {including new brackish water for use by household and agricultural (food and feed) production}.
- Utilize assistance donor groups such as the FAO and IFAD to develop capacity for feed micro enterprise.
- Have the National High School develop capacity for the production of vegetables, herbs and spices using hydroponic technology.

4.1.4 Economic Diversification and Resilience Building

Tuvalu's economic vulnerability is a direct result on it dependence on a very narrow range of products and services for generating foreign exchange to pay for imports. As pointed out earlier, this situation is to a large degree a result of the economies of scale, economic diversification. Resilience building in the short to medium term will therefore have to be based primarily on:

- Developing niche export markets and services -- an example of ongoing efforts in this area is tourism development;
- Minimizing the outflow of foreign exchange – based on earlier discussions an example would be an energy efficiency program that reduces the amount of diesel that is imported; and
- Building capacity for sustainable development.

Economic diversification and resilience building in the medium to long term will be based on exploiting the abundant natural resources of the country, namely its marine and renewable energy.

- The report recommends the following niche market opportunities for the development of small scale industry based on coconuts:
 - Production of natural fibres for use in the automobile, construction, and furnishing industries.
 - Production of activated charcoal from the cup of the coconut for water purification.
 - Production of high quality edible oil, natural soaps, and animal feeds.

The United Nations Industrial Organization is a likely partner in helping to assess feasibility and building capacity in the above areas.

- For economic diversification and greater resilience in the longer term, it is recommended the Tuvalu Government pursue partnerships to develop technological systems that allow the country to capitalize on its main resources, i.e., ocean and renewable energy.
- Another critical need for diversifying the economy and resilience building is keeping the population healthy. In this regard, the report recommends a comprehensive public education and outreach programme to address:
 - Increasing rates of HIV/AIDS;
 - Increasing rates of Type 2 diabetes;
 - Need for effective personal hygiene, waste management and proper sanitation;
 - Increasing frequency of hypertension and heart disease; and
 - Prevalence of skin problems such as elephantitis.

The capacity for such a programme should be built nationally and should, if possible, be infused into the education curriculum to help improve dietary practices and food choices, sexual behaviour, and personal hygiene and waste disposal attitude.

- As some aspects of the population's general health is considered linked to the quality of imported food, it is recommended that the twenty-year old National Food Act be revised so that: labels on imported foods provide necessary dietary information and nutritional status; the entry of expired or near expired food into the country is prevented.
- Economies of scale and availability of professionals means that small countries will have difficulty retaining certain professionals. The conventional approach of replacement training has not proven effective, and the limited resources available dictate that different approaches be tested. This report recommends that government evaluate: the possibility of establishing a

partnership with other relatively close islands such as Fiji and Samoa, to access the possibility of a population-based health partnership that would provide visiting medical specialists in key areas such as Cardiovascular, Orthopaedics, Gynaecology and Paediatrics. A similar partnership could be evaluated for the purchase of drugs and medical equipment.

- A major challenge to economic growth in all small economies will be economic globalization. For Tuvalu, this will mean a series of negotiations ranging from economic to environmental matters.
 - In the area of International Trade, new rules to be negotiated start with issues of major importance to Small States such as tariff structures for imports, trade in services and brain-drain, preferential markets, and domestic subsidies. New rules such as environmental standards threaten to make exports from developing island states more difficult, requiring in some cases new technology. These global negotiations are further complicated by the regional trade agreements. It is imperative that Tuvalu develop effective capacity that allows it to contribute to the combined efforts of the SIDS in these negotiations.
 - In the area of Environment the challenges are equally daunting given the ongoing evidence of global climate change. As with the case of Trade, the country will have to develop effective capacity to participate in the delicate global negotiations related to the UNFCCC. As pointed out, the major issue that will have to be addressed is adaptation and responsibility for the cost.

4.1.5 Adaptation to Climate Change and Sea Level Rise

Addressing this key determinant of the nation's future will be done primarily at the international level. However, national level decisions will determine the moral high ground of the international negotiations. If Tuvalu remains dependent on petroleum fuels for its energy needs, it is very difficult to confront another who also depends on fossil fuels. Actions such as formulating and implementing a sustainable energy strategy for the future, based energy efficiency and renewable energy as recommended previously, would give added dimension to Tuvalu's position at the international negotiations, as the country would be showing that it is possible to do otherwise. From an economic perspective, this approach also helps reduce vulnerability, by reducing dependence on imports.

Other actions at the national level such those recommended earlier, that help ensure that the fragile coastal ecosystem is in best health so as to provide maximum protection to the shoreline, will help to minimize the level of investment that would otherwise be required later, in the hard engineering structure to help protect against coastal erosion. However, realizing high environmental quality of the coastal ecosystems requires the population to avoid actions that results in water pollution, such as improper disposal of waste, waste water, and sewage. Actions such as the physical removal of sand and other material from coastal areas should be prohibited by law, as it results in making the coastal areas more prone to erosion.

Experience from the Maldives showed that the cost of protecting coastal areas against erosion is very high. For example, building 1 kilometre of tetrapods to protect the capital, Mahlee, from erosion, is US\$4000 per meter. Tuvalu could, in the not too distant future, face such as decision if mining and sea level rise continues. In order to provide the material needed for construction, government should evaluate the feasibility of doing sand and aggregate mining on the islands that are be submerged by the rising sea level. Minimizing the negative impacts of climate change require the government to resolutely practice integrated planning at all levels, as well as making sure that the education system is producing graduates with this capacity in effective numbers.

Minimizing the cost of adaptation to climate change and sea level rise will require capacity to effectively negotiate in the international and regional arenas, and formulation of sound sustainable development polices that reduces economic, social and environmental vulnerability.

5.0 CONCLUSION

“What challenges us most is the lack of opportunities to develop our people’s ability in development let alone to integrate into the world economy”²⁴

At the present time, the country does not have all the necessary individual, institutional or systemic capacity to pursue the above recommendations. There will be need for a capacity building programme to support the recommendations that the government chooses to pursue. However, this is expected as there have only been limited initiatives focused on capacity building for implementation for Agenda 21 for sustainable development. The education system of the country consists of primary and secondary education, with a limited number of opportunities for tertiary education off shore

Based on the recommendations above, key areas for capacity building at the national level includes:

- Energy policy and planning;
- Energy management and technology;
- International Negotiating;
- Water resources assessment and management;
- Waste management;
- Integrated planning – that factor in climate change and energy considerations in every investment decision or policy;
- Institutional building (public and civil);
- Development of micro-enterprises, and;
- Agricultural techniques and practices, e.g., hydroponics.

Given the ongoing initiatives in areas such as the revision to the primary and secondary education curricula to include increased coverage of life skills, it is recommended that the revision also address the skills and capacity for

²⁴ Tuvalu’s statement at the International Conference on Financing for Development, Monterrey, Mexico, June 2002

environmentally sound management of the fragile resource base. The nature of the task will likely require an ongoing system of teacher retraining to achieve educational curricula that addresses the knowledge and practices necessary to ensure that the population has the wherewithal to coexist with the fragile ecosystems.

As only limited resources are available to support human resource development (HRD), government will need to put in place a framework for identifying priority needs. In view of limited resources, maximum use should be made on information and communication technologies.

The NGOs have very limited capacity, and for them to play their critical role, their capacity needs to be significantly improved. As a first step, the NGOs need to decide whether the nature of the activities to be promoted by them will be complementary and/or alternative to government. Given the social dynamics of small communities, the role suggested for NGOs is complementing government, and being a real partner in the vulnerability reduction and resilience building process.

There are certain advantages that NGOs enjoy as people organizations and this provides them with a foundation from which they can effectively implement at the community level. Government and TANGO need to enter into dialogue on how activities like waste management, potable water management, efficient lighting, development of micro-enterprises and promoting new agricultural practices to lessen dependence on imported food, and alternative cooking fuel programmes could be effectively implemented, and the required capacity developed. These kinds of activities provide both services to the community as well as reducing hazards.

Among the possible sources of funding that could be mobilized for national capacity building includes: National Assessment under the UNDP/GEF CDI; UNDP Capacity 2015; UN Foundation; and Bilateral Sources, accessible through the various focal points within the national government.

REFERENCES

- Golder Associates**, (June 2002). Tuvalu Waste Management Project Document – Australian Aid.
- Government of Tuvalu** (2000). First National Communication Report to the Secretariat of the UNFCCC.
- Government of Tuvalu** (2002). Statement at the COP 6, The Netherlands, November 2000.
- Government of Tuvalu** (2002). Statement at the International Conference on Financing for Development, Monterrey, Mexico, June 2002.
- Government of Tuvalu** (2002). Statement at the WSSD, South Africa, August/September 2002.
- IPCC** (2001). Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, United Kingdom
- Ministry of Environment, Energy and Tourism** (2002). The Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid, June 2002.
- Ministry of Environment, Energy and Tourism** (June 2002). Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid.
- Ministry of Environment, Energy and Tourism** (2002). Table prepared from The Project for Upgrading of Electric Power Supply in Funafuti Atoll – Application for Japan’s Gant Aid, June 2002.
- Takahashi, P ands Trenka, A.**, (1997) Ocean Thermal Energy Conversion, UNESCO.
- Taulima, Filipino** (2002). Case Study: Water Management In Tuvalu with Special Emphasis on Rain Water Harvesting; Filipino Taulima, Director, Public Works Department, Ministry of Public Works, Funafuti, Tuvalu. Pacific Regional Consultation on Water In Small Island Countries, Outrigger Hotel, Sigatoka, Fiji, 29th July –3rd August 2002.
- Tuvalu Association of Non-Governmental Organizations**, 2001-2004. Our Way Forward, Strategic Plan.

United Nations Development Programme/Global Environment Facility (UNDP/GEF) (2000a) Binger, Al, Douglas, Charles. "Assessment of Capacity Development Needs in the Context of the Priorities of SIDS," UNDP/GEF Capacity Development Initiative (CDI).

United Nations Development Programme. (2002) Human Development Report.

Vega, L.A., and Trenka A.A. A., (1989). Near markets potential for OTEC in the Pacific Islands, International Center for High Technology Research, Honolulu. Hawaii.

WEA (2000). Table 7.25, p. 266; Natural Gas & Coal from Table 8.4, p. 281; PWR: Ampere Commission, 1-7 and 1-9.

APPENDIX A

Capacity 2015 Partnership with Tuvalu on Sustainable Development Strategies and Local Level Capacities

Terms of Reference for Technical Assistance

Background

Following the Johannesburg Summit on Sustainable Development, the new Government of Tuvalu, having been established in early August 2002, is committed to apply the principles of sustainable development in guiding the development of Tuvalu from now on. Of priority concern at this point in the time, is the need to build on the existing local capacities in Tuvalu through the execution of sustainable development strategies right across all levels of the Tuvalu society – national government, local governments, down to the grassroots and the civil society at large.

In order to effectively apply the principles of sustainable development and to make them indeed meaningful to the lives of the people of Tuvalu, it would be useful to have an overall national sustainable development strategy in place. In this regard therefore, Tuvalu will very much like to apply the long term planning principles of sustainable development. The Government of Tuvalu is currently putting together a framework to hold a National Sustainable Development Summit sometime in 2003.

Having been aware of the dynamics of the Capacity 21 Project under the United Nations Development Programme, and its immense contribution to the social and economic development of many developing countries, the Ministry of Finance, Planning and Industries of Tuvalu made enquiries with the new Capacity 2015 Project based in New York, for a possible partnership.

The following Terms of Reference therefore is being submitted for the consideration of Capacity 2015, after having indicated a positive response to send a Technical Advisor to Tuvalu.

Terms of Reference

1. Meet and hold consultations with relevant stakeholders on Funafuti, the capital of Tuvalu – in Government, Local Government, NGOs and civil society and gauge local awareness and support for the need for local capacity building and national sustainable development strategies.
2. Consult with staff at the Economic Research and Policy Development Department in the Ministry of Finance, Planning and Industries on the National Sustainable Development Summit framework and make amendments as necessary to incorporate elements of the partnership with capacity 2015.

3. Prepare a Capacity 2015 Programme for the involvement in the National Sustainable Development Summit scheduled for mid-2003, and set out a broad framework for the implementation of a Partnership platform between Tuvalu and Capacity 2015, on local capacity building and sustainable development strategies.

APPENDIX B

List of Persons Interviewed

Honourable Saufafu Sopoaga
Prime Minister of Tuvalu
Office of the Prime Minister
Funafuti, Tuvalu.

Honourable Bikenibeu Paeniu
Minister of Finance, Economic Planning and Industries
Funafuti, Tuvalu

Honourable Otinielu Tausi
Minister of Home Affairs and Rural Development
Funafuti, Tuvalu

Mr. Paaniani K. Laupepa
Assistant Secretary for Environment, Energy and Tourism
Ministry of Environment, Energy and Tourism
Funafuti, Tuvalu

Mrs. Elenisi Malona
Senior Education Officer
Ministry of Education and Sports
Funafuti, Tuvalu

Mr. David Manuela
Director of Education
Ministry of Education and Sports
Funafuti, Tuvalu

Mr. Filipo Taulima
Director, Public Works Department
Ministry of Works, Communication and Transportation
Funafuti, Tuvalu

Mrs. Susan Tupulaga
Department of Waste Management
Ministry of Environment, Energy and Tourism
Funafuti, Tuvalu

Mr. Lancelot Panapa
Funafuti, Tuvalu

Mrs. Annie Homasi
Tuvalu Association of NGO's
Funafuti, Tuvalu
Mrs. Misalaima Nelesone

Final Draft

Secretary for Health
Ministry of Health
Funafuti, Tuvalu

Mr. Samuelu Laloniu
Assistant Secretary for Works, Communication and Transportation
Ministry of Works, Communication and Transportation
Funafuti, Tuvalu

Mr. Iefata Paeniu
Director of Marine
Ministry of Works, Communication and Transportation
Funafuti, Tuvalu

Mrs. Sunema Aunese
Economic Adviser
Economic Research and Policy Department (ERPD)
Ministry of Finance, Economic Planning and Industries
Funafuti, Tuvalu

Mr. Tapugao Falefou
Assistant Secretary for Finance, Economic Planning and Industries
Ministry of Finance, Economic Planning and Industries
Funafuti, Tuvalu

Mr. Letasi Iulai,
Senior Economic Adviser
ERPD
Ministry of Finance, Economic Planning and Industries
Funafuti, Tuvalu

Mr. Vila A. Fuavao PhD.
Sub-Regional Representative for the Pacific
Apia, Samoa

Mr. Solofa Uota
Secretary for Finance, Economic Planning and Industries
Ministry of Finance, Economic Planning and Industries