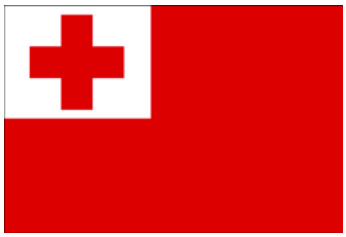

CDM PROJECT OPPORTUNITIES
TONGA

October, 2012

ACP MEAs

UNEP

UNEP RISØ CENTRE
ENERGY, CLIMATE AND SUSTAINABLE DEVELOPMENT

Cover photo: Household solar panel in Tonga. Curtsey to Tonga Energy Planning Unit.

ACKNOWLEDGEMENT AND DISCLAIMER

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ABBREVIATIONS

ACP	African, Caribbean and Pacific countries
ADFD	Abu Dhabi Fund for Development
CD4CDM	Capacity Development for the CDM
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO2e	Carbon Dioxide equivalent
COP	Conference of the Parties to the UNFCCC
DNA	Designated National Authority
GDP	Gross Domestic Product
GHG	Greenhouse Gas
JBIC	Japan Bank for International Cooperation
LDC	Least Developed Country
LOA	Letter of Approval
LON	Letter of No-objection
MEAs	Multilateral Environmental Agreements
MW	Megawatt
MWh	Megawatt-hour
NACCC	National Advisory Committee on Climate Change
PV	Photovoltaic
SIDS	Small Island Developing State
TERM	Tonga Energy Road Map
TERM-IU	Tonga Energy Road Map Implementation Unit
TJ	Terajoule
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollars (currency)

1. ABOUT TONGA

1.1. Location, Population, and Climate Conditions

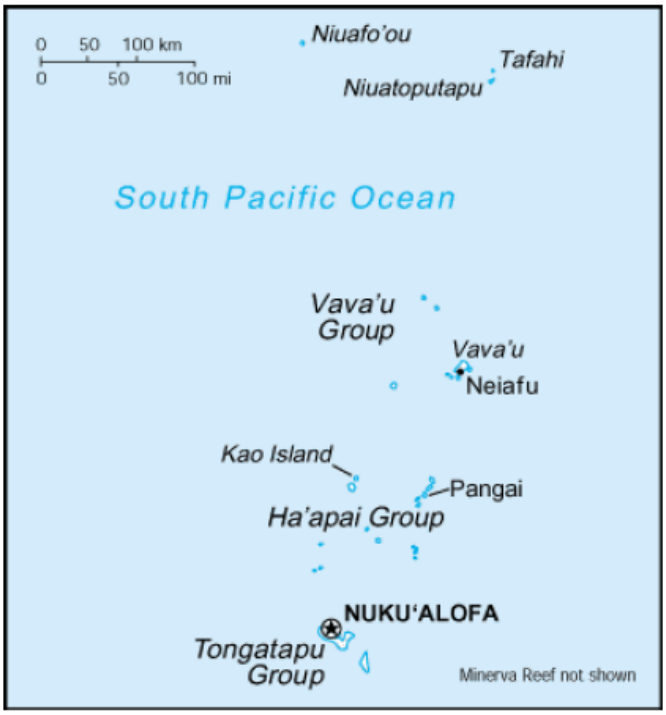

Figure 1: Map of Tonga

Location

Tonga lies between 15° and 23° 30' South and 173° and 177° West. It has a large sea area of 720,000km^2. It is an archipelago of 172 named islands with an area of 747km^2, of which 36 islands are inhabited with a total area of 649km^2 .Tonga consists of four clusters of islands extended over a north-south axis: Tongatapu (260km^2); 'Eua (87 km^2) in the south; Ha'apai (109km^2) in the middle, Vava'u (121km^2) in the north; Niuafo'ou and NiuaToputapu (72km^2) in the far north. Tonga's archipelago is situated at the subduction zone of the Indian-Australian and the Pacific tectonic plates and within the Ring of Fire where intense seismic activities occur.

Population

The 2006 population census of the Kingdom of Tonga was its sixth decennial census.Tonga is divided into five island divisions (Tongatapu, Vava'u, Ha'apai, Eua and the Niuas divisions) and within each island division it is further divided into districts for demographic purposes. According to the 2006 census, Tonga's population is 101,991 people, which distributed amongst 17,529 households. Tongatapu is the most populous

island division and has the highest population density. Its population totaled 72,045 in 2006, which accounted for 71% of the national total population, 15,505 people (15%) inVava'u,7,570 people (7%) for Haapai, 5,206 (5%) inEua, and 1,665 (2%) in the Niuas.

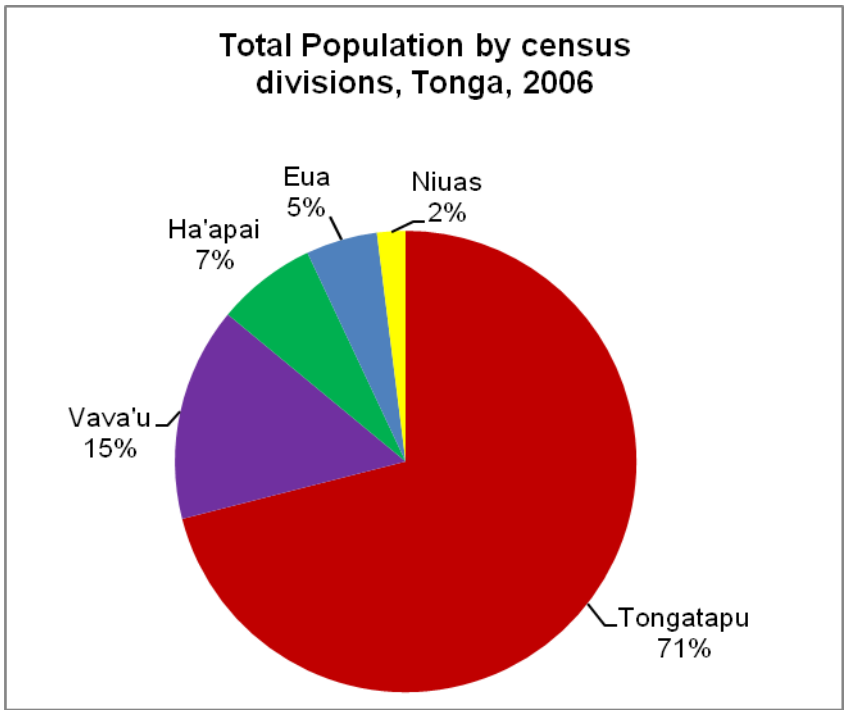

Figure 2: Total population by census divisions, Tonga, 2006

Climate

The climate of Tonga is warm and tropical. Tonga is warm all year round and can get hot in the summer, but seldom reaches above 35°C. Tonga lies within the south-east trade wind zone of the South Pacific. Wind speed over its surrounding oceans averages around 12 knots. Strong winds are not common except during tropical cyclone passages in summer (November –April) and gales from eastward migrating high-pressure systems during winter (May – October).

Temperature variations throughout the Kingdom show an increase in daily and seasonal variations with increasing latitude. Mean annual temperatures vary from 26°C at Niuafo'ou and Niuatoputapu (~15s) to 23°C on Tongatapu (~21s) with a diurnal and seasonal range of 6°C and 2°C and 6°C and 5°C respectively. During the Hot Wet Season (November- April), the average temperature ranges from 25 - 26^{0}C whereas at Dry Cool Season (May – October), the average temperature ranges from 21-24^{0}C.

Energy Supply

Tonga's energy sources are limited to indigenous sources, particularly biomass, renewable (solar, wind, waves) and imported petroleum products. Biomass accounted

for 26.8% and solar energy accounted for 0.1% while the imported fuel product provided the remaining 73.1% of the total energy supply.

Table 1 Energy Sources in Tonga

Energy Sources	Terajoules [TJ]	%
Indigenous Biomass	519.1	27%
Renewables [solar]	1.8	0%
Imported Petroleum	1,415.8	73%
Total	1,936.7	100%

1.2. Economic and Energy Profile

Key Economic Sectors

The Tongan economy's base is agriculture, which contributes 30% of GDP. Squash, coconuts, bananas, and vanilla beans are the main crops, and agricultural exports make up two-thirds of the Kingdom's total exports. The country has to import a high proportion of its food, mainly from New Zealand. The industrial sector accounts for only 10% of the country's GDP. Tourism is the primary source of hard currency earnings. The country remains dependent on sizable external aid and remittances to offset its trade deficit. The government is emphasizing the development of the private sector and especially encourages investment.

- GDP: $816 million (purchase power parity)
- GDP per capita: $7,500 (purchase power parity)
- GDP growth: 1.4%
- GDP by sectors:agriculture, 20.8%; industry, 18.1%; services, 61.1%.

Energy Consumption

Tonga is a small Island country. It is almost 100% dependent on imported petroleum for meeting its energy needs. In 2008 the country faced extreme hardships due to majorincreases in petroleum prices and import costs.

Electrification

According to the 2002 census report, nearly 80% of households nationally were electrified but no breakdown by island group was made available. However, it is assumed that this number has grown to around 90% (PREA 2004 Tonga National Report Volume 14) due to the remote island RE electrification programs hence RE electricity production in not included.

Tonga has a total electricity generation capacity of 12 MW in 2009, all of which relies on imported fossil fuel. The country has no oil refinery facility and all its fossil fuel imports are in the form of petroleum products. In 2011, the Kingdom's import of petroleum

projects is estimated at 445,665 barrels (CIA, WorldFactbook). Tonga's electricity consumption is estimated at 38.13 million kWh.

2. CLIMATE CHANGE

The Kingdom of Tonga like other Small Island Developing State (SIDS) is highly susceptible to the impacts of climate change and natural hazards due to its geographical, geological and socioeconomic characteristics. Tonga is also highly vulnerable to other extreme climate events including, for example, coral bleaching associated with high ocean surface temperatures and/or extremely low tides. The impacts of climate-related events are felt right across the nation's economic, social and environmental systems, thus making future changes in climate, including extreme events, an issue of great concern nationally. Coastal erosion is another critical environmental issue facing Tonga, partially as a result of sea level rise.

2.1. Climate Change and Greenhouse Gas Emission Reduction Project Opportunities in Tonga

Tonga is among the countries in the Pacific region that are most vulnerable to the risks of climate change, climate variability and sea level rise. The livelihood of people and economy are inter-woven, shaped and driven by climate sensitive sectors. The effect of climate and sea level change are already very real and pose a tangible threat to the future socio-economic well-being of Tonga. Climate change is likely to impact on all sectors that are pertinent to the sustainable development of Tonga. As a Least Developed Country (LDC), the country will be severely constrained financially and in terms of human and institutional capacity, to meet the challenges of this additional stress. For the people of Tonga, their livelihood and social structure are inextricably linked to the natural environment and its resource base. Any perturbations to this availability of natural resources will have a direct bearing on the poverty levels and the very survival of the people. Changes to the traditional social system, coupled with any decrease in food security and water availability, could lead to deterioration of social systems and law and order. Overall, the country is extremely vulnerable to natural disasters. Contact details for the Tonga's relevant government officials on climate change and greenhouse gas (GHG) emission reduction projects aregiven at the end this booklet.

2.2. Main Sectors for GHG missions

Obviously there is an understanding that the increase in the amount of GHGs being released into the atmosphere will have adverse effects on the global weather systems including that of Tonga. Under the UNFCCC convention, countries must communicate to the Conference of the Parties (COP) its national inventories of anthropogenic emissions of all greenhouse gases by source and sinks. In 1980, Tonga's total GHG emissions were equivalent to 27.26 Gg CO_2-e. In 1990, total GHG emissions have increased by 29.22 Gg (51.73%) to 56.48 Gg CO_2-e. Over the period 1991 to 2000, the average annual growth in overall emissions has been 5.04 percent. Fluctuations in the

trend are largely driven by emissions from the “Electricity Sector” category (Figure 3: Tonga’s Energy Sector CO_2 Emission 1980 – 2000). This category shows fluctuations because of the commissioning of the Ha’apai& ‘Eua Power Stations in 1983 and the increase of the generation capacity in late 1980s.

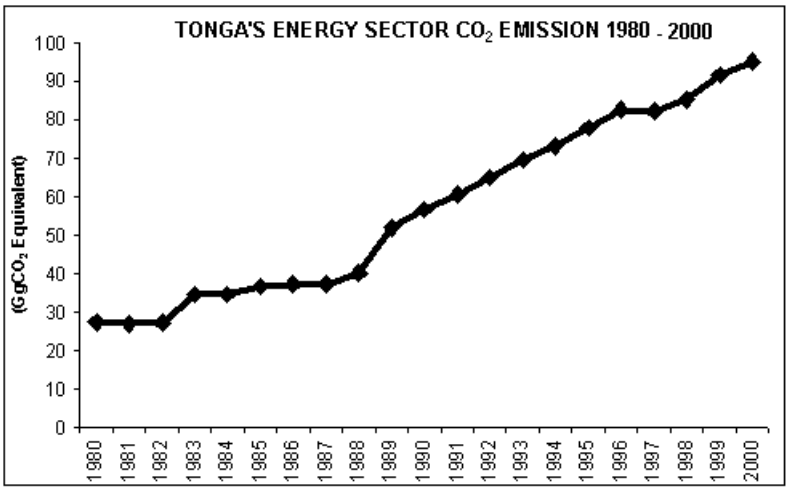

Figure 3: Tonga's Energy Sector CO_2 Emission 1980-2000

2.3. Tonga Energy Road Map (2010-2020)

Tonga depends almost a 100% on imported petroleum for its energy needs. In 2008 the country faced extreme hardships due to severe rise in cost of petroleum. The Tongan Government, in 2009, responded to the twin challenges of reducing the Tongan contribution to global Green House Gas (GHG) emissions and improving national energysecurity by approving a policy to supply 50% of electricity generation through renewableresources by 2012. From 2009 to 2011, the country implemented a project known as "Tonga Energy Road Map (2010-2020)" to identify strategies and plans for promoting renewable energy investment and use, improving energy efficiency, and converting waste into energy.

The country is making policy and legislation changes to improve the business conditions and providing incentives for investment in renewable energy, energy efficiency, and biogas capture and energy use project. These initiatives and efforts also provide supportive business environment in Tonga for investment in CDM projects.

2.4. Clean Development Mechanism (CDM) in Tonga

Kingdom of Tonga is classified as a non-Annex I country under the United Nations Framework Convention on Climate Change (UNFCCC). The country has ratified the Kyoto Protocol in 2001. The Government of Tongahas been actively participated in relevant training and capacity building activities on the CDM and carbon finance and shows strong interests in supporting the implementation of CDM projects and voluntary carbon market projects in Tonga. It has had some international discussions regarding the establishment of a CDM Designated National Authority (DNA) andthe Minister for Environment and Climate Change has been chosen to be the country's CDM DNA. The

DNA is proposed to be established in the Ministry ofEnvironment and Climate Change, with the National Advisory Committee on Climate Change (NACCC), an interdepartmental committee made up of senior officers from across government and mandated by the Council of Ministers, Government of Tonga as overseeing body to issue binding recommendations for the DNA when answering requests for issuing of Letters of No Objection (LoN) or Letter of Approval (LoA). The DNA Operational Guideline has been endorsed by the NACCC and is currently awaiting approval by Council of Ministers. Contact Details for the TonganMinister Environment and Climate Change, who is the national focal point for the UNFCCC, is provided at the end of this booklet.

3. POTENTIAL CDM PROJECT OPPORTUNITIES

Under the ACP MEA project, Tonga representatives had been invited to participate in the 5 regional CDM capacity building workshops in the Pacific. The country has also received some support to facilitate the establishment of a CDM DNA, and advising support for the formulation and adaptation of CDM project approval procedures and rules. In addition, three voluntary carbon market projects have been identified by the government. Local consultant and international consultant have developed Project Idea Notes (PINs) for three potential CDM projects to boost renewable energy development and use in the country. The PDD of one of these three projects is currently under development. The three PINs and one PDD are developed using the CDM PIN and PDD templates, so that the project proponents and investors have the flexibility to register these projects for CDM after Tonga formally establishes a CDM DNA.

These PINs are available for free downloading at the ACP MEA project website, www.acp-cd4cdm.org. Below is summary about these potential CDM and voluntary carbon market projects.

3.1. Popua 1MW Solar Farm

Background

Energy shortage is quite common in Tonga, which seriously lowers the living standard of local people and harms the socio-economic development of this country. The objective of the proposed project is to utilize solar energy for electricity generation. By providing 1,880MWh of electricity annually, the project will save 423,000USD per year through diminishing consumption of 470,000L diesel. The project is also expected to generate huge economic and social development benefits in the region, such as providing working opportunities, reducing greenhouse gas emission through replacing diesel generators as well as training skilled local workers and engineers for renewable energy industry in Tonga.

Figure 4 View of solar farm

Project Description

The Popua 1MW solar farm has been proposed as an important part of the Tonga Energy Road Map (TERM) 2010-2020. The power plant is located in Popua of Tongatapu, the Kingdom of Tonga. As the first grid-connected photovoltaic (PV) plant in Tonga and the second largest in Oceania, the project will be a milestone for the development of regional renewable energy industry and lead the trend in this field. The project is constructed by Meridian company from New Zealand and 9 million USD of fund has been provided by New Zealand's Ministry of Foreign Affairs & Trade Aid Programme. The electricity generation capacity is 1MW and the original annual energy output is about 1,880MWh, accounting for about 4% of Tongatapu's energy supply and saving 470,000L diesel. The construction cost is 11.8 million USD and the annual O&M cost is around 20,000USD for the first five years.

CDM Aspect

The project will displace the diesel fired power generation and reduce CO_2 emission significantly, thus mitigating the global warming and its adverse impacts of sea level rise. As a clean energy project, the proposed PV plant will almost not release any pollutant except some garbage produced by operators. After the 35-year operation period, the PV modules will be recycled thus no industrial waste will be left in Tonga.

Plenty of eco-social benefits will be offered to local communities, including:

- Greater access to electricity.
- Improvement of energy structure
- More work opportunities.
- Paving the way for further development of Tonga's renewable energy industry
- A milestone for the development of renewable energy industry in the South Pacific region

Project Schedule

The project is expected to be operational by June 2012. The first CER delivery is expected in 2013.

Contact Information

Tsutomu Nakao II
Tonga Power Limited (TPL)
PO Box 429
Nuku'alofa, Tonga
Telephone/Fax: +67628-525

3.2 500kW Photovoltaic Plant on Vava'u Island in the Kingdom of Tonga

Background

Electricity generation throughout Tonga is dominated by imported diesel. Moreover, only 30% of the total population on average has access on electricity.The objective of the project is to utilize solar energy in Vava'u for electricity generation, which will improve Tonga's energy supply and structure. The project is also expected to bring in economic and social development in the region, such as providing work opportunities, reducing greenhouse gas emissions through replacing diesel-based generators as well as training skilled local workers and engineers for renewable energy industry in Tonga.

Project Description

The 500kW solar photovoltaic (PV) plant scheme has been proposed as an important part of the Tonga Energy Road Map (TERM). The proposed power plant will be located in Vava'u, the Kingdom of Tonga.The proposed project will be constructed by Masdar Company from Abu Dhabi, the United Arab Emirates with a financial grant provided by the Abu Dhabi Fund for Development (ADFD). The project's estimated power generating capacity is 500kW and the expected original annual energy output is 695MWh, saving 180,990L diesel and providing 13.8% of Vava'u's annual electricity supply. The total cost for the project is estimated to be around four million US dollars.

Figure 5 Location for photovoltaic plant

CDM Aspect

The proposed project will displace diesel-based power generation, reducing CO_2 emissions significantly, thus mitigating the global warming and its adverse impacts on sea level rise.

Plenty of eco-social benefits will be offered to local communities, including:

- Greater access to electricity.
- Improvement of energy structure
- More work opportunities.
- Paving the way for further development of Tonga's renewable energy industry
- A milestone for the development of renewable energy industry in the South Pacific region.

Expected CER Generation and Project Schedule

The project annual expected Emission Reduction Credit generation is 531 tCO_2e/year and the total quantity for its 10-year crediting period (2014-2023) is 5,310 tCO_2e in the period.The project is expected to be operational by September, 2012. The first CER delivery is expected in 2013.

Contact Information

The project proponent is Tonga Energy Road Map Implementation Unit (TERM-IU), Kingdom of Tonga. The contact details are as follows:

Contact Person: Polly Dacre
Address: TERM-IU, PO Box 827, Nuku'alofa, Tonga
Telephone/Fax: +676 8494823

3.3 500+ 500kW Combined Photovoltaic and Wind Power Plant in the Kingdom of Tonga

Background

Electricity generation in Tonga is dominated by diesel, resulting in high electricity tariffs. Moreover, only 30% of the total population has access to electricity supply. Energy shortage is common in Tonga, which seriously constraints the living standard improvement of local people and harms the socio-economic development of this country. The objective of the proposed project is to utilize the plentiful solar and wind resources in this tropical island state to improve its energy supply and structure. The project is expected to benefit economic and social development in the region, such as providing working opportunities, reducing greenhouse gas emissions through replacing diesel generators as well as improving the skills and building experiences of local workers and engineers for renewable energy industry in Tonga.

Project Description

The 500 + 500kW combined photovoltaic (PV) and wind power plant scheme has been proposed as an important part of the Tonga Energy Road Map (TERM) 2010-2020. The project will be funded by the Japan Bank for International Cooperation (JBIC). The estimated annual output is 1,659 MWh, which can save about 432,000L diesel per year.

CDM Aspect

The proposed project will displace diesel-based power generation, reducing CO_2 emissions significantly, thus mitigating the global warming and its adverse impacts on sea level rise.

Plenty of eco-social benefits will be offered to local communities, including:

- Greater access to electricity.
- Improvement of energy structure
- More work opportunities.
- Paving the way for further development of Tonga's renewable energy industry
- A milestone for the development of renewable energy industry in the South Pacific region

Expected CER Generation and Project Schedule

The project's estimated annual emission reduction is 1,302 tCO_2e/year and the total CER output for a 10-year crediting period (2014-2023) is 13,024 tCO_2e.The project is expected to be operational by, 2013. The first CER delivery is expected in 2014.

Contact Information

The project proponent is Tonga Energy Road Map Implementation Unit (TERM-IU), Kingdom of Tonga. The contact details are as follows:

Contact Person: SiakalaTaumoefolau
Address: TERM-IU, PO Box 827, Nuku'alofa, Tonga
Telephone/Fax: +676 8494823

Photo: Ha'apai solar home system installation, EESLI project in 2009. Curtsey to Tonga Energy Planning Unit.

Tonga's Focal Point for International Cooperation on Climate Change

Mr. Asipeli Palaki
Chief Executive Officer
Ministry of Lands, Environment, Climate Change and Natural Resources (MLECCNR)
Address: PO Box 917 Nuku'alofa
Phone: +676-23-611/ 23-210
Fax: +676-23-216
E-mail: apalaki@gmail.com