Federated States of Micronesia

2010

Energy Policy

Volume I

Department of Resources and Development

Division of Energy

The Government of the Federated States of Micronesia acknowledges

the support of the European Union and the Asian Development Bank in

the development of this national energy policy.

Foreword

The FSM is fully committed to the mandates of sustainability.

This is most especially true when we talk about about energy, both in how it is acquired and how it is used. As a nation and as a people, we must remain focused on the broadening of the energy base and toward a reduction in our dependence on outside sources of energy. If we are to achieve the long-term goals laid out in our National Strategic Development Plan, the energy that powers our economic and social aspirations of self-reliance must be affordable, reliable and above all, clean.

Not only our people and governments, but our utilities – the very foundation of our fledgling economies – require that we proactively address the energy issue on a number of levels, especially for electricity and transportation. The rising cost of fuel, combined with the global economic recession has severely impacted the utilities' ability to provide reliable electricy. Add to this the rising cost of equipment and essential supplies needed by our four state utilities, and we can see the seeds of long-term financial insolvency of most, if not all of them.

This has a multiplier effect on the rest of society. Families and businesses all feel the crunch. This is why the time is now to improve operational and consumer efficiencies, working toward lowering fuel prices by all means possible, increasing revenues across the board, and perhaps most important, increasing our use of renewable energy when and where possible.

The challenges are great, but so too are the possibilities. They are numerous, and this Energy Policy – a first for the nation – is the tool by which we will move forward into an era of enhanced alternative energy use throughout society: in governments, in communities, at our schools and health centers, and within the private sector and business community.

I remain committed to leading the way; for the FSM to become a leader in the application of economically sound and technically proven alternative means; in the use of renewable energy, in the implementation of energy efficiency measures and in the promulgation of incentives and regulations that support these aims. We can and must make this happen.

Let us work together to make it a reality.

H.E. Emmanuel Mori
President

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ABBREVIATIONS

ACF	Advocacy Coalition Framework
ADB	Asian Development Bank
AMU	Association of Micronesian Utilities
BAU	Business as Usual
CNMI	Commonwealth of the Northern Mariana Islands
CPUC	Chuuk Public Utilities Corporation
DSM	Demand Side Management
EU	European Union
EEM	Office of Environment and Emergency Management
FSM	Federated States of Micronesia
GDP	Gross Domestic Product
GoFSM	National Government of the Federated States of Micronesia
IPIC	Infrastructure Planning and Implementation Council
KUA	Kosrae Utilities Authority
MDG	Millennium Development Goals
NEW	National Energy Workgroup
NGO	Non-Governmental Organization
NSAs	NonState Actors
PetroCorp	FSM Petroleum Corporation
PIC	Pacific Island Countries
PIREP	Pacific Island Renewable Energy Programme
PUC	Pohnpei Utility Corporation
PPA	Pacific Power Association
RMI	Republic of the Marshall Islands
RE	Renewable Energy
REP-5	Support to the Energy Sector in 5 ACP Pacific Islands (EU funded under EDF 9)

R&D	Department of Resources and Development
SBOC	Office of Statistics, Budget & Economic Management, Overseas Development Assistance & Compact Management
SDP	FSM Strategic Development Plan
SEW	State Energy Workgroup
SHS	Solar Home System
SIDS	Small Island Developing States
SOPAC	South Pacific Applied Geosciences Commission
SPREP	Secretariat of the Pacific Regional Environment Programme
SPC	Secretariat of the Pacific Community
SSM	Supply Side Management
T&I	Department of Transportation and Infrastructure (Pohnpei State)
TC&I	Department of Transportation, Communication and Infrastructure (FSM)
UN	United Nations
UNDP	United Nations Development Programme
US	United States of America
US DOE	United States Department of Energy
USDOI	United States Department of Interior
YSPSC	Yap State Public Service Corporation

PREFACE AND ACKNOWLEDGEMENTS

The leadership of the Federated States of Micronesia acknowledged the need for the development of a National Energy Policy and Action Plans that would assist the Nation in becoming less dependent on fossil fuel and more prepared to withstand the heavily fluctuating energy prices that nearly lead the FSM into a national emergency in 2008. The development of this national policy started in July 2008 when the nation's leaders endorsed a resolution during the Chief Executive Council meeting held in Kosrae State to develop a national energy policy and have national and state actions plans included. After this initial meeting, the State Governors selected the members of the respective State Energy Workgroups and the National Government established the National Energy Workgroup. During the first few weeks of the development of the energy policy, several workshops and consultations were held and a rough draft policy was presented to the President in July 2009.

After the draft was considered by the National Government and the four State Governors, the Energy Division of the Department of Resources and Development started a new round of consultations to the four FSM states. The final development of the policy with the various action plans started in January 2010 with as objective to have a policy ready for endorsement by May 2010, with workable and realistic goals and objectives for the National Government as well as for the FSM States. The policy contains two Volumes; Volume I covers the overarching policy, while Volume II contains the energy action plans. The development and finalization of the policy and action plans was completed with considerable effort by many people from the national government as well as from the four FSM states.

The efforts of the following individuals and groups are greatly appreciated:

- H.E. Emmanuel Mori, President of the Federated States of Micronesia, for his endless support and personal interest throughout the development of the policy;
- Governor Robert Weilbacher, Kosrae State; Governor John Ehsa, Pohnpei State; Governor Wesley Semina, Chuuk State; Governor Sebastian Anafel, Yap State, for their support;
- FSM Congressman Peter Christian, Former Secretary of the Department of Resources and Development for his wisdom, patience and strong support during the development of the policy;
- Director Andrew Yatilman, Office of Environment and Emergency Management;
- The European Union for assisting the initial development of this policy and the action plan through the 9th European Development Funds' REP-5 Pacific energy program;
- The Asian Development Bank for supporting the development of the energy policy;
- The private sector, state and national governments, College of Micronesia and NGO participants at a July 2008 workshop who actively and enthusiastically considered a wide range of strengths, weaknesses, opportunities and threats regarding energy issues in the FSM;
- The National and State Energy Workgroups who actively participated in the overall development of the policy and action plans;
- Mr.Maderson Ramon, former Asst. Secretary, Department of R&D, Energy Division for starting and supporting the development of the energy policy;
- Marieke Kleemans and Peter Konings for their guidance, and professionalism during the development of the national energy policy and action plans.

Marion Henry
Acting Secretary, Department of Resources and Development

CHAPTER I: INTRODUCTION

1. POLICY STRUCTURE

Chapter I provides a brief introduction on the structure and summary of the policy. Chapter II highlights background information of the FSM such as geography, economics and the energy overview. Chapter III contains the detailed policy framework. Chapter IV addresses the National and the State Action Plans. Chapters I to III are presented in Volume I while Chapter IV is presented in Volume II.

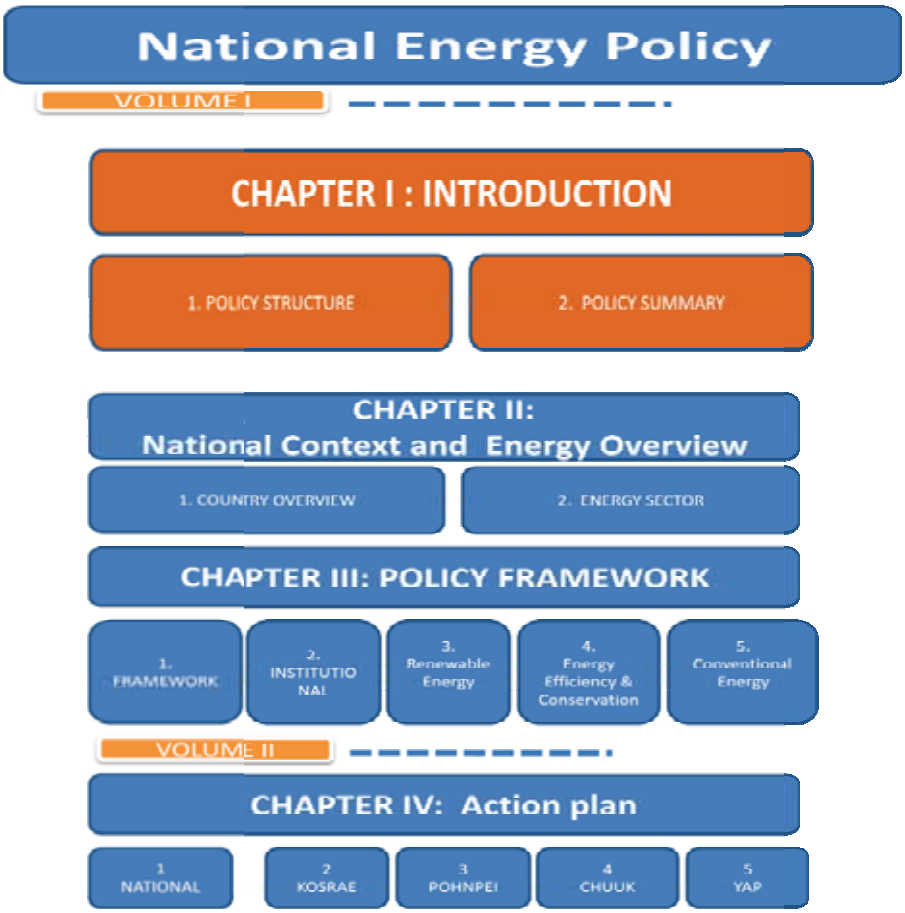

Figure 1: Structure of the policy

2. POLICY SUMMARY

2.1 GENERAL

FSM is highly dependent on imported petroleum fuels to sustain its economy. Petroleum fuels are used for both electricity generation and transportation with the former being the major user. In 2008, the FSM Petroleum Corporation (PetroCorp) was established in a combined effort to achieve greater economies of scale and currently serves all four FSM states; PetroCorp is a wholly government-owned enterprise. The impacts of the high fuel prices of 2008 have resulted in the rise in the costs of goods and services in FSM.

The Nation currently expends approximately 40 million dollars annually on imported fuel. This amount represents more than 50% of the aggregate sectoral grants that the Nation receives from the US Government under the Compact II Treaty, and nearly 20 percent of nominal GDP for the country, marking energy as a priority need and the most costly sector of its fragile economy.

Biomass in the form of wood and coconut husk products are used for local cooking and in most outer island communities, biomass is the primary energy source. Renewable energy sources are being introduced in the outer islands and in the State Centers. PV solar energy is being accepted as a sustainable and economically viable source of energy nationwide, while Pohnpei has hydro energy potentials; Kosrae is looking at wave energy; Yap is looking at wind power, and Chuuk at bio-fuels to broaden the nations' energy mix.

The Strategic Development Plan (SDP) for FSM provides a road map for social and economic development for the next 20 years (2004 – 2023). The SDP has four main objectives:

1. **Stability and Security**—to maintain economic assistance at levels that support macroeconomic stability. Achievement of *this objective required levels of funding close to prevailing levels to avoid the large periodic step-downs in funding that were a characteristic of the first 15-year funding package.*

2. ***Improved Enabling Environment for Economic Growth****—to be achieved through the FSM commitment to economic reform and the provision of an enabling environment to support open, outward-oriented and private sector led development.*

3. ***Improved Education and Health Status****—the third objective concerned the use of the annual Compact grants to support the provision of basic services in education and health.*

4. ***Assured Self-Reliance and Sustainability*** *—to be achieved through the establishment of a Trust Fund that would, after a period of time, replace the annually appropriated transfers from the US.*

Energy is an integral component of the SDP and this is clearly noted in all fourobjectives mentioned above, particularly when one considers abundantly available renewable sources. To achieve economic stability and security requires a vibrant energy sector, and the necessary energy infrastructure to promote economic and social development in both the State Centers and Out-lying Islands is of high priority. Equally, education and health services deliveries are contingent on the quality of energy infrastructure and services available.

The Energy Policy has been developed based on four primary components.

These are Policy and Planning, Conventional Energy (fossil fuel), Energy Efficiency & Conservation, and Renewable Energy.

Within these main components the policy seeks to achieve these goals:

1. An effective, coordinated, resilient and dynamic joint State and National energy sector;
2. A safe, reliable, cost-effective and sustainable energy supply;
3. An efficient, responsive and competitive energy sector;
4. A diversified energy resource base, creating a balanced energy mix; and
5. The environmentally sound and efficient use of energy.

2.2 VISION STATEMENT, OBJECTIVES AND GOALS

The **National Vision** statement for Energy is:

To improve the life and livelihood of all FSM citizens with affordable, reliable and environmentally sound energy.

The **National Objective** for Energy is:

To promote the sustainable social and economic development of FSM through the provision and utilization of cost-effective, safe, reliable and sustainable energy services.

Whereas energy services refer to work relating to the sale, supply, storage and distribution of energy.

The **Major Goal** of the Policy is:

To become less dependent on imported sources of energy by having (1) an increased share of renewable energy sources and having (2) cross-sectoral energy conservation and (3) efficiency standards in place; and therefore,

By 2020 the share of renewable energy sources will be at least 30% of total energy production, while energy efficiency will increase by 50%.

In addition, the following broad goals relate to energy services in the FSM:

- Provision of affordable and safe electricity to all the households in the main island centers by 2015
- Electrification of 80% of rural public facilities by 2015
- Electrification of 90% of rural households by 2020
- Enhance the supply side energy efficiency of the FSM utilities by 20% by 2015

2.3 OVERALL ASPIRATION

In line with the above stated objective, vision and major goal, the National Energy Policy has indentified the following focal areas:

- **Disadvantaged and/or Geographically Remote Communities**

- Encourage the application of appropriate support and incentives to enable disadvantaged and/or geographically remote communities to access affordable energy.

- **Capacity Building**

- Improve adequate and institutional capacity to plan, manage, and develop the energy sector by providing appropriate energy-related training opportunities at all educational and professional levels.

- Accelerate research and development of energy technologies that are appropriate for adoption within the nation and facilitate international transfers of appropriate technologies that the nation is capable of operating and maintaining.

- Assess and promote indigenous resource potential and technical capacity for all aspects of energy sector planning and development.

➢ **Public Awareness**

- Increase training and public awareness on renewable energy and fuels for vehicles, energy efficiency, and conservation through publicity campaigns and school curricula.

➢ **Private Sector Involvement**

- Enhance public-private partnerships and expand private sector participation, investment, ownership, and management for energy supply including electricity generation, transmission and distribution with job creation in mind.

- Establish an enabling and competitive environment for the introduction of independent energy providers where these may provide efficient, reliable, and affordable service to consumers.

➢ **Community Level initiatives**

- Promote involvement and input from non-government organizations and local communities, including youth and women, in policy implementation and integrated planning.

CHAPTER II: NATIONAL CONTEXT AND ENERGY OVERVIEW

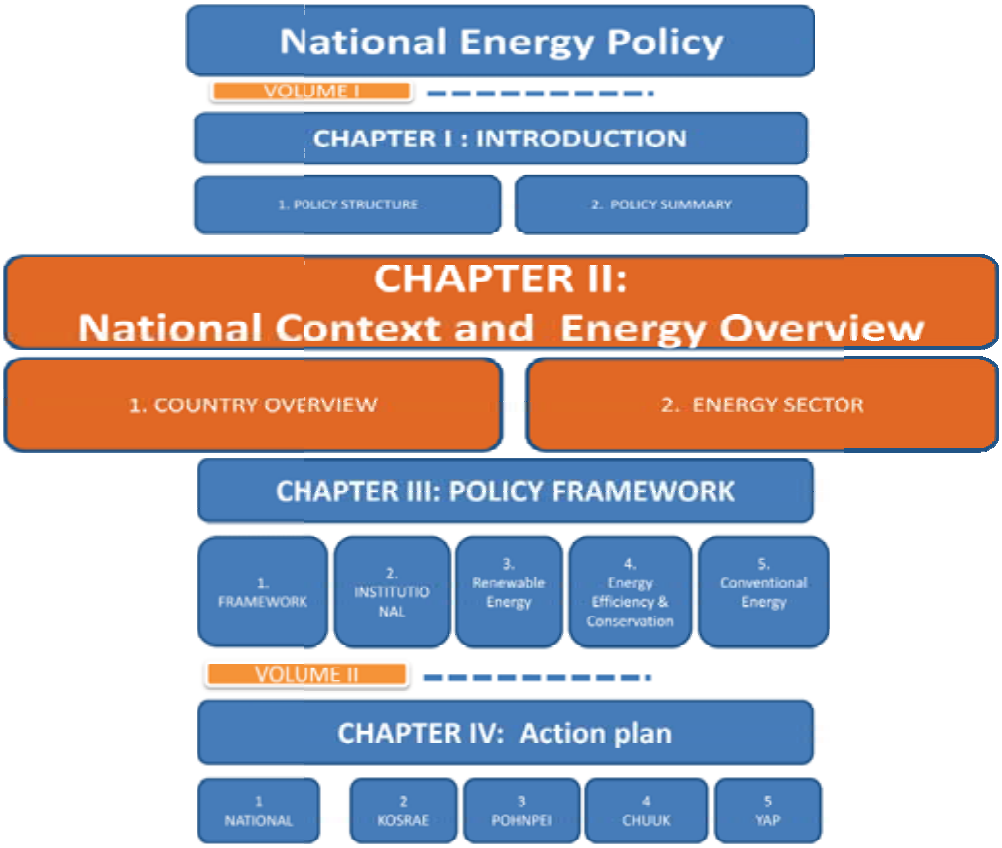

Figure 2: Structure of the policy

1. COUNTRY OVERVIEW

In 1986 the Federated States of Micronesia was created and gained independence from its former administrator, the United States. Five years after the birth of the nation, the FSM joined the United Nations in 1991 (GoFSM, 1997).[1] From west to east, it stretches about 2,700 kilometers, and is located in the western Pacific Ocean between the equator and 14 degrees North latitude (**Figure 2**). With a total population of 107,000, there are four states in the FSM – Yap, Chuuk, Pohnpei and Kosrae. Each State maintains considerable autonomy for their own development strategy, while the national government provides an integrated prospective and vision, which is described in the FSM National Development Plan (GoFSM, 1997). Except for Kosrae, each state consists of a State center, which is often the largest island, and a multitude of outer islands. The FSM has a total of 607 islands, 74 of which are inhabited.

[1] This section builds heavily on GoFSM, 1997

1.1 GEOGRAPHY

The islands in general can be categorized into two types of landscape. The state centers of Pohnpei, Chuuk Lagoon and Kosrae are high volcanic islands with steep and rugged uplands. Most outer islands and the State center of Yap are low coral atolls and characterized by gently sloping uplands surrounded by swampy lowlands. Due to agro-forestry or secondary vegetation, the natural upland forests, which once covered the islands, are disappearing fast.

Today, sizeable forest areas can only be found on the islands of Pohnpei and Kosrae (GoFSM, 1997).

Inside the Exclusive Economic Zone (EEZ), the marine area of the FSM, which accounts for over 2.6 million square kilometers, has abundant and diverse resources. While the nation consists of 607 islands, its land area totals only 701 square kilometers. Besides the natural environment, cultures also vary considerably between islands. After thousands of years since the settlement of the islands, there are significant environmental and cultural differences involved even within the four states of FSM. It is thus that the natural environment and especially the marine and the land resources have a profound and vital influence in shaping the physical and cultural life of the inhabitants (GoFSM, 1997).

Figure 3: Map of the Federated States of Micronesia

1.2 DEMOGRAPHY

Between 1989 and 1994, FSM has experienced an internal migration. With a 10 percent increase in total population during this period, the population share of Pohnpei, where the capital is located, increased by 13 percent, as people immigrated to seek economic opportunity. On the other hand, Kosrae's share of the population only increased slightly, by 4 percent. In spite of the internal movement, the overall population structure of FSM remains the same, and the population of FSM remains one of the youngest in the region, with almost 24 percent of the population under 24 years of age. Similar to other parts of the world, the median age of the population has increased, rising from 16 to 18 over the last 30 years. The average population density in 1994 was 150 persons per square kilometer. However, this overall figure might be misleading, as the population density varies considerably across the nation, ranging from 418 per square kilometer in Chuuk to a low of 63 per square kilometer in Kosrae (GoFSM, 1997).

1.3 CLIMATE

The FSM has a typical tropical climate: stable temperature, high humidity and high rainfall. The temperature averages between mid 20 and 30 degrees Celsius, while the humidity is on average over 80 percent. Rainfall is in general high, but varies geographically, with a low record of 3 meters on drier islands to over 10 meters per year in the mountainous interior of Pohnpei. As with many tropical islands, there is a wet season (June to October) and dry season (November to May) in FSM. Occasionally, the western region of the country suffers from typhoons (one in 20 years return period), which can cause serious damage to the region such as landslides and devastation of vegetation, buildings and infrastructure (GoFSM, 1997).

1.4 ECONOMY

The FSM is a small and domestic-based economy with a market of 107,000 people (SBOC, 2009) with modest income (GoFSM, 1997). The Nominal Gross Domestic Product of the FSM in 2006 was $236.9 million. Per capita GDP for 2006 was $2,194. The trade balance has remained highly negative since 1997. In 2005, the trade balance was estimated at negative $117.2 million, an equivalent to 50.5 percent of GDP (DoI, 2006, pp. 198).

The economy of the FSM is mainly determined by agriculture, including fishing and every related aspect to this (such as the lease of fishing rights to FSM waters), government employment and tourism. In the period 1997-2005 the number of visitor arrivals grew with almost 10 percent. In 2005, 18,958 people visited the FSM. Most of the visitors were from the US and Japan, about 40 percent and 17 percent, respectively, in 2005 (DoI, 2006, pp. 198).

The infrastructure is under-developed and cannot meet the demands of the growing population and the condition of the infrastructure is poorly maintained due to severe limitations on the availability of government local revenue funds (GoFSM, 1997).

SECTORAL DEVELOPMENT

Except for the offshore fisheries, there limited resources in the FSM. Except for the wholesale/retail and service industries, the private sector is under-developed and the FSM has a large external trade deficit. The country is very dependent on external aid and on the public sector for providing jobs and government expenditure. In the FSM National Development Plan (SDP), the government acknowledged the distinct dichotomy between the cash and traditional economies (GoFSM, 1997). The commercial sector is characterized primarily by small businesses, with only a few larger public companies, co-operatives and credit unions. Most of the family-based businesses focus on commercial import/export, wholesale and retail business. Alternatively, the families might also engage in small service enterprises, such as restaurants, taxis, car rentals, repair and maintenance, etc. Only a few have ventured into the industrial sector (GoFSM, 1997).

Thus the FSM economy is dominated by the public sector as the primary sector of economic activity. The government provides one third of total employment, while the agriculture and fisheries industries together account for 28 percent of the jobs.

14,400 persons are estimated to be involved in the cash economy, and half of them are engaged in the public sector, mainly operating public facilities, engaging in construction work (through government infrastructure projects) as well as supporting community services. As the public wage in general is considered to be significantly higher than the comparable work in the private sector, this has suffocated the entrepreneurial growth and technical skills development which could in fact help to increase the efficiency of production and export service sectors of the economy. The scattered consumer markets and the lack of adequate transportation infrastructure have contributed to the minimal trade between states. Agricultural products are the primary goods traded within FSM, as well as for export, with sakau (kava), betelnut and citrus being some of the primary products (GoFSM, 1997).

FINANCIAL TRANSFERS FROM THE US

Economic development in the FSM needs to be analyzed in the context of the Compact Agreement with the United States, as it is heavily dependent on the financial assistance provided under the Compact of Free Association (DoI, 2006, pp. 198). The Compact since 1986 has provided large external financial transfers to support the operations of the Government of the FSM and substantial public sector investment at the State level. Compact economic assistance, initially meant to last 15 years until 2001, was characterized by reductions in grant funding of 15 percent after 5 years and 22 percent after 10 years. Transfers were partly indexed to United States' inflation, resulting in an overall average real decline in resource flows of 4 percent per year. The Compact was extended for a further two years through fiscal year 2003 during renegotiations (DoI, 2006).

The Compact was designed to assist the FSM with infrastructure and development of its economy. Infrastructure development had been successful but the development of a self sustaining economy had only very limited success. Roads, electric utilities, harbors, airports, schools, hospitals and public facilities were all constructed during the 15 years of Compact I. Kosrae, Pohnpei and Yap have maintained their facilities in a responsible manner and have expanded their facilities. Chuuk has not performed as well (DoI, 2006, pp. 198).

In 2003 the United States and FSM entered into an Amended Compact II agreement, wherein FSM receives payments of $92.7 million per year from the United States with $76.2 million being in the form of grants and $16.0 million to be placed in a trust fund and $500,000 allocated each year for an annual audit. The trust fund is expected to increase and become a permanent interest-bearing fund such that after Compact II expires in 2023 the trust fund will provide the same level of income available to FSM as the present Compact II (DoI, 2006, pp. 198). However, current financial trends indicate that the FSM Trust Fund will not provide such funding required after 2023, when the current Compact ends.

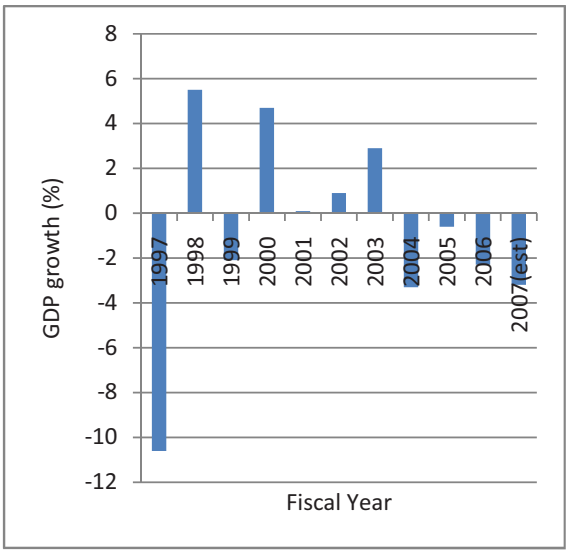

Figure 4: Real GDP growth in FSM 1997-2007

(Source:http://www.spc.int/prism/country/fm/stats/Economic/NAacc't/gdp-summary.htm)

Already at the start of Independence in 1987 the economy depended strongly on Compact flows, representing 88 percent of the country's gross domestic product (GDP). Because the non-traded goods production dominated the private sector, the export volume was negligible and the tourism sector was still in its early stage. From then onwards, GDP grew 1.6 percent annually and the private sector realized an average rate of growth of 2.9 percent annually (**Figure 3**). Although this is not very high, it is comparable to the economic performance of other Pacific Island countries.

ECONOMIC DEVELOPMENT

The FSM is classified as a medium income country by World Bank categorization and by the UNDP as a country in the medium Human Development Index category. The FSM scores moderately on other development indicators. In 2003, the ADB concluded the following for the FSM in relation with meeting the Millennium Development Goals (MDG):

"Shows little progress towards meeting the MDGs by 2015. Poverty incidence isestimated to be high with approximately 40 percent of the population falling below the national poverty line in 1998 and there are signs of increasing inequalities. One of the key issues is delivery of basic social services, which often fail to reach the poorer strata of society, the outer islands and rural areas. There are significant differences in the poverty situation between the various states but little disaggregated data is available. FSM not only faces the challenge of increasing enrollment rates at all levels but also of improving the quality of education, retention rates and access in the outer islands. FSM has poor health indicators.

Although maternal mortality rates have fallen significantly, FSM still has a relatively high maternal mortality rate and a rapidly increasing incidence of non-communicable diseases. Child mortality rates have decreased slightly. Available data suggest that only 41 percent of the population has access to an improved water source and about 45 percent to improved sanitation" (ADB, 2003).

DEVELOPMENT OF STATES

There is considerable autonomy for the States in the FSM and there are also large differences. As shown in **Table 1** Pohnpei, with the national government, accounts for only 32 percent of FSM's population but 47 percent of GDP. Chuuk, with half of the population has 28 percent of GDP. Economic performance has varied considerable, partly reflecting differences in policies and responses to external developments. Pohnpei and Yap grew the most rapidly at 0.5 and 1.1 percent respectively per annum from 1987-2007.

In Kosrae and Chuuk the GDP declined with 0.9 percent per year. (PIREP, 2004)

State	GDP	Population
Kosrae	8%	7%
Pohnpei	47%	32%
Chuuk	28%	50%
Yap	17%	11%

Table 1: Percentage of Population and GDP per state, 2007 (Source: SBOC, 2009)

The economy of Kosrae is limited. In 2005 the average income per household in Kosrae was $12,842, which is 4.3 percent below the national average. However, the average expenditure per household was $11,778 which is 8.2 percent less than the national average. Kosrae is the only State in which the median savings is positive. The 2006 Gross Domestic Product was $15.9 million, a decline of 3.3 percent compared to 2005 when inflation is considered. The 2007 GDP per capita was $1,963 (DoI, 2006, p. 196).

Pohnpei has the highest amount of average savings at $2,658, which is 450 percent of the national average savings. The median savings are minus $192, which is more than $2,000 more compared to the national average and almost $4,000 more than in Yap. The average income per household is $15,593, the highest of the four states. It is almost 43 percent higher than the average income in Chuuk, which has the lowest of the country. The 2006 GDP was $94.3 million, a decline of 0.2 percent related to 2005. With a 2007 GDP per capita of $2,685, Pohnpei was 47 percent above the national GDP per capita (DoI, 2006, p. 197).

The average and median income of Chuuk is very low, respectively 18 and 36 percent below the national average. The average savings is approximately $1,000 lower than the national average. However, the median savings is $300 above the national average. This is due to the fact that the median expenditure in Chuuk is only 67 percent of the national median expenditure. The GDP per capita in 2007 was $1,006 which is 55 percent of the national GDP per capita and 67 percent less than Yap, the State with the highest GDP per capita (DoI, 2006, p. 197).

Chuuk has suffered from several financial crises and has not yet made the adjustments necessary to repay debts, which were equivalent to 30 percent of state GDP at the height of the crisis in FY1996. Large inflows of funds to assist Chuuk recover from Typhoon Chata'an in 2003 helped stimulate economic growth (PIREP, 2004).

The Yap economy has declined slightly in recent years since Compact II began but is stronger than some other FSM states. Yap has developed a relatively strong private sector employment base with approximately 72 percent of employees in the private sector. Yap State's economy continues to be dominated by government spending, both for wages and the purchase of goods and services from the private sector.

The closure of a garment factory eliminated the manufacturing sector. Tourism is down significantly after the reduction of scheduled flights by one-third (DoI, 2006).

As mentioned before, Yap has the highest GDP per capita, $3,034 in 2007. The average income per household is also the highest of the four States, with $15,616. It is 16 percent above the national average and a massive 43 percent above the average in Chuuk. Despite the high average income, the average and median savings are the lowest in the country. This is due to the high Consumer Price Index in Yap. The average expenditure is 38 percent above the national average. The GDP dropped by 6.5 percent in the period 2005-2006 to $36.2 million (PIREP, 2004). Employment in Yap State dropped from 3,680 in 2001 to 3,023 in 2004. Average mean income in 2004 was $6,605. In 2006, the real GDP was estimated to be $36.2 million (DoI, 2006, p. 197).

2. ENERGY SECTOR

The energy sector in FSM is overwhelmingly dependent on the import of petroleum fuels for commercial energy use for transport, electricity, business and households. Hydropower has been a minor contributor as the Nanpil hydro system (Pohnpei) has provided several percent of the total electricity supply. Current problems with the dam have reduced this share. Other sources of renewable energy, such as solar energy and bio-energy account for a minor percent of the energy supply (PIREP, 2004, p.14). This section will first give a brief overview of the use of conventional energy, including the sources and its use, after which the largest part of this section will focus on renewable energy, where the greatest potential for expansion exists.

2.1 ENERGY DEMAND

2.1.1 HOUSEHOLDS

Roughly 55% of all households in FSM had electrification from some source (2000 census) (**Table 2**).

	Chuuk	Yap	Pohnpei	Kosrae
% HH electrified (2000 census)	33%	59%	68%	99%
% HH electrified (main island)	75%	100%	98%	98%
% HH electrified (2009 estimate)	46%	70%	87%	100%

Table 2: Household electrification figures

It shows that some alternative solutions are being used in some states that provide electricity (mainly PV and diesel generators).

The energy demand in the rural areas generally corresponds to basic needs such as lighting (often with kerosene, oil lamps, flashlights) and cooking (wood or other biomass (coconut-husk) and some kerosene). No specific statistical study has been carried out on the energy use habits and expenditures in rural places. However, on the basis of a survey conducted during the course of the REP-5 implementation in 2009, the average can be estimated around $15 to $35 per month and per household (in the outer islands around $15 (depends on availability) while in the rural areas on the main islands the average is $ 35).

Besides lighting, kerosene is also used for cooking, but its consumption at the national level has dropped mostly in rural areas and replaced by traditional wood and charcoal fuel sources. This can be largely attributed to the increase in fuel costs and the decrease in rural household incomes.

2.2 PETROLEUM / CONVENTIONAL ENERGY

Foremost as the primary source of energy for the FSM is petroleum. The use of energy in the FSM is comparable to the energy use in other tropical islands in the sense that the majority of petroleum is used for electricity generation and for transportation (DoI, 2006, pp. 209). More specifically, gasoline and diesel fuel are mainly used for transportation purposes and diesel is used for the generators at the utilities.

Furthermore, a small amount of liquid petroleum gas (LPG) is used for heating water and cooking (DoI, 2006, pp. 197).

In the transportation sector, mainly gasoline and diesel are used. Because the FSM does not have a large land mass, the use of fuel for vehicle transportation is modest. Transportation fuel is therefore mostly used for marine services, including commercial fishing boats, patrol boats and the cargo and passenger ships within the nation. Many use fuel from Pohnpei, which has emerged as the 'fleet headquarters' of the region and others use fuel tenders on the open ocean.

For cooking, kerosene and liquid petroleum gases (LPG) are used, as well as wood and coconut waste (DoI, 2006, pp. 198).

In 2009, around $40 million US$, which is comparable to over 50% of the national budget, was spent on the import of fossil fuel. Since world oil prices and the demand for oil continue to rise, this number will only increase. Recent history indicates major nation-wide hardships due to such trends. The average price for a barrel of oil was just above $50 in January 2007. In October 2007 the price reached almost $90 a barrel, causing the price to increase by 80 percent. The following year, in April 2008, the price increased to $110, causing what amounted to a full-blown fuel crisis in the Summer of 2008 in the FSM (GoFSM, 2008a).

Table 3 shows the price summary of fuel and electricity costs in the US.

Price Summary

	Year				Percent Change		
	2008	**2009**	**2010**	**2011**	**08-09**	**09-10**	**10-11**
WTI Crude[a] ($/barrel)	**99.57**	**61.66**	79.78	83.50	**-38.1**	29.4	4.7
Gasoline[b] ($/gal)	**3.26**	**2.35**	2.84	2.97	**-27.9**	20.8	4.8
Diesel[c] ($/gal)	**3.80**	**2.46**	2.95	3.16	**-35.2**	19.8	7.0
Heating Oil[d] ($/gal)	**3.38**	**2.52**	2.85	3.10	**-25.4**	13.0	8.9
Natural Gas[d] ($/mcf)	**13.67**	**12.03**	12.51	13.49	**-12.0**	4.0	7.8
Electricity[d] (cents/kwh)	**11.36**	**11.58**	11.47	11.68	**2.0**	-1.0	1.9

[a] West Texas Intermediate. [b] Average regular pump price.
[c] On-highway retail. [d] U.S. Residential average

Table 3: Crude oil price summary (Source: http://www.eia.doe.gov/steo)

At that time, the cost for fuel for the nations' four Utilities to keep the generators running was up to 91 percent of total revenue collections, leaving no financial reserve for maintenance and system improvement. Subsequent steep and sudden fuel and energy prices to consumers created pockets of the population that could no longer afford to have the convenience of electricy or transport on the main islands.

Beyond the traditionally steep increase of the price for electricity and fuel caused by an over-dependence on fossil fuel, other aspects of socio-economic progress also become problematic, particularly in regard to the overall commensurate increase in the Consumer Price Index. All goods and services become more expensive. Therefore, even people who are not connected to the electricity grid will suffer from the price increase of fuel (GoFSM, 2008a). This hampers development and fosters inequality as it disproportionally harms the poorer segments of the society. Because of this, the development of renewable energy and energy efficiency are key elements in preventing this scenario. Although oil prices have cooled considerably from the high in the Summer of 2008, the latest trends show that oil prices are once again on the upswing, bringing even more pressure on the FSM people and the utility corporations, most of which are still dealing with the last oil price spike.

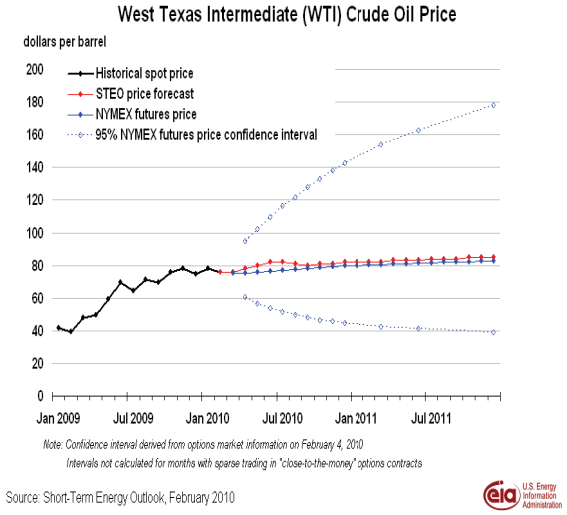

Figure 5: WTI crude oil price (Source Short-Term Energy Outlook, February 2010)

Electricity use can be divided into five main categories: residential use (39 percent), commercial and industrial use (22 percent), use by the government (17 percent), use for utilities (10 percent) and losses of the system (12 percent). The largest amount of electricity is used for air conditioning and lighting (DoI, 2006, pp. 209). The government in particular uses the bulk of its energy consumption for air conditioning (DoI, 2006, pp. 198).

Each state has its own electricity system and public authority responsible for the provision of utilities. A board appointed by the governor and confirmed by the state legislatures (DoI, 2006, pp. 199) governs these utility companies. All utility companies, especially in Chuuk, face serious economic problems as a result of high fuel costs.

Figure 6: Generator of the Kosrae Utilities Authority. (Source: DoI, 2006)

For more specific information please refer to **Table 11**: Yap State Public Service Corporation – financial and technical data(YSPSC); **Table 12**: Kosrae Utility Authority – financial and technical data (power generation and distribution); **Table 13**: Pohnpei Utility Corporation – financial and technical data (power generation and distribution); **Table 14**: Chuuk Public Utility Corporation – financial and technical data (power generation and distribution) in the Appendix, which sum up the main operating details of the four utility companies.

2.3. RENEWABLE ENERGY

There are several existing and potential sources of renewable energy in the FSM. The potential use is particularly high for solar energy and hydropower (Pohnpei State) but also the potential of wind energy, bio-fuel, methane-gas and tidal and wave energy will be reviewed. For each source of renewable energy the section will briefly describe both existing and potential use.

2.3.1 SOLAR ENERGY

High solar insolation throughout the FSM creates a rich resource of solar energy although the available energy varies from place to place because of local cloud formation. This is especially the case on the islands with mountains, such as the main islands of Pohnpei and Kosrae and the Lagoon Islands of Chuuk. **Table 4** gives an overview of the average estimated insolation on the four states using data from NASA Surface Meteorology and Solar Energy (2009).

Like other Pacific Island countries, solar energy provides a particularly good source of energy for outer islands that are further away from the state centers and often have low population sizes. Stand-alone systems can provide a solution for the energy needs in these places. There remain many opportunities both to expand the use of off-grid installations on the outer islands and for grid-connected systems on the main islands where electricity networks are available (DoI, 2006). In the state of Pohnpei, 400 solar home systems (SHS) were installed on several islands in the early '90s. This program formed the largest outer island PV system program of the North Pacific (DoI, 2006) for a long time.

Month	Kosrae	Pohnpei	Chuuk	Yap
Jan	4.72	5.1	5.13	5.4
Feb	5.34	5.8	5.71	6.04
Mar	5.34	5.84	5.93	6.5
Apr	5.41	6.07	5.79	6.72
May	5.01	5.71	5.8	6.55
Jun	4.94	5.31	5.3	5.43
Jul	5.16	5.59	5.41	5.48
Aug	5.53	5.57	5.42	4.96
Sep	5.42	5.36	5.55	5.43
Oct	5.43	5.23	5.32	5.27
Nov	4.82	4.77	5	5.17
Dec	4.87	4.91	4.88	5.34
Avg.	5.16	5.43	5.44	5.69

Table 4: Estimated Solar Resources Horizontal plane in kWh/m2/day (Source: NASA Surface Meteorology and Solar Energy

Besides the SHS in Pohnpei state 300 SHS were installed in various outer islands in Yap and 402 households in Chuuk (2000 census).

Figure 7: Installing solar module racks in the FSM. (source: Akker, 2006).

This was done after the 1982 cholera outbreak, where solar powered pumps to provide flush water for toilets aimed at reducing the use of water from shallow wells and the spread of cholera.

The project was set up by the University of Guam that provided workshops on installation, operation and maintenance.

More recently, under the European Development Fund (EDF-9 REP5 programme), a major PV electrification was implemented in the outer islands of Pohnpei, Chuuk and Yap. PV off-grid systems were installed in 11 outer islands with a total capacity of 120.88 kWp and in Kosrae five grid-connected PV systems were installed, with a total capacity of 52.5 kWp. The PV systems in Kosrae are being monitored by the utility and a more detailed analysis of data from the grid-connected systems is being an ongoing activity. The data from Kosrae is being compared with similar PV grid-connected systems in Nauru and Palau.

It is obvious that it is much harder to collect performance data from the outer island installations. FSM has therefore initiated a plan to install VSAT satellite dishes to the REP-5 installations that will enable them to do remote monitoring of the systems. In addition, the communities will be connected to the Worldwide Web for communication, education and emergency purposes. Summarized performance information for Palau, Nauru and Kosrae is given in **Table 5** below.

Location	Size (kWp)	Yield per month (kWh)	Specific yield (kWh/kWp/yr)
Palau	98.3	10,000	1,220
Nauru	40.2	4,600	1,370
Kosrae	52.5	5,600	1,280

Table 5: Performance of grid-connected PV systems in Palau, Nauru and Kosrae

It is clear then that despite some limitations, solar energy has a large potential in the FSM. There remain many outer islands where solar energy can provide affordable energy to people that would otherwise have to live without. On islands in the state centers where electricity systems are available, PV systems can provide energy to the grid in order to significantly reduce the need for fossil fuels and create a more sustainable energy mix, as well as reduce overall costs to both utilities and families.

State	Island	Site	System size
Yap	Asor	PV mini-grid	19.5 kWp
	Fadrai	PV mini-grid	28.08 kWp
Chuuk	Satawan	High school	6.6 kWp
	Moch	Public facilities - PV mini-grid	6.7 kWp
	Udot	High school	3.4 kWp
	Onoun	Public facilities - PV mini-grid	10.5 kWp
Pohnpei	Kapingamarangi	School	5.8 kWp
		Dispensary and municipal office	4 kWp
	Nukuoro	Dispensary	3 kWp
		School	4.6 kWp
	Sapwaufik	School and municipal office	8.4 kWp
		Dispensary	3 kWp
	Mwaokillao	Dispensary	2.5 kWp
		School	6.1 kWp
	Pingelap	School	6.2 kWp
		Dispensary	2.5 kWp

Table 6: Installed PV systems under E.U. EDF-9

2.3.2 HYDRO ENERGY

The hydro sites on Kosrae have limited potential and are unlikely to be cost effective for development. However further study could show that Kosrae might have a potential of PICO Hydro installations that can act as stand-alone systems and power some houses located close to the rivers. Yap and Chuuk have no hydro sites. On Pohnpei there is a hydro power installation on the Nanpil River. There have been surveys that indicate other developable sites in Pohnpei are present; however at the time of the survey the economics for the development of the sites

were bad. Those surveys should be reviewed in light of the fact of higher current fuel prices and the sites for which it is economically reasonable to be seriously considered for potential hydro development.

Due to the uplift of moist air by the mountains, the rainfall on both Pohnpei and Kosrae is high. The interior rainfall on both islands is 200-300 inches per year, which offers opportunities for hydro development on numerous of its approximately 35 streams. The stream flows however, vary a lot due the rapid runoff and small catchments. Due to this, the streams are generally not practical for base load hydropower without using expensive and environmentally problematic storage ponds. Despite this, hydropower has an acceptable tradeoff between reliability of power delivery and cost of installation. In some cases, drinking water reservoirs have been used as storage ponds to secure more constant water supply (DoI, 2006).

The Nanpil hydro facility was originally developed by the Japanese in the 1930s. In 1988, the United States Army Corps of Engineers came to develop a hydro plant next to the old, non-operating one, using a different water intake and a new building for the installation, see **Figures 10 and 11**. The total amount of power that can potentially be produced is 2.06 MW. This is a substantial amount of energy as it exceeds one-third of the peak load on the whole island. However, this amount of energy has never been produced due to water intake limitations, which reduces the maximum output to 1.8 MW. The average is reduced even more due to cyclical dry and wet periods on the island and the lack of an appropriate water storage facility to spread the production more evenly.

Figure 8: Hydro generators (Nanpil dam, Pohnpei)

In the beginning of the 1990s, there was an idea for increasing the catchment area at Nanpil at a cost of $6 million. This idea was scrapped however, because the additional output was uncertain due to the limited hydrological data.

In 1981, a United States Army Corps of Engineers study identified numerous potential hydro sites, one on the Senipehn River and three on the Lehnmasi River. Due to lack of access roads, the relatively high cost per kW for the site development and the distance from the existing grid, they were not developed. The total peak potential power of the sites is approximately 4 to 5 MW, with an average of 2 to 3 MW. Obviously, during the two dry months less power would be produced. The production site with the highest potential was on the Lehnmasi River.

The hydro sites that were labeled economically unviable in the 1980s and 1990s should again be reviewed due to the increased energy costs, and if feasible, steps taken to being developed. Despite the small catchments and the variable stream flows so that there is not enough water flow to secure a continuous base load, the harm to the environment of systems that make use of existing streams (so-called run-of-the-river development) is minimized and the systems are relatively cheap.

During its extensive operational life, it can provide substantial fuel savings. The greatest renewable energy opportunity for fuel saving is offered by the small hydro development, especially for the state Center of Pohnpei, and possibly Kosrae, and therefore a thorough review of the hydro potential seems appropriate.

Figure 9: Hydro system in the Nanpil River, Pohnpei.

2.3.3 WIND ENERGY

The resource for wind energy is not very well known in the FSM. Experts believe that it is borderline regarding the economic feasibility of energy production from wind. Meteorological measurements and low latitude location indicate moderate resource availability. Furthermore, typhoons form a risk for wind power systems. **Figure 12** gives an overview of the average wind speed throughout the year in the four states.

Due to the mountainous nature of some of the islands, however, there may be locally beneficial conditions for wind energy. The main recommendation that also came out of earlier studies on potential renewable energy use is to carry out a feasibility study on the use of wind energy throughout the FSM. After broadly defining locations where wind energy could potentially be implemented, detailed wind assessments and wind maps should be created to more precisely identify the main wind energy sites. **Appendex A** shows the wind speed data from Yap.

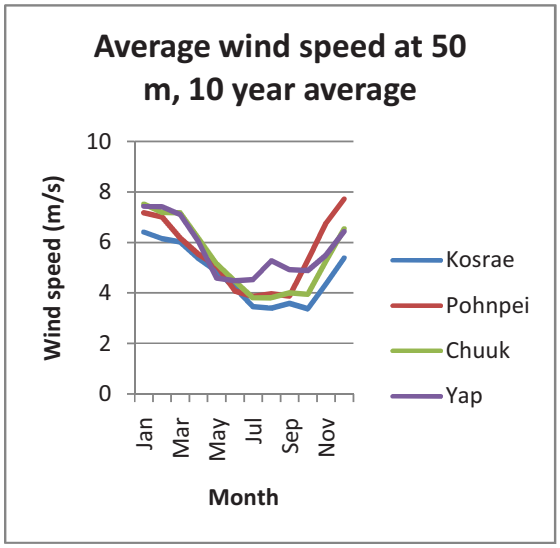

Figure 10: Average wind speed at 50m

2.3.4 BIOFUEL

A very interesting source of biofuel is coconut oil. The outer islands have a large and underutilized resource that could be further developed. Using coconut trees is not new to the country. There has been an active industry for copra, the dry meat of coconuts, after the Second World War until the 1970s. Although the price of copra remained stable after this period, the costs of living had increased and so had the labor costs. This reduced the incentive to commercially exploit copra. As a result, there were few new coconut plantings to replace an increasing share of senile trees (DoI, 2006).

The country has the opportunity to develop coconut production on outer islands and thereby increase income for the outer islands. At current prices and production levels, coconut oil could be shipped to the state centers where large diesel fuel users, especially the utility companies and certain businesses that might have back-up generators, could add coconut oil to create a fuel mix and reduce their use of diesel fuel. This would boast the coconut oil industry and prepare it for production on a larger scale when diesel prices increase further. Revenues to rural communities and reduction in costs to the private sector in the centers would certainly benefit the macroeconomic fabric of the nation.

Until recently, there was an active coconut factory on the main island of Pohnpei that produced biofuel from coconuts. The company could produce 150 gallons of coconut oil, more than 550 liters, in an eight-hour day. Besides using this for their own vehicles, they sold coconut oil to individual and corporate customers on the island. With little effort, an engine can be adjusted to run on a mix of diesel and biofuel. The owners of the coconut factory were making plans for increased production and to start selling fuel for boats. However, in July 2008, a fire destroyed the whole factory. The owners had no insurance and there were no readily available funds to rebuild the factory. In 2001 a copra warehouse in Yap was devastated by a fire (DoI, 2006), and in Chuuk a copra oil production facility was also consumed by a fire. Neither has been rebuilt.

This impacted the total amount of copra produced and exported within the nation. **Tables 7 and 8 below** give some numbers on the historical amount of copra production for Pohnpei and Yap.

	1992	1994	1996	1997
Pohnpei	18.63	9.32	6.68	13.2
Mwoakilloa	27.53	56.05	49.06	37.83
Pingelap	14.75	3	20.13	32.86
Pakin	33.9	15.11	18.27	20.13
Sapwahfik	2.95	43.26	63.34	25.25
Nukuoro	55.79	42.49	19.3	56.15
Kapinga	19.61	11.49	14.08	0.88
Oroluk	4.66	2.12	8.69	11.33
Total	177.81	182.83	199.55	197.63

Table 7: Copra production (in tons) in Pohnpei State (Source: Pohnpei State Office of the Governor)

	1999	2000	2001	2002	2003
Tons	292	210	35	130	80

Table 8: Yap copra exports in tons2 (Source: 2002 Annual Statistical Yearbook, Yap)

Biofuel from coconut oil remains a socially and economically viable source of renewable energy and efforts should be strongly pursued to once again integrate it into the overall energy mix.

[2] The low value for 2001 was due to the loss of much of the copra in a warehouse fire.

2.3.5 BIOMASS

Biomass remains the largest source of energy for cooking. For the mountainous islands of the state centers of Pohnpei, Kosrae and Chuuk, and some of the outer islands, biomass in the form of wood is sufficiently available without danger of deforestation. Also in low-lying atolls biomass is used for cooking but in different forms, such as coconut shells, fronts and husks, mangrove wood or plants (PIREP, 2004).

As in other Pacific Island countries, commercial use of biomass for electricity production by means of combustion or gasification is limited to facilities that process agricultural or forest products. There are no industries in the FSM that processes such products as agricultural processing tends to be done in small scale, often family-owned, decentralized facilities. There is currently no industry that produces biomass waste. If biofuel from coconut oil would become a large-scale industry, enough biomass waste could be generated to justify commercial biomass combustion or gasification to produce heat or electricity (DoI, 2006). In that case, a feasibility study should be carried out to give insight in the potential use.

Waste to Energy is another development that is being carefully followed by the FSM government and plans are being made to start a (solid) waste composition study in 2010.

2.3.6 BIOGAS

There are some animal farms in the FSM that produce enough waste to generate biogas in an economically viable way. This way, animal waste is disposed in an environmentally friendly way with biogas as a byproduct. Some small pilot biogas installations are being installed in Pohnpei, with the assistance of the Chinese government in 2008, and these are being monitored by the Pohnpei State government. There is also independent biogas producer on the main island of Pohnpei that tries to create a closed, environmentally sustainable cycle in its household energy use. Animal waste produced by a pig serves as input for the biogas digestion tank, which provides gas for daily cooking. There has been some interest noted by the Kosrae State Government to replicate such low-scale household digester systems as well.

Currently no facilities for sewer or landfill treatment are used to generate biogas. When these facilities are upgraded, a feasibility study should be carried out to investigate the economic and environmental sustainability of an add-on facility to extract biogas.

2.3.7 OCEAN ENERGY

Although the country is surrounded by ocean, there is at the moment no sufficiently mature ocean energy technology that can be used in the FSM. Available resources for tidal energy are present in the FSM. The tidal range is not very large, but through certain reef passages and some man-made causeway and bridge infrastructures, high speeds and high volumes of water flows are observed locally. The FSM energy sector is following the development in ocean and tidal technologies and it is planned to have pre-studies done between 2010 and 2012.

2.4 ENERGY COSERVATION & EFFICIENCY

A recently completed report has estimated the potential of renewable energy and energy efficiency to reduce greenhouse gas (GHG) emissions in a number of Pacific Island countries (See: **Table** 10: GHG Emissions and Potential Savings (Source: FSM SEFP country report, IT Power **2006**)). The total GHG emission estimates are derived from corresponding estimates of reductions of fossil fuels in all sectors of the economy, including power generation, transport, household use, etc.

The table shows that in FSM by the year 2011, it is, in principle, possible to reduce projected fossil fuel use only by 14%, with about 70% of the savings coming from renewable energy and 30% from energy efficiency measures.

As shown in the table energy efficiency is an important part of the energy sector, particularly in supply side management for the utilities. The Pacific Power Association started an energy efficiciency assistance programme in 2009 for the utilities but presently no large-scale measures have been undertaken. However, the average estimated electricity consumption in electrified households is not that high and decreasing over the last four years, revealing that that demand-side management (DSM) are starting to bear some fruitage. High electricity cost and the introduction of cash power meters (pre-paid meters) have significantly developed some energy saving behavior at the customer level (**Figure 11** below).

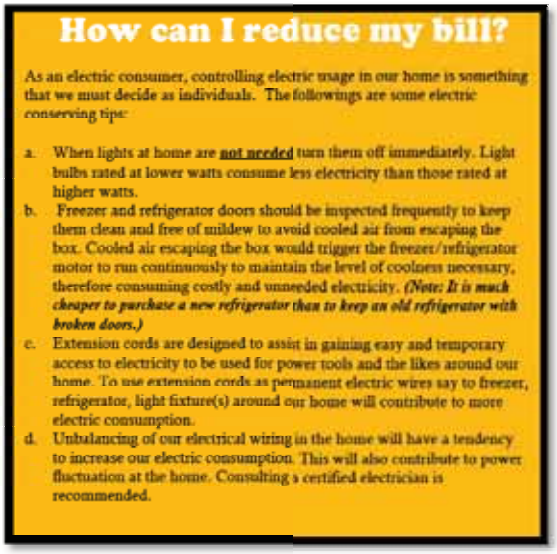

Figure 11: YSPSC customer education Source: YSPSC newsletter July '08

It shows that EE and DSM could have a significant impact in case of consideration at a large scale, and that broad-scale programs need to be implemented to create more awareness amongst consumers.

Some of the utilities have actively started to advise the public on DSM and discussions are being held to start programmes such as changing light bulbs and other energy efficiency appliances. In addition, regulatory frameworks and incentive programs at the states can help spur private sector investment and consumption in this area.

CHAPTER III: POLICY FRAMEWORK

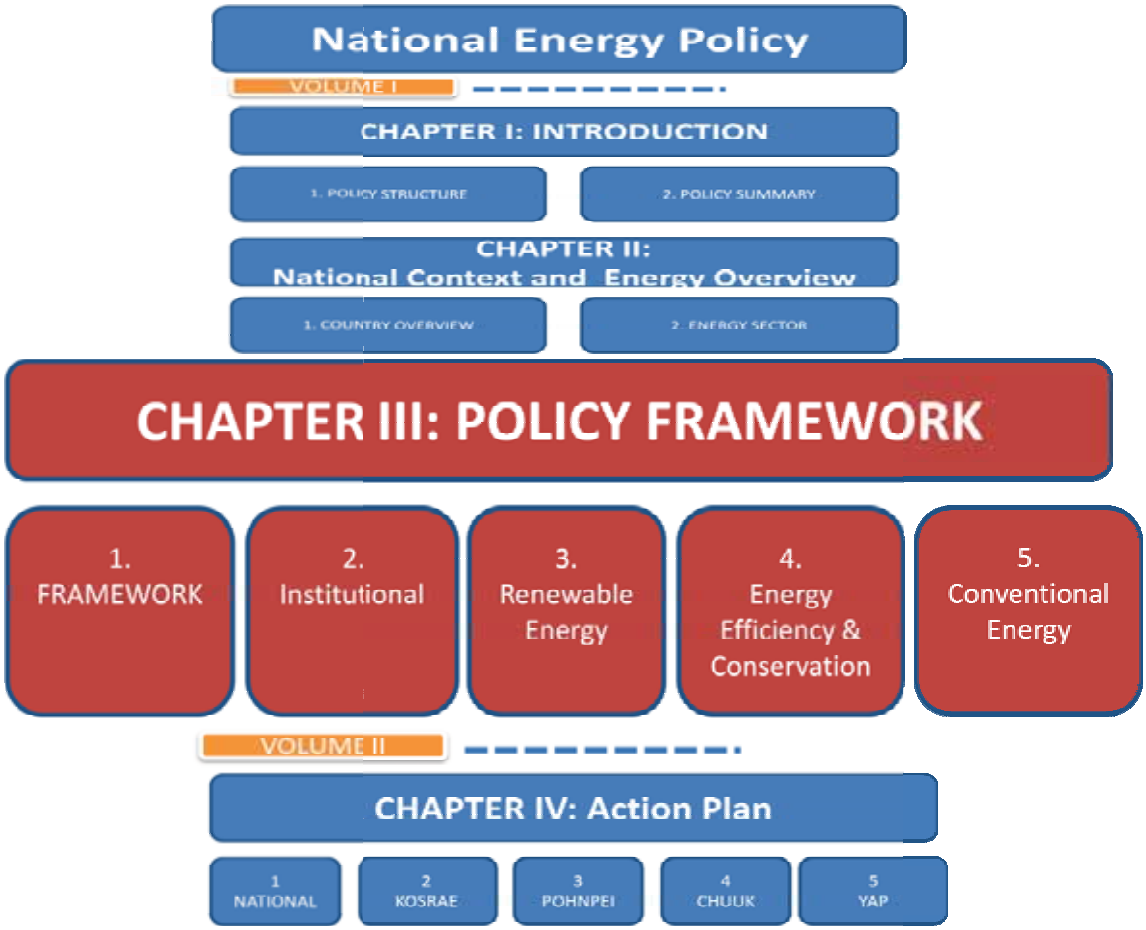

Figure 12: Structure of the policy

1. INSTITUTIONAL AND SYSTEMIC FRAMEWORK

Figure 13: Policy Structure

2. INSTITUTIONAL

In any national policy, providing a good and clear institutional structure is a top priority. This counts especially for an energy policy where the sector is still under development and defractured under the four States. In the institutional and systemic structure, formal linkages between actors and clear definitions of their responsibilities are being addressed. The main actors and institutions active in the energy sector should be involved, including the government at various levels, the utility companies, the private sector and non-state actors (NSAs), including NGOs and community groups. Due to the current lack of coordination in the energy sector, between national and state, there is a need for an organization in charge of overseeing and coordinating activities in the country and in the respective states. This organization should interact with various stakeholders at the national and state level and with the government, the utilities, the private sector and NGOs.

2.1 ACTORS AND INSTITUTIONS

A National Energy Workgroup (NEW) has been established and consists of members from the key Departments in the National Government[3], a State Representative coming out of each State Energy Workgroup, a Representative from the Association of Micronesian Utilities (AMU), a Representative from the College of Micronesia (COM-FSM) and the Government Energy Advisor(s). NEW has as its main task to oversee and coordinate the activities in the energy sector especially in relationship to the implementation of the national energy policy. Since the NEW consists of the main stakeholders involved in the energy sector, this provides a forum to discuss development in the energy sectors, especially as it pertains to renewable energy, and to help steer these stated priority developments in the direction as indentified in the energy policy/action plans.

As can be seen in **Figure 15** (page 39) the NEW interacts closely with the national government and with the Regional Energy Committee (REC) and Association of Micronesian Utilities (AMU). REC is the body under the Micronesian Chief Executives Council (MCEC) consisting of energy sector representatives from Micronesia. Besides members from the FSM, this body includes members from the Republic of the Marshalls Islands, Palau, Guam and the Commonwealth of the Northern Mariana Islands. It meets regularly and is set up to discuss developments in the energy sector of respective countries, learn from each other's experiences and advices the Governments in their energy planning.

The NEW should be strongly connected to the four State Energy Workgroups (SEW). These consist of three or four people: one from the state government, one representative from the utility company, the state energy officer (this position only exists in Pohnpei) or an energy expert and a private sector or NGO representative. The SEWs are responsible for developing and updating the state action plans, which are detailed in **Volume II**.

These plans are in line with the national energy policy and put forward specific objectives and implementable actions at the state level. Furthermore, the main task of the SEWs is overseeing, coordinating and

[3]Energy Division, Department of Resources & Development; OEEM; SBOC (ODA); Department of Transportation, Communication and Infrastructure

implementing activities in the energy sector of the state.

2.2 COORDINATION AND PROGRAM MANAGEMENT

This part of the energy policy is focused on the responsibilities of the actors (NEW and SEWs) related to the implementation of the policy on national level and the coordination role in implementing the various state action plans.

2.2.1 IMPLEMENTATION OF THE ENERGY POLICY

- Implement all State Action Plans and the National Action Plan aimed at reducing overall fossil fuel imports and greenhouse gas emissions and strive to meet national and state renewable energy targets.
- Develop timely a reliable nationwide energy statistic database for effective and fact-finding planning, monitoring and evaluation.
- Revise the National Energy Policy as needed to ensure it is up-to-date and maintains aggressive but achievable outcomes.
- Ensure every State has an Energy Coordinator, who is part of the State Energy Workgroup and keeps close contact with the National Energy Workgroup (see next section 'Division of Responsibilities and Organizational Structure').
- Promote the development of a National Energy Bill that addresses the reduction of fossil fuel import and green house gas emissions in line with this Energy Policy.

2.2.2 ALIGNMENT WITH LEGISLATION AND OTHER POLICIES

- In line with the FSM Trade Policy and the SDP, support opportunities for local manufacturers to supply equipment and human resources for project design, implementation, management and maintenance.
- Integrate environmental concerns and regulations into all energy-related plans and projects, including transportation, power supply, and building codes.
- Promote proper alignment with policies that are and will be developed in the future, including policies in the field of environment and climate change; Review this Energy Policy in light of these policies.
- Assist in the development and implementation of public awareness campaigns supporting renewable energy expansion geared toward key stakeholders within the FSM, including NGOs, business sector, governments and utilities, state and national legislatures and the general public.

2.3 DIVISION OF RESPONSIBILITIES AND ORGANIZATIONAL STRUCTURE

The responsibilities of the stakeholders are defined under this section. It needs to be noted that the composition of the National and State Energy Workgroups can change, however the overall objective will remain the same.

2.3.1 NATIONAL ENERGY WORKGROUP

The National Energy Workgroup, coordinated by the Energy Division in the Department of R&D, is responsible for:

- overseeing all national efforts in the energy sector
- coordinating overseas development assistance that will be used for implementing the Action Plans
- developing timely a nationwide energy statistic database for effective and fact-finding planning, monitoring and evaluation.
- assisting in implementing the action plans by the State Energy Workgroups (SEW)
- providing technical assistance to the State Energy Workgroups as requested
- annually review the Energy Policy and revising this Energy Policy as needed in consultation with the SEW

Members:

- Department of R & D (energy division)
- Department of TC&I
- Office of EEM
- Office of SBOC (ODA)
- Representative from the SEWs
- Association of Micronesian Utilities
- College of Micronesia (COM-FSM)

In order to carry out these responsibilities, the National Energy Workgroup keeps close contact with:

- State Energy Workgroups
- National Government
- Association of Micronesian Utilities
- Regional Energy Committee
- Secretariat of Pacifc Community
- other relevant organisations

2.3.2 STATE ENERGY WORKGROUPS

The four State Energy Workgroups, including an Energy Coordinator in each State Energy Workgroup, are responsible for:

- Overseeing and coordinating all State efforts in the energy sector.
- Implementation of State Energy Action Plan
- Advising the state government on energy issues
- Assist in developing and designing specific and technically-sound Energy Efficiency and Renewable Energy projects for donor consideration, funding and implementation

Members:

- State Utility (can be the energy officer/coordinator, if the energy officer is staff of the state utility)
- State government (can be the energy officer/coordinator, if the energy officer is staff of the state government)
- State Planner (Infrastructure - IPIC)
- Private sector or NGO representative

In order to carry out these responsibilities, the State Energy Workgroups keeps close contact with:

- National Energy Workgroup
- State Utility
- State Government
- State Chamber of Commerce
- State community sector, including Non-Governmental Organizations

2.4 OVERALL GOALS

The overall goals apply to all the segments of the policy (renewable energy, energy efficiency & conservation and conventional energy). More specific goals and objectives will follow in the sections for renewable energy, energy efficiency and conventional energy separately.

2.4.1 DISADVANTAGED AND/OR GEOGRAPHICALLY REMOTE COMMUNITIES

- Encourage the application of appropriate support and incentives to enable disadvantaged and/or geographically remote communities to access affordable energy

2.4.2 CAPACITY BUILDING

- Improve adequate human and institutional capacity to plan, manage, and develop the energy sector by providing appropriate energy-related training opportunities at all educational and professional levels.

- Accelerate research and development of energy technologies that are appropriate for adoption within the nation and facilitate international transfers of appropriate technologies that the nation is capable of operating and maintaining.

- Assess and promote indigenous resource potential and technical capacity for all aspects of energy sector planning and development.

2.4.3 PUBLIC AWARENESS

- Increase training and public awareness on renewable energy and fuels for vehicles, energy efficiency, and conservation through publicity campaigns and school curricula.

2.4.4 PRIVATE SECTOR INVOLVEMENT

- Enhance public-private partnerships and expand private sector participation, investment, ownership, and management for energy supply including electricity generation, transmission and distribution.

- Establish an enabling and competitive environment for the introduction of independent energy providers where these may provide efficient, reliable, and affordable service to consumers, in light of existing state laws.

2.4.5 COMMUNITY LEVEL INITIATIVES

- Promote involvement and input from non-government organizations and local communities, including youth and women, in policy implementation and integrated planning.

3. RENEWABLE ENERGY

The application of Renewable Energy is relatively new inthe FSM. The definition that we have used in this policy is:

***Renewable energy** is energy generated from natural resources such as sunlight, wind, rain, tides, geothermal heat, biomass, biofuel, waves and waste that are locally available and sustainable (naturally replenished).*

In other words: Energy obtained from sources that are essentially inexhaustible, unlike fossil fuels, of which there is a finite supply.

3.1 GOAL

AN INCREASED SHARE OF RENEWABLE ENERGY IN THE NATIONS' OVERALL ENERGY SUPPLY

30 % OF THE ENERGY SUPPLY SHOULD COME FOR RENEWABLE ENERGY BY 2020

3.2 OBJECTIVES

- Promote the increased use of renewable energy technologies in all sectors of society and strive to meet national and state-level renewable energy targets.
- Promote the effective management of both grid-connected and stand-alone renewable-based power systems.
- Promote partnerships between the private sector (including local communities and NGOs) and public sector, and mobilize external financing to develop renewable energy initiatives.
- Promote equitable availability of renewable energy in remote islands, rural areas on the main islands, and in the state centers, with social-economic development in mind.
- Encourage implementation and markets for environmentally clean technologies and alternative fuels for transportation by using non-fossil fuels and other power sources in both new and existing vehicles.
- Establish opportunities for better access to renewable energy technologies through the provision of incentives and the removal of barriers and constraints to sustainable energy sector development.

4. ENERGY EFFICIENCY & CONSERVATION

Energy Efficiency and Energy Conservation are closely related terms. However, during the NEW meetings it was clear that people have different understandings when we talk about efficiency and conservation. The following definitions are used for this policy:

ENERGY EFFICIENCY (EE) *encompasses all changes that result in a reduction in the energy used for a given energy service (heating, lighting...) or level of activity. This reduction in the energy consumption is not necessarily associated to technical changes, since it can also result from a better organization and management or improved economic efficiency in the sector (e.g. overall gains in productivity).*

Energy Conservation (EC): *is achieved through efficient energy use, in which case energy use is decreased while achieving a similar outcome, or by reduced consumption of energy services*

Simply said: reducing energy use is called ***energy conservation*** *and* ***efficiency*** *is the percentage of energy that is actually used to perform work the rest of energy that is '' lost '' to the surroundings*

4.1 GOAL

IMPROVE ENERGY CONSERVATION AND EFFICIENCY IN ALL SECTORS OF THE ECONOMY AND SOCIETY

ENHANCE THE SUPPLY SIDE ENERGY EFFICIENCY BY 20% BY 2015 AND INCREASE THE OVERALL ENERGY EFFICIENCY BY 50% BY 2020

4.2 OBJECTIVES

- Improve the efficiency of energy production, transmission, and distribution through supply side management.
- Introduce demand side management programs for enhancing energy efficiency and conservation so as to reduce the energy consumption in government facilities, residential and commercial buildings, industry, agriculture and forestry.
- Introduce and adopt building energy codes.
- Promote appropriate incentives (including taxes, subsidies and tariffs) to encourage efficient energy use and minimization of waste.
- Encourage co-operation in energy efficiency and conservation programs amongst the private sector, consumers and governments, by increasing public awareness and improving access to information.

5. CONVENTIONAL ENERGY

The importing of fossil fuels takes up more than 50% of the FSM aggregate sector grants. This highlights the reliance of this type of energy source in FSM and the urgent need for finding solutions for being less dependent on fossil fuels. The term "conventional energy" is widely used for fossil-based energy, nuclear energy, and large-scale hydro and geothermal (whereas hydro and geothermal also are renewable energy sources). In this policy, the focus is only on fossil-based energy like diesel, petrol, kerosene and natural gas.

5.1 GOAL

SAFE, RELIABLE, AND AFFORDABLE SUPPLY OF CONVENTIONAL ENERGY

REGIONAL BULK PURCHASE, CENTRALIZED STORAGE AND COORDINATION TO SECURE AND OBTAIN EFFICIENCY BY 2015

5.2 OBJECTIVES

- Improve the competitiveness of petroleum supply and support a national approach to negotiations with suppliers.
- Promote the collection, transportation, and environmentally responsible re-use, disposal, or removal of waste oil and other petroleum by-products to minimize adverse impacts on soil, ground water, and near shore fisheries.
- Encourage suppliers to maintain the quality of petroleum products and promote the use of appropriate technologies to reduce the emissions of green house gas and other pollutants from conventional energy at the supply and demand side.
- Phase out government subsidies on the purchase of fossil fuel for energy production.
- Work closely together with other Pacific island countries to collect and disseminate information on fuel demand, regional fuel prices, and related issues.
- Work with the other North Pacific Island States toward regional fuel purchasing, thereby enhancing economies of scale and reduced costs to governments and consumers.

OVERVIEW ACTORS AND INSTITUTIONS			
	Actor/ Instutition	**Advocacy Coalition**	**Resources**
Regulators	Department of Resources & Development	Convenience	Financial and human resources available to use for the energy sector. They host the Energy Division and are in the middle of network of energy sector.
	Office of the President	Convenience	Responsibility to allocate financial resources and determine strategic development plan. Network to acquire international funds.
	Department of Transportation, Communication and Infrastructure	Convenience	Financial and human resources in the field of infrastructure.
	Office of Statistics, Budget & Economic Management, Overseas Development Assistance & Compact Management	Convenience	Host the Overseas Development Assistance office. Financial and human resources to develop and maintain contact with international donors including the European Union.
	Office of the Environment and Emegency Management	Progressive	Financial and human resources dedicated to the environment and climate change.
	Department of Finance and Administration	Convenience	Authorization of each payment will be decided by them.
	State governments	Convenience	Financial and human resources dedicated energy matters in their state. By maintaining contact with the national government and/ or directly with international donors they can acquire funds for energy projects.
Supply Side	State utility companies (KUA, PUC, CPUC, YSPSC)	Convenience	Financial and human resources to maintain their energy systems. They also have and use their expertise to advise the government on energy matters.
	FSM Petroleum Corporation	Conservative	By determining the energy prices, they have a large influence on the energy sector and more generally on the country. One important resource is a contract with the government that states a minimum amount of energy that will be bought (see in text).
	European Union Renewable Energy Programme	Progressive	Financial resources to build projects and expertise to advise the government on energy matters.
	Private sector renewable energy initiatives	Progressive	Resources to build projects, and expertise to try to convince policy makers.
	Coconut Development Authority	Progressive	Financial and human resources to develop coconut oil production.

Demand Side	Inhabitants FSM	Convenience	Try to influence the state and national government to provide affordable, reliable and sustainable energy by voting, purchasing power and forming of advocacy groups.
	Tourism sector (and representatives in National and state Government)	Convenience	Put pressure on the state and national government to provide reliable, renewable and affordable energy.
	Department of Health	Convenience	Allocation of resources of the health sector with which they can try to influence policy making for the energy sector.
	Department of Education	Convenience	Allocation of resources of the health sector with which they can try to influence policy making for the energy sector.
	Private sector	Convenience	Put pressure on the state and national government to provide reliable and affordable energy.
	Local civil society	Progressive	Try to influence the state and national government to provide affordable, reliable and sustainable energy by voting and forming of advocacy groups.
	Continental Airlines	Conservative	Since they are the only airline company serving the country they have a monopoly position in which they can put pressure on the government.
Financiers	European Union, and other donors	Progressive	Besides developing renewable energy projects they can also enter agreement with the government and local suppliers and provide funds and expertise.
	United States Compact Fund	Progressive	Providing funds and expertise for energy projects.
	Governments with bilateral contacts, such as with Italy	Progressive	Providing funds and expertise for energy projects.
	National Government	Progressive	Providing funds and expertise for energy projects.
	State Government	Progressive	Providing funds and expertise for energy projects.
Civil Society	Local civil society including NGOs	Progressive	Try to influence the state and national government to provide affordable, reliable and sustainable energy by voting and forming of advocacy groups.
	International NGO (including UN organizations)	Progressive	Provide funds, expertise and use information campaign in an attempt to influence policy making.
	College of Micronesia	Progressive	Develop and provide expertise related to energy.

Table 9: Overview actors and institutions

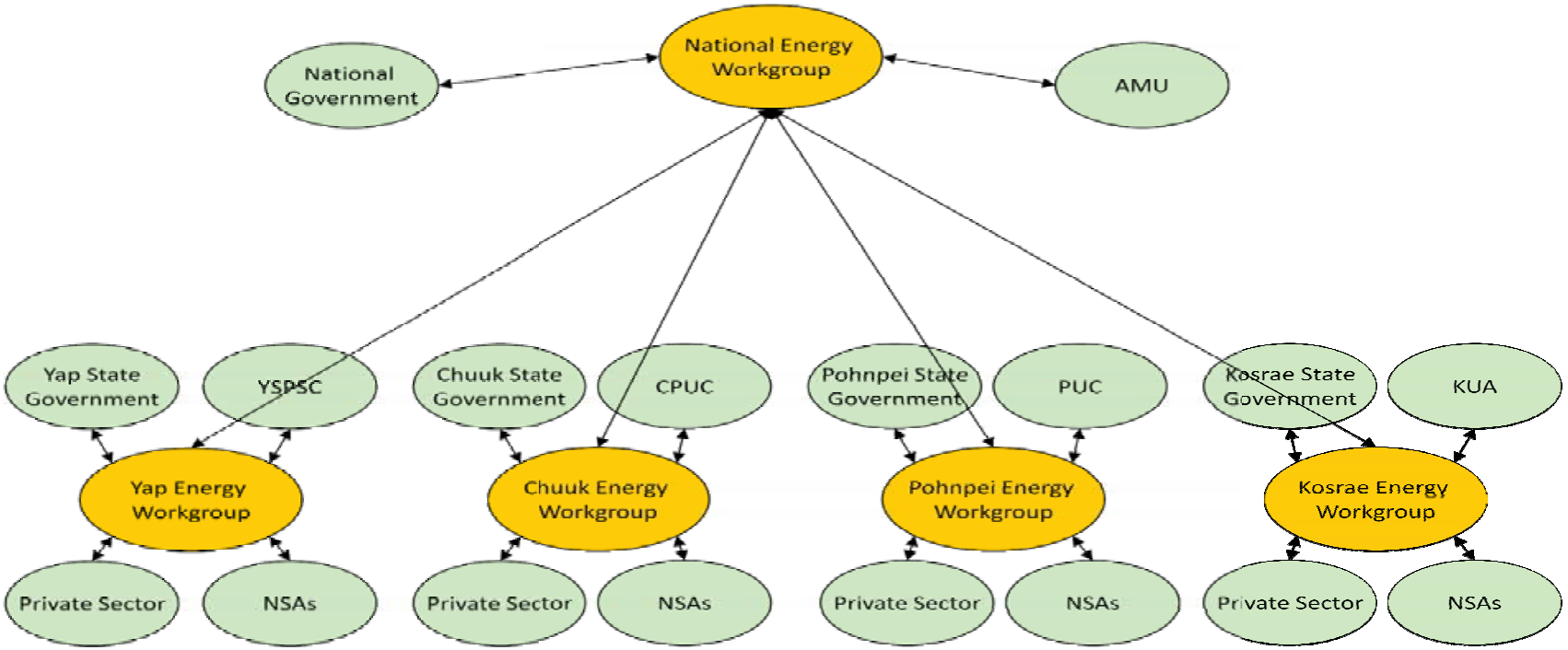

Figure 14: Proposed institutional structure for implementation

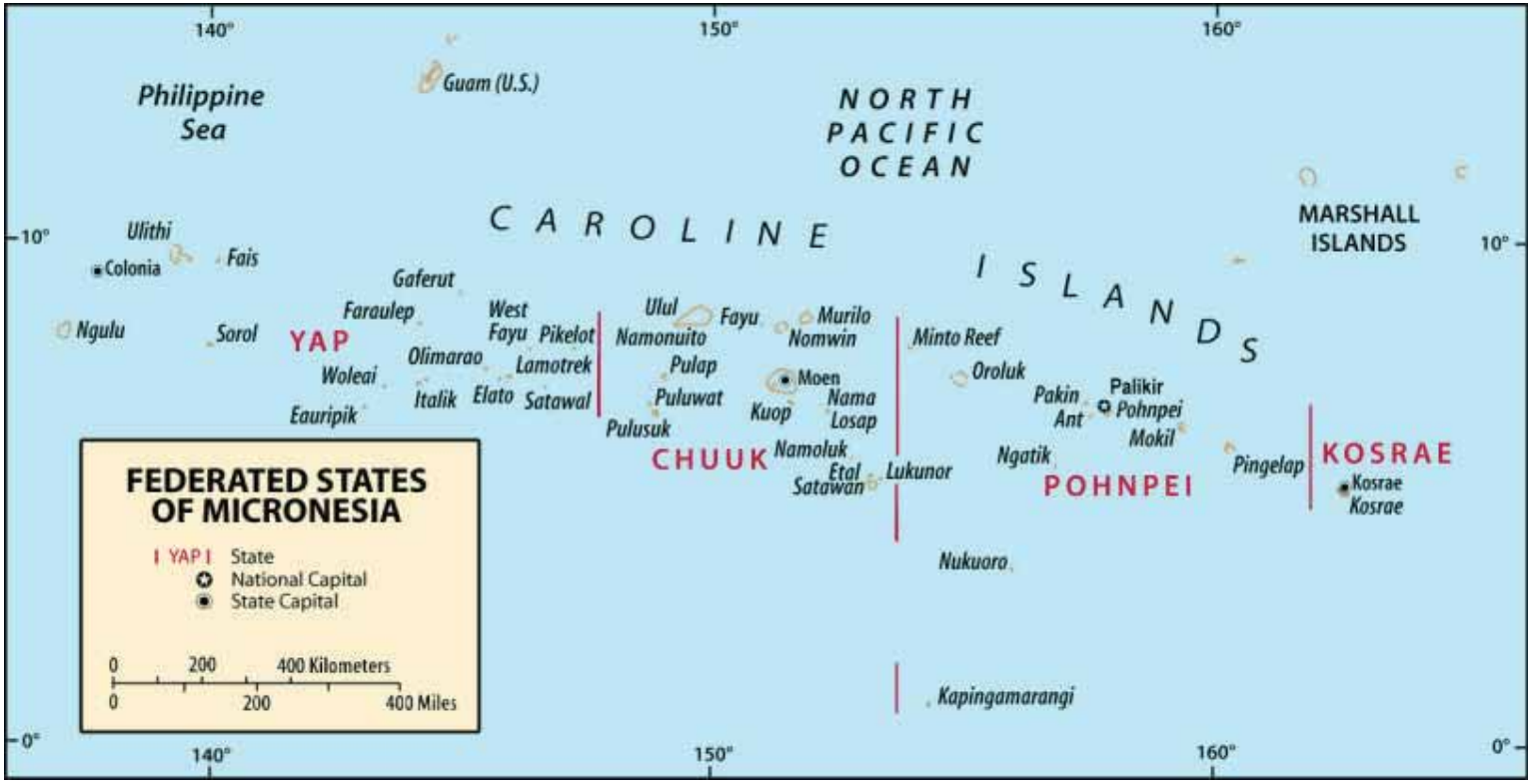

Figure 15: Map of the Federated States of Micronesia

APPENDIX A

TABLES & FIGURES

Country	Projected baseline emissions in 10 years, BAU		Potential Annual GHG Savings			Relative Savings from Renewable Energy and Energy Efficiency			
	CO2 (Gg)	Year	Gross (Gg)	Adjusted (Gg)	Adjusted as % of baseline	RE (Gg)	% of total	EE (Gg)	% of total
FSM	**~ 168**	**2012**	**23.9**	**23.9**	**14%**	**16.8**	**70%**	**7.1**	**30%**
Kiribati	72.2	2013	26.5	26.5	37%	24.5	92%	2.0	8%
RMI	400	2013	22.3	22.3	6%	8.0	36%	14.3	64%
Palau	441	2013	49	49	11%	12	24%	37	76%

Table 10: GHG Emissions and Potential Savings (Source: FSM SEFP country report, IT Power 2006)

Yap State Public Service Corporation (YSPSC)			
2164 customers			
Financial data		**Technical data**	
KWhr sales revenues:	$4,618,148	Peak load:	2.3 MW
Operating profit without depreciation (2007):	$761,774	Annual generated power:	13,117 MWh
Depreciation (2007):	$757,028	Annual sales:	11,413 MWh
Price of electricity (2008): Price of electricity (2010):	26 cents per kWh 45 cents per kWh	Number of running generators:	3
Fuel cost (2004): Fuel cost (2006):	$0.90 per gallon $1.94 per gallon	Combined capacity:	6.6 MW
Fuel cost (2010):	$3.68 per gallon	Number of distribution circuits:	4
Fuel cost for electricity (2004): Fuel cost for electricity (2006): Fuel cost for electricity (2010):	7.5 cents per kWh 16 cents per kWh 31 cents per kWh	Efficiency generation plant:	95 percent
Fuel purchased from:	FSM PC	Losses distribution system (Including non technical losses – 2.4% - meters inaccuracy):	8 percent
Reduction with Cash Power meter:	N/A	Percentage of Cash Power meters installed:	5 percent

Table 11: Yap State Public Service Corporation – financial and technical data (power generation and distribution)

The Kosrae Utilities Authority (KUA)			
1,800 customers			
Financial data		**Technical data**	
KWhr sales revenues:	$1,864,866	Peak load :	1.40 MW (2005) 1.01 MW (2009)
Operating expense:	$1,650,000 (2005) $2,547,365 (2009)	Annual sales :	6,132 MWh(2005) 5,169 MWh(2009)
Operating loss without depreciation:	$190,000 (2005) $ 171,571 (2009)	Number of generators:	5
Depreciation :	$470,000 (2005) $ 510,828 (2009)	Combined capacity:	4,580 kW
Price of electricity :	27 cents /kWh (2005) 36 cents / kWh (2009)	Portable emergency generator	650 kW
Fuel cost:	$2.15 / gallon (2005) $2.85 / gallon (2006) $ 4.40 / gallon (2008) $ 3.42 / gallon (2009)	Number of distribution circuits:	3
		Efficiency generation plant:	32 percent
Fuel cost for electricty:	24.3 cents/ kWh (2005) 28 cents/ kWh (2009)	Losses distribution system:	9 percent
Fuel purchased from:	FSM PC	Efficiency of fuel in to kWh:	29.4 percent 14 kWh/Gal
Reduction with Cash Power meter:	5 percent	Percentage of Cash Power meters installed:	70 % (2005) 80% (2009)

Table 12: Kosrae Utility Authority – financial and technical data (power generation and distribution)

The Pohnpei Utility Corporation (PUC)			
6,399 customers			
Financial data		**Technical data**	
KWhr sales revenues:	$6,950,000	Peak load:	6.5 MW
Operating profit without depreciation (2004):	$616,840	Annual generated power:	40,465 MWh
Depreciation (2004):	$1,976,598	Annual sales:	34,053 MWh
Price of electricity (2004):	20.4 cents per kWh	Number of generators:	8
Fuel cost (2004):	$1.33 per gallon	Combined capacity:	15.46 MW
Fuel cost (2006):	$2.30 per gallon	Number of distribution circuits:	4
Fuel cost for electricty (2004):	12.1 cents per kWh	Efficiency generation plant:	32.9 percent
Fuel purchased from:	Mobil Oil Corp.	Losses distribution system:	12.5 percent
Reduction with Cash Power meter:	3 percent	Percentage of Cash Power meters installed:	85

Table 13: Pohnpei Utility Corporation – financial and technical data (power generation and distribution)

The Chuuk Public Utilities Corporation (CPUC)			
XXX customers			
Financial data		**Technical data**	
KWhr sales revenues:	$2,837,260	Peak load:	4 MW
Operating expense (2006):	$2,822,126	Annual generated power:	21,520 MWh
Operating profit without depreciation (2006):	$15,134	Annual sales:	12,200 MWh
Depreciation (2006):	$1,157,080	Number of generators:	3
Price of electricity (residential customers):	32.26 cents per kWh	Combined capacity:	3.4 MW
Fuel cost (2006):	$1.95 per gallon	Number of distribution circuits:	3
Fuel purchased from:	FSM PC.	Percentage of Cash Power meters installed:	small

Table 14: Chuuk Public Utility Corporation – financial and technical data (power generation and distribution)

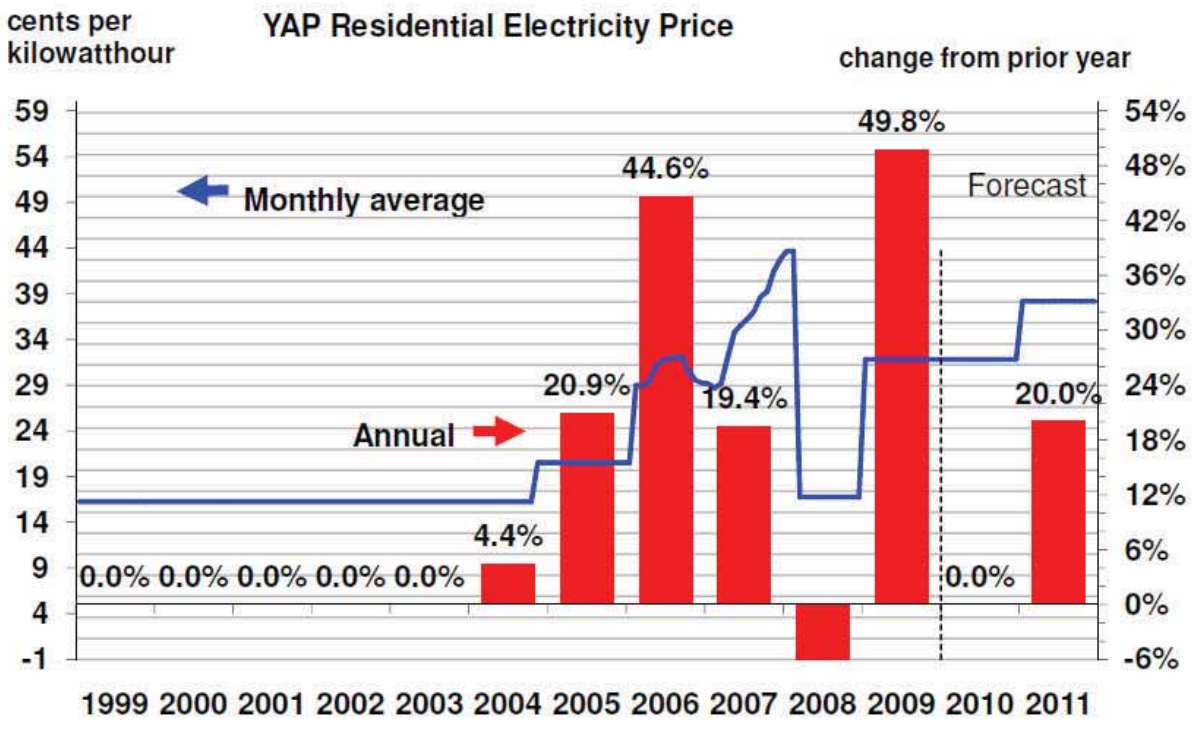

Table 15: Yap State Public Service Corporation – Residential Electricity Rates Trend ('99 thru 2011)[4]

[4] Note: in November 2004 YSPSC included flexible fuel (adjustment) charges in their fee structure. From November 2004 until February 2006, the fuel adjustment stayed stable but starting from March 2006 YSPSC adjusted the fuel charge monthly. In March 2008, Yap State Legislature reversed the 2006 adjustments and the fuel charge was put back to 3.5 ct/kWh. Acklowledging the financial problems the Yap State Government advised YSPSC to change the tariff structure again and from December 27, 2008 untill March 2010 the tariffs are without fuel charge adjustments but with the Government subsidizing the tariff by paying 73.7 ct per kWh while residents pay 31.8 ct per kWh.

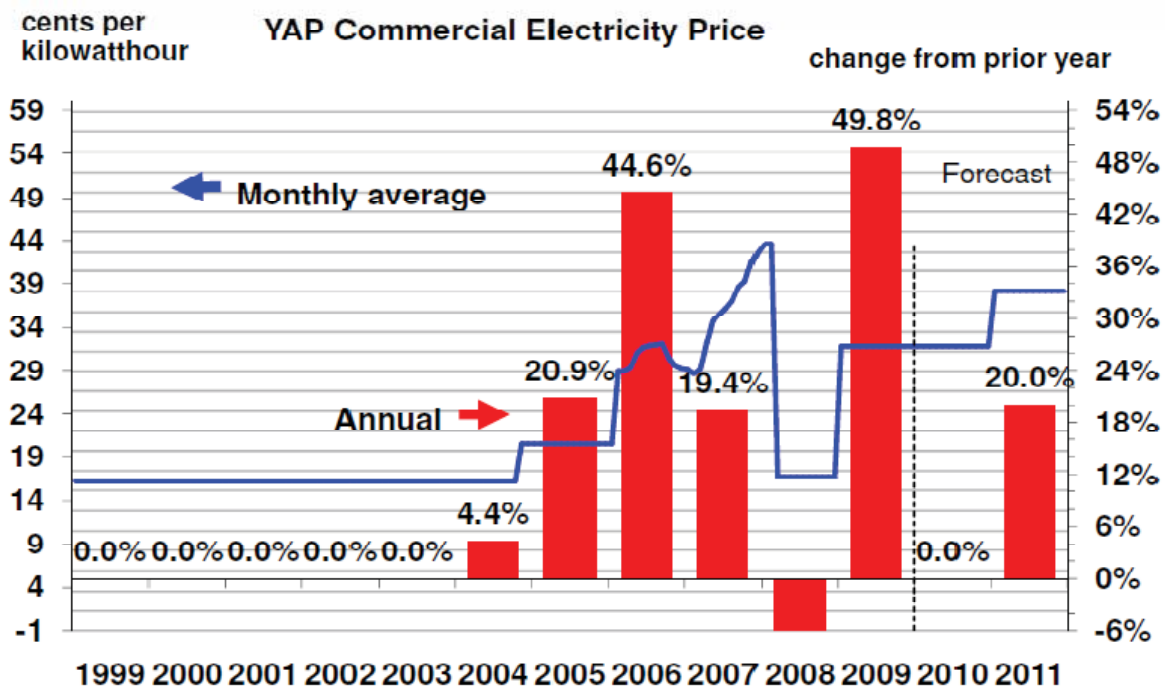

Table 16: Yap State Public Service Corporation – Commercial Electricity Rates Trend ('99 thru 2011)[5]

[5] See Note on Residential Tarifs footnoot [8]

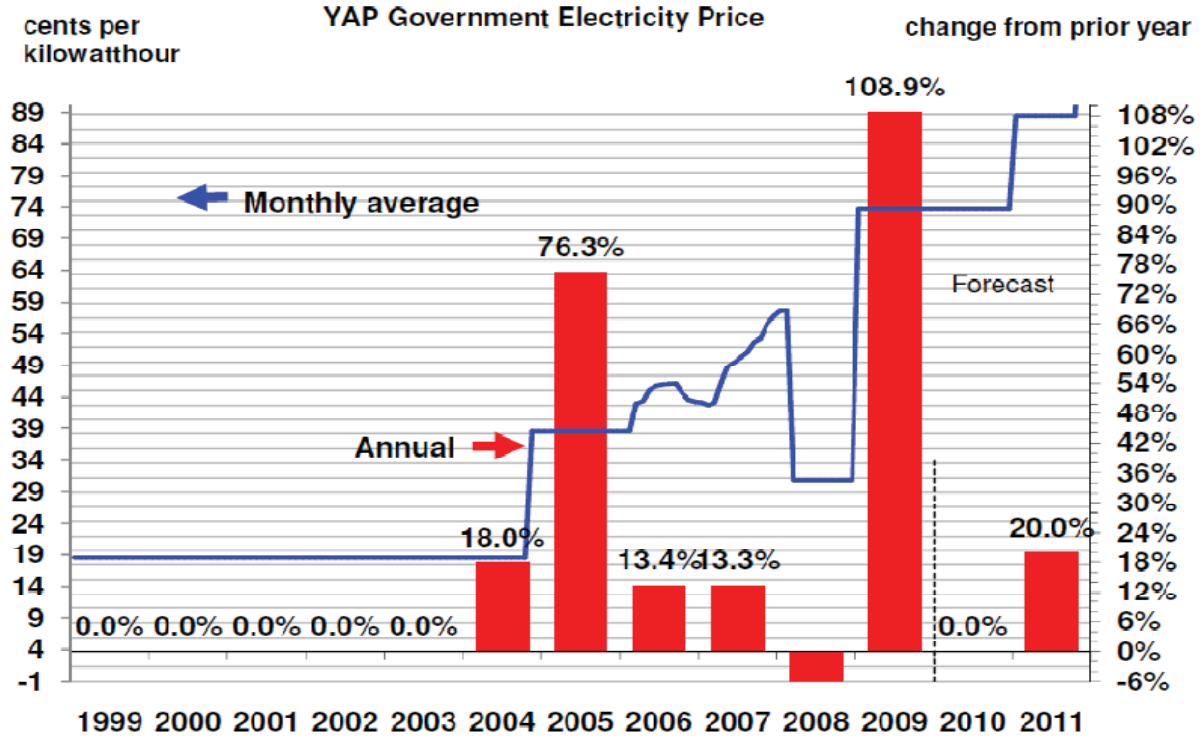

Table 17: Yap State Public Service Corporation – Government Electricity Rates Trend ('99 thru 2011)[9]

YAP STATE WIND MEASUREMENTS

Merry Tower 147 m	CH1 m/s	CH2 m/s	CH1 mph	CH2 mph
Jul-09	5.0	5.2	11.18	11.63
Aug-09	5.5	5.5	12.30	12.30
Sep-09	6.8	7	15.21	15.66
Oct-09	4.6	4.8	10.29	10.74
Nov-09	6.4	6.6	14.32	14.76
Dec-09	5.9	6.1	13.20	13.65
Jan-10	9.2	9.2	20.58	20.58
Feb-10	7.8	8	17.45	139.58
Average	6.5	6.6	14.48	14.65

Gagil Tower 80 m	m/s	mph
Jul-09	4.5	10.07
Aug-09	4.8	10.74
Sep-09	5.9	13.20
Oct-09	4.1	9.17
Nov-09	5.9	13.20
Dec-09	5.3	11.86
Jan-10	7.9	17.67
Feb-10	7.0	15.66
Average	5.7	12.69

Table 18: Yap State Wind Data, July 2009 – February 2010

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