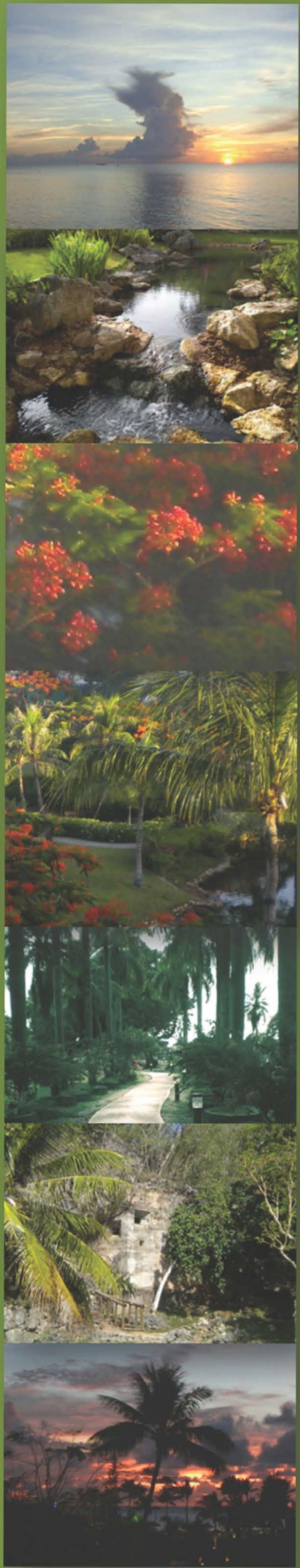

Commonwealth of the Northern Mariana Islands

Energy Action Plan

Misty Dawn Conrad and J. Erik Ness

Sponsored by the Department of the Interior Office of Insular Affairs

July 2013

Produced under direction of the U.S. Department of the Interior Office of Insular Affairs by the National Renewable Energy Laboratory (NREL) under Interagency Agreement IAG-10-1773 and Task No. WFF41010

This energy plan was prepared and facilitated by Misty Dawn Conrad and J. Erik Ness
of the National Renewable Energy Laboratory
under the guidance of the CNMI Governor's Energy Task Force

ACKNOWLEDGMENTS

The National Renewable Energy Laboratory (NREL) thanks the U.S. Department of the Interior's Office of Insular Affairs (OIA) for providing funding for this effort. In particular, NREL would like to thank OIA Assistant Secretary Eileen Sobeck for her vision and leadership in moving this energy document and planning process forward in the Pacific Territories.

NREL would like to acknowledge the valuable assistance of OIA staff: Director Nikolao Pula, Angela Williams, and Mark Brown.

NREL would also like to thank CNMI Governor Eloy Inos and the members of the CNMI Governor's Energy Task Force (listed in appendix A.1.) for their dedication to the ongoing energy transformation efforts in the CNMI.

In addition, the following NREL staff should be acknowledged for their roles in helping develop, review, and finalize this energy action plan: Caley Johnson, John Nangle, Judy Powers, Sheila Hayter, Randolph Hunsberger, and Stephanie Savage.

EXECUTIVE SUMMARY

This document describes the three near-term energy strategies selected by the CNMI Energy Task Force during action planning workshops conducted in March 2013, and outlines the steps being taken to implement those strategies.

This action plan incorporates several of the areas identified in the CNMI's Strategic Energy Plan as essential components of a comprehensive approach to developing energy security for the Commonwealth: outreach and education on energy issues, implementing energy efficiency technologies, and developing renewable energy generation.

The three energy strategies selected by the task force are:

1. Designing a demand-side management program focusing on utility, residential, and commercial sectors.
2. Developing an outreach and education plan focused on energy conservation in government agencies and businesses, including workplace rules.
3. Exploring waste-to-energy options.

The task force also discussed several other medium- and long-term energy strategies that could be explored at a future date. Those strategies are summarized in the Other Approaches section at the end of this document and will be formally explored within the next quarter.

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BACKGROUND: DEVELOPING A STRATEGY TO TACKLE RISING ENERGY COSTS

With the exception of a few small renewable energy systems, the CNMI is completely dependent on fossil fuels for meeting its energy generation needs. No natural oil reserves exist on the islands, forcing the CNMI to import all of its fuel oil at high shipping rates and prices. All of the electric power plants in the CNMI are powered by diesel fuel.

The 2008 energy crisis in the CNMI focused attention on the need to develop alternatives to the Commonwealth's near-100% reliance on fossil fuels. The CNMI recognized that creating energy security is critical for future economic development and sustainability, and that proper long-term planning is required to achieve desired success.

In March of 2010, the U.S. Department of the Interior (DOI) Office of Insular Affairs (OIA) sponsored a regional energy meeting in Golden, Colorado, that included the CNMI, American Samoa, and Guam. CNMI delegates from the Governor's Office, the Commonwealth Utilities Corporation (CUC), and the Northern Marianas College (NMC) met with representatives from the U.S. Department of Energy (DOE) and senior principals from DOE's National Renewable Energy Laboratory (NREL) to discuss ways to improve energy efficiency and increase the deployment of renewable energy technologies in the Pacific. As a result of this meeting, the CNMI Governor established an energy task force to help coordinate energy policy and promote long-term planning.

In the summer of 2010, OIA funded NREL to conduct an initial technical energy assessment for CNMI[1] that detailed energy consumption and production data to establish an energy baseline. This assessment was used to conduct an energy analysis that estimated the energy efficiency and renewable energy potential for the CNMI.

The CNMI's *Initial Technical Assessment Report* was published in July 2011, and was used by the CNMI Energy Task Force as the starting point for developing the *Commonwealth of the Northern Mariana Islands Strategic Energy Plan*, which was completed in 2012 and formally adopted in March 2013.

With continued funding from OIA and with the support of NREL staff, the CNMI Energy Task Force conducted action planning workshops in March 2013 to identify the near-term strategies that would likely have the greatest impact on reducing the CNMI's fossil-fuel energy consumption. Those strategies are described in detail in this document.

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[1] Ian Baring-Gould et al., *Commonwealth of the Northern Mariana Islands Initial Technical Assessment Report*. National Renewable Energy Laboratory, NREL/TP-7A40-50906, July 2011. http://www.nrel.gov/docs/fy11osti/50906.pdf

THE CNMI ENERGY TASK FORCE

The CNMI Energy Task Force (ETF) was established by Executive Order March of 2010. The task force's vision and mission are described below, and information about the task force members is contained in the appendices to this document.

Vision

To create a sustainable energy future for the CNMI.

Mission

The CNMI ETF is charged with the development and oversight of a strategic energy plan for the CNMI with the overarching goals of reducing dependence on imported fossil fuel and establishing a sustainable energy solution for the Commonwealth in the interest of improving quality of life and promoting economic prosperity. The ETF is also charged with assessing the efficacy of implemented energy strategies and with evaluating and recommending new approaches as appropriate.

THE ENERGY ACTION PLANNING PROCESS

After establishing an energy baseline and developing a strategic energy plan for the CNMI (described on page 1 of this document), the next step on the road to changing existing patterns of energy use is to create an energy action plan.

Unlike the strategic energy plan, which established the overall long-term goals for energy consumption and electricity generation in the Commonwealth, this action plan selects a handful of specific strategies that are achievable in the short term (1-2 years), breaking those strategies down into feasible incremental steps, identifying the desired outcomes, identifying the organizations and individuals responsible for implementing the actions, and setting a timeline for each step.

There are a variety of technological and non-technological options that can effect change in energy use. When evaluating technology options, the CNMI ETF focused on mature, proven energy efficiency and renewable energy technologies that are commercially available and financially viable today.

Care was taken to ensure that the actions selected were not duplicating existing efforts and that they leveraged work in other agencies and organizations as much as possible. The task force also gave considerable thought to ways of measuring the impact of the strategies in terms of reductions in fossil fuel consumption. The text within this document is representative of the collective voice of the ETF and energy action planning participants.

The CNMI energy action plan is a living document that will be regularly updated by the task force. Programs and strategies will be modified or replaced as the task force gathers new information about different approaches to reducing energy consumption and as new technologies for generating electricity and reducing energy consumption emerge, or existing, but previously impractical, technologies become commercially viable.

During deliberations at several action planning workshops held in March 2013, group consensus was reached on the three strategies described in the following pages.

STRATEGY 1. DEMAND-SIDE MANAGEMENT PROGRAM

During the action planning workshops, representatives of the Commonwealth Utilities Corporation (CUC) established that there would be a benefit to limiting the overall demand for electricity in CNMI. A demand-side management (DSM) program can help to accomplish this goal.

DSM refers to actions undertaken by a utility to change the level or timing of energy use on the customer side of the electricity meter, generally with the intention of optimizing existing and planned generation and transmission assets on the utility side of the meter. It encompasses utility-initiated actions to improve energy efficiency, increase energy conservation, and reduce peak electricity demand. Examples include rebates, incentives and utility investments that improve building shell insulation and the efficiency of heating and cooling systems, and rate structures that shift demand from times of peak energy use to off-peak hours.

DSM includes other load management approaches, such as direct load control systems that enable the grid operator to regulate the electricity used by individual appliances or equipment on customer premises (usually residences), and contractual arrangements that allow the utility to reduce demand by specific customers (usually businesses) through direct action by the grid operator (remote tripping) or by the customer voluntarily taking action to reduce demand when requested by the grid operator.

The ETF decided to focus on the following strategies:

- **Energy efficiency** — The process of using less energy to provide the same service, or using the same amount of energy to provide more services. Energy efficiency typically requires the use of a different energy technology or using existing technology in a different way. For example, a compact fluorescent light (CFL) or light-emitting diode (LED) bulb is more energy efficient than a traditional tungsten incandescent light bulb because it produces the same amount of light (measured in lumens) using significantly less electrical energy.
- **Energy conservation** — The process of using less energy by reducing or going without a service. Energy conservation typically requires a change in behavior or not using an existing technology, e.g., turning off a light, using the stairs instead of taking the elevator, or turning up the thermostat on an air conditioner. Popular approaches to accomplishing energy conservation goals include: (1) educating people about how to conserve energy, and (2) implementing non-energy-consuming technologies such as cool roofs, which reduce the need for air conditioning.

The ETF chose to implement three specific actions as part of CNMI's DSM program.

A. Simplify the Process of Purchasing Energy-Efficient Equipment

There are a wide variety of energy-efficient products that can reduce the demand for electricity, ranging from straightforward drop-in solutions, such as energy-efficient lighting (e.g., CFL and LED bulbs), to solutions requiring more assistance, such as installing more-efficient motors in water pumping stations.

Responsible for coordinating implementation:

Commonwealth Utilities Corporation

Potential challenges:

- Customers may get the efficient equipment and "go dark," i.e., stop paying their bill. Sometimes when a customer has significant trouble paying their utility bill, they drop the account and another family member starts service at the same address. This is also referred to as the "name change game." It isn't usually worth the legal fees to recover the unpaid sums.
- Projected savings are often higher than actual savings. When customers have initially lower electricity bills due to use of efficient equipment, some will be less watchful about monitoring their overall electricity use, leading to a partial increase in energy use above the potential savings.

Proposed solutions and specific actions:

- Modifying the disconnection policy to make it more difficult to play the "name change game."
- Educating consumers about monitoring their overall electricity use could help mitigate the risk of not realizing all potential savings from the use of more-efficient equipment.

B. Outreach and Education on Efficiency and Conservation

Education is an essential component of a DSM program. This action item focuses on educating residential and commercial users of electricity about energy efficiency and conservation options available to them. Specific messages include encouraging consumers to implement measures such as cool roofs (300 homes already use this technology), which use reflective paint to reduce heating from solar radiation, and weatherization (1,000 homes already implemented).[2] Weatherization involves a variety of measures, such as sealing air gaps and insulating exposed pipes, that are designed to reduce air infiltration and heat exchange between the building and the outside air.

There is some overlap between strategy 1.B and strategy 2.B, which is a campaign focused on reducing energy use in the commercial sector.

Responsible for coordinating implementation:

Commonwealth Utilities Corporation

Potential challenges:

- Community mistrust of CUC motives.
- Evaluating the effectiveness of the outreach and education program.

[2] CNMI Energy Office

C. Install More Prepaid Meters

Another option for promoting energy conservation is to purchase and install prepaid electrical meters in residential, commercial, and governmental buildings.

There are two strong reasons for installing more prepaid electricity meters:

- Electricity consumers are more likely to reduce consumption if they have the opportunity to establish which activities use more electricity. Typically, demand drops 15%-20% shortly after a prepaid meter is installed.
- Installing a prepaid meter before providing energy-efficient equipment will help ensure that energy customers actually pay their bill.

Prepaid electricity meters cost approximately $350 each. There are currently about 1200 prepaid meters installed system-wide (throughout CNMI), with a waiting list of 700 customers who want these meters. CUC does not charge existing customers to install the meters and there is no extra charge to the customer if a prepaid meter is installed at a new service address.

Responsible for coordinating implementation:

Commonwealth Utilities Corporation

Potential challenges:

- The existing prepaid meter is good quality but the keypad used to restart electricity service is delicate and has a tendency to break.
- It is easy to tamper with some of the meters. They use a 24-digit code, and some people have figured out how to break the code.
- Responding to telephone requests to recharge accounts in a timely manner. The delay to recharge accounts in Rota and Tinian is the greatest.

Proposed solutions and specific actions:

- CUC is in the process of switching to a different type of prepaid meter. As of March 2013, there are roughly one thousand of these new meters in a warehouse waiting to be installed. With the new type of meter, customers who have a credit card can recharge the account on line or through a phone call instead of punching a code into the meter itself.

Strategy 2. Outreach to Government and Commercial Sectors

A. Change Energy Consumption Patterns in Government Offices

Energy consumption in the government sector is rising. Government agencies represent 5% of the connections to the CUC grid (total number of meters) and 22% of the total energy consumption in the CNMI (measured in kilowatt-hours). A sustained outreach program aimed at government agencies could potentially lead to substantial savings in total energy consumption.

Outreach messages could include providing examples of the dramatic energy savings already experienced by some energy users. The Northern Marianas College, for example, has reduced energy consumption by 20% through simple conservation strategies such as rules requiring that air conditioner thermostats be set at 23°C or higher and air conditioners be turned off completely until 10 AM.

Possibilities suggested by the ETF include:

- **Recommending efficiency and conservation measures** — Examples include encouraging or requiring government offices to install LED lights on timers, and install timers on air-conditioning units with thermostat settings that cannot be overridden.
- **Creating a competition between government departments** — This strategy would involve giving rewards and recognition to those departments that reduce energy use the most.
- **Installing prepaid meters in government offices** — This strategy would be relatively inexpensive for single-phase power but expensive for three-phase power. CUC estimated that it could afford to install approximately 300 prepaid meters in agency buildings. Three-phase power prepaid meters cost at least $35,000 so it is not viable to install these meters.

The details of the outreach program will be developed by the strategy coordinators.

Responsible for coordinating implementation:

CNMI Energy Office

Potential challenges:

- Enforcement — There is already a 10% energy reduction mandate that is not being observed.

Proposed solutions and specific actions:

- Require that division heads receive a copy of utility bills, so that a person with authority to implement energy-saving reductions is made aware of how much energy is being used from month to month. Utility bills are currently sent to the finance offices, which have no decision-making authority.
- Develop a proposal outlining achievable short-term initiatives that could reduce energy consumption, including a possible timeline for implementing each step, and report back to the ETF to discuss resources needed to carry out the plan. Utilize the existing structure of the Energy Marshalls. [Responsible parties: Vince Attao, CNMI Energy Office; Esther Fleming, Governor's Office]

Reporting on progress and measuring impact:

The impact of this strategy can be tracked through reductions in energy use from the time the strategy is implemented, as indicated by utility bills for individual electricity users.

B. Create a Competition Amongst Businesses and Institutions to Reduce Energy Use

Energy consumption in the commercial sector is declining. This trend needs to be encouraged. There is some urgency about this because there is a possibility that hotels that are currently self-generated could be required to connect to the grid.

Developing laws to mandate energy reductions in the commercial sector would likely take some time to implement, and could be difficult to enforce. The ETF decided that action needs to be taken quickly, and the most promising strategy is to create a competition between commercial users of electricity, with rewards and significant public recognition given to those who reduce their energy use the most. This strategy would include education about some straightforward ways to reduce energy consumption.

Outreach messages could include providing examples of the dramatic energy savings already experienced by some energy users. For example, the public school system accomplished energy savings of 40% by installing timers on their air conditioners, painting roofs white, and implementing weatherization measures.

The details of the competition will be developed by the strategy coordinators.

Responsible for coordinating implementation:

Saipan Chamber of Commerce

Potential challenges:

- Designing an effective competition.

Proposed solutions and specific actions:

- Create a plan including details about how to structure the competition, the types of incentives and rewards to be included, and a timeline for implementation, and report back to the ETF to discuss resource needs and identify which individuals will be responsible for each step.

Reporting on progress and measuring impact:

The impact of this strategy can be tracked through reductions in energy use from the time the strategy is implemented, as indicated by utility bills for individual electricity users, and by overall statistics for the commercial sector that are available from CUC.

Strategy 3. Explore Waste-to-Energy Power Generation

Waste-to-energy (WTE) power generation provides baseload power and could make productive use of some of the trash that is currently disposed of in landfills.

WTE power generation encompasses a wide variety of technologies, including anaerobic digestion of organic wastes and sewage, landfill gas (methane) capture, direct combustion (incineration), co-firing with other fuels (such as biomass or coal), gasification (to produce a combustible gas), and pyrolysis (producing bio-oils that can be used to generate electricity). The viability and applicability of each technology varies depending on the type of waste available.

WTE projects have dual advantages for CNMI: increased baseload power generation and a reduction in the amount of trash being landfilled, which would prolong the life expectancy of the Marpi landfill. Technologies that could make use of the trash at the closed Puerto Rico dump are particularly attractive.

The ETF decided to focus first on an existing WTE project that is already under consideration, and to consider other WTE strategies later (described in the Other Approaches section).

Investigate the Advantages and Disadvantages of the Existing WTE Plasma Gasification Proposal

Alliance Federated Energy (AFE) has proposed 1 MW WTE power plant for CNMI using plasma gasification technology, to be implemented in two stages (500 kW each). AFE estimates that it could generate up to 5 MWh of electricity per day assuming a daily supply of 100 tons of trash, based on a waste characterization study that AFE carried out in 2011. AFE would cover the costs of building the plant and the onus is on CNMI to provide the trash to the power plant.

Tipping fees are usually essential to making the economics of a WTE plant work, and the project proposal gives AFE permission to negotiate new tipping fees with the Department of Public Works (DPW). The proposed waste feedstock agreement is for a minimum of 15 years, and a power purchase agreement (PPA) guaranteeing an electricity price of 15 cents/kWh is ready to be signed. However, the project has stalled.

The ETF decided to investigate the implications of the proposal for CNMI, including the possibility that higher tipping fees could result in more illegal dumping, and evaluating whether or not there are risks to the CNMI in signing the PPA.

Responsible for coordinating implementation:

This strategy has two co-champions:

- CUC (interested in the possible baseload power generation)
- DPW (interested in the possible trash reduction)

Potential challenges:

- Plasma gasification of waste to produce electricity is not a mature technology, so there are questions about the reliability of the technology.

- There may not be enough trash to generate power at the levels anticipated by AFE. DPW estimates that there is currently 81 tons of trash brought to their facilities daily, but this estimate needs to be updated.
- Possible air quality impacts of the plant.
- Political resistance — CUC was told to cancel the procurement. There has been political interference with many power projects over the past 20 years. If there is a protest from someone in the government, it typically takes about a year to resolve the dispute.
- Public resistance — This could stem from (1) a lack of familiarity with the technology, and (2) resistance to potentially higher tipping fees, which could also lead to more illegal dumping.

Proposed solutions and specific actions:

- Immature technology — May not be an issue, as CUC is only required to buy what the plant produces, but if tipping fees are raised significantly to make the power plant viable this could have undesirable consequences. CUC would like NREL to review the proposed PPA for any pitfalls as NREL has considerable experience with a variety of PPAs.
- Not enough trash — DPW will carry out a review to ascertain how much trash is currently being delivered to their facilities.
- Air quality issues — The Division of Environmental Quality (DEQ) will be engaged to investigate this issue.
- Political resistance — This is less likely now because there is a new administration, but the workshop participants discussed asking the Governor to empower the ETF to make final decisions about energy development in the CNMI.
- Public resistance —Consumers are expected to accept any WTE project that reduces their power bill. Concerns about the technology could be addressed through education, and the risk of illegal dumping could be mitigated by raising the fee for littering and creating more in-village trash collection sites. The proposed AFE facility would be located in the north of Saipan, so the network of trash collection points needs to be expanded.
- CUC and DPW will develop a plan outlining the various issues that need to be investigated and addressed. The plan will include a timeline for investigating each issue. CUC and DPW will present the plan to the ETF for formal adoption and identification of any additional resources and support that might be needed to implement the plan.
- CUC and DPW will suggest to the Governor that the CUC Board be reinvoked and members appointed. The last time the CUC Board convened was in 2006. The new board could then help to speed up investigation of the AFE proposal. The Governor would need to lift the emergency order before the board could be reinstated.

Reporting on progress and measuring impact:

As this strategy is purely investigative in nature, it will not have an impact on fossil energy consumption unless the outcome of the investigation is to move forward with the AFE proposal.

OTHER APPROACHES

A wide variety of strategies were discussed during the energy action planning workshops, some of which were tabled by the ETF for consideration once implementation of the first three strategies is well under way. This section lists strategies that will be discussed later to determine which of the strategies will be implemented next alongside other strategies described in the CNMI strategic energy plan.

- **Develop an integrated resource plan for the CNMI** — The CNMI energy action plan is the precursor to developing an integrated resource plan (IRP) that will create a roadmap for project identification and completion. An IRP would be an opportunity for CUC to review options for generation type and mix, associated issues with system integrity and losses, conservation, generation ownership and operation, and financing in a holistic and integrated fashion while combining solid technical review, energy forecasts, and economics to determine short-, medium-, and long-term effects of new baseload alternatives. It would incorporate strategies for the CNMI to reduce fossil fuel dependency while providing reliable generation and distribution at the least cost possible for consumers.
- **Investigate options to add more baseload power generation in the CNMI** — All of these options would take longer than two or three years to implement or were considered less pressing than the three strategies selected for immediate implementation. CUC is about to enter into a new contract with Mobil to buy diesel fuel for power plants; some of these options may allow CUC to reduce the size of the next fuel-purchase contract to be negotiated when this new contract expires in four years. Many of these technologies would be investigated during the preparation of a CNMI IRP.
    - **Liquefied natural gas (LNG)** — This technology could be viable for the CNMI. Most LNG tankers being used today carry 160,000 cubic meters or more of LNG, which requires the development of expensive port facilities to receive and store deliveries of LNG, but the newest generation of LNG tankers carries only 10,000 cubic meters of LNG, significantly reducing the cost of the required port facilities. The CNMI could issue an RFP to ascertain likely costs. One factor to consider is that the CNMI is most likely to receive its LNG from Asia, where LNG is roughly five times the cost of LNG from the US mainland and trending up very quickly.
    - **Nuclear power** — Investigate two proposed nuclear power technologies: (1) small modular nuclear reactors, and (2) nuclear fusion plants, to ascertain the viability of using these technologies in the CNMI.
    - **Geothermal energy** — May be an option for baseload power generation. However, various geothermal energy experts have said that the maximum potential generation capacity in the CNMI is likely to be in the order of 5 MW, in which case it would be uneconomic to build a geothermal power plant. The accuracy of this evaluation needs to be determined.

- **WTE** — Investigate WTE power generation technologies other than plasma gasification.
  - This would include carrying out detailed waste characterization studies, which are essential before the most appropriate WTE technology can be chosen. The quantity and type of waste is currently uncertain. A public waste characterization study was carried out around the year 2000, but that information is now out of date. AFE carried out a study in 2011 in connection with its proposed plasma gasification plant, but that information is proprietary.
  - It would be a good idea to evaluate the viability of a WTE project on Rota, partly to reduce the quantity of waste being sent to Saipan on barges.
  - Conduct a WTE analysis and develop a WTE project plan. The initial objective would be to conduct a waste-stream analysis on Saipan and Rota including, but not limited to, issuance of a request for proposal (RFP) from private-sector professionals to establish composition, tonnage, and moisture content of waste streams. This work would be followed by a technical review of appropriate technologies, load, and economic forecasting to identify possible solutions.
- **Investigate other renewable energy technologies:**
  - **Solar hot water systems** — As an alternative to using electricity to heat water.
  - **Distributed photovoltaic (PV) power** — According to CUC, the grid cannot currently accommodate any more centralized solar electric systems (6 MW to 7 MW of projects are already planned), but distributed PV power generation systems likely won't add stress to the grid so may be viable.
- **Implement additional utility efficiency initiatives** — Expand the work CUC is already doing to improve efficiency in power generation and reduce losses in transmission and distribution systems.
  - **CUC to size, purchase, and install new electricity transformers serving homes and businesses** — This includes the "right sizing" of transformers for current loads, which would reduce technical loses, providing more efficient and reliable electrical service.
  - **CUC to install new fuel pumping equipment on diesel generators** — This project would accelerate conversion of these generators to ultra low sulfur diesel (ULSD fuel). Converting the generators to ULSD would not only reduce carbon emissions; it would be part of a larger program to increase engine efficiency and reduce the overall use of fossil fuel.
- **Reduce theft of electricity** — Expand inspection and monitoring of energy use to reduce the number of residential customers who steal power (currently roughly 10% of customers).
- **Reduce baseload electricity used to distribute water** — It currently costs $6 million per year to deliver water (roughly 60 cents on average per 1000 gallons pumped into a residence). This is just the electricity cost of delivering water; there are also costs associated with chlorination and pipe maintenance. Options could include pumping water using PV or wind energy.
  - Identify and install energy efficient equipment on CUC water and wastewater facilities.
  - Employ modular PV systems on remote CUC well sites and various wastewater pumping and treatment facilities.

- **Develop an energy efficiency portfolio standard (EEPS)** — This could also be used as an opportunity to rewrite the renewable energy portfolio standard (RPS) so that energy savings via conservation or energy efficiency would be an acceptable alternative to renewable energy for meeting overall fossil-fuel reduction targets
- **Create new laws mandating cuts in energy use** — These laws should focus on reducing energy consumption in the government and commercial sectors. This is a major undertaking unlikely to be accomplished over the next couple of years.
- **Change the structure of the CUC Board** — Use elected commissioners as is the case in Guam. Past Boards have consisted of political appointees who have a tendency to implement their own agendas instead of focusing solely on the benefits to CNMI of specific energy strategies. This approach would take some time as it would require a change in the current law.

APPENDICES

A.1. Participants in the CNMI Action Planning Workshops

Vincent Attao

Deputy Director, CNMI Division of Energy, CNMI Department of Public Works

Mr. Attao first began working for the Energy Division in late 2009 as an Energy Auditor under the State Energy Program. In late 2010, he was appointed Deputy Director of the Division to oversee the Energy Efficiency and Conservation Block Grant Office.

Pamela Brown

Acting Field Representative, Office of Insular Affairs, U.S. Department of the Interior

Ms. Brown is also the Federal Labor Ombudsman for the Marianas, a former Attorney General of the CNMI, and former Legal Counsel to Governor Juan N. Babauta. She has lived in the CNMI for 24 years and is a licensed Attorney.

Frank Dela Cruz

Vice Speaker, 18th CNMI House of Representatives

Mr. Dela Cruz is also the Vice Chair of the House Public Utilities, Transportation and Communications Committee, a position he also held during the 15th CNMI Legislature. He is a four-term Congressman.

Christopher Leon Guerrero

Representative, 18th CNMI House of Representatives

Joseph P. Deleon Guerrero

Speaker of the House, 18th CNMI House of Representatives

Lorenzo Deleon Guerrero

Representative, 18th CNMI House of Representatives

Mr. Guerrero is also the Chairman of the Public Utilities, Transportation and Communications Committee (PUTC), Vice Chairman of the Federal and Foreign Relations Committee, a member of the Education, Judiciary and Government Operations Committee, and Chairman of the PUTC Committee of the Saipan 3rd Senatorial Legislative Delegation.

Dr. Sharon Hart

President, Northern Marianas College (NMC)

Prior to her tenure at NMC, Dr. Hart served as President of Middlesex Community College in Connecticut, President of the North Dakota State College of Science, and Deputy President of the University College of the Caribbean in Jamaica. Dr. Hart is a commissioner to the Western Interstate Commission of Higher Education. Her doctorate is from the University of Illinois.

Thelma B. Inos

Director, CNMI Division of Energy, CNMI Department of Public Works

Ms. Inos has worked for the Division of Energy of the CNMI Department of Public Works for more than 20 years and has been the Director for the past 10 years.

Frank Rabauliman

Director, CNMI Division of Environmental Quality

Mr. Rabauliman oversees the operation and administration of environmental programs in the CNMI. He has held this position since 2006.

Alex Sablan

President, Saipan Chamber of Commerce

Mr. Sablan is also Vice President of the Tan Holdings Corporation.

Pete A. Tenorio

Senior Policy Advisor to CNMI Governor Eloy Inos

Charles Warren

Chief Financial Officer, Commonwealth Utilities Corporation

Mr. Warren has over 30 years of senior finance and operations experience, and has been CFO of CUC since early 2010. He has twice been named to *Pacific Magazine*'s list of "Pacific People You Need to Know".

Wallon Young

Deputy Director for Power, Commonwealth Utilities Corporation

A.2. Fossil Fuel Consumption Scenarios: Wedge Analysis

The purpose of this "wedge" analysis is to show, in graphical form, the likely impact of measures taken to reduce the use of fossil fuels. After an alternative technology or policy is implemented, it usually creates an irregular-looking wedge on the graph, hence the name given to this type of analysis.

General Methodology and Assumptions

The wedge analysis for CNMI was performed by NREL using information provided by the CUC and other stakeholders. The first wedge analysis was developed for CNMI's strategic energy plan using 2010 data and covered the period from 2010 to 2026. Subsequent analyses cover the period from 2010 to 2025. The first wedge analysis established a business as usual (BAU) or base case against which the impact of any actual and proposed changes to CNMI's energy consumption patterns can be compared. Those changes could be the result of energy efficiency measures, energy conservation, or expanded use of alternative power-generation technologies.

Energy can be measured using a variety of units, such as kilowatt-hours or kWh (for electricity) and British thermal units or Btu (for heat energy). Units of energy can readily be converted into each other.

As both the earlier strategic energy plan and this action plan focus on fossil-fuel reduction, the analysis illustrates the consumption of electricity in barrels of oil equivalent (BOE) through 2025. BOE is a unit of measure that indicates how many barrels of oil would need to be consumed to meet the total demand for energy. Electricity generation from non-fossil-fuel technologies (such as solar arrays or waste-to-energy plants) and electricity generation avoided through efficiency and conservation measures are converted to BOE. The charts assume 5,800,000 Btu for every barrel of oil.

The graphs in this action plan are visual representations of a wedge analysis performed in 2013 using updated information. They cover the period from 2010 to 2025, and reflect actual changes in power generation and energy use by sector from 2010 to 2012 as supplied to NREL by the CUC, with projections for the future based on information from the CUC and other official sources.

CNMI has experienced declining electricity demand since 2010. However, for the purposes of this analysis, energy use is assumed to remain constant at 2010 levels due to uncertainties regarding whether there will be further declines in consumption or increases as a result of potential future economic growth. The wedge analysis provides a high-level perspective depicting potential fuel reductions from various commercially available and ready-to-deploy technologies. It assumes no major fluctuations in fuel prices and uses the average fuel cost for the past 10 years.

Base-Case Scenario

In the base-case scenario (figure 1), it is assumed that no significant steps are taken to curb fossil fuel use. This scenario depicts the business as usual energy consumption pattern as it was in 2010 — in other words, the energy consumption level and sources are assumed to be unchanged during the years from 2010 to 2025.

The base case graph is a solid blue color, reflecting the fact that CNMI’s electricity was generated almost exclusively from fossil fuels in 2010.

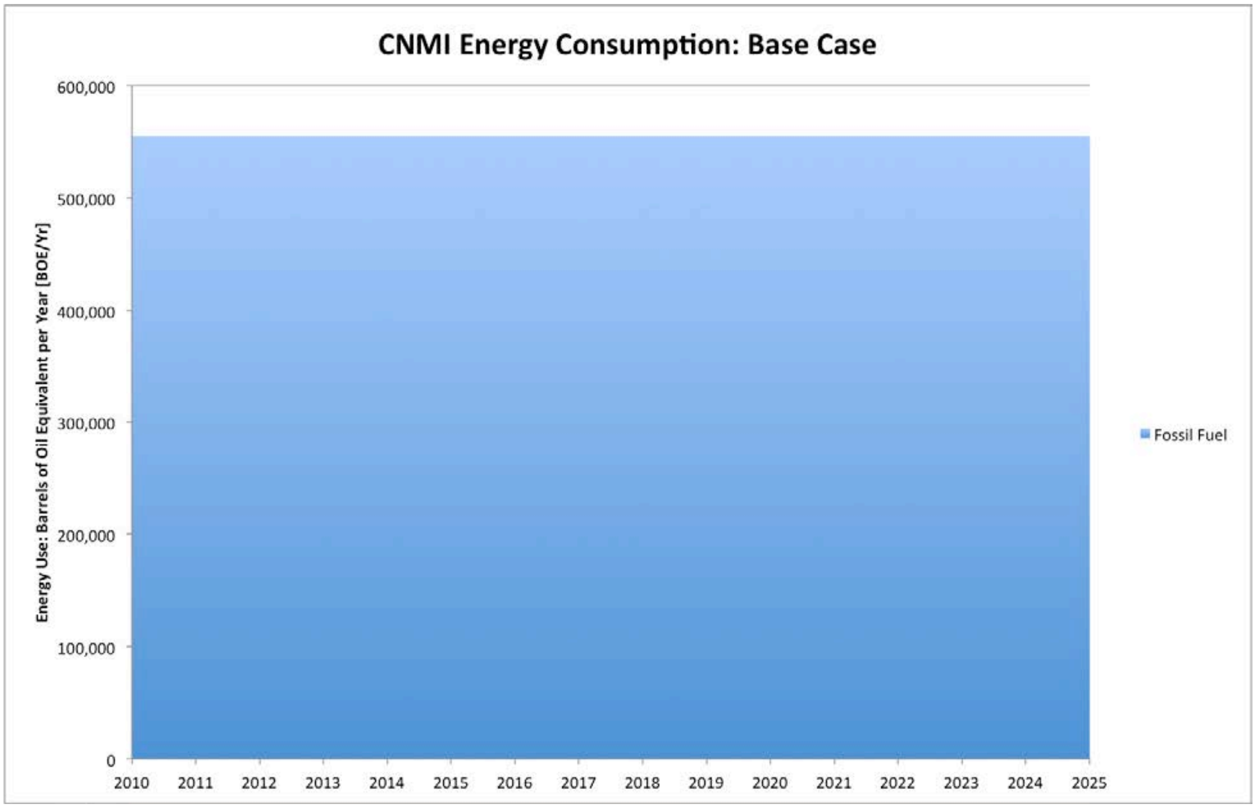

Figure 1. Base Case

Future Scenario

In the future scenario (figure 2), the overall shape of the graph is the same as the base case in figure 1, with the level of electricity consumption in 2010 projected out to 2025. That is the top edge of the graph. The graph has been updated with actual energy consumption and generation data from 2010 to 2012. The purple area at the top of the graph shows the drop in energy demand during those two years.

Projected data is used for the period from 2012 to 2025. Both actual and projected data can be updated each year as more information becomes available. Future projections derive from communication and published information from CUC and other official sources regarding planned efficiency upgrades to electricity generators, legally binding contracts or laws governing additions of renewable energy generation to the electricity grid or observed additions initiated by electricity consumers, and the anticipated impact on energy demand of energy efficiency and conservation measures stemming from this action plan.

The actual criteria included in the future projection in this action plan are described in the methodology and assumptions section below the graph. The actual energy demand in 2012 is projected forward to 2025 as a fixed percentage of the total BAU energy demand, which means that the thickness of the "demand reduction" wedge is a fixed proportion of BAU demand.

Because there are currently no legally binding contracts requiring future implementations of renewable energy, efficiency or conservation, the future scenario graph shows a fixed-thickness thin line of renewable energy carrying forward to 2025, reflecting the future impact of measures already implemented by 2012. If additional renewable energy generation were to replace fossil fuel generation, the red renewable energy line would become an expanding wedge.

Because of inefficiencies in the process of power generation and transmission as well as other system losses, approximately 1.107 MWh of electricity must be produced for every 1 MWh of electricity that is sold. Total losses are thus roughly 11%. This means that installing on-site power generation from renewable resources (e.g., net-metered PV systems) produces a disproportionate reduction in CNMI's fossil fuel consumption.

This point is quite significant:

> ***Each unit of electricity generation from on-site renewable resources results in a 111% reduction in units of fossil fuel consumed to generate electricity*.**

The renewable energy and energy efficiency measures already implemented in the CNMI by 2012 are reducing the Commonwealth's fossil fuel consumption by 10,257 barrels of fuel oil each year. This translates into a fuel cost savings of approximately $1,446,000.

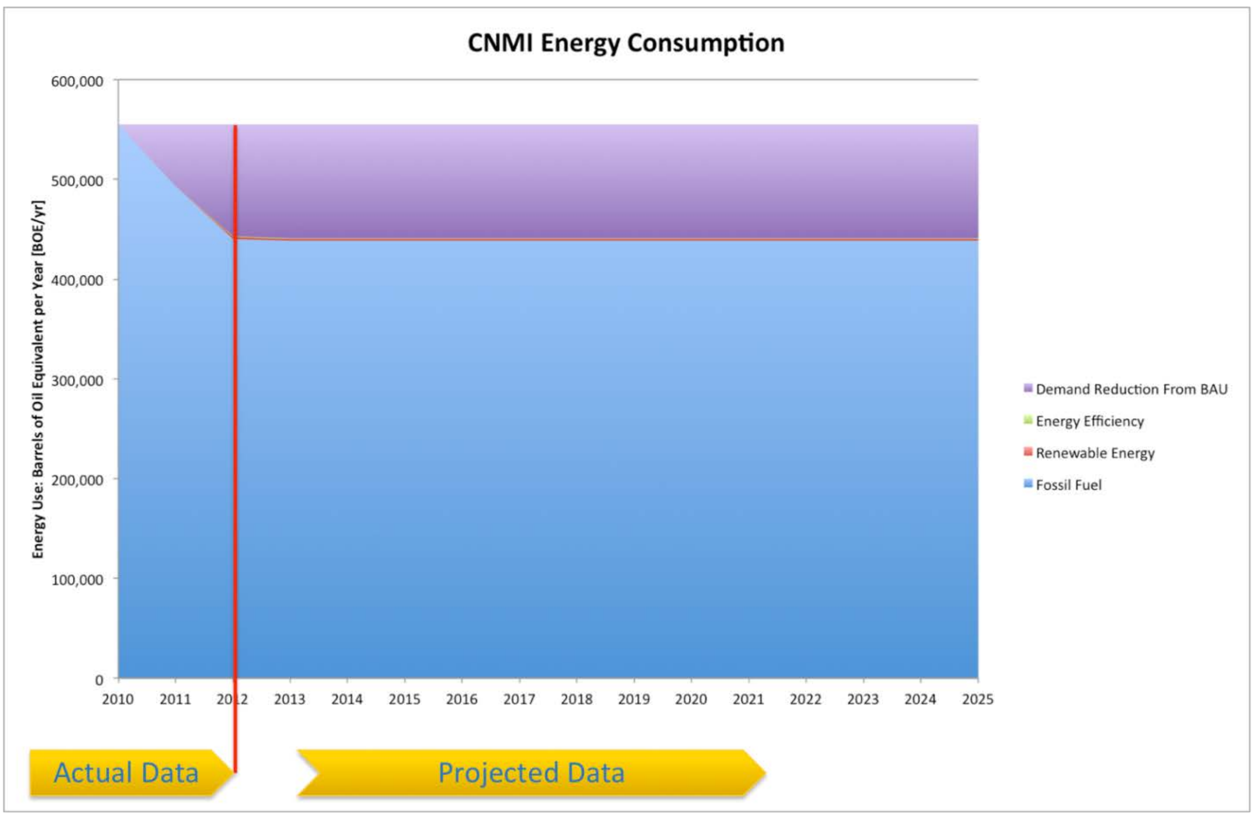

Figure 2. Future Scenario

Methodology and Assumptions for the Future Scenario

This section walks through the key calculations used to develop the graph in figure 2.

Assumptions Included in the Future Scenario

Installed fossil-fuel saving measures:

- LED streetlight project, which has been documented in news articles[3]. Data on the project was provided by CUC.
- A total of 2.8 MW of net-metered PV systems with data provided by CUC.

Calculation of Fuel Savings from Renewable Energy and Energy Efficiency Measures

Calculations use fuel cost data for 2010-2012 as provided by the utility:

CNMI Average Fuel Costs [$/bbl[4]]		
2010	**2011**	**2012**
101.10	138.70	141.10

The calculations also use electricity generation data provided by the utility:

2012 Fuel Generation Data – CNMI	
Total Electricity Generation [MWh]	247,901
Total Net Electric Sales [MWh]	224,002
Generation Efficiency (Heat Rate) [MMBtu/MWh]	8.997

In 2012, the CNMI generated 247,901 MWh of electricity, of which 224,002 MWh was sold.

The ratio of generated power to net sales can be used to derive a single number that summarizes the approximate transmission and distribution system losses, losses in the electricity generating process, and other losses associated with the avoided energy generation:

247,901 generated MWh/224,002 sold MWh

= 1.107 generated MWh/sold MWh

In other words, 1.107 MWh is generated for every 1 MWh sold.

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[3] http://www.mvariety.com/cnmi/cnmi-news/local/49706-cuc-installs-over-1000-led-streetlights.php

[4] barrels

It is assumed that the renewable energy and energy efficiency systems reduce total energy consumption, offsetting transmission and distribution losses as well as the cost of fuel required to generate the electricity.

Net-metered PV estimated annual energy production:

2.8 MW * 8760 hrs * 0.16 capacity factor = 3,924 MWh

Due to the 10.7% losses associated with conventional power generation and delivery, the 3,924 MWh of electricity produced by the PV system offsets a greater amount of fossil-fueled generation (assuming the PV is installed at or close to the point of use, which it is) :

3,924 MWh * 1.107 = 4,344 MWh of conventional generation offset by on-site PV generation

It is reasonable to assume a linear relationship between electricity generated and the fuel consumed to generate that electricity. The model is evaluating electricity generation (and fuel savings) at the margin, so power plant efficiency will not be impacted significantly by an incremental increase or reduction in power plant output.

According to CUC, total fuel consumption for power generation was 440,248 barrels in 2012, and total electricity generation was 247,901 MWh.

The barrels of fuel oil that would have been required to generate the 4,344 MWh offset by PV is thus:

(4,344 MWh/247,901 MWh) *440,248 bbl = 7,715 bbl

The fuel savings information related to the LED streetlights was provided by CUC via an email to NREL on March 11, 2013. The utility estimates an annual fuel savings of 106,761 gallons (2,542 barrels) from the streetlights. This amounts to 0.6% of the 2012 fuel consumption of 440,248 barrels.

Total fossil fuel consumption offset by the PV systems and LED streetlights is thus:

7,715 bbl + 2,542 bbl = 10,257 bbl

The associated fuel cost savings is calculated using the average cost of fuel for the CNMI in 2012:

10,257 bbl * $141.10/bbl = $1,446,237

PHOTO CREDITS

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Appendix A.1: All workshop participant photographs are by Angela Williams except for the photograph of Sharon Hart, which is courtesy of Northern Marianas College.

NATIONAL RENEWABLE ENERGY LABORATORY — LEADING CLEAN ENERGY INNOVATION

Prepared by the National Renewable Energy Laboratory (NREL), a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC. NREL is the U.S. Department of Energy's primary laboratory for renewable energy and energy efficiency research and development.

15013 Denver West Parkway, Golden, CO 80401 • 303-275-3000 • www.nrel.gov

NREL/MP-7A40-59193 • July 2013