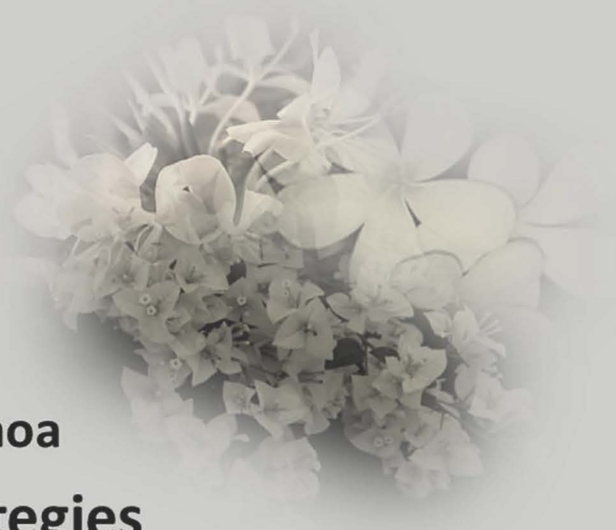

American Samoa

Energy Strategies

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Introduction

In recent years, global energy prices have become increasingly volatile. Due to fluctuating energy prices, global competition is at its highest. In 2008, a global fuel price increase impacted American Samoan government budgets and when a tsunami hit in September 2009, it crippled American Samoa industry and government, impacting the welfare of American Samoa's citizens.[1]

Natural disasters have been occurring more frequently and with greater intensity, threatening the stability of fuel sources, and the reliability and affordability of electricity generation. Rapid changes in cost or availability of energy can have serious effects on an entire community. This strategic energy plan recognizes the significance of these past occurrences, the effect they had on American Samoa's economy and the community, and the increasing likelihood they will happen again. American Samoa's response to this will be what defines and determines its quality of life and economic future.

This strategic energy plan also addresses the imminent crisis at the Futiga landfill. The Futiga landfill is the only on-island landfill and is predicted to reach capacity by 2015. Because solutions to the landfill crisis may be found in waste-to-energy (WTE) technologies, the American Samoa Renewable Energy Committee (ASREC) determined the strategic energy plan should be deployed to preemptively address the crisis and assist the government in finding a solution.

Meant to be a fluid foundational document, this strategic energy plan lays out a variety of strategies that should be revisited and updated appropriately. Subsequently, energy action plans are being developed that will implement these strategies. The energy action plans are meant to be much more detailed and specific, assigning specific tasks to particular individuals with detailed deadlines. ASREC will review the status of the energy action plan monthly to report on progress. The energy action plan is the tool that will bring the strategic energy plan to life and keep it moving forward. It is important for ASREC to provide strong leadership to ensure this plan is successfully implemented.

The strategic energy plan for American Samoa considers solutions that are needed in the near future. Therefore, the plan will initiate strategy and actions toward achievable goals to be completed by October 2016. ASREC recognizes the more complicated the plan becomes, the less likely it is to be realized. Great effort was made to keep the strategic energy plan simple and solutions short term; greater detail can be found in the resulting energy action plan. It is also noteworthy that the direction the strategic energy plan lays out was decided under current circumstances. As circumstances change, the plan must change as well. The flexibility of the plan is of high importance and will lead to future success in the plan's development and implementation.

[1] "USGS Scientists in Samoa and American Samoa Studying Impacts of Recent Tsunami, October-November 2009." U.S. Department of the Interior, 2010. http://walrus.wr.usgs.gov/news/samoareports.html.

With the development and release of this plan, American Samoa is pursuing a path of sustainability that will ensure the needs of the present are met while preparing for the needs of future generations. This path will also lead to economic security through stable energy pricing and reliable electricity production. Energy intersects with every sector of a community. There are far-reaching consequences when prices soar. Stability is threatened and environmental impacts increase. Conserving energy usually means energy savings. By utilizing indigenous energy resources, American Samoa promotes economic self-reliance.

There is a green revolution under way, and American Samoa can benefit, and even thrive, by embracing it. Investing in energy conservation, energy efficiency, renewable energy, efficient transportation, green building design, smart grids, and utility schemes can create a new energy infrastructure that transforms American Samoa from reliance on fossil-fueled centralized power to independent, renewable, distributed power. Creating efficient, integrated systems promotes energy security, resource efficiency, and sustainability. By investing in green businesses and technologies, American Samoa can create sustainable growth, new jobs, and help lower energy prices.

American Samoa's strategic energy plan outlines the path toward participation in the new economic framework. The plan puts American Samoa at the forefront of progress, innovation, and change in the field of energy, while also making the most out of its own natural resources. There is a perception that American Samoa has limited resources and, therefore, suffers economically without assistance from abroad. Investing in energy efficiency and renewable energy is an opportunity to alter that perception. This strategic energy plan prepares American Samoa to harvest its abundant energy resources for the betterment of all its citizens.

Approach

This section reiterates the parameters of the energy study and planning process as originally outlined in the *American Samoa Initial Technical Assessment Report*[2] published in 2011. Certain topic areas, such as transportation and water systems, are important to overall energy strategies but were not considered in detail within the assessment report due to lack of data on energy use by these sectors and the priority of targeting energy efficiency and renewable energy opportunities.

There are many energy efficiency and renewable energy technologies on the market today. Included within the 2011 assessment study's parameters were mature technologies that are commercially available and feasible. As a reference, the previous report included technologies with the following criteria:

- Commercially available
    - Tested and demonstrated
    - Carry warranty
    - Service and parts available.
- Ready for immediate deployment
- Demonstrated to be a sound investment
- Financing available from private sector organizations.

There are a number of power generation options potentially available to American Samoa, such as diesel, heavy fuel oil, liquefied natural gas, modular nuclear, and renewable energy technologies including solar, wind, biomass, waste-to-energy, and geothermal. Each of these technologies has its own operational characteristics, initial and operational costs, implementation time horizon, and near- and long-term environmental impacts. Most power generation choices require a large investment that can impact a community for many years. For these reasons, any technology choice should be arrived at through a process of strategic energy analysis to help ensure the most appropriate choices are made for current and future generations of American Samoa. An alternative to increased power generation is reducing the amount of energy consumed. Energy conservation and efficiency are cost-effective methods of reducing the need for investments in new electricity generation.

For the purposes of this document, commercial clean energy technologies considered include energy conservation and efficiency; wind; solar (photovoltaic [PV] and water heating); biomass; and waste-to-energy technologies, including anaerobic digestion and gasification, and geothermal technologies. NREL did not assess opportunities associated with other renewable energy technologies, such as; ocean thermal energy conversion, off-shore wind, marine hydrokinetic, or nonrenewable technologies, such as nuclear, coal, or natural gas.

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[2] S. Busche, M. Conrad, K. Funk, A. Kandt, P. McNutt. *American Samoa Initial Technical Assessment Report.* NREL/TP-7A40-50905. Golden, CO: National Renewable Energy Laboratory, September 2011. www.nrel.gov/docs/fy11osti/50905.pdf.

This plan discusses energy efficiency and renewable energy technology potential, as well as current barriers and opportunities. Further investigation is needed to quantify the impact of specific technologies, programs, and/or projects. Environmental, regulatory, legislative, and financial considerations will also need to be addressed during the project development process. Technologies and markets are constantly changing and evolving. Continual reevaluation of options and strategies is necessary. Therefore, this plan should be considered a living document that can be changed at the direction of ASREC.

An energy action plan is the next step in the energy transformation process and will be developed based on the strategies recommended in the strategic energy plan. It will also be developed and implemented by ASREC. The energy action plan will be flexible and realistic, and will set specific goals, assign people to the goals, and establish completion dates. The energy action plan will be revised as appropriate.

Background

American Samoa is a group of five volcanic islands located in the South Pacific Ocean (roughly 14° S and 170° W) approximately halfway between Hawaii and New Zealand (see Figure 1). American Samoa is an unincorporated territory of the United States. The president of the United States has assigned administration of American Samoa to the Secretary of the Interior.

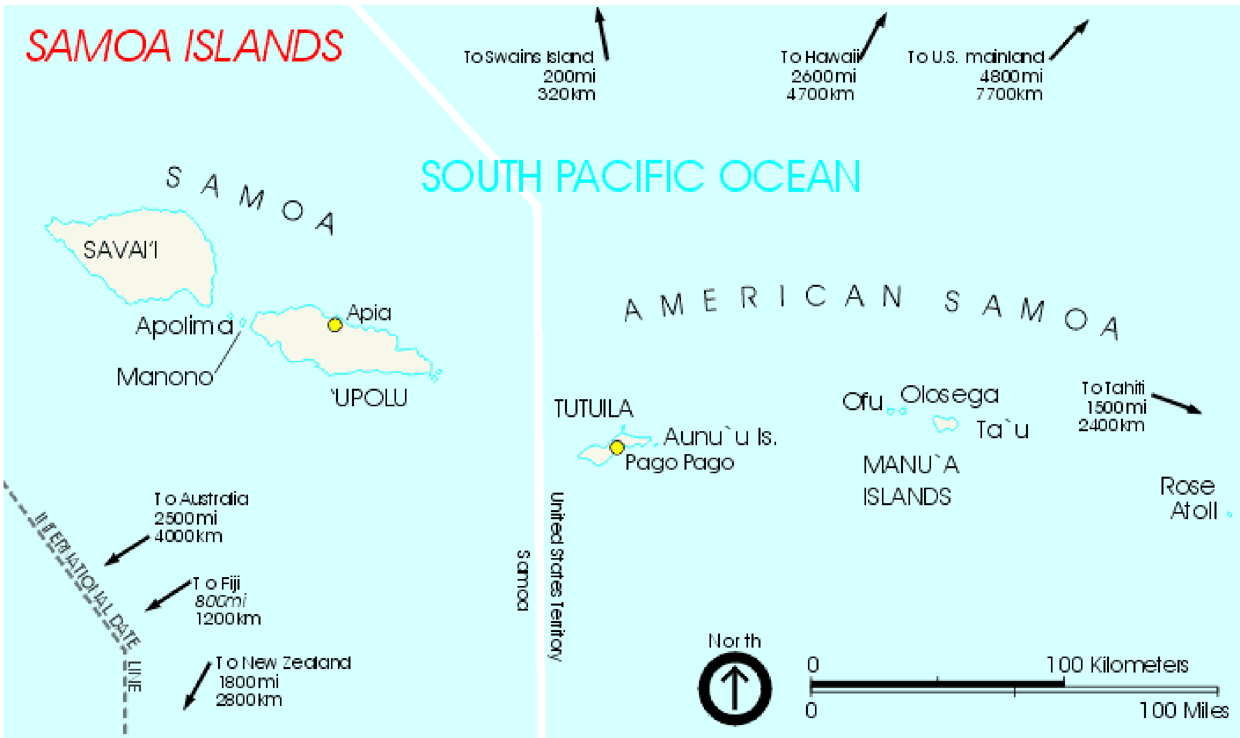

Figure 1. Map of American Samoa
Source: U.S. National Park Service

The total land area of American Samoa is 76 square miles. There are two coral reefs that are part of the territory: Rose Island and Swains Island, which are low, tropical atolls.

Tutuila is the major island of American Samoa, accounting for 69% (55 square miles) of the territory's land area and 97% of the total population. The topography of Tutuila is rugged, volcanic terrain.

Aunu'u Island is located one mile off the southeastern shore of Tutuila and has a land area of 375 acres. It is a small volcanic island with a very small population (under 500), and the power demand is only 90 kilowatts (kW).

The Manu'a group of islands, Ofu, Olosega, and Ta'u, are approximately 70 miles east of Tutuila. Similar to Tutuila and Aunu'u, the Manu'a Islands have a rugged, volcanic terrain. Ofu and Olosega are connected by a bridge, and they share a power grid with a capacity of approximately 150 kW. The Island of Ta'u has a slightly larger population and a power grid capacity of approximately 300 kW.

The population of American Samoa in 2010 was approximately 55,500 people.[3] This is a decline from previous reported population statistics.

Tuna fishing and tuna processing are the primary economic activity in American Samoa. Canned tuna export is the backbone of the private sector, with the United States as the main trading partner. Two tuna canneries accounted for 80% of employment until one cannery closed in September 2009 following a nearby undersea earthquake and resulting tsunami. This tsunami devastated American Samoa, disrupting transportation and power generation. The U.S. Federal Emergency Management Agency currently oversees relief programs in American Samoa totaling more than $100 million. When trying to develop a broader economy, the government is limited by the islands' remote location, limited transportation, and hurricanes.[4]

Fossil Fuel Dependence and High Energy Costs

In 2011, with the exception of a few small renewable projects, American Samoa was completely dependent on fossil fuels for meeting its energy generation needs. In 2012, American Samoa installed a 1.75-megawatt (MW) PV system at the Tafuna airport, allowing for 10% of energy generation needs to be met with renewables. No natural oil reserves exist in American Samoa, forcing it to import all of its fuel oil at high shipping rates and fuel prices. The cost of electricity for residential and commercial customers was approximately $0.31/kilowatt-hour (kWh) in September 2010, $0.40/kWh in December 2012, and $0.42/kWh in the third quarter of 2013—a strong indication that energy costs will continue to rise. The price of electricity in American Samoa is mainly a function of the volatile world price of diesel fuel.

Office of Insular Affairs Energy Initiative

In 2011, the Department of the Interior Office of Insular Affairs funded the Department of Energy's (DOE's) National Renewable Energy Laboratory to deliver technical assistance to the islands of American Samoa by conducting an initial territorial technical assessment. This assessment laid out energy consumption and production data, establishing baseline energy data, which was then used to conduct an energy analysis that estimated energy efficiency and renewable energy potential for American Samoa.

[3] "U.S. Census Bureau Releases 2010 Census Population Counts for American Samoa." US Census Bureau, Aug. 24, 2011. www.census.gov/2010census/news/releases/operations/cb11-cn177.html.
[4] "The World Fact Book." U.C. Central Intelligence Agency, undated. www.cia.gov/library/publications/the-world-factbook/geos/aq.html.

American Samoa Renewable Energy Committee Development

American Samoa Executive Order

Through Executive Order #004-2010, the ASREC has been asked to deliver a long-term strategic energy plan that focuses on decreasing dependence on fossil fuels and encouraging the introduction and adoption of renewable technology. As stated in the executive order, this plan should address the following objectives:

- Reduction of reliance and expenditures on fossil fuels
- Development of indigenous and renewable energy sources
- Improvement of energy generation infrastructure
- Preservation, restoration, and enhancement of resources
- Training and education regarding energy efficiency and conservation
- Development of funding and financial strategies for sustainability and economic development
- Engagement in national and regional efforts to address island energy concerns
- Development of a vision, mission, and goals for reducing dependence on fossil fuels, improving energy efficiency, and developing renewable energy resources
- Establishment of an organizational structure to appropriately develop a comprehensive, long-term strategic energy plan for American Samoa.

American Samoa Renewable Energy Committee Charter

ASREC adopted a charter outlining its purpose, mission, organization, staffing, directive, and duration. Succinctly, ASREC must develop a long-term strategic energy plan that creates a sustainable energy future for American Samoa with input from various sectors and stakeholders.

Vision

"Create a sustainable future by reducing dependence on fossil fuels."

Mission

"Enhance the well-being of our citizenry, ensure energy and economic security through energy independence and diversification, and improve environmental quality. Educate all stakeholders on the importance of our vision by embracing conservation, energy efficiency, and alternative energy. The ASREC will be a forum for considering options and offering guidance related to the achievement of its energy goals through policy, projects, and programs."

Directive

"Due to fluctuating energy prices, natural disasters, such as the September 2009 earthquake and tsunami, American Samoa has focused attention on the need to develop alternatives to its near 100% reliance on fossil fuels by implementing energy efficiency and renewable energy technology. American

Samoa is in a unique position to rebuild more effectively and efficiently incorporating renewable energy and energy efficiency due to the almost total destruction of our power stations. American Samoa Renewable Energy Committee is undertaking a concerted effort to address current energy and environmental challenges. Due to our geographic isolation, nonrenewable resources are extremely limited and subject to large volatility in pricing and availability. Energy security is fundamental to American Samoa's economic future and quality of living. Consequently, creating a stable investment atmosphere remains challenging, while the quality of life for residents and visitors continues to be affected.

"American Samoa's indigenous resources are abundant and should be considered to achieve energy diversity. Through appropriate study and discussion, ASREC will determine cost-effective alternatives that will successfully support our vision.

"The ASREC is a nonregulatory advisory group sponsored by the current Administration composed of local volunteers from multi-sector stakeholder communities and supported by federal agencies and first convened in November 2010."

Energy Planning and Project Development

Sound energy planning involves evaluating at least three different aspects of project development simultaneously: (1) the available technology options, (2) policies, programs, and incentives that are needed to ensure the success of the project, and (3) financing mechanisms. This is sometimes referred to as the three-legged stool of energy planning. Without considering all three aspects, a project is unlikely to succeed.

During project development, adopting a more comprehensive framework, such as NREL's SROPTTC™ framework ,[5] to examine the key issues and identify next steps toward resolving them can reduce investor uncertainty. The following key areas are addressed by the SROPTTC model:

- **Site**—Identify the physical location for the physical assets of a project, including property rights, length of tenure, terms and conditions, etc.
- **Resource**—Characterize and understand the renewable resource being considered.
- **Off-take**—Establish and secure by contract the buyer of both the energy and any other characteristics of output (e.g., renewable energy credits).
- **Permits**—Identify and obtain all permits necessary for project construction and operation.
- **Technology**—Invest in engineering design, equipment selection, and procurement activities of the chosen technology.
- **Team**—Assemble a fully qualified team that addresses all business, technical, financial, legal, and operational aspects.
- **Capital**—Attract financial resources necessary for final development, construction, commissioning, and initial operations.

Communities utilizing a project development framework, such as SROPTTC, can dramatically reduce the investor risk associated with a project. Other strategies can also be implemented, such as determining and offering quality information to investors through the request for proposal (RFP) mechanism. This supplies potential investors accurate information and the level of detail needed to reduce the amount of background research they need to do, reduce their risk, and hence increase their level of interest. It also casts a wider net, bringing in high-quality companies. By looking at how a community does business, what the legal requirements are for building a project (such as site resource and access, permitting and environmental processes, and what types of ownership and delivery is recognized) can be highly beneficial to potential investors. Communities are surveying their processes, eliminating unnecessary steps, and streamlining processes as an incentive to bring in investors. This strategy has multiple

[5] "Project Development Model." The National Renewable Energy Laboratory, 2012. www.nrel.gov/tech_deployment/project_development_model.html.

benefits—it organizes a community, identifies existing processes and current needs, provides consensus, offers investors high quality information, and reduces their uncertainty.

Policy Framework and Development

A strong energy policy provides formal guidance on how to coordinate and execute energy programs. Policy should be used as a tool in establishing widespread applications and setting the standards for energy development and procedures. Policy sets the direction and broad parameters for energy programs, while the energy programs detail the specifics of how to make progress in the defined direction. For example, a renewable portfolio standard establishes a requirement for renewable energy penetration. Utilities then react by designing energy programs that utilize new wind, solar, or geothermal developments to achieve the requirement. Policy cannot be overlooked when striving toward a fossil fuel reduction goal. It can be just as effective, and sometimes more effective, than market mechanisms. Policy is also not set in stone, and processes need to be included that allow it to evolve along with new obstacles and revelations. Therefore, policy evaluation is also a critical aspect of policy development. Evaluation should be centered on determining the effectiveness of the policy.

Table 1 lists example energy policies that could be considered to help American Samoa meet its goal of increasing use of energy efficiency and renewable energy, increasing energy supply diversity, and reducing dependence on imported fossil fuels.

Table 1. Policy Framework and Development

CLEAN ENERGY POLICY CONSIDERATIONS FOR AMERICAN SAMOA	
• Renewable portfolio standard	• Smart metering
• Energy efficiency portfolio standard	• Tax incentives
• Lead by example	• Industry recruitment incentives
• Latest building codes	• Rebates and grant programs
• Energy codes	• Loan and loan guarantees
• Permitting and siting standards	• Public benefit fund
✓ Net metering	• Public financing programs
✓ Interconnection	
• Appliance exchanges and rebates	✓ Denotes policy has been implemented

Financing

Project financing is a critical and often difficult step in project development. Financing determines the scope of a project and can make or break a project. Understanding project costs and all of the available finance options can lead to greater success in securing project financing. Table 2 lists the approximate costs of some renewable energy technologies. The costs are highly dependent on project characteristics.

Table 2. Cost of Energy

Technology	Resource Potential	Representative Technology Characteristics	Approximate Cost of Delivered Energy ($/kWh)		Estimated Capital Cost of Installation ($/kW)		Land Use Impact
			Global	Islands (sample)	Global	Islands (sample)	
Biomass and WTE Incineration	Medium	Plant size: 25-100 MW Capacity factor: 70%-80%	$0.08-$0.18	$0.13-$0.28	$3,000-$4,700	$8,500	Low
Solar PV (rooftop, small-scale systems)	High	Peak capacity: 3 kW-5 kW (residential) 100 kW (commercial) 500 kW (industrial)	$0.22-$0.44	Not available	$2,500-$3,300	$5,000-$8,000	Negligible
Solar PV (ground-mounted, utility-scale)	High	Peak capacity: 2.5 MW-100 MW	$0.20-$0.37	$0.19-$0.36	$1,800-$2,400	$4,000-$6,000	2-8 acres per MW
Land-Based Wind (small-scale)	High	Turbine size: up to 100 kW	$0.15-$0.20	$0.10-$0.20	$3,000-$6,000	$4,000	Low
Land-Based Wind (utility-scale)	High	Turbine size: 1.5 MW-3.5 MW Capacity factor: 20%-40%	$0.05-$0.17	$0.10-$0.20	$1,400-$2,500	$3,600	High
Offshore Wind	High	Turbine size: 1.5 MW-7.5 MW Capacity factor: 35%- 45%	$0.11-$0.22	$0.20-$0.30	$3,800-$5,900	$4,300	Low
Solar Hot Water[a] (rooftop)	High	Collector type: flat-plate, evacuated tube	Not available	$0.15-$0.20	$1,000-$1,700	$4,000 per system	Negligible

[a] Global capital cost for solar hot water is for systems ranging in size from 2.1 kW_{th}-35 kW_{th}. Island capital cost is the cost of a system sufficient to meet the needs of a four-person household. Island energy cost is based on the system costs and electrical energy consumption offset by the use of the solar thermal system.

Explore Financing Options

Below is a list of financing options to consider.

1. Explore public-private partnerships with local businesses, developers, and banks with the idea of creating local markets for renewable power generation, energy efficiency, and energy conservation products and services
2. Investigate third-party financing
3. Pursue subsidies for renewable projects
4. Consider opportunities, such as peak pricing, grants, and subsidies, to reduce overall cost of electricity
5. Investigate alternative financing models, such as power purchase agreements and performance savings' contracting.

Private Sector Investment

Private sector investment can create additional support for renewable energy, allowing it to become the long-term solution to the current problems faced by American Samoa. Unfortunately, renewable energy has high capital costs, making it difficult to secure private investment. Low-cost financing needs to be made available for renewable energy projects. The strategic energy plan aims to include all socioeconomic groups in overcoming the energy challenges facing American Samoa. To do this, it is strongly recommended that low- to no-cost interest-free loans for private-sector investment are made available for renewable energy projects. Government grants and subsidies are a quick fix in the short term. But the private sector must be encouraged to come forward and take ownership of this strategic energy plan for it to work. To do that, private-sector companies must want to invest. The availability of low- and no-cost loans would encourage such investment. The loans could come from government grants designed to roll over and be reloaned again and again. The Development Bank of American Samoa is set up and structured to handle such loan programs.

Small Island Energy Strategies

As of August 2013, the cost of electricity delivered to the consumer on the main island of Tutuila is approximately $0.32/kWh but is billed to the consumer at $0.42/kWh. Smaller island populations such as Ofu, Olosega, Ta'u and Aunu'u, usually have a higher electricity generation and distribution cost because they are primarily reliant on small diesel engines. For example, In Manu'a (Ta'u, Ofu, and Olosega), the true cost of delivered energy is $0.48/kWh but it is sold to the consumer at the same price as on Tutuila ($0.42/kWh). ASPA runs at a loss in this area, and Tutuila subsidizes Manu'a at a rate of $400,000 per year. Based on this data, deploying sustainable and renewable power options to the small island populations is a strong step toward economically viable solutions that benefit both the small islands and the main island of Tutuila that subsidizes them. It would also increase the stability of their energy supply by mitigating fuel delivery problems and avoiding the risk of fuel leaks and spills that can devastate the pristine waters surrounding the islands. Solar and wind, with proper storage solutions, could allow 100% renewable energy penetration, and would have far-reaching benefits for the small islands of American Samoa.

Swains Island is 200 miles north of Tutuila and has a very small fluctuating population that ranges from zero to 20 people throughout the year. There are complicated issues with addressing Swains Island in this strategic energy plan, as Swains Island is a privately owned island with a population that would not normally warrant government investment in the infrastructure. Swains Island energy, however, has a costly price tag for the government; fuel and other supplies are delivered to the island by an American Samoan government vessel on a regular basis. For the purpose of this plan, the Swains Island strategy will be to focus on attractive private sector investment options, such as a low- to no-cost renewable energy revolving loan fund as mentioned in the Private Sector Investment section. The details of the revolving loan fund will be described in more detail in the energy action plan.

Energy Literacy and Workforce Development

Energy literacy and workforce development are important components of the energy strategy. This section identifies strategies and steps to improve energy literacy and promote workforce development.

Energy Literacy

The following is a list of strategies to improve energy literacy.

1. **Community involvement**—Involving the community in the energy system transformation process will help keep ASREC activities transparent, creating public support. Community involvement will be established by creating a website where all materials and calendars can be viewed and a blog or feedback loop implemented for people to comment on said materials and voice their concerns. The sharing of information can bolster public support, increase the success of projects, and create new ideas from public input.
2. **Energy education**—Small residential users interested in renewable energy investment will need to be educated on the financial and technical side of deploying renewable energy at their homes. Solar water heaters and similar technologies can be part of the education process. These projects may also be part of the low- to no-cost revolving loan fund discussed in the plan. Increasing public energy education creates citizen acceptance of new technologies, programs, and policies. Holding educational fairs and creating fact sheets, radio announcements/shows, electronic newsletters, as well as doing a variety of other activities, promote energy literacy from cradle to grave—understanding where energy comes from, how it is transported and used, how to make use more efficient, how to conserve it, and its life cycles. Additional activities will be aimed at educating younger generations through a contest within the school system for materials, such as a logo, song, posters, etc.
3. **Courses and materials**—Distribute educational materials to schools, libraries, media, and other appropriate organizations.

Workforce Development

The following is a list of ways to develop the workforce with training and materials.

1. Educate parties responsible for executing and enforcing building and energy codes to ensure that they have proper inspection and enforcement capabilities.
2. Develop training courses and materials for both architects and workers in the construction sector to improve energy awareness. Energy efficiency in retrofit, renovation, and new construction can be included in design, materials, and equipment.
3. Create guidebooks and self-assessment checklists. These guidebooks could be designed as stand-alone products for specific sectors or integrated into the training described above.
4. Sponsor workshops and invite local builders, architects, homeowners, and business owners.
5. Create educational displays.

Energy Efficiency Strategies

NREL's preliminary assessments indicate significant energy efficiency opportunities within all sectors. Recommended energy efficiency strategies include:

1. Free energy audits focused on conservation and cost reduction, conducted by TEO
2. Energy seminars or presentations held at publicly accessible places, such as the Chamber of Commerce, and focus on energy efficiency and renewable energy options for commercial businesses
3. Low- and no-cost administered through a revolving loan fund to be used on energy efficiency upgrades and renewable energy projects
4. An inventory of the building stock
5. A "watch the kilowatts" program
6. An audit program (commercial and residential)
7. Alternative cooling.

Buildings

Energy audits have been funded on Tutuila, most recently by TEO (e.g., audits of government facilities and homes through the Weatherization Assistance Program). Although audits have occurred in the governmental sector, these audits should continue and, where possible, the measures that are applicable to similar buildings should be gleaned from audit reports and implemented across the building stock. For example, if two of the island's buildings are being audited, the measures that are most commonly recommended may be applicable to other similar building types. These measures may include improving lighting fixtures and controls; installing low-flow faucets, toilets, and shower heads; or installing thermostatic controls to reduce the energy consumption of air conditioning units. A strategy for identifying and implementing the measures that are most commonly recommended could be a next step, but would require disclosure from the entities conducting the energy and water audits.

Similarly, as part of both an outreach and buildings program, developing a "watch the kilowatts" program would focus on understanding how much energy is being used within a household or small commercial business. The objective is to tell consumers how much energy they are using at various intervals and for what end uses. Through this awareness, consumers can begin to practice conservation, limiting various activities or managing conservation strategies. This exercise could also inform consumers about which appliances are high energy users. In many cases, replacing outdated appliances with higher energy efficient ones will save large amounts of energy and dollars with a high return on investment. Devices such as the "Kill-A-Watt" meter, which displays plug loads for appliances both when running and when turned off, can be an important tool for informing consumers about how electrical devices use energy—many are not aware that appliances can consume electricity even when turned off—which could also result in energy savings.

Cooling is one of the biggest uses of energy in American Samoa. Considering and implementing promising alternative cooling technologies will assist with reducing fossil fuel consumption related to conditioning indoor spaces. There are a number of options available under the umbrella of alternative cooling technologies, such as solar air conditioning, desiccant cooling, or opting for a higher seasonal energy efficiency ratio (SEER) rating.

A medium-cost option is to install solar air-conditioning units. While relatively new on the market, solar air-conditioning units are available from a number of manufacturers and suppliers, and have a variety of different installation applications, from split-wall window units to larger outdoor units. This technology is an efficient type of air conditioner (above SEER 20) that is powered by a solar PV panel, which reduces the energy demand from the grid during times when cooling and conditioning are needed.

Cool Roof Program

Former DOE Secretary Steven Chu launched a series of initiatives in July 2010 to encourage cool-roof technologies in the federal government. Secretary Chu directed all DOE offices to install cool roofs whenever cost-effective over the lifetime of the roof, when constructing new roofs or replacing old ones, and in areas where cool roofs will be beneficial to energy efficiency savings (typically in hot climates).

A cool-roof program could be implemented island-wide by using low-cost technologies, such as elastomeric paint (approximately $40/gallon), which would need to be applied to roofs and maintained through a cleaning program (to prevent debris and mold buildup). More information about selecting buildings and implementing a cool-roof program can be found on the DOE website.[6]

Building Design

- Promote energy and water conservation design features in major renovation and new development projects.
- Encourage efficient use of water and reduce runoff through the use of natural drainage, landscaping techniques, and efficient irrigation systems.
- Promote head-load reduction strategies by using landscaping to shade and designs that maximize tree canopies to reduce heat buildup.
- Install ceiling fans as one lower-cost option in buildings with no requirements for conditioning for moisture control. Where moisture buildup is not a concern, it may be possible to utilize natural ventilation (from breezes and open structures of windows, doors, etc.), and ceiling fans, which are in operation only when needed. There may be open structures where this could be a suitable option.

[6] "Covered Product Category: Cool Roof Products." U.S. Department of Energy, Energy Efficiency & Renewable Energy, 2013. www1.eere.energy.gov/femp/technologies/eep_roof_products.html.

- Plant “green roofs” when possible, which may be a lower-cost option to consider in building design integration. Where roofs are flat and structurally sound, they can be used to plant vegetation, which provides a thermal barrier and creates a wicking-type action. The wicking of moisture and heat upward and out of the building is beneficial in reducing cooling loads in buildings.[7]
- Encourage the installation of energy-saving roofing materials.

[7] “Green Roofs.” *Federal Technology Alert.* U.S. Federal Energy Management Program, August 2004. www1.eere.energy.gov/femp/pdfs/fta_green_roofs.pdf.

Renewable Energy Strategies

The initial screening of renewable energy technology potential indicates considerable resource and technical possibilities.

Grid Strategies

When considering adding the amount of renewable energy generation, it is important to consider impacts to the existing utility grid. The following items should be part of the grid strategy:

1. Investigate the grid stability impact of adding different levels of wind and PV generation into various locations of transmission and distribution grid.
2. Explore the use of energy storage technologies to increase potential for higher-level renewable energy implementation.
3. Examine the use of modern "grid friendly" functionalities of PV systems and wind turbine generators (active and reactive power control) to enhance grid stability.

Wind Strategies

Wind energy has the potential to play a significant role in supplying electrical energy to American Samoa. Good wind resources, plentiful existing infrastructure, and high energy costs make wind technology an attractive potential addition to the current generation portfolio. The following items should be part of the wind strategy:

1. Initiate an active social acceptance outreach and education activity around wind.
2. Complete anemometry study.
3. Collect and validate data.
4. Conduct a detailed wind development assessment.
5. Expand investigation of additional potential sites for community and large wind development.
6. Conduct an initial screening of potential turbine options for high-wind environments.

Solar Strategies

There are great opportunities for using solar technologies in America Samoa, including both solar thermal and solar electric (PV) applications. Solar thermal technologies, also known as solar hot water, capture energy from the sun to heat water; they can also be used to heat air for direct use or to make steam for electrical production. PV technologies use the photons from the sun to create electricity. The following items should be part of the solar strategy:

1. Develop solar hot water heating program for all sectors.
2. Perform field assessments of each PV site identified, especially those on the outer islands.
3. Implement solar and solar thermal programs similar to energy efficiency programs where customer pays back agency (utility) through savings.

4. Consider solar rebates, credits, or solar set asides.
5. Evaluate the performance of the recently installed PV systems to compare actual generation versus expected generation.
6. Conduct performance measures from the 1.5-MW solar project at the airport. Evaluate the success and lessons learned from this project.

Wind and Solar Opportunities Identified

The islands of Manu'a (Ofu, Olosega, and Ta'u) have a cost of power production that is 50% higher than the cost of electrical power production in Tutuila. The reason for this is primarily that the smaller diesel generators on Manu'a are less efficient than the large units on Tutuila. There is also an additional cost from the delivery of fuel to Manu'a.

The Manu'a grids of Olosega and Ta'u are small enough to facilitate energy storage, opening an avenue for nearly 100% solar and wind penetration on the Manu'a power grid. Making Manu'a 100% solar and wind dependent will eliminate the need for challenging fuel deliveries, greatly enhancing the islands power stability issues and mitigating the risk of spills into the pristine waters that surround both islands. Standby diesel generators will need to run on occasion, acting as viable backups for the grid. With sufficient capital, solar and wind for Manu'a can be completed as early as the end of 2016.

The Aunu'u power grid is approximately 90 kW. A subsurface marine extension was constructed in Manu'a a few decades ago, but continuous problems with the undersea cable and the cost of repairs has led to abandoning the line. Now Aunu'u is 100% reliant on self-generating diesels. The problems and solutions for Aunu'u are very similar to Manu'a, as the grid is small enough to consider solar and wind with sufficient storage. This can be completed by the end of 2016.

Swains Island offers some unique challenges for the implementation of renewable energy projects. As Swains is a privately owned Island, it would make sense to encourage private investment into energy related strategies. A recommendation in this strategic energy plan involves paving the way for low- to no-cost loans for private sector investment into renewable energy.

Rose Atoll is currently uninhabited, with no known plans to change that status. The energy requirements at Rose Atoll are expected to remain at zero.

Geothermal Strategies

Tutuila requires a baseload solution to its energy challenge. The strategic energy plan recognizes Tutuila and Manu'a as having very different energy profiles, requiring different strategies. Tutuila has a daily peak power demand greater than 20 MW, while Manu'a's has two separate grids (Olosega and Ta'u), each under 500 kW. Due to the magnitude of power consumption in Tutuila and the challenges that high levels of solar and wind penetration create in grid stability, a baseload scenario with a primary focus on geothermal will be the primary option. Fortunately, American Samoa's geological makeup and proximity to the Pacific "Ring of Fire" give it a very high probability of having a sufficient geothermal resource for providing baseload generation for Tutuila. Solar and wind will be considered as a secondary option should geothermal fall short of expectations. However, provided the geothermal resource is abundant, Tutuila will develop the resource so that it provides 100% of the baseload power. This will eliminate the need and cost of diesel power generation, currently estimated at roughly $50 million annually or greater than 10% of the overall American Samoa government budget. This can potentially be completed by the end of 2016.

As a point of reference, included is a geothermal developer's checklist:

1. Determine exclusions
2. Identify cultural issues
3. Contact lead agency
4. Secure geothermal rights and land access/control
5. Apply for exploration permit
6. Conduct environmental study
7. Obtain well-field development permits
8. Determine water regulations
9. Obtain construction permits
10. Identify utility and transmission requirements
11. Evaluate resource potential
12. Issue RFP for independent power producer investment.

Biomass and Waste-to-Energy Strategies

Futiga landfill accumulates approximately 70 tons of solid waste daily. The landfill is expected to reach critical capacity by 2015. A waste-to-energy solution could mitigate the imminent crisis. There are several technologies existing today that can assist with this problem. A WTE plant that also embraces recycling needs to be at the forefront of this very serious problem. The strategic energy plan strongly encourages an approach that recognizes the environmental impact of hazardous refuse reduction methods. The EPA should be included in all discussions to develop plans that deal with the landfill.

Initially, the most effective and fastest strategy to implement is to recycle usable materials before they go into the landfill. American Recovery and Reinvestment Act funding initiated a recycling project with GHC Reid; the parameters of this project will be investigated. While recycling is a very effective program to reduce what goes into the landfill, it only buys time as the landfill will still continue to grow. Reduction of landfill waste will require a waste-to-energy strategy.

Large landfills in the United States often use methane gas recovery. While this is a waste-to-energy strategy, it is not a reduction strategy that is recommended for the Futiga landfill.

Gasification is a new technology that offers the potential to reduce landfill refuse safely and effectively without harmful emissions; however, the technology is not yet commercial. New developments in the field of waste-to-energy allow for further breakdown of solid waste and landfill refuse into usable products, such as liquefied materials compatible with diesel, and carbon that can be used locally or exported for sale.

Aspects of biomass and waste-to-energy strategies that could be explored include the following:

1. Technology assessment and site economics
2. New technologies for WTE and waste reduction to recyclable materials
3. Fish oil and waste (technology selection and comparison analysis)
4. Waste characterization study and WTE feasibility evaluation
5. Economic and technical feasibility of anaerobic digestion for wastewater treatment
6. Small-scale biomass power
7. Small-scale biodiesel production
8. Generation of electricity from municipal solid waste
9. Use of biodiesel in existing diesel power plants.

Hydropower Strategies

The tropical environment in American Samoa sees more than 200 inches of rain annually. Due to steep terrain and mountains, the run off to the ocean is quite quick and flooding is normally avoided. Hydroelectric generation will most likely not appeal to ASPA as a potential high-value renewable resource because there are only many small streams and no single large source of water flow that would allow for the development of a single large hydro plant with dam storage and utility grade hydroturbine generation. However, several steadily flowing streams at 20-50 gallons per second at elevations of 300-600 feet may very well be worth private-sector investment if acceptable power purchase agreements can be made between the private land and resource owners, ASPA, and other entities.

A post-WWII hydro plant built by the U.S. Navy in Fagatogo generated 60 kW 24 hours a day, seven days a week, when it was in operation many years ago. The dam and piping still exist today and are in the process of being restored for historic purposes. The Fagatogo plant shows the hydro capability that exists in American Samoa on a smaller scale, and provides evidence that investment may be practical at the private-sector level. Low- and no-cost loans could play a very big part of this renewable energy development.

Private sector investment will be critical for the implementation of these long-term sustainable solutions. If the strategic energy plan does not entice private sector investment and private sector ownership of renewable energy strategies, the plan has little chance of long-term success. To entice the private sector to begin investing in energy conservation and renewable energy strategies, the strategic energy plan must provide financial motivation with minimal investment risk to the consumer. This can be done in many ways, but the plan recommends establishing a revolving loan fund, the details of which will be explained further in the subsequent energy action plan.

Transportation Strategies

Transportation has yet to be surveyed and studied. This is an important sector, as approximately half of the fuel purchased and brought on the island is for transportation. Transportation is usually a very large portion of island energy use, and therefore, it is critical to establish and achieve meaningful petroleum reduction goals. There are many transportation strategies that could be identified and implemented. The following is a brief outline for a transportation study:

The three most important transportation statistics are as follows:

1. Number of vehicles on the island (from the Department of Motor Vehicles)
2. Vehicle miles traveled per vehicle (Department of Motor Vehicles or survey)
3. Motor fuel use (from Department of Revenue or importing company).

It is best to have these broken down by vehicle type, if possible.

Once this information is gathered, there are many other statistics that are needed and can be collected through other methods. For example, surveys can be used where data cannot be obtained. If vehicle statistics necessary to complete a full investigation are not available, assumptions will have to be made and estimated until data becomes available.

Outcomes:

- Database of statistics with sourcing
- Options
- Reduction scenarios
- Alternatives.

Electric Vehicles

Should large-scale renewable energy for baseload generation prove effective in American Samoa, the government could initiate an effective strategy to reduce transportation petroleum via hybrid or electric cars. The first steps of this program would include establishing infrastructure throughout the island for recharging electric cars. The government could pave the way by requiring new government passenger cars to be electric. Charging outlets would need to be convenient and plentiful at all major government facilities. However, should full penetration of baseload renewables be realized on the utility power grid in American Samoa, every measure should be taken to tap into the resource by utilizing electric and hybrid vehicles, further reducing fossil fuel consumption.

Water Infrastructure Energy Opportunities

Existing Conditions

Water infrastructure on Tutuila is composed of the Central ASPA system, six ASPA satellite systems, and several independent gravity-powered village systems. The ASPA systems include 52 wells, mostly located at lower elevations that often pump directly into a network of over 300 miles of distribution pipelines. Approximately 150 miles of larger diameter (greater than 6 inches) distribution mains and approximately 150 miles of small diameter (less than 4 inches) service laterals make up the ASPA system. Refer to the map below of Tutuila's water system illustrating head loss and pressure zones.

A small number of the wells have telemetered controls or pump directly to an elevated storage tank. The remainder run continuously every day, supplying a network at a generally higher elevation that leaks or loses an estimated 60% of the water.

Most of the wells are located within an unconfined water table lens approximately at sea level. Wells are generally cased only to the water table, so even if an artesian pressure head exists, they lose the gravitational advantage back into the upper unconfined water table.

Former microfiltration plants at Vaipito and Fagatogo are currently not in use. Very small amounts of energy are used for disinfection by chlorination (not ultraviolet), so current power usage for disinfection is nominal.

Electric meter reading of the pumps at the well head during 2011 indicated well pumping costs between $250,000 and $300,000.[8] Significant additional power is used at booster pumping stations to convey the water. Large volumes of water are exported from the Tafuna Aquifer to meet wash down and retort demand at the canneries in Atu'u.

Village water systems and the Manu'a Island systems are generally smaller, more efficient, and thus have less opportunity for major energy savings than the central and satellite ASPA water systems on Tutuila.

[8] Fong, Setwyn, and Schaller. Written Correspondence, 2012.

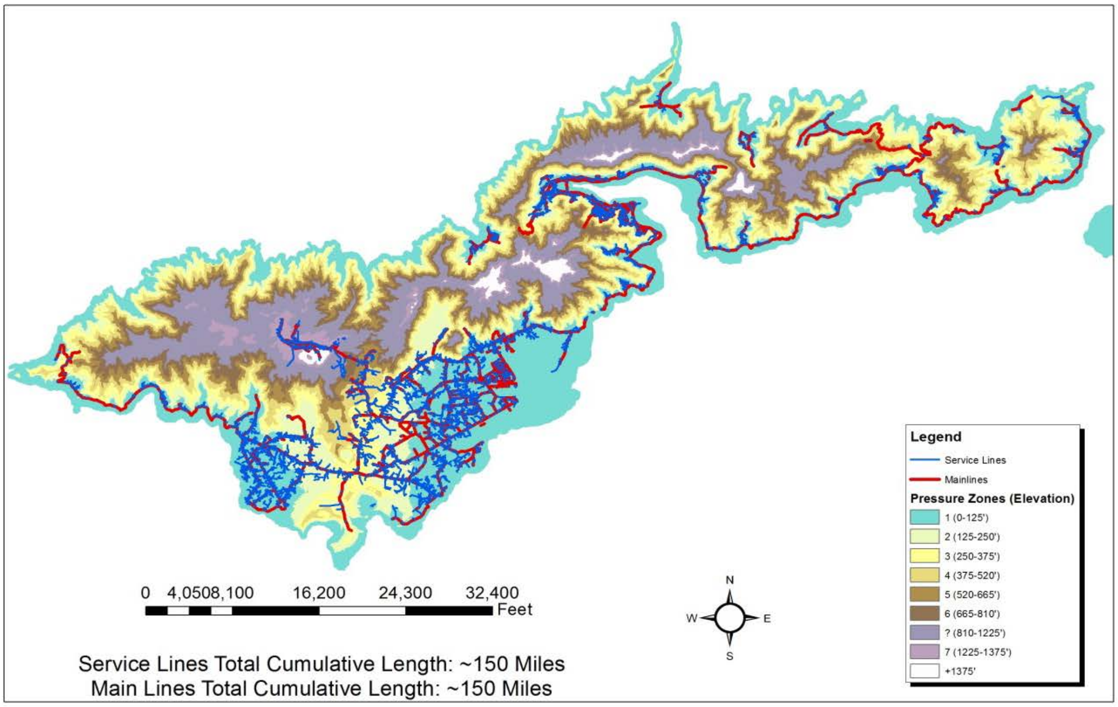

Figure 2. Tutuila water system map illustrating head loss and pressure zones
Source: U.S. Environmental Protection Agency

Sustainable Water System Improvement Opportunities

ASPA is currently undergoing an intensive program to redevelop the water production and distribution facilities primarily for water quality purposes. Many of the proposed redevelopments that will improve water quality are synergetic with power savings, but only if energy considerations are implemented as a design criteria.

Opportunities for substantial and possibly "net zero" power usage in the drinking water system include:

1. Development of new wells at higher elevation that gravity feed into elevated tanks at appropriate elevations to supply established pressure zones.
2. Abandonment of sea level aquifer wells, especially those that are pumping deep, high salinity water, damaging the basal fresh water lens aquifer.
3. Development of new wells within the upper aquifer mountain front potentiometric zone, which flows under artesian pressure to the water storage tanks (see Figure 3).
4. Regulate rampant and uncontrolled well pumping and erratic flow direction reversal by connecting wells only to water supply tanks, not directly into the pipeline distribution network.
5. Locate future water storage tanks at appropriate elevations to serve only customers within the prescribed pressure zone. Minimize connections between pressure zones and regulate with the use of pressure-reducing and altitude-control valves.

6. Where feasible, maintain gravity distribution through trenching, tunneling, or horizontal boring in lieu of pumping up and over a pass (i.e., Afono to Aua or Faga'alu to Pago).
7. Size distribution main lines adequately and only T-off of mains and laterals; never T-off service lines to maintain lower velocities and decrease extensive friction losses.
8. Utilizing variable renewable energy sources, such as wind turbines, windmills, or PV, to pump water and store it at high elevations eliminates the need for expensive battery storage.
9. Where possible, perform pumping with renewable power sources. This practice will have the added benefit of saving power generation costs internally without decreasing customer revenue of external renewable energy customers. It will also significantly reduce operation costs, and therefore, justify more capital improvement costs. Additionally, it will make capital improvements eligible for upcoming power conservation grant and financing programs under President Obama's net zero proclamation in Executive Order 13514.

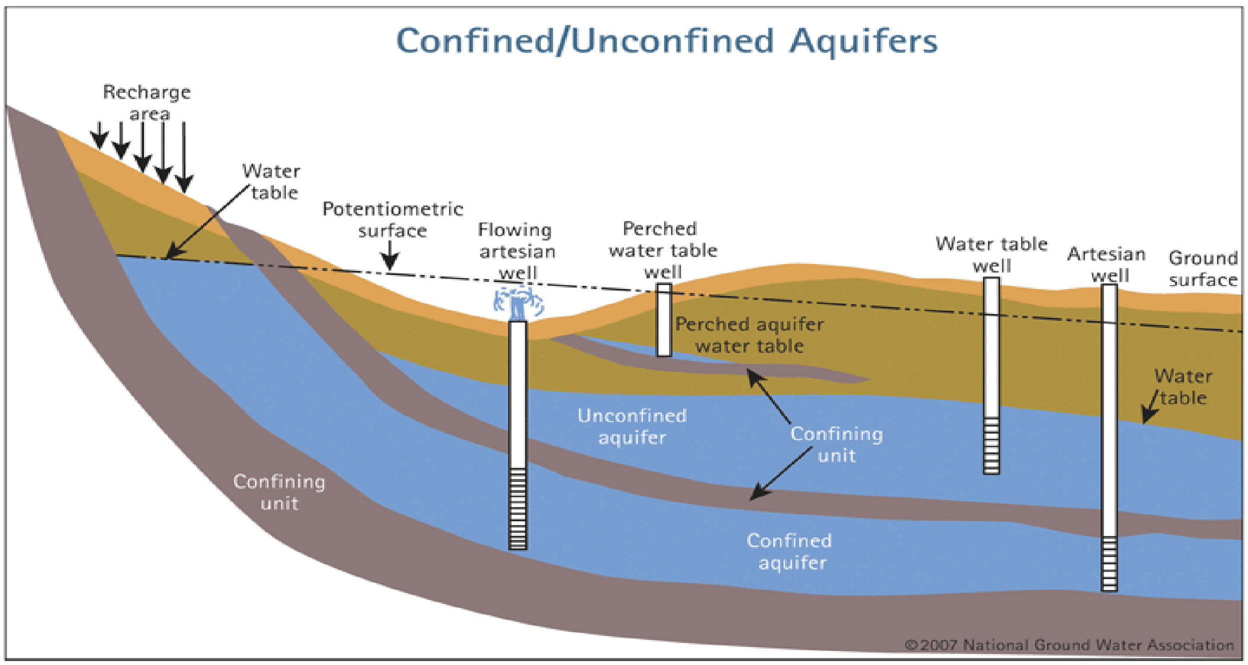

Figure 3. Cross-section through confined and unconfined aquifers
Source: National Ground Water Association

Wastewater Infrastructure Energy Considerations

As ASPA removes cesspools, adds treatment capacity, increases wastewater collection and disinfection, energy use for wastewater collection and treatment will increase. The east-side lift stations and ultraviolet-light disinfection projects currently under construction will add significant internal power usage to ASPA.

By developing renewable power for these internal uses, ASPA can reap the same added values and revenue synergies as providing internal renewable power for the water system:

1. Save power generation costs internally without decreasing customer revenue of external renewable energy customers.
2. Significantly reduce operation costs, and therefore, justify more capital improvement costs.
3. Make capital improvements eligible for power conservation grant and financing programs under President Obama's net zero proclamation in Executive Order 13514.[9]

[9] For more information on Executive Order 13514, see www.whitehouse.gov/administration/eop/ceq/sustainability.

Conclusion

American Samoa has shown that it is committed to embracing renewable energy and energy efficiency technologies. Support for this shift in energy policy will help lower future energy prices and increase energy security. During a time when many islands are embracing “green” energy, American Samoa also has the opportunity to act as a pioneer and model the successful methods for transforming a conventional energy system into an innovative energy system.

A precursor in directing American Samoa’s energy transformation is to establish energy-related policies. American Samoa’s policy principles are below. These principles are not exhaustive, but were selected to guide American Samoa toward a prudent and sustainable energy future.

- Enhance quality of life
- Promote healthy environment
- Promote environmental stewardship
- Support economic vitality
- Emphasize alternative energy resources.

American Samoa will utilize the strategies in this plan to encourage individuals to change the way they consume and view energy. American Samoa's legislators will also need to embrace the strategies and create policies that benefit public interest, not only for the short term, but for the long term as well. Financiers should be encouraged, through policies and incentives, to embrace the “triple bottom line,” instead of making investments based on traditional methods of risk assessment and analysis. American Samoa’s success in reaching its energy goals will largely depend on cooperation and a combined effort from all stakeholders.

Appendix

A.1. A Model for Energy Planning

The ASREC subcommittees participated in the community energy planning process defined below.

Plan

The planning phase includes these steps:

- Identifying and bringing together stakeholders
- Developing vision.

  The goal of this phase is to create a vision for the community's energy transformation.

Assess

The assessment phase includes these steps:

- Determine an energy baseline
- Evaluate options
- Develop goals
- Prepare a plan
- Get feedback on the plan from a broad set of stakeholders.

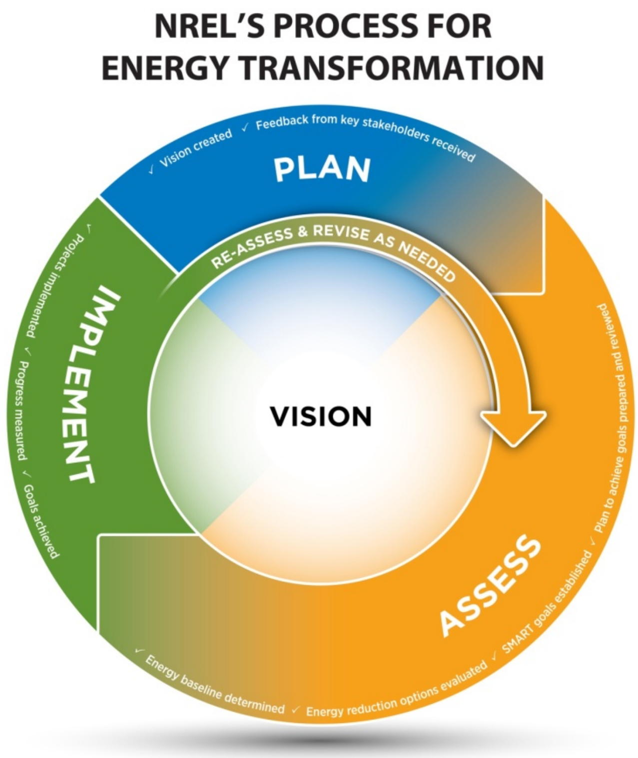

Figure 4. The National Renewable Energy Laboratory's process for energy transformation

The goals of this phase are to:

1. Determine the community's energy baseline
2. Establish specific, measureable, attainable, relevant, and time-bound goals for energy transformation
3. Put the goals into a plan for action.

Implement

The implementation phase includes these steps:

- Develop, finance, and implement projects
- Create early successes
- Evaluate effectiveness and revise as needed.

The goals of this phase are to:

1. Implement energy projects that can build community support for ongoing and future energy projects
2. Measure the progress and effectiveness of the plan and its projects.

A.2. Wedge Analyses

The wedge analysis was used to develop three future energy scenarios labeled *Base Case, Low-Reduction Scenario,* and *High-Reduction Scenario.* They are presented in the plan.

Presenting these scenarios offers a view of the potential energy portfolio options that American Samoa has, and the potential results of each of those options by the year 2025. The scenarios are meant to show energy profiles resulting from various energy mixes, with slightly different mixes in end-use energy efficiency and renewable energy, with the same set of supply-side efficiency improvements. The scenarios are not prescriptive; they are tools designed to serve as a guide. As American Samoa develops opportunities, with it will come an understanding of the costs and benefits involved. This advanced understanding will influence and shape the projects implemented. The results displayed here should be viewed with this in mind and followed by more detailed economic and power system studies. Additionally, these models should be run annually comparing annual statistics with baseline to measure progress. Also, it is important to incorporating updated information such as growth rates. Comparing the two will show actual progress toward goal reductions and can influence energy action plans and priority projects.

Methodology and Assumptions

The wedge analysis was completed using information provided from the American Samoa Power Authority (ASPA) and various stakeholders to establish a business-as-usual case or base case. From this, as well as information gathered for the *American Samoa Initial Technical Assessment Report*,[10] low- and high-impact scenarios were created reflecting 20% and 50.8%[11] fossil fuel reduction and then compared to the base case. The wedge assumes 2.2% linear consumption growth rate over 25 years that was calculated from utility meter data from the last ten years of consumption. The wedge analysis includes 644 kilowatts of photovoltaic, and while this analysis includes some small specific renewable energy projects, it is designed for high-level analysis to depict potential fuel reductions from various commercially available and ready-to-deploy technologies. It assumes no major fluctuations in fuel prices by estimating the average fuel cost for the past 10 years. The rise was based on ASPA growth figures that are currently outdated. There has been a decline in recent years in overall population, and the analysis that is shown in the following graphs should be updated.

[10] S. Busche, M. Conrad, K. Funk, A. Kandt, P. McNutt. *American Samoa Initial Technical Assessment Report.* NREL/TP-7A40-50905. Golden, CO: National Renewable Energy Laboratory, September 2011. www.nrel.gov/docs/fy11osti/50905.pdf.

[11] This was the maximum percentage the group of experts from the National Renewable Energy Laboratory found was technically possible without further evaluation.

Base Case

The base case does not attempt to curb fossil fuel use. It depicts the cost of business as usual, and is used to compare the potential impacts of deploying energy efficiency measures and alternative technologies. The base case for American Samoa's electricity usage is mainly from fossil fuel generation.

Figure 5 illustrates the consumption of electricity in barrels oil equivalent through 2026. This chart assumes 5,800,000 British thermal units for every barrel of oil. The units are barrels of oil equivalent, or how many barrels of oil will need to be consumed to provide the demand in energy.

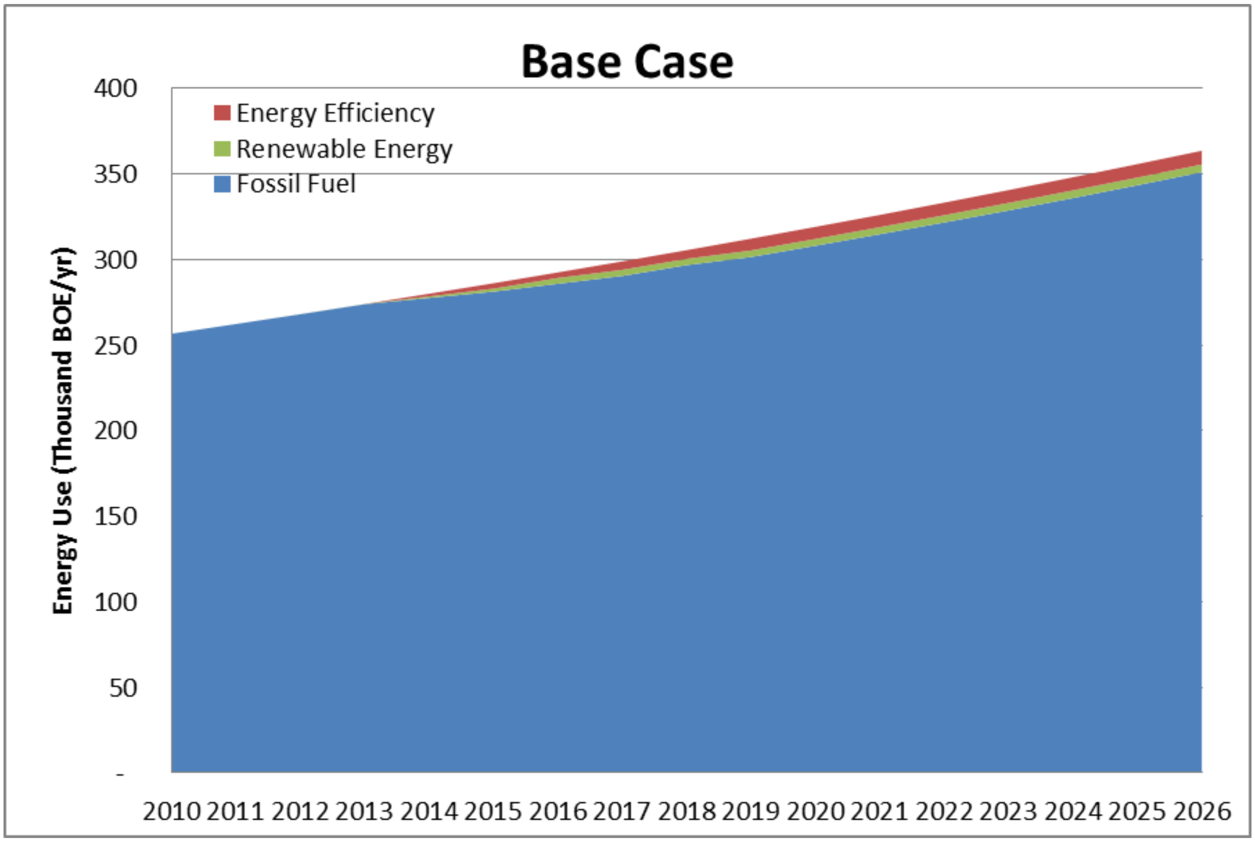

Figure 5. Base case

Low-Reduction Scenario

The low-reduction scenario (Figure 6) was determined by attempting to meet a 20% fossil fuel reduction goal. The top of the graph represents the same linear increase as in the base case. The red wedge shows the direct reduction of energy not needing to be produced due to efficiency improvements in generation and/or end-use consumption. The green wedge represents the contribution of various renewable energy technologies to the reduction of fossil fuels.

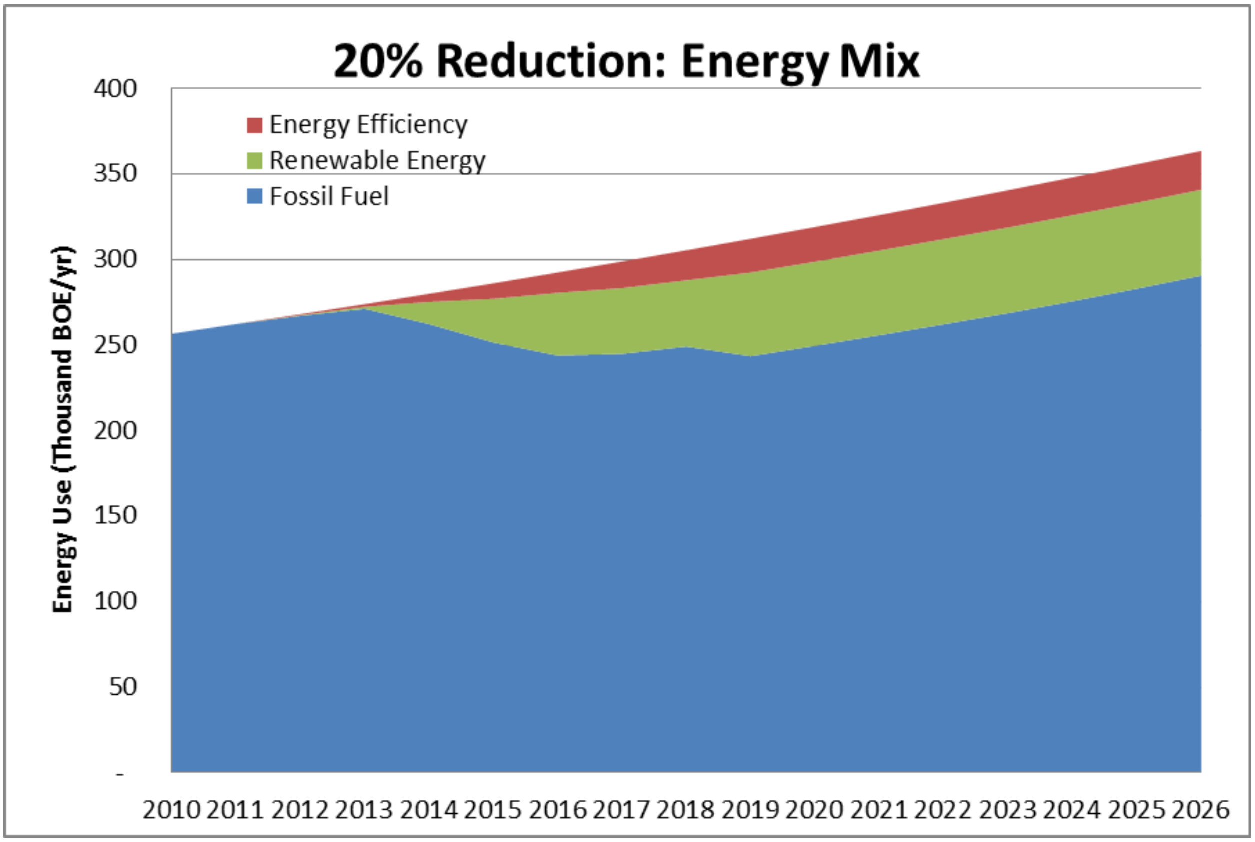

Figure 6. 20% reduction: energy mix

Figure 7 represents the same information as Figure 6 but in more detail by showing how each energy efficiency and renewable energy technology would contribute to the overall reduction of the fossil fuel consumption in the energy portfolio for American Samoa. Note the legend is in the same order as each wedge is stacked. Similarly, the area cut out by energy efficiency improvements matches that of the red wedge in the low impact energy mix chart above; additionally, the renewable energy wedge matches the same area in both charts.

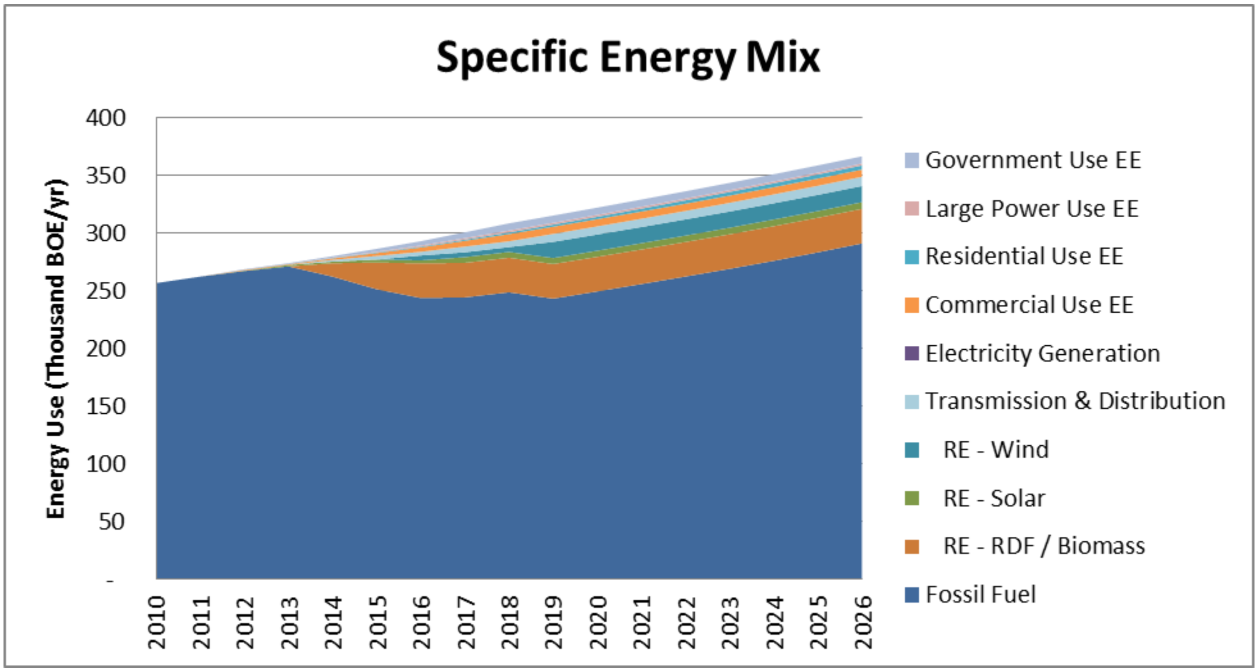

Figure 7. 20% reduction: specific energy mix

High-Reduction Scenario

The high-reduction scenario (Figure 8) was determined by attempting to meet a 50.8% fossil fuel reduction goal. The top of the graph again assumes the same linear increase as the base case. The red wedge shows the direct reduction of energy not needing to be produced due to efficiency improvements in generation or end-use consumption while the green wedge represents the contribution of various renewable energy technologies to the reduction of fossil fuels.

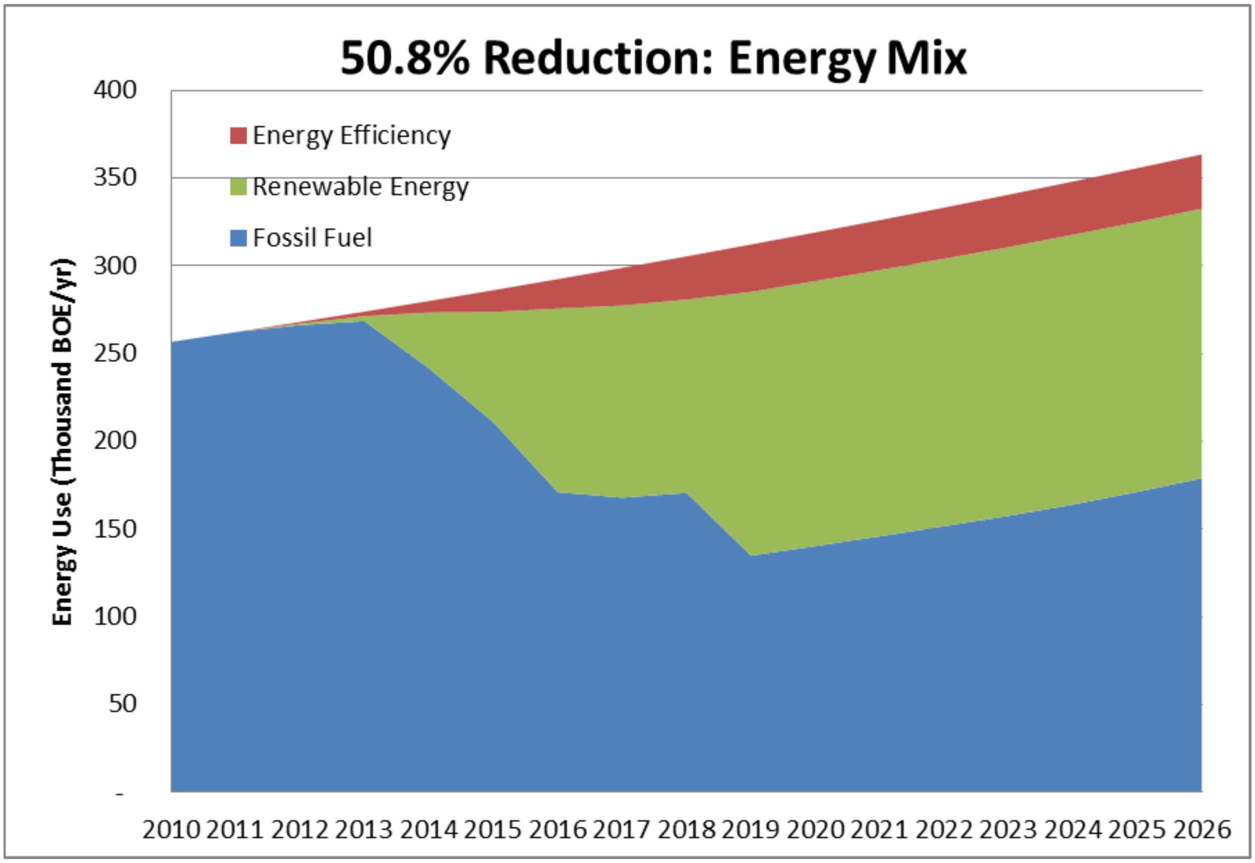

Figure 8. 50.8% reduction: energy mix

Figure 9 represents the same information shown in Figure 8 but in more detail by showing how each energy efficiency and renewable energy technology would contribute to the overall reduction of the fossil fuel consumption in the energy portfolio for American Samoa. Note the legend is in the same order as each wedge is stacked. Similarly, the area cut out by energy efficiency improvements matches that of the red wedge in the low impact energy mix chart above; additionally, the renewable energy wedge matches the same area in both charts.

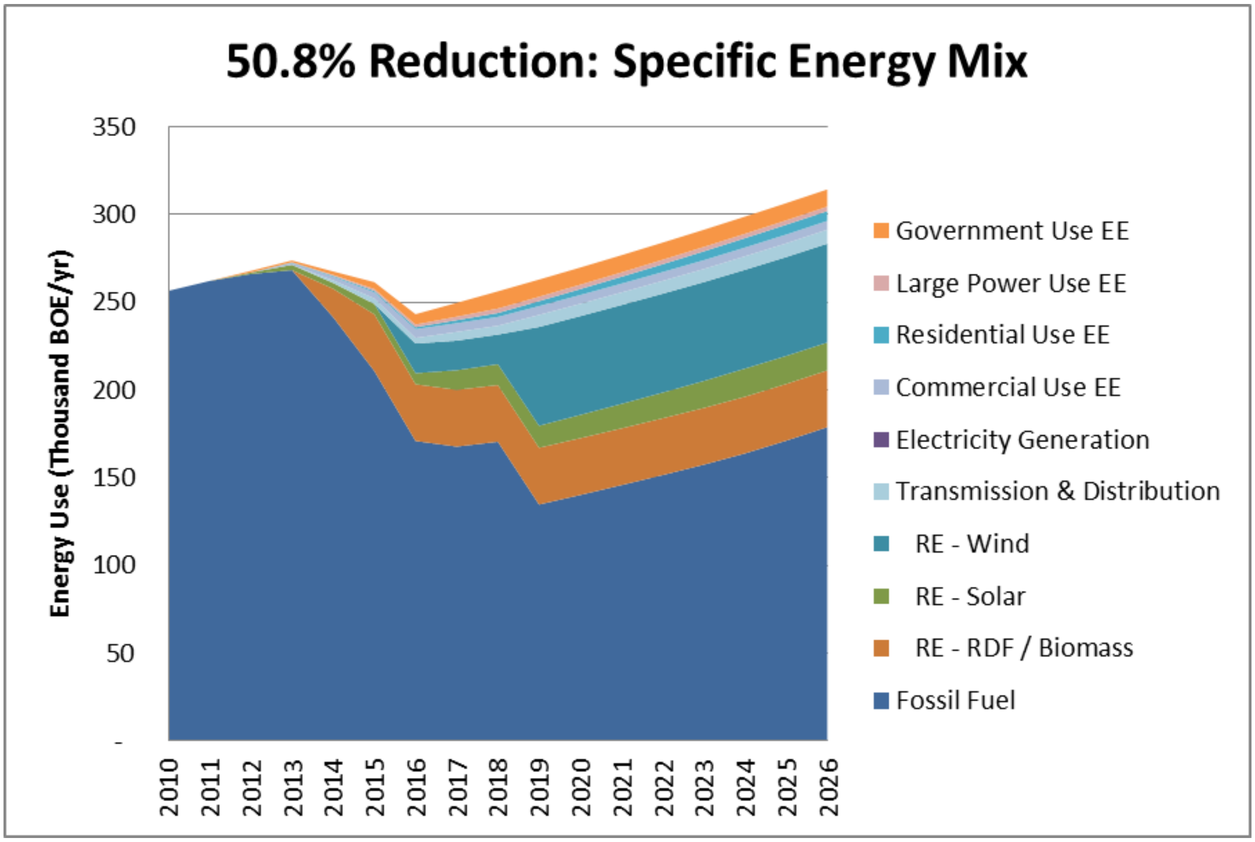

Figure 9. 50.8% reduction: specific energy mix

Comparing all scenarios, one can see how implementing a wide range of energy efficiency and renewable energy technologies over time can reduce fossil fuel consumption and begin to paint a picture of sustainability. Strategy implementation takes time and so does project development. Change does not happen overnight, but with decisive goals and clear action steps, change will be incremental.

A.3. American Samoa Renewable Energy Committee Members and Other Contributors to the Strategic Energy Plan

- Chair: **Timothy Jones**, representing the Territorial Energy Office
- Vice Chair: **Utu Abe Malae**, representing the American Samoa Power Authority
- **Tim Bodell**, representing the American Samoa Environmental Protection Agency
- **David Herdrich**, a renewable energy stakeholder
- **Mark Kneubuhl**, a renewable energy stakeholder
- **Ameko Pato**, representing the American Samoa Environmental Protection Agency
- **David Robinson**, representing the private sector
- **Lee Slater**, representing the private sector

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NATIONAL RENEWABLE ENERGY LABORATORY — LEADING CLEAN ENERGY INNOVATION

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