Commonwealth Utilities Corporation
2015 Integrated Resource Plan

The CNMI is currently almost entirely dependent on diesel-fueled power plants for its electricity supply. While the power supply resources on Tinian and Rota are more than sufficient to serve their loads, the power plants on Saipan are nearing the end of their useful lives and the expectation is that they will need to be retired within the next ten years. To prepare for this eventuality, CUC decided in 2014 to develop an integrated resource plan (IRP) to examine its options for replacing these generation assets and to prepare for anticipated future growth in the demand for electricity on the three major islands.

An IRP is the outcome of a standard industry process to determine the optimal mix of energy supply resources and demand-reduction measures required to meet anticipated energy needs, given a particular utility's priorities and constraints. It is a comprehensive decision-support tool and road map that addresses the substantial risks and uncertainties inherent in the electric utility business.

CUC's goal for this IRP is to lower the cost of electricity for its customers while improving the quality of its service with as little environmental impact as possible given the overarching need for low-cost, reliable electricity supplies. The IRP has a 25-year planning horizon, covering the period from 2016 to 2040. CUC faces several uncertainties during this time period, including issues related to:

- The reliability of CUC's aging power transmission and distribution infrastructure.
- Future load growth on Saipan due to an increase in tourism and associated hotel construction.
- Uncertain renewable generation potential, including utility-scale solar photovoltaic (PV), distributed (rooftop) PV systems, wind, and geothermal power.
- Volatility in the price of fuel oil.
- CUC's financial condition and its impact on CUC's ability to procure new generating assets.

The IRP addresses these and other uncertainties to the extent possible given the information currently available. As more information about prices, resources and other constraints is gathered over the coming months and years, CNMI's energy supply and demand picture will change, gradually becoming more clearly defined, and the IRP will be updated to reflect this new information. Integrated resource planning is an ongoing process — an IRP is a living document that evolves over time, not a fixed prescription for the optimal mix of energy resources throughout the entire planning horizon.

The IRP Development Process

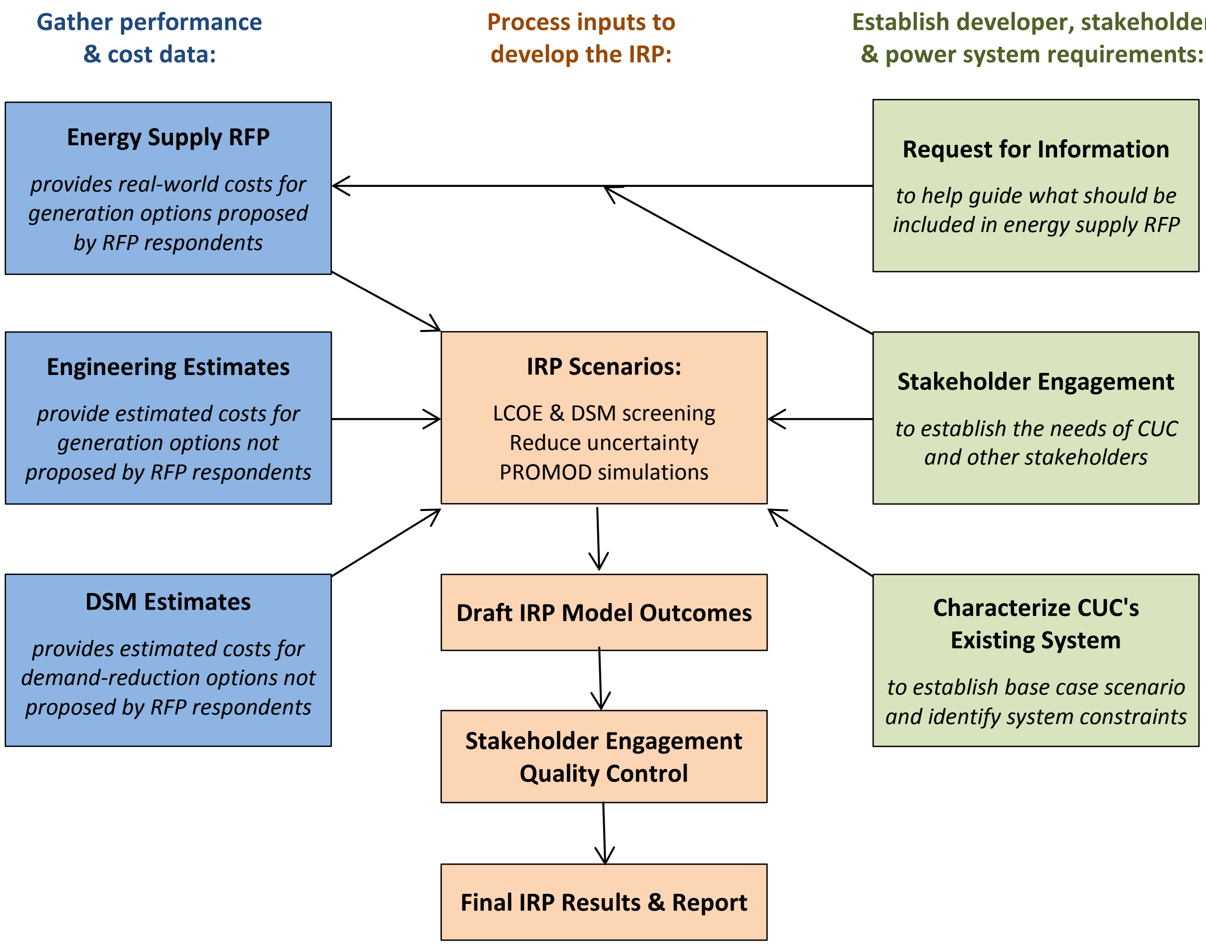
The traditional integrated resource planning and selection process, as used by utilities on the U.S. mainland, usually starts with the utility developing a list of potential power supply options that are applicable to its local conditions, writing an IRP guidance document incorporating the known range of costs and technical parameters of the preferred resource options that could meet the utility's needs, issuing requests for proposals (RFPs) to potential vendors asking them to submit bids for the energy supply options that interest them, modeling the proposed solutions under different scenarios, and then selecting the vendor(s) that submitted the best price/performance package to implement the IRP.

This process had to be modified for the CNMI as the solutions that are available on the mainland are not always applicable to islands in the western Pacific. Equipment prices are higher, there are fewer existing installations to use as a basis for estimating the cost of new projects, installation costs are very site-specific, some of the technologies are not suited to marine environments or require special modifications to withstand severe storms, and it is much more difficult to develop and bring projects to fruition due to long equipment delivery times and lack of familiarity on the part of many vendors with doing business in the Pacific. The reality is that every installation in the Pacific is unique and few vendors have the requisite experience to provide reliable project cost estimates.

As a consequence of these special circumstances, there is no robust pool of information about typical technology parameters and costs that CUC could use to develop an IRP and vendors could use to develop cost proposals. To complicate matters, CUC did not have detailed information about the nature of its power supply and distribution system. These factors increase uncertainty for potential vendors.

To help it navigate these issues, in June 2014 CUC engaged Leidos Engineering LLC (Leidos) to lead the development of both the IRP and the energy supply RFP under the direction of CUC staff. Figure 1 summarizes the major steps in the process used by CUC and Leidos.

Figure 1 : The IRP Development Process



The fundamental difference between the standard IRP process and that used by CUC is that the vendor RFP was issued first in order to obtain concrete cost and technology inputs for the IRP scenario modeling. As a preliminary step aimed at improving the likelihood of getting useful responses to the planned RFP, CUC issued a request for information (RFI) in September 2014 to a broad group of developers asking them what elements should be included in the RFP in order to reduce vendor uncertainty and encourage them to respond.

Developing the IRP entailed the following additional tasks, some of which are described further below.

- Stakeholder engagement activities and the development of a comprehensive IRP strategy.
- Developing comprehensive assumptions characterizing CUC's system — its power plants, fuel costs, historical and future loads — so that the power system parameters could be modeled.
- Developing and issuing an RFP for energy supply and evaluating the responses.
- Developing cost and performance estimates for energy supply and demand-reduction (energy efficiency and conservation) options that are of interest to stakeholders but were not proposed by any of the RFP respondents.
- Screening potential resource options and conducting detailed scenario modeling of options.

Stakeholder Engagement

Extensive stakeholder engagement activities were conducted via interviews and workshops at the outset of IRP development, with the purpose of:

- Explaining the IRP process, including the goals and timeline.
- Discussing challenges CUC would have to overcome to succeed with the IRP.
- Soliciting input from stakeholders in order to incorporate community priorities in the IRP goals.

Input was obtained from a broad group of vested organizations and agencies including the U.S. Environmental Protection Agency (EPA), the CNMI Public School System, the Commonwealth Public Utilities Commission, the Chamber of Commerce, the Hotel Association of the NMI, the CNMI Department of Community and Cultural Affairs, the Division of Fish and Wildlife, the CNMI Department of Public Works, the CNMI Bureau of Environmental and Coastal Quality, and the CNMI Legislature.

Stakeholder consensus was that lowering electricity rates should be the primary goal of the IRP, emphasizing the importance of this goal over concerns related to environmental impacts, sustainability, fuel diversity and other issues. Stakeholders also wanted CUC to evaluate the potential for liquefied natural gas (LNG) and demand-side management (DSM) options as part of the resource plan.

Cost and Performance Estimates: Energy Supply RFP and Other Resource Options

CUC issued the CNMI energy supply RFP in November 2014. The RFP was open to all technologies that have been proven both technically and economically feasible and have been operating reliably in a utility-scale environment for a minimum of two years. Proposed projects were also required to have a generating capacity of at least 1 megawatt (MW) and respondents were required to address the suitability of the proposed technology for island environments.

The RFP received responses from nine companies proposing 16 potential projects. The Source Selection Committee — consisting of six CUC staff and three Leidos staff — evaluated the proposals for completeness, the technical and performance characteristics of the solutions being proposed, and the financial health and operational experience of the proponents. Four of the proponents were disqualified, which left five proponents in the running. Qualified bids included proposals for one heavy fuel oil (HFO) and two light fuel oil (LFO) diesel-engine power plants and two of the respondents proposed PV projects. These bids provided real-world cost and performance characteristics for these technology categories.

As stakeholders had expressed interest in LNG and DSM options that were not included among the RFP responses, Leidos developed comprehensive assumptions for these technology categories so that they could be screened and modeled alongside the firm bids received via the RFP. DSM energy efficiency (EE) programs are also a requirement of CNMI Senate Bill 15-38.

Screening and Modeling Potential Resource Options

All of the supply-side options — LFO, HFO, PV, and LNG — were evaluated using a levelized cost of energy (LCOE) screening process. This makes it possible to compare the total costs of generation options that have very different characteristics: as an example, PV generating plants do not require any fuel whereas diesel generating plants do, and the LCOE figure takes this into account. The LCOE screening evaluated the capital, operating, fuel and other costs for each of the resource options, and then estimated the total cost in dollars per megawatt hour ($/MWh) of each option for a range of plausible capacity factors. This made it possible to eliminate redundant bids with similar technologies, reducing the number of scenarios that needed to be modeled.

In parallel with the LCOE analysis, Leidos evaluated several residential and commercial DSM programs using a cost-benefit analysis to determine the most cost-effective solutions. The probability of success was also considered — it is important for consumers to have a positive experience so that they will be interested in implementing additional DSM measures in future. Leidos recommended residential programs focusing on measures that can easily be implemented by customers, including low-flow shower heads, faucet aerators and low-energy light bulbs distributed via a free kit. Recommended commercial programs include measures to reduce lighting and refrigeration loads, administered via a "turnkey" direct install program.

Once the screening process eliminated the prohibitively expensive solutions, the remaining options were modeled in detail using the industry-standard PROMOD electricity market simulation tool. Various scenarios, each representing a different mix of energy resources, were run through PROMOD to determine which mix of available resources would best meet the needs of CUC and its customers at the lowest possible cost under a variety of future circumstances. PROMOD takes into account customer energy demand forecasts, transmission grid constraints, fuel price forecasts, and the operating and cost characteristics of existing and future supply-side and demand-side energy resource options.

Initially, five "base case" scenarios — representing baseload power solutions — were developed and run through the PROMOD simulation tool:

- **Case 1: Business as usual (BAU)** — the reference scenario used to compare the production cost differentials of all the other scenarios; assumes that CUC is able to extend the life of its existing LFO generating assets until 2040.
- **Case 2: Light fuel oil (LFO) replacement** — assumes that the least-cost LFO resource (of the two bids received) is located at the existing CUC Power Plant 4 site and that the existing Power Plant 1 unit is kept on line to provide backup power.
- **Case 3: Heavy fuel oil (HFO) replacement** — assumes that CUC will retire its existing Power Plant 1 units and rely upon the HFO bid for future generation, using LFO in Power Plant 4 for backup.
- **Case 4: LNG replacement (Saipan only)** — assumes that CUC will retire its existing Power Plant 1 units and rely upon a potential LNG alternative for Saipan only, using Power Plant 4 for backup.
- **Case 5: LNG replacement (all islands)** — assumes that the existing power plants on Tinian and Rota and the Power Plant 1 units on Saipan will all be replaced by new LNG-fueled generators with the existing Power Plant 4 being used for backup power on Saipan.

Additional scenarios were then developed to evaluate the individual PV resource options proposed by RFP proponents in combination with the BAU case (cases 6-10). These "PV additions" scenarios model all of the RFP PV bids, which ranged from 1 MW to 10 MW in size.

The other base cases were combined with PV resource options to determine whether there would be any cost savings from adding PV to those baseload power solutions (cases 11-16). Additional "sensitivity" scenarios, reflecting varying assumptions regarding future CUC loads, fuel prices, and customer adoption of distributed PV systems, were then run through PROMOD to account for the uncertainties inherent in these variables. The sensitivity cases include the requirement in Public Law 18-62 for 20% of electricity sales to come from renewable resources.

IRP Results and Key Findings

It was determined early on in the IRP process that the power plants on Tinian and Rota are more than sufficient in terms of both capacity and generation to serve their anticipated future loads. The focus of the IRP switched to addressing the power supply needs on Saipan, and an addendum to the energy supply RFP was issued making this clear to potential respondents. However solutions that addressed more than one island were not ruled out and Leidos ran some model simulations for all-island solutions.

Table 1 below shows the results of the LCOE analysis for all of the modeled energy technology combinations but does not show the extensive sensitivity cases. Scenarios in green are less costly than business as usual, those in red are more expensive.

All of the scenarios in the table include distributed PV generation. For the purposes of this analysis, Leidos assumed that half of the PV systems currently planned for installation by CUC customers will actually be completed and generate power. Other levels of distributed PV adoption were modeled in the sensitivity cases. "PV" in the technology resources column refers to the addition of new utility-scale PV systems. Scenarios 6-10 reflect specific PV project proposals received via the RFP: "PV(1)" refers to one of the PV proponents, "PV(2)" refers to the other PV proponent.

Table 1 : Ranked Levelized Production Cost Comparison for Scenarios 1-16 ($/MWh)				
IRP Scenario	Technology Resources Included in Each Scenario	Levelized Cost of Energy ($/MWh)	Difference from Case 1 ($/MWh)	Difference from Case 1 (%)
16 - LNG All, 10MW PV	LNG (new units), LFO (backup), DSM, PV	329.02	-135.46	-29%
15 - LNG All, 5MW PV	LNG (new units), LFO (backup), DSM, PV	331.06	-133.42	-29%
05 - LNG All Islands	LNG (new units), LFO (backup), DSM	334.23	-130.24	-28%
04 - LNG Saipan	LNG (new units), LFO (backup), DSM	353.42	-111.05	-24%
10 - BAU, 10MW PV(2)	LFO (existing units), PV, DSM	435.89	-28.58	-6%
09 - BAU, 10MW PV(1)	LFO (existing units), PV, DSM	439.26	-25.22	-5%
08 - BAU, 5MW PV(1)	LFO (existing units), PV, DSM	446.36	-18.12	-4%
07 - BAU, 2MW PV(1)	LFO (existing units), PV, DSM	450.19	-14.29	-3%
06 - BAU, 1MW PV(1)	LFO (existing units), PV, DSM	451.65	-12.82	-3%
14 - HFO, 10MW PV	HFO (new units), LFO (backup), DSM, PV	453.09	-11.38	-2%
13 - HFO, 5MW PV	HFO (new units), LFO (backup), DSM, PV	456.80	-7.67	-2%
03 - HFO	HFO (new units), LFO (backup), DSM	460.42	-4.05	-1%
01 - BAU	**LFO (existing units)**	**464.48**	**0**	**0%**
12 - LFO, 10MW PV	LFO (new & existing units), DSM, PV	466.88	+2.40	+1%
11 - LFO, 5MW PV	LFO (new & existing units), DSM, PV	473.66	+9.18	+2%
02 - LFO	LFO (new & existing units), DSM	480.40	+15.93	+3%

The LCOE numbers generated by the scenario cost modeling resulted in several key findings:

- All of the fuel-oil-fired generation options (LFO, HFO and BAU) have very similar costs from a planning perspective, as differences of up to 5% in the model results are not statistically significant.
- The LNG option is projected to be significantly less costly than any of the fuel-oil generation options.
- Utility-scale PV generation facilities are projected to be significantly less costly than any of the fossil fueled generation options, including LNG. However their relative savings is significantly lower than the LNG option as a result of the inherently low capacity factor of PV plants and in particular the limited contribution of PV generation during CUC's peak demand periods.
- The proposed DSM measures are projected to be significantly less costly than all of the supply side (fossil fuel and PV) options. While the total impact of these measures on CUC's loads is limited, they would produce immediate bill savings for customers, which was a key stakeholder priority.

However there are some important caveats to these findings that are not reflected in the numbers.

The BAU option presents some significant challenges:

- Resource planning — While it may be technically feasible to extend the life of CUC's existing generating plants through 2014, the scarcity of adequate replacement parts for Power Plants 1 and 4 may force the retirement of those assets before 2014.
- Reliability — As the generators age, forced outages are likely to increase, even with diligent efforts by plant engineers to prevent them.
- Maintenance costs — The IRP BAU scenario reflects CUC's and Leidos's best estimates regarding anticipated maintenance but these costs are highly uncertain and could exceed the IRP estimates.

HFO is a dirty fuel with significant regulatory and economic uncertainty:

- Permitting and siting — The RFP HFO bid did not include all expected costs; Leidos and CUC attempted to identify the likely costs associated with permitting and siting a new HFO facility but a detailed feasibility and regulatory compliance study is required to produce more accurate estimates.
- Environmental impacts and compliance costs — The environmental compliance costs associated with using HFO in CNMI are unknown. They were not included in the RFP response and were estimated by Leidos. Further study is required to improve the estimates. In addition, given CUC's desire to pursue sustainable energy development, the environmental impacts of using HFO to generate electricity cannot be ignored, regardless of the economics.
- Fuel handling costs — Substantial new fuel handling infrastructure would be required to accommodate the toxic nature of HFO; the new infrastructure would impose additional environmental impacts as well as additional costs that are unknown at this time.

No LNG bids were received via the RFP so Leidos developed the engineering and cost estimates for the LNG cases. The economic viability of LNG is highly site-specific and some aspects —the optimal source of LNG supplies, shipping costs and the costs of developing LNG infrastructure — are difficult to estimate. However the modeled cost differential between the fuel oil options and LNG is large enough to warrant a detailed feasibility study. If CUC is interested in this option, the feasibility study should be started soon as it typically takes several years from the time studies are initiated until the LNG facilities are completed and generating power. The study could explore potential regional partnerships with Guam or other Micronesian islands to jointly develop a central LNG regasification facility and shipping hub.

Identifying and acquiring suitable land areas are expected to be significant challenges with respect to the development of utility-scale PV generation. Additionally, CUC's Renewable Integration Study identified an upper limit to how much intermittent, renewable generation could be accommodated given CUC’s existing assets and system infrastructure. It is possible that this limit may increase following infrastructure upgrades, but those potential upgrades have not yet been contemplated by CUC.

Next Steps

The IRP process has provided CUC with enough information to identify energy supply solutions worthy of further investigation. Before making the final selection, additional studies are needed to clarify the costs and other impacts associated with some of the potential generation options.

The LFO diesel-based proposals are mostly "drop-in" solutions at an existing power plant location and have been fully modeled during this initial IRP process. However, as mentioned above, the LNG, HFO and PV scenarios need to be modeled in greater detail in order to fully evaluate those options. Detailed feasibility studies will develop a more comprehensive understanding of the costs of LNG delivery and distribution systems and any potential energy security concerns with fuel delivery for that option, regulatory and environmental challenges associated with HFO power plants, and issues with identifying land for a potential utility-scale PV power plant. CUC will also consider additional energy efficiency and conservation programs given the favorable modeling of DSM solutions.

Other factors need to be considered before determining the best energy supply solution for CNMI. As an example, the IRP process did not incorporate disaster resiliency and the possible future effects of climate change into the selection process for new generating assets. Climate change is associated with increasing frequency and strength of storms and rising sea levels, which could potentially threaten CNMI's power systems as a result of high winds and storm surge in low-lying coastal areas. However following the devastation caused to Saipan's power generation and distribution system by Typhoon Soudelor, CUC has decided to incorporate storm resiliency as a criterion in the final selection process.

In addition to the above activities, Leidos recommended the following actions related to CUC's operations and future planning efforts:

1. Develop an IRP implementation plan including specific milestones.
2. Collect detailed operations data related to hourly loads, generation, distributed PV penetration, electricity sales, fuel costs, and other key system parameters. This will aid future planning efforts and operational budgeting and benchmarking.
3. Develop a fuel price hedging program to compensate for the inherent volatility in fuel prices. Such a program could be used to mitigate the price swings that are inevitable in the world oil markets, and which ultimately impact CUC's customers.
4. Conduct a cost of service study to identify the true costs of service by customer class and to quantify administrative and general expenses associated with CUC's operations. The results of such a study would be very useful in determining whether rate design modifications may be appropriate to recover CUC's true costs of service.

CUC is currently focused on the timely and efficient restoration of utility services following the recent storm damage. Within the constraints imposed by the recovery effort, CUC will start implementing the recommended actions identified in the Leidos report following adoption of the 2015 IRP by the CUC Board of Directors.