



Planning for GPA's Future - GPA's Integrated Resource Plan



Joaquin C. Flores, P.E., GPA General Manager

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GPA Fact Sheet

Customers Served:	~ 46,000
Annual Budget:	\$350 M
Employees (FTE):	528
Generation Capacity:	552 MW
T&D Line Coverage:	663 Miles
Avg. Daily Production (Gross/Sales):	~ 5,100,000 / 4,500,000 KWH
Avg. Daily Fuel Consumption:	~ 7,800 bbls/day
Avg. Peak Demand:	~ 260-265 MW
Highest Peak Demand To Date:	281.5 MW

IRP Process

- **Objective:**

Determine the timing of and type of generation resources required to meet the near future electric needs of Guam economically and efficiently
- **Stakeholder Approach:**

Involved community representatives from military, construction & tourism industry, local regulatory agencies & the legislature to participate in an open dialogue regarding the development of the IRP through four public work sessions
- **PUC Timeline**

GPA ordered to complete IRP by Dec. 2008

Key Assumptions

- Resource Options
 - Existing Resources
 - New Plant Type, Size, & Operational Costs
 - Production Tax Credits (Renewable Options)
 - Infrastructure Upgrades
 - Demand Side Management
 - Unsolicited Information
 - Cap & Trade Costs (GHG/CO2 Emissions)
- Fuel Forecasts
- Load Forecasts



INTEGRATED RESOURCE PLAN REVIEW

Integrated Resource Plan

1. Situation Analysis
2. Strategic Issues
3. Scope of Work
4. IRP Process
5. Future Electric Requirements of Guam
6. Future Fuel Costs & Choices for GPA
7. Supply Side Options
8. Demand Side Management
9. Policy Issues & External Factors
10. Capital Requirements
11. Key Results
12. Recommendations
13. Next Steps

Situation Analysis

- GPA has had relatively flat growth since FY 1998.
- Economy outlook for Guam anticipated to boom due to resurgence in tourism and the proposed US military buildup.
- GPA has experienced effects of fuel price volatility and is required to look into fuel diversification.
- Federal and Public laws have impact in future planning in regards to Carbon Cap & Trade and Renewable Portfolios Standards.
- GPA must establish plan for new loads and capital cost requirements.

Strategic Issues

- Fuel Diversity, fuel supply risk, and renewable energy;
- Supporting the electric power service requirements for the impending Department of Defense (DOD) build-up and its economic consequences; and
- Acquisition of new electric energy supply and its implication on human resource requirements and the Authority business model.

Scope of Work

- The Need For Generation Capacity (Next Unit Addition);
- Retirement Of All Generation Units Singly And In Combination;
- Benefits and Costs of GPA's Demand-Side Management Program;
- Projected Effect of Implementing a Deep Sea Water Cooling Distribution System in Tumon Bay;
- Implementation of Renewable Portfolio Standards Policy; and
- An Optimized Near and Long-Term Generation Expansion Plan.

IRP Process

- Analytical Process
 - Review planning environment;
 - Develop inputs and assumptions;
 - Develop load and resource balance;
 - Define candidate resource list;
 - Use the capacity expansion optimization tool STRATEGIST;
 - Develop and use planning scenarios to test results;
 - Create risk analysis portfolios; and
 - Select preferred portfolio based on evaluation criteria

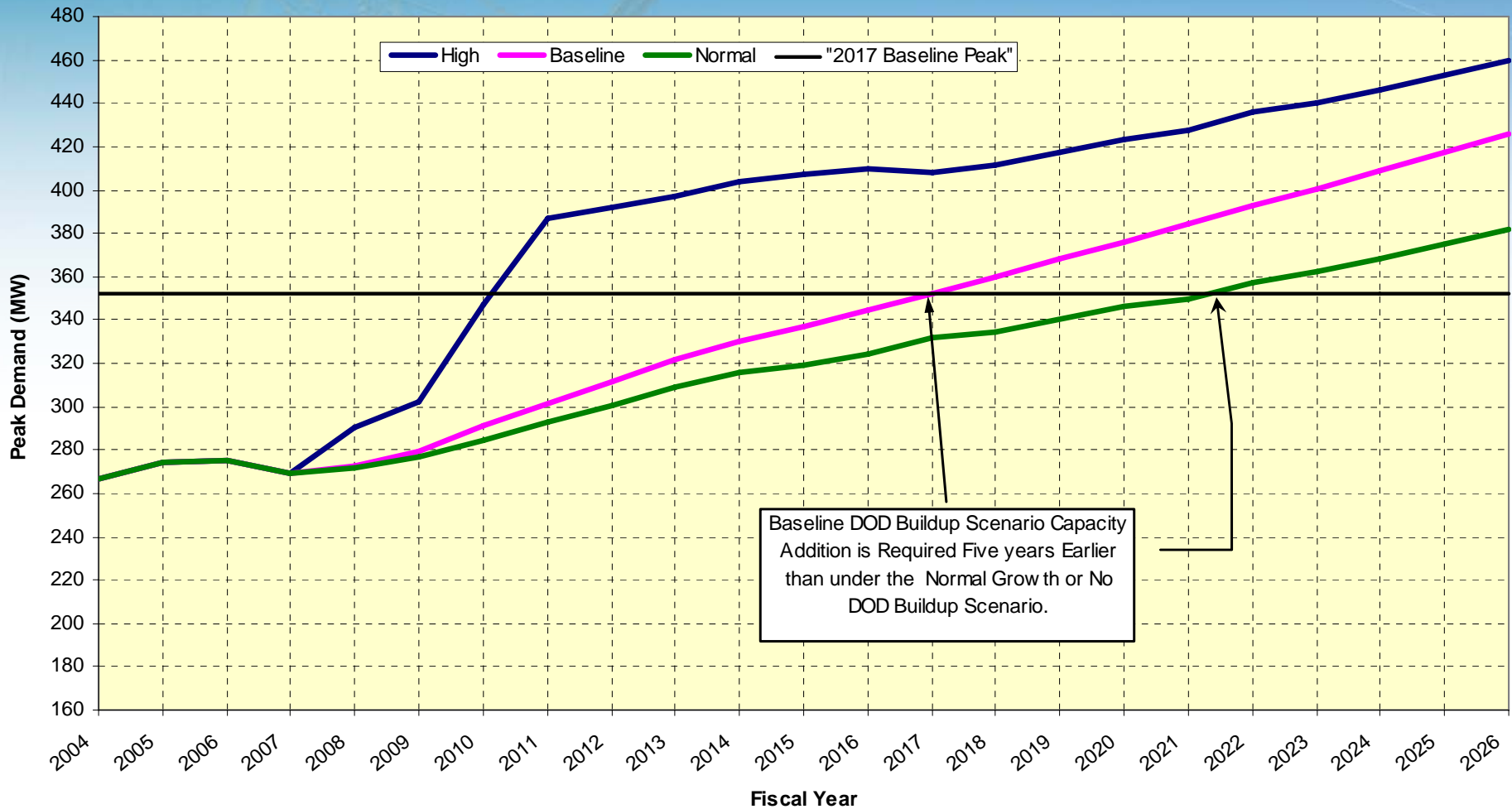
IRP Process *continued*

- Stakeholder Process
 - Involved community representatives from military, construction & tourism industry, local regulatory agencies & the legislature
 - Conducted four public stakeholder work sessions

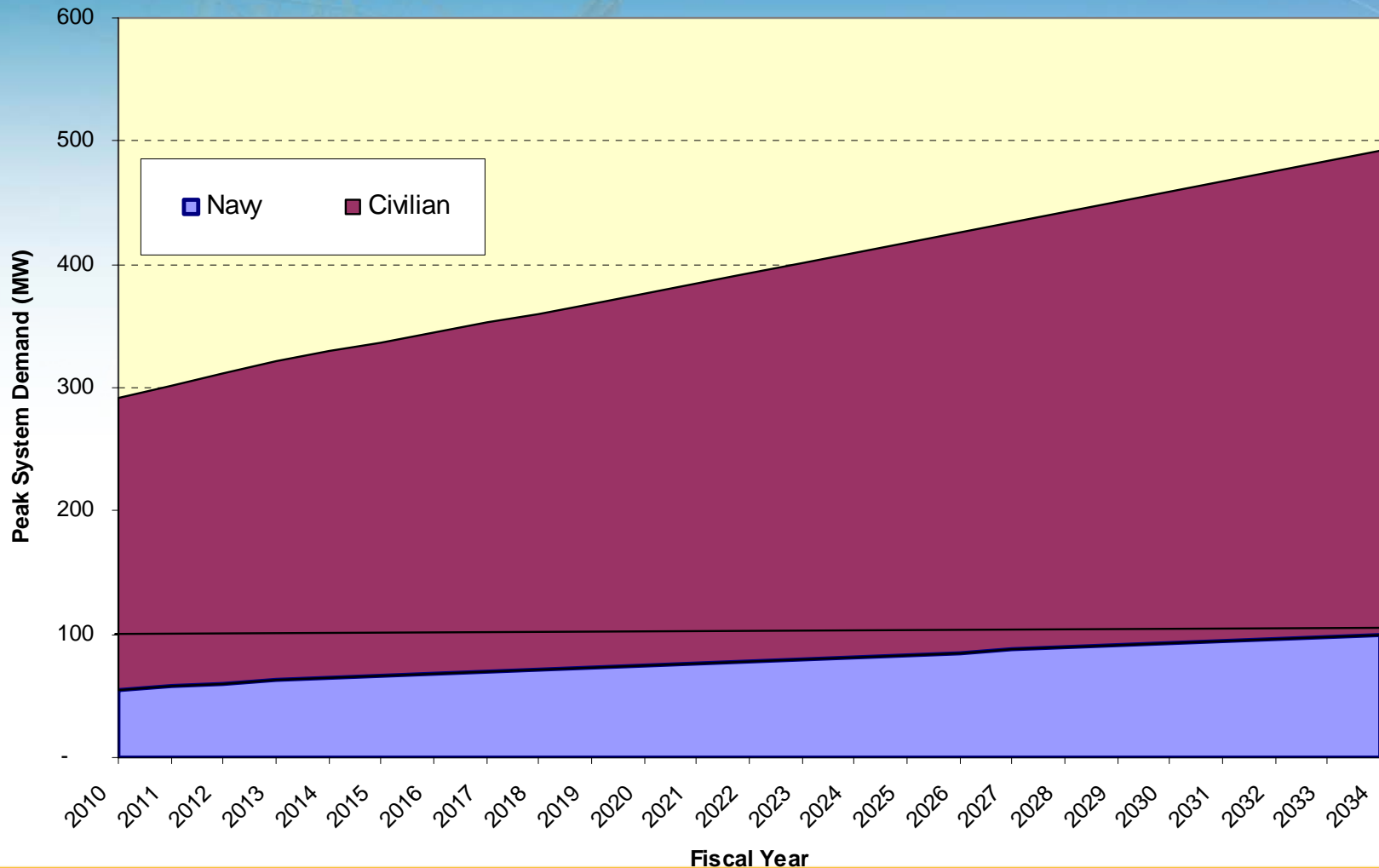
Future Electric Requirements of Guam Load Forecast

- GPA looked at three load forecast scenarios:
 - **Normal** - “Business as Usual” (No DOD Buildup);
 - **Baseline** - Moderate Tourism Growth and Department of Defense (DOD) Buildup; and
 - **High** - Rapid Tourism & Rapid Infrastructure Growth
- GPA worked with consultant P.L. Mangilao to develop econometric model using various data and assumptions

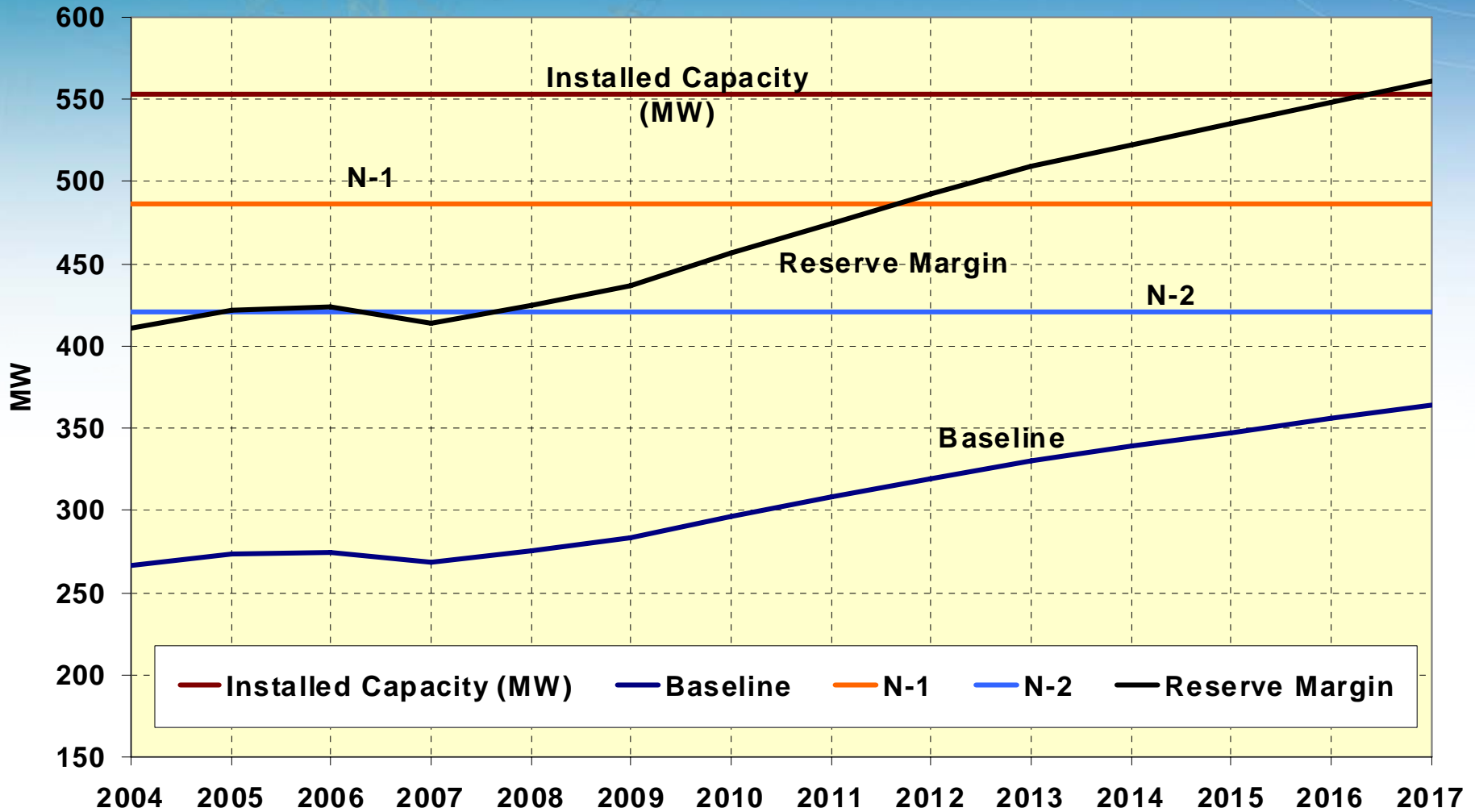
GPA Demand Forecast Scenarios



Peak System Demand Forecast Disaggregated by Civilian and DOD Coincident Demand



Load/Resource Balance – Reserves

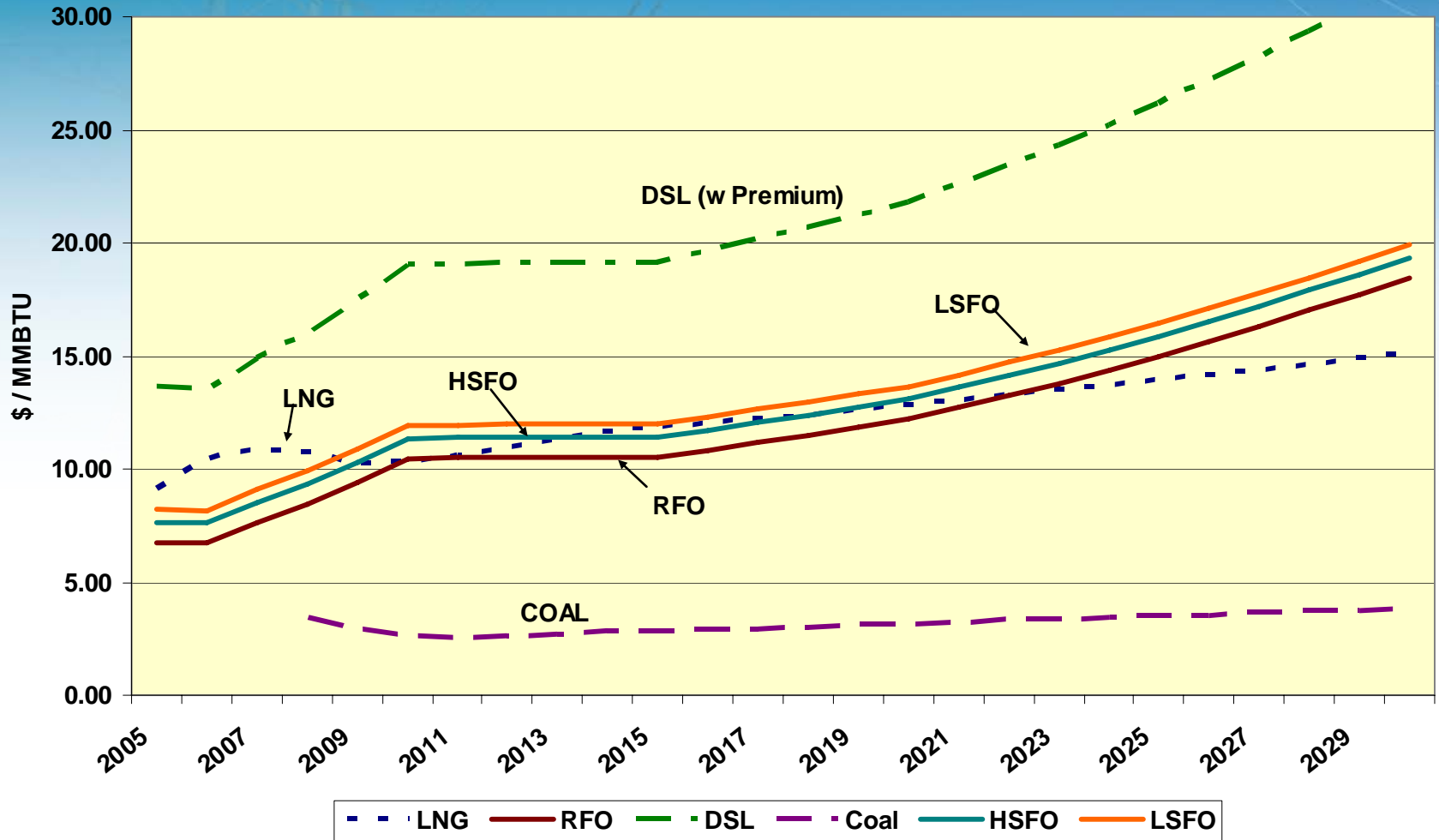


Future Fuel Costs & Choices for GPA

Fuels Forecast

- GPA contracted P.L. Mangilao to perform fuels forecast
- Fuels forecasted include:
 - RFO #6
 - Diesel No. 2
 - Coal
 - LNG (cost includes regasification and local storage)
- Fuel delivery
 - INDONESIA: Coal & LNG
 - SINGAPORE: RFO

FUELS FORECAST



Supply Side Options

- GPA contracted Winzler & Kelly/R.W. Beck engineering consulting team to perform research into viable power production technology for Guam. Research included:
 - Resource Option & Operational Characteristics
 - Resource Option capital and operational costs
 - Fuel use and source discussion
 - Environmental and Permitting discussions
 - Construction Schedules

Supply Side Options: Cost Models

Plant Description / Technology	Nominal Capacity MW	Primary Fuel	Capital Cost \$000	Capital Cost \$/kW	FOM \$000	VOM \$000	VOM \$/MWh
Steam / PC/CFB	60	Coal	300,250	5,004	\$ 4,928	\$ 2,061	4.61
CC w/ LNG / LM6000	60	LNG	334,000	5,567	\$ 4,004	\$ 1,212	2.56
Wind / 20x2MW On-shore	40	Wind	97,076	2,427	NA	NA	19
Retrofit / Piti 7 CC	60	No. 2	71,601	NA	\$ 2,464	\$ 2,206	4.61
Biomass / Stoker/CFB	10	MSW	85,608	8,561	\$ 4,107	\$ 5,690	76.88
Recip / 2x20MW S/MSD	40	No. 6	70,980	1,775	\$ 2,135	\$ 1,669	5.64

Supply Side Options: Timelines

Plant Description	Technology	Months		
		Permitting	Start of Eng to CO	Total Duration
Steam	PC/CFB	30	36	66
CC w/ LNG	LM6000	30	28	43
Wind	20x2MW Onshore	15	9	18
Retrofit	Piti 7 CC	24	18	30
Biomass	Stoker/CFB	30	30	45
Recip. Engine	2x20MW S/MSD	24	18	30

Supply Side Options: LNG Conversion of Fuel Oil Plants

CAPITAL COSTS

Existing Fuel Oil Plants	LNG Conversion Costs (\$000)
Tenjo Plant	\$39,608
TEMES CT	\$8,633
Cabras 1&2 Plant	\$17,667
Tanguisson Plant	\$22,821
Macheche CT	\$10,407
Dededo CT 1&2 Plant	\$21,800
Yigo CT Plant	\$14,020

Conversion costs include new pipeline installation and facility upgrade

Unsolicited Information

- **Solar & Others**
 - 25MW & 50MW plant sizes
 - Modeled as purchased power with provided \$/kwh
- **OTEC**
 - 20MW Plant
 - Proponent provided capital and operating costs, and operational parameters

Cap & Trade Costs and Production Tax Credit (PTC) Assumptions

- Carbon Cost Rates:

- Implemented by 2012 and increased until 2020, with a fixed rate thereafter.*

Fuel Type	(\$/MWH)	
	Low	High
Coal	12.5	37.5
RFO	7.5	22.5
LNG	5	15

- Production Tax Credits (PTC):

- Applied as credit to operation costs first ten years after commissioning*

Unit Type	\$/MWH	\$/kWH
WIND	19	0.019
MSW (Biomass, Open Loop)	10	0.01
OTEC	10 / 19	0.01 / 0.019

Demand Side Management

- In FY 2005 GPA completed a feasibility study for the Guam Sea Water Air Conditioning (GSWAC)
- R.W. Beck consultants also evaluated GSWAC and other “small scale” programs suitable for Guam. The research included:
 - Identifying potential programs
 - Determine peak and energy impact
 - Identify program costs
 - Perform economic screening results

Demand Side Management Evaluated Programs

DSM Measures	Energy & Demand Reductions		
	Annual Energy Reduction (kWh)	Non-Coincident Demand Reduction (kW)	Summer Peak Demand Reduction (kW)
Residential Measures:			
Energy efficient lighting retrofit	675	0.46	0.23
Solar photovoltaic (10kW)	13,000	5	4
Solar thermal (40 gal Wtr Htr)	2,700	4.5	0.68
Residential energy audits	670	0.17	0.05
Commercial Measures:			
Energy efficient lighting retrofit	3,000	0.7	0.56
Solar photovoltaic (10kW)	26,000	10	8
Solar thermal (40 gal Wtr Htr)	2,700	4.5	1.35
Commercial energy audits	1,650	0.33	0.13

Demand Side Management GSWAC, Energy Conversion Project

- Modeled as DSM transaction
- Commission Unit in 2013
- Energy savings is ~ 92 GWH per year

Policy Issues & External Factors

- Federal & Local Legislation impacts:
 - Public Utility Regulatory Policies Act of 1978 (PURPA)
 - Energy Policy Act (EPAAct of 2005)
 - P.L. 27-132 (Net Metering)
 - P.L. 29-62 (Renewable Portfolio Standard)
 - Pending/Unpassed Local Bills

Capital Requirements

- Based on optimal plans for the Base Case and High Case scenarios GPA should plan for potential capital investments for resource acquisitions listed on the next two slides

Capital Requirements Base Scenario

Project	Description	Construction Schedule	Commission Year	Capital Requirement (\$ 000)
WIND	Wind Farm20x2MW	18 Months	2011	97,076
WIND	Wind Farm20x2MW	18 Months	2012	97,076
TEML	TEMES Conversion to LNG40MW		2012	8,633
SSD	Reciprocating Engine (Slow Speed Diesel)2x20MW	30 Months	2017	70,980
WIND	Wind Farm20x2MW	18 Months	2018	97,076

Capital Requirements High Scenario

Project	Description	Construction Schedule	Commission Year	Capital Requirement (\$ 000)
RETR	Retrofit / Piti 7 CC	30 Months	2010	71,601
WIND	Wind Farm20x2MW	18 Months	2011	97,076
WIND	Wind Farm20x2MW	18 Months	2012	97,076
CLNG	CC w/ LNG / LM6000	43 Months	2013	112,000
WIND	Wind Farm20x2MW	18 Months	2013	97,076
SSD	Reciprocating Engine (Slow Speed Diesel)2x20MW	30 Months	2016	70,980

Key Results

- Deferment of Base Load Unit and Intermediate Unit Retirements;
- Base Case Analysis; and
- Robustness analysis of supply-side options:
- Effectiveness of supply-side options as a function of Capital Costs;
- Effectiveness of Wind Farm as a function of Capital Costs, Capacity Factor, Carbon Cap & Trade and Production Tax Credits.
- The Authority analyzed other emerging technologies including:
 - Solar Thermal Power Conversion;
 - Ocean Thermal Energy Conversion;
 - Municipal Solid Waste Conversion;
 - Initial Look at Integrated Gasification Combined-Cycle Plant Technology; and
 - Initial Look at Geothermal Energy Technology.

Key Results

Optimal Retirement Years

Unit	Type	Optimal Retirement Year
Cabras 1	Baseload	2026
Cabras 2	Baseload	2027
Cabras 3	Baseload	2035
Cabras 4	Baseload	2036
MEC 8 (Piti 8)	Baseload	2038
MEC 9 (Piti 9)	Baseload	2039
Tanguisson 1	Intermediate	2028
Tanguisson 2	Intermediate	2029

Key Results

Optimal Plan Results Summary

SCENARIO	Net Present Value Utility Costs (\$000)	Difference from NORMAL Scenario Utility Costs (\$ 000)	WIND DETAILS		
			Wind Farm before 2017?	No. of Wind Farms	Year Installed
NORMAL	\$5,401,374.00	\$0.00	-	0	-
BASE	\$5,717,896.50	\$316,522.50	YES	2	2011, 2012
HIGH	\$6,672,279.50	\$1,270,905.50	YES	3	2011, 2012, 2013

Key Results

Comparison of Selected Options

YEAR	NORMAL	BASELINE	HIGH
2010			RETR
2011		WIND	WIND
2012		WIND TEML	WIND
2013			CLNG WIND
2014			
2015			
2016			SSD
2017	WIND TEML		SSD
2018	WIND	WIND	

Key Results

Effectiveness of WIND Technology

CAPITAL COST ADJUSTMENT	No. of Wind Farms coming in before 2017:	Total Wind Farms for study period:
-30%	2	5
-20%	2	5
-10%	2	5
Base Case	2	5
10%	2	5
20%	2	5
30%	2	4

Key Results

Wind Farm Viability

ANALYSIS CRITERIA	Capacity (Wind Farm):	40 MW	40 MW	40 MW	40 MW
	With Carbon Cap & Trade?	Yes	-	-	Yes
	With PTC?	Yes	-	Yes	-
RESULTS	CAPACITY FACTOR (%)	Wind Farms Selected Prior to 2017:			
	15	2	0	0	1
	20	2	1	2	2
	25	2	2	2	2
	30	2	2	2	2
	35	2	2	2	2

Key Results

Other Key Explorations

SOLAR Power System

- Uses Parabolic Solar Troughs to collect and concentrate the sun's energy
- Energy is then transferred to a liquid medium which is heated to the ideal operating temperature from which it can be used to produce electricity
- Energy can also be stored in large thermal storage tanks for round-the-clock power production

IMPROVES ON BASE CASE COST

Year	Units
2006	
2007	
2008	
2009	
2010	
2011	WIND
2012	WIND, TEML
2013	WIND
2014	
2015	
2016	SOLAR
2017	
2018	
2019	SSD
2020	WIND
2021	WIND
2022	CLNG
2023	SSD, CLNG
2024	SSD
2025	
2026	CLNG
2027	
2028	SSD
2029	CLNG
2030	
2031	
2032	
2033	SSD
2034	
2035	

Key Results

Other Key Explorations (continued)

Ocean Thermal Energy Conversion

- Use of the Temperature Difference of the tropical ocean's Warm Surface Water and Cold Deep Water to drive heat engines and generate electricity
- Needs a subsidy of ~ \$100-130 Million
- Other business opportunities such as water production, aquaculture, hydrogen generation, and bottled deep-sea water may provide subsidy.

Key Results

Other Key Explorations (continued)

Integrated Gasification Combined Cycle Plant (IGCC)

- Coal is converted to synthetic gas and used in a normal gas fired combined cycle plant
- Just as clean as a combined cycle plant using LNG
- Fuel price tied to coal prices
- IGCC technology allows for carbon capture -a significant advantage to coal plants.
- Reliable carbon sequestration is still under development - significant advantage to a coal plant
- Some challenges include high capital costs, no reference plant design yet, very few vendors/engineers, hard to get favorable contract terms/risk sharing

Key Results

Other Key Explorations (continued)

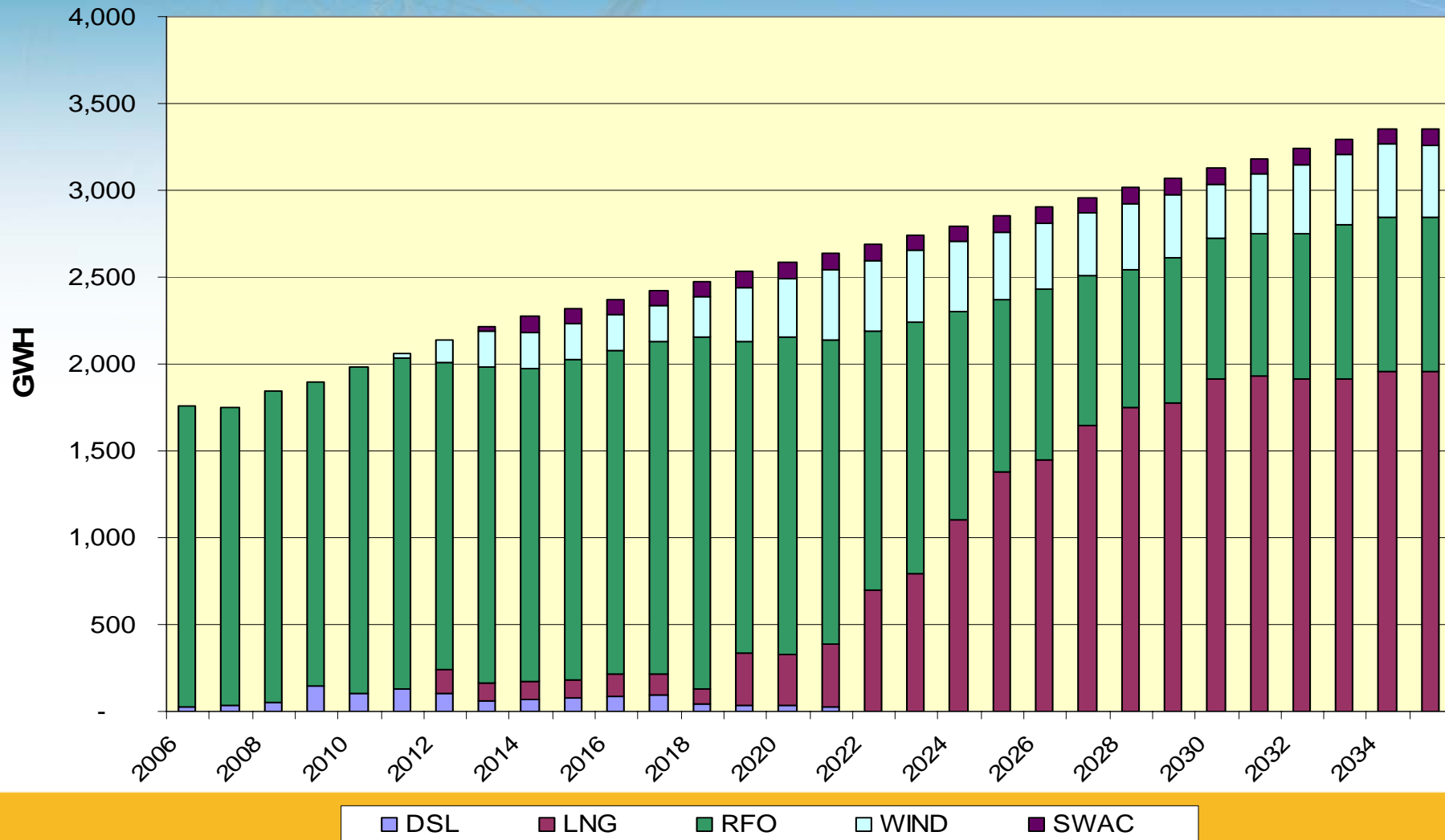
Geothermal Option

- GPA has initiated a conversation with Bottle Rock Power (BRP) to discuss the possibilities for electricity production from geothermal sources
- BRP's principal asset is a 55-megawatt geothermal power plant at The Geysers Geothermal Field in northern California and they expect the facility to produce ~200,000 megawatt-hours of electricity annually and will be sold to Pacific Gas & Electric Company
- BRP believes there is geothermal potential on Guam
- This exchange is still ongoing

Key Results

Fuel Diversity Outlook

Generation by Fuel Type
(Base 9-3)



Recommendations

- Initiate procurement process to integrate renewable energy as quickly as practical
- Begin process to bring LNG as substitute fuel
 - Work with DOD for Japan's pledge on infrastructure support
 - Renegotiate TEMES CT contract for fuel conversion project
 - Consider supplying gas to improve economy of scales
- Plan and permit for additional non-petroleum plant in anticipation of potential DOD growth
- Ensure all existing plants meet or exceed performance standards set before PUC

Recommendations (continued)

- Examine life extension plans for existing plants Continue to evaluate renewable & energy efficiency technologies to achieve lowest possible costs for customers
- Work collaboratively with PUC and stakeholders to improve Authority's financial position to obtain funds for these projects
- Continue to investigate geothermal, ocean thermal (OTEC), integrated gasification combined cycle (IGCC), and others
- Find a business partner to develop sea water air conditioning (GSWAC) project

Recommendations (continued)

- Work with PUC to establish the rules of engagement for and rates for net metering
- Work with PUC on implementing small scale demand side management (DSM) programs

Next Steps

- Work with PUC to finalize the IRP Plan;
- Development of Requests for Proposals (RFPs) to initiate the competitive process for resource development; and
- Award Contracts for resource to chosen developers.

THE END