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An Initial Look at Future Power Options

October 18, 2007

*GPA Integrated Resource Plan
Stakeholder Meeting*



Candidate Technologies

- **Renewable Energy**
- **Supply Side Generation**
- **Demand Side Management (DSM)**
 - *will be discussed later*

Renewable Energy

- **Wind Farm**

On-shore, ridgeline configuration wind turbines
Off shore a possibility

- **Biomass Power Generation Facility**

Steam turbine generator plant fueled by biofuels and
municipal solid waste

- **Guam SWAC**

Deep seawater cooling for air conditioning along
Tumon Bay (energy conversion)

Other Renewable Proposals

- **Solar Thermal Plant** – NAAVONO Energy USA, Inc
Utilizes a liquid medium running parallel through parabolic solar trough which is heated vaporization to drive turbine
- **Biogas (Methane) Extraction** – Ship Supply, Logistic/Provisions
Plant fueled with captured methane from decomposing waste at the Ordot dump
- **Ocean Thermal Energy Conversion (OTEC)** – OCEES
Using warm surface water to vaporize system fluid (ammonia) to drive turbine to produce electricity. Cold deep water cools fluid to cycle the process

Supply Side Generation Options

- **Small Coal-Fired Power Plant** – a pulverized coal (PC) boiler or circulating fluidized bed (CFB) boiler powering steam turbines
- **Small Combined-Cycle Power Plant W/ Liquefied Natural Gas (LNG) Facility** – Combustion Turbines fueled by LNG
- **Re-power Piti Power Plant** - Retro-fitting Piti 7 CT into a Combined-Cycle plant by adding an HRSG and an ST
- **Reciprocating Engine** – Low or medium speed water cooled diesel units utilizing efficient reciprocating engines

Other Supply Side Generation Options

- **Heavy Fuel Conversion** –
Convert medium speed diesels to use residual fuel oil
- **LNG + H2 Motor Generator** – h2ondemand
Fuel blend of natural gas and hydrogen with Deutz Hydrogen motors

Cost Model

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	240,000	4,000	\$ 4,800	\$ 2,010	4.5
CC w/ LNG / LM6000	60	LNG	275,000	4,583	\$ 3,900	\$ 118	2.5
Wind / 10x2MW On-shore	20	Wind	40,000	2,000	NA	NA	NA
Retrofit / Piti 7 CC	60	No. 2	34,000	NA	\$ 2,400	\$ 125	4.5
Biomass / Stoker/CFB	10	MSW	75,000	7,500	\$ 4,000	\$ 5,552	75
Recip / 2x20MW S/MSD	40	No. 6	60,000	1,500	\$ 2,080	\$ 1,628	5.5

Construction Times

Plant Description	Technology	Months		
		Permitting	Start of Eng to CO	Total Duration
Steam	PC/CFB	30	36	51
CC w/ LNG	LM6000	30	28	43
Wind	10x2MW 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

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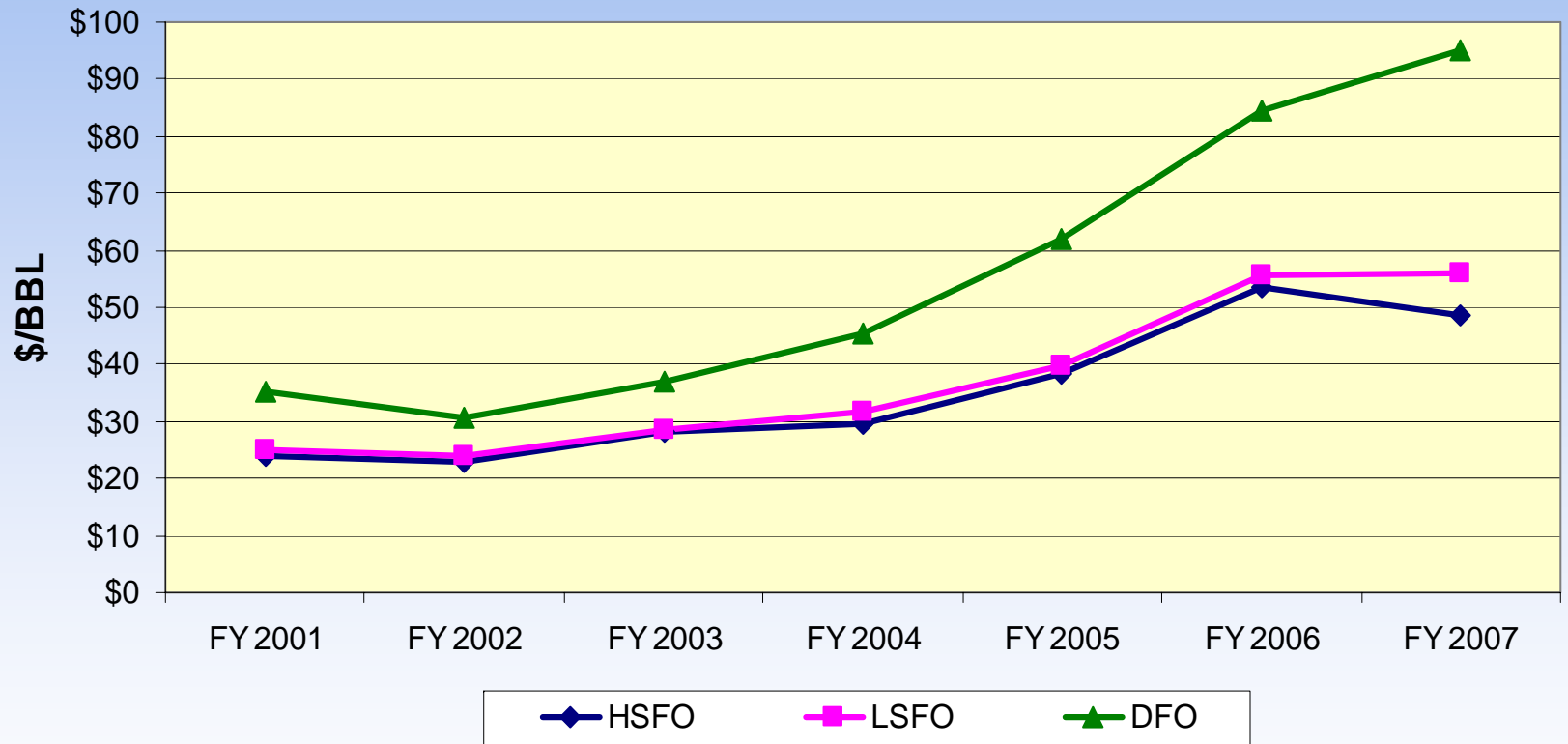
Fuel Supply Issues



Residual Fuel Oil & Diesel

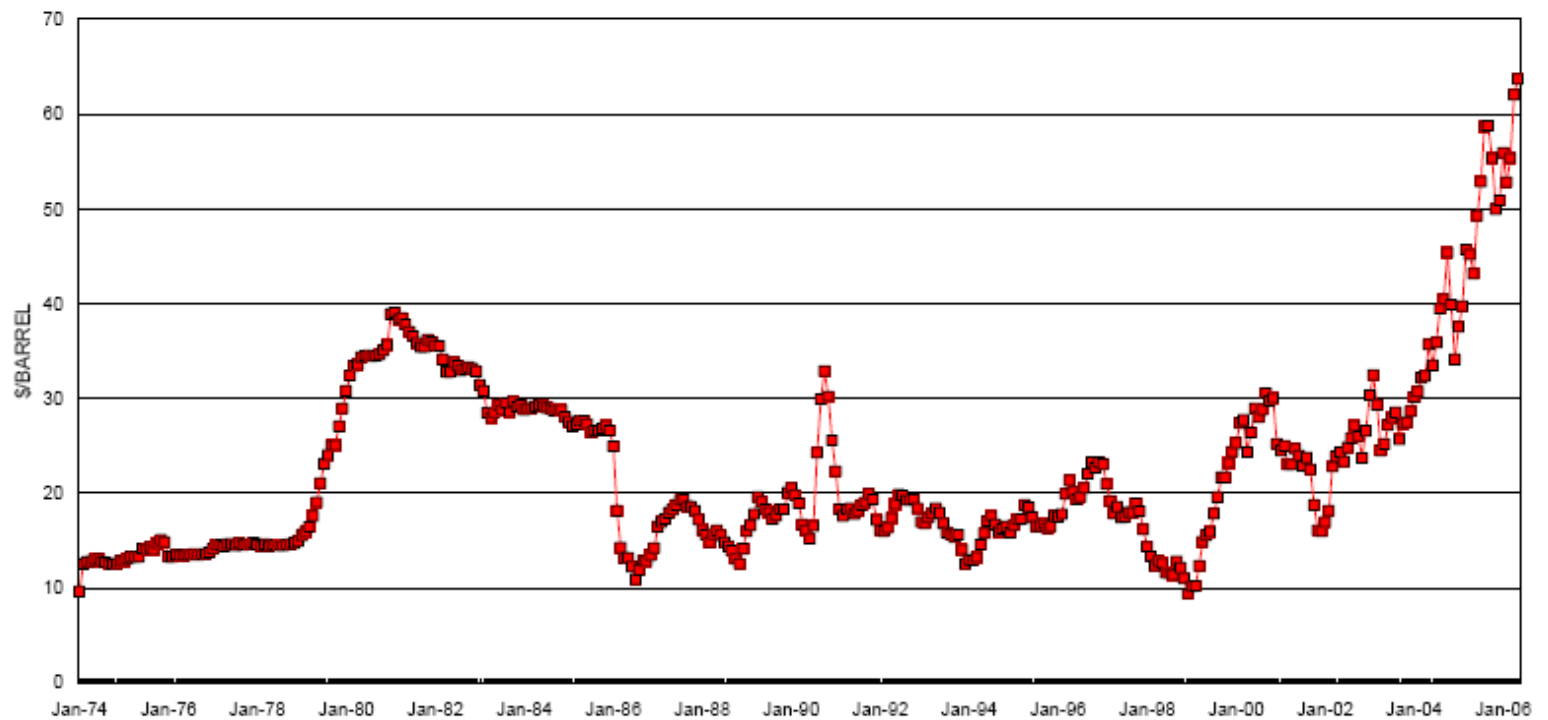
- GPA uses the following fuels:
 - High Sulfur Fuel Oil (HSFO), Low Sulfur Fuel Oil (LSFO), No. 2 diesel distillate (DIESEL), Low Sulfur Diesel
- Fuel supply contracts: 3yr base, 2yr optional ext.
- RFO Bulk storage is located at GPA fuel farm and leased tanks in Piti-Cabras area
- Diesel fuel is delivered to sites as needed
- Rising fuel oil prices have caused a cash crunch because of rising fuel inventory costs
- GPA uses Zero-Cost Hedge Collars to mitigate the volatility of Fuel Prices
 - May Hedge 25%, 50%, 75%, or 100% of contracted volume each quarter.

Historical Fuel Oil Purchase Prices (GPA)



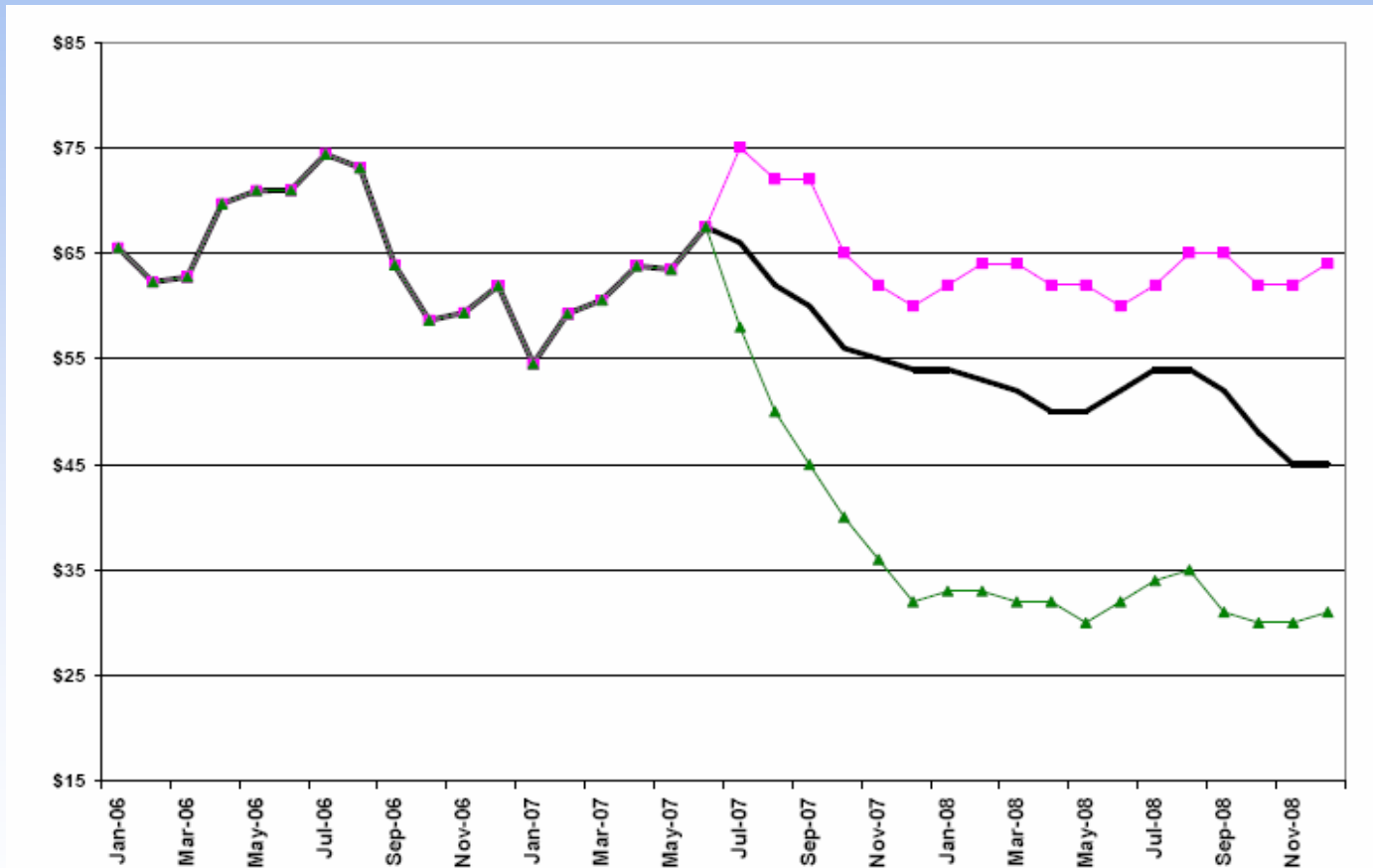
Global Seer - Nominal Oil Price

Oil Price
(nominal)



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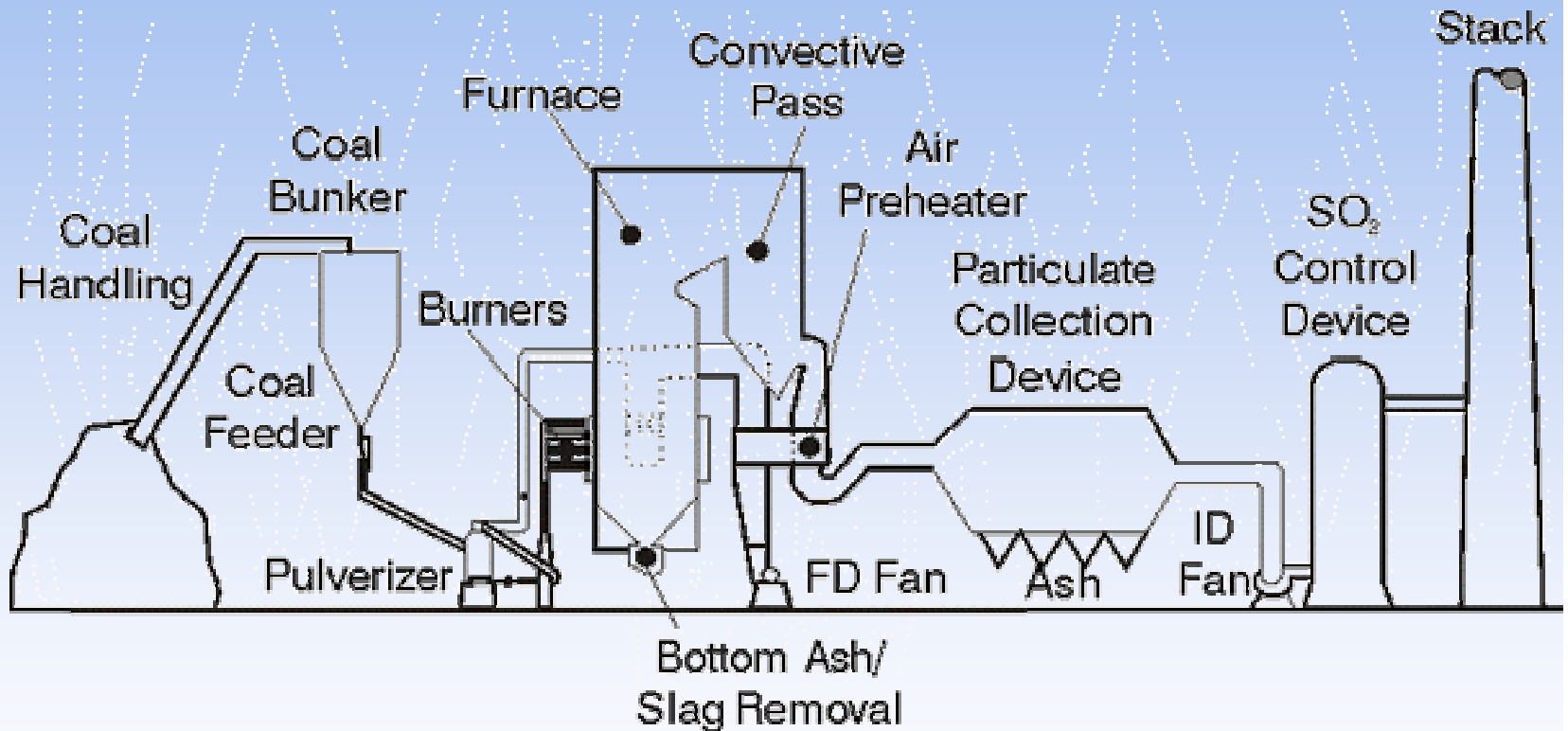
Fuel Oil remains a Volatile Commodity to Forecast



Coal

- Low-sulfur, high quality coals available from Australia and Indonesia
- Requires considerably large areas of land for coal storage and ash disposal (New facilities required for coal delivery)
- Environmental permitting requirements and concerns

Typical Coal-Fired Power Plant



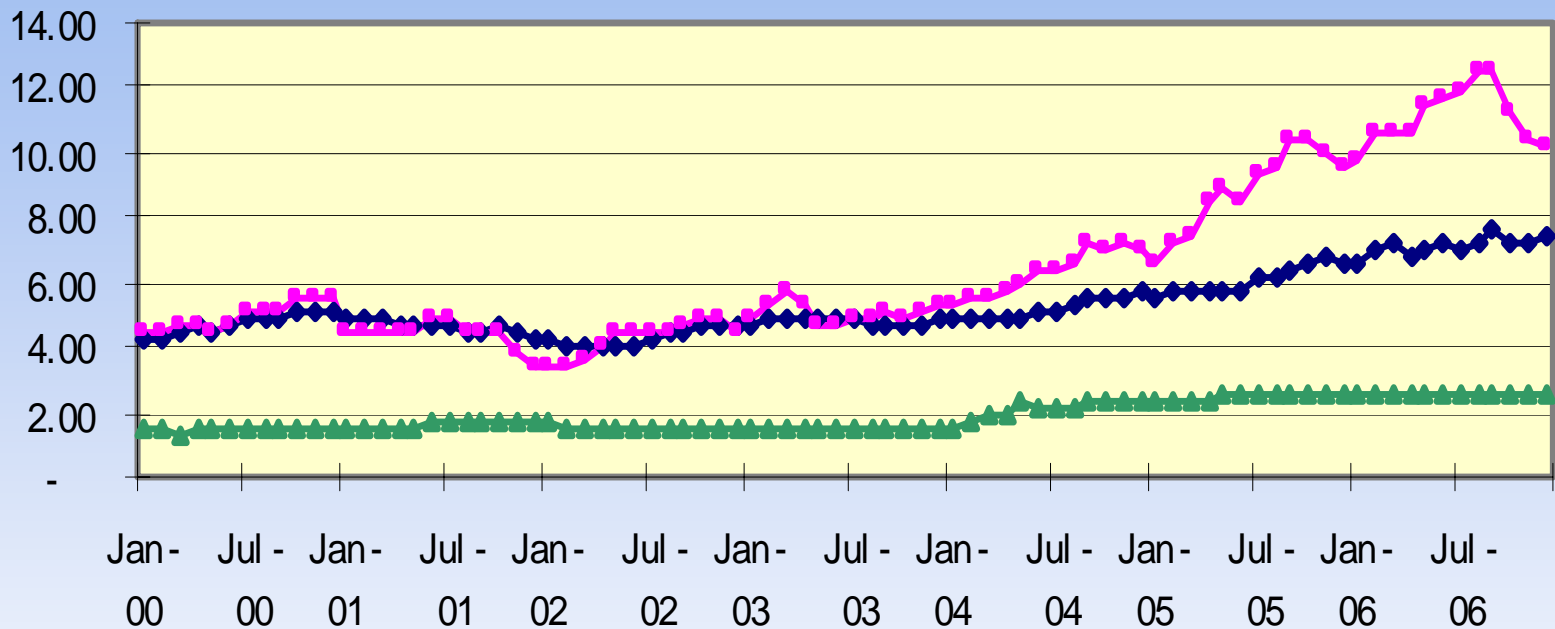
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Typical Coal-Fired Power Plant



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Japanese CIF Price



—◆— LNG US\$/MMBTU —■— Crude Oil US\$/MMBTU —▲— Thermal Coal US\$/MMBTU

Liquid Natural Gas

- Available from Australia and Indonesia
- Natural gas is chilled to -270 F for storage and delivery and requires regasification for use
- Typical tanker delivery facilities are costly, smaller tankers may be more affordable but also require frequent deliveries (2-3 days)
- LNG prices have historically followed crude oil market but Henry Hub prices have become the pricing point away from crude oil

Bio-Diesel

- Blending up to 20% (15%-ethanol) recommended
- Additives required to prevent microbial growth
- Long term affects to elastomeric seals and metals still unknown
- 5-10% loss in heat content per gallon
- 98% of GPA production is RFO fueled
- Additional fuel storage may be required
- Biodiesel costs comparable to diesel fuel

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Environmental Issues



Air Emissions

- USEPA Region IX jurisdiction
- **New Source Review (NSR)** required for major new or modification of existing source of air pollution
- “Non-attainment” vs. “Attainment” areas for SO₂
- GPA is pushing for attainment status for Cabras-Piti based on Air Emissions Monitoring results

Water Use and Discharge

- **Clean Water Act** regulates the intake of water for power plant cooling and the discharge of heated water (may also include stormwater discharge)
- Fresh water supply limited and far from resource
- **US Army Corps of Engineers** permitting may be required (wetlands and waterways)
- **National Environmental Policy Act (NEPA)** compliance may affect project schedule and cost

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Transmission Constraints

New Infrastructure required to support new DOD loads in the south and north near those facilities



System Description

- Predominantly southern baseload generation and heavy northern load demands
- Large power flows along the main south-to-north transmission lines
- System disturbances on south-to-north lines can be catalysts for isolation trips and further line outages or blackouts depending on load redistribution requirements
- Transmission Capability
 - GPA will have to build additional substation facilities at Cabras-Piti to interconnect a new unit
 - GPA will have to build additional transmission capability to support additional loads at DOD facilities in the south