our energy future
Background – Bermuda and BELCO

Regulatory Reform – New Electricity Policy and Act

BELCO IRP Overview and Methodology

BELCO IRP Findings and Proposed Energy Plan

Energy Plan – Projects in Detail

Q&A
BERMUDA Key Facts

- Population ~ 65,000
- Size ~ 21 sq. miles
- GDP ~ $96,000 USD per capita
- Primary Industries
  - International Business
  - Tourism
- Location
  - 32°N 64°W
  - ~700 nm east of North Carolina, USA
  - ~900 nm NNE of Santo Domingo, DR
- British Overseas Territory - settled in 1609
**BELCO Key Facts**

**BELCO Mission Statement**: To provide a secure reliable and sustainable electric power system for the people of Bermuda

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<th><strong>Number of Metered Connections</strong></th>
<th><strong>35,712</strong></th>
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Generating Plant: Maximum capacity approximately 168 megawatts, consisting of 12 diesel engines and 5 gas turbines. Individual engine capacity ranges between 4.5 and 14.3 megawatts. System frequency is 60 cycles.

Type of Fuel Used: Approximately 1 million barrels a year of fuel oil consumed per year. Heavy Fuel Oil (90%) and Diesel (10%)

Kilowatt Hours Generated: 632 million

Highest Peak Load: 111 MW

Electric System: 34 substations, 135 miles of underground transmission cable, 120 miles high voltage underground distribution cable, 545 miles high voltage overhead distribution lines and 370 miles of low voltage overhead service lines. Transmission voltage is 34,000 and 23,000 volts. Distribution is 4,160 volts.
Regulatory Reform
2015 National Electricity Sector Policy Objectives

- Least Cost and High Quality
- Affordable
- Sustainable
- Secure
The Bermuda 2016 Electricity Act became operational in October 2016.

The Act transferred responsibility from the Energy Commission to the Regulator Authority (RA) of Bermuda.

The Act establishes a framework by which future investments in the production and sale of electricity will be evaluated and regulated.

The Act establishes a Single Buyer Market and facilitates competitive generation.
IRP Overview and Methodology

- **Study Period** - 20 Years

- **Load Forecast**

- **Fuel Forecast**
  - based on Energy Information Administration (EIA) 2015 Annual Energy Outlook (AEO)

- **Financial and Other Planning Criteria**

- **Review of Existing BELCO Resources**
IRP Overview and Methodology
BELCO Generation Replacement Need
IRP Overview and Methodology

- **Existing BELCO Resources**
- **Supply and Demand side Candidate resources:**
  - Traditional Thermal plant selection
  - Energy Efficiency & Energy Conservation
  - Renewable Energy – Solar resources, Wind, Biomass
  - Battery Energy Storage System (BESS) for Spinning Reserve.
  - Distributed Generation/Combined Cooling Heat & Power for large commercial/industrial customers
- **Quantitative analysis**
  - LCOE ($/MWh) screening
  - Production cost modeling – 7 scenarios
- **Qualitative analysis**
  - Supply quality
  - Environmental sustainability
  - Security and cost resilience
  - Logistics
  - Economic development
IRP Findings

- Overall ranking of 7 practical scenarios based on combined quantitative and qualitative scoring

- “Four Finalist Cases” highlighted based on plausibility and alignment to policy*
  - Full LNG Conversion Case
  - Partial LNG Conversion Case
  - Partial LPG Conversion Case
  - Fuel Oil Case

*All of the above cases included deployment of Solar Based Renewable Energy Resources; Energy Efficiency and Conservation; and Battery Energy Storage

- Sensitivity analysis:
  - Fuel Cost
  - Carbon Monetization
  - Cost of Capital
  - Reserve Margin
  - Load Forecast
Proposed Energy Plan

- Supply Side Resource Portfolio
  - 60 MW of replacement generation capacity - dual fuel reciprocating internal combustion engines by 2019
  - 100% Transition to LNG as the primary fuel for thermal power generation plant by 2020
  - Utility Scale Solar PV

- Energy Storage
  - Battery Energy Storage System for Spinning Reserve and other ancillary services initially.

- Demand Side Resource Portfolio
  - Energy Efficiency and Energy Conservation Program (0.5% CAGR)
  - Combined Heat & Power (CHP)/Distributed Generation (DG) ~ 6MW
Energy Plan – Projects in detail
New Power Station Concept

New Power Station location
Establishing the LNG Value Chain

- **Background**
  - BELCO began investigating LNG in 2010
  - Initially limited small scale supply options, market continues to develop and credible supply options exist.

- **LNG Supply**
  - BELCO intends to issue RFP for LNG supply subject to Regulatory Approval

- **LNG Infrastructure Requirements**
  - LNG marine import terminal
  - Onshore LNG storage and regasification equipment
  - 9-mile natural gas pipeline to BELCO Central Plant
  - Conversion of existing BELCO generation assets to dual fuel (natural gas or liquid fuel) operation
Utility Scale Solar PV RFP

- Airport “Finger” Represents Bermuda’s largest open land mass.
- Government issued RFP for 1st Phase of Development (6MW)
Advanced Metering Infrastructure (AMI) Project

- OMS (outages)
- CIS (Billing)
- MDMS (meter & engineering data)
- Revenue Protection
- Pilot Phases nearing completion
- Enables integration of future Distributed Energy Resources, Demand Response and other Demand Side Management Resources
LED Street Light Project
Energy Efficiency

- Total # of streetlights – 4,400
- Project Timeline – 2 years (Dec 2015 to 2017)
- $10M NPV over 20 years
- 100% utility financed
BELCO Electric Vehicle Project

- Motor Pool Pilot - 2 Renault Zoe’s pilot
- Intermediate Van Replacement – 12 Renault Kangoo’s
- Truck Pilot (BELCO) – Heavy Truck/Bucket Truck
- High Level Benefits
  - Fuel and Maintenance Savings.
  - Environmental Stewardship.
  - Reduction of tailpipe pollutants
  - Increased kWh Sales
35th America’s Cup Support – The value of DG

- 4MW of temporary power to support Event Village in remote location.
The Trend...increasing interconnection

BELCO Power Generation

Utility Scale Storage

IPPs – Distributed Power Generation

IPPs – Large Scale Solar

Competitive Bulk Generation

Smart Buildings

Energy Efficiency & Conservation

Small Scale Renewable Energy

EVS

Distributed Storage

“CONsumers to PROsumers”
Summary

- The electric system in Bermuda, like many other island nations, is on the precipice of change.

- The Integrated Resource Planning approach has created a replicable process capable of dynamically evaluating a range of complex scenarios; the end goal is to achieve Energy Policy alignment through deployment of cost effective and sustainable energy resources.

- Grid Modernization will be needed to accommodate increasing power generation participants and interconnection requirements.

- Effective collaboration with regulators, governments and other key stakeholders will be essential to successfully transition to a new energy future.
Questions?

BERMUDA – “The Jewel of the Atlantic”