Agenda

- Introductions and Project Team
- Background
- IRP Approach
  - Generation Analysis
  - Transmission Analysis
  - Balancing Authority Gap Analysis
- Comments and Q&A
Company & Project Team Introduction
Siemens Team Organization

Project Director
- Gary Vicinus*

Project Manager
- Nelson Bacalao

AURORAxmp®
- Olivia Valentine
- Michael Korschek

PSS®E Modeling
- Jack Henry
- Yan Du

Risk Analysis
- Brian Despard
- Dennis Wu

Technology Assessments
- Michael Shuster

MISO Expertise
- Gerry Cauley

Load and DR/EE/DSM
- Tim Pettit

Environmental
- Melissa Haugh

*Gary Vicinus is also responsible for the Stakeholder Process
PTI – Solutions that Maximize Client’s Business Value

Energy Business Advisory
Opening doors to future value creation
- Integrated Resource Planning
- Integrated G, T, and D planning
- Storage and Microgrid Assessments
- Forecasting and Risk Assessments
- Transaction Advisory
- Risk Management Advisory

Power System Consulting
Complete set of analysis, design & optimization studies
- Steady-state System Studies
- Dynamic System Studies
- Transient System Studies
- Protection & Control System Studies
- Power Quality and Grounding Studies
- Transmission and Distribution Planning
- Nodal Production Cost Analyses

Software and Training
State-of-the-art system planning and data management
- Planning and Simulation of Power Systems
- Planning and Simulation of Pipe Networks
- Model and Data Management
- Dynamic and Protection Security Assessments in Operation
- PSS®E, PSS®SINCAL, PROMOD, AURORAxmp®
PSAT Engagement Plan

Start of IRP
August 14, 2019

- Describe the purpose of the IRP
- Describe the methodology that will be followed
- Gather PSAT insights into some key IRP issues

Monthly Meetings through September, and March

Next meetings:
- Provide guidance to
- Scenarios
- Input assumptions
- Options to be considered
- Alternative Strategies
- Preliminary results

Objectives and Expectations

- Get commitments to participate
- Support the stakeholder process
- Guidance and perspective
## Stakeholder Engagement Plan

| Start of IRP  
August 14, 2019 | Midpoint of IRP  
(November) | Conclusion of IRP  
(March) |
|----------------|----------------|----------------|
| Engage wide range of stakeholders from the beginning of the process  
- Inform, educate and listen  
- Provide high level overview of what to expect  
- Allow for comments and clarifications | Share  
- Strategies to be considered  
- Options  
- Input Assumptions  
- Alternative Scenarios  
- Screening Analysis  
Give an opportunity to comment and recommend | Present findings of the study and the recommended strategy and portfolio of assets  
Provide an opportunity for comment and recommendations |
# Project Schedule

<table>
<thead>
<tr>
<th>Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kickoff Meeting Preparation</td>
<td>4 days</td>
<td>Jul-19</td>
<td>Jul-19</td>
</tr>
<tr>
<td>Project Kickoff Meeting</td>
<td>1 day</td>
<td>Jul-19</td>
<td>Jul-19</td>
</tr>
<tr>
<td>Develop Objectives, Metrics &amp; All IRP Input Assumptions</td>
<td>29 days</td>
<td>Jul-19</td>
<td>Aug-19</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Aug-19</td>
<td>Aug-19</td>
</tr>
<tr>
<td>Screen Resource Options (Technologies)</td>
<td>14 days</td>
<td>Aug-19</td>
<td>Sep-19</td>
</tr>
<tr>
<td>Develop Baseline &amp; Stochastic Inputs</td>
<td>14 days</td>
<td>Aug-19</td>
<td>Sep-19</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Sep-19</td>
<td>Sep-19</td>
</tr>
<tr>
<td>Supply Strategies &amp; Selection of Portfolio Options</td>
<td>30 days</td>
<td>Sep-19</td>
<td>Oct-19</td>
</tr>
<tr>
<td>Select Portfolios for risk Analysis</td>
<td>2 days</td>
<td>Oct-19</td>
<td>Oct-19</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Oct-19</td>
<td>Oct-19</td>
</tr>
<tr>
<td>Perform Risk Analysis</td>
<td>31 days</td>
<td>Oct-19</td>
<td>Nov-19</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Nov-19</td>
<td>Nov-19</td>
</tr>
<tr>
<td>Initial Transmission Analysis</td>
<td>14 days</td>
<td>Nov-19</td>
<td>Nov-19</td>
</tr>
<tr>
<td>Perform Gap Analysis</td>
<td>7 days</td>
<td>Nov-19</td>
<td>Dec-19</td>
</tr>
<tr>
<td>Draft IRP Report</td>
<td>14 days</td>
<td>Dec-19</td>
<td>Dec-19</td>
</tr>
<tr>
<td>Refinement of Risk Analysis</td>
<td>32 days</td>
<td>Dec-19</td>
<td>Jan-20</td>
</tr>
<tr>
<td>Select Best Portfolio</td>
<td>4 days</td>
<td>Jan-20</td>
<td>Jan-20</td>
</tr>
<tr>
<td>In-Depth Transmission Analysis</td>
<td>65 days</td>
<td>Jan-20</td>
<td>Mar-20</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Feb-20</td>
<td>Feb-20</td>
</tr>
<tr>
<td>Final IRP Report</td>
<td>14 days</td>
<td>Mar-20</td>
<td>Apr-20</td>
</tr>
<tr>
<td>Stakeholder Meetings</td>
<td>2 days</td>
<td>Apr-20</td>
<td>Apr-20</td>
</tr>
</tbody>
</table>
Background
### Integrated Resource Planning (IRP)

#### Why Do an IRP

Offers presented to MLGW have been incomplete and self-directed -

An Integrated Resource Plan will be

- Independent and unbiased
- Comprehensive regarding strategies and options
- Address the risk associated with market, regulatory and technology uncertainty
- Compare the TVA Full Requirements Contract to alternatives on an equivalent basis (generation, plus transmission, plus balancing, plus services)
- Reflect the opinions and views of PSAT and Stakeholders
- Reflect the objectives of MLGW, PSAT and Stakeholders

#### What is an IRP

The purpose of an IRP is to provide a plan for energy resource (primarily generation and demand side programs) development to meet future load and compare the status quo (TVA FRC to market and self generation options)

- The plan must be *forward looking* and reflect views of future regulations, market conditions and expectations of technology changes
- The plan will suggest what portfolio of generating assets (power plants), energy efficiency programs and transmission adjustments best meets its’ future needs
- The plan must meet future regulatory requirements, and provide for a reliable supply of power to customers at lowest reasonable cost.
- The IRP is quickly evolving to something more complex. Resilience is one driver that requires that distribution and transmission solutions be considered with generation solutions. Large renewable development will also require a more integrated solution.
## Existing Studies Review (MLGW)

<table>
<thead>
<tr>
<th></th>
<th>ICF</th>
<th>ACES</th>
<th>Brattle</th>
<th>GDS</th>
<th>IRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 year load forecasting</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Transmission analysis</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>20 year Present Value (PV) of revenue requirements</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Risk evaluation (i.e. fuel price volatility, carbon taxes, electric demand)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Public involvement throughout process</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Evaluate current and future staffing requirements</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Business or special interest led analysis</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Scenario and sensitivity analysis to ensure least-cost supply option</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Existing Studies Review

<table>
<thead>
<tr>
<th></th>
<th>ICF (Bellefonte Developer)</th>
<th>ACES</th>
<th>Bratte (Friends of the Earth)</th>
<th>GDS (MLGW)</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Horizon</strong></td>
<td>2024 to 2043</td>
<td>2024 to 2038</td>
<td>2024 and 2050</td>
<td>2022</td>
<td>2019 to 2038</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>IPM Zonal with PROMOD nodal</td>
<td>Probabilistic resource planning model and financial model</td>
<td>Power System Optimizer</td>
<td>Full nodal analysis using PROMOD IV</td>
<td>Aurora Zonal and PROMOD Nodal, PSS/E</td>
</tr>
<tr>
<td><strong>Combined Cycles and Gas Peakers</strong></td>
<td>Can be procured as physical hedge</td>
<td>13% of portfolio energy comes from CC 900MW 4% comes from 650MW Quick Start peakers</td>
<td>For higher renewable scenario, 26-32% of Supply Portfolio comes from renewable energy in 2024, 89-100% comes from renewable energy in 2050</td>
<td>One scenario includes 2 new CC’s, and 6 new CT’s (new capacity of 2,606 MW)</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Nuclear or Baseload</strong></td>
<td>Bellefonte (1350 MW, 70% of MLGW’ energy) for $39/MWH with a 2.1% annual inflator</td>
<td>No nuclear – 1GW market PPA</td>
<td>-</td>
<td>Four scenarios, three of them include Bellefonte</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Market Purchase</strong></td>
<td>Physical Hedges or Spot Market</td>
<td>7% of portfolio energy comes from MISO (market access)</td>
<td>For Balancing purposes</td>
<td>-</td>
<td>TBD</td>
</tr>
</tbody>
</table>
## Existing Studies Review

<table>
<thead>
<tr>
<th></th>
<th>ICF (Bellefonte Developer)</th>
<th>ACES</th>
<th>Brattle (Friends of the Earth)</th>
<th>GDS (MLGW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Savings</strong></td>
<td>$7.9 billion (2024 to 2043)</td>
<td>$9.2 billion (2024 to 2038)</td>
<td>$240 to $333 MM per year relative to TVA</td>
<td>$417.8 MM for 2022</td>
</tr>
<tr>
<td><strong>TVA full service costs ($/MWh)</strong></td>
<td>$75/MWh in 2024 to $95/MWh in 2038</td>
<td>From $70/MWh to $100/MWh in 2038 (2.1% annually increase)</td>
<td>~$75/MWh</td>
<td>“Energy only” cost of production is $18.5/MWh; full-delivered, all requirements cost is ~$66.0/MWh</td>
</tr>
<tr>
<td><strong>Portfolio Cost (Partial cost)</strong></td>
<td>$57/MWh without regulatory/transmission; $68/MWh with regulatory/transmission</td>
<td>$38/MWh to $81/MWh (energy, capacity, ancillary services, and network transmission charges in 15-year horizon)</td>
<td>$50/MWh Lowest cost portfolio for 2024, $55/MWh lowest cost portfolio for 2050 (Gas focused)</td>
<td>Averaged $47/MWh for portfolio without wind; Averaged $48/MWh for portfolio with wind</td>
</tr>
</tbody>
</table>
Existing Studies Review – Energy and Capacity Prices

Indicative MISO - Arkansas ATC Power Prices

Indicative MISO Capacity Prices
Existing Studies Review – Technology Costs

Indicative Solar LCOE

Indicative Wind LCOE
Overview of TVA’s FRC Cost Breakdown

- TVA full requirements contract must be assessed (with TVA’s support)
  - Generation costs
    - Fuel costs
    - O&M
    - Capital cost
      - Interest /depreciation
  - Transmission costs
    - O&M, Capital Cost
  - Stranded cost recovery
  - Premiums/Overhead
    - e.g. bond retirement
  - Other costs (identify)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost* $/MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Cost</td>
<td>18.9</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>26.1</td>
</tr>
<tr>
<td>Emission Cost</td>
<td>3</td>
</tr>
<tr>
<td>Purchased Power</td>
<td>5.6</td>
</tr>
<tr>
<td>Interest Expenses</td>
<td>6.3</td>
</tr>
<tr>
<td>Depreciation</td>
<td>15.3</td>
</tr>
<tr>
<td>Tax Equivalent</td>
<td>4.1</td>
</tr>
<tr>
<td>Regulatory/transmission costs</td>
<td>9</td>
</tr>
<tr>
<td>Total Cost of Power</td>
<td>79</td>
</tr>
<tr>
<td>Selling Price to LPC</td>
<td>88</td>
</tr>
</tbody>
</table>

*TVA cost breakdown by ICF
Siemens Approach
Siemens Approach Considers Multiple Objectives

<table>
<thead>
<tr>
<th>Traditional Approach</th>
<th>Siemens Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Process focuses on minimizing utility costs</td>
<td>▪ Utilities have multiple objectives: Reliability, stability, sustainability, resilience and cost are all important objectives.</td>
</tr>
<tr>
<td>▪ Portfolio evaluation is one-dimensional</td>
<td>▪ Process focuses on the simultaneous evaluation of multiple objectives and tradeoffs</td>
</tr>
<tr>
<td>▪ T &amp; D resources are not fully integrated</td>
<td>- Rate stability</td>
</tr>
<tr>
<td></td>
<td>- Utility cost minimization</td>
</tr>
<tr>
<td></td>
<td>- Reliability and resilience</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Utility Costs</th>
<th>Port. 1</th>
<th>Port. 2</th>
<th>Port. 3</th>
<th>Port. 4</th>
<th>Port. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram:
- Risk
- Utility Costs
- Reliability

Unrestricted © Siemens AG 2019
Page 18
Siemens Energy Business Advisory
Identifying and Evaluating Tradeoffs

Customer Perspective

ENVIRONMENT
- CO₂ Emissions
- Renewable Energy

COST
- Cost Minimization

RISK
- Reliability
- Cost Stability

Examine Tradeoffs
Supply Options (Discuss and Comment)

- **TVA Full Requirements Option**
  - A base case of MLGW’s current supply which is a full-requirements contract with TVA for comparison purposes with other supply options. With TVA being a public utility, we may simply be able to draw from its latest IRP, which should provide details on its recommended path.

- **Self Supply Options**
  - **Self Build**
    - Select and screen various resource self-build options with input from MLGW on the various types of generation technologies, demand-side and energy efficiency, and other known available capacity and energy alternatives.
  - **Market**
    - Select and screen the option of purchasing all energy and capacity from MISO.
  - **Combination**
    - Select and screen any combination of self-build and market transactions to maximize cost savings to MLGW over the study period.
IRP Structured Approach

Step 1: Develop Objectives, Metrics, and IRP Inputs Assumptions

Step 2: Screening Resource Options (Technologies)

Step 3: Develop Baseline and Stochastic Inputs

Step 4: Supply Strategies and the Selection of Portfolio Options

Step 5: Select Portfolios for Risk Analysis

Step 6: Perform Risk Analysis

Step 7: Perform Transmission Analysis

Step 8: Select Best Portfolio

Step 9: Perform Gap Analyses

Report
### List of Objective and Metrics used in other IRPs – Discuss and Comment (Some use diversity/flexibility as well)

<table>
<thead>
<tr>
<th>OBJECTIVES (illustrative)</th>
<th>METRICS (illustrative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Cost (financial viability)</td>
<td>PV of revenue requirements (everyone)</td>
</tr>
<tr>
<td>Reliable</td>
<td>Meets or exceeds Loss of Load Hour (LOLH) or FERC/NERC requirements</td>
</tr>
<tr>
<td>Resilient</td>
<td>Able to maintain supply to critical loads, timely restoration of supply to customers (PREPA, OUC)</td>
</tr>
<tr>
<td>Sustainable</td>
<td>Carbon (proxy) or total emissions (most everyone)</td>
</tr>
<tr>
<td>Economic Growth</td>
<td>Job creation (occasional)</td>
</tr>
<tr>
<td>Stability (Volatility)</td>
<td>95% (worst) outcome (everyone) Exposure to Market (energy and capacity) – (many)</td>
</tr>
</tbody>
</table>
Key Issue: Selection of Resource Options

Task

- Screen feasible options for each “issue category”
- Combine individual options into integrated portfolios
- Perform quantitative scenario-based risk analysis

Approach

1. Meet planning constraints; 2. Rank by cost and environmental performance

Collaborate to construct portfolio options that meet constraints and incorporate various strategy options

Test each portfolio against external market risks and all key metrics (Full portfolio assessment)

Select “best” portfolio
Key Issue: Portfolio Expansion Strategies – Discuss and Comment

Supply Side Plan Technologies

- Generation Options: Solar PV, wind, biomass, utility-scale storage, combined cycles, flexible peakers (frame type or aeros), reciprocating engines, existing capacity retrofits, nuclear
- Demand Side Options: Energy efficiency, demand response
- Multiple strategies will be assessed as following:
  - Strategy 1: Full Requirements Contract with TVA
  - Strategy 2: Self Supply
  - Strategy 3: MLGW-MISO
  - Strategy 4: Mixture of strategy 2 and 3 that embodies a combination of the benefits of each strategy

Combination of scenarios and strategies can define portfolios and address a wide range of issues:

<table>
<thead>
<tr>
<th>Scenarios / Portfolios</th>
<th>Portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BAU</td>
</tr>
<tr>
<td>State of the World</td>
<td></td>
</tr>
<tr>
<td>Scenario 1</td>
<td>P1</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>P1</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>P1</td>
</tr>
</tbody>
</table>
Scenarios – Discuss and Comment

Siemens will utilize scenario based modeling to evaluate various regulatory constructs. The base case is considered the most likely future. The alternative scenarios are shown as higher than, lower than, or the same as the base case.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>ACE</td>
<td>ELG</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
</tr>
<tr>
<td>High Tech</td>
<td>Low CO2 Tax</td>
<td>ELG</td>
<td>Higher</td>
<td>Higher</td>
<td>Lower</td>
<td>Lower</td>
<td>Lower</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>High Reg.</td>
<td>High CO2 Price</td>
<td>Fracking Ban</td>
<td>ELG</td>
<td>Lower</td>
<td>Lower</td>
<td>Higher</td>
<td>Lower</td>
<td>Higher</td>
<td>Higher</td>
</tr>
</tbody>
</table>

*No bottom ash conversion required based on size of the unit and delay requirement for 2 years
**ACE Delayed for 3 years
States of the World Can be Informed by Stochastics

- 5-95 Pct Band
- History
- Ref Case
- Scenario A
- Scenario B
- Scenario C
Regional Market Price Forecast, Portfolio Expansion, and Plant Dispatch is Integrated within a Single Production Cost Model

Long-Term Capacity Expansion

- Standard Chronological Run (Electric Price Forecast)
- Convergence Criteria Met?
  - Yes: Create RMT and Expansion Plan Results
  - No: Modify Retirements and Additions
- Determine Resource Value (Revenue – Cost)

Dispatch Engine

- Fuel Prices
- Emission Prices
- Load
- Capital Costs
- State of the Worlds Scenarios

- Portfolio Options
- Plant Parameters
- Local Distribution Footprint

- Hourly Dispatch
- Build & Requirements
- Detailed Market Representation
- Bilateral Transactions

- AURORAxmp®

- NPV of revenue req
- Range of costs

- Power Prices
- Plant Generation
- Portfolio Costs
Key Issue: Accounting for Risk – Discuss and Comment

- The risk profiles of each of the Supply Options are different as each may be affected differently by future uncertain outcomes.
  - For example, spot market options may result in lower “expected” costs but have much higher volatility.
  - FTR have a cost but manage volatility.
  - Self build give more certainty on CapEx / OpEx once in service.

- A discussion of risks and their ranges is a fundamental input to this part of the analysis.
Transmission Assessments
Methodology Overview
The Analysis of Supply Options and Transmission Analysis are closely related and Central for the IRP.

- The economics of the resources are a function of intrinsic costs and the need (or not) of transmission investments manage associated reliability / congestion issues.
- This will affect differently the self supply options and the market (MISO) options.
- Our procedure provides a comprehensive assessment of these impact and costs.
Transmission Analysis Methodology – Expanded Analysis

• Develop intermediate power flow cases from the LTCE results
  o These are cases that are year dependent based on when the LTCE indicates resources are added
  o Representative load and known transmission build out modeled
  o Model anticipated generation dispatch from the nodal production cost models
  o Carry out load flow contingency analysis for complete evaluation of transmission needs
  o Based on the above select the transmission investments required in service dates (new investments may be identified)

• Update the nodal production cost model based on the LTCE results covering selected years
  o Determine the expected dispatch for specific year models to utilize in the power flow model.
  o Update model to reflect transmission additions from power flow.
  o Review congestion in the nodal production cost model to determine if other transmission issues need to be resolved
  o Interaction with power flow analysis may be required if congestion issues found and changes in transmission in service dates are needed

• Update transmission costs in the overall assessment model. Confirm adequacy of LTCE.=
Transmission Analysis Methodology – Expanded Analysis

• Develop intermediate power flow cases from the LTCE results
  o These are cases that are year dependent based on when the LTCE indicates resources are added
  o Representative load and known transmission build out modeled
  o Model anticipated generation dispatch from the nodal production cost models
  o Carry out load flow contingency analysis for complete evaluation of transmission needs
  o Based on the above select the transmission investments required in service dates (new investments may be identified)

• Update the nodal production cost model based on the LTCE results covering selected years
  o Determine the expected dispatch for specific year models to utilize in the power flow model.
  o Update model to reflect transmission additions from power flow.
  o Review congestion in the nodal production cost model to determine if other transmission issues need to be resolved
  o Interaction with power flow analysis may be required if congestion issues found and changes in transmission in service dates are needed

• Update transmission costs in the overall assessment model. Confirm adequacy of LTCE.
Gap Analysis
Key Issues
Balancing Area Gap Analysis

Prepare requirements document
- NERC Balancing Authority (BA)
- MISO Local Balancing Authority (LBA)
- Industry best practices

Review MLGW existing capabilities through interviews and procedure/document review
- Control center: UPS/backup power, security access, and backup of essential functions
- SCADA and control systems capabilities
- Balancing area boundary metering
- Voice and data communications; ability to meet data exchange requirements
- Ability to perform operational and outage planning, real-time control, situational awareness
- Ability to plan and provide operating reserves
- Contingency and emergency response capabilities
- Energy accounting and transaction management capabilities
- Personnel staffing and training
- Cyber security measures

Prepare report and recommendations, including high level costs estimates for planning purposes
Step 8: Select Best Portfolio (Discuss and Comment)

<table>
<thead>
<tr>
<th>Portfolio /Criteria</th>
<th>Cost</th>
<th>Risk</th>
<th>Environmental</th>
<th>Reliability</th>
<th>Diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td><img src="image1" alt="Green" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 2</td>
<td><img src="image1" alt="Green" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 3</td>
<td><img src="image1" alt="Yellow" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 4</td>
<td><img src="image1" alt="Green" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 5</td>
<td><img src="image1" alt="Red" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 6</td>
<td><img src="image1" alt="Red" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
<tr>
<td>Portfolio 7</td>
<td><img src="image1" alt="Red" /></td>
<td><img src="image2" alt="Green" /></td>
<td><img src="image3" alt="Green" /></td>
<td><img src="image4" alt="Green" /></td>
<td><img src="image5" alt="Green" /></td>
</tr>
</tbody>
</table>

Index Ranking (0-10 Scale)

<table>
<thead>
<tr>
<th>Assessment (Green &lt; 3.33; Yellow 3.34-6.67; Red &gt; 6.67)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Green" /></td>
</tr>
</tbody>
</table>
Breakout Group Discussions
Break Out Group Questions

Question 1: Refer to the Objectives and Metrics Slide (following) 30 min

What Changes would you make to the Objectives of the Study?
What Changes would you make to the metrics for each of the Objectives?
Do you believe that weights should be applied to the metrics or not?

Question 2: Refer to the strategies slide (following) 30 min

Do you propose different Strategies be considered in the study?
If so, what strategies would you recommend?
Are there any strategies that are unnecessary?

Question 3: Refer to the scenarios slide (following) 30 min
A Base case, a High Technology Case and a High Regulatory case were recommended
Do you agree that these are relevant?
Are there others that you believe are more important (what would you replace and why)?
Do you have any concerns with the directional changes in key inputs for the cases selected?
### List of Objective and Metrics used in other IRPs – Discuss and Comment
(Some use diversity / flexibility as well)

<table>
<thead>
<tr>
<th>OBJECTIVES (illustrative)</th>
<th>METRICS (illustrative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Cost (financial viability)</td>
<td>PV of revenue requirements (everyone)</td>
</tr>
<tr>
<td>Reliable</td>
<td>Meets or exceeds Loss of Load Hour (LOLH) or FERC/NERC requirements</td>
</tr>
<tr>
<td>Resilient</td>
<td>Able to maintain supply to critical loads, timely restoration of supply to customers (PREPA, OUC)</td>
</tr>
<tr>
<td>Sustainable</td>
<td>Carbon (proxy) or total emissions (most everyone)</td>
</tr>
<tr>
<td>Economic Growth</td>
<td>Job creation (occasional)</td>
</tr>
<tr>
<td>Stability (Volatility)</td>
<td>95% (worst) outcome (everyone)</td>
</tr>
<tr>
<td></td>
<td>Exposure to Market (energy and capacity) – (many)</td>
</tr>
</tbody>
</table>
Key Issue: Portfolio Expansion Strategies – Discuss and Comment

Supply Side Plan Technologies

- Generation Options: Solar PV, wind, biomass, utility-scale storage, combined cycles, flexible peakers (frame type or aeros), reciprocating engines, existing capacity retrofits, nuclear
- Demand Side Options: Energy efficiency, demand response

- Multiple strategies will be assessed as following:
  - Strategy 1: Full Requirements Contract with TVA
  - Strategy 2: Self Supply
  - Strategy 3: MLGW-MISO
  - Strategy 4: Mixture of strategy 2 and 3 that embodies a combination of the benefits of each strategy

- Combination of scenarios and strategies can define portfolios and address a wide range of issues:

<table>
<thead>
<tr>
<th>Scenarios / Portfolios</th>
<th>Portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State of the World</strong></td>
<td><strong>BAU</strong></td>
</tr>
<tr>
<td>Scenario 1</td>
<td>P1</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>P1</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>P1</td>
</tr>
</tbody>
</table>
Siemens will utilize scenario based modeling to evaluate various regulatory constructs. The base case is considered the most likely future. The alternative scenarios are shown as higher than, lower than, or the same as the base case.

<table>
<thead>
<tr>
<th>Increasing Regulation</th>
</tr>
</thead>
</table>

| Scenarios – Discuss and Comment |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>ACE</td>
<td>ELG</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
<td>Base</td>
</tr>
<tr>
<td>High Tech</td>
<td>Low CO2 Tax</td>
<td>ELG</td>
<td>Higher</td>
<td>Higher</td>
<td>Lower</td>
<td>Lower</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>High Reg.</td>
<td>High CO2 Price</td>
<td>Fracking Ban</td>
<td>ELG</td>
<td>Lower</td>
<td>Lower</td>
<td>Higher</td>
<td>Lower</td>
<td>Higher</td>
</tr>
</tbody>
</table>