Agenda

1. Grid Strategy Drivers and “Trifecta” Components
2. A Structured Framework for Grid Strategy Development
3. Grid Modernization Assessment
4. DER Integration Impact Analysis
5. Grid Operations and Optimization
An effective Grid Strategy requires the parallel integration of:

- Grid Modernization requirements with select technology
- Economic and reliable DER penetration, and
- Grid Operations optimization

Designed & evaluated to ensure that Grid technical & economic performance objectives are achieved, including:

- Reliability
- Customer Service and Adaptability
- Environmental & Economic Stewardship
- Cost Recovery and Growth
- Other objectives…
Siemens End-to-End Distributed Resource Solution: Plan, Enable, and Optimally Manage

Current State
- Requires manual integration at significant effort & cost
- High cost for customers
- Complex solution sale is difficult to sell by individual segments

Future State
- Standardize integration
- Align service offerings
- Establish product platform roadmap
- Develop coordinated solution sales across DG

Benefits
- Reduce costs/customer price
- Make more accessible to market
- Enable future products (IoT, SaaS, etc.)
Structured Framework
Business Transformation Solutions (BTS)
*Compass*: Framework to Implement a Grid Strategy of the Future

Compass Dimensions

- **Objectives**: What are we trying to achieve?
  Business objectives an organization wishes to achieve

- **Business Capabilities**: How can we do this?
  Ways an organization can execute strategy components depending on the extent of their smart grid capability

- **Technologies**: What do we need?
  Different smart grid technologies; roadmap & modeling, analysis

- **Operations**: How can I maximize value?
  Grid management optimization and necessary tools, skills

Utilizing the dimensions above, the Compass-BTS process and tools achieves objectives with smart technologies combined in value-based applications.
## Structured Framework
A structured approach with 5 sequenced phases to guide the utility to meet its grid performance objectives

### Step 1: Screening

**Input**
- 24 Business Objectives & 41 Business Capabilities
- Current Capability
- Aspirational Capability
- Impact
- Priority
- Metrics

**Output**
- Define initiatives to reach aspiration state
- Procedures
- Processes
- Technologies
- Simulation Tools

### Step 2: Strategy

**Technology Evaluation**
- Existence
- Initiative Evaluation
- Impact
- Strategy Investment Sequencing
- Metrics
- Value Packs, Initiatives
- Scenario Creation

**Determine Initiative Business Value**
- Business Synergy Determination
- Capabilities, Tools
- Metrics
- Cost : Benefit Methodology
- Risk Management Oversight

### Step 3: Execution

**Identify Performance Parameters**
- Values
- Owners
- Determine KPI's

**Reporting Templates**
- Process Handbook
- Document Control
- Governance Model
- Change Management
- Value Management (Process Management)
- Project Management

### Step 4: Execution

**Ensure the organization has the capabilities, resources and oversight to execute the program**
- Prepare detailed, integrated plans for the early stages
- Corporate Governance & Communications Plan

**Execute Initiative Value Packs**
- Refine business value
- Continuously adapt to changes in the business environment
- Improve Success Factors
- Commit Resources

### Step 5: Status-Quo

**As is Process**
- To be Process
- Defined Roles & Responsibilities
- Continuously Adapt to Changes (Fail Fast)
- Value Realization and Target Achievement
- Baseline and Target KPI's
Value Pack Development: Combinations of Linked Initiatives, Technologies in Dynamic Sequence

Initiatives

Technologies

Objectives

Value Pack 3

<table>
<thead>
<tr>
<th>Manage Grid Information</th>
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<th>Manage KPI Forecasting</th>
<th>Manage KPI Forecasting</th>
<th>Manage eMobility Scheme</th>
<th>Manage Meter-to-cash</th>
<th>Manage Meter-to-cash</th>
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<td>0 --&gt; 1</td>
<td>1 --&gt; 2</td>
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- Introduce a basic cross silo KPI system for key assets
- Manage Asset Information consistently across organizational boundaries
- Introduce sophisticated, single KPI forecasting models leveraging historic information
- Vary parameter sets to setup different scenarios
- Introduce enhanced driver services for individual charging network operator
- Introduce pre-payment schemes
- Introduce automated meter reading
## Grid Modernization Circuit Simulation and Detailed Engineering in Compass BTS Framework

<table>
<thead>
<tr>
<th>Circuit Selection</th>
<th>Model Case Runs</th>
<th>Investment Class Filter</th>
<th>Technology Selection</th>
<th>Impact Analysis</th>
<th>Circuit &amp; Cluster Ranking</th>
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<tr>
<td>Single / Multiple</td>
<td>Baseline / Single, Multiple Technology Scenarios</td>
<td>Eight Core Classes and Additional Suggested</td>
<td>Relevant Technology Application by Class &amp; Circuit</td>
<td>Baseline Case vs. Single, Multiple Technology &amp; Circuit Applications</td>
<td>Benefit / Cost &amp; KPIs Ranking Tied to Objectives and Initiatives</td>
</tr>
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</table>

See Circuit Selection Criteria
- SINCAL Case Simulation Analysis
- Augment with Excel and Technology – Specific Models
- Apply to Grid Modernization Investment Technology Classes
- Apply SIGM, Compass-BTS Libraries
- Identify Synergies & Extrapolate Investment Analysis and Projected KPIs
Whether Its 2% or 100% Renewable Penetration
Growing Emphasis on Distribution and DER Planning

Baseline Distribution Assessments
Forecasting DER capacity and locations now key to analysis
Modeling & Analysis to Define DER Hosting Capacity with and without system improvements
Iterative Assessment to Define Least Cost Alternatives (Traditional or DER) That Meet System and Customer Requirements
Microgrid and Community Solar Modeling

Distribution modeling to deliver:
Integrated Analysis of DER Penetration
Network studies cover system hosting capacity, design and optimization

- **Steady-state system studies**
- **Dynamic system studies**
- **Transient system studies**
- **Protection and control system studies**
- **Power quality system studies**
- **Business transformation Solution engineering**
Grid Enterprise Asset Management - Emerging Framework
Real Time Commercial and Asset Optimization Components

Data Libraries
- Pricing & Load Data Inputs
- Operations and Management Data
- Performance Criteria

T&D Systems Data
- Price History & Forecasting
- Load History & Forecasting
- Distribution Network
- Transformer Loading
- DER Utilization
- Reliability
- Reduce Outages
- Stability

Objectives
- Manage Load
- Metering Efficiency
- Lower Op Costs
- Maximizing Availability
- Measuring Costs
- Optimizing DER

Real Time Pricing & Library Inputs
Cloud, IoT Support
(“MindSpheres” Capabilities)

Cost Allocation, Shadow Pricing

ISO

DSO

Virtual Real-Time Forecasting & Decision Support
Simulated Strategies & Stochastic Analysis
(Grid Optimization Decision Support System)

Dynamic KPI's (Stability, Voltage, Margin, COS, etc.)
Robust planning and asset optimization in real time

EAM Dashboards
(Enterprise Asset Management)

Active Signals

Min. Loss Avoidance & Max. Revenue Extraction

Phase 1

Phase 2

Phase 3
Sample Market – Clearing Operations for Distributed Solar
Real Time Commercial and Asset Optimization Components

Using Energy IP Real-Time Billing Data

Real Time Solar Net Metering KWh, $ by Customer, Feeder, Sub-Station, System Cloud, IoT Support ("MindSpheres" Capabilities)

Customer – Specific DER Energy & Capacity, Performance
Cost Allocation, Shadow Pricing
ISO - LMP

T&D Data
Weather, Load
DSO – Feeder, Circuit, Substation

Settle KWh, Billing at the Customer Level; Aggregate to Feeder, Substation and DSO for Planning & Analytics Purposes

Virtual Real-Time Forecasting & Decision Support
Simulated Strategies & Stochastic Analysis (Grid Optimization Decision Support System)

Min. Loss Avoidance & Max. Revenue Extraction
Active Signals
EAM Dashboards (Enterprise Asset Management)

Dynamic KPI’s (Stability, Voltage, Margin, COS, etc.) Robust planning and asset optimization in real time
Real-time Data Visibility across Utility Operating Platforms

SGEM
Time Smoothed Data Model Archive

Energy IP - DEMS
Forecasting

ADMS
DER Registration, Program
DER Service Point Updates, Monitor & Control Model

DERMS
DER Service Point Updates, Control Model, Forecast Specification, Program

MDM
New DER Model Types
DER Service Point Updates, Metering Profile

Automation and online activation of model updates due to new registration of DER within a specified utility prosumer program (Siemens “Unify”)

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