Exhibit to Agenda Item #1

Board Strategic Development Committee
Tuesday, September 10, 2019, scheduled to begin at 5:30 p.m.
Customer Service Center, Rubicon
DERs and Grid Integration

- SMUD plans for 5kW of peak load contribution per home today
- Increasing DER adoption creates opportunities, and risks if not managed
- With addition of EVs and Building Electrification, we could face significant infrastructure upgrade costs without load flexibility
- Goal is to integrate these new loads and renewables as much as possible onto our existing grid
Briefing Overview

- DERs and the IRP
- DER Evolution
- Operational Considerations
Post IRP Forecasted Load Growth

- **New Loads From Electrification**
- **Transportation**
- **Buildings**
- **Other**

- **Existing Loads**
- **Buildings**

Electricity Loads (TWh)

- **2015**
- **2020**
- **2025**
- **2030**
- **2035**
- **2040**
- **2045**
- **2050**
DER Impacts on Electricity Sales in 2030

Figure 12. Annual energy demand components in 2030 (GWh)

- Unmanaged Load: 12,014
- Energy Efficiency: -1,450
- BTM Solar & Storage: -571
- TOD Effect: -7
- Building Electrification: 365
- Transp Electrification: 936
- Other Incremental Load: 552
- Managed Load: 11,838

Increase | Decrease | Total
DER EVOLUTION
Transportation Electrification

145% increase with IRP for 2030
Light Duty EV Evolution

- Largest residential loads will be EVs
- Subcompact $\rightarrow$ full-size long-range EVs creating options for higher charging levels (19kW Tesla option)
- DCFC 50kW $\rightarrow$ 450kW
- 70% participating in our EV rate
- Opportunity for alignment with solar curtailment mitigation and avoiding possible new midnight peak
- Autonomous testing in CA
Medium & Heavy Duty EVs

• Interest and model availability increasing for electrification of commercial medium and heavy duty vehicles

• Class 8 Trucks: 1.5MW charging or higher

• West Coast Corridor Truck Charging – Electrifying I-5

• Fleet electrification: charge management and future-ready (V2G)

• Integrated solutions for customer load management
By 2030, we expect to electrify 20x homes per year that we will do in 2019
Building Electrification

• Momentum building based upon decarbonization
  – Built Environment TAC
  – 50+ Municipalities considering ordinances
  – CPUC unanimously opened up $1B EE funding for electrification

• New LAX terminal all-electric, even restaurants

• Load management needed to avoid more costly upgrade options
  – Customer panel considerations
  – Utility infrastructure needs
Battery Storage Evolution

• Declining prices in line with 2023
• LADWP “Record Setting Solar Power Price”
• Leveraging the value of storage: Grid & Customer
PV Forecast

PV Adoption Forecast

- 2016 Forecast
- 2019 Forecast
- Actual

MW

PV Evolution

- Renewables increasing to serve decarbonization goals
- Solar generation curtailment in CA
- Bills in Congress to extend ITC at 30% for five more years (2025)
- Solar plus storage becoming the standard offer for behind the meter installations
DER Challenges and Opportunities from within the control room
## Operational Considerations

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Opportunities</th>
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</thead>
<tbody>
<tr>
<td>Localized Voltage Issues from over generation (PV)</td>
<td>Offset over generation conditions (EVs &amp; Storage)</td>
</tr>
<tr>
<td>Resource Variability (PV)</td>
<td>Reduction of peak load (Demand Management, Storage)</td>
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<td>Overloaded equipment (EV and Building Electrification)</td>
<td>Deferred or reduced capital investments</td>
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<tr>
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<td>Reduction of losses</td>
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### Tools/Technology Gaps

- Modeling of DERs
- Forecasting of DERs
- Visibility and control
PV: Power Quality

Transformer Loading

Negative loads due to excess generation

Meter Voltage

Voltage spike due low loads and excess generation
PV: Hidden Load
Powerline-Elkhorn Substation

- System load (green line) is what was visible to the operators
- Actual customer usage (orange line) is the amount of load we need to be prepared to serve if solar production is impacted by cloud cover
- “Hidden load” is the difference between the green line and the orange line
PV: Resource Variability
Cloud Coverage Impact

- Thunder Storm
  - Loss of 40 MW in 15 minutes
    - equivalent to 330A in 69kV
  - Impacts to switching
PV: Resource Variability
Solar Eclipse & Cloud Cover Impact

- 9:00 am Eclipse
  - Forecast/Actual
  - ~90% Drop in Solar Production

- 3:00 pm Cloud
  - Loss of 10 MW is equivalent of 80A
  - Impacts to switching
EV: Overloaded Equipment
Transformer Loading

100kVA padmount transformer
- Serving 16 customers
- Design assumption of 5kW per home
- Originally built with 75kVA transformer

Overloaded in July
- 5pm – 8pm on July 28th
EV: Overloaded Equipment
Metered Usage

EV Customer 1
- Peak usage of 12.5kWH at 5pm on 7/28

EV Customer 2
- Peak usage of 16.5kWH at 7pm on 7/27
  - 15.5kWH on 7/28 at 3am
  - 14.5kWH on 7/28 at 3pm

EV Customer 3
- Peak usage of 8.5kW at 4pm on 7/28
Evolution of the Distribution System

Source: Paul De Martini and Lorenzo Kristov, 2015
SMUD’s Technology Advancements

Implementation of New Control Center Technologies:

• Advanced Distribution Management System (ADMS)
  – Distribution Supervisory Control and Data Acquisition (D-SCADA)
    • Increased Control
  – Real Time Load Flow
    • Enhanced Monitoring
  – Volt/Var Optimization
  – Fault location, isolation and service restoration
  – Operator Training Simulator

• Distributed Energy Resource Management System
  – Phase 1: Visibility of DERs
  – Phase 2: Local Benefits
  – Phase 3: Market/Economic Benefits
DERMS Phase 1: Visibility

- DERs added to the system model
- DER Forecasting
- Real-time estimation of non-telemetered DERS
- Alarming/Events for DER related grid conditions
- DER communication and control by type
DERMS Phase 2: Local Benefits

- Dispatch DERs to solve real time grid conditions
- Schedule DERS for electrical performance
- Utilize ADMS Functionality for DERs: State Estimation, Pre-Operation Analysis, Feeder Reconfiguration, Volt/Var Optimization
DERMS Phase 3: Market/Economic Dispatch

- Generate DER operating constraints
- Aggregation of DERs
- Scheduling DERs for economic performance and electricity markets
Questions?