October 4, 2017
Michigan Municipal Electric Association Fall Conference
Using AMI Data for Cost-of-Service and Rate Design Analyses, Resource Planning, and Financial Planning

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NewGen Strategies and Solutions, LLC
Lapeer, MI
Introduction
NEWGEN STRATEGIES AND SOLUTIONS, LLC

NewGen Overview

- Created in 2012 by former R. W. Beck / SAIC / Leidos and J.Stowe & Co. owners and consultants
- Consulting firm specializing in serving the municipal utility industry
- Dedicated to our clients’ missions and recognized experts in our respective fields of service
- National presence
- Significant growth since our inception in 2012, driven by our market leading expertise in helping public power
- Employ 36 expert and support staff with 10 offices across the country
- 290+ clients across the Energy and Environmental Practices

Thoughtful Decision Making for Uncertain Times
NewGen Core Competencies

**Economics**
- Cost of Service
- Rate Design
- Financial Modeling & Planning
- Litigation & Regulatory Support
- Valuation & Appraisals
- Resource Planning

**Strategy**
- Distributed Resources
- Community Solar
- Joint Action
- Procurement
- Strategic Planning
- Contract Negotiations
- Rate Strategy

**Stakeholders**
- Stakeholder Engagement
- Education & Training
- Facilitation
- Council / Board Meeting Support
- Customer Surveys

**Sustainability**
- Carbon Neutrality
- Sustainability Reporting
- Sustainability Strategy
- Renewables
- Waste Resources
Agenda

• Introduction
• Roles and Implications Related to Advanced Metering Infrastructure (AMI) Data – or Smart Meter Data:
  • Customer Segmentation and Rate Design Analyses
  • Cost-of-Service Analyses
  • Resource and Financial Planning Analyses
Key Industry Trends/Considerations

- Renewables
- Conservation
- Distributed Generation
  - Unbundling
  - Residential Demand
- Demand Destruction
- Regulation

- Technology
- Aging Infrastructure
- Low Income
- Financial Strength
- Stakeholders
AMI Data Utilization

• Many utilities recognize that using AMI data only for billing is a very limited application
• To find beneficial uses of AMI data, utilities should view its application across existing utility functions
• AMI data can help utilities streamline their operations and planning functions and ultimately reduce costs
AMI Data Can Support More Advanced Modeling Analytics

AMI Data

- Allows Greater Visibility Into Customer Usage Characteristics
- Enables Data Driven Support for Politically Sensitive Changes
AMI Data Management and Analysis

- Meter Data Management System (MDMS) captures / reports data
- Data from MDMS will require scrubbing
- Avoid “canned” reports from MDMS – data may be compressed
- Need to store multiple years of data
- Check reasonableness of results
- Excel applications now able to handle large amounts of data
Rates, Policy, Technology Converge

- High Penetration of Time of Use Rates
- Broad Solar Adoption by Customers
- Policies Driving Electric Vehicles, Energy Efficiency, and Distributed Generation Adoptions

Source: CAISO
Customer Segmentation and Rate Design
Customer Segmentation and Rate Design

• Then:
  – Types of customer classes rarely change
  – No interval (time-of-use) data for most customers
  – Need to estimate billing determinants if rate structures changed

• Now:
  – More insight into customer usage patterns
  – Ability to send better price signals to customers through customer segmentation and advanced rate designs
  – Actual information that can be used to estimate billing determinants if rate structures changed
• Do similar customers, grouped within a class, really operate in similar manner?
The Noise

Residential Average Summer Load Profile by Meter
The Average

Residential Average Summer Load Profile by Meter
The Segments

Residential Average Load Profile by Segment

Hour Ending

Percent of Daily Load

Afternoon
Steady
Night
Morning
Customer Segmentation

Opportunities through customer segmentation:

- Provide increased rate options and price signals, targeting segments
- Improve system load factors and class behaviors
- Optimize energy efficiency and demand response measure offerings/rebates to customers with most to gain / benefit the system
AMI Facilitating Demand Rates

- Current strategies used to introduce / implement demand rates in historically energy-only classes
  - Pilot programs
  - Net Meter or PV customers
  - Full transition
- Education and engagement will be key
- Design to be revenue neutral
- Align with COSA results
NewGen Rate Model – AMI / TOU

- Annual system load profile and monthly customer class profile
- Assumptions related to expansion of PV and EV
- TOU/Time differentiated rate structure selections
- Customer class and system load impacts of rates and EV/PV
- Customer billing impacts
- Impact to system load duration curve
Advanced Time-of-Use Rate Design

• Ability to optimally develop and immediately understand impacts of time-differentiated rates
Advanced Time-of-Use Rate Design
Detailed Bill Impact Results

- Comfort is gained with knowledge
  - Comprehensive comparisons summarized in simple terms
  - Full set of AMI data can be used in rate design
Cost-of-Service Analyses
Cost-of-Service Analyses

Cost-of-Service Model Components:
- A: Unbundled Revenue Requirement
- B: Classified Costs
- C: Customer Allocations
# Example Cost of Service Results

<table>
<thead>
<tr>
<th>Function</th>
<th>Allocation Factor</th>
<th>Residential</th>
<th>Small Commercial</th>
<th>Large Commercial</th>
<th>Industrial</th>
<th>Street Lights</th>
</tr>
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<tbody>
<tr>
<td>Generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Purch. Power</td>
<td>Energy (kWh)</td>
<td>13,625,687</td>
<td>1,437,467</td>
<td>7,393,543</td>
<td>3,046,814</td>
<td></td>
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<tr>
<td>Demand</td>
<td>3 Coinc. Peak</td>
<td>979,081</td>
<td>138,516</td>
<td>579,091</td>
<td>183,688</td>
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<td>Transmission</td>
<td>3 Coinc. Peak</td>
<td>1,448,568</td>
<td>204,937</td>
<td>856,776</td>
<td>271,770</td>
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<tr>
<td>Distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand</td>
<td>Non-coinc Pk</td>
<td>2,183,179</td>
<td>332,874</td>
<td>1,299,699</td>
<td>388,349</td>
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<tr>
<td>Customer</td>
<td>No. Cust</td>
<td>2,441,079</td>
<td>282,782</td>
<td>283,725</td>
<td>10,587</td>
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<tr>
<td>Street Lt.</td>
<td>Direct Assign</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>260,583</td>
</tr>
<tr>
<td>Customer</td>
<td>Wtd. No Cust.</td>
<td>332,771</td>
<td>38,549</td>
<td>65,829</td>
<td>1,300</td>
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<tr>
<td><strong>Total COS</strong></td>
<td></td>
<td>$21,010,364</td>
<td>$2,435,126</td>
<td>$10,478,663</td>
<td>$3,902,508</td>
<td>$260,583</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Small Commercial</th>
<th>Large Commercial</th>
<th>Industrial</th>
<th>Street Lights</th>
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<tbody>
<tr>
<td>Base Rate</td>
<td>$13,625,687</td>
<td>$1,437,567</td>
<td>$7,393,543</td>
<td>$3,046,814</td>
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<tr>
<td>Power Cost – Pass-through</td>
<td>$7,384,677</td>
<td>$997,659</td>
<td>$3,085,120</td>
<td>$855,694</td>
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</table>

NEWGEN STRATEGIES AND SOLUTIONS, LLC
Power Generation and Transmission systems constructed to meet system peak demands. Distribution systems constructed to meet localized geographic demands.
Development of Cost-of-Service/Load Research Allocators

• Then:
  – Proxy data and /or feeder data
  – Deployment of load research meters for sampled customers – usually expensive and inherent sampling errors
  – Little consideration to changing load shapes/consumption characteristics or further customer segmentation

• Now:
  – Sampled AMI data – inherent sampling errors
  – Full set of AMI data – eliminates sampling error
  – Can use to develop current and future anticipated consumption characteristics for various groups of customers
AMI Sample Data Summary

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Month</td>
<td>CP Time</td>
<td>NCP Time</td>
<td>Total kWh at Meter</td>
<td>Light Load Hours kWh</td>
<td>Heavy Load Hours kWh</td>
<td>AMI Data SMD</td>
<td>AMI Data NCP</td>
<td>AMI Data CP</td>
<td>Load Factor</td>
</tr>
<tr>
<td>1</td>
<td>124/13 3:00</td>
<td>114/13 3:00</td>
<td>32,050,308</td>
<td>40,054,900</td>
<td>52,035,308</td>
<td>413,710</td>
<td>195,424</td>
<td>178,457</td>
<td>30%</td>
</tr>
<tr>
<td>2</td>
<td>211/13 7:00</td>
<td>211/13 7:00</td>
<td>62,302,323</td>
<td>27,585,206</td>
<td>35,407,117</td>
<td>395,729</td>
<td>163,072</td>
<td>140,111</td>
<td>26%</td>
</tr>
<tr>
<td>3</td>
<td>313/13 3:00</td>
<td>314/13 7:00</td>
<td>55,275,924</td>
<td>22,888,347</td>
<td>22,410,577</td>
<td>346,746</td>
<td>163,729</td>
<td>140,111</td>
<td>21%</td>
</tr>
<tr>
<td>4</td>
<td>417/13 7:00</td>
<td>417/13 7:00</td>
<td>41,751,011</td>
<td>15,839,432</td>
<td>25,911,580</td>
<td>310,542</td>
<td>134,634</td>
<td>134,634</td>
<td>19%</td>
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<tr>
<td>5</td>
<td>500/13 17:00</td>
<td>500/13 17:00</td>
<td>37,361,308</td>
<td>14,190,502</td>
<td>23,170,807</td>
<td>281,030</td>
<td>119,667</td>
<td>111,391</td>
<td>18%</td>
</tr>
<tr>
<td>6</td>
<td>600/13 17:00</td>
<td>600/13 17:00</td>
<td>44,076,508</td>
<td>17,706,100</td>
<td>26,370,505</td>
<td>280,000</td>
<td>142,536</td>
<td>118,000</td>
<td>2%</td>
</tr>
<tr>
<td>7</td>
<td>700/13 17:00</td>
<td>700/13 17:00</td>
<td>44,076,508</td>
<td>17,706,100</td>
<td>26,370,505</td>
<td>280,000</td>
<td>142,536</td>
<td>118,000</td>
<td>2%</td>
</tr>
<tr>
<td>8</td>
<td>800/13 17:00</td>
<td>800/13 17:00</td>
<td>44,076,508</td>
<td>17,706,100</td>
<td>26,370,505</td>
<td>280,000</td>
<td>142,536</td>
<td>118,000</td>
<td>2%</td>
</tr>
<tr>
<td>9</td>
<td>900/13 17:00</td>
<td>900/13 17:00</td>
<td>44,076,508</td>
<td>17,706,100</td>
<td>26,370,505</td>
<td>280,000</td>
<td>142,536</td>
<td>118,000</td>
<td>2%</td>
</tr>
</tbody>
</table>

AMI - Residential (Sample Size Data Set Applied to Full Class to Create Est.)

- **Total kWh at Meter**
  - 92,090,208
  - 62,992,323
  - 55,278,924
  - 41,751,011
  - 37,361,308
  - 44,076,508

- **Light Load Hours kWh**
  - 40,054,900
  - 27,585,206
  - 22,888,347
  - 15,839,432
  - 14,190,502
  - 17,706,100

- **Heavy Load Hours kWh**
  - 52,035,308
  - 35,407,117
  - 22,410,577
  - 25,911,580
  - 23,170,807
  - 26,370,505

- **AMI Data SMD**
  - 413,710
  - 359,729
  - 346,746
  - 310,542
  - 281,030
  - 280,000

- **AMI Data NCP**
  - 195,424
  - 163,072
  - 163,729
  - 134,634
  - 119,667
  - 111,391

- **AMI Data CP**
  - 178,457
  - 163,072
  - 140,111
  - 134,634
  - 111,391
  - 118,000
Fixed Cost Recovery Issues

- Utility costs are predominately fixed
- Majority of utility revenues are misaligned with cost structure

Three cost classifications, allocated to customers based on costs imposed on system
1. Demand (fixed)
   - Peak Demand Responsibility
   - Time Differentiation
   - Coincident/Non-Coincident/Sum of Max Demands
2. Customer (fixed)
   - Minimum system
   - Number/weighted number of customers
3. Energy (variable)
   - Energy consumed, include losses by service voltage

Utility Costs
- Fixed, 65%
- Variable, 35%

Utility Revenues
- Fixed, 20%
- Variable, 80%
Resource and Financial Planning
Resource and Financial Planning

• Then:
  – Fairly static load shapes are often used – do not take into account future deployment of technologies and rate designs that can affect load shapes
  – Load shapes may be based on proxy data or stale actual data
  – Rate design assessment – which is inherently necessary for load shape forecasting – is usually an afterthought in resource planning
  – For financial planning, load shape changes are not often considered when forecasting revenues from rates

• Now:
  – Analyses of AMI data, historic load shapes, and projected load shapes provides more informed resource and financial planning
  – Consider rates as a “resource” that impacts load shapes
Why Are Customer Load Shapes Changing?

• Customer load shapes in today’s power systems are significantly changing as a function of Distributed Energy Resources (DERs)
  – For Residential customers, this is primarily due to rooftop solar and electric vehicles
  – For Commercial and Industrial customers, various DERs (solar, storage, thermal generators) are being deployed to reduce and manage demand charges
  – Load shapes may change independent of DER penetration (e.g. customers on new time-of-use (TOU) rates)
Why Do We Care?

• Distributed energy resources may change the timing, level, and ramping requirements to accommodate peak demands
• This influences a utility’s coincident peak and can lead to a change in the amount and type of capacity resources required
• Also impacts future rate designs and associated revenues from rates
High Solar PV Deployment Scenario

- Substantial impact on DSCR
- Slower, consistent erosion of revenues
- Reduced Res. energy sales
High Electric Vehicle Deployment Scenario

- Improved DSCR
- Increased revenue without increased power costs

**Debt Service Coverage Ratio**
- Debt Service Coverage vs. Goal Debt Service Coverage

**Fund Balances ($M)**
- Emergency Reserve
- Operating Reserve
- Revenue Fund
- Required Reserve

**Days Operating Cash/Liquidity**
- Additional Days Liquidity (Rev. Fund & Rate Stab.)
- Days Cash on Hand (Emergency and Gen Funds)

**Annual Rate Revenue and Sales**
- Residential
- Commercial
- Industrial
- Energy Sales

Illustrative
Key Takeaways

• Inaccurate estimates of load shapes can impair a utility’s ability to forecast needs for reserve capacity and fast-ramping resources, as well as revenues from rates

• Utilities should consider approaches that accomplish the following:
  – Accurately forecasts load and load shapes incorporating DERs
  – Ability to forecast ramping requirements and requisite fast-ramp capacity to meet peak demand
  – Consider rate design as a way to incentivize efficient use of the system and to impact load shapes that reduce ramping and capacity resource requirements

• More accurate load shape forecasts that are influenced by targeted rate design changes can likely improve projections of production costs and revenues from rates
NewGen’s Proprietary Load Shape Analysis Model (LSAM) Leverages Our Core Competencies in Rate Design and Big Data Management

### NewGen Strategies & Solutions - Load Shape Analysis Model (LSAM)

#### Proposed Rates - Time of Use Rate Design

<table>
<thead>
<tr>
<th>Item</th>
<th>Effective</th>
<th>Summer Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Charge</td>
<td>$13,068</td>
<td>$27,620</td>
</tr>
<tr>
<td>Energy Charge</td>
<td>$2,376,090</td>
<td>$2,376,090</td>
</tr>
<tr>
<td>Total</td>
<td>$2,550,558</td>
<td>$2,550,558</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Effective</th>
<th>Non-Summer On-Peak Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Charge</td>
<td>$14,171.13</td>
<td>$15,524.13</td>
</tr>
<tr>
<td>Energy Charge</td>
<td>$2,276,894</td>
<td>$2,276,894</td>
</tr>
<tr>
<td>Total</td>
<td>$2,421,065</td>
<td>$2,421,065</td>
</tr>
</tbody>
</table>

### Solar Assumptions

- **DEEM**
- FIT Solar Credits (Remainder of 2018)
- Capacity Factor (DFC)
- Debt (DFC)
- Debt Term (Year)
- ITC CAPEx Appropriability
- Local Tax Credits
- Solar Cost Projections
- Year of Solar Introduction
- Solar-Feasible Residential (Cost of Market)
- Solar-Results New Residential

### Customer Economics of Solar - Part of DEEM

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$25,200</td>
<td>$26,300</td>
<td>$27,400</td>
</tr>
<tr>
<td>NOPAT</td>
<td>$25,200</td>
<td>$26,300</td>
<td>$27,400</td>
</tr>
<tr>
<td>Net Margin</td>
<td>10.6%</td>
<td>10.6%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

### EV Load - Jul 2035

- **EV Adoption Forecast**
  - High EV Adoption Multiplier Over EIA 120%

### PV Adoption Forecast

- **Effective Btu's (net) 2016**
- **Effective Btu's (net) 2017**
- **Effective Btu's (net) 2018**
- **Effective Btu's (net) 2019**
- **Effective Btu's (net) 2020**
- **Effective Btu's (net) 2021**
- **Effective Btu's (net) 2022**
- **Effective Btu's (net) 2023**
- **Effective Btu's (net) 2024**
- **Effective Btu's (net) 2025**

### Current Rates - Tiered

<table>
<thead>
<tr>
<th>Item</th>
<th>Change</th>
<th>Dec.</th>
<th>Exs.</th>
</tr>
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<tbody>
<tr>
<td>Customer Charge</td>
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<td>9040</td>
<td>$35,600</td>
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<tr>
<td>Summer Charges</td>
<td>$15,966</td>
<td>$27,620</td>
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<tr>
<td>Tier 1</td>
<td>$0.1200</td>
<td>$1,074,563</td>
<td>$128,940</td>
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<tr>
<td>Tier 2</td>
<td>$0.1200</td>
<td>$1,150,265</td>
<td>$276,204</td>
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<tr>
<td>Tier 3</td>
<td>$0.1200</td>
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<td>$152,004</td>
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<tr>
<td>All kWh</td>
<td>$0.1200</td>
<td>$2,658,364</td>
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### TOU Demand Elasticity

- **Raw Residential Demand Elasticity**
- **TOU Energy Efficiency**
- **EV Assumed Percent (Ignore TOU Signal)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Load</td>
<td>41.16%</td>
<td>10.5%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

### NewGen Strategies and Solutions, LLC

- **NEWGEN STRATEGIES AND SOLUTIONS, LLC**
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Questions
Thank You

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