PLUGGING THE HOLES IN LEAKAGE: METHODS FOR CALCULATING LEAKAGE OUT OF AND INTO UPSTREAM RESIDENTIAL LIGHTING PROGRAMS

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What is Lighting Program Leakage...and Why do We Care?

- Sales of program-discounted bulbs to customers of another utility
  - Can’t limit sales with upstream program design
- Lighting program savings are shrinking as market transforms
  - Limiting leakage is one way to maximize remaining savings
  - But first, we need to be confident in how to measure it
Little consistency in measurement or application of leakage across country

Reviewed 11 TRMs and the UMP

- Less than half mentioned leakage (5 of 12)
- Only two described leakage methods
  - In-store interviews
  - GIS Analysis

<table>
<thead>
<tr>
<th>State</th>
<th>Mentioned Upstream Res. Lighting Leakage</th>
<th>Estimation Methods Described?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>UMP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Illinois</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Pennsylvania</td>
<td>Yes</td>
<td>No</td>
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<td>New York</td>
<td>Yes</td>
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<td>Massachusetts</td>
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<td>Indiana</td>
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<td>Texas</td>
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<td>Connecticut</td>
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<td>Wisconsin</td>
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<td>Vermont</td>
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<td>No</td>
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</table>
Leakage Methods: In-Store Customer Intercept Interviews

- Estimate leakage by asking customers for the name of their electric utility
- Main objective is usually to estimate program free-ridership
- Sample stores may not be selected in a manner to accurately estimate secondary objectives such as leakage (coverage bias)
- Can only measure leakage out
Leakage Methods: GIS Analysis

- Estimate leakage by mapping participating retailers and utility customers
  - Define store territories by drawing distance-based buffers around each store
- Leakage rate is the percentage of opposing utility households within the buffer
  - Sales weight the results so that stores with more sales have a greater influence on overall leakage rate
Leakage Methods: GIS Analysis (2)

- Requires simplifying assumptions about customer purchase behavior (questionable internal validity)
- Can estimate both leakage out and leakage in, though sales data are required for the most precise estimates
Two Methods, Two Utilities, One Border, Zero Walls

- Ameren Illinois Company (AIC) and Commonwealth Edison (ComEd)
- Estimate leakage along the AIC/ComEd border using intercepts and GIS
- AIC: 725 participating stores
- ComEd: 1,151 participating stores
Defining Leakage Out & Leakage In for AIC

Leakage Out

Leakage In

AIC Program bulbs

ComEd Program bulbs

Legend:
- AIC Stores
- AIC Customer
- AIC Territory
- ComEd Stores
- ComEd Customer
- ComEd Territory
Intercept Method Details

- Conducted intercept interviews at between 23-26 stores
  - AIC: 335
  - ComEd: 400
- Examined leakage from sampled stores within 15 miles of AIC/ComEd border
- Most sampled participating stores near territory borders, mirrors population

<table>
<thead>
<tr>
<th>Utility</th>
<th>Population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stores Within 15 Miles of Border</td>
<td>Part. Stores</td>
</tr>
<tr>
<td>AIC</td>
<td>47</td>
<td>725</td>
</tr>
<tr>
<td>ComEd</td>
<td>106</td>
<td>1151</td>
</tr>
</tbody>
</table>
Results: In-Store Intercepts

- Intercept interviews at stores within 15 miles of AIC/ComEd border did not identify any customers from the neighboring utility purchasing program-discounted bulbs.

- Overall intercept sample reflects population pretty well in terms of distance to all borders, but sample size is too small to estimate leakage out of or into a single border.

<table>
<thead>
<tr>
<th></th>
<th>AIC</th>
<th>ComEd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage Out</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Leakage In</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total Leakage</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>
GIS Method Details

- Uses sales data from participating stores
- Store territory = 15 mile buffer surrounding the store
  - Assumes that all customers within the territory have equal opportunity to purchase bulbs
  - We distribute program-discounted bulbs sold at each store equally across all households in territory
- Focused on “leakage susceptible stores” along AIC/ComEd border
  - Those that have customers from neighboring utility within store territory
Results: GIS Analysis

- Calculated leakage out and leakage in for both utilities for both years
  - AIC has more bulbs leaking **in** than leaking **out**
  - ComEd has more bulbs leaking **out** than leaking **in**
    - ComEd had more leakage-susceptible stores near the border than AIC, which also sold more program-discounted bulbs than AIC leakage-susceptible stores

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<thead>
<tr>
<th></th>
<th>AIC</th>
<th>ComEd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage Out</td>
<td>2.51%</td>
<td>1.68%</td>
</tr>
<tr>
<td>Leakage In</td>
<td>3.16%</td>
<td>1.33%</td>
</tr>
<tr>
<td>Total Leakage</td>
<td>0.65%</td>
<td>-0.35%</td>
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The leakage estimates can vary significantly using different buffer radii.

These differences may be due to the irregular shape of the AIC/ComEd border, varying communities on either side of the border, and sporadic shifts in household density.

<table>
<thead>
<tr>
<th>Utility</th>
<th>10-Mile Radius</th>
<th>15-Mile Radius</th>
<th>20-Mile Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIC</td>
<td>8.53%</td>
<td>0.65%</td>
<td>-4.92%</td>
</tr>
<tr>
<td>ComEd</td>
<td>-6.35%</td>
<td>-0.35%</td>
<td>1.13%</td>
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</tbody>
</table>
### Example of Parameter Sensitivity for Single AIC Store

<table>
<thead>
<tr>
<th>Radius (in miles)</th>
<th>AIC Customers</th>
<th>ComEd Customers</th>
<th>% Leakage Out to ComEd</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>13,784</td>
<td>453</td>
<td>3%</td>
</tr>
<tr>
<td>15</td>
<td>19,537</td>
<td>2,531</td>
<td>11%</td>
</tr>
<tr>
<td>20</td>
<td>23,301</td>
<td>20,544</td>
<td>47%</td>
</tr>
</tbody>
</table>

- **ComEd Customers**
- **AIC Customers**
- **10-Mile Radius**
- **15-Mile Radius**
- **20-Mile Radius**
Key Takeaways

Intercept Method

Pros
- Can produce accurate estimate of leakage out for overall territory if sample stores locations are representative of population

Cons
- Samples are too small to estimate leakage to a single utility
- Not practical to estimate leakage in
- Expensive

GIS Method

Pros
- Both leakage out and leakage in
- Can use to estimate leakage to single utility
- No sample required
- Is inexpensive

Cons
- Requires untested simplifying assumptions
- Requires access to bulb sales data from opposing program for leakage in estimates to be precise
Thank you

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