Assembling a Grid Resiliency Toolbox: The Tools That Make it Possible
By: Josh Schellenberg, Vice President
Thought Leaders from Nexant Strategy & Planning

Mr. Josh Schellenberg
- Vice President
- 10+ years of energy / utilities experience
- M.A., Economics

Dr. Eric Bell
- Principal
- 10+ years of energy / utilities experience
- Ph.D., Economics

Ms. Candice Potter
- Principal
- 13+ years of energy / utilities experience
- M.S., Statistics

Dr. Myles Collins
- Managing Consultant
- 15+ years of energy / utilities experience
- Ph.D., Policy Analysis

Dr. Michael Sullivan
- Senior Vice President
- 44+ years of energy / utilities experience
- Ph.D., Sociology

Dr. Stephen George
- Senior Vice President
- 42+ years of energy / utilities experience
- Ph.D., Economics

Multi-disciplinary team at the forefront of rethinking regulatory structures, the role of the utility and the relationship that utilities have with their customers
In 2017, the U.S. experienced 16 extreme weather events with damages exceeding $1 billion, which is expected to cost a record total of $300 billion.
In 2018, total weather-related damages were lower ($91 million), but electric utilities were disproportionately impacted.
“I am pleased to announce the release of two OE-sponsored research products that provide timely assistance for this electric utility planning challenge. These research products, which were developed in a public-private partnership (Lawrence Berkeley National Lab and Nexant), are the *Estimating Power System Interruption Costs: A Guidebook for Electric Utilities* and the * Interruption Cost Estimate (ICE) Calculator 2.0.*”

**Bruce J. Walker**  
Assistant Secretary, Office of Electricity  
U.S. Department of Energy  
[energy.gov](http://energy.gov)
ICE Calculator Microgrid Example: How much do customers benefit from avoiding a 16-hour power outage? (Step 1)

1. Go to icecalculator.com and click “Estimate Interruption Costs”

The Interruption Cost Estimate (ICE) Calculator is a tool designed for electric reliability planners at utilities, government organizations or other entities that are interested in estimating interruption costs and/or the benefits associated with reliability improvements.
ICE Calculator Microgrid Example: How much do customers benefit from avoiding a 16-hour power outage? (Step 2)

2. Provide inputs on customers, reliability and state (Illinois in this example)

Number of Customers

- Non-Residential *: 10
- Residential *: 1,000

Reliability Inputs

Enter values for two of the three index values.

- SAIFI *: 1.000
- SAIDI *: 960.0
- CAIDI *: 960.0
ICE Calculator Microgrid Example: How much do customers benefit from avoiding a 16-hour power outage? (Step 3)

3. Review and incorporate results into benefit-cost analyses

<table>
<thead>
<tr>
<th>Sector</th>
<th># of Customers</th>
<th>Cost Per Event (2016$)</th>
<th>Total Cost (2016$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1,000</td>
<td>$29.03</td>
<td>$29,025.25</td>
</tr>
<tr>
<td>Small C&amp;I</td>
<td>9</td>
<td>$10,390.31</td>
<td>$93,512.83</td>
</tr>
<tr>
<td>Medium and Large C&amp;I</td>
<td>1</td>
<td>$68,485.45</td>
<td>$68,485.45</td>
</tr>
<tr>
<td><strong>All Customers</strong></td>
<td>1,010</td>
<td><strong>$189.13</strong></td>
<td><strong>$191,023.53</strong></td>
</tr>
</tbody>
</table>

Total Cost of Sustained Interruptions by Sector:
- Residential: 15.2%
- Small C&I: 35.9%
- Medium and Large C&I: 49.0%
Assessing risk over the lifetime of a 20- to 50-year resilience investment is an especially challenging planning problem

- **Variety of challenges at each step in the risk assessment process**
  - Identifying relevant power interruption scenarios
  - Forecasting probability of each scenario
  - Estimating economic impact of each scenario (beyond 16 hours)

- **Challenges arise from nature of long duration power interruptions**
  - Infrequent (few data points)
  - Potentially catastrophic impacts across multiple sectors of the economy
    - Critical infrastructure
  - Significant indirect costs that extend to areas not directly affected by the outage
Academics, think tanks, consultants and government institutions are working together to address these resilience planning challenges.

1. Mitigation and Resilience Trade-offs In Electricity Outages by Jonathan Eyer and Adam Rose (USC)

2. Estimating Residential Customers’ Costs of Large, Long-Duration Blackouts by Sunhee Baik, Selin Sirinterlikci, Jun Woo Park, Alex Davis and M. Granger Morgan, (Carnegie Mellon University)

3. Economic Consequence Analysis of Electric Power Infrastructure Disruptions: An Analytical General Equilibrium Approach by Ian Sue Wing (Boston University) and Adam Rose (University of Southern California)

4. Using Stated Preferences to Estimate the Value of Avoiding Power Outages: A Commentary with Input from Six Continents by Daniel Shawhan (Resources For the Future)

5. Evaluating Methods of Estimating the Cost of Long-Duration Power Outages by Jeffrey Roark (EPRI)

6. Data Landscape: Challenges and Opportunities by Josh Schellenberg, Myles Collins, Michael Sullivan, Shannon Hees, Stephanie Bieler (Nexant, Inc.)
For comments or questions, contact:

Josh Schellenberg  
Vice President  
JSchellenberg@nexant.com  
(415) 369-1117  
@EnergyDataGuy