Changes to the Underlying Econometric Models for the Interruption Cost Estimate (ICE) Calculator

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In March 2018, Lawrence Berkeley National Laboratory (LBNL) and Nexant released a significant upgrade of the Interruption Cost Estimate (ICE) Calculator. While most of the improvements involved a modernization of the user interface, there are two notable modifications to the underlying econometric models. LBNL and Nexant documented the original models and customer interruption cost meta-analysis in a 2009 report. They subsequently revised the meta-analysis and econometric models for the ICE Calculator in 2015, as documented in an updated report. The models for the current version of the ICE Calculator are based on two additional modifications summarized below.

Accounting for Regional Variation for Medium & Large C&I Customers

Economic productivity per unit of electricity usage varies widely throughout the country, as measured by 2016 state-level data on Gross Domestic Product (GDP) from the U.S. Bureau of Economic Analysis and Non-residential Electricity Usage (kWh) from the U.S. Energy Information Administration. Based on these data sources, GDP/kWh varies from $2.8/kWh in Wyoming to $16/kWh in Connecticut. Significantly larger states such as Mississippi ($3.5/kWh), Alabama ($3.7/kWh), New York ($15.5/kWh) and California ($15.6/kWh) are also near the minimum and maximum values, indicating that this wide range of economic productivity per unit of electricity usage is not driven by a couple of small outlier states.

The prior version of the ICE Calculator accounted for regional variation in non-residential interruption costs by including state-level inputs for customer size and industry mix. However, these two variables may not account for a substantial portion of the regional variation in interruption costs for commercial and industrial (C&I) customers. Therefore, Nexant re-ran the meta-analysis for the two C&I segments with the GDP/kWh variable included, based on the year of each survey response and location (state) of the respondent. This analysis found that the GDP/kWh variable significantly improved the predictive accuracy of the econometric models across states for the medium and large C&I segment. As a result, LBNL and Nexant incorporated this improvement in the econometric models into the new version of the ICE Calculator. The small C&I segment did not show a similar improvement in predictive accuracy with the GDP/kWh variable included, so those econometric models are the same as in the prior version of the ICE Calculator.

Removed Two Residential Surveys

The prior meta-analysis included two residential surveys that asked the Willingness of Pay (WTP) questions quite differently from the other eight surveys. These surveys were for the Southwest utility in 2000 and the Northwest-2 utility in 1999, as summarized in Table 1-1 of the 2015 report. After examining the survey instruments more closely, Nexant concluded that it was inappropriate to combine these responses with the rest of the meta-database. The outage costs for those surveys were generally lower as a result of the different question structure, so the residential interruption cost estimates increased slightly

after removing those responses from the meta-analysis. The meta-database still has 26,315 observations for residential customers.

Updated Coefficients

Consequently, the model coefficients underlying the ICE Calculator were updated. The tables that follow are an update to the coefficients described in Sullivan et al. (2015). Note: Decimal places have been truncated in the tables below—please use the ICE Calculator or the corresponding ICE Calculator spreadsheet tool found on the ICE Calculator documentation page to produce the most accurate results.

Table 1. Residential Model Coefficients and Average Values

Variable	Probit Model Coefficients	GLM Model Coefficients	Average Value
Interruption Characteristics			
duration	0.002	0.002	167.8
duration^2	-6.735E-07	-9.474E-07	82,197.8
summer	0.224	0.237	73.4%
afternoon	-0.255	-0.291	48.8%
evening	-0.083	-0.096	29.1%
Customer Characteristics			
ln(annual MWh)	0.130	0.262	2.4
household income	2.340E-07	1.653E-06	69,243.0
Constant	-0.053	1.299	N/A

Table 2. Small Commercial and Industrial Model Coefficients and Average Values

Variable	Probit Model Coefficients	GLM Model Coefficients	Average Value
Interruption Characteristics			
duration	0.003	0.004	190.8
duration^2	-1.783E-06	-2.155E-06	107,424.9
summer	0.215	-0.384	89.3%
morning	0.537	-0.057	45.5%
afternoon	0.664	-0.032	37.6%
Customer Characteristics			
ln(annual MWh)	0.124	0.069	2.6
backupgen or power conditioning	0.082	0.308	27.1%
backupgen and power conditioning	0.272	0.538	3.5%
Industry			
construction	0.261	0.786	4.6%
manufacturing	0.176	0.587	7.8%
Constant	-1.332	7.000	N/A

Table 3. Medium and Large Commercial and Industrial Model Coefficients and Average Values

Variable	Probit Model Coefficients	GLM Model Coefficients	Average Value
Interruption Characteristics			
duration	0.005	0.005	162.4
duration^2	-2.689E-06	-2.912E-06	82,724.2
summer	0.380	0.032	86.5%
Customer Characteristics			
ln(annual MWh)	0.118	0.489	6.6
Interactions			
duration x ln(annual MWh)	-3.183E-04	-1.270E-04	1,059.8
duration^2 *x ln(annual MWh)*	1.481E-07	1.071E-07	530,871.5
Industry			
manufacturing	0.203	0.818	23.3%
Regional Characteristics			
GDP / kWh (Non-residential)	0.024	0.073	$6.93
Constant	-1.082	4.916	N/A

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