Methodology for Estimating Generation Efficiency Potential in Minnesota

GDS Associates has developed a model to estimate the potential for efficiency improvements in electric generation facilities in Minnesota. The model analyzes recent performance data from generation assets serving the state to identify potential improvement. Improvement is measured by comparing the heat rate of each facility to a similar one with the most efficient heat rate on record. The applicable MN TRM measure is used to calculate efficiency gains (in equivalent CIP metric terms) from technically-possible heat rate improvements at each facility.

Baseline

We first collect data from industry sources and generation facility owners to characterize the operation of facilities owned by utilities serving MN load. The data collected from industry sources (FERC Form 1 filing information and information gleaned from the SNL/S&P database) shows specific plant operating characteristics, in most cases representing five recent years' worth of collected data. Plant characteristics include: Plant Name, Unit #, Owner, Technology, Fuel Type, Commercial Operation Date, State, Nameplate Capacity (MW), 5-year Average Operating Capacity (MW), 5-year Average Net Generation (MWh), 5-year Average Capacity Factor (%), and 5-year Average Heat Rate (Btu/kWh). In cases where data is missing, plant operators are contacted directly to fill in gaps. Owners are also asked about annual O+M costs and previous heat rate improvement projects at the site.

Classification

After characterization data is collected, generation facilities are grouped by similar characteristics into classes. Classes are broken out by fuel type (coal or gas), generation technology (subcritical, critical, super critical; gas turbine, gas-steam turbine, combined cycle), capacity (2 ranges), and age of the facility. There are 24 potential classifications using the current combinations of characteristics, but in practice there will be fewer classes of plant actually serving MN.

Identify Best-in-Class Facilities

For each classification of facility, the best-performing plant serving MN load is identified as the best-in-class plant, determined by the most efficient heat rate. Additionally, a national best-in-class facility is identified from industry research data, which will likely introduce even better performing characteristics to compare to.

Comparison – Technical Potential Calculation

Each existing facility serving MN load is compared to the best-in-class facility of the same class. Technical potential is calculated at the site by applying the TRM measure "Generation Heat Rate Improvements"[1] to the facility data, assuming an improvement in the heat rate from the measured value to the match the best-in-class value. This operation is the crux of the model and demonstrates the conditions that would pertain if all plants were immediately upgraded to achieve the heat rate of the top-

[1] http://mn.gov/commerce-stat/pdfs/mn-trm-v2.1.pdf

performing units in the state. A second run of the model performs the same operation, but uses the national best-in-class facilities as the comparison.

Summing the calculated potential at each site produces the annual statewide technical potential for efficiency improvements at generation facilities serving Minnesota load. In practice, it is extremely unlikely that all technical potential will be captured, but it represents a theoretical possible efficiency gain. These gains are projected forward in time to the planned retirement date of the facility to determine potential for efficiency gains in the future (out to the planning horizon of 20 years).

Verification

As a verification step, our results are compared to those generated by a similar EIA model developed in 2015. That model was discovered as part of our initial literature review for the EUI efforts in Minnesota and had some of the same goals as this project. Those results do not quite apply directly to this effort, but will serve as a viable benchmark.

For facilities where the model identifies significant technical potential, a further look into the plant operations is warranted. Discussions with plant operators will be conducted to determine whether site specific conditions change the understanding of efficiency potential. For example, capturing process steam for useful heat at subcritical facilities is often not captured in the facility heat rate. Adjustments may be made to the estimated heat rate improvement potential by applying engineering judgment after discussions with plant operators.

Economic Potential

The next step in the potential study will be to pare the technical potential opportunities down to those that are economically feasible to implement. This will be completed by comparing first cost, O+M cost, and avoided fuel costs of plants and best-in-class facilities. This will be done on a high level comparing costs to heat rates, rather than looking at specific projects that might be completed to improve heat rates. Thus, the results would best be interpreted as identifying sites that are likely to be able to cost-effectively capture efficiency gains by examining operations and maintenance protocols or considering capital upgrades.

Some work has already been done in this area in a white paper produced for Xcel Energy and by a 2015 EIA study. The results of that work as well as conversations with plant operators will be used to inform the economic potential estimates. Any feedback or ideas from Advisory Committee members concerning estimating project costs is welcomed.

Achievable Potential

Estimating achievable potential is accomplished by applying ramp rates to the implementation of the calculated economic potential. Interviews with Advisory Committee members and plant operators will help guide the development of ramp rates along a realistic path. Ramp rates will account for existing planned projects and planned facility retirements. Any feedback or ideas from the Advisory Committee would be welcomed in developing a plan to best quantify realistic values for ramp rates.