ComEd
Energy Efficiency Program

FAN ENERGY INDEX MARKET RESEARCH EXECUTIVE SUMMARY

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1.0 EXECUTIVE SUMMARY

Fans consume an average of 16% of electricity used in commercial buildings. The primary measure for saving fan energy has been converting constant speed systems to variable speed. Little attention has been paid (in the energy efficiency world) to optimal fan selection: minimizing fan power while also meeting the required flow rate for a given application at its actual operating point. The Air Movement and Control Association (AMCA) has developed a new metric, the Fan Energy Index (FEI), which allows for the comparison of different fans at application specific operating conditions. This is a significant improvement over the current Fan Efficiency Grade metric. This new rating metric is incorporated in the newest versions of ASHRAE 90.1-2019 and IECC-2021. These codes set the baseline FEI as 1.0. More efficient fans will have FEIs greater than 1.0. Until these codes are adopted, utility program personnel, designers and contractors will need to become familiar with this metric and how to successfully select fans using it. Utility programs may claim savings for projects which select more efficient fans using the FEI metric. ***The purpose of this project was to test the market readiness of FEI and to identify the program offerings where it will be most effective.***

Energy Savings and Economics Summary

The project team quantified the energy savings potential of using the FEI metric across variety of sectors, fan types, fan speeds, drive types and fan powers. The project team also developed typical installed costs across the range of fan applications. This information was combined with the data from the energy modeling and with ComEd utility rates to analyze the economics of a typical fan installation for ComEd's service territory.

Upgrading a fan's FEI has significant energy savings and favorable economics across many applications. The industrial sector has higher normalized savings as compared to the commercial sector due to its longer hours at higher (and therefore less efficient) speeds. Smaller fans have higher normalized savings as compared to larger fans since they tend to be less efficient, meaning there is more room for improvement. The Industrial sector had median normalized savings of 613 and 584 kWh/hp for the small and large fan applications, respectively. The Commercial sector had median normalized savings of 388 and 362 kWh/hp for the small and large fan applications, respectively.

The simple paybacks are more favorable (shorter) in the industrial, as compared to the commercial, sector due to higher energy savings and similar costs. The simple paybacks are more favorable in larger, as compared to smaller, fans due to their comparatively lower cost per horsepower. Also, the smaller fans require a larger percentage increase in size to achieve the savings compared to a smaller percentage increase in size for the larger fans. The Industrial sector had median simple paybacks of 9.0 and 2.4 years for the small and large fan applications, respectively. The Commercial sector had median normalized savings of 14.2 and 3.8 years for the small and large fan applications, respectively.

Within the commercial sector, the energy savings is largest in building types with longer hours of fan operation such as Multifamily, Healthcare, Hotels and Restaurants. It would be lowest in building types with shorter hours of fan operation such as Warehouses and Schools.

Inline and Mixed Flow fans have the highest normalized energy savings of 624 kWh/hp. This reflects their low baseline FEI for the retrofit cases. The Centrifugal Unhoused fans have the lowest normalized energy of 425 kWh/hp because their baseline FEI in the retrofit case is relatively high.

Retrofits have higher normalized savings as compared to new construction to their lower baseline FEI. Note that new construction savings are the same across fan types since they have a consistent baseline FEI of 1.0. The Industrial sector had median normalized savings of 498 and 699 kWh/hp for the New Construction and Retrofit baselines, respectively. The Commercial sector had median normalized savings of 310 and 441 kWh/hp for the New Construction and Retrofit baselines, respectively.

The simple paybacks are more favorable (shorter) in new construction as compared to retrofit. Although the savings are higher in retrofits, the cost is much higher. This is because in retrofits the cost was assumed to be the full replacement cost, as opposed to only the incremental cost in new construction. Also, the retrofit case included the labor cost of uninstalling the old fan and installing the new fan. As is the case with many other applications, once an inefficient piece of equipment is bought, paid for and installed, it's not economically feasible to change it out until its end of life. The Industrial sector had median simple paybacks of 2.2 and 12.7 years in large fans for the New Construction and Retrofit baselines, respectively. The Commercial sector had median simple paybacks of 3.5 and 19.8 years in large fans for the New Construction and Retrofit baselines, respectively.

Constant speed drives have higher normalized savings as compared to variable speed drives. This is due to the variable speed drives being inherently more efficient, meaning there is less energy to save from improved FEI. For the same reason, belt drives have higher normalized savings when compared to direct drives. The Industrial sector had median normalized savings of 788, 726 and 359 kWh/hp for the Constant – Belt, Constant – Direct, and Variable – Belt drive types, respectively. The Commercial sector had median normalized savings of 440, 405, and 324 kWh/hp for the Constant – Belt, Constant – Direct, and Variable – Belt drive types, respectively.

The simple paybacks are most favorable (shorter) in constant speed, direct drive applications due to the higher energy savings. The Industrial sector had median simple paybacks of 1.9, 2.1 and 4.2 years in large fans for the Constant – Belt, Constant – Direct, and Variable – Belt drive types, respectively. The Commercial sector had median simple paybacks of 3.4, 3.7 and 4.6 years in large fans for the Constant – Belt, Constant – Direct, and Variable – Belt drive types, respectively.

Unsurprisingly, higher proposed FEIs have higher normalized savings as compared to lower proposed FEIs. The increase in energy savings is proportional to the difference in baseline and proposed FEIs. The Industrial sector had median normalized savings of 388, 610 and 797 kWh/hp for proposed FEIs of 1.1, 1.2 and 1.3, respectively. The Commercial sector had median normalized savings of 245, 383, and 499 kWh/hp for proposed FEIs of 1.1, 1.2 and 1.3, respectively.

The simple paybacks are most favorable (shorter) in the highest proposed FEIs. This is a result of energy savings increasing more than costs as FEI improves. The Industrial sector had median simple paybacks of 3.2, 2.4 and 1.9 years in large fans for proposed FEIs of 1.1, 1.2 and 1.3, respectively. The Commercial sector had median simple paybacks of 5.1, 3.8, and 3.1 years in large fans for proposed FEIs of 1.1, 1.2 and 1.3, respectively.

Savings Extrapolation

The project team estimated the total savings potential in ComEd's service territory by combining the per fan energy savings from the performance potential analysis with an estimate of the number of applicable standalone fans. ***The annual technical potential is approximately 53 and 26 million kWh for the commercial and industrial sectors, respectively.***

Stakeholder Interviews

The project team interviewed fan manufacturers and their distributors; contractors; designers; and building owners and operators to collect information on potential market barriers to using the FEI metric. There were several points of agreement among all the interviewees:

- Fans are very reliable pieces of equipment and it is not unusual for a fan to last 20 years or longer.
- It is very rare for customers to replace a working fan. They are replaced at end-of-life (usually a bearing or motor failure) or if the requirements change (like for upgrading filtration as a pandemic response).
- Most of the fans serving the customers of interest (commercial, industrial, multi-family) are quite small, normally 3-5 hp or less

- Training and other efforts to raise awareness were thought to be useful by interviewees from all groups.
- Interviewees generally agreed that a midstream incentive made sense.

Program Recommendations

The project team also interviewed program staff from ComEd, DNVGL, and Slipstream that would be responsible for implementation of an FEI offering (if it were launched today). We also spoke with staff from the Cadeo Group and the Northwest Energy Efficiency Alliance (NEAA), who together are implementing a related program.

A midstream program incentive seems likely to be most successful in terms of market uptake. Administratively it benefits from a relatively small number of participating distributors as customer touchpoints. And, because fans are most often replaced at end of life, in an urgent or emergency replacement scenario, working with distributors can ensure consistent availability of premium equipment. Furthermore, the trade association AMCA and two of the major fan manufacturers (Greenheck and Twin City Fan) were also in favor of a midstream offering. Some thoughts from interviewees on a midstream incentive program include:

- Distributors need a very simple offering. An offering that defines incentives in terms of the FEI rating, or even defines bins or thresholds of qualifying ratings will be regarded as somewhat confusing or burdensome for distributors. The most successful approach based on a program designed by NEEA and the Cadeo Group was to look at the product line of the specific distributor and assign incentives to their equipment models by FEI rating. Behind the scenes, program administrators would still determine those incentives by looking at the FEI of the products.
- Incentives can be a combination of per-unit incentives and/or sales quantity targets with associated bonuses developed individually with distributors. Sales targets with bonuses can prove to be a significant motivator, especially for larger distributors.
- A two-tiered incentive bin or threshold approach can be beneficial because it provides higher incentives for the highest efficiency equipment. This is particularly helpful if some distributors (and their manufacturers) do not have the highest efficiency equipment in their product line, but they do carry moderately high efficiency products.
- A midstream offering could easily be, and should be, coupled with training and education, which is important to driving uptake of higher efficiency products. This is especially true given the lack of understanding from distributors of how midstream incentives could influence their buyers'

decisions. We would need to change their paradigm to one where they have back and forth with their buyers and help promote the higher-FEI equipment. Incentives will of course motivate this.

- The largest savings potential from FEI comes with the combination of fan, motor, and drive. Distributors should consider this as a package and even be required to sell it as such to obtain the incentive. Fortunately, the common selection and sales software in the industry now generally forces users to input all three of these items in a typical selection, so there is already a tool in place to help distributors (as well as other stakeholders) think this way.

More work, however, is needed to understand the costs of launching and operating a midstream offering, or whether it can be coupled with other midstream offerings serving the same distributors. Some key factors to consider are:

- number of IL distributors and their market potential
- incentive level required to drive uptake of their premium equipment
- estimated education/marketing costs to influence those distributors