A Midstream Cogged V-Belt Pilot Program: Concept and Early Challenges

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ABSTRACT

Cogged v-belts (also known as notched v-belts) are about three percent more efficient at power transmission than smooth v-belts and are commonly recommended to replace smooth v-belts in industrial and commercial energy audits. While the energy-efficiency properties of cogged v-belts are widely accepted and documented, smooth v-belts still persist in practice. Moreover, few utility or government efficiency programs target v-belts for efficiency savings. As a result, many questions remain regarding the relative market penetration of cogged versus smooth v-belts, the technical potential for market transformation, and effective efficiency program design strategies to encourage adoption of cogged v-belts.

This paper describes the early challenges of developing a midstream cogged v-belt pilot program that addresses these questions. The concept of why a midstream program was selected will be discussed, followed by pilot program design, incentive design, early challenges, and best practices in pilot development. The cogged v-belt pilot program is a collaboration of several electric utilities, a regional energy efficiency organization, a national lab, and a state manufacturing trade association.

Background

The Commercial Midstream Incentive Project (CMIP) idea came from the confluence of two partnerships. Argonne National Laboratory (Argonne) and the Midwest Energy Efficiency Alliance (MEEA) were looking to design and pilot a midstream commercial program in the Midwest focused on measures not commonly associated with midstream program design. As energy efficient lighting is a common measure in upstream and midstream program design, the team sought other commonly recommended commercial and industrial measures.

At the same time, Ohio utilities (AEP Ohio, Dayton Power & Light [DP&L]) and the Ohio Manufacturers' Association (OMA) were partnering to increase energy efficiency program participation rates for manufacturers in Ohio. Also, AEP Ohio had engaged in conversations with Go Sustainable Energy (*Go*) regarding a v-belt-focused pilot program in early 2014. Finally, MEEA and Argonne were concurrently granted U.S. Department of Energy (US DOE) funding to study this particular incentive concept.

Thus, the CMIP was formed as a partnership between all these organizations with the goal of piloting a midstream incentive concept in Ohio aimed at business-to-business distributors and suppliers. While the primary aim of the CMIP was to create and execute a midstream incentive pilot that yielded demonstrable energy savings, a secondary goal was to use the pilot results along with distributor feedback to create a best practices toolkit to help guide other Midwestern utilities on how to launch future distributor incentive programs.

A Midstream Approach

A midstream energy efficiency program is typically carried out at the distributor or retailer level instead of the end user or manufacturer level. Advantages of such a program include reduced transaction costs and increased simplicity for customers and utilities. The pilot partners reasoned that customers of commercial products would respond best to less time-intensive approaches. The utility partners were interested specifically in program formats that reduced transaction costs and administrative burdens but still delivered significant energy savings to a small business or small commercial audience. Also, while midstream incentives may appear modest from a per unit perspective, their advantage to a business-to-business distributor is often in influencing a particular product's profit margin, which the incentive may increase substantially (EPA 2014). If applied to a high-volume product and taken in aggregate, these margin increases can amount to a significant impact on revenue.

The US DOE Industrial Assessment Center (IAC) Database was consulted to determine the most commonly recommended energy conservation measures in industrial and commercial settings, as well as the frequency of various program design approaches used to promote them. The database contains records of over 126,000 unique energy saving recommendations from 16,700 energy assessments of small to mid-size manufacturers. None of the top ten most frequently recommended measures are offered by Ohio utilities through midstream programs, but several, including upgrading to cogged v-belts, are available as custom incentives.

From a program design perspective, custom programs often provide a catch-all alternative to prescriptive programs, which are used for well-established, discrete measures with predictable energy savings. Conversely, custom programs are used for complicated measures that lack a deemed energy savings either because the measure is not well established or because energy savings are highly contingent on application. Existing prescriptive and custom incentive programs could represent opportunities to streamline administration and reduce transaction costs by changing to a midstream approach. However, such a change would require a solid understanding of existing market share, the measure's energy savings, and the most effective incentive strategies.

Why Cogged V-belts?

For this pilot, product selection was a key component of program design. Pilot partners determined the ideal product would not only be scalable, relatively simple, and widely available, but also have low existing market share, high potential for market transformation, high levels of manufacturer engagement, proven energy savings, and high potential to enhance distributor relationships. Cogged v-belts (also known as notched v-belts) were identified as meeting all of these specifications; additionally, cogged v-belts are installed in the same straightforward manner as less efficient smooth v-belts and to date had not been targeted by utility incentive programs in the area.

Cogged v-belts are typically estimated to improve power transmission by about 3% (Almedia and Greenberg, 1995). For a belt driven fan with a 10-hp motor, operating at 75% load for half of the year, at a blended electricity cost of $0.10/kWh-saved, the annual cost savings would be approximately $82.00 per year.[1]

Although switching a smooth v-belt with a cogged v-belt represents a relatively small efficiency gain, v-belts are typically found in large quantities in commercial or manufacturing facilities. Thus, cogged v-belts represent a large aggregated energy-savings opportunity. Also, although the power savings from a single measure is small (about 3%), individual measure savings may actually be considerable when a v-belt is coupled with a motor that draws a large amount of power.

The impact of the low cost savings per belt is significant because cogged v-belt upgrades are typically treated as a custom measure; thus, the customer must bear the costs of educating themselves on the measure, inventorying their belt stock, correctly quantifying energy and cost savings, and filling out the appropriate paperwork. Even at the point of submitting the form, there is higher risk with any custom project because the customer does not know if the program administrator will accept the technology as an eligible technology. It is thus possible that the associated cost and risk of participating in a custom program outweighs the perceived savings benefit, creating a serious barrier to program participation. On the other hand, from a utility standpoint, v-belt upgrades are not readily acceptable prescriptive measures due to the variety of variables that may influence a given motor's energy consumption.

Another interesting feature of v-belts is that most types show strong sales seasonality. For example, v-belts associated with commercial heating, ventilation, and air conditioning (HVAC) applications are often located in large roof-top units. Early distributor feedback indicated spring and fall as ideal seasons for performing maintenance on these units, as winter and summer present challenges to installers on roofs. Also, most installers prefer to not store large quantities of v-belts longer than one year. For these reasons, spring and fall v-belt sales are consistently high, while winter and summer sales are lower. Figure 1 below shows aggregated cogged v-belt sales from several participating distributor branch locations throughout 2014.

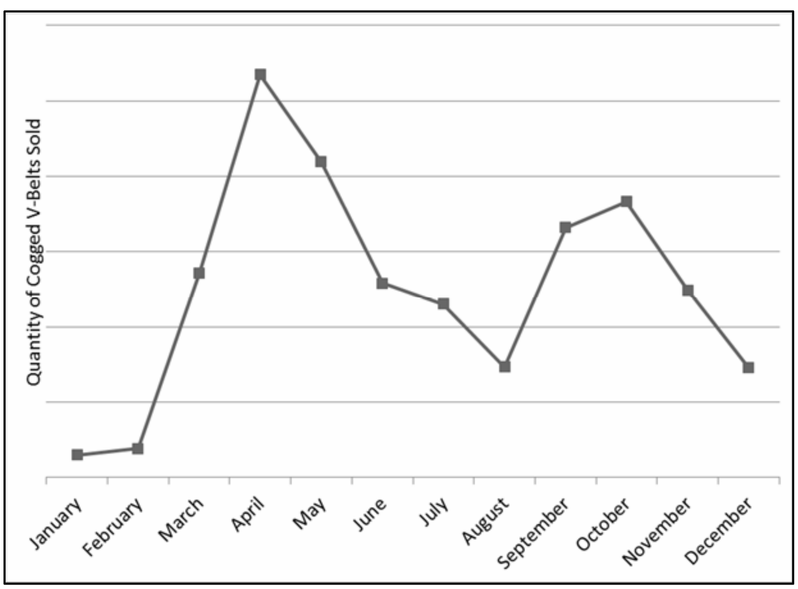

Figure 1. Seasonality of v-belt sales (2014).

[1] 10 hp x 0.746 kW/hp x 75% loaded / 90% efficient x 8,760 hours/year x 50% duty x 3% savings x $0.10 /kWh **= $82 /year**

For all of these reasons, cogged v-belts were deemed an appropriate technology to incentivize at the midstream level. By targeting distributors and suppliers of commercial equipment, several barriers are overcome. First, considerably fewer businesses require education. Second, the distributors are easily leveraged to educate a variety of industrial and commercial customers. Third, the utility endorsement of cogged v-belts as an energy saving technology substantially reduces risk for consumers because the utility endorsement implies that it is a legitimate technology. Fourth, the distributor handles a considerable amount of the interaction with the program administrator at scale, dramatically reducing overall administrative costs of the program and customer time involvement. Finally, deemed power savings for cogged v-belts constructed by *Go* (Sever et al. 2015) and a resource provided by Emerson Climate Technologies linking belt types with common motor sizes were developed to aid in the estimation of energy savings in the hope of avoiding the need to collect cumbersome motor information from the v-belt customer.

Program Design

Several design features made this pilot unique. In order to keep the pilot focused solely on market transformation and affecting the changes in distributor stocking practices necessary for long-term shifts in market share, incentives were made available only for cogged v-belts sold above a predetermined monthly sales baseline. As is common in midstream programs, incentives were paid directly to distributors, rather than v-belt purchasers. Also, distributors were required to collect detailed information on each cogged v-belt sale that would aid in the post-pilot evaluation of utility attribution and energy savings. The total intended pilot period was six months. All major incentive design and data requirement features are illustrated in Figure 2.

The implications of the “above-baseline” design are that distributors can only achieve incentive payments of any amount by increasing sales of cogged v-belts above their typical sales volumes or by shifting regular sales of smooth v-belts to cogged v-belts though innovative sales pitches, customer training, or other methods. The hope was that this strategy would help limit free-ridership, encourage distributors to independently find creative solutions to boost or shift v-belt sales, and provide useful insight into what resources distributors need to make such solutions possible.

An obvious drawback to this structure is the challenge of motivating distributors to participate when incentives are only available after they achieve a sales volume considered typical for them. For example, distributors who fail to increase cogged v-belt sales above their historical baseline may become discouraged and cease participation. This could be even more likely to occur given how distributors had to collect and report detailed data on each cogged v-belt sale, regardless of whether a particular sale was below or above their historical baseline. It was feared that distributors not achieving meaningful incentives could become frustrated and cease data collection; for this reason, additional incentives, called stipends, were made available.

The first was a data reporting stipend, intended to compensate distributors’ sales staff for the time and effort required to collect additional information on each cogged v-belt sale. Early distributor feedback indicated that this would not only encourage them to continue participating despite a month or two of failing to sell past their baseline, but also allow them to motivate their sales staff with some kind of participation-based reward system or contest during or at the end of the pilot period.

The second was a training stipend, intended to support in-house training of the distributor's customers. This stipend was added based on distributor feedback that suggested in-house training was an important tool in converting mechanical contractors from smooth to cogged v-belts, as it presented an opportunity to not only educate on cogged v-belt benefits and proper installation techniques, but also strategies for communicating these benefits in order to convert contractors' customers. Specifically, in-house training reportedly helped convert high-volume customers, who represent a significant portion of total v-belt sales for a given distributor branch location. Also, while it is possible to achieve energy savings under a simple swap-out scenario involving smooth and cogged v-belts, additional energy savings and efficiency can be gained through proper belt installation, belt tension, and sheave maintenance - all of which can be taught easily during a brief training session. If possible, third party verification of the pilot program will assist the team in capturing and quantifying these additional savings beyond the expected 3%. Thus, in-house training presents a unique opportunity for pilot partners to ensure estimated energy savings associated with increases in cogged v-belt sales are being met or exceeded.

Another strategy for preventing the historical baseline from discouraging distributors was to allow each company to choose their own baseline calculation methodology. Using sales data from each participating branch location from the previous year on both smooth and cogged v-belts, the pilot partners generated two possible baseline calculation scenarios. One was to create an average monthly sales volume of cogged v-belts from the latest twelve months and use that amount as an unchanging baseline for each month during the pilot period. The other technique was to match each monthly baseline during the pilot period with the sales volume of cogged v-belts from that month last year. Due to the seasonality of v-belt sales, each methodology has benefits and drawbacks. By giving each company the responsibility of establishing their own baselines, it was hoped that this would deepen their sense of investment and their understanding of the goal that must be reached. Interestingly, of the two companies participating as of the time of this writing, one company has chosen the former method, and one is considering the latter.

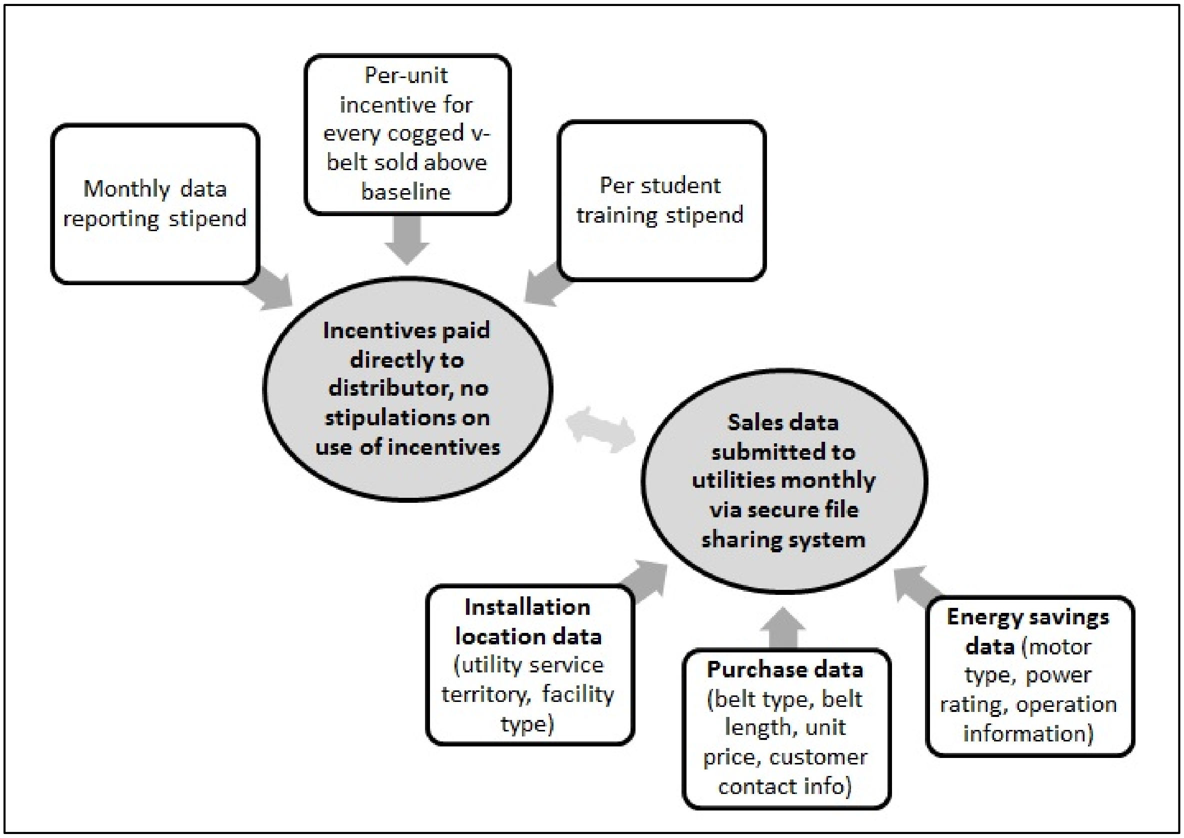

Figure 2. Incentive design and data reporting requirements

Useful lessons were applied to early program design from the Commercial Lighting Market Shift (CLMS) program operating in the Pacific Northwest in partnership with Argonne, Bonneville Power Administration, the Northwest Energy Efficiency Alliance, and D&R International. A distinguishing feature of both the CLMS and CMIP pilots was the intent to pay incentive awards and stipends directly to distributors and give them full discretion in the use of earned funds. Early distributor feedback indicated a likely scenario was to distribute incentives to their sales force via sales bonuses or contests as rewards for successful sales and marketing approaches. This approach, however, was perceived differently by each distributor. For example, one distributor did not believe it was possible to convert customers to more expensive cogged v-belts without some sort of standard rebate that covered a portion of the cost differential. This company elected to offer a portion of their per-belt incentive to their customers. As only cogged v-belt sales above a historical baseline were eligible for incentives, this approach was not recommended by the pilot partners, but permitted.

Another major lesson learned from the CLMS was to seek early feedback from prospective distributors and manufacturers on proposed incentive design and data requirements and allow the program to take shape around this feedback. This proved invaluable for the CMIP in that gaining an understanding of common v-belt sales practices allowed pilot partners to determine optimal approaches to incentive levels, data collection, data privacy needs, and communication strategies. Also, early sales data contributions from a participating distributor, Allied Supply Co., enabled the pilot partners to estimate potential pilot budgets.

Taking the “keep it simple” lesson and mandate from the CLMS pilot, the incentives were designed to be simple to explain and understand. Creating a simple data collection process proved difficult, but every effort was made to streamline data reporting requirements while still collecting as much data for evaluation as possible. One particular challenge was in developing a system for utility attribution without burdening the customer. Because the typical v-belt customer does not represent the installation facility, but rather the installation contractor, it was important to understand upfront the extent of an average customer's knowledge and design a simple data collection system around those parameters. Because of unique challenges such as these, the CMIP pilot needed significantly more pre-launch planning time than the CLMS pilot. The hope is that lessons learned from the added effort will be useful to future pilot planners looking to launch midstream incentive programs on new or relatively untested products. The general progression of major steps in this partnership from inception to pilot launch is illustrated in Figure 3.

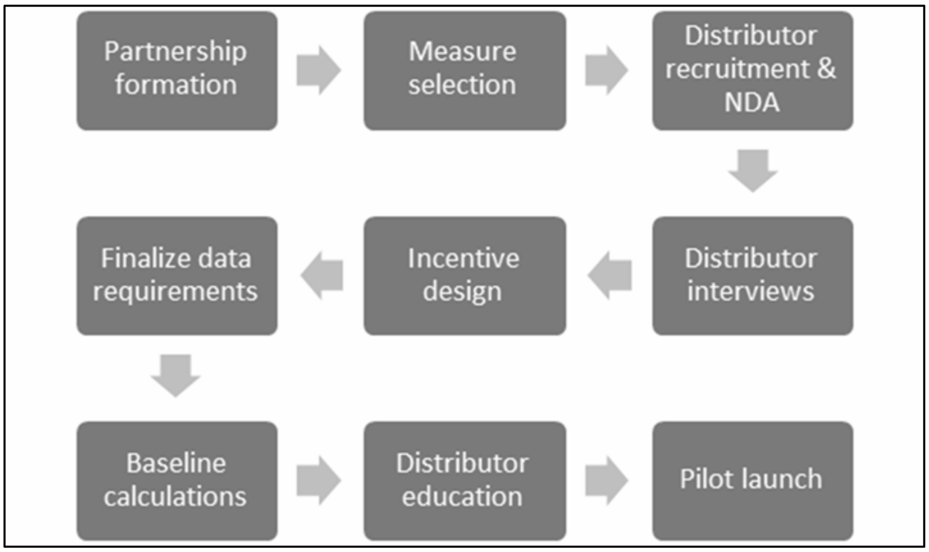

Figure 3. CMIP process chart from partnership formation to pilot launch.

The final stage of program design was to convey all finalized pilot details and provide an opportunity for feedback. This was handled through individual distributor presentations given by webinar. Each presentation included an overview of incentives and data requirements and plenty of time for questions and discussion. All members of the sales staff of each company were invited to attend, and identical webinars were offered at two different times during the same day to accommodate everyone's schedule.

Early Challenges

Program Participation

Securing distributor participation was a primary challenge throughout program design. Identifying the correct representative at a particular company and communicating a fairly complex pilot model proved difficult. This may have been partly due to the fact that the unique incentive structure was a challenge to communicate. Potential participants were unfamiliar with not only midstream models but also the concept of focusing incentives only on product sales above a historical baseline. Initially, only one distributor was willing to participate and obtain the necessary data from customers.

Outreach was performed through several mediums, including the Ohio Manufacturer's Association. Success was realized by working with a major v-belt manufacturer, Emerson Climate Technologies. A representative from this manufacturer of Browning® belts was able to use strong existing relationships with sales managers and other key personnel at likely distribution companies to more effectively communicate program goals and, with the help of AEP Ohio and DP&L reaching out through their existing business networks, secure participation from additional companies.

Partnership Management and Consensus

Achieving consensus among pilot partners and distributors on the pilot's incentive structure presented another challenge. Distributor feedback was solicited early on, but given the pilot's unique structure, feedback was generally inconclusive in terms of incentive amounts that would stimulate results. Because it was difficult for both distributors and pilot administrators to estimate how much a particular branch location would be able to increase sales above their historical baseline, it was difficult to estimate potentially valuable incentive amounts.

There are many rewarding aspects of collaboration, but there's no denying the collaborative effort is cumbersome. With five distinct entities participating in the pilot, all with aligned but unique agendas, the consensus process has required patience and fairly rigid coordination. For example, at the time of this writing, there were eighteen participants on a weekly conference call distribution list. All team members were solicitous of buy-in, which while inclusive, was not always efficient.

To mitigate these effects, MEEA and Argonne took lead roles in daily coordination of conference calls, routine tasks, and deliverables. While remote collaboration is the only feasible way to conduct a multi-stakeholder project such as this, it does make communication and comprehension more challenging. One potential solution to this may be to have periodic face-to-face meetings. In retrospect, it would have been reasonable and helpful to schedule workshop-type in-person meetings on a bi-monthly or quarterly basis.

Budget Development

Although most program design processes typically begin with a budget, piloting an entirely new concept presented barriers to cost prediction. The budget parameters for this pilot were not discussed at all in the early months of planning beyond an agreement that the utilities would be responsible for funding the incentives. Baseline sales data and sales forecasts were the primary inputs when constructing an incentive budget for this program, but these only became available once distributor participation was confirmed. The incentive development process ultimately took several months to finalize, and open, frequent communication between all partners, especially funding partners, was of particular importance during this stage.

Evaluation and Data Needs

The data collection needs of the pilot are relatively extensive. These needs include sufficient and reliable data to determine historical v-belt baseline levels, monthly cogged v-belt sales growth above baseline during the pilot, monthly incentive payments (if any), attribution of each cogged v-belt sale to utility partners' service areas, and estimated energy savings associated with each cogged v-belt sale. These data needs represent significantly more information than what would typically be on a standard point-of-sale purchase order; thus, program partners worked closely with distributor and manufacturer representatives to understand which data types could be collected easily, and which types would be more difficult to obtain. A particular data type may be difficult to obtain due to either a customer's lack of knowledge (they are not the product end user, but the installer) or their unwillingness to share information they consider confidential.

The data reporting stipend was developed out of these discussions as a way to give sales managers additional leverage to motivate their sales staff to collect the extra data. Ultimately, the data reporting form contained data types which were deemed both easy and difficult to collect, given that a desired pilot outcome is to guide future utility v-belt incentive programs in understanding which types of data can be reasonably expected.

It was also evident early on that, from an evaluation perspective, flexibility would be critical. Available research showing expected energy savings was conducted largely in controlled laboratory settings with proper belt placement and tension, sheave quality, and controlled ambient temperatures. The hope was that the training stipend would increase the likelihood of belts being installed close to these parameters. Regardless, in order to give distributors as much certainty as possible, it was decided that incentives would be paid on all cogged v-belt sales above historical baselines irrespective of utility attribution, training, or other considerations.

Legal and Privacy Challenges

Legal requirements presented utility-specific hurdles. For example, required legal documentation, including letters of support, non-disclosure agreements, and a contract for the utilities' evaluation requirements, slowed progress. In each of these steps, each party had its own paperwork and processes. Also, one of the participating distributors required a protracted discussion in order to sign a non-disclosure agreement. Most privacy issues were mitigated by implementing a secure, online file sharing system through which pilot partners and distributors could transmit and view confidential sales data and other information.

Expected Future Challenges

Going forward, several challenges are anticipated. The utilities must administer incentive payments to the distributors and determine attribution of savings, but without the opportunity to see an invoice before launch or fully understand how payments for different pilot aspects such as incentives or data reporting stipends will work, it is difficult for the utilities to anticipate associated coordination challenges. The incentive structure in its current design could result in numerous invoices and payments and thus could be administratively cumbersome and by extension, costly.

Also, it will be important for the utilities to create relationships with each distributor. Thus far this has been managed by MEEA and Argonne as part of an effort to not overwhelm potential distributor partners by requesting their participation in multiple planning meetings. Regardless, this is a stark deviation from other AEP Ohio and DP&L business programs, in which they are either dealing directly with their customers or with a network of channel partners. Transitioning these relationships from MEEA and Argonne to the respective utilities will not only allow them to build positive connections with commercial customers, but will also lend legitimacy to the pilot from the distributor perspective. Furthermore, these relationships will be critical if the concept is expanded out of pilot phase. Feedback from one distributor indicated a willingness to work with their utility and develop an ongoing relationship through their participation in the pilot.

Building strong relationships between distributors, utilities and pilot partners will greatly enhance the evaluation stage of the CMIP pilot. Feedback from distributors on lessons learned and best practices on effective sales approaches and incentive outcomes will be used to guide potential expansion beyond the pilot or future midstream-targeted incentive programs. Analysis of v-belt sales during the pilot will contribute towards an understanding of market conditions and drivers to guide future incentive programs promoting growth in cogged v-belt sales.

Summary

The Commercial Midstream Incentive Project (CMIP) began as a concept to convert the program type for cogged v-belts, a well-known and often recommended energy-efficiency measure, to a more streamlined utility incentive program. The main goal of the CMIP is to not only show the feasibility of a novel program design and convert a new measure into a fully functioning program for the involved utilities, but also to serve as a pilot template for utilities throughout the Midwest. The implementation of this straightforward concept was anything but simple even with a group of committed entities including two electric utilities, a regional energy efficiency organization, a national lab, and a state manufacturing trade association. The CMIP team faced a variety of unexpected challenges, including distributor recruitment, ensuring reliable energy savings estimates, communicating a complex pilot model, facilitating data collection through the distributor, and developing an incentive structure that would keep the distributors invested in the program. The pilot is still ongoing and the authors aim to discuss the results of the pilot in a future paper.

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References

Almedia and Greenberg, 1995, "Technology Assessment: energy-efficient belt transmissions", *Energy and Buildings*, 22: Pg 245-253.

Sever, F. A.Q.Mohammed, S.Ritchey, and J.Seryak. 2015, Deemed Power Savings of Cogged v-belts versus Smooth v-Belts, White Paper - Go Sustainable Energy.

IAC - Database. Top ten recommendations since 2005. Accessed at http://iac.rutgers.edu/database

U.S. Environmental Protection Agency (EPA). 2014. How to Use Midstream Incentives to Promote ENERGY STAR® Certified Consumer Electronics. Accessed at www.energystar.gov/ia/partners/downloads/CE_Guide.pdf