Nicor Gas | Energy Efficiency Program

Emerging Technology Program

#1147: Residential Smart Dryer Sensor

FINAL PUBLIC Pilot Assessment Report

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Executive Summary

Introduction

As a part of the Nicor Gas Energy Efficiency Program, the Emerging Technology Program (ETP) assesses new technologies that have the potential to realize natural gas savings for the 2.3 million Nicor Gas customers in northern Illinois. GTI Energy provides program implementation for the Nicor Gas ETP. GTI Energy conducted a field pilot to test the operation of a residential Internet of Things (IoT) or “smart” clothes dryer sensor, that detects the dryness levels inside a gas-fired dryer and automatically stops the load before excess energy is used on clothes that are already dry. This report summarizes the findings from the pilot study and highlights the potential for this technology to provide energy efficiency savings to Nicor Gas residential customers.

Background

Residential clothes dryers have not changed significantly in their operation for decades. They typically offer either a time-dry setting (which uses a set timer) or an auto-dry setting (which uses a built-in moisture sensor to determine when the clothes are dry). Most of these built-in manufacturer moisture sensors do not work well and users tend to predominantly use the time-dry setting. A residential sensor is an add-on device, which turns any dryer into a smart dryer. The device consists of two physical components integrated to a software application:

1. IoT sensor (Figure 1, left), which is magnetically attached inside a dryer drum centrally near the baffle.
2. Hub (Figure 1, right) with a built-in auto shut-off plug into which the dryer outlet is plugged in.
3. A third component of the residential smart dryer sensor is a smartphone application (Figure 2), which provides notifications to the user. The smartphone app is configured and linked to the hub and the IoT sensor by connecting to the 2.4Ghz band of the user’s Wi-Fi.

The IoT sensor monitors the temperature, humidity, and motion inside the dryer drum to determine when a load is dry. The dryness levels can be user-defined based on selectable options in the smartphone application such as Less Dry, Dry, and More Dry. After the device determines that a load is dry, a smartphone notification is sent out to the user informing them that the clothes are dry. Within seconds of this notification, the auto shut-off smart plug in the hub automatically cuts power to the gas dryer (120V outlet), turning it off.

Figure 1. (Left) Sensor Magnetically Attached inside Dryer Drum; (Right) Hub with Auto Shut-off plugged into Dryer Outlet

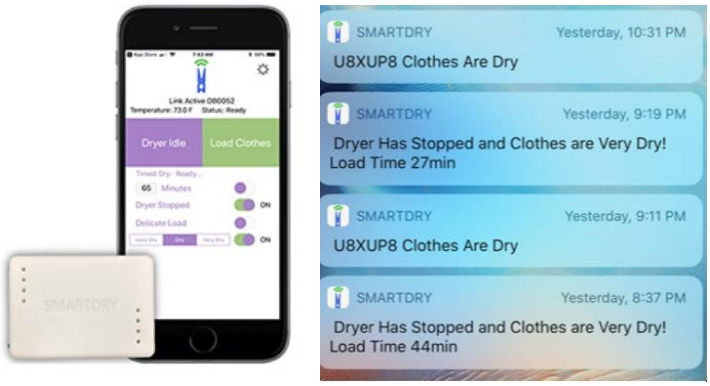

Figure 2. (Left) Smartphone App Settings; (Right) Smartphone Notifications when Clothes are Determined to Be Dry

Potential Savings

Potential energy savings from a residential smart dryer sensor are twofold:

1. Natural gas savings from eliminating excess burner runtime by turning off the burner as soon as the smart dryer sensor detects the clothes are dry.
2. Electric savings from eliminating excess motor runtime by turning off the drum motor in the dryer as soon as the smart dryer sensor detects the clothes are dry.

Field Demonstration

This Nicor Gas ETP pilot field study targeted 25 sites with natural gas-fired dryers to characterize the operation of a residential smart dryer sensor. The objective of the study was to evaluate the potential energy savings of the device in the field across various dryer types, vintages, and number of loads per week. GTI Energy worked with the manufacturer to distribute the devices to homeowners directly. All users successfully self-installed the sensors inside their dryers and linked the hub with their smartphone apps using instructions provided in the packaging.

The selected field sites were all single-family homes with dedicated clothes dryers. At the time that this pilot study was conducted, the functionality of the sensor was not suited for dryers with coin operated mechanical timers in laundromat facilities or commercial clothes dryers.

Results

The Nicor Gas ETP team completed field monitoring for the study with two months of baseline data collection and three months of data collection when the auto shut-off mode was activated. During the baseline phase, the homeowner was asked not to interfere with normal dryer operation. For the auto shut-off phase, the homeowner activated the smart dryer sensor to turn off the dryer automatically. Note that over the course of the demonstration, 5 pilot sites dropped out. Thus, the energy savings results for the auto shut-off phase presented in this report consider data gathered from 20 field sites instead of the full 25.

The measured gas savings (Figure 3) from the auto shut-off feature ranged from 5% to 51% of natural gas used by the dryer across all field sites. The electric savings (Figure 4) ranged from 8% to 66% of electricity used by the drum motor across all monitored dryers. The wide variation in the realized savings range can be attributed to the multiple types of dryers models, vintages, load types, and usage characteristics of the homeowners.

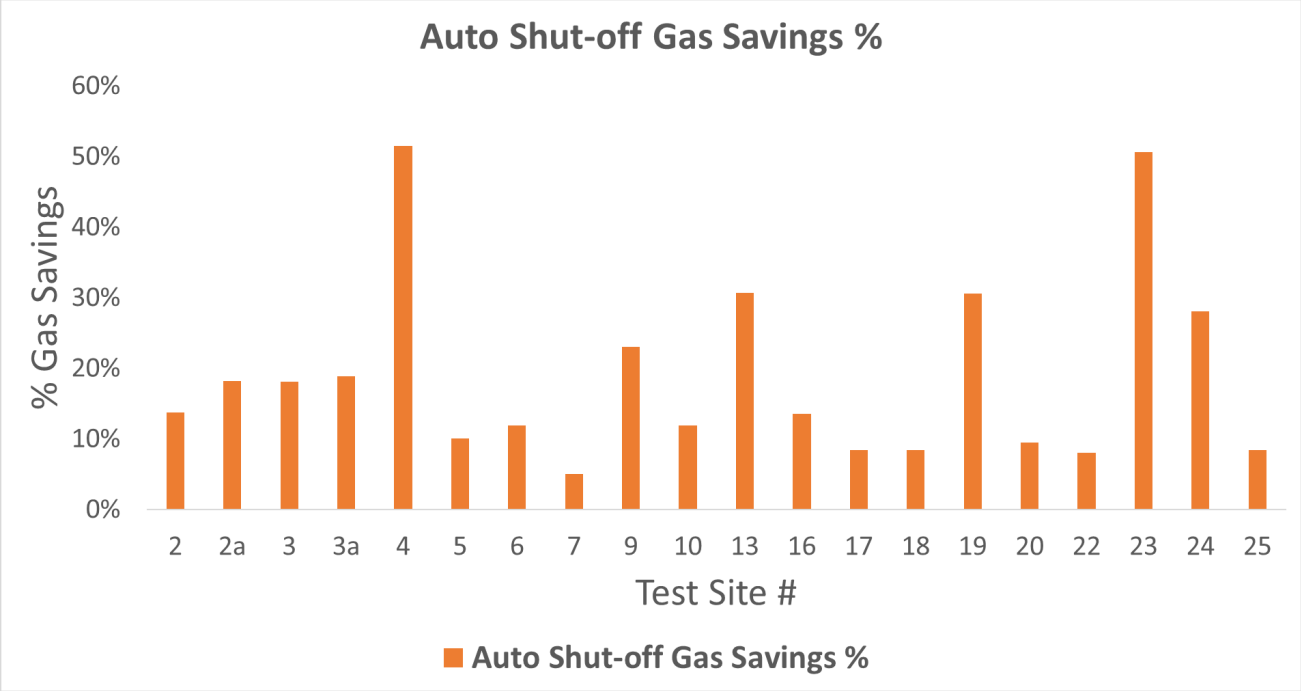

Figure 3. Natural Gas Savings % from the Auto Shut-off Feature

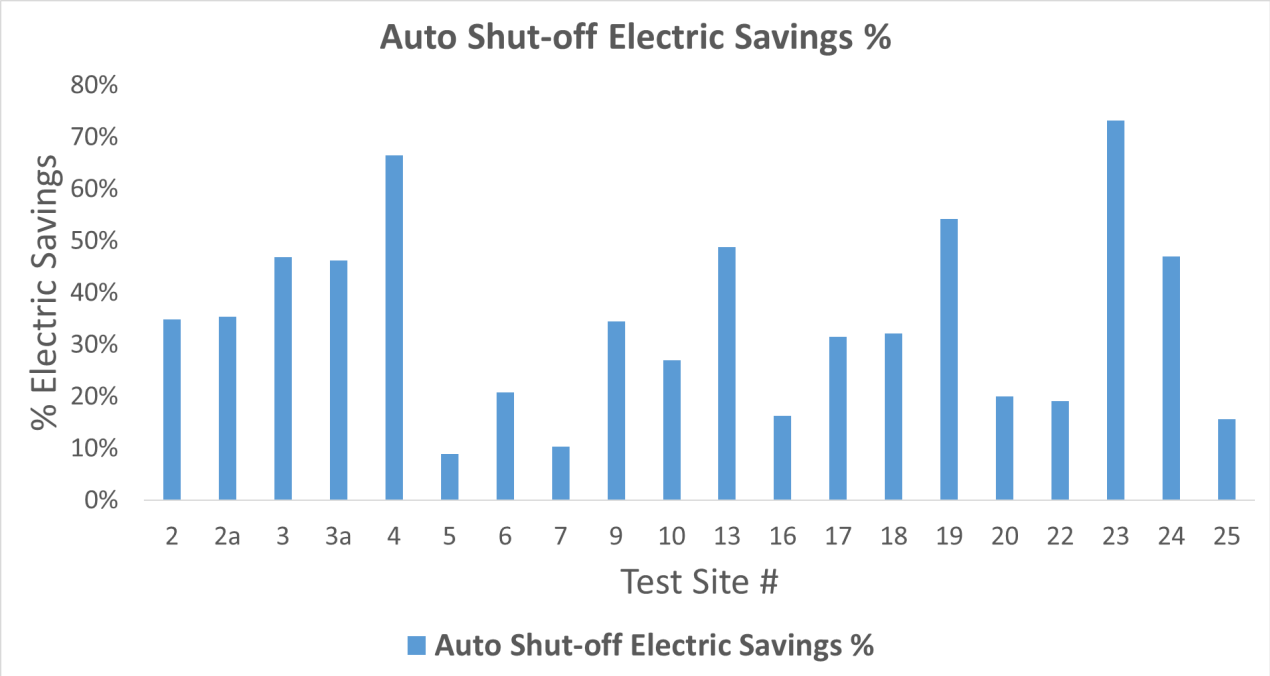

Figure 4. Electric Savings % from the Auto Shut-off Feature

Table 1 lists the projected energy savings from a residential smart dryer sensor derived from averaged normalized energy savings from all monitored field sites. The gas and electric savings were normalized based on the excess runtime savings per load for the gas burner and the drum motor respectively. These savings are illustrated in Figure 5 for gas and Figure 6 for electricity.

Table 1. Project Energy Savings for a Residential Gas-fired Dryer

Dryer Loads	Projected Annual Gas Savings (therms)	Projected Annual Electric Savings (kWh)
100	1.8	9.8
150	2.7	14.6
200	3.6	19.5
250	4.5	24.4
300	5.4	29.3
350	6.3	34.1
400	7.2	39.0
450	8.1	43.9
500	9.0	48.8

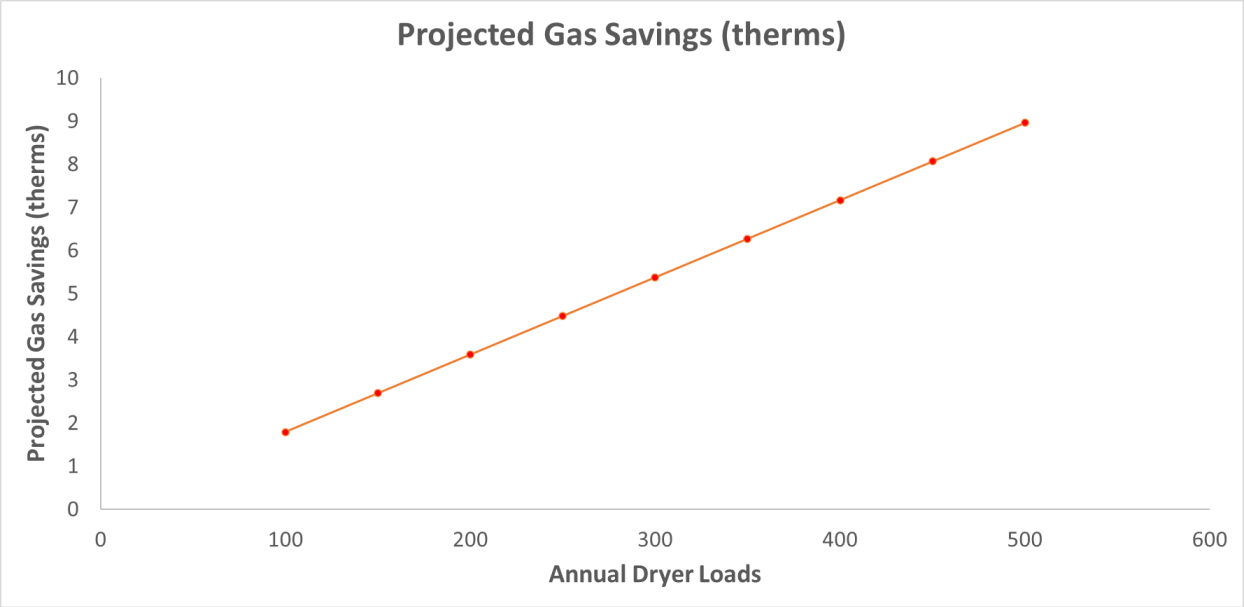

Figure 5. Projected Gas Savings vs Dryer Loads

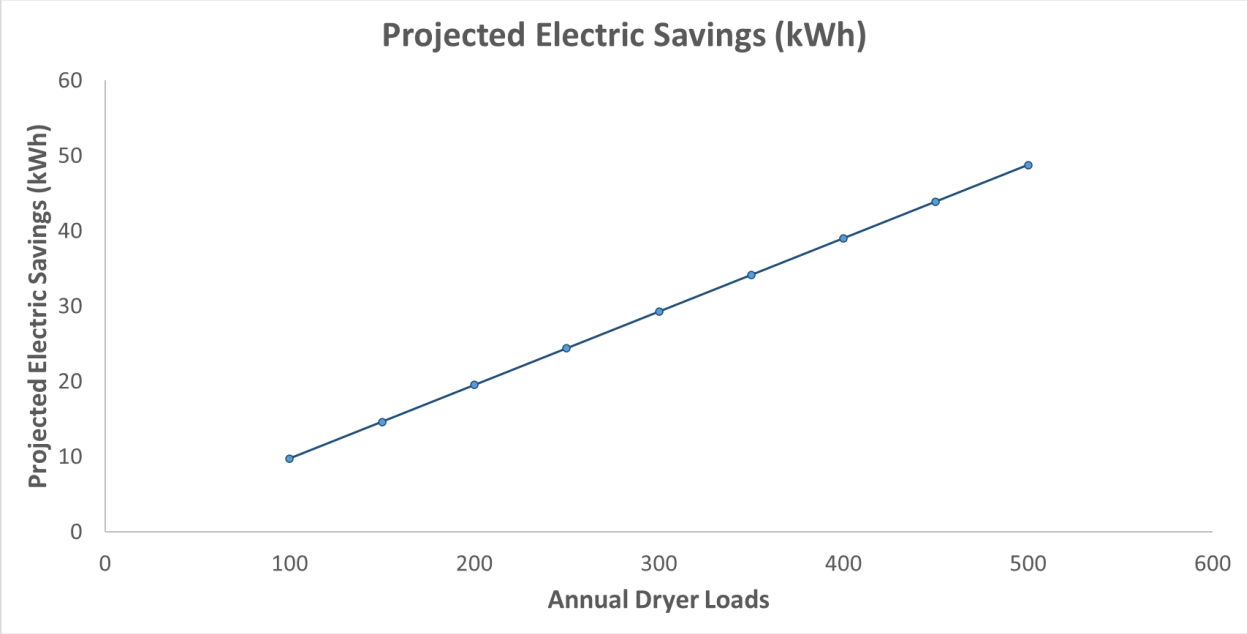

Figure 6. Projected Electric Savings vs Dryer Loads

Implications for the Nicor Gas Energy Efficiency Program

This technology is a cost-effective way to introduce smart technology retrofits into old dryers. The normalized cost of the smart dryer sensor based on the pilot demonstration was $60 per device. Because there is no labor cost (it is an easy self-install for a homeowner), this is an excellent fit for an energy-saving kit type application. A utility-led energy efficiency program can potentially realize significant energy savings through such an application.

Nicor Gas ETP successfully submitted a technical workpaper based on the pilot results to incorporate this technology into the Illinois Technical Resource Manual (TRM) as a prescriptive measure. The measure targets the retrofit market for residential gas-fired dryers. The ETP team would like to note that the tested product was discontinued by the manufacturer in September 2022 and is no longer available for purchase in the market.