Looking At Laundry: Heat Pump and Hybrid Clothes Dryers Enter the U.S. Market

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Presentation Overview

Why Dryers?
- Technology Overview
- Market Status

Building a Case for Savings
- Baseline Conditions
- Savings Assumptions

Where We’re Going
- Super Efficient Dryer Initiative
- Updating Test Procedures and Standards
WHY SHOULD WE CARE ABOUT DRYERS?
Old Fashioned Technology

Electric Dryer Operation

- Motor and controls operate on 120 v.
- Resistance coils operate on 240 v.
- Coil(s) are cycled on/off depending on the temperature settings and sensors. Some dryers have two separately controlled coils.
- One motor drives the fan and the tumbler. The fan draws air across the heating coils and forces it through the tumbler drum.
- Older dryers with electro-mechanical controls have no standby energy usage.
Dryer Technology Advancements

- Improved sensors & auto-termination controls
- Hybrid and full heat pump electric clothes dryers
- Ultrasonic dryers (TBD 2017)
Market Status

1930s
- Electric dryers first introduced in the US

Q4 2014
- LG and Whirlpool awarded the ENERGY STAR 2014 Emerging Technology Award (ETA) after introducing hybrid heat pump dryers to US market
- 68 efficiency program providers offered incentives for ENERGY STAR dryers
- 7 efficiency program providers offered incentives for 2014 ETA dryers

Early 2015
- Arcelik / Blomberg introduced a third ETA dryer - compact, full heat pump model

January 2016
- 80 ENERGY STAR electric dryers (US Market)
- 27 ENERGY STAR gas dryers (US Market)
- 10 ENERGY STAR Heat Pump Models (Beko, Blomberg, Whirlpool, Kenmore & LG)

2017
- Anticipated market introduction of new ultrasonic dryer technology (GE and ORNL)
BUILDING A CASE FOR SAVINGS
Baseline Conditions: NEEA & NEEP EM&V Forum Study Key Findings

<table>
<thead>
<tr>
<th>Key Finding or Factor</th>
<th>NEEA Study</th>
<th>NEEP Study</th>
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<tbody>
<tr>
<td>Average annual energy usage (kWh) per single family household of 2.8</td>
<td>915</td>
<td>993</td>
</tr>
<tr>
<td>Average # of dryer loads per year</td>
<td>311</td>
<td>439</td>
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<tr>
<td>Average annual dryer runtime (hours)</td>
<td>307</td>
<td>351</td>
</tr>
<tr>
<td>Average drying time per load (minutes)</td>
<td>56</td>
<td>48</td>
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<tr>
<td>Reported percentage of washer loads dried in dryer (opposed to hang dry)</td>
<td>93.5%</td>
<td>79%</td>
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<tr>
<td>Increase in drying time for heavy fabrics</td>
<td>13%</td>
<td>NA</td>
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<tr>
<td>Percentage of medium &amp; high temperature settings selection</td>
<td>50/50%</td>
<td>NA</td>
</tr>
<tr>
<td>Cycle time variation for medium &amp; high temperature settings selection</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Average annual standby energy usage (kWh)</td>
<td>1.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Energy savings associated with auto-termination vs. timed drying</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Energy penalty associated with make-up air (kWh - electric resistance heat)</td>
<td>NA</td>
<td>120</td>
</tr>
<tr>
<td>Percentage of horizontal axis (front load) washers in study</td>
<td>23%</td>
<td>62%</td>
</tr>
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1 NEEA study actual average household size was 2.8 – NEEP study normalized to 2.8 (note: only annual energy usage is normalized for household size)
2 Extrapolated from partial year metered data
3 Difficult to differentiate distinct loads from "touch-up" loads
4 Limited metered data demonstrates some increased drying time during winter months
Load Shapes Vary By Region / Season

[Graphs and charts illustrating load shapes varying by region and season.]
Annual Energy Usage: 
Comparison To Other Jurisdictions

NEEP Baseline Study: 993 kWh

- NEEA (2014): 915 kWh
- DOE EIA’s Residential Energy Consumption Survey (2001): 1,079 kWh
- Southern California Edison (1991): 1,070 kWh
- BPA / ELCAP (1986): Existing homes 918 kWh and new homes 987 kWh
- Progress Energy Florida (1999): 885 kWh
- Multi-Housing Laundry Association (2002): 993 kWh
How Dryers Stack Up

Conclusions From NEEP Study

- Average annual energy usage for monitored sites: 1,060 kWh
- Average annual energy usage, normalized for avg. household size of 2.8: 993 kWh ± 129*
- Daily load shape is relatively flat between 11am and 10pm
- Highest average demand occurs on weekends
- Seasonal variations: colder months require more energy
- Dryer runtime average: 48 minutes
- Average number of loads: 439**
- Make-up air energy consumption varies: estimated to be: 120kWh; 2.3 gals fuel oil; 3.2 therms NG, or approximately 12% of dryer energy usage

* Applying a standard 90% confidence interval analysis results in ± 13%, although this statistical analysis is not fully appropriate for the sample and for extrapolated data
** Estimated from metered data – difficult to differentiate distinct individual loads from “touch-up” loads
How Do We Measure Savings?

Three approaches in the absence of field performance data on high performance dryers

- Gather data in lab tests
- Use ENERGY STAR calculations
- Gather baseline information

Future field data will improve savings estimation

- NEEA Field Evaluation Report (Q1 2016) includes an evaluation of Whirlpool and Blomberg dryers
ENERGY STAR Approach

- ENERGY STAR uses a baseline CEF based on D2 test procedure tests for small sample of standard dryers
- CEF = test load size (8.45 lbs) / Machine electric energy use during standby and operational cycles
- Loads/year = average loads from RECS (2009)

\[
\text{Annual kWh savings} = \left[ \frac{1}{CEF_{\text{standard}}} - \frac{1}{CEF_{\text{efficient}}} \right] \times \text{lb/load} \times \text{Loads/year}
\]

ENERGY STAR Calculator

Approach Using Baseline Data

Using baseline field evaluation data and 20% savings (3.93 CEF for ENERGY STAR dryers)

\[ \text{Annual kWh savings} = \text{baseline annual kWh} - \text{baseline annual kWh} \times 0.8 = 199 \text{ kWh} \]

Using baseline field evaluation data and 30% savings (4.5 CEF for hybrid heat pumps)

\[ \text{Annual kWh savings} = \text{baseline annual kWh} - \text{baseline annual kWh} \times 0.7 = 298 \text{ kWh} \]

Full heat pump dryers have CEF = 5.7 for compact load (3 lb.)
Full heat pump dryers have CEF = 10.4 for standard load

\textit{Savings increase with full heat pump models:} \sim 700 \text{ kWh}
WHERE WE’RE GOING
Future Test Procedures and Standards

DOE released an RFI regarding amendments to the 2015 clothes dryer standard in March 2015

- Adding a class for standard sized non-venting electric dryers
- Assessing several dryer technologies, including heat pump and microwave technology
- Considering requiring “full cycle testing” (D2 test procedure)

Potential plans for 2016/2017 advanced dryer specifications

- CEE clothes dryer specification
- 2017 ENERGY STAR Most Efficient criteria for clothes dryers
SEDIl in 2015/2016

Increase builder industry engagement and SEDI
Call to Action on Multifamily

Develop both retail and commercial sales with retailer and distributor/dealer sales channels

Address needs in new home industry for partnership
- Longer term commitment to rebates
- Streamlined point-of-sale rebates
- Budget & rebate levels need to be set to support early acceleration in market
CLOSING: ADD DRYERS TO YOUR PORTFOLIOS AND JOIN SEDI!
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