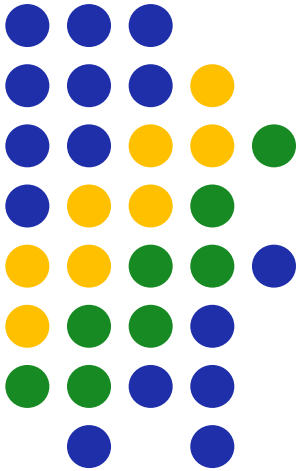
Looking At Laundry: Heat Pump and Hybrid Clothes Dryers Enter the U.S. Market

Elizabeth Titus, NEEP, Lexington, MA
Brian McCowan, ERS, Andover, MA
Rebecca Foster, VEIC, Burlington, VT

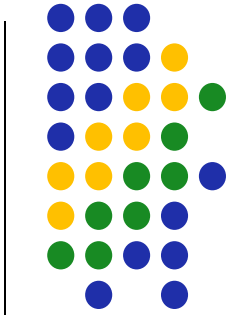


SEDI
SUPER EFFICIENT DRYER INITIATIVE

NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS
FACILITATING PARTNERSHIPS TO ADVANCE ENERGY EFFICIENCY

ers
energy & resource solutions

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

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WHY SHOULD WE CARE ABOUT DRYERS?

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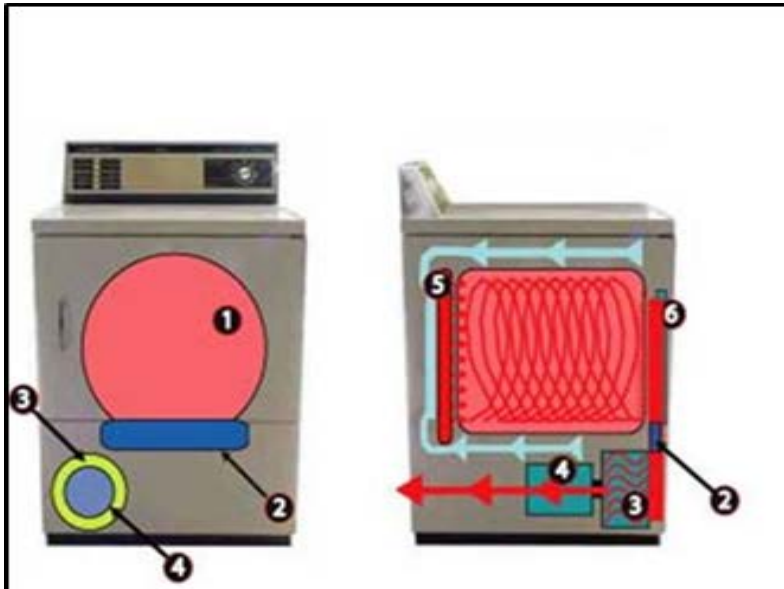
Old Fashioned Technology



1. Tumbler
2. Lint Screen
3. Fan
4. Motor
5. Heating Element
6. Door

Graphic How Stuff Works

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.

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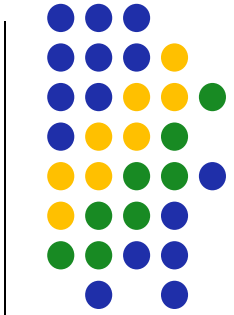
Dryer Technology Advancements



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

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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)

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BUILDING A CASE FOR SAVINGS

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Baseline Conditions: NEEA & NEEP EM&V Forum Study Key Findings

Key Finding or Factor	NEEA Study	NEEP Study
Average annual energy usage (kWh) per single family household of 2.8 [1]	915	993
Average # of dryer loads per year	311	439 [2, 3]
Average annual dryer runtime (hours)	307	351 [2]
Average drying time per load (minutes)	56	48 [3]
Reported percentage of washer loads dried in dryer (opposed to hang dry)	93.5%	79%
Increase in drying time for heavy fabrics	13%	NA [4]
Percentage of medium & high temperature settings selection	50/50%	NA
Cycle time variation for medium & high temperature settings selection	None	NA
Average annual standby energy usage (kWh)	1.5	1.1
Energy savings associated with auto-termination vs. timed drying	None	NA
Energy penalty associated with make-up air (kWh - electric resistance heat)	NA	120
Percentage of horizontal axis (front load)washers in study	23%	62%

[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

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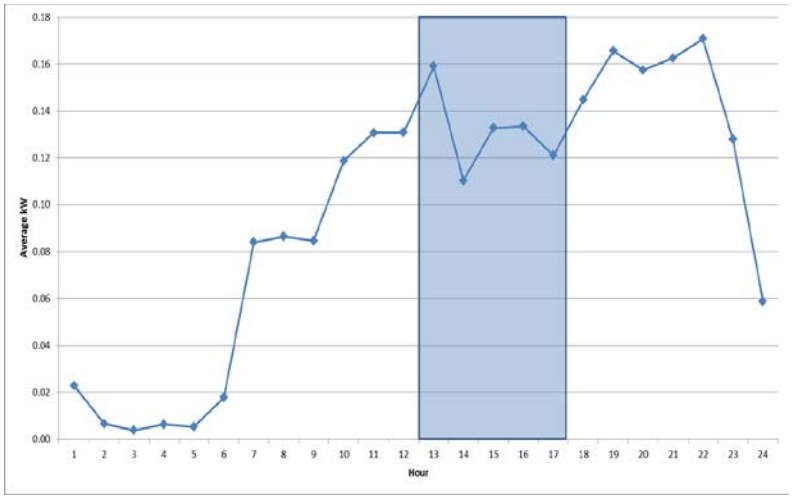
Load Shapes Vary By Region / Season



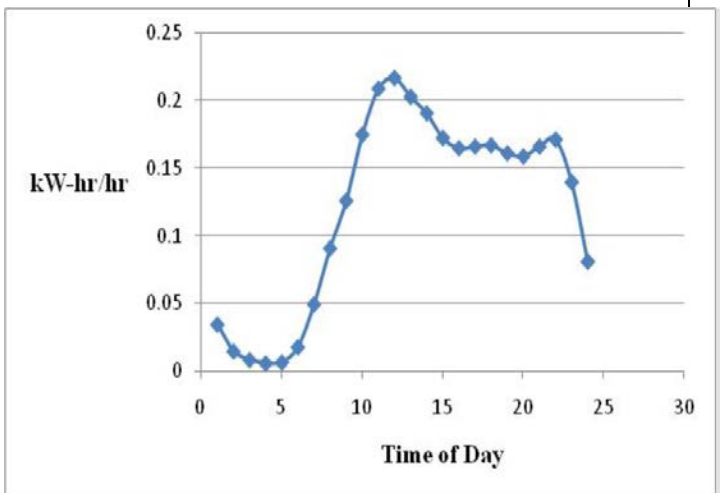
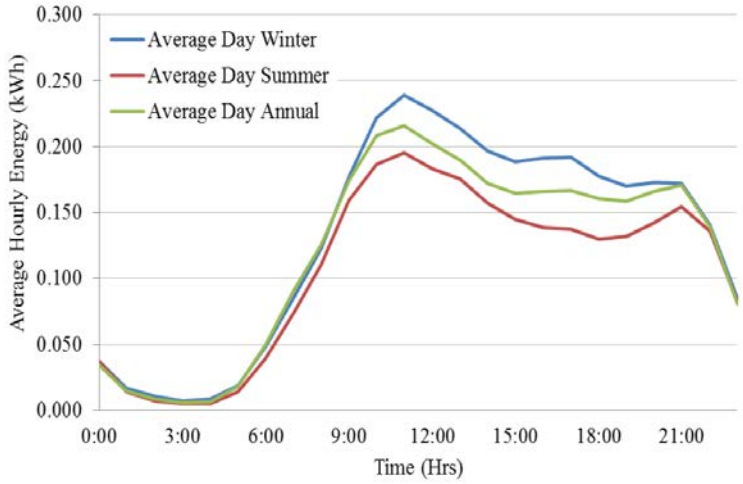
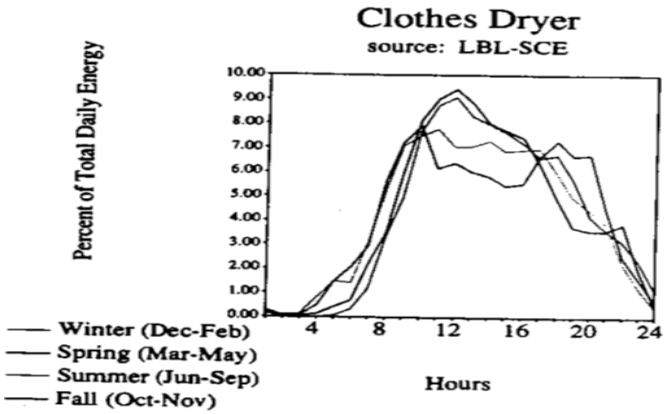


Figure 10. Daily Load Shape - Clothes Dryer
source: LBL-SCE





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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

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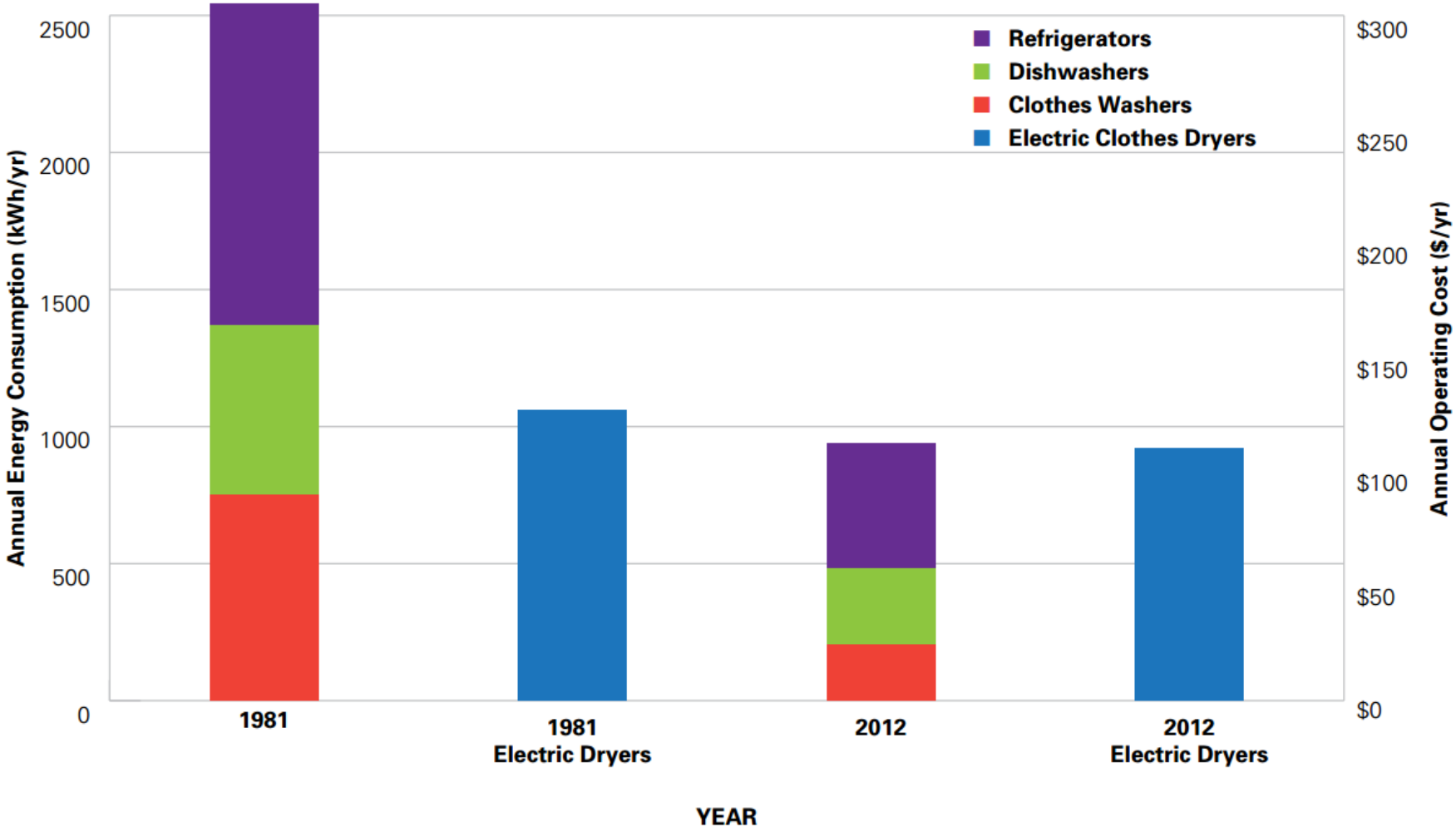
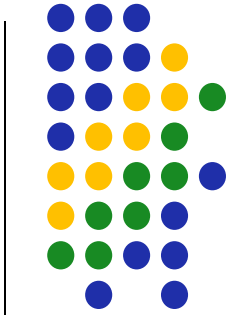
How Dryers Stack Up



Source: A Call to Action for More Efficient Clothes Dryers: U.S. Consumers Missing Out on $4 Billion in Annual Savings. http://www.nrdc.org/energy/files/efficient-clothes-dryers-IB.pdf

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

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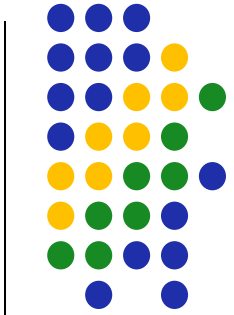
How Do We Measure Savings?



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

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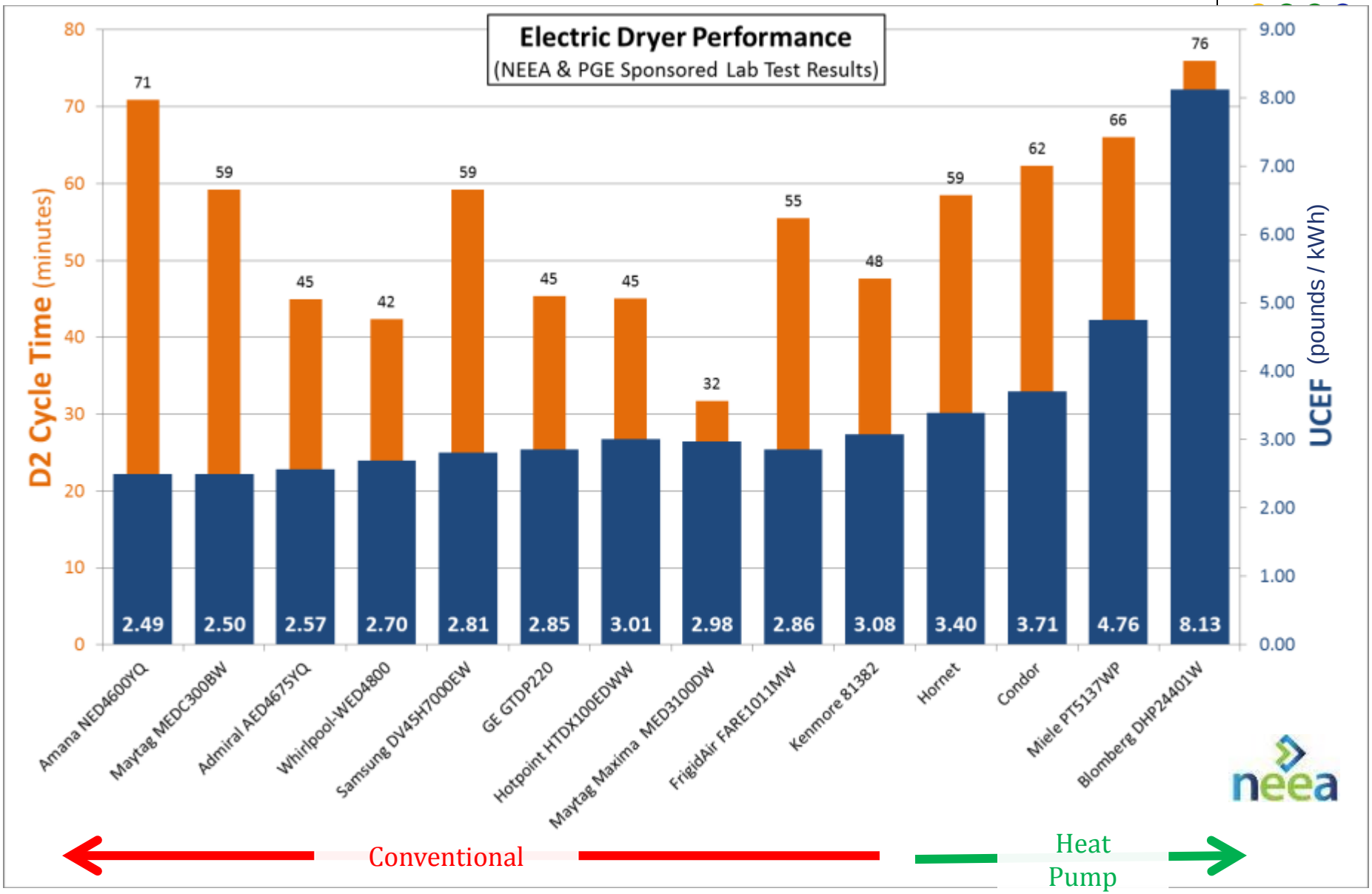
Lab Testing Approach



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)

$$Annual\ kWh\ savings = \left| \frac{1}{CEFstandard} - \frac{1}{CEFefficient} \right| x\ lb/load\ x\ \ Loads/year$$

ENERGY STAR Calculator

- http://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx

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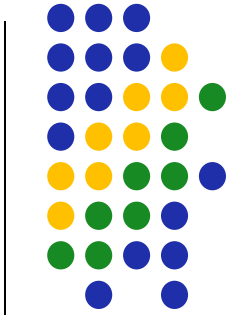
Approach Using Baseline Data



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

$$Annual\ kWh\ savings = baseline\ annual\ kWh - baseline\ annual\ kWh\ x\ 0.8 = 199\ kWh$$

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

$$Annual\ \ kWh\ savings = baseline\ annual\ kWh - baseline\ annual\ kWh\ x\ 0.7 = 298\ kWh$$

Full heat pump dryers have CEF = 5.7 for compact load (3 lb.)
Full heat pump dryers have CEF = 10.4 for standard load
Savings increase with full heat pump models: ~700 kWh

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WHERE WE'RE GOING

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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

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SEDI 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

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CLOSING: ADD DRYERS TO YOUR PORTFOLIOS AND JOIN SEDI!

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Contact Information

Elizabeth Titus
Senior Manager, Research and Evaluation
NEEP
781-860-9177 x111
etitus@neep.org

Brian McCowan
Senior VP of Technology and Development
ERS
978-521-2550,x301
bmccowan@ers-inc.com

Rebecca Foster
Director, Consulting
VEIC
802-540-7882
rfoster@veic.org

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