Super Efficient Clothes Dryers
Ready, Set . . . . Set . . . . Go?

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NORTHWEST ENERGY EFFICIENCY ALLIANCE

Outline

Background

Federal Standards and Test Procedures

NEEA Field Study

Current and Future Actions

Collaboration and Thanks To

SEDI

Pacific Gas and Electric Company®

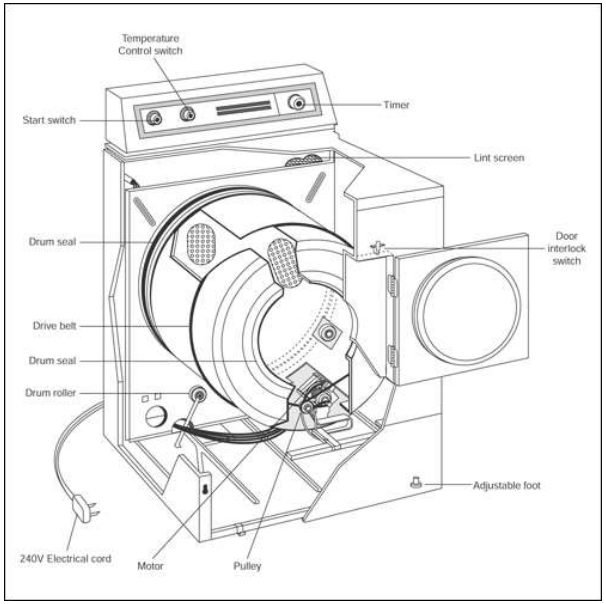
Energy Efficient Clothes Drying

The Happy House Wife Era

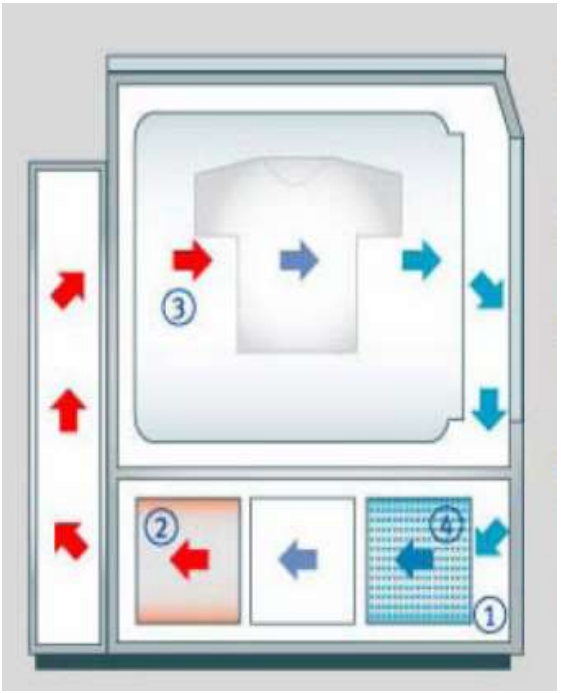
Electronic Control (circa 1963)

Super Efficient Clothes Dryers

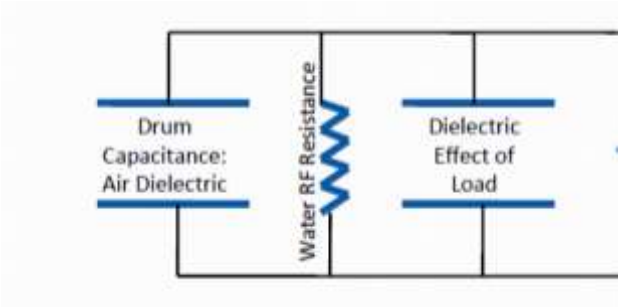
Advanced Electric



Heat Pump



Radio Frequency



Clothes Dryer Market

6.5 million dryers sold in U.S. in 2010

- 80% are electric dryers and 20% are gas dryers
- ~ 99% are vented
- ~ 98% are 27 inch wide “Full Size” variety
- >80% of high end models are paired with washer

90.2 Million Households

- 72 million electric
- 18.5 million gas or propane

Total Technical Potential

- ~300 kWh/unit per year
- 6.5 million sold per year
- Total Potential Savings of ~21 billion kWh per year (about 5 Hoover Dams worth of electricity)

Estimated Unit Energy Savings

Clothes Dryer Efficiency Level	Energy Use		Savings Over Baseline	
	KWh	KW	KWH	KW
Baseline Electric Resistance Dryer *	967	4.6		
ENERGY STAR v. 1.0 **	822	4.0	145	0.7
ENERGY STAR® Emerging Technology Award (>30%)	677	1.6	290	3.0
Heat Pump Equivalent ***	484	1.2	484	3.5

* Baseline energy usage reflects 2005 DOE Federal Standard
** Assumes 15% average efficiency gain
*** Assumes 50% average efficiency gain

- Spring/Summer 2013 – Findings from Lab and Field Testing

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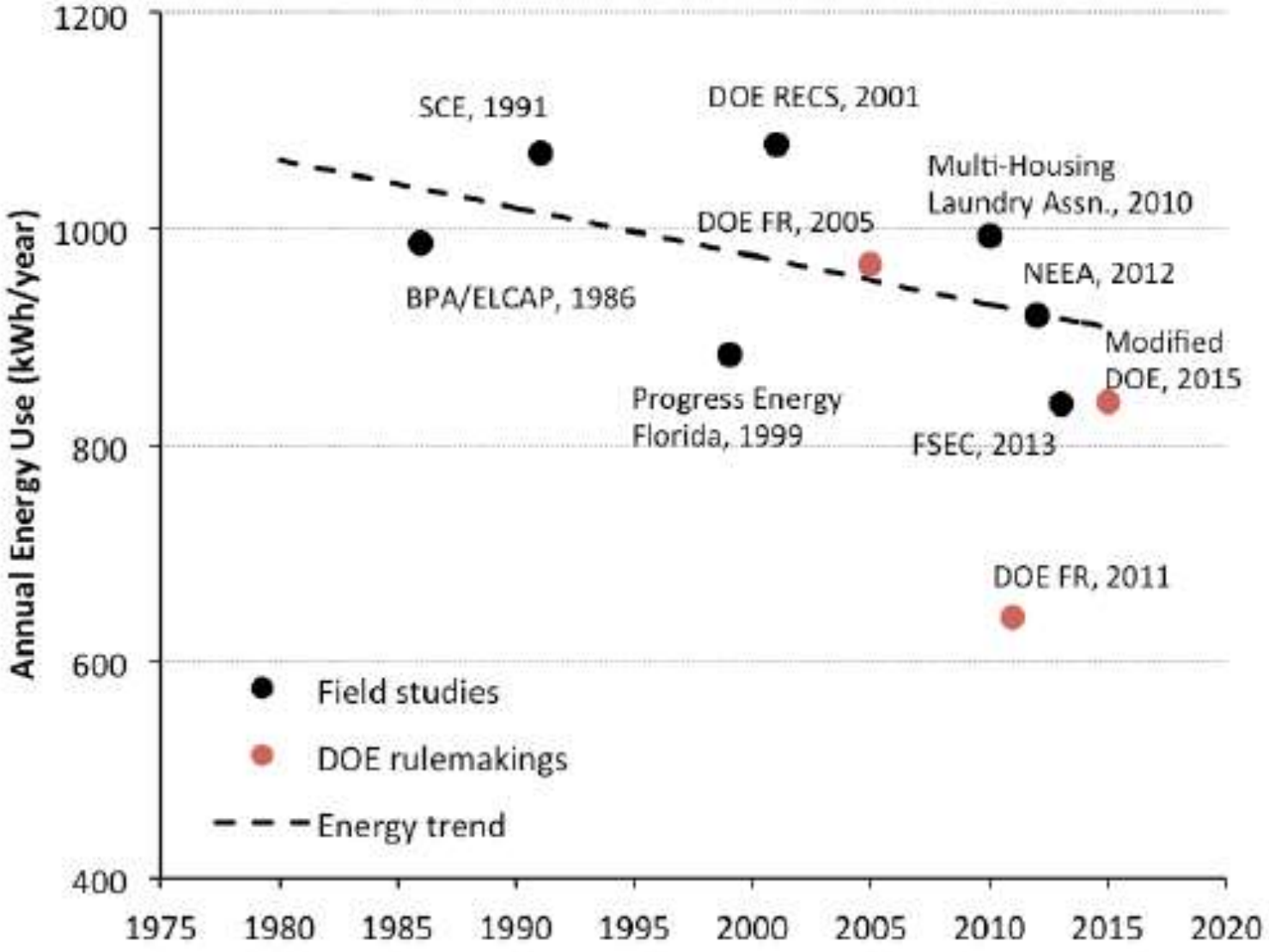
Current Situation

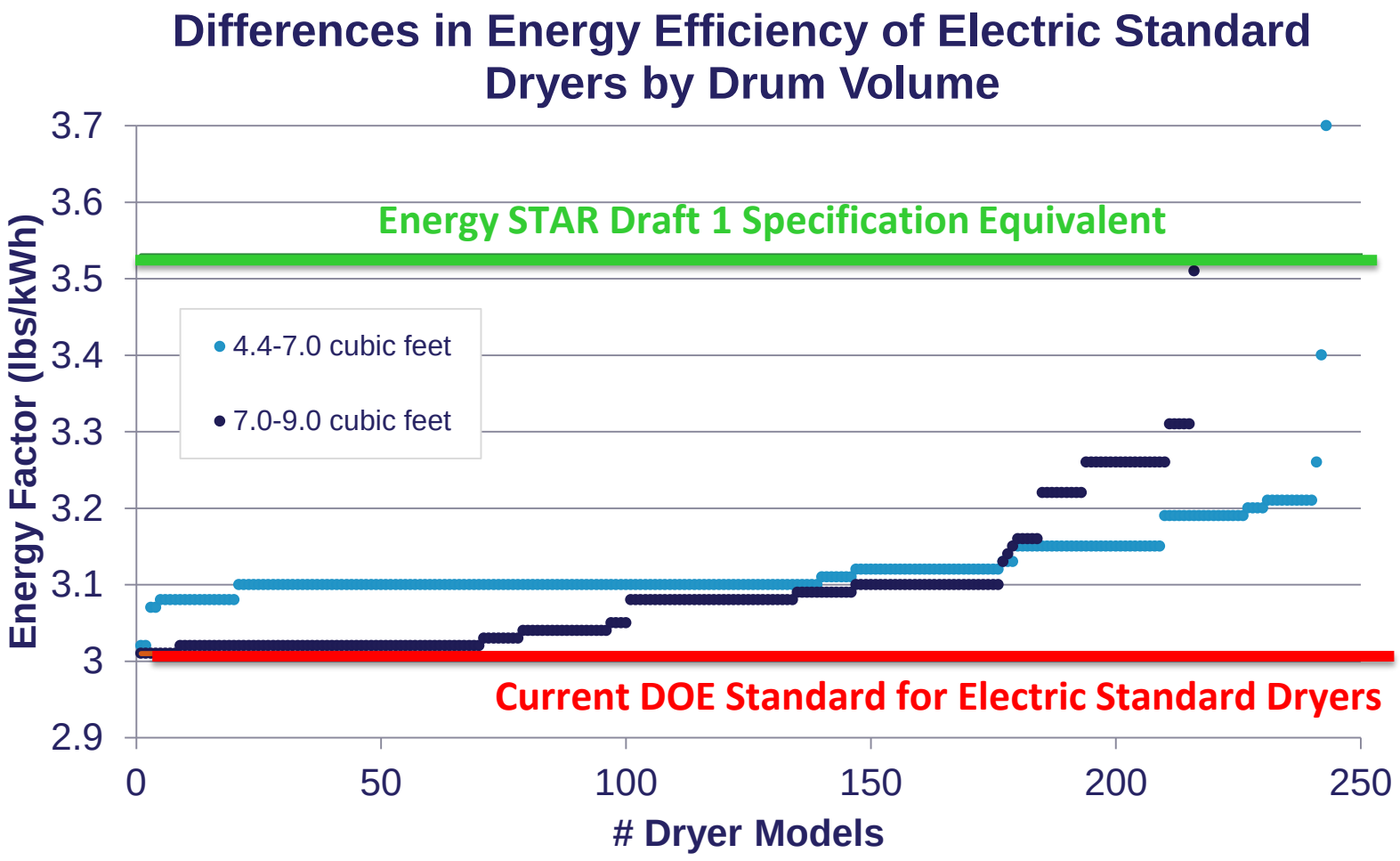
- No “super efficient” product in US
- Current test procedure is not accurate
- Washer and dryers are sold as pairs
- EE units are not low cost models
- EE versions have longer drying time
- 2015 Standard is based on 2005 procedure

"I thought you wanted a clothes dryer."

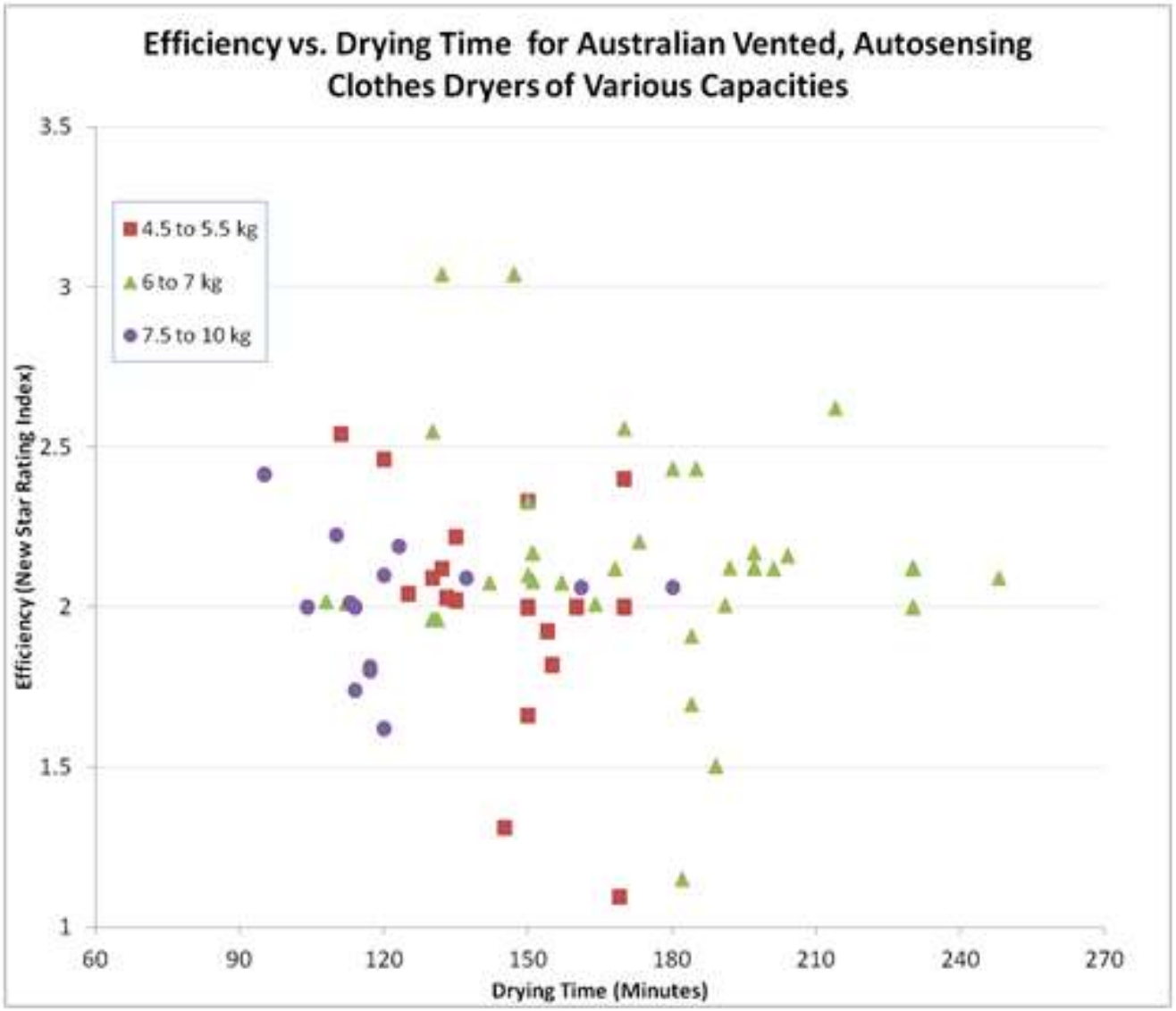
Dryer Annual Energy Use Estimates



Performance Ranges



Australian market Variation



NEEA Laundry Field Study

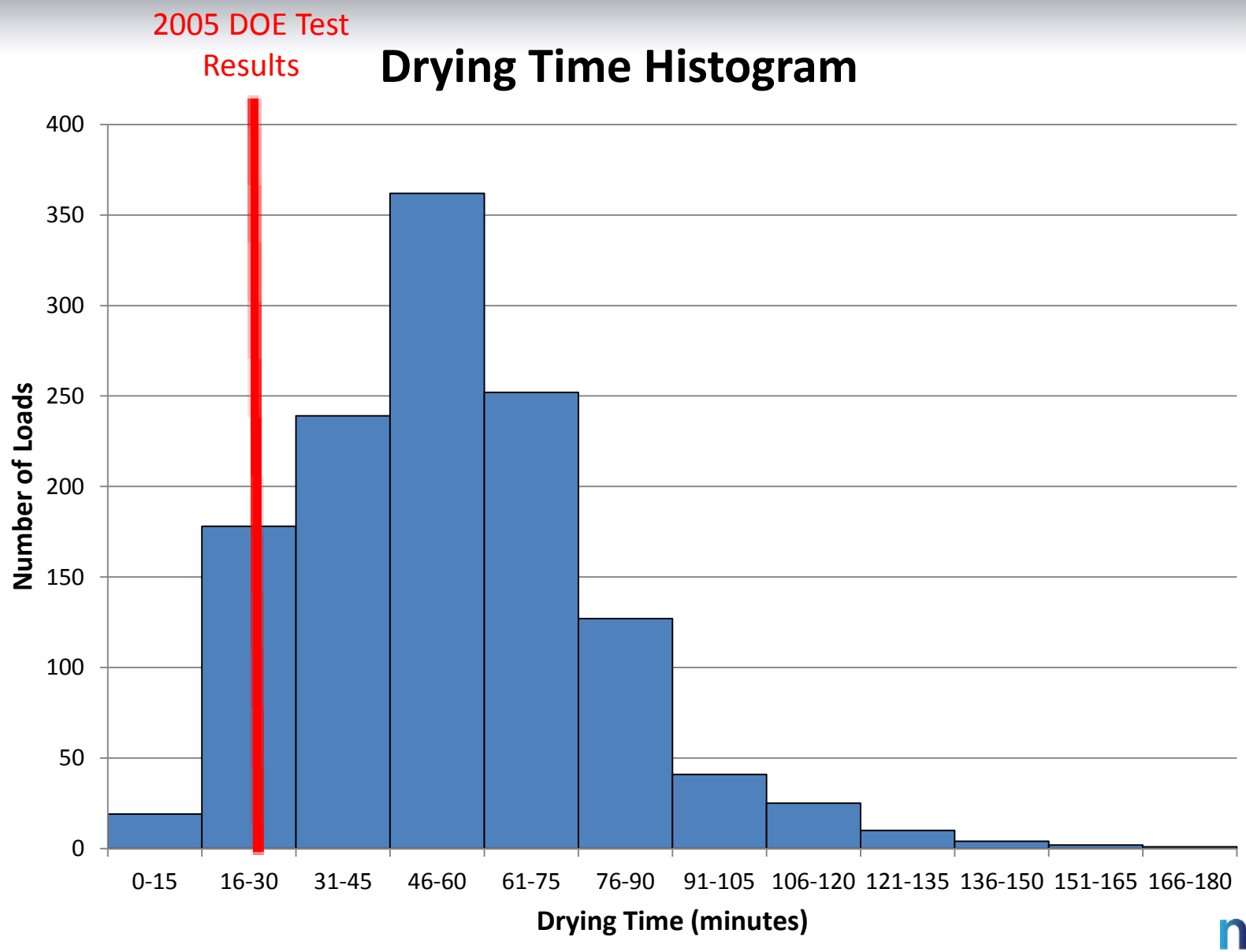
Residential Building Stock Assessment

- Approximately 1,850 homes

Laundry Supplemental Study

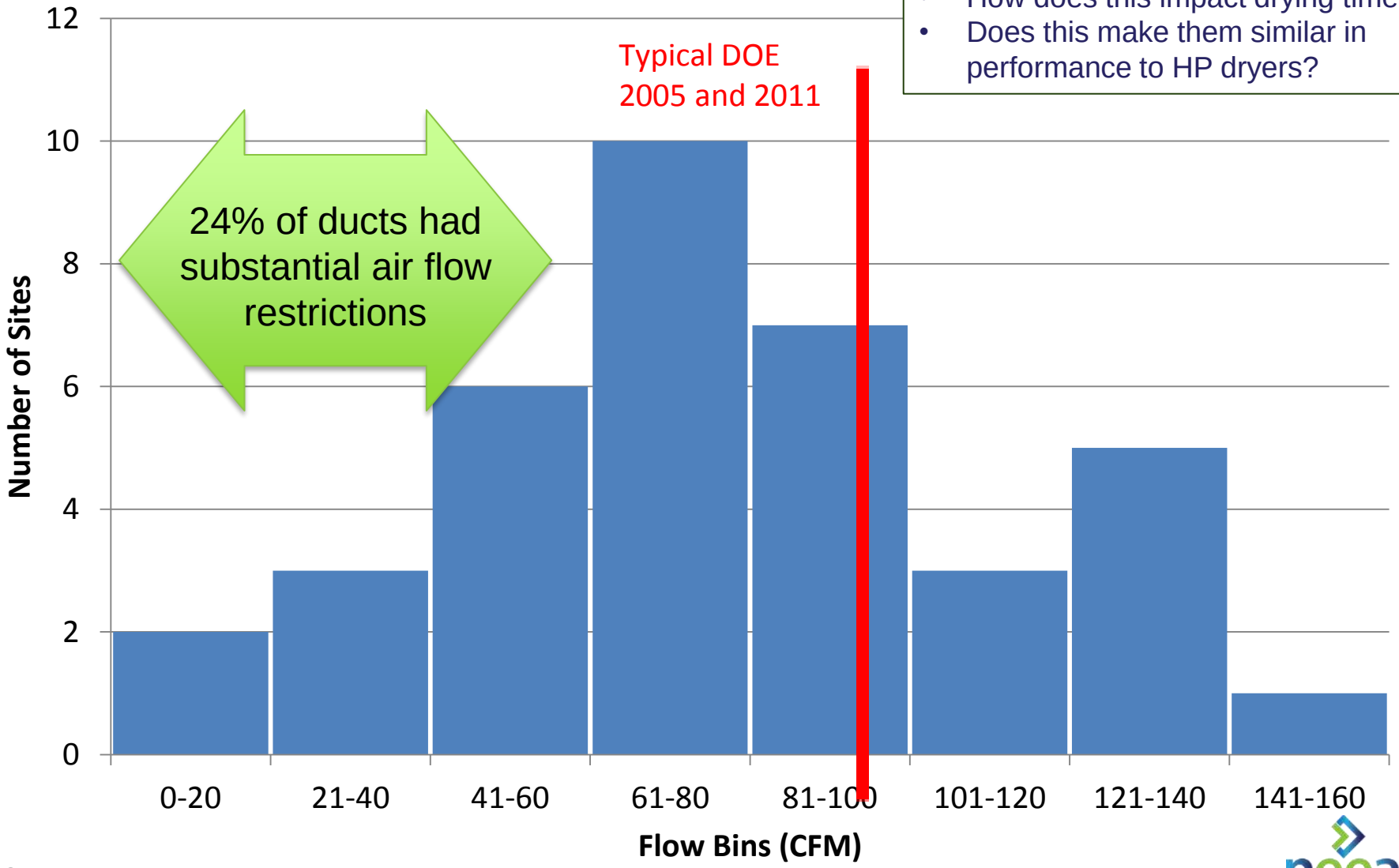
- Final report due July
- 50 sites – 1 month
- Statistically significant sample
- 2005 and newer models
- 3 weight measurements
- kWh monitoring of both washer and dryer
- Participants paid to provide load and setting details

Drying time is longer



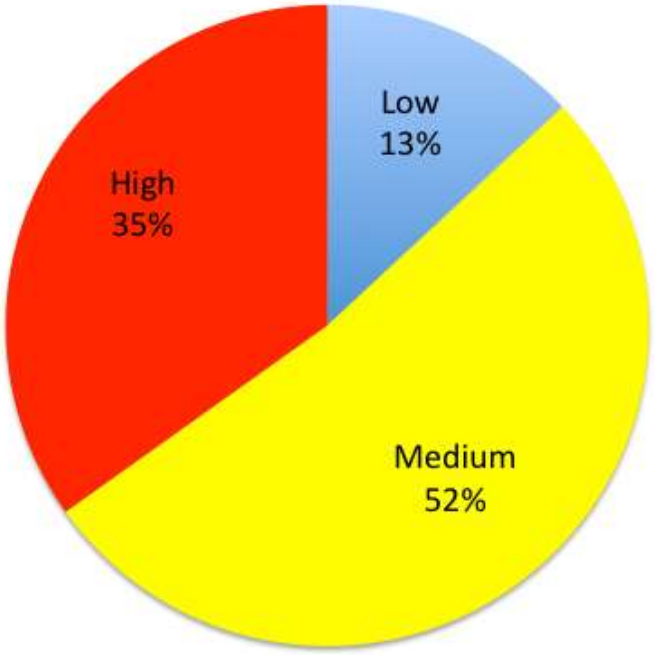
Air flow rates are lower

Questions
- What is the real world vent rate?
- How does this impact drying time?
- Does this make them similar in performance to HP dryers?

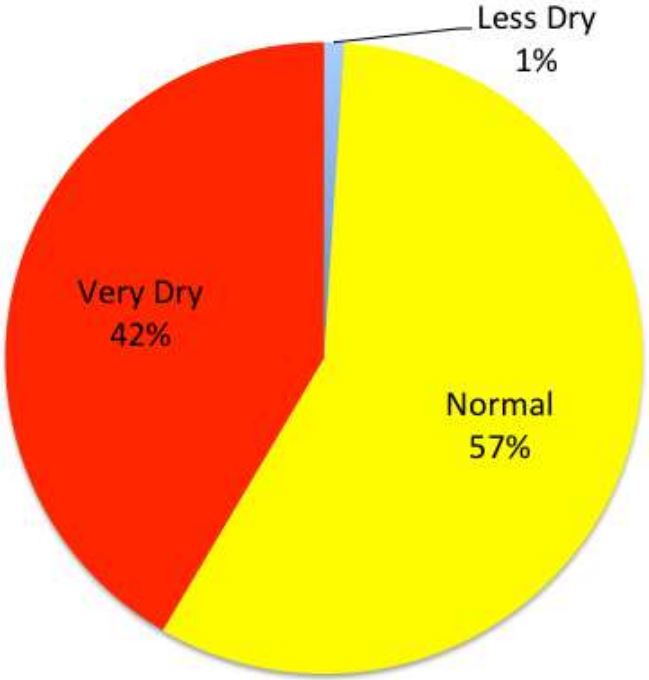


Dryer Settings are not the same

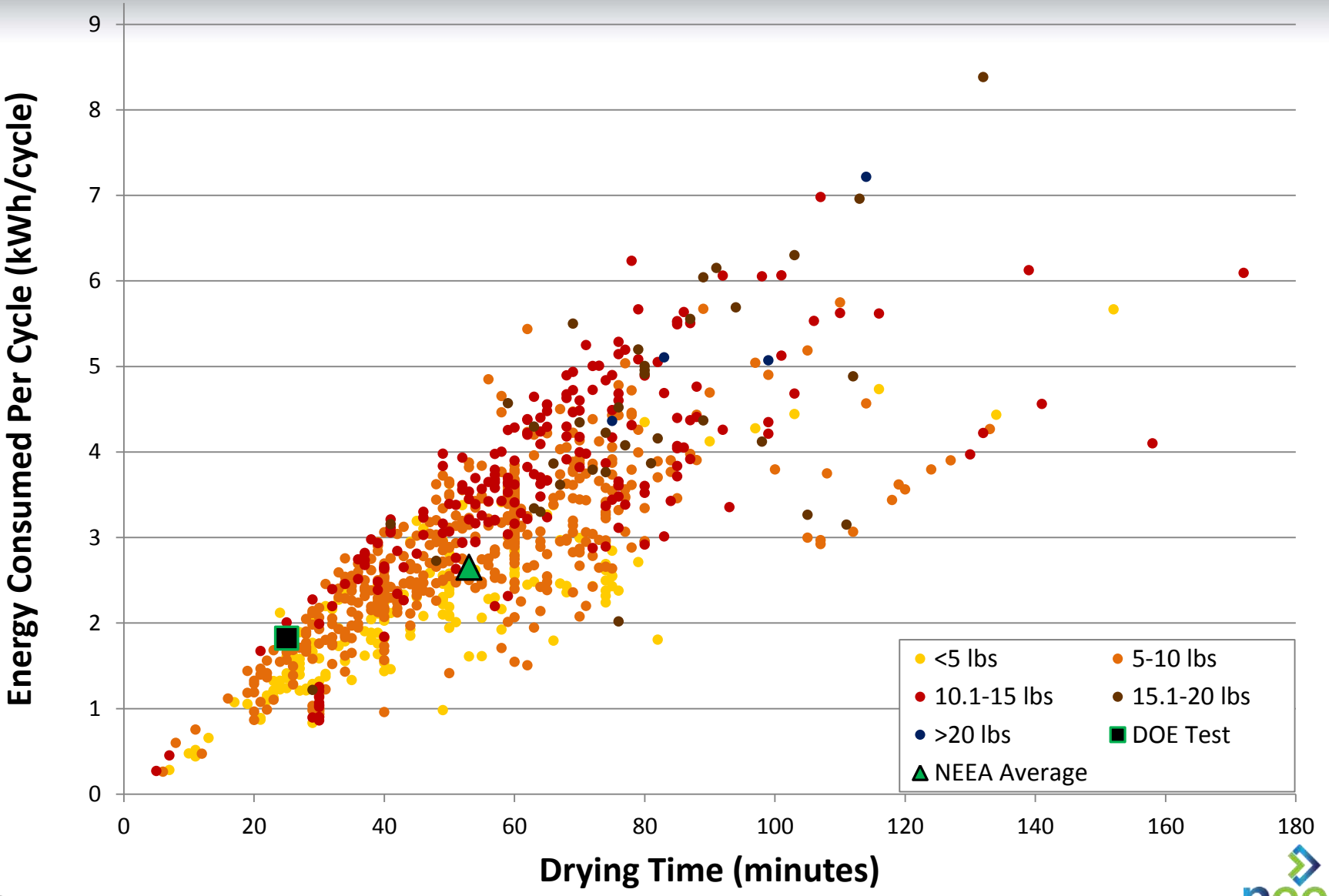
Dryer Temperature



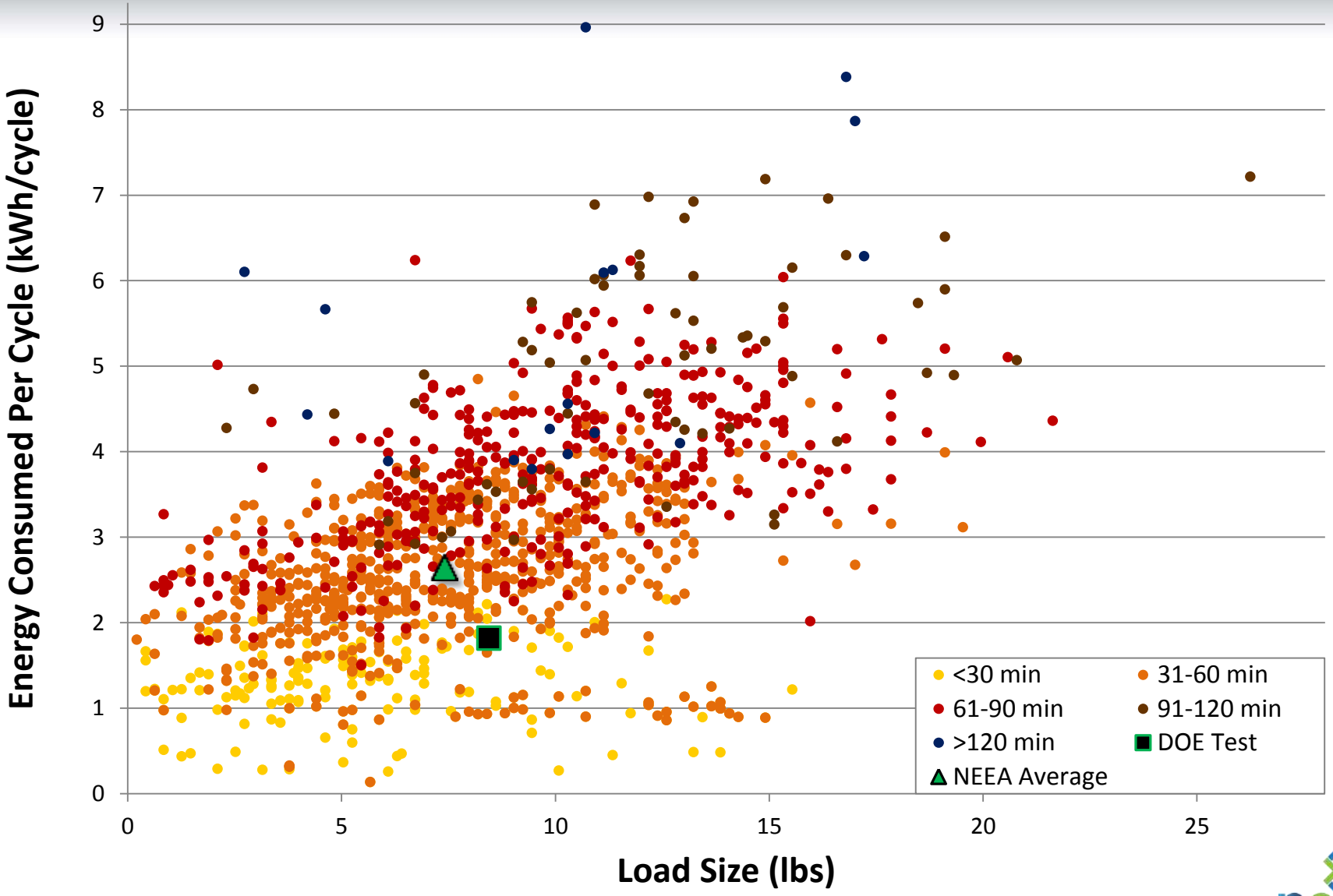
Dryness Level



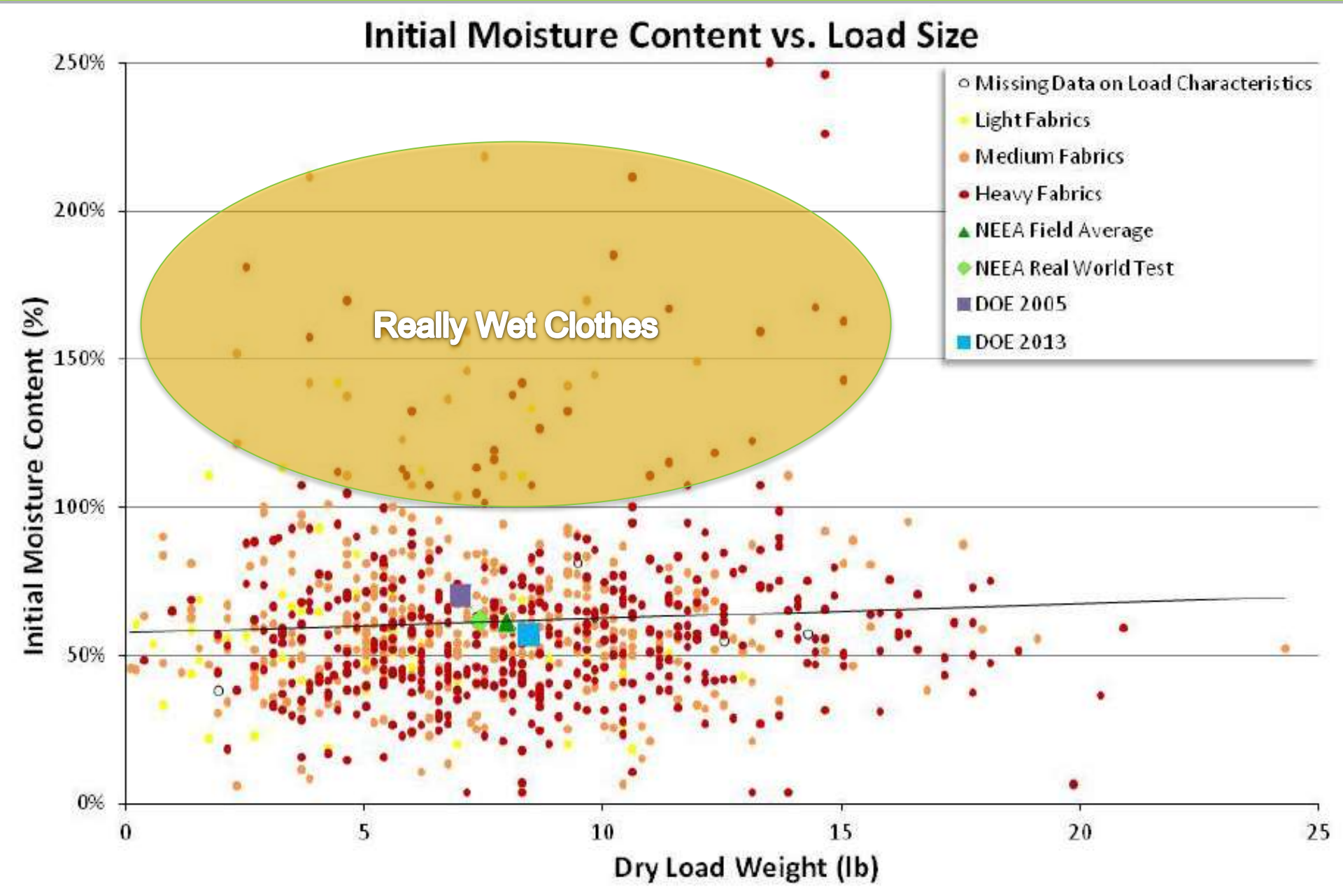
Energy Consumption vs Drying Time



Energy Consumption vs Load Size



Initial Moisture



Preliminary Summary

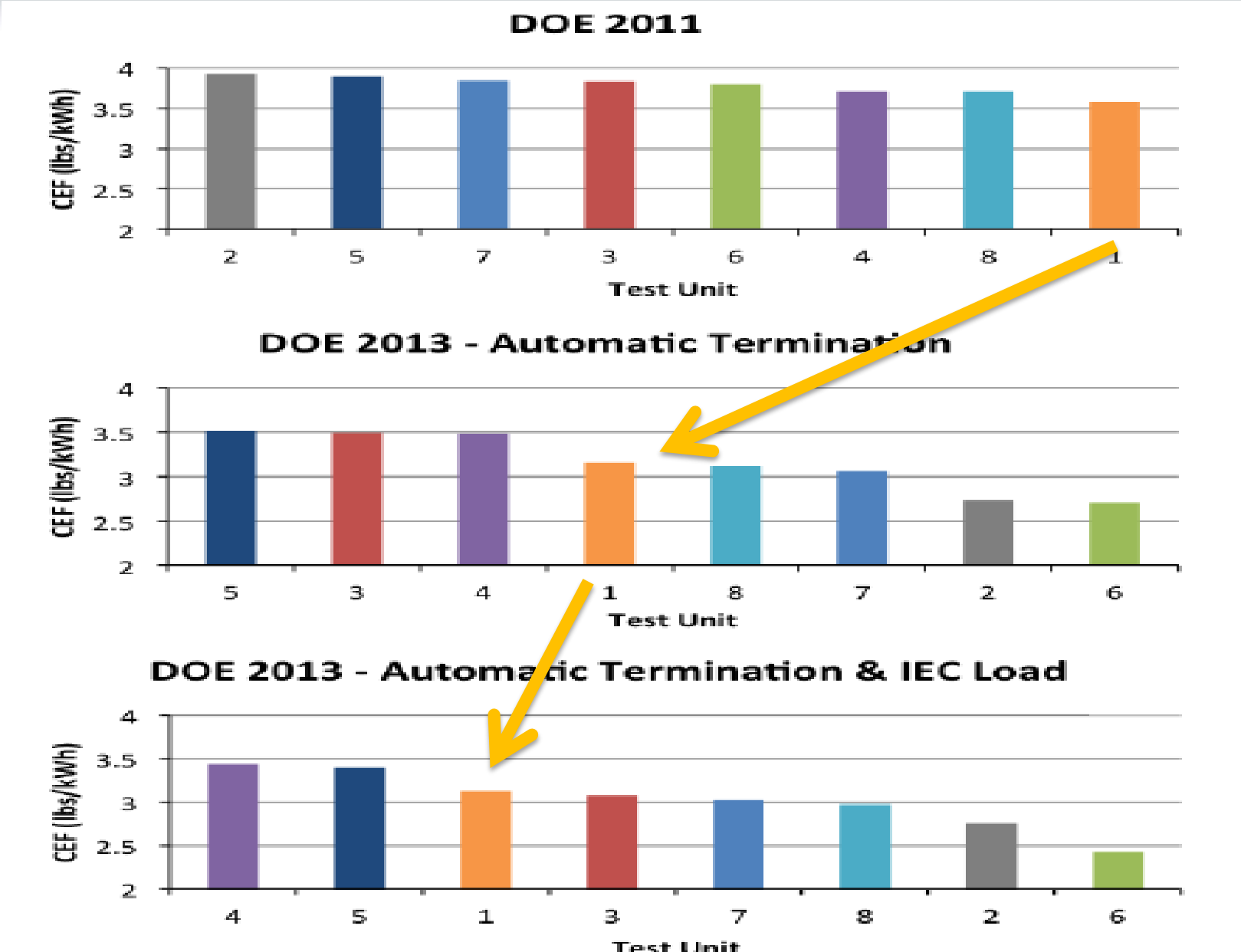
- Energy use was higher than expected
  - More loads
  - Longer run times
- Considerable variability
  - between models
  - Owner behavior
  - Types of laundry loads
- 70% use auto termination – not always good
- Medium heat is most common
- Many selected “Extra Dry”
- There were 124% as many dryer loads

Implications for DOE Test Procedure

Proposed standard improved but flawed

1. Low quality auto-termination can increase energy use over timer based systems
2. Variability is much higher between models largely because of loads don't behave like test cloths
3. FUF results in significant underestimate of annual energy use
4. An accurate procedure would help spread the field and provide product differentiation

DOE Test group comparison



DOE is stuck between laws and market

1. Standard must not increase over time
2. Test procedure must be accurate
3. Changes would require restart of rule making
4. Changes would impact manufacturers product efficiency ranking

Dryer Test Procedure Evolution

2005 DOE Test Procedure

- Based on 1994 era test standards
- 5% RMC termination
- 50% Polyester test clothes

2013 DOE Test Procedure

- Final version TBD

DOE Test Cloths

NEEA "Real World" Procedure Differences

1. Test Cloths are cotton, thicker, 3-dim
2. Wetter to start
3. Test run until auto termination achieved
4. More loads per year
5. Field Utilization Factor

Near Term Actions

Ecova lab testing of super efficient dryers

- CLASP testing of 3 electric + 4 European HP - *done*
- DOE Award winner – advanced resistance heat
- LG – 24” Heat Pump w/boost
- Panasonic – 24” Variable Speed Heat Pump

Field Testing

- NEEA – pilot best options
- FSEC – Building America

Support “Americanized” Product

- Cheap, big, and fast
- PNNL Product development support
- Ecova Frankenstein Hybrid Test?

LG Heat Pump Clothes Dryer

with Electric Resistance Boost

Panasonic Heat Pump Clothes Dryer

Panasonic
24” HP

Typical
27”

Unit has Variable Speed Compressor

Closing Comments

2 manufactures will bring high efficiency products to US market this year*. More would come if demand emerges.

If we get the data right, we can generate a qualified product list, offer incentives and drive up market demand for these products.

* Not guaranteed

Questions & Comments

Filling the Energy Efficiency Pipeline

Accelerating Market Adoption

Delivering Regional Advantage

Thank You!

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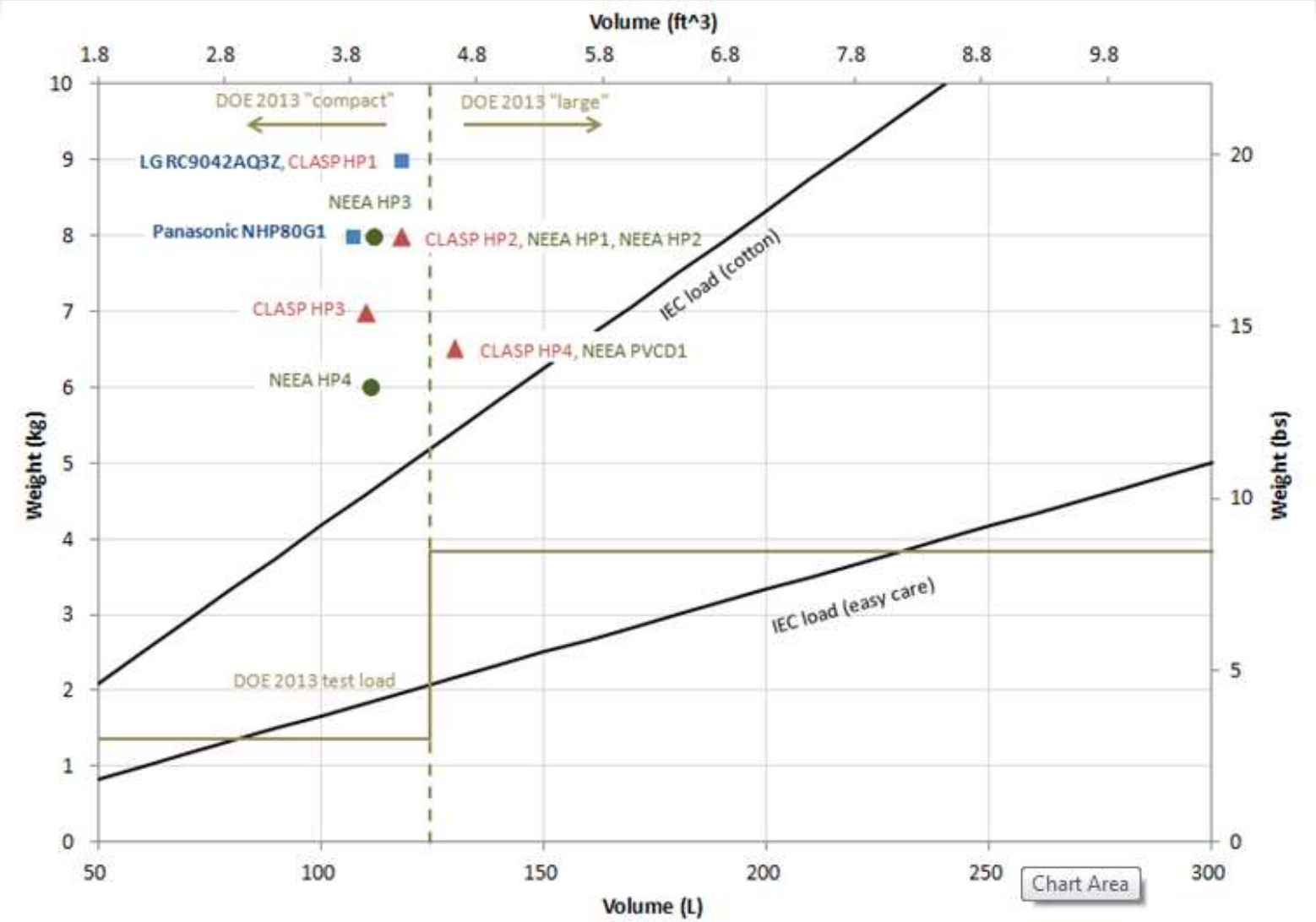
Extra Slides

Ecova Tested* Dryers

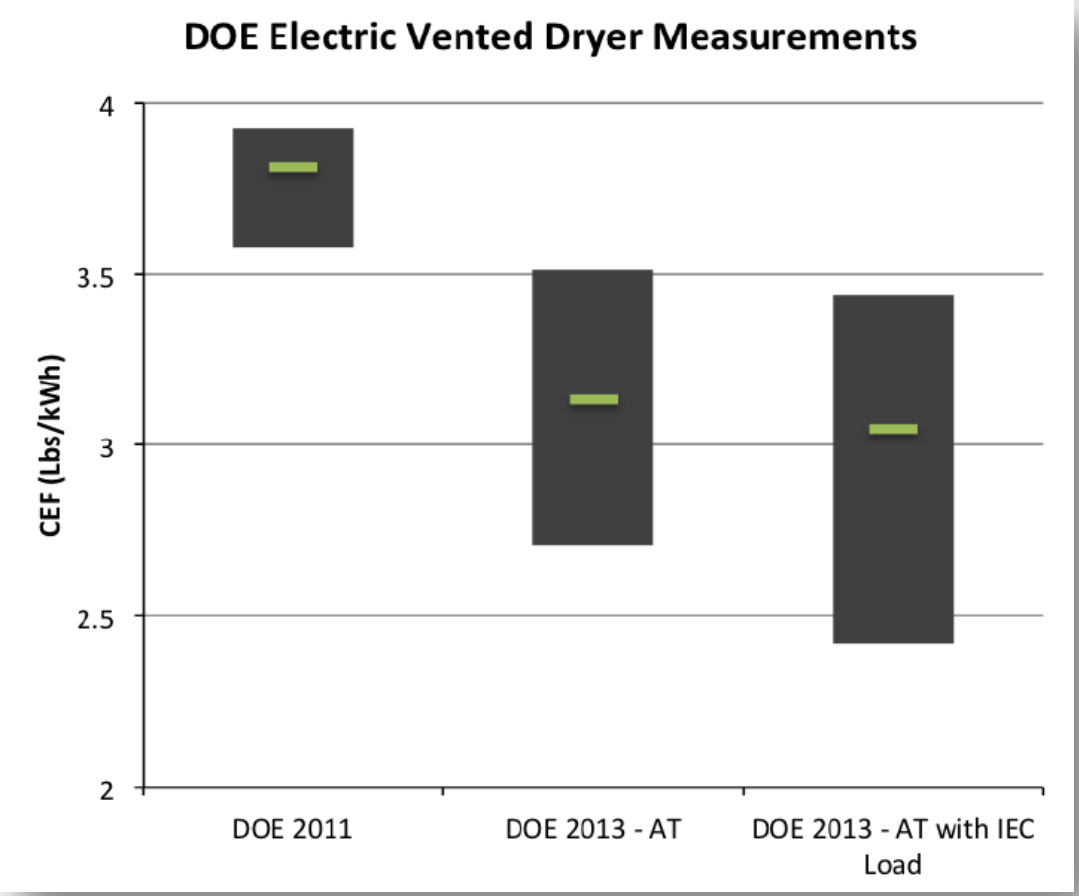


* And soon to be tested

Tight Cluster with 2005 Procedure

Very little product differentiation using the old test procedure

Including Auto termination increased spread substantially



Test Procedure Highlights

	DOE 2005 Test Procedure, Standard	DOE 2013 Procedure, Lab Tests	NEEA Field Study Averages	NEEA "Real World" Test Procedure
Moisture	66.5%-73.5%	57.5% +/- 0.3%	62%	62% +/- 0.3%
Termination	Manual	Auto	Auto	Auto
Load Composition	2-Dim	2-Dim	3-Dim	3-Dimy 3D
Drying Time	23 min	47	58	47
Field Use Factor	1.04	0.8	1	1
Adj. Use/Load	2.3 kWh	1.7 kWh	3.1 kWh	2.5 kWh
Washer Loads Dried	107%	91%	124%	124%
Loads/year	416	283	337	337
kWh/year	967	570	920	840
CEF	3.01	4.2	2.4	3.0

Significant Difference, Largely a result of FUF

Ecova HP Dryer Testing (done and planned)

	Notes	Claimed Energy Efficiency (kWh/kg of clothing)	Purchase Price
Heat Pump Clothes Dryers Tested by CLASP			
CLASP HP1	Highest rated 2011 heat pump efficiency and largest rated capacity	0.23	~$1,100
CLASP HP2	Entry-level heat pump clothes dryer model	0.34	~$800
CLASP HP3	Most efficient European model in 2010; small drum volume	0.27	~$1,050
CLASP HP4	Semi-professional with moisture sensing technology on drum vanes	0.24	~$3,450
Other Heat Pump Clothes Dryers considered as part of this market research			
NEEA HP1	High-efficiency entry-level condensing heat pump clothes dryer (A++)	0.34	~$800
NEEA HP2	One of the two highest rated 2013 heat pump clothes dryer efficiency (A+++) that recently became available in Europe.	0.18	~$1,560
NEEA HP3	One of the two highest rated 2013 heat pump clothes dryer efficiency (A+++) that recently became available in Europe.	0.17	~$1,370
NEEA HP4	Listed as the fastest drying heat pump clothes dryer model in the Australian database	0.30	~$3,500
NEEA PVCD1	Professional vented clothes dryer with a recirculation drying system, DN 100 exhaust ducting, and tubular heating elements. It was considered because it is listed as the most efficient dryer in the U.S. DOE Compliance database.	0.59	~$2,900
Models Recommended for Purchase and Testing by NEEA			
Panasonic NHP80G1	Variable speed compressor allows unit to vary power use with selected temperature setting or load size.	0.14 - 0.225	~$1,140
LG RC9042AQ3Z	Offers optional electric resistance boost mode when faster drying times are preferred. Also one of the larger load rated capacity amongst heat pump clothes dryers considered in this study.	0.18	~$1,420

neea

Drying time in different modes (LG)

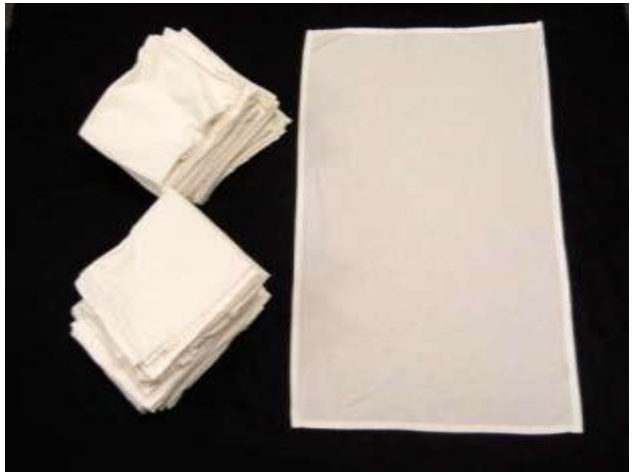
Drying Guide

CYCLE		Capacity of dryer	Display Drying Time (Including Cooling Time)	
			Eco	Speed
Cotton	Extra	9 kg	200min	125min
	Very	9 kg	190min	120min
	Cupboard*	9 kg	180min	115min
	Light	9 kg	170min	103min
	Iron	9 kg	160min	97min
Mixed Fabric	Very	4.5 kg	100min	53min
	Cupboard	4.5 kg	90min	48min
	Iron	4.5 kg	70min	41min
Easy Care	Cupboard	4 kg	70min	41min
	Iron	4 kg	60min	35min
Bulky Item		2 kg	120min	70min
Jeans		3 kg	110min	60min
Steam Hygiene		3 kg	56min	-
Steam Refresh		Dress Shirts Max.5EA	25min	-
Sports Wear		2 kg	50min	-
Quick Dry		3 kg	-	50min
Delicate		1.5 kg	48min	-
Wool		1 kg	29min	

* Tested in accordance with EN61121 : 2005 test program

Test Load Item Comparison

DOE Test Load



IEC Easy Care Test Load

AHAM Test Load

NEEA Laundry Field Study

Top Analysis Objectives

- Dryer energy usage
- Annual cycles – e.g. demographics
- Remaining Moisture Content correlations
- Energy use after 5% RMC
- Energy use and cycle times
- Consumer choices
- Clothes load types and sizes
- Accuracy of sensors used in auto termination
- How often are clothes hand dried
- Energy use impact by clothes washer