



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

Christopher Dymond, Sr. Product Manager 33rd Utility Energy Forum May 15-17, 2013, Tahoe

# Outline

Background Federal Standards and Test Procedures NEEA Field Study Current and Future Actions



# **Collaboration and Thanks To**







The power of action.





# **Energy Efficient Clothes Drying**



# The Happy House Wife Era





#### **Electronic Control (circa 1963)**

MAYTAG

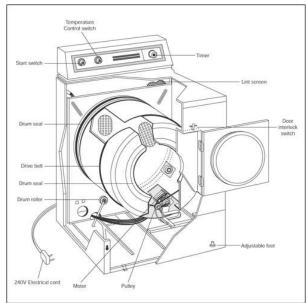
After 30 dryings in a Maytag Electronic Control Dryer, this all-nylon nightgown is as fresh as it was when new. No timer setting is necessary. Electronic Control

senses moisture in the

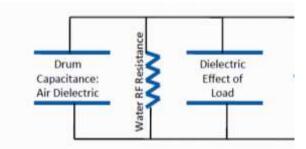
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#### **Super Efficient Clothes Dryers**

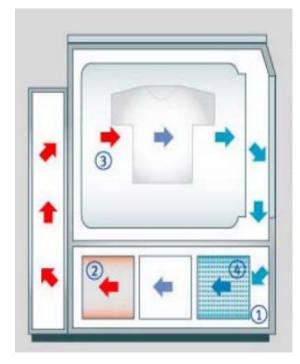
#### **Advanced Electric**



#### Radio Frequency



**Heat Pump** 





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### **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 Loyal	Energy Use		Savings Over Baseline	
Clothes Dryer Efficiency Level	KWh	KW	КШН	ĸw
Baseline Electric Resistance Dryer *	967	4.6		
ENERGY STAR v. 1.0 **	822	4.0	145	0.7
ENERGY STAR <sup>®</sup> 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



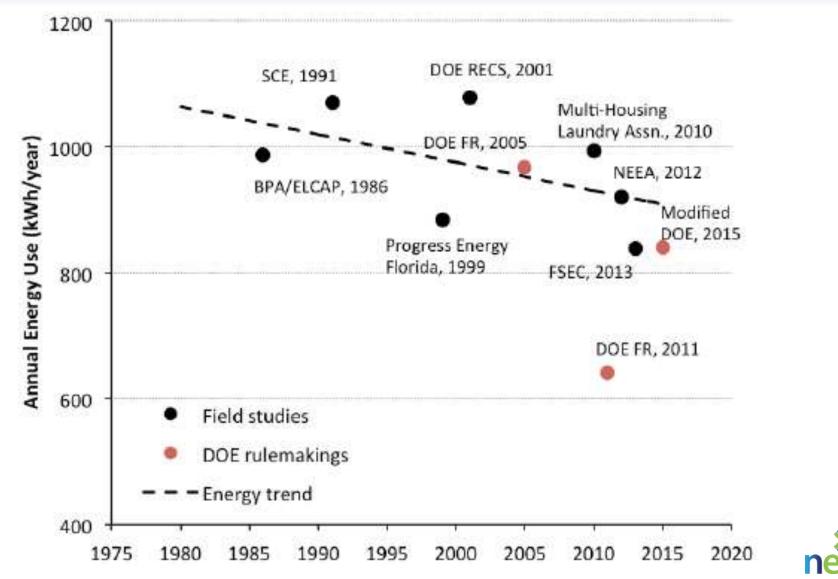
# **Current Situation**

- 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



<sup>&</sup>quot;I thought you wanted a clothes dryer."

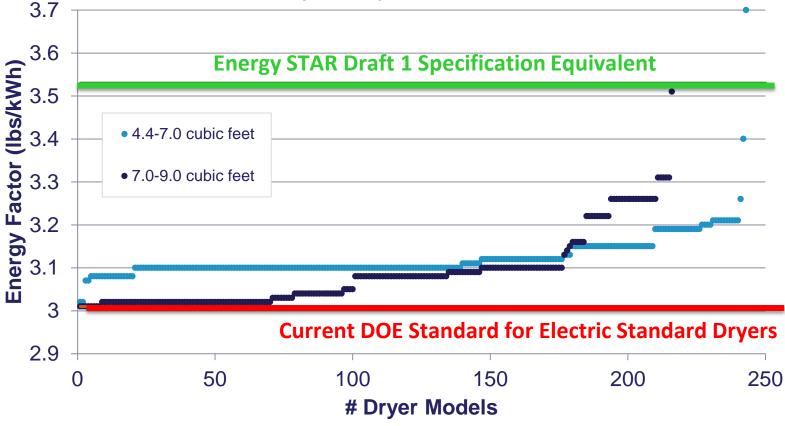
#### **Dryer Annual Energy Use Estimates**



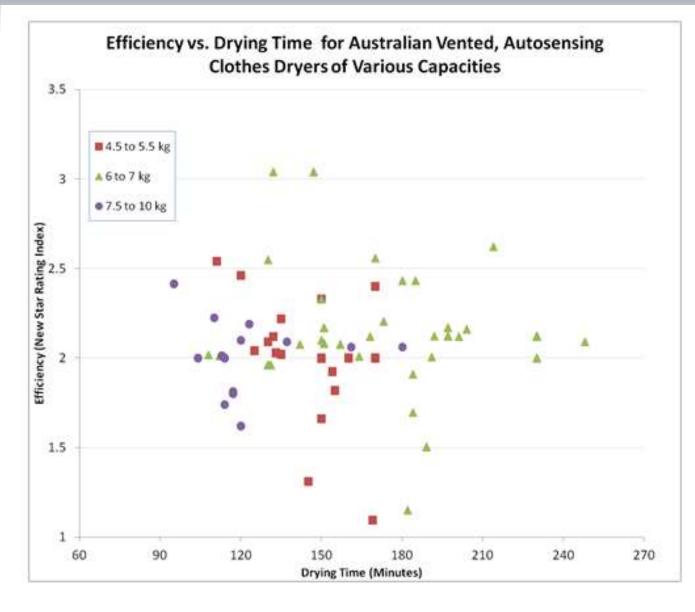
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### **Performance Ranges**

#### Differences in Energy Efficiency of Electric Standard Dryers by Drum Volume



#### Australian market Variation





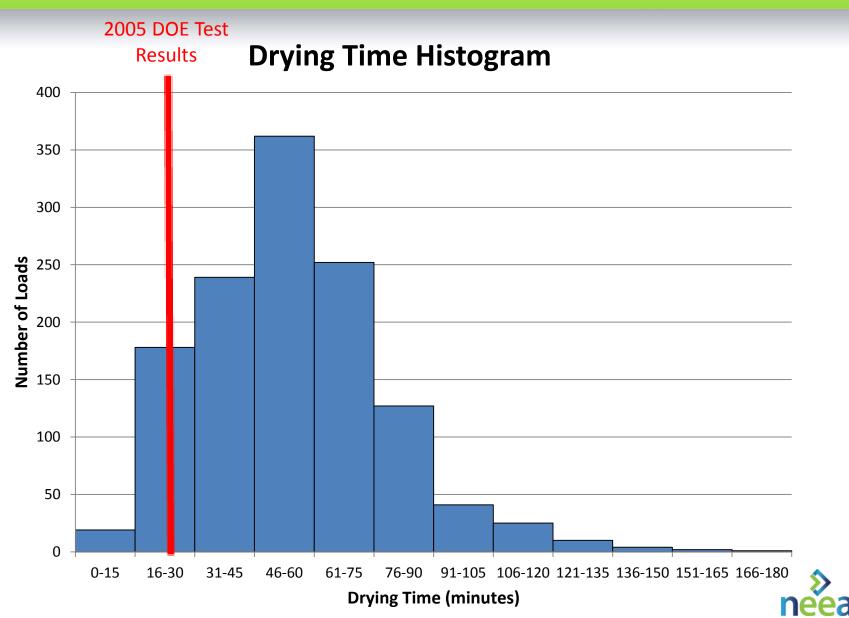
### **NEEA Laundry Field Study**

**Residential Building Stock Assessment** 

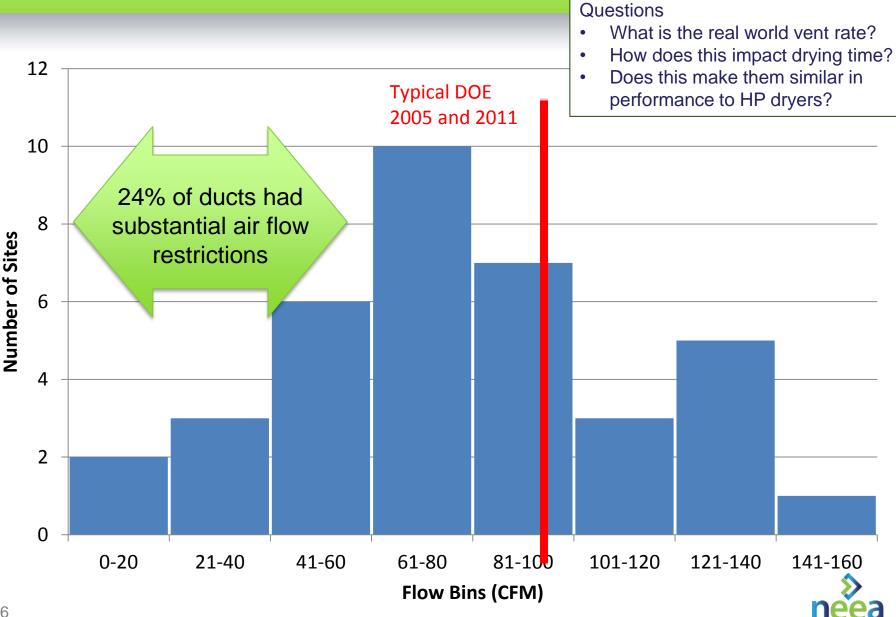
- Approximately 1,850 homes
- Laundry Supplemental Study
  - Final report due July
  - 50 sites 1 month
  - Statistically significant sample
  - 2005 and newer models
  - 3 weight measurements
  - kWh monitoring of both washer and dryer
  - Participants paid to provide load and setting details

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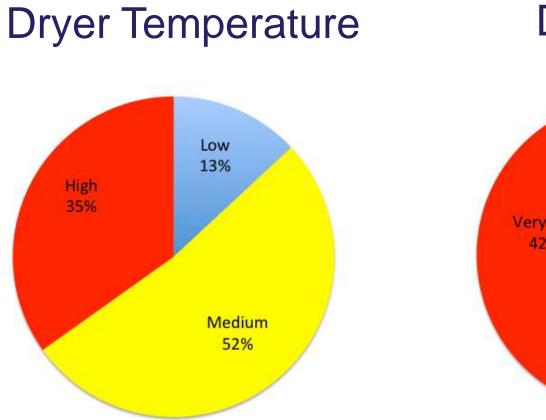
# Drying time is longer



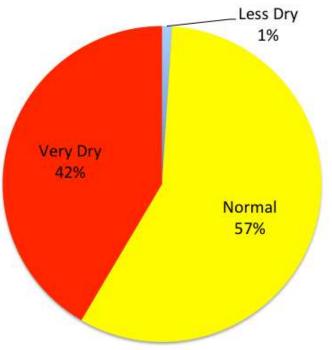
#### Air flow rates are lower



#### Dryer Settings are not the same

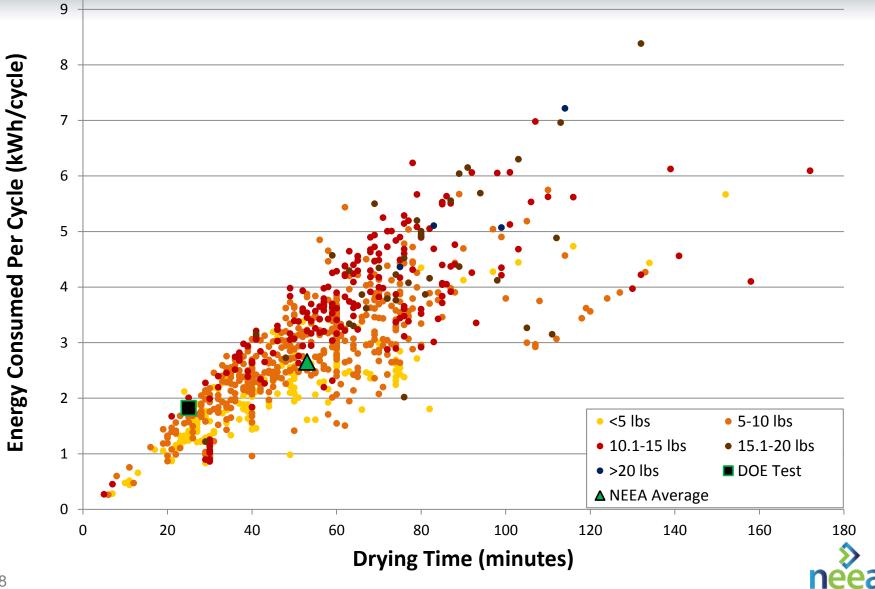




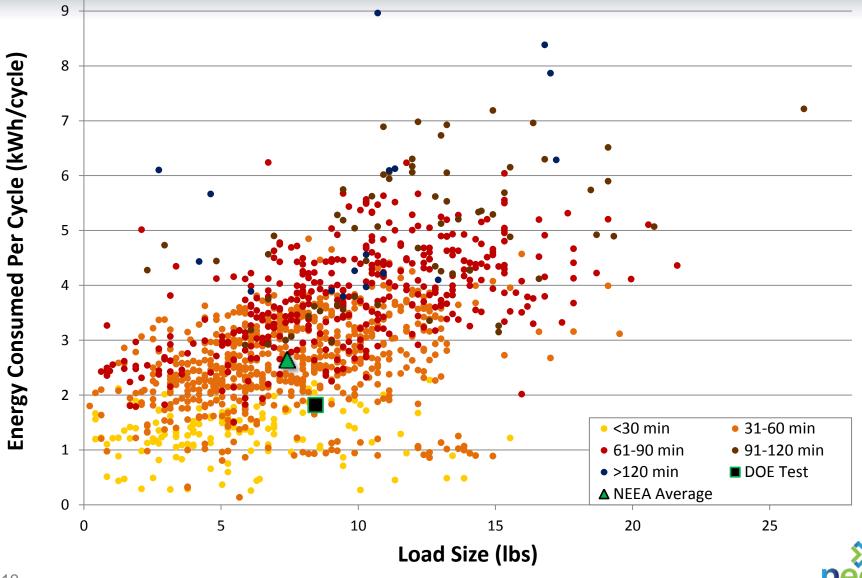




### **Energy Consumption vs Drying Time**



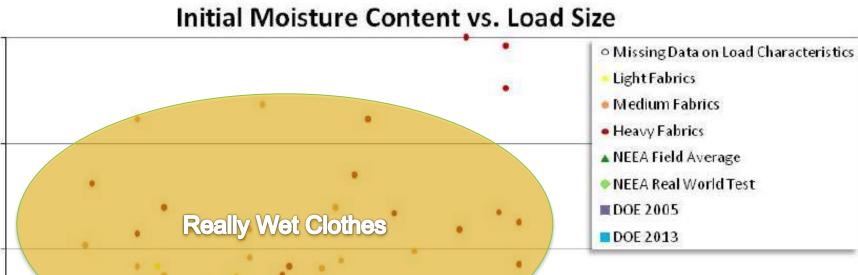
#### **Energy Consumption vs Load Size**

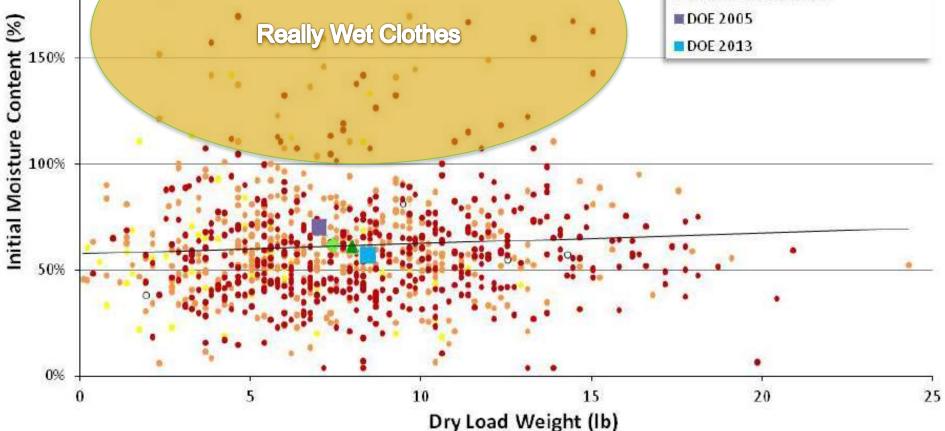


#### **Initial Moisture**

250%

200%





# **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



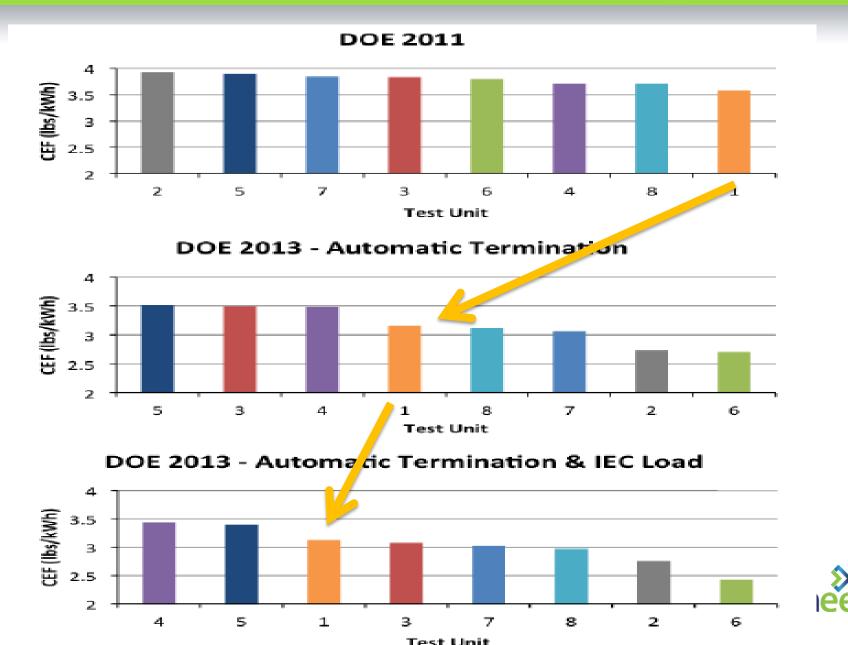
# Implications for DOE Test Procedure

Proposed standard improved but flawed

- 1. Low quality auto-termination can increase energy use over timer based systems
- 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**



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### 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



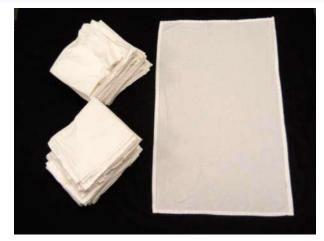
# **Dryer Test Procedure Evolution**

#### 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



#### Unit has Variable Speed Compressor



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.



#### **Questions & Comments**

Filling the Energy Efficiency Pipeline

#### Accelerating Market Adoption

Delivering Regional Advantage



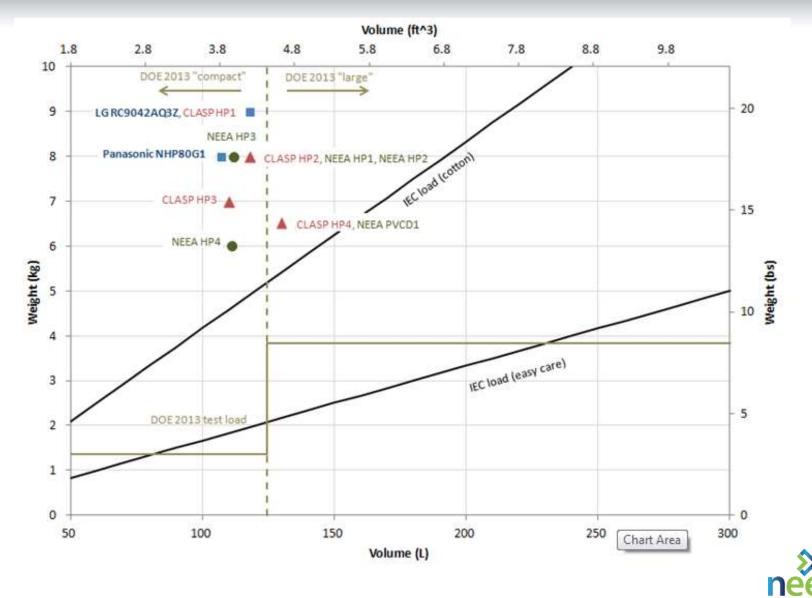
Thank You!

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#### **Extra Slides**



#### **Ecova Tested\* Dryers**

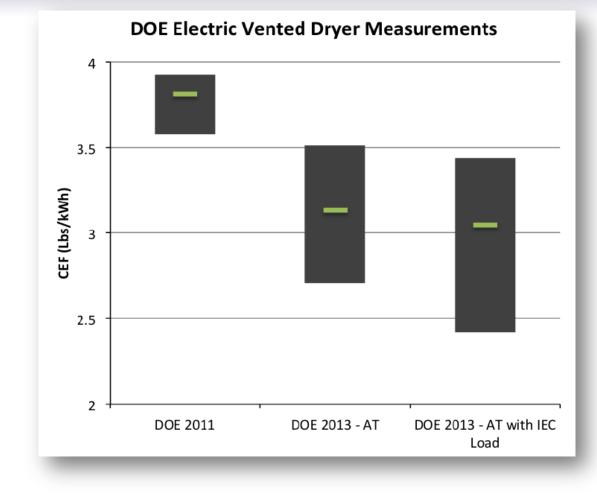


\* And soon to be tested

# **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%	<b>57.5%</b> +/- 0.3%	62%	<b>62%</b> +/- 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 CLASP HP3	Entry-level heat pump clothes dryer model Most efficient European model in 2010; small drum volume	0.34 0.27	~\$800 ~\$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 thi	s 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	<b>NEEA PVCD1</b> 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.		~\$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	



#### Drying time in different modes (LG)

#### Drying Guide

CYCLE		Capacity of dryer	Display Drying Time (Including Cooling Time)		
			Eco	Speed	
Cotton Cupboard* Light Iron	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	
Very	Very	4.5 kg	100min	53min	
Mixed	Cupboard	4.5 kg	90min	48min	
Fabric	Iron	4.5 kg	70min	41min	
Easy Care Cupboard Iron	Cupboard	4 kg	70min	41min	
	Iron	4 kg	60min	35min	
Bulk	y Item	2 kg	120min	70min	
Je	ans	3 kg	110min	60min	
Steam	Hygiene	3 kg	56min		
Steam	Refresh	Dress Shirts Max.5EA	25min	(34)	
Sports	s Wear	2 kg	50min	(a)	
Quic	k Dry	3 kg		50min	
Del	icate	1.5 kg	48min	-	
W	lool	1 kg	29	min	

\* 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

