

Super Efficient Dryers

Product Research & Testing

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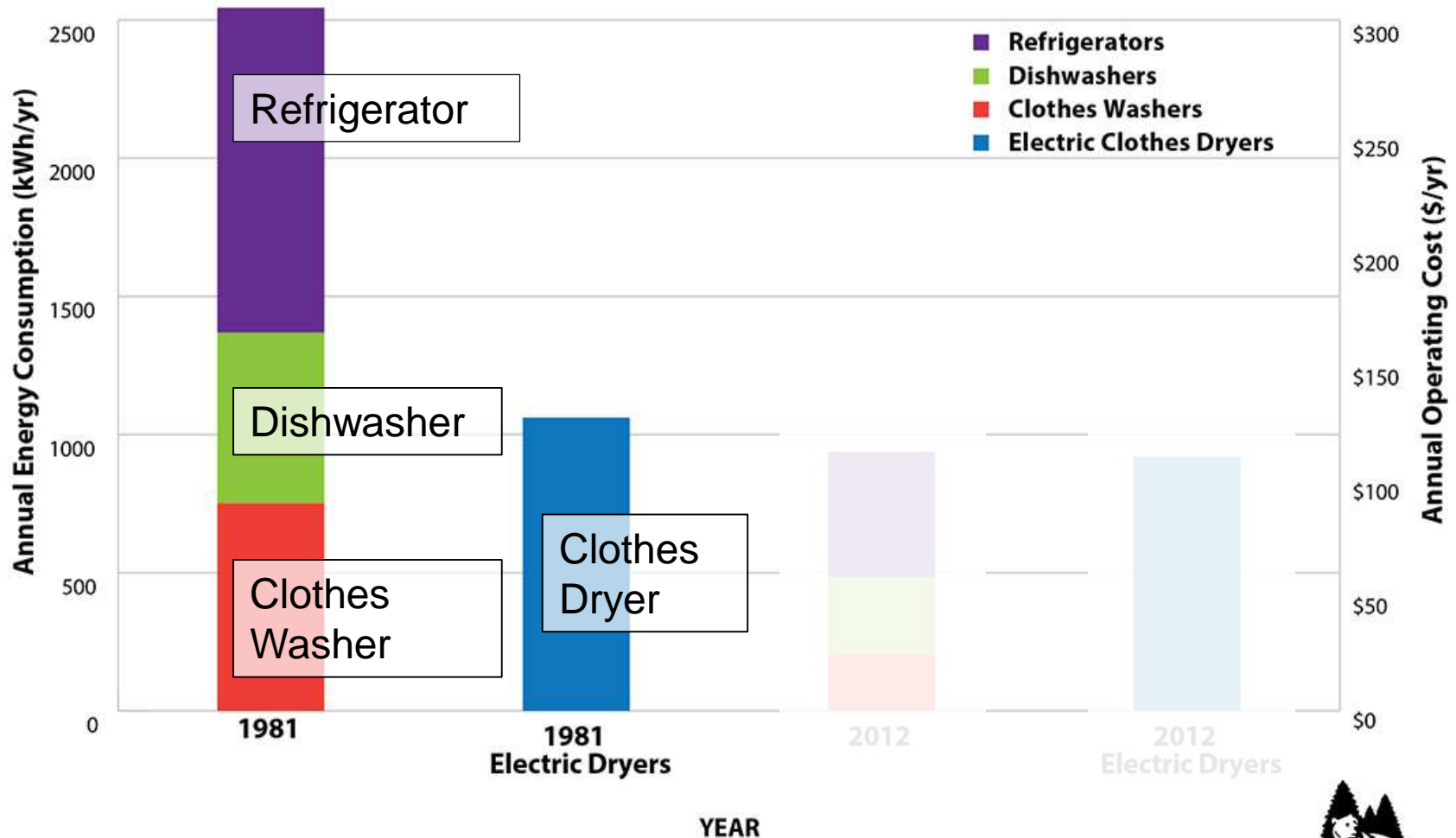
Outline

- Background
- Lab Testing
 - Performance
 - Clothing wear
- Field Testing
- IMC and Savings

Super Efficient Clothes Dryers

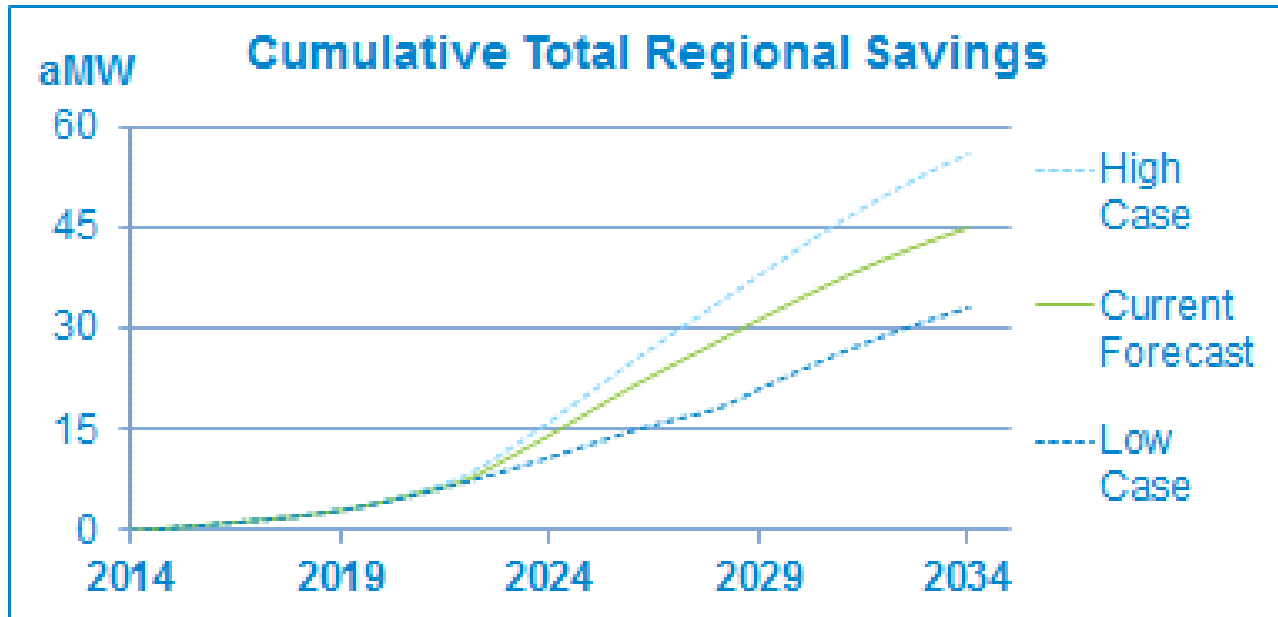
- ✓ Performance Metric & Accurate Savings
- ✓ Lab Testing and Baseline
- ✓ Field Testing Completed
- ✓ Qualified Products List Established
- ✓ Products are Available
- ✓ Good Consumer Response
- ✓ Incremental Measure Cost Established

Dryers use *LOTS* of Energy



Source: Data for refrigerators, dishwashers, and clothes washers from the Association of Home Appliance Manufacturers on new purchases. Data for dryers estimated from a collection of field studies conducted over the past four years by Ecova and others.

Northwest Energy Savings Forecast



Near-Term Savings Forecast (aMW)	2015	2016	2017	2018	2019	Total
Total Regional Savings	0.5	0.5	0.6	0.6	0.9	3.0
Co-Created Savings	0.1	0.2	0.2	0.2	0.4	1.0

Efficient Dryer Types

Conventional
ENERGYSTAR



Hybrid
Heat Pump



Heat Pump

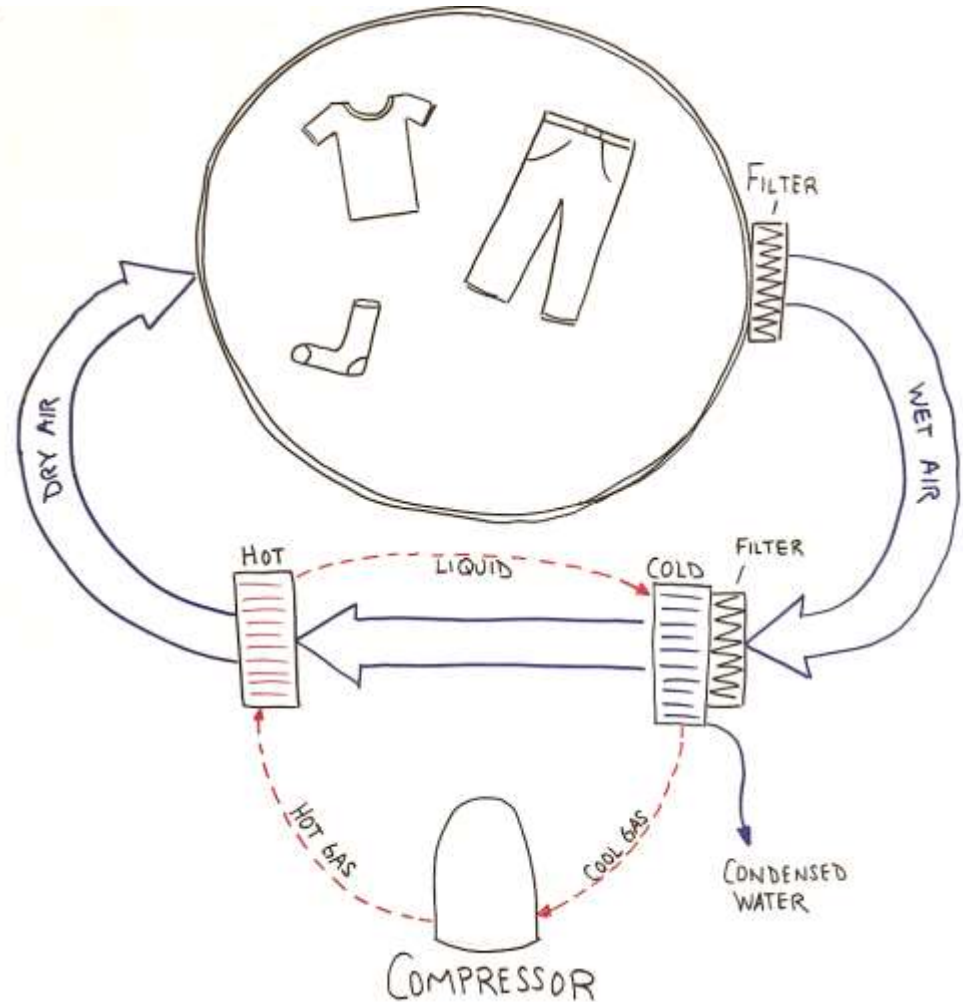


What is a HP Dryer?

A heat pump dryer uses a dehumidifier to dry clothes.

The heat pump removes the moisture and returns the warm dry air into the dryer drum.

It operates at a lower temperature and uses about half the energy of a conventional heater based clothes dryer.



2012

NEEA Laundry Field Study

- Laundry Supplemental Study
 - Report available from NEEA
 - 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



User Conditions ≠ Test Conditions

		Temperature Setting			Total
		Low	Medium	High	
Load Weight	0-6.5 lbs	6.6%	small 17.4%	16.5%	40.5%
	6.6-10.5 lbs	eco 3.0%	20.8%	fast 13.1%	36.9%
	10.6-25 lbs	3.0%	large 12.9%	6.7%	22.6%
Total		12.6%	51.1%	36.3%	100%

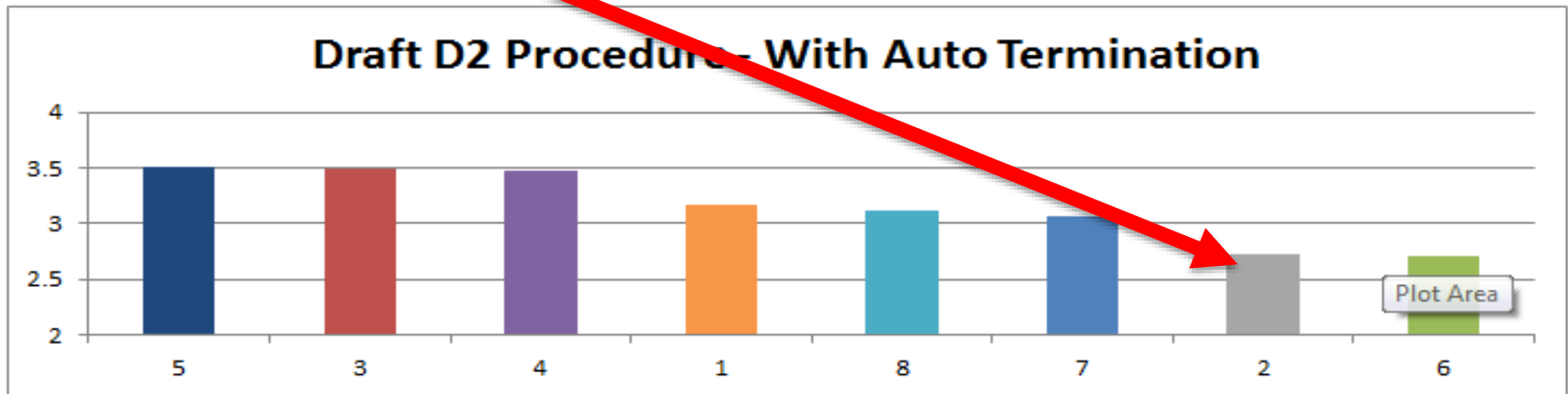
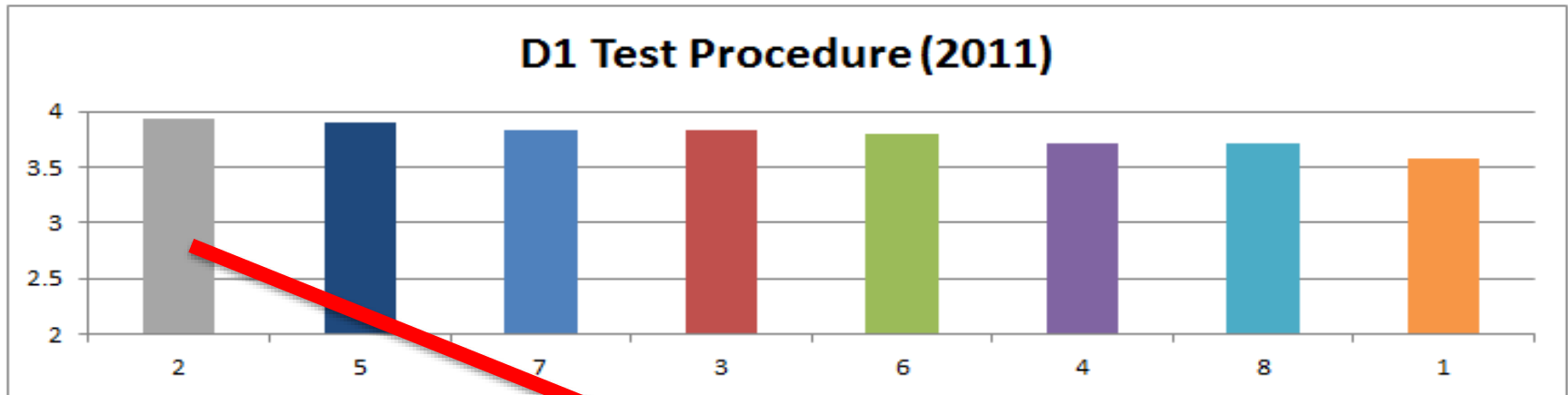
Fed Test Procedure evaluates performance under conditions seldom used

Current D1 Test Procedure is not a good performance predictor

Best Dryer



Worst Dryer



Dryer Supplemental Test Procedure

Combination of 5 tests – 4 with real clothing

Test	Common Test Name	Load Type	Cycle Setting	Cycle Temp	Nominal Weight (lbs)	IMC	RMC
DOE Test	D2	DOE Test Cloths	Default	High	8.45	57.5%	2%
One	Small	Supplemental Test Load	Normal	Medium	4.2	62%	4%
Two	Large	Supplemental Test Load	Normal	Medium	16.8	62%	4%
Three	Eco	Supplemental Test Load	Mfr Defined	Mfr Defined	8.4	62%	4%
Four	Fastest	Supplemental Test Load	Heavy Duty	High	8.4	62%	4%

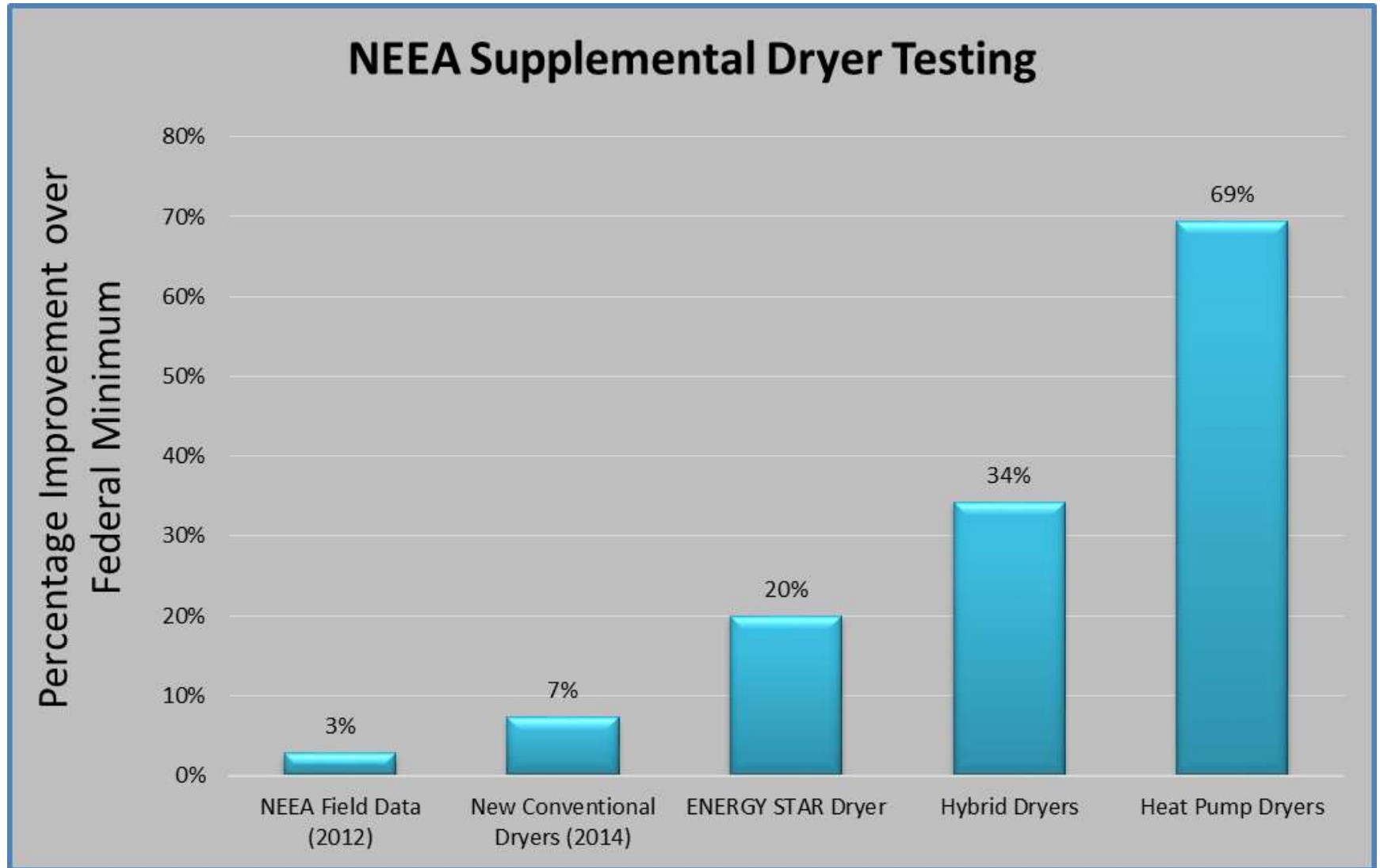
DOE Test Cloth



Supplemental Test Load - Land's End catalogue



Dryer Performance Comparison



Qualified Products List

Tier 1 Clothes Dryers

EPA Website <https://www.energystar.gov/productfinder/product/certified-clothes-dryers/results>

Tier 2 and above Clothes Dryers - LAB TESTED WITH SUPPLEMENTAL (real clothing) TEST PROTOCOL

Product Brand	Model	Tech	Type	Volume (ft3)	RTF Tier	Savings (kWh/yr)	UCEF	D2 Drying Time (min)	Test Date & Lab
-- any --	ENERGYSTAR	Conv	Vented	varies	1	93	3.0	62	Q4 2014 Ecova
Beko	HPD24412#	HP	Ventless	4.1	6	513	8.3	76	Q3 2015 UL
Blomberg	DHP24412#	HP	Ventless	4.1	6	513	8.3	76	Q3 2015 UL
Blomberg	DHP24400#	HP	Ventless	4.1	6	513	8.3	76	Q3 2015 UL
LG	DLHX4072#	Hybrid	Vented	7.3	2	183	3.5	59	Q3 2015 UL
Kenmore	8159#	Hybrid	Vented	7.3	2	183	3.5	59	Q3 2015 UL
Whirlpool	WED99HED##	Hybrid	Ventless	7.3	2	228	3.7	62	Q3 2015 UL
Whirlpool	WED7990F#	Hybrid	Ventless	7.4	3	325	4.1	76	Q2 2016 UL
Whirlpool	WED9290F#	Hybrid	Ventless	7.4	2	228	3.9	67	Q2 2016 UL
Whirlpool	WHD3050##	HP	Ventless	4.3	4	411	5.3	99	Q3 2016 UL
Whirlpool	WHD3090##	HP	Ventless	4.3	4	411	5.2	98	Q3 2016 UL

"#" indicates a place holder for sub-model specification designation. For example, "W" typically indicates white color.

Clothing Wear Study

a search for non-energy benefits

– Research Team

- Ecos Research
- Underwriters Laboratory
- Texas State University – Textile Scientist
- Funding and technical direction by NEEA and PG&E

– Study Details

- Clothing set of mixed fabric types
- 5 Clothing Wear Tests of 25 dryer cycles
- Pre, During and Post condition evaluation

Testing Conducted

- Load & lint weight—every 5 cycles
- Spectrophotography—beginning and end
- Photography—every 5 cycles
- Fiber Strength (per ASTM D5034) —after 25 cycles
- Microphotography—after 25 cycles
- Consumer evaluation—after 25 cycles

Testing



Key Findings

- No significant clothing wear differences
- Longer drying times does not increase damage
- Consumers preferred hybrid dryer
- Most laundry damage occurs when fibers are wet*
- Once clothing is dry, very little damage occurs

* Mostly during wash cycle - Literature review supported

NEEA Dryer Field Studies

- Whirlpool – WED99HED Q1 2015
 - 10 Homes in Portland metro
- Blomberg – DHP24412 Q3 2015
 - 10 Apartments in Renton WA
- LG – DLHX4072 Q3 2016
 - 10 Homes in Boise metro

Reminder: These studies are small samples, results are indicative, but not statistically significant

Field Testing of SEDs

1. Customer experience and satisfaction
2. Real world performance
3. Data for Federal Standards

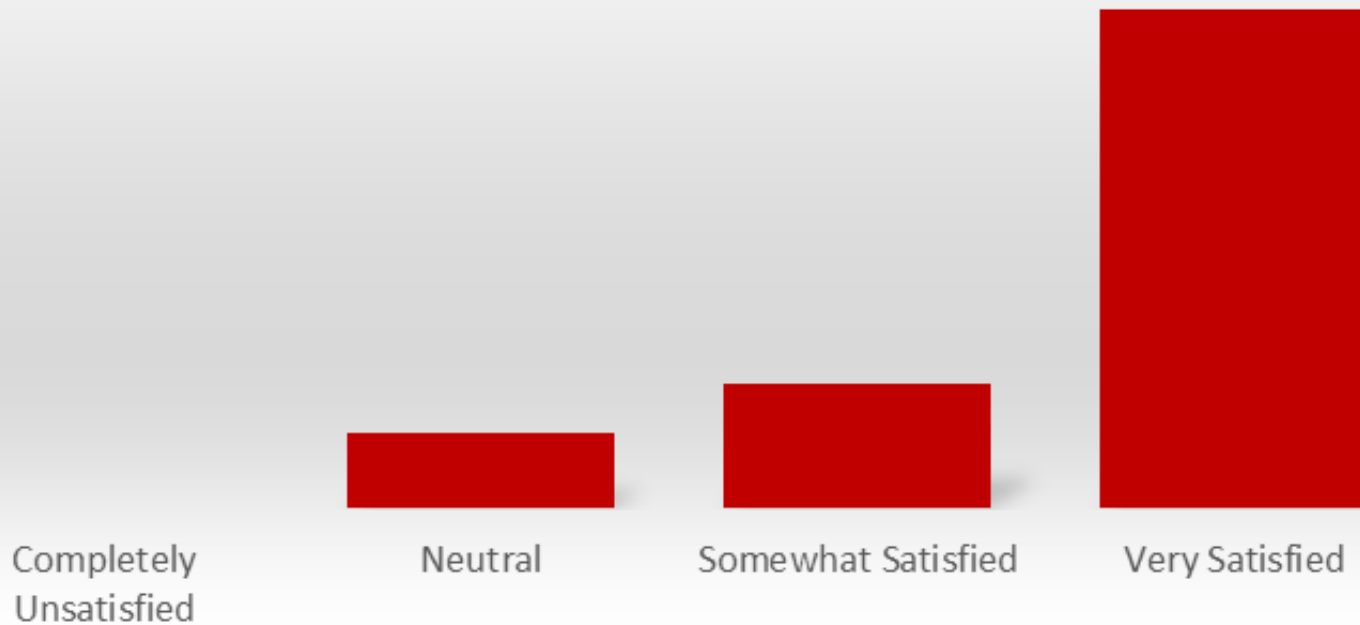


SEDI Field Study Protocol

1. Washer and dryer energy use
2. Participant records
 - Load weight
 - cycle setting
 - experience notes
3. 10+ cycles of pre-existing machine
4. 20+ cycles of new machines
5. Customer experience survey

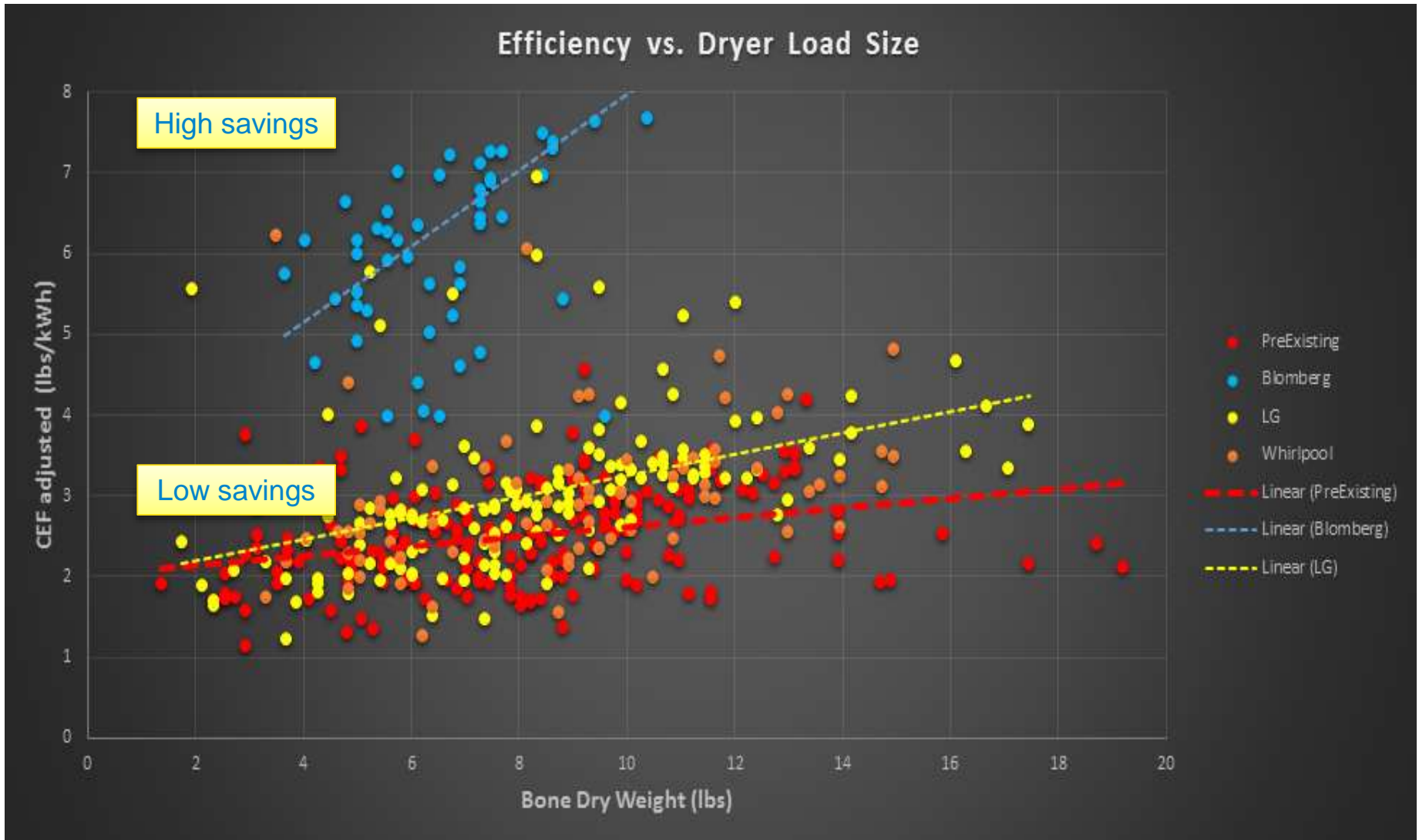
Customer Satisfaction

Field Test Satisfaction Questionnaire



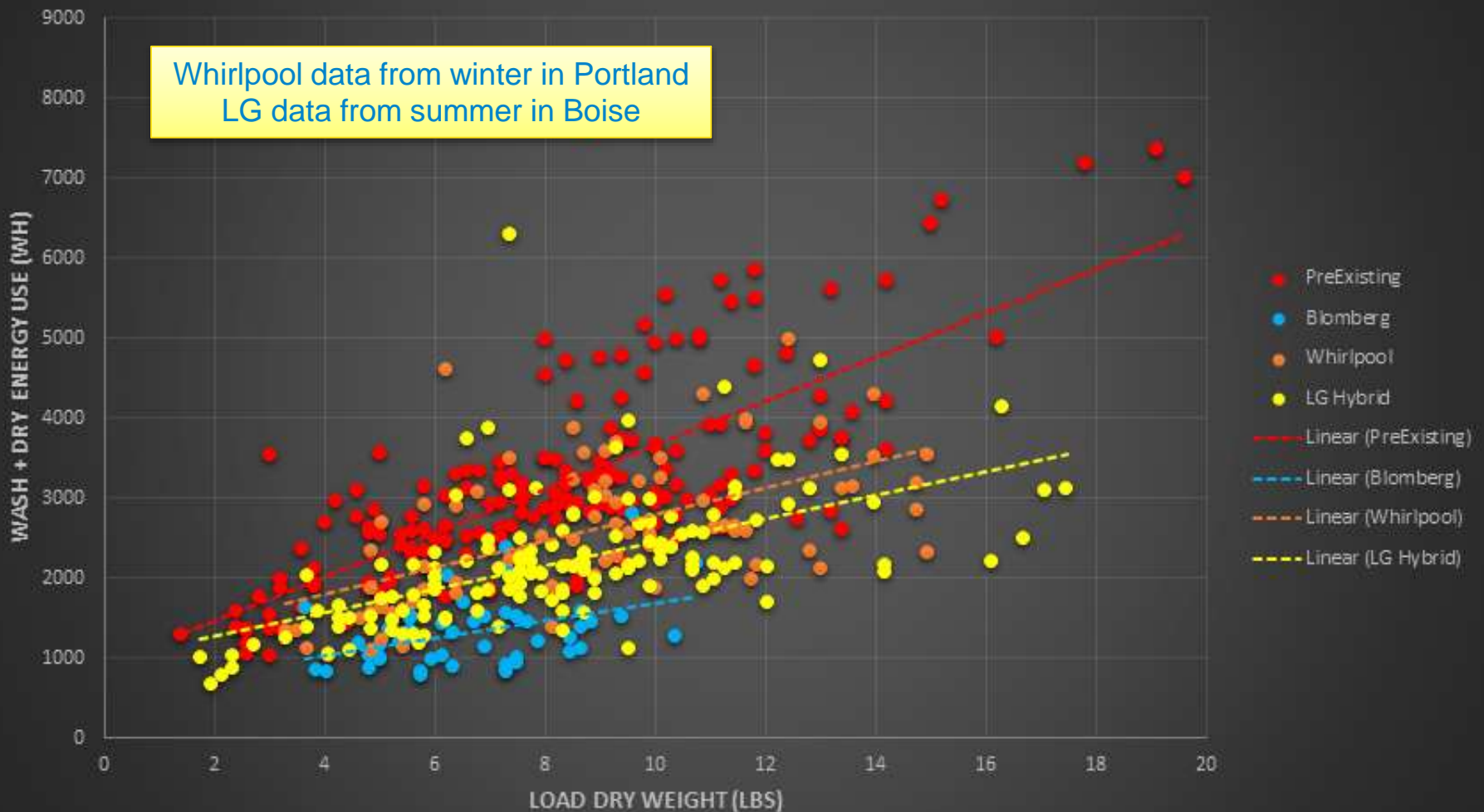
Total Sample size is only 28 Participants

Dryer Performance



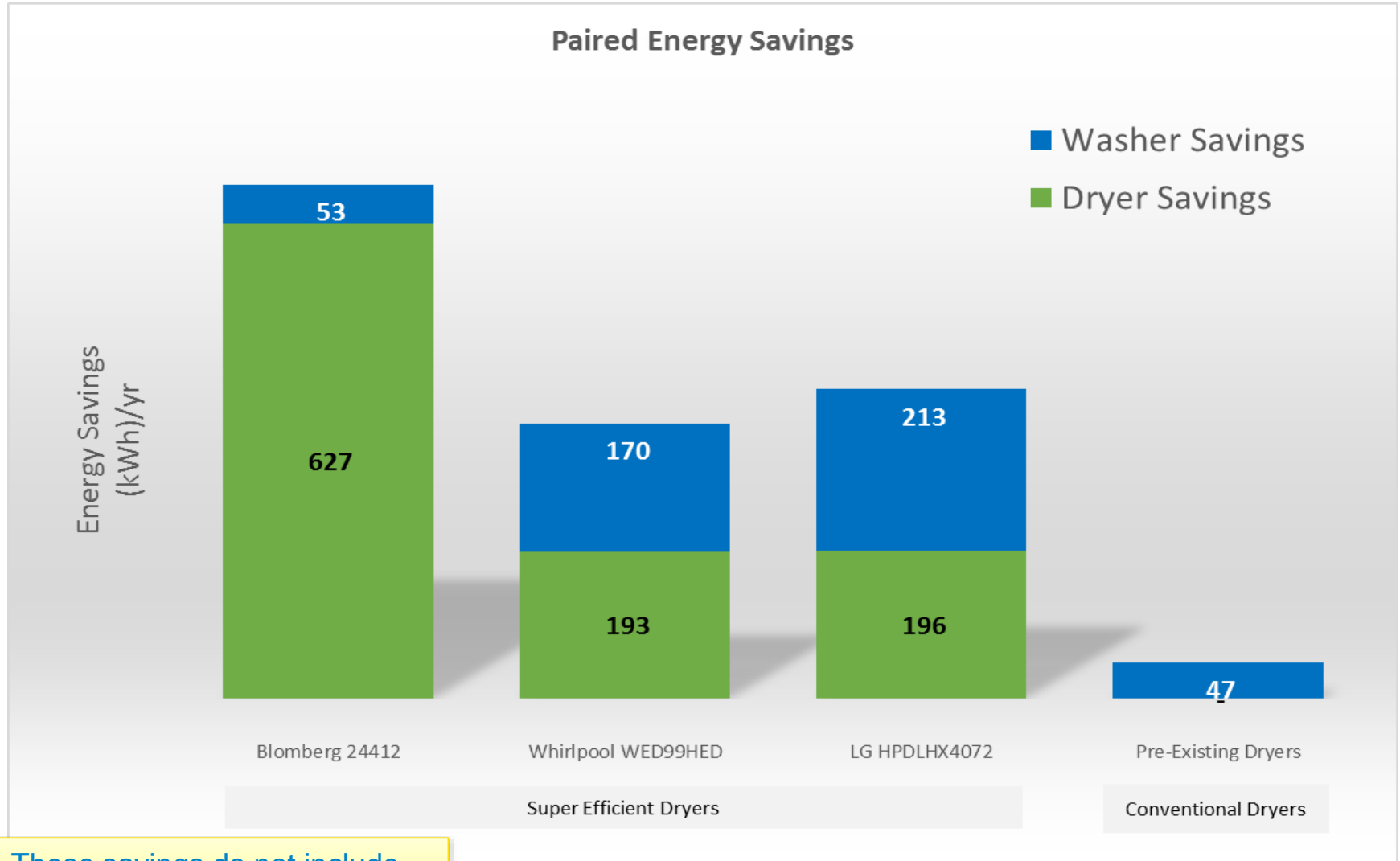
Washer + Dryer Energy Use

Washer+Dryer Energy Use vs. Bone Dry Weight



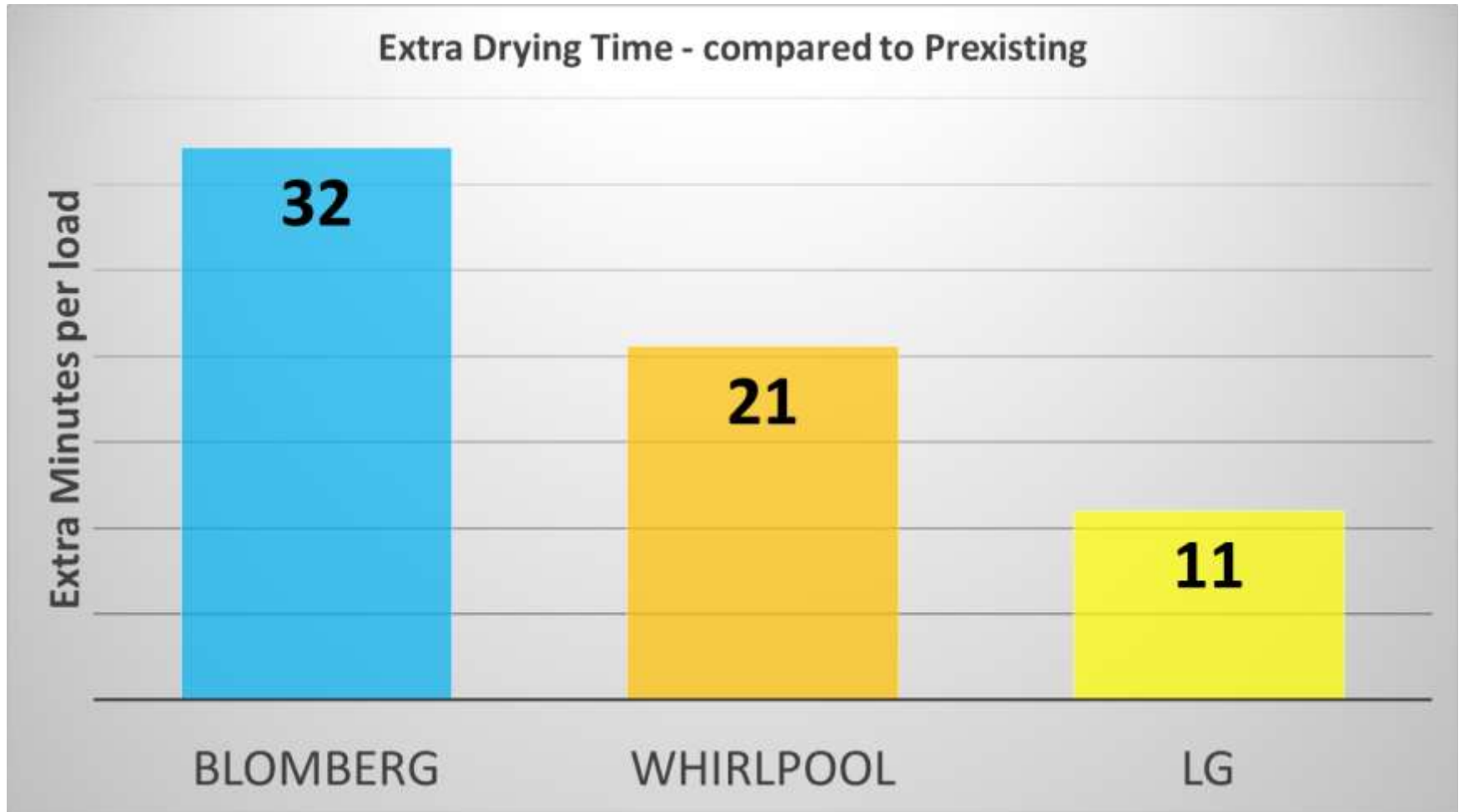
Savings are Good

(Compared to Pre-Existing Machines)



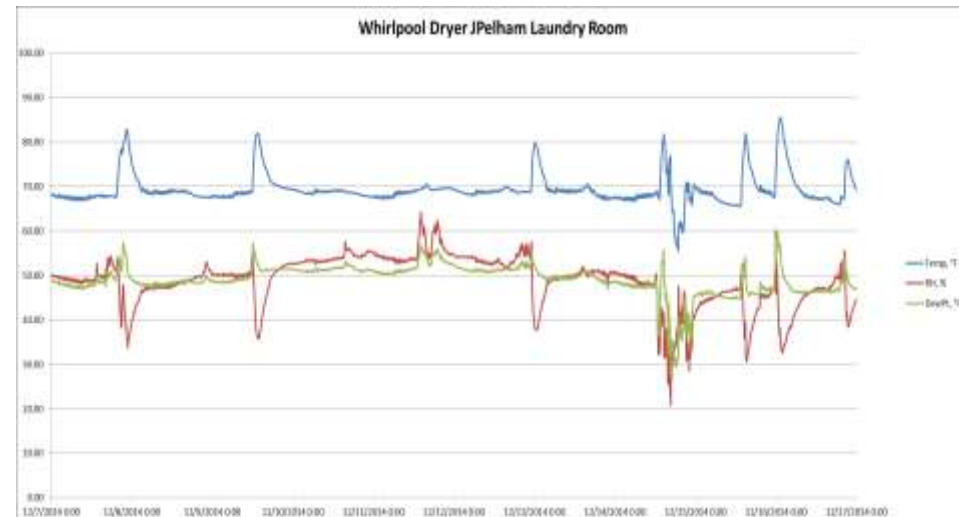
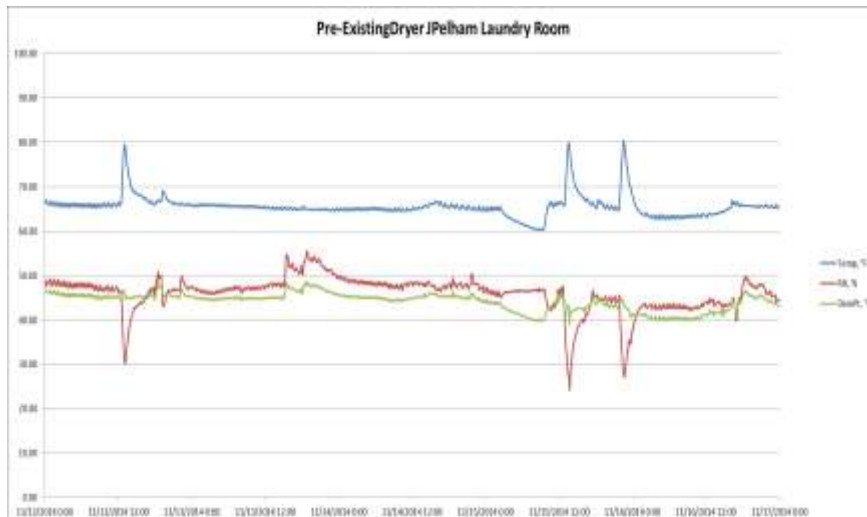
These savings do not include HVAC savings for ventless dryers

Drying Time is a little longer



Room Temp and RH

- Minimal impact on most laundry rooms
- Ventless dryers should not be placed in small enclosed spaces – some air circulation is needed
- Heat benefits heating climates, but adds to cooling loads

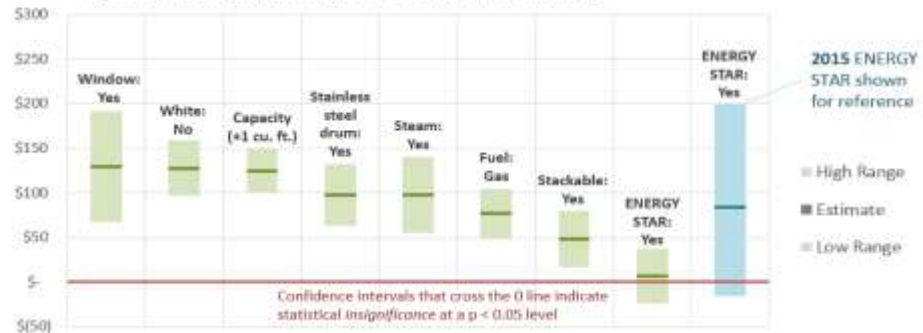


IMC & Savings

- TIER 1* vented	-\$24 to +\$38	93 kWh/yr
- TIER 2 vented	+\$300 to +\$450	183 kWh/yr
- TIER 3 ventless	+\$300 to +\$450	325 kWh/yr
- TIER 4+ ventless	+\$200 to +\$600	411 kWh/yr

ENERGY SOLUTIONS April 2017 – Hedonic pricing model

2017: 'ENERGY STAR' is the Only Statistically Insignificant Attribute in the Clothes Dryer Hedonic Price Model
[\$ Coefficient Estimates and 95% Confidence Intervals]



* aka ENERGY STAR

Super-Efficient Dryers

- Well establish technology – but new to the USA
- Save 20-60% in energy costs (\$20-120/year)*
- Take 10-30 minutes longer to dry medium load
- Slightly gentler to clothing (despite longer time)
- Lower fire risk – no flame or hot element
- Ventless is good in heating climates, but perhaps not great hot humid climates
- Incremental Measure Cost = \$300-\$400 over equivalent featured conventional dryer

* Depending on your local utility rates, and the model chosen

Super Efficient Clothes Dryers Ready for Market Adoption!

TOGETHER We Are Transforming the Northwest



Calibration of UCEF Metric

Setting Weightings of Different Dryer Tests

■ Lab Test ■ 2012 Field Test ■ Whirlpool 2015 Field Test ■ LG 2016 Field Test ■ Blomberg 2015 Field Test

