



January 25, 2013

Abigail Daken
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

RE: ENERGY STAR® Clothes Dryers Draft 1 Version 1.0 Specification

Dear Ms. Daken:

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SCGC), and San Diego Gas and Electric (SDG&E) in response to the Environmental Protection Agency (EPA) ENERGY STAR® Clothes Dryers Draft 1 Version 1.0 Specification.

The signatories of this letter, the California Investor-Owned Utilities (IOUs), represent some of the largest utility companies in the Western United States, serving over 40 million customers. As energy companies, we understand the potential of appliance efficiency specifications to cut costs and reduce consumption while maintaining or increasing consumer utility of the products and preserving electrical safety and grid reliability.

Clothes dryers have become ubiquitous in US households with nearly 80% penetration. In total, dryers now represent a \$9 billion annual national energy bill—about 6% of residential electricity consumption and 2% of residential natural gas consumption. They consume as much electricity per year—60 billion kWh—as the entire state of Massachusetts, and are responsible for 40 million metric tons of annual carbon dioxide emissions. Curbing energy consumed by these products has become a global concern. As EPA prepares Draft 2 of the ENERGY STAR specification for clothes dryers, we strongly urge EPA to consider the following comments.

**SIGNIFICANT OPPORTUNITIES EXIST FOR COST EFFECTIVE ENERGY SAVINGS,
ESPECIALLY FOR ELECTRIC DRYERS**

Vented, full-sized electric and natural gas dryers account for 99% of the U.S. dryer market¹. Electric dryer operating costs are higher than natural gas because electric dryers require significantly more source energy than gas and cost their customers significantly more to operate per load of clothing dried. As a result, efficiency improvements to electric dryers can be more cost-effective than the same improvements implemented on natural gas dryers. For this reason, these comments focus on promising efficiency improvements to vented electric, full-sized dryers.

¹ <http://eec.ucdavis.edu/aceee/2010/data/papers/2224.pdf>

The California IOUs recommend that ENERGY STAR pursue a specification at least as stringent as proposed in its Draft 1 specification (e.g. 13% for electric dryers), if not more stringent. Our technical consultant Ecova estimates based on laboratory research and numerous other sources that savings of 15-25% are cost-effectively achievable today, justifying a stricter specification for full-sized electric dryers. In this letter, we recommend an implementation timeline for the ENERGY STAR specification, and we summarize research to date on cost-effective modifications to electric dryers.

A MORE STRINGENT SPECIFICATION IS ACHIEVEABLE AND COST-EFFECTIVE

In its Market & Industry Scoping Report,² ENERGY STAR identified a number of design upgrades to improve the energy efficiency of dryers. From this list, we chose several of the most promising upgrades to research further, evaluate for cost-effectiveness and support with laboratory testing. These improvements include adding insulation, adding an air-to-air heat exchanger, and modulating heater power and airflow (Table 1). Total energy savings projected with all modifications range from 15-25%. We are in the process of retrofitting a commercially available dryer and are gathering preliminary results. The goal of this project was to understand how much energy a combination of improvements can save, as well as potential interactions among the modifications.

Table 1: Electric Vented Dryer Modifications and Associated Savings Potential

Modification	Estimated site energy savings (%)		Total Estimated Incremental Consumer Cost (\$)	Estimated Payback (years) ³
	Estimated	Measured ⁴		
Insulation	2-6%	2%	\$27-31	4-14
Air-to-air heat exchanger	15%	15%	\$120-200 ⁵	7-11
Modulation of heater power and airflow	10%	TBD	\$50 ⁶ -\$200 ⁷	5-19
Total	25-28% ⁸	TBD	\$200-\$430	8-18

Below we discuss the preliminary results of our research.

Insulation Cost-Effectively Improves Efficiency by 2 to 6% over Conventional Dryers

Adding insulation between the drum and the dryer helps to better retain heat in the dryer enclosure. Previous studies by the European Union Ecodesign for Energy Using Products initiative and by DOE

² (2011) http://www.energystar.gov/ia/products/downloads/ENERGY_STAR_Scoping_Report_Residential_Clothes_Dryers.pdf

³ Used 920 kWh per year, at \$0.11 per kWh

⁴ The test procedure used was DOE 2011 with automatic termination.

⁵ IOU estimate for a condensing heat exchanger; DOE's estimate (\$80) cannot be compared directly because it is based on a smaller, non-condensing heat exchanger with controls for limiting condensation. DOE only considers a non-condensing heat exchanger because it assumes that condensation would require use of expensive stainless steel or glass to prevent corrosion. The IOUs assume that inexpensive aluminum fins could be used, as in air-conditioning systems. **The range reflects uncertainty in production volume and how cleaning is implemented (by the user or with a flushing system – both systems are currently commercially available).**

⁶ DOE estimate of multiple stage heater power and fan speeds, capturing most of the energy savings of fully variable modulation.

⁷ IOU estimate of fully variable heater power and fan speed.

⁸ Savings are generally multiplicative, not additive, which is why the total does not equal the sum of estimated site savings per modification.

estimate that insulation saves 3⁹ to 6¹⁰ % over conventional vented dryers, respectively. Our preliminary tests show a 2% efficiency gain from adding insulation using a method described in the following paragraph.

In our laboratory tests of this concept, we used 3/4-inch thick expanded polystyrene foil-faced insulation with an insulation value of R-5. The foil acts as a radiant barrier to reduce heat transfer and prevents pieces of insulation from breaking off into the dryer enclosure. We fully insulated the top, back and bottom of the cabinet with one layer of insulation. The greatest heat loss was through the back of the cabinet because of the presence of the heater there, so additional insulation on the back could achieve even greater cost effective savings than we measured. The drum comes very close to sidewalls, so we only insulated areas that did not inhibit drum rotation, about two-thirds of the total sidewall area. Similarly, we insulated some areas of the front wall where the insulation did not prevent the dryer from functioning. These relatively simple and inexpensive improvements increased dryer efficiency by 2% without impacting drying time.

Based on cost data collected through secondary research and outreach to suppliers, we estimate the incremental retail cost to consumers of adding insulation to be \$36, resulting in a payback period of approximately 4-14 years. Assuming an average dryer life of 16 years based on EPA's scoping document, payback periods shorter than about 12 years yield a good return on investment, indicating that the addition of insulation is a cost-effective energy efficiency improvement.

Air-to-Air Heat Exchanger Cost-effectively Improves Efficiency by Up To 26%

A dryer equipped with an air-to-air heat exchanger reuses waste heat coming out of the drum to increase the temperature of incoming air. When warming incoming air, the hot air leaving the drum is cooled to a lower temperature in the heat exchanger, condensing water as it cools. The DOE Technical Support Document evaluated a condensing exhaust heat exchanger, projecting a 14% savings.¹¹ The results from 1984 study by Lawrence Berkeley National Laboratory (LBNL) in which researchers modified and measured a dryer showed a 20-26% efficiency gain using a heat recovery ventilator as the heat exchanger¹². To test this concept, we also used a heat recovery ventilator as the heat exchanger. In Ecova preliminary laboratory measurements, the heat exchanger saved 17%, and reduced drying time by 18%.

Based on cost data collected through secondary research and outreach to suppliers, we estimate the incremental retail cost to consumers of adding an air-to-air heat exchanger to be \$170, resulting in a payback period of approximately 7-11 years. This result indicates that this modification could be a cost-effective energy efficiency improvement for electric dryers.

Modulating Heater Power and Airflow Improves Efficiency Cost-effectively by 10%

Fast airflow and high temperatures generally reduce drying time, though high exhaust airflow provides little benefit when the dryer is first coming up to temperature and when the load is nearly finished drying. As a general rule, optimizing dryers to minimize drying time uses more energy. Some dryers offer a slower drying option, typically labeled "eco-mode." So far, however, laboratory tests of a small sample of the early models to offer eco-mode have not consistently found resulting energy savings relative to other

⁹ <http://www.ecodryers.org/>

¹⁰ U.S. Department of Energy - Technical Support Document for Residential Dryers, EERE-2007-BT-STD-0010.

¹¹ U.S. Department of Energy - Technical Support Document for Residential Dryers, EERE-2007-BT-STD-0010.

¹² Hekmat, D. and W.J. Fisk. 1984. Improving the Energy Performance of Residential Clothes Dryers, Presented at the 25th Annual International Appliance Technical Conference, Ohio State University, May 15-16.

pre-set modes.¹³ A truly energy-saving “eco-mode” would modulate both the heater power and fan speed. Slower air movement allows more time for heat transfer and evaporation, still removing moisture from the clothing but not wasting as much heat to the exhaust air.

Conventional vented dryers draw the intake air over the motor, which spins both the blower and the drum, to reclaim the motor heat. This means there is less of an incentive to increase motor efficiency. In order to implement the high energy savings modulation, a variable speed blower motor is required, which is inherently a more efficient type of motor than those typically used in dryers today.

We estimate 10% energy savings are achievable by implementing modulation with a variable speed blower motor. A study by TIAX in 2005 measured efficiency improvements of up to 25% for small and medium load and 10 to 15% for large loads as a result of implement modulation. Drying time will be slower with modulation, though still within ENERGY STAR’s 50-minute time limitation.

The IOUs tested a compact 120 V dryer that utilizes low airflow and is commercially available today. The exhaust temperature was significantly lower than the conventional dryer, indicating less heat waste. In preliminary testing, the drying process was approximately 10% more efficient than conventional dryers, though the drying time was longer (58 minutes with the 2011 test procedure without automatic termination).¹⁴

Based on cost data collected through secondary research and outreach to suppliers, we estimate the incremental retail cost to consumers of adding fully variable modulation to be \$200, resulting in a payback period of approximately 19 years. DOE estimates multiple speed modulation (as opposed to fully variable) to cost \$50. This is likely a more accurate estimate of the most cost-effective modulation method because fully variable modulation is not necessary to achieve energy savings. Assuming multiple speed modulation can save 10% of energy, the payback would be only 5 years. This result indicates that modulation could be a cost-effective energy efficiency improvement for electric dryers.

IMPLEMENT A TWO-TIER SPECIFICATION WITH ADVANCE NOTICE OF THE SECOND TIER SPECIFICATION’S TIMING AND STRINGENCY LEVEL

In order to provide continued incentive for dryer manufacturers to pursue cost-effective energy efficiency improvements, we recommend that ENERGY STAR consider a two-tiered specification. Tier 1 would take effect quickly (Summer-Fall 2013) with the proposed Combined Energy Factor (CEF) levels.

One commercially available electric dryer (the Miele Little Giant) already meets the proposed CEF levels specified in the Draft 1, while others are close to these levels today and would need only minor refinements to qualify (Figure 1). Incorporating the improvements required by the forthcoming DOE standard, coupled with insulation and modulation, could allow most dryers on the market to meet the proposed specification with some increase in drying time. These changes would be fairly straightforward to implement and therefore could be done quickly.

¹³ Denkenberger, D., Mau, S., Calwell, C. and Wanless, E. 2011. Residential Clothes Dryers: A Closer Look at Energy Efficiency Test Procedures and Savings Opportunities. Ecova prepared for Natural Resources Defense Council.

¹⁴ The overall CEF showed a smaller improvement because the standby power of compact dryers relative to the energy used to dry clothing is larger than for conventional dryers. This standby power can be reduced by techniques explained in the DOE technical support document.

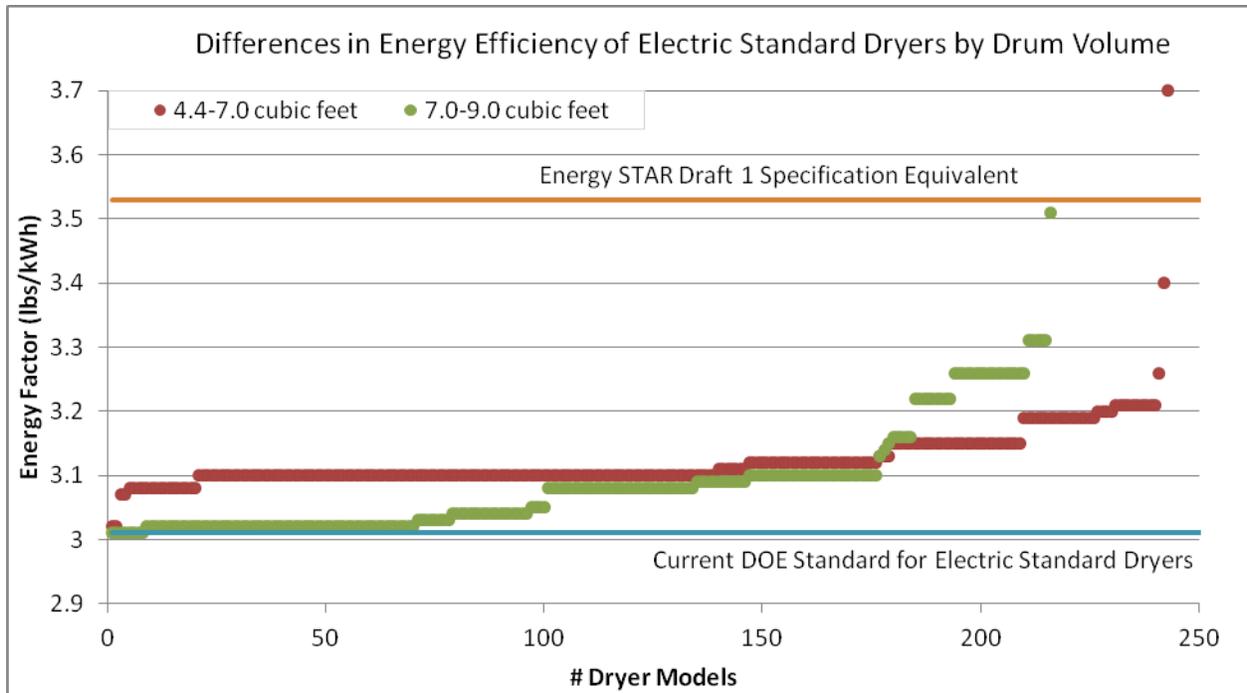


Figure 1. Energy factor of full-size electric dryers according to the 2005 test procedure.¹⁵

We proposed that Tier 2 (or Version 2) take effect coincident with the January 2015 release date of the U.S. Department of Energy (DOE) standard. By this time, manufacturers could make larger changes to the dryers, including the air-to-air heat exchanger. Therefore, we recommend that this specification be 20-25% more stringent than the mandatory standard for electric dryers, a 7-12% additional energy savings over Tier 1.

As when ENERGY STAR originally proposed its version 4 and version 5 specification levels for televisions, both tiers should be adopted simultaneously to give manufacturers as much advance notice as possible about the timing and the stringency of the second tier, so they can plan accordingly in their product design process. ENERGY STAR would reserve the right, as it did with televisions, to make minor updates to the second tier specification as its adoption date draws closer.

¹⁵ In order to determine how currently available dryer models compare to the proposed ENERGY STAR levels, conversion between test procedures and adjustment for changing standards are required. The available dryer energy use data uses the 2005 DOE test procedure. ENERGY STAR uses the 2015 federal standard as a baseline, which uses the 2011 test procedure. This standard will save 5% relative to the old standard. However, much of the savings is due to greater efficiency in standby mode, which is not measured in the 2005 test procedure. Therefore, we assume that the non-standby energy efficiency measured in the 2005 test procedure will need to increase 2% to meet the new standard. Then, the ENERGY STAR proposed levels would save 13%, which corresponds to a 15% increase in energy efficiency. Therefore, the ENERGY STAR proposed level we plot in figure 1 correspond to a 17% increase in energy factor above the old DOE standard.

MEASURE DRYING TIME ACCURATELY

We agree that a measurement of drying time is important for consumer satisfaction. However, when using the 2011 DOE test procedure without automatic termination, a typical full-size electric dryer can dry the test cloths (two dimensional 50% polyester/50% cotton) in under 30 minutes. As anyone who does laundry knows, drying often takes significantly longer than 30 minutes, so a more realistic test is required to compare to typical washing times. Therefore, we strongly encourage EPA to include an additional test that would measure the drying time of a more realistic test load. The AHAM 1992 test load uses actual articles of 100% cotton clothing with varying thicknesses and will be a better proxy for real-world drying times. We propose to measure automatic termination according to the manufacturers and advocates petition to the DOE. In addition, we recommend ENERGY STAR consider simulating real-world duct restriction according to the recommendation in the forthcoming NEEA comment letter to ENERGY STAR. Measuring drying time with more realistic conditions will give ENERGY STAR confidence in the real-world performance of the products that earn the label.

In conclusion, we thank EPA for the opportunity to be involved in this specification development process and encourage EPA to consider the recommendation outlined in this letter.

Sincerely,

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