A Call to Action for More Efficient Clothes Dryers:

U.S. Consumers Missing Out on $4 Billion in Annual Savings

While major appliances like air conditioners, refrigerators, and even clothes washers have undergone significant energy efficiency improvements during the past 20 years, the amount of energy wasted by clothes dryers in the United States has received little attention, and energy efficiency standards for them remain essentially unchanged. In fact, today's typical electric clothes dryer sometimes consumes as much energy per year as a new energy efficient refrigerator, clothes washer, and dishwasher *combined*. Currently, Americans spend $9 billion annually to operate their dryers, but extensive research by the Natural Resources Defense Council and its consultant Ecova shows that just updating residential dryers to the level of the most efficient versions sold overseas could save U.S. consumers a whopping $4 billion a year.[1] Now is the time to seize the massive energy savings opportunity more efficient dryers represent.

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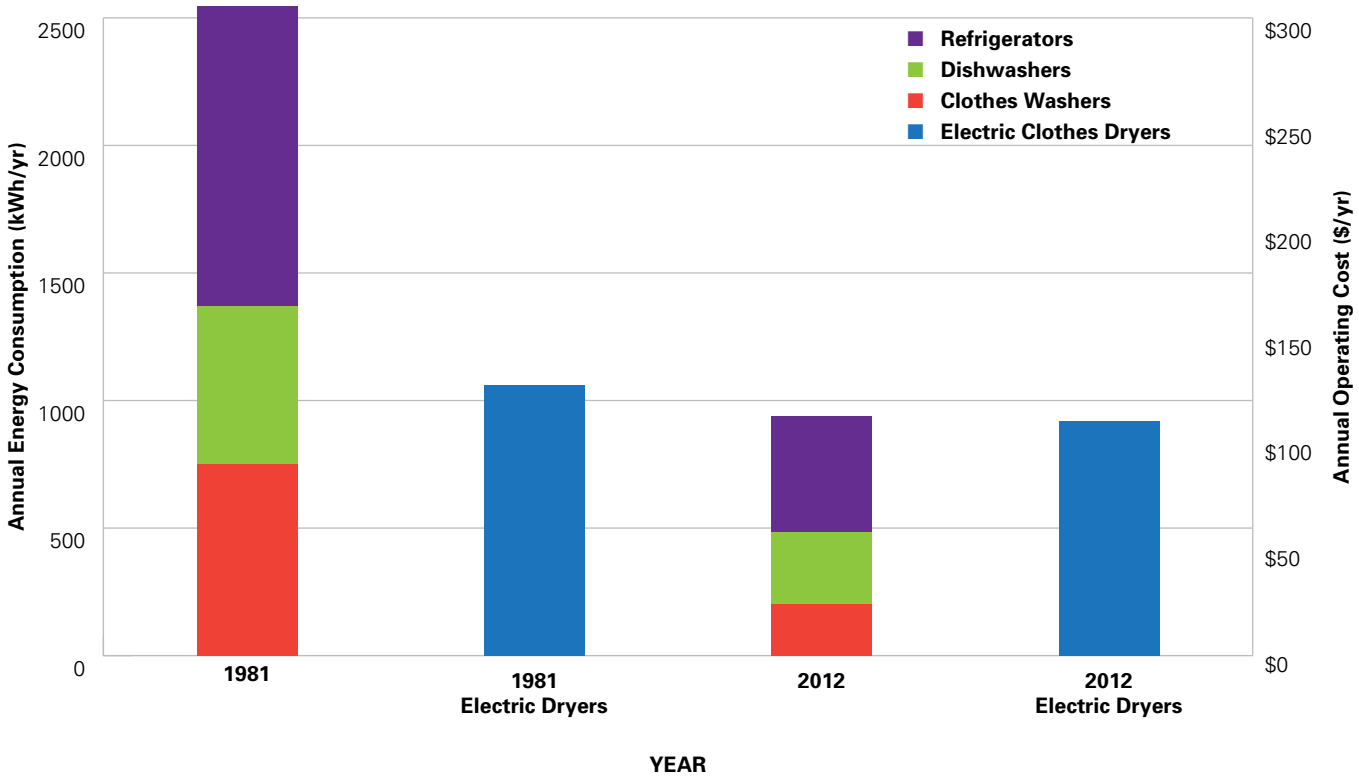
Other key findings from our testing and analysis:[2,3]

- There are 89 million residential clothes dryers in the United States (75 percent are electric models, 25 percent use natural gas). Although electric dryers dominate the U.S. market, natural gas dryers typically cost 50 percent to 75 percent less to operate.
- A typical household pays over $100 in annual utility bills to operate an electric dryer and $40 for a gas dryer. Homes with electric dryers pay at least $1,500 over the dryer's lifetime for the electricity to power the machine.
- If all of America's electric dryers were updated to the most efficient models sold in other parts of the world, U.S. consumers would not only save $4 billion worth of energy per year, it would prevent roughly 16 million tons of carbon dioxide emissions annually, equivalent to the pollution from three coal-fired power plants.
- U.S. policies for clothes dryers lag behind those for other appliances. More focus is needed to a) update the test method for measuring dryer energy use, b) develop improved dryers for the U.S. market, c) implement labeling programs such as ENERGY STAR™ to help consumers identify the most efficient models, and d) provide utility rebates for the most energy efficient models.
- How a consumer uses a dryer is almost as important as which dryer is purchased. Choosing a lower operating temperature can slow the drying process a little, but it cuts energy use significantly. Stopping the dryer before all of the clothes are bone-dry saves time and energy, while reducing wrinkles and helping clothes last longer.

BACKGROUND

Clothes dryers are arguably the most important of all residential appliances in need of an energy efficiency upgrade. Of the washer-dryer pair, clothes washers have received more attention with a complete makeover over the past two decades. Nearly half of all models now open from the front rather than the top, which allows them to spin more water out of the clothing and reduce energy and water consumption. Additionally, washers today contain sophisticated technology for optimizing detergent, energy, and water use across various sizes and types of loads, which means they use about 75 percent less energy and 40 percent less water than they did in 1981. This remarkable success was accelerated by substantial rebates from energy and water utilities over the years.

Figure 1. Annual energy consumption of electric clothes dryers vs. other major home appliances, 1981 and 2012



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.

New refrigerators and dishwashers have also made significant progress during this time, cutting energy use by more than half. Now it's time for the clothes dryer—the less glamorous laundry sibling—to become a critical focus of future energy savings efforts because it may be using as much energy as a typical clothes washer, refrigerator, and dishwasher combined.

Dryers have yet to participate in the appliance efficiency revolution in America. They are stuck in the 1970s when it comes to the kind of smart technology that can cut energy use and make clothing last longer. While manufacturers have made additional improvements in their laboratories and in some of the products they sell in other countries, many of these innovations have not been incorporated into the products offered in America. This is due to the lack of proactive government policies that would pull the next generation of more efficient dryers to the U.S. market. As a result, U.S. consumers spend billions of dollars more per year drying their clothes than necessary, and potentially even more than that replacing worn-out clothes because of exposure to excessive heating and tumbling in clothes dryers.

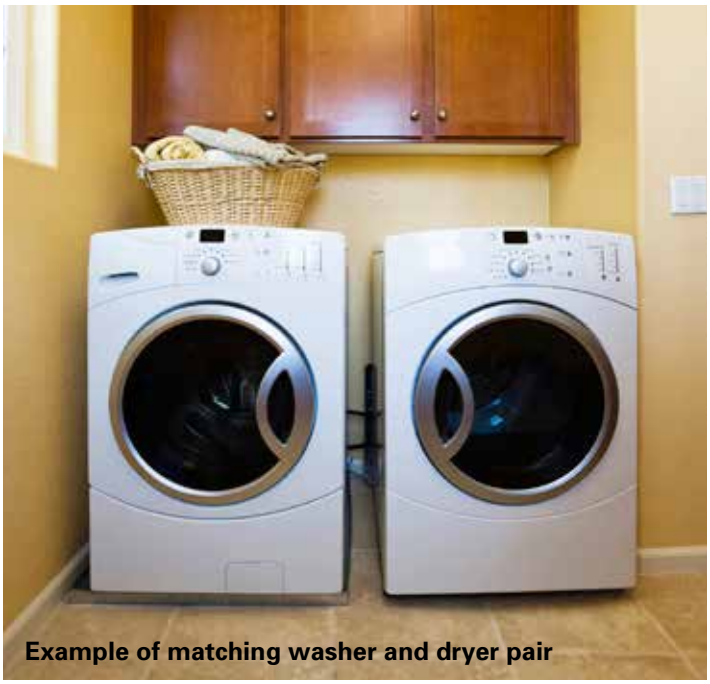
In Australia, Europe, and Asia, significantly more efficient dryer models already represent large percentages of dryer sales. If all of America's electric clothes dryers were updated to the most efficient models sold overseas, Americans would save about $4 billion worth of energy per year and about 16 million tons of carbon dioxide emissions, according to modeling performed by NRDC's consultant Ecova. This is equivalent to taking three coal-fired power plants—and their associated pollution—offline.

The Reasons Behind Dryers' High Energy Use

Why do clothes dryers use so much energy? Five basic factors are at work:

1. Decades-old technology. Most clothes dryers are incredibly simple inside: equivalent to an oversize hair dryer connected to a big, spinning metal drum. They bake the water out of clothing with brute force, wasting a lot of energy because of the inefficient way they heat the air that goes into the dryer.

2. Government has failed to push industry to improve. California and the federal government have published or updated mandatory efficiency requirements for refrigerators seven times since the 1970s. However, during that same period, the federal government has published or updated its clothes dryer standards just three times, capturing only modest energy savings on each occasion. Prior to May 2014 there was no ENERGY STAR specification for clothes dryers (with the label, consumers will be able to more easily identify the models that exceed federal efficiency standards and these ENERGY STAR models are expected to be available before the end of 2014); no mandatory EnergyGuide labeling to help consumers compare the energy use of different models as is required on many other appliances; and no widespread utility rebate support for significantly more efficient clothes dryers. Government policies can and should do more to improve dryer efficiency and reduce consumers' drying costs.



Example of matching washer and dryer pair

3. Consumers have a surprising preference for electric over gas models. Almost 60 percent of U.S. households consume natural gas for some fraction of their energy use, typically to heat their homes or to heat water. Where natural gas is available, it tends to be one of the lowest-cost ways to provide on-site heating in a home. The same is true of drying clothes: It costs about 50 to 75 percent less to do so with natural gas than with electric resistance heating. Yet only 25 percent of U.S. households have a gas dryer, meaning the majority of homes with access to natural gas are missing an opportunity to cut their energy bills by switching from an electric to a natural gas clothes dryer.

4. Dryers have to work harder when washers don't extract as much water as they are capable of. Most new clothes washers are equipped with faster, more powerful motors that are capable of spinning clothes at higher speeds and for longer periods than older models. This should give dryers far less work to do, as the clothes coming out of the washer hold less water. Yet data from the field show that dryer energy use per home has dropped only modestly over the past 25 years. Users may not be selecting the most efficient settings on their washers, and small, unbalanced loads can make it difficult for washers to achieve their full spin potential. That means dryers sometimes have to work harder to eliminate moisture from clothing. Furthermore, the effectiveness of dryers' termination controls varies, meaning that some dryers keep tumbling and cooking clothes for 20 to 30 minutes even after the clothes are dry.

5. Convenience trumps energy savings in the U.S. market. Any method of drying clothing trades energy use for convenience. For example, line-drying requires no purchased energy but is too inconvenient and time-consuming for most Americans. Most popular U.S. dryers do their work quickly but require a considerable amount of energy. In parts of the world that use less energy to operate clothes dryers, the drying process takes significantly more time. The U.S. market is unique in favoring very large dryers that run at high temperatures to dry clothes as quickly as possible. These designs commonly overdry clothing, which wastes energy and accelerates clothing wear and tear. Today's dryer drums also tend to be mostly empty while they're operating; this wastes energy because the dryer heats the drum and the air inside it instead of the water in the clothing.

Because U.S. clothes dryers have not been differentiated by energy use, manufacturers and retailers market dryers primarily on the basis of purchase price, capacity, features, and speed. Manufacturers also design the dryer cabinet to precisely match the size, style, and color of the companion washing machine, hoping to persuade customers to buy a set when they upgrade the washer (about 70 percent of all dryers are sold as half of a laundry pair). Washers and their matching dryers typically sell for the same price, yet washers are far more expensive to produce and are the primary way manufacturers distinguish their laundry pairs from the competition. As a result, most of the profit in selling laundry appliances comes from the dryers, giving manufacturers an incentive to keep the upfront cost of the products as low as possible and discouraging energy efficiency innovation.

TEST METHODS

One of the biggest barriers to improving clothes dryer efficiency is the failure of the U.S. Department of Energy (DOE) to properly measure how clothes dryers actually perform. More than 150 million dryers have been sold in the United States in the 27 years since the federal government started regulating dryers, but without an effective means of differentiating efficient from inefficient models.

The current, flawed energy efficiency tests for dryers make it tricky for consumers and utilities to figure out which ones are the best and how much energy they use. Unlike nearly every other appliance, dryers lack the yellow EnergyGuide labels that tell consumers how much energy a given model consumes. But until DOE tests dryers more accurately, an EnergyGuide label could prove more confusing than useful.

There are several key problems with the way in which the energy use of dryers is measured today:

The test load doesn't reflect real-world laundry loads. To test a dryer, the DOE must use a representative laundry load so that measured energy consumption is consistent with real-world use. Many years ago, the DOE decided to test dryers with a load composed exclusively of thin, synthetic cloths similar to a dinner napkin or dish towel. These are not as heavy, thick, or challenging to dry as the items in a typical household load, like jeans and towels. The dryer doesn't have to work as hard to dry the test cloths, and in most cases, this produces an artificially low number for a dryer model's energy use.

Only one setting is tested. Many consumers select dryer settings according to the size of the load, the fabric of the clothing, how dry they want their clothes to be, and how fast they need dry clothes. Yet the DOE tests dryers in only one setting, despite testing washers in several different settings and load sizes. Not all U.S. households use their dryers in the same ways, but in its testing, the DOE acts as if they do.

Old test methods do not measure accuracy of controls. Prior to the new testing rule that takes effect in 2015, DOE has never measured how effectively dryers stop their cycles once the clothes are dry. They give all models with "automatic termination" capability a fixed 13 percent energy credit but do not measure how well that capability works. The best automatic termination designs save about 15 percent to 20 percent of total energy use—and reduce unnecessary clothing wear and tear—simply by shutting off promptly when they sense that the clothes are dry. But the worst automatic termination dryers can use even more energy than dryers running simply on a timer. The EPA is requiring use of DOE's new test procedure that auto-terminate capabilities be tested for those dryers seeking the voluntary ENERGY STAR label. But these models can be tested the old way to meet mandatory federal standards, even though most consumers dry clothes using an automatic termination setting. It's very difficult to make energy efficiency comparisons when the government allows models to be tested using two different methods.

Drying time is not reported. A given load of clothes will take less energy to dry if the heat is reduced and the clothes spin for a longer period. But well-designed automatic termination circuits in a dryer can save energy use and time. The only way to fairly compare the performance of one dryer to another is to know its energy use and its drying time, but the DOE does not require manufacturers to report the latter.

Utilities can help by conducting additional testing on the most promising new models they intend to offer rebates on to consumers. These new tests are more challenging and realistic than current government testing. ENERGY STAR will require disclosure for the drying time for the efficient models that bear its label.

GAS VS. ELECTRIC VS. HEAT PUMPS: HOW DO THEY COMPARE?

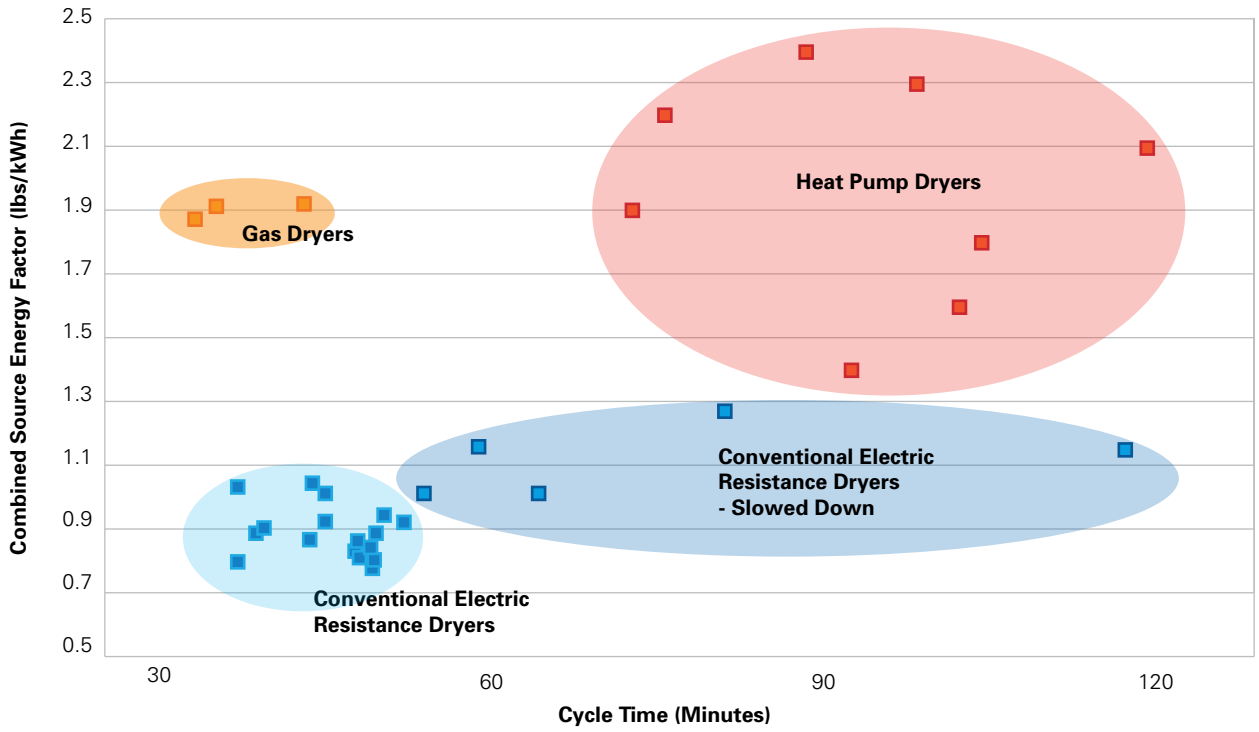
Early field testing in the Pacific Northwest and laboratory testing at Ecova both show that clothes dryers use more energy in real-world operation than the federal government estimates, increasing the value of the energy savings that would be produced by improving the energy efficiency of dryers. The data also show that an electric clothes dryer can draw 5,000 watts or more of peak power when its internal heater is operating, making dryers one of the largest single electric loads in the home during operation.

One simple strategy for improving dryer efficiency is to turn down the heating element and slow the drying process. This simple step, which most consumers can perform by switching their dryer to run in "delicates" mode or another low-heat setting, can save a modest amount of energy. Some newer dryer models offer an "eco mode," which sometimes saves more energy but takes longer to complete.

Many dryer models sold in Europe, Australia, and Asia incorporate heat pump technology, which creates heat more efficiently by collecting it from the drum outlet air (see "What Makes Heat Pumps Better?" on Page 6). This technology is poised to enter the U.S. market in late 2014 or early 2015. Lab testing suggests heat pump models can save 50 to 60 percent of the energy used by conventional electric dryers, depending on design. One key drawback is that most European heat pumps tested so far have longer drying times than Americans are accustomed to.

Another option is to turn natural gas into heat inside the dryer, instead of having the utility convert the fuel to electricity, send it over wires to a home, and then turn the electricity back into heat. Comparing the total energy consumption of electric versus natural gas dryer models is tricky; one must take the comparison all the way back to the origins of each energy source instead of looking only at energy use in the dryer. Figure 2 illustrates the source energy use and drying time for three technologies. Natural gas dryers are the clear winner compared to an electric resistance dryer fueled by an electric power plant as they are relatively efficient (a higher combined source energy factor represents a higher degree of energy efficiency) and fast. Conventional electric resistance dryers are fast but waste energy; they can be marginally more efficient, but slower when run on a lower temperature setting. Heat pumps have the potential to be the most efficient and environmentally friendly option (especially if their electricity is largely supplied by renewable energy sources), but they also take the longest to dry a given load of laundry.

Figure 2. Source energy–adjusted efficiency vs. drying time for different drying technologies



Each of the boxes in this figure represents individual dryer models on the market today. Source energy accounts not only for the energy used at home to dry the clothes, called site energy, but also the energy losses incurred during electricity generation and transmission to the home.

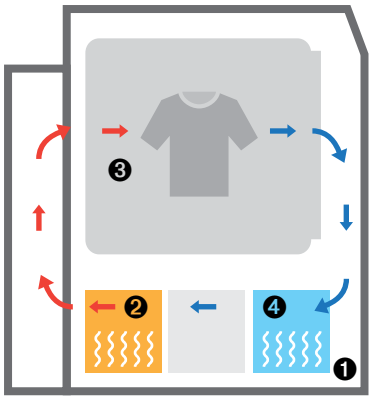
MAKING A BETTER DRYER

Conventional electric dryers run quickly but use too much energy. Heat pump dryers save energy but take more time. Natural gas dryers best balance drying time and energy use, but many U.S. households do not have access to natural gas or might object to the cost to extend existing gas lines to the laundry area where the dryer is located.

Conventional electric dryers can be made to use less energy by more accurately monitoring temperature, humidity level, and clothing dryness to prevent over-drying. The dryer's outgoing hot air can also be used to help warm the incoming cool air through a heat exchanger. Dryers can also be manufactured to save energy by gradually throttling down the heat and airflow periodically at particular times during the drying cycle.

What Makes Heat Pumps Better?

Instead of creating heat from scratch, heat pumps collect heat from the drum outlet air and concentrate it within the dryer's drum, thus saving energy. European heat pump models usually condense the water out of the laundry into a tank, rather than venting it outdoors as steam, because European homes often lack laundry vents. These models are very energy efficient but are typically smaller, slower, and more expensive to purchase than U.S. dryers. Heat pumps introduced into the U.S. market may combine the best of both worlds, allowing users to choose a mix of conventional electric resistance heating (for speed) and heat pump heating (for efficiency) when the user is not in a hurry. They will have a bigger drum volume, like typical U.S. dryers, and may allow moisture to vent outdoors as well. These design changes should yield faster drying times than in Europe, while still delivering energy savings of 40 percent to 50 percent relative to standard U.S. dryers.



RECOMMENDED ACTIONS FOR CONSUMERS, MANUFACTURERS, UTILITIES, AND POLICYMAKERS

We can convert dryers from energy wasters to energy savers through a variety of actions that have the potential to reduce electricity consumption by about 40 percent by 2030, according to modeling by Ecova. To determine the amount of energy that dryers could save, we considered the impacts of the technical and policy changes described in Table 1 on Page 7. Particularly important for long-term energy savings is a strong federal energy efficiency standard. Once significantly more efficient models enter the market, utilities should consider offering early incentive programs to permanently retire and recycle functioning electric dryers and replace them with substantially more efficient ones. Already, leading utilities across the nation are working together through the Super Efficient Dryer Initiative (SEDI) to help accelerate the shift to dryers that don't waste as much energy. In order to make this transition possible, consumers, utilities, manufacturers, and the federal government must work together to demonstrate the cost-effectiveness and user acceptance of advanced dryer technologies.

In the meantime, consumers can dramatically reduce the amount of energy used to dry laundry without buying a new machine. The first step is to lessen the amount of water in the clothes before they enter the dryer by using the maximum speed of the washer's spin cycle. If not in a rush, consumers can choose lower temperatures and slower settings on the dryer. Filling the drum about two-thirds to three-quarters full, if possible, gives the clothes room to tumble but minimizes the wasteful heating of empty space inside. Drying two or more loads consecutively also saves energy because the drum is already heated for the next load. If natural gas is an option, consumers with electric dryers should consider switching. By the end of 2014, ENERGY STAR–labeled dryers will be available for the first time. These models will be more efficient, and the label will provide an easy way for consumers to identify the energy-saving models. Over time, consumers should consider migrating to heat pumps or other super-efficient dryer technologies as they become available. And, of course, consumers can save the most energy by simply line-drying clothing.

Table 1: NRDC Recommendations for Manufacturers, Utilities and Government Agencies to Help Reduce Dryer Energy Use			
Stakeholder	**Near-Term: Easier Actions**	**Mid-Term: More Ambitious Actions**	**Long-Term: Maximum Savings Potential**
Manufacturers	■ Ensure dryers provide information to users on efficiency of settings chosen. ■ Test and certify as many models as possible using automatic termination. ■ Assist in development of more realistic test procedure.	■ Conduct R&D on promising new dryer technologies. ■ Introduce large number of ENERGY STAR-compliant models that meet targets without increasing drying time and offer even greater energy savings in optional slower modes.	■ Bring heat pumps and other advanced technologies like radio frequency drying, heat exchangers, and heat and airflow modulation to market to maximize energy savings.
Utilities	■ Support development of more fair and realistic testing to determine which products should receive rebates. ■ Provide rebates for most-efficient dryers. ■ Conduct field studies to determine baseline energy use and real-world savings potential.	■ Gas and dual-fuel utilities should rebate ENERGY STAR natural gas models and encourage gas line extension to the laundry area in new and existing homes. ■ Establish even higher rebates for heat pump or equally efficient technologies that can dry more quickly.	■ Test washers and dryers as a pair with realistic loads to determine typical energy savings and synergies from operating both as efficiently as possible.
Government Agencies	■ Publish test data on current dryer models measured with automatic termination. ■ Launch initial ENERGY STAR and Emerging Technology specifications for electric dryers.	■ Regularly update ENERGY STAR specifications to increase stringency. ■ Update test procedures to more accurately reflect real-world loads and use for electric dryers. ■ Change the metric for dryer efficiency from site energy to source energy so that requirements are technology neutral.	■ Test products with new test procedures and publish results. ■ Develop new mandatory standards and labeling on the basis of that new data.

ENDNOTES

1 Denkenberger, D, S. Mau, C. Calwell, E. Wanless, and B. Trimboli. 2012. *"What Lurks Beneath: Energy Savings Opportunities from Better Testing and Technologies in Residential Clothes Dryers."* Proceedings of the American Council for an Energy-Efficient Economy: Summer Study.

2 Denkenberger, D., S. Mau, C. Calwell, and E. Wanless. 2011. "Residential Clothes Dryers: A Closer Look at Energy Efficiency Test Procedures and Savings Opportunities." Ecova and NRDC.

3 Denkenberger, D., C. Calwell, N. Beck, B. Trimboli, D. Driscoll, C. Wold. 2013 "Analysis of Potential Energy Savings from Heat Pump Clothes Dryers in North America," Collaborative Labeling and Appliance Standards Program (CLASP).

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