Energy-efficient heat pump driers – European experiences and efforts in the USA and Canada

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Abstract

The use of clothes driers[1] is becoming more and more popular. As the penetration of electrically powered clothes driers increases in European homes, associated electricity consumption will increase considerably. However, energy efficient heat pump clothes driers consume only about half the electricity of conventional driers. The recent market success of this new technology should help to contribute to energy savings in Europe.

Only heat pump clothes driers are currently able to qualify for an "A" rating under the EU energy label. More than 34 models under 15 brands are currently offered on the European market for residential and semi-professional use and most of them are significantly more efficient than the actual "A" rating requirements. The sales share of all new clothes driers that have heat pump technology is highest in Switzerland (24.5% in 2009), but also substantial in Germany and Italy. Based on this success, the Swiss government will require all clothes driers sold in Switzerland to carry the "A" rating starting in 2012, effectively banning conventional driers. This successful market introduction and progress towards market transformation has been strongly supported by Topten (www.topten.eu) and its partners.

Over the past 15 years little attention has been paid to clothes drier efficiency in Canada and the USA. The Super Efficient Dryer Initiative SEDI was recently formed to learn from the European experience and to bring together energy efficiency program providers, drier manufacturers and governments to support large improvements in North American drier energy efficiency. SEDI's goal is to build a consensus around a target efficiency level for a super efficient drier and create the market conditions to support the introduction of new technologies and products. SEDI is not focused on a specific new technology, but SEDI stakeholders are studying the European experience to understand how heat pump technology conquered some national markets in Europe. First tests of European heat pump clothes driers have been undertaken to current US efficiency test standards.

Any successful super efficient drier for North America must be designed for the local market, and laundry habits. SEDI must also successfully facilitate the support of leading manufacturers and the ENERGY STAR appliance efficiency labeling program (there is currently no ENERGY STAR label for driers).

Introduction

The most ecological way of drying clothes is to hang them under the sun in fresh warm air. However, due to different reasons such as climate conditions, air pollution, limited space in small urban flats and less time for doing the laundry with more women going to work, the use of tumble clothes driers has gathered ground.

A domestic tumble clothes drier (in the following drier) is "an appliance in which textiles are dried by tumbling in a rotating drum, through which heated air is passed" [1]. In North America (USA and Canada) it is referred to as a clothes dryer. There are two main types of driers: 1) air vented driers

[1] The authors use in this paper the spelling „drier" as used in the European regulations and as opposed to the American spelling "dryer".

and 2) condenser driers. Air vented driers draw in fresh air and exhaust moist air into the room or through a vent to the outside. Condenser driers remove moisture from the air used for drying with a heat exchanger and collect the water as a liquid.

Currently the most efficient driers are condenser driers with heat pump technology. They use about 50% less energy than conventional condenser driers and are currently the only type of drier that qualifies for the class A European energy label (see Regulations in place: energy label). Vented driers are slightly more efficient than conventional condenser driers, except that venting the air used for drying to the outside may waste additional heating or cooling energy. A drier's energy consumption in practical use also depends on the spin-drying efficiency of the washing machine: if clothes are less wet when they exit the washing machine, there is less to be done by the drier [2].

Topten is an independent, internet-based platform fostering the introduction and penetration of the most energy efficient appliances – including driers - worldwide.

Europe

Market: stock and sales

The stock of driers in the European Union (EU) was estimated at 41 million units in 2000. An increase of over 20 million units was estimated by 2010 (see Figure 1).

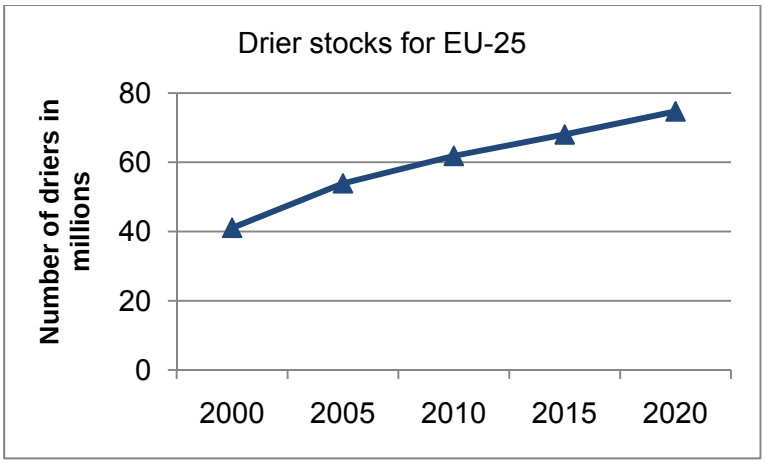


Figure 1. Drier stock development in the EU-25
Source: [3]

Within the European stock, the share of the ten new Member States[2] is expected to grow from 0.3% in 2000 to 6% in 2020 [3]. This shows that there are significant differences in the penetration of driers between East and West. This also applies for the North-South relation. To give an example, the number of driers sold in a year is about the same in Italy as in Switzerland [4], although the population of the two countries differs significantly (in 2009: 60 million and 8 million respectively) [5].

In 2007, more than 3.8 million tumble driers were sold Europe-wide, of which 93% were electrically heated. The share of condenser driers was estimated to 60% in 2007. Industry experts confirmed that sales have shifted towards condenser driers from air vented driers over time. A trend of increasing size has also been observed. The market has moved from driers with an average capacity of 4.5 to 5 kg in 2002 to a loading capacity between 5.5 kg and 6 kg in 2005 and in particular between 6.5 kg and 7 kg in the years after [3].

In 2005, 90% of driers sold on the European market were of energy efficiency class C [3] (see Regulations in place: energy label). In 2008, the market share for class A models was highest in Switzerland, Italy and Germany respectively (see Figure 2). By 2010, the class A market share rose sharply to over 30% in Switzerland and Italy and to over 20% in Germany according to expert opinions. In other European countries the class A market share remained low.

[2] Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia.

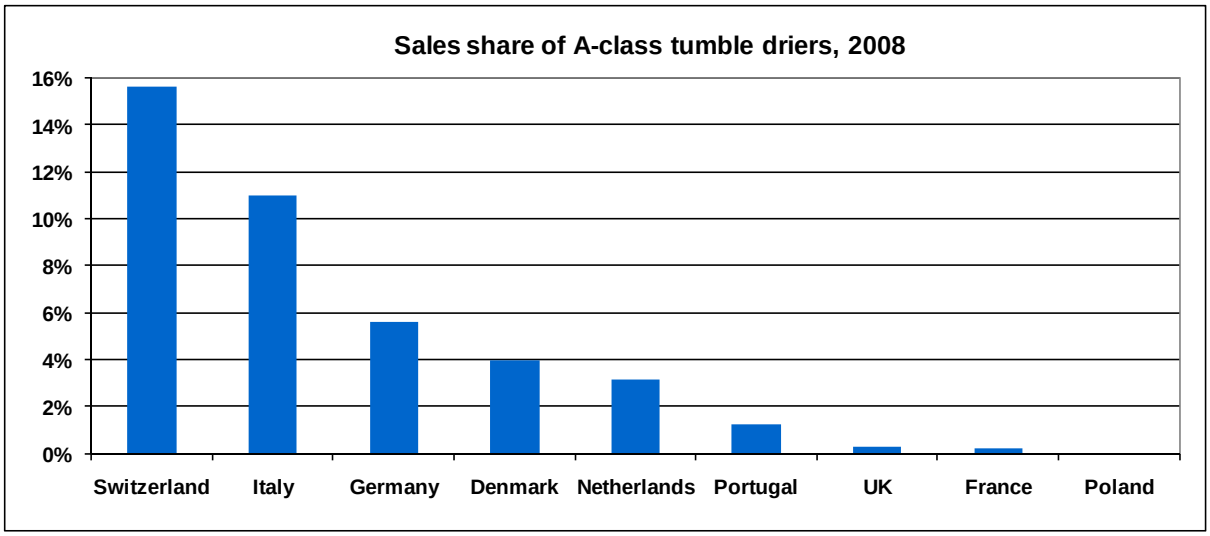
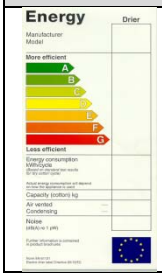


Figure 2. Sales share of class A models in 9 European countries in 2008
Source: [4]

Regulations in place: energy label

In 1995, the European Commission decided to introduce an energy label for tumble driers (Commission Directive 95/13/EC) [9]. The classification ranges from A to G (see Table 1).

Table 1. Energy efficiency class scheme for condenser driers

Energy label	Energy efficiency class	Energy consumption (C) in kWh/kg laundry* based on 60% initial moisture
	A	C ≤ 0.48
	B	0.48 < C ≤ 0.56
	C	0.56 < C ≤ 0.64
	D	0.64 < C ≤ 0.72
	E	0.72 < C ≤ 0.80
	F	0.80 < C ≤ 0.88
	G	C > 0.88

*According to test standard DIN EN 61121:2005 (based on 60% initial moisture). The Commission Directive 95/13/EC is based on 70% initial moisture.

Heat pump driers are the only technology to meet the class A requirement. The best heat pump models consume about 0.23 kWh/kg laundry, while the least efficient about 0.4 kWh/kg laundry (both at 60% initial moisture). Thus, heat pump driers not only meet the class A requirement but the best models exceed it by far. Although choosing between a class A and a class B model does not suggest much difference in efficiency for a user, there is a 50% efficiency gap between a typical heat pump drier and a conventional class B condenser drier [10]. Clearly, the energy label needs revision to better reflect the recent technological developments.

Switzerland: setting minimum energy performance standards to ban inefficient driers

Topten

Switzerland is the cradle of Topten, an initiative which aims at the acceleration of market transformation towards efficient energy-using products. Topten offers a website where a selection of the most efficient household appliances, office equipment, consumer electronics, building components, lamps and cars is listed, creating a dynamic benchmark for the most efficient technologies.

The first Topten site appeared in Switzerland in 2000 (www.topten.ch). Since then it has travelled the world and is online in 16 European countries (Austria, Belgium, Czech Republic, Finland, France,

Germany, Greece, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Romania, Spain and Switzerland), China (www.top10.cn) and the USA (www.toptenusa.org).

On www.topten.eu Topten presents the "Best Products of Europe".

Brand	V-ZUG	GEHRIG	SIBIR	Miele	FUST	V-ZUG	Bauknecht	SIBIR	GEHRIG	Blomberg	Inefficient model
Model	Adora TL WP	WT-TL WP 958	WT-TL WP 958 Swiss	T 86-27 WP / T 86-26 WP	ADORA 599TW	Adora TSL WP	TRW 6060	WT TSL WP Swiss	WT-TSL WP 959	TKF-1350 A	
List price €	2313	2313	2313	2434	1995	2625	2625	2562	2562	1744	1406
Electricity costs (€ 15 years)	585	585	585	675	720	720	720	720	720	742	1575
Capacity (kg)	6	6	6	6	6	6	6	6	6	6	5
Drying time (min)	120	120	120	104	90	90	90	90	90	120	90
Energy class	A	A	A	A	A	A	A	A	A	A	C
Energy Consumption (kWh/kg laundry)	0.26	0.26	0.26	0.30	0.32	0.32	0.32	0.32	0.32	0.33	0.70
Countries available	AT BE CH DE FR LU NL UK	CH	CH	NO, HR, EU without CY,MT,LT,LV,EE, UK	CH	BE CH DE FR IE LU NL UK	CH	CH	CH	CH CZ DE	

Figure 3. Snapshot of the most efficient driers on the European market on www.topten.eu
Snapshot made on 27 April 2011, driers for residential use, 6 kg capacity, energy consumption as declared at 60% initial moisture (according to test standard DIN EN 61121:2005).

Topten also provides recommendations for consumers on optimal product use. In the case of driers, the first advice is to dry clothes on a clothesline under the sun, if this is possible.[3] Besides user recommendations, Topten also formulates recommendations for policy makers.

Topten together with the Swiss Agency for Efficient Energy Use (S.A.F.E.) had a key role in achieving the market breakthrough of heat pump driers in Switzerland.

What is the recipe for success?

In 2003, Topten undertook the first tests of heat pump driers available on the Swiss market. Based on real-use feedback, Topten formulated user recommendations for driers. In 2003, Topten convinced the city of Zurich to choose only heat pump driers for its housing projects. In 2006, Topten convinced the power utility of Zurich (EWZ Elektrizitätswerk der Stadt Zürich) to offer consumers a rebate of up to EUR 200 [6] upon purchasing a heat pump drier. Since 2007, several other Swiss utilities and communities have launched rebate programs for heat pump driers [7].

As a result of these efforts, the market share of heat pump driers in Switzerland constantly increased, reaching 24.5% by 2009 (see Figure 4). Experts estimate the market share for 2010 to over 30%.

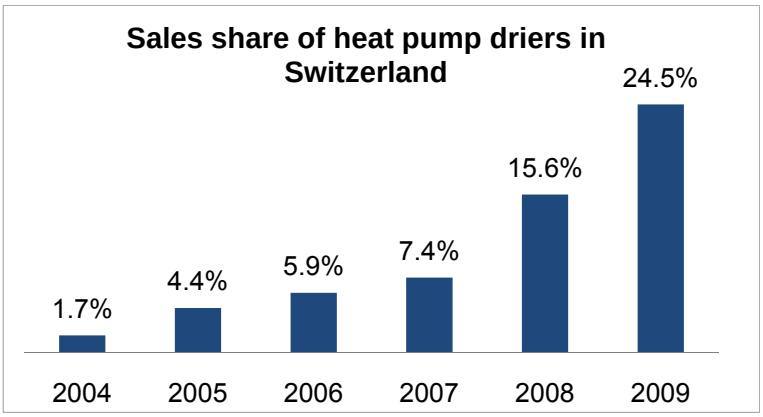


Figure 4. Sales share of class A driers sold in Switzerland
Source: Swiss Association of the Domestic Electrical Appliances Industry FEA

[3] During heating periods, it can be more energy-efficient to use a heat pump drier than to hang up clothes in the flat. See: Ina Rüdenauer, Carl-Otto Gensch, Ran Liu. *Vergleich der Umweltauswirkungen und Kosten verschiedener Wäsche-trocknungssysteme*. 17. June 2008. www.oeko.de

Topten estimated the savings potential at 400 GWh/year, if all driers in Switzerland were replaced by class A driers [8]. Observing market developments and aiming to realize this potential, Topten, S.A.F.E. and Swiss ecological and consumer organisations had advocated setting minimum energy performance standards (MEPS) for heat pump driers. In 2009, the time was ripe. Swiss policy makers decided to ban all drier models below class A from the Swiss market, starting in 2012. From then on, only class A (heat pump) driers can be sold in Switzerland.

Economic analysis of heat pump driers listed on Topten

The first heat pump drier appeared on www.topten.ch in 2000.[4] The number of available models expanded continuously to three in 2007 and eventually to 33 in 2011 (see Table 2). In 2010, the heat pump models on Topten were separated into two subcategories, based on their load capacity (6 kg and 7 kg load).

Figure 5 shows the evolution of purchase price for the heat pump driers listed on Topten from 2007 to 2011.[5]

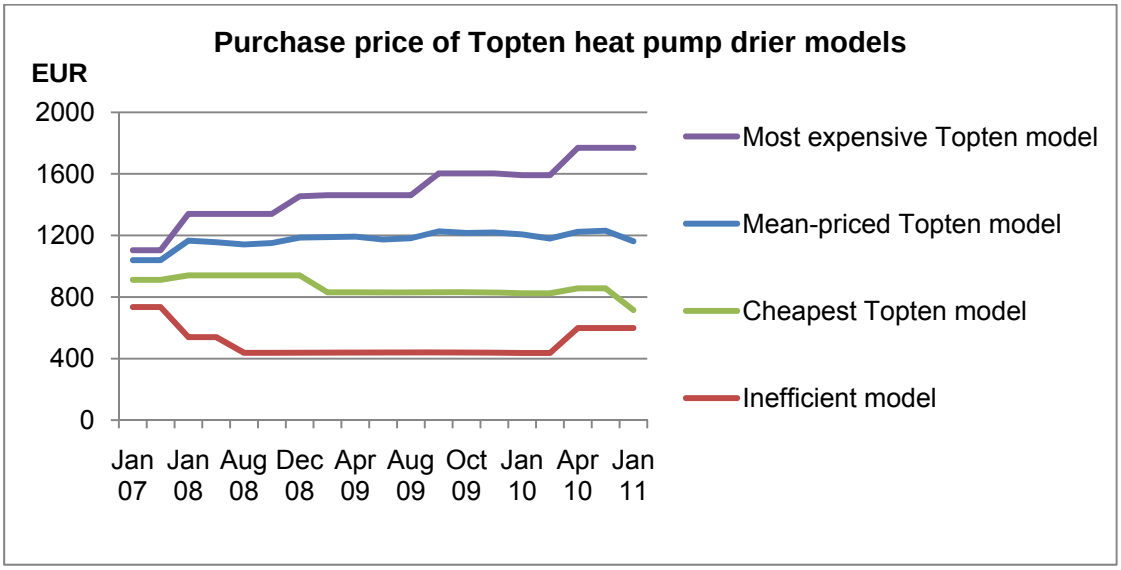


Figure 5. Purchase price of heat pump driers listed on www.topten.ch between 2007 - 2011
Prices are corrected for inflation.[6] Mean-priced Topten model stands for the average purchase price of all heat pump models listed on Topten. Inefficient model is an average class C condenser drier (as declared by the manufacturer) available on the market, used as a baseline for comparison.

The first heat pump drier to appear on Topten was available for EUR 1300. Figure 5 shows that the purchase price range of heat pump models became wider as more products entered the market.

Table 2. Number of heat pump models on www.topten.ch

	Jan 07	Jan 08	Mar 09	Jan 10	Jan 11
purchase price > EUR 1200	0	3	6	17	17
purchase price < EUR 1200	3	3	6	10	16
Total	**3**	**6**	**12**	**27**	**33**

The average purchase price of the listed models is about the same over time. A trend towards lower purchase prices was observed with a number of competing heat pump drier models and brands, such

[4] An AEG model.
[5] Time periods between the different data points are not equal. This is because Topten lists were updated each time a new model was available on the market. For 2011 there is one data point, for 2007 two, for 2008-2010 there are 4-7 data points per year.
[6] See all assumptions for calculation in Annex.

as a range of models offered by manufacturer AEG, priced around 1300 Euro in 2005 and around 1000 Euro by early 2011.

The average efficiency of the heat pump models on Topten was 0.38 in 2007 and 0.28 in 2011 (at 60% initial moisture).

In 2008, the market share of class A driers reached 15.6% in Switzerland. In 2010 Topten chose a more efficient class C model as a baseline for comparison, in accordance with the market developments.

The first heat pump models to offer automated condenser filter-cleaning are already available. This is a big comfort benefit for users, as they do not have to clean the (heat pump) filter manually anymore. Other features offered in high-end models include: low noise levels, extra short programs (e.g. 40 minutes for a 2 kg load), interior drum lighting, sensor drying (the drier automatically stops when a certain level of humidity is reached) and of course, very gentle care of clothes. All these benefits and features as well as best available technology components lead to higher purchase prices of these high-end models.

If a consumer decides on which drier to buy based on the life cycle costs (see Figure 6), it is evident that a cheap heat pump model is the most economical choice. The life cycle costs of a mean-priced heat pump model are still lower than - but closer to – the life cycle costs of an inefficient model. Targeted information is certainly helpful to convince the consumer for the more efficient model.

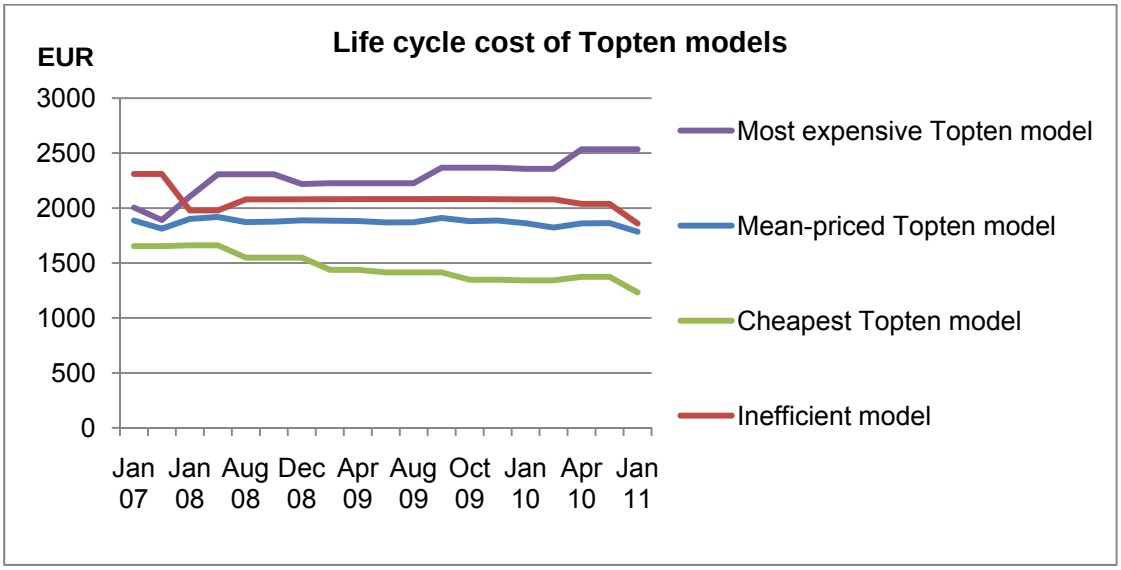


Figure 6. Life cycle cost of heat pump driers listed on www.topten.ch between 2007 - 2011
Assumptions: 1000 kg laundry dried per year, life span 15 years, electricity price 0.15 EUR/kWh[7].

A cost gap remains between inefficient and high-end models. Consumers are more likely to purchase the more expensive model if (i) they have a great appreciation for high-end quality or (ii) if financial contribution is offered. If a single subsidy is provided for class A models without regard to the price of the drier, it will not interfere with manufacturers' pricing strategy, or consumers' perception of value.

Coming regulations: no Eco-design requirements, revised energy label

In 2005, the EU established a framework for setting Eco-design requirements for energy-using products (Directive 2005/32/EC) [11]. The aim of the directive was to set minimum energy performance standards for such products taking into account their environmental impacts throughout their whole life cycle. In 2009, with the recast version Directive 2009/125/EC [12] it was expanded to energy-related products.

[7] Electricity prices for EU-27, first semester/second semester in EUR/kWh: 2007: n.a. / 0.156; 2008: 0.158 / 0.166; 2009: 0.164 / 0.164; 2010: 0.168 / n.a. Source: Eurostat http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_204&lang=en.

In Lot 16, tumble driers are assessed. The preparatory study[8] was completed in March 2009 and analysed the technical, environmental and economic aspects of driers. Based on this, a proposal for a draft regulation was made in June 2010, at the last meeting of the Consultation Forum. According to this proposal [1]:

1. No Eco-design requirements shall be set for tumble driers.

2. The energy label shall be revised.

As for point 1:

The reasoning behind the proposed (non-)action is that the following conditions of Directive 2009/125/EC [12] are not met:

- "the product shall present significant potential for improvement in terms of its environmental impact without entailing excessive costs" (Article 15(2) (c));

- “Concerning energy consumption in use, the level of energy efficiency or consumption must be set aiming at the life cycle cost minimum to end-users for representative product models” (fifth paragraph of point 1 of Annex II).

The proposed draft acknowledges that heat pump driers are gaining market share. With the revision of the energy label, it anticipates accelerated market transformation towards more efficient driers which is likely “to lead to a significant fall of their price” [1]. The adoption of Eco-design measures at a later stage in time is left open.

As for point 2:

The revision of the energy label includes the following:

- including gas fired household tumble driers;

- one common energy classification for electric air-vented, gas air-vented or electric condenser driers, to allow easy comparison for users;

- adding program time and condensation efficiency for condenser driers on the label;

- adding classes A+, A++ and A+++. This would allow the take up of more efficient appliances on the market. The best driers currently on the market would reach class A++ in this scheme.

- revised calculation method for the energy efficiency index, being the basis of the labelling.

The revised calculation method for the energy efficiency index would align to the revised methodology of the energy labeling of household washing machines [13] and dishwashers [14]. The proposed method would relate to the annual energy consumption (and no longer to kWh/kg laundry), based on a fixed amount of drying cycles per year with mixed load and low power modes. The efficiency class would be a function of the rated capacity of the drier.

Policy recommendations for the heat pump drier market breakthrough

Policy measures should stimulate and foster market transformation, marking the path. Therefore, technological change should be supported by adequate policies, instead of lagging behind the actual market developments.

Topten agrees that the energy label is a very powerful tool for pulling the European market towards more energy efficient appliances. It certainly should anticipate the arrival of new technologies.

[8] Carried out by Ecobilan, PricewaterhouseCoopers’ Centre of Excellence, in cooperation with Conception Développement Durable Environnement (CODDE) and KERP Center of Excellence in Electronics & Environment, for the European Commission.

However, instead of introducing three new classes (A+ to A+++), Topten proposes the following scheme:

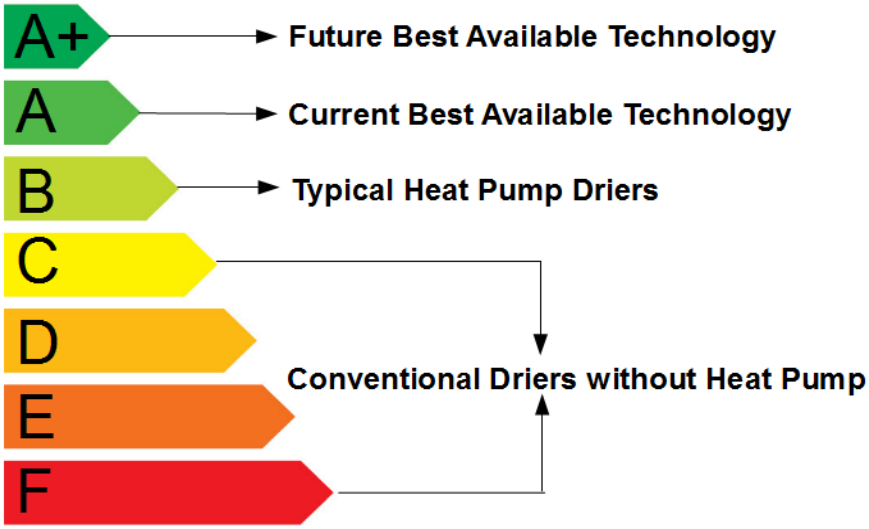


Figure 7. Energy label classification proposed by Topten

Today's Best Available Technology (the most efficient heat pump driers) shall fall into class A. A+ would be reserved for future Best Available Technology. Class B shall be reserved for heat pump driers only (typical, not the most efficient models). Conventional models without heat pump technology would fall into class C and below (being unable to reach class B). Class G would be banned from the market.

Topten strongly encourages the introduction of minimum energy performance standards MEPS. This could be done in two steps:

- Tier 1: banning the most inefficient products from the market.
- Tier 2: setting heat pump driers (class B in Figure 7) as MEPS with sufficient delay, with the option for revision - should pre-defined market shares not be met.

In addition, promotion, discount and rebate programs could help to bridge the purchase price gap between heat pump and conventional condenser driers.

Last but not least, consumers' awareness shall be raised with targeted information (e.g. on life cycle costing). Topten is an ideal platform for this activity.

To sum it up, Topten proposes to:

- Push the market with MEPS;
- Pull the market with the energy label, incentive programs and information campaigns.

United States of America (USA) and Canada

Market: stock and sales

There are more than 80 million residential electric driers in use in American and Canadian homes today. Tumble clothes driers are now approaching the penetration of washing machines in North America. Table 3 shows that residential drier penetration was already high in both Canada and the USA in 2007.

Electrically heated driers dominate in both countries, but more in Canada than in the USA, where a significant share of driers are heated with natural gas or propane. Also, while condensing driers are the dominant technology in Europe, almost all driers in Canada and the U.S. are non-condensing,

vented models. Vented driers pull ambient air from inside the home, heat the air and use it to dry clothes, and then expel the hot moist air through a duct to outdoors.

Table 3. USA (2009) and Canada (2007) clothes drier stock

Market Penetration		USA	Canada	Both
Total households	million	113.6	12.9	126.5
Households with electric driers	%	63.2%	82.9%	65.2%
	million	71.8	10.7	82.5
Households with gas or propane driers	%	16.3%	4.9%	15.1%
	million	18.5	0.6	19.1
Households without driers	%	20.6%	11.6%	19.7%
	million	23.4	1.5	24.9

Source: Residential Energy Consumption Survey conducted by the U.S. Energy Information Agency http://www.eia.doe.gov/consumption/residential/data/2009 and data from the Natural Resources Canada Survey of Household Energy Use 2007
http://www.oee.rncan.gc.ca/publications/statistics/sheu07/pdf/sheu07.pdf
On average, one drier per household is assumed.

Annual sales of electric tumble driers in the USA and Canada are estimated to be in the range of 6 – 7 million units, based on Appliance Magazine's annual appliance industry snapshot [15] and the U.S. Department of Energy's technical assessment document for residential driers [16]. The average North American electric clothes drier has a service life of 12-17 years [15] [16].

Regulations in place

American and Canadian energy policy ignored clothes drier energy efficiency for many years because it was widely believed that not much could be done to improve efficiency. Starting in 1994 and 1995 respectively, the USA and Canada adopted the same minimum efficiency standards and energy efficiency test procedures for clothes driers. The minimum efficiency standard as of the publication of this paper is at 1.37 kilograms (3.01 pounds) of water removed per kilowatthour [17] – equivalent to 0.73 kWh per kg water removed - of electricity consumed. However, on January 6, 2011 the US Department of Energy issued a new energy efficiency test procedure for clothes dryers which should allow more accurate measurement of the energy use of modern clothes dryer models. On April 21, 2011 the US Department of Energy also issued a Direct Final Rule [18] for energy conservation standards for residential clothes dryers which will increase the minimum efficiency standard for electric clothes dryers by 24% to 1.7 kg (3.73 pounds) of water removed per kilowatthour – equivalent to 0.59 kWh per kg water removed - in 2014.

Canada requires that clothes driers carry the "EnerGuide" label showing relative energy efficiency. However, there is no requirement for US driers to carry an equivalent "Energy Guide" label. More importantly for both countries, the ENERGY STAR voluntary energy efficiency labelling program currently covers clothes washers but not driers. Therefore North American consumers today have little information upon which to base energy efficiency comparisons.

Savings potential

In 2010, Ecos Consulting, an American energy efficiency consulting firm, tested a popular model of heat pump clothes driers currently available on the European market using the US test procedure to establish a baseline for comparison of energy efficiency between European and North American driers. Ecos found that the European heat pump drier used 40-50% less energy than the average conventional North American vented tumble electric drier to dry the same load of laundry.

Ecos also found that there were significant differences in energy efficiency between clothes driers currently on the market in the USA. Table 4 shows the potential savings of the European heat pump clothes drier versus both the average conventional new U.S. drier ("Standard") and the best new conventional drier ("Higher Efficiency"). Both the "Standard" and "Higher Efficiency" driers are air vented models.

Table 4. Potential savings from heat pump clothes drier in the USA and Canada

European heat pump clothes drier compared to:		Standard	Higher Efficiency
Annual savings	kWh/year	462	332
Annual savings	USD/year	76	54
Lifetime savings*	kWh	6,926	4,984
Lifetime savings*	USD	1,136	817

*SEDI (Super-Efficient Dryer Initiative) analysis assuming an average drier lifespan of 15 years, and New Jersey average electricity price of USD 0.16 per kilowatthour.

Ecos Consulting also reported that the European heat pump drier cycle length was 110 to 122 minutes, compared to 23 to 59 minutes for the US driers. In Europe, heat pump driers compete with condensing electric resistance driers, which also tend to have longer drying cycle times. In addition, the length of the washing and drying cycles is about the same in Europe, while in the USA washing cycle times are also shorter. Canadians and Americans are accustomed to shorter drier cycles but it is not clear if this will present a barrier to adoption of heat pump drier technology.

Challenges

At this time, there are no heat pump clothes driers that are widely available to Canadian and American consumers. Other than the recent Ecos Consulting research discussed above, there is little data available on the actual energy consumption of clothes driers in the USA and Canada. North American consumers are used to clothes driers that are larger than typical European models, and are also used to shorter cycle times. Clothes washers and driers and electricity all tend to be less expensive in the USA and Canada than in Europe. These differences between the clothes drier markets, and the differences in the European and North American electricity distribution grid, require that manufacturers develop new, energy efficient driers for the USA and Canada. It will also be necessary to educate consumers on the benefits so that they will be willing to pay for more efficient clothes drier technology.

Policy change: first initiatives

There is a growing awareness of the European experience with heat pump clothes driers, and interest in exploring similar opportunities in Canada and the USA. In 2010 the US government also awarded funds to technology development firms and appliance manufacturers for the development of new super-efficient clothes driers. On January 6, 2011 the U.S. Department of Energy culminated a two-year review process and released updated drier energy efficiency test procedures. This is a critically important development that will allow an accurate assessment of the energy efficiency of driers now on the market, and of new products which may soon be introduced.

In 2009, the New Jersey Clean Energy Program awarded research funds that created the Super-Efficient Dryer Initiative (SEDI). During the summer of 2010 SEDI held meetings across the USA and Canada to support the development of super-efficient electric tumble clothes driers for the American and Canadian markets. SEDI is working with appliance manufacturers to draft voluntary technical specifications for efficient driers that could be the basis for energy efficiency program incentives, and also for a future ENERGY STAR for clothes driers program.

Goal

Because successful market transformation efforts have made refrigerators and clothes washers much more energy efficient, clothes driers are now one of the largest single electricity consuming appliances in American and Canadian homes (after heating and cooling equipment and lighting). Electric tumble clothes driers may account for 7-8% of all electricity usage in Canadian and American homes that have them[9].

[9] based on estimate 827 kWh average drier consumption, and average annual total consumption of 11,480 kWh per home in USA (2005 Residential Energy Consumption Survey http://www.eia.doe.gov/emeu/recs/recs2005/).

SEDI will work together with drier manufacturers, ENERGY STAR, U.S. and Canadian energy efficiency programs and TopTen USA [19] to develop common energy efficiency specifications, to support new, energy efficient driers in the market place with labelling and incentives, and to educate consumers.

Summary and conclusions

In Europe there is an increasing demand towards tumble clothes driers. North America has a high penetration of tumble clothes driers.

Heat pump driers are currently the most energy efficient driers, rapidly gaining market share in Europe. Switzerland has set minimum energy performance standards for driers at the current class A, effectively banning driers without heat pump technology from the market starting in 2012. Rising market share for heat pump driers has led to declining prices. Life cycle cost comparisons show that heat pump driers are cost-effective compared to conventional driers. Topten advocates the setting of minimum energy performance standards for heat pump driers all over Europe, subsidies and targeted information for consumers.

In North America first test results show the energy savings potential of heat pump driers. Challenges of their introduction on the market include consumer behavior (e.g. being used to shorter cycle times and larger loads) and education, as well as cheaper electricity prices. Changes in policy and support for innovation may lead to the introduction of new, more efficient driers in Canada and the USA soon. SEDI aims to stimulate this process.

Acknowledgements

The Topten project team gratefully acknowledges the financial support of:

- The European Commission's Intelligent Energy Europe Programme (http://ec.europa.eu/energy/intelligent/) which made it possible for Topten to be present in 16 European countries and continues to support the build-up in three more European countries (www.topten.eu).
- The European Climate Foundation (www.europeanclimate.org) who supports Topten in updating and expanding technical and policy analysis of the most energy-efficient products.
- WWF (www.wwf.org) who supports the build-up of Topten China (www.top10.cn) and supports other Topten projects in Hongkong, the USA (www.toptenusa.org) and Europe.
- The Swiss government: REPIC (Renewable Energy & Energy Efficiency Promotion in International Co-operation - www.repic.ch) and SECO (State Secretariat for Economic Affairs - www.seco.admin.ch) who supports the build-up of Topten China.

Grasteu Associates acknowledges the US Environmental Protection Agency for providing funding to Ecos Consulting to allow the testing of clothes dryers.

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Annex

Assumptions for the calculation of the purchase price of Swiss heat pump driers in EUR:

1. Prices have been corrected for base year 2007 with consumer price increase:

Year	Annual price increase (%)	Price index (basis year 2007)
2007		100.0
2008	2.4%	102.4
2009	-0.5%	101.9
2010	0.7%	102.6

Source:
http://www.bfs.admin.ch/bfs/portal/de/index/themen/05/02/blank/key/jahresdurchschnitte.html

2. 30% off of list prices (except for cheap models) to account for Swiss pricing practices.

3. 70% of the corrected list prices, to account for the fact that prices in Switzerland are higher than in the surrounding countries.

   OECD monthly comparative price levels:

Country	Comparative price level of Switzerland (CHF)	
	October 2008	October 2010
Austria	74	68
Belgium	78	72
France	77	71
Germany	75	68
Italy	76	70
Luxembourg	76	76
Netherlands	75	69
United Kingdom	71	60

The table shows how many Swiss francs (CHF) are needed in the countries listed to buy the same representative basket of consumer goods and services, which in Switzerland costs 100 CHF.
Source: http://stats.oecd.org/Index.aspx?DataSetCode=CPL and private communication with Anette Michel.

4. 1.5 EUR/CHF for the whole period. Foreign exchange rate fluctuations do not largely influence Swiss list prices but would influence EUR prices of this analysis.

   Average exchange rates, calculated from the daily published reference exchange rates of the European Central Bank:

Year	EUR/CHF
2004	1.5438
2005	1.5483
2006	1.5729
2007	1.6427
2008	1.5874
2009	1.5100
2010	1.3803

Source:
http://www.bundesbank.de/statistik/statistik_zeitreihen.php?lang=de&open=devisen&func=row&tr=WJ5622