

# IBNW24: Innovation Briefing Note on domestic laundry drying products

Version 1.3

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

## 1 Summary

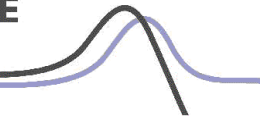
Domestic laundry drying represents a significant amount of electricity use in the UK, accounting for 4.3% of the total domestic energy consumption. The principal methods used for laundry drying are outdoor air-drying, indoor air-drying and tumble-drying. Indoor air-drying, while it appears to be free, actually consumes energy in the form of the additional space-heating needed to evaporate the water from the laundry and heat the cold air brought in by the additional ventilation required.

Electrically-heated tumble dryers make up over 95% of the tumble dryer market. Although manufacturers have improved the energy efficiency of these appliances over the last ten years, there is little scope for further significant improvements without the introduction of fundamentally new designs.

There are two options for more efficient tumble-drying currently available: gas-heated tumble dryers and heat pump tumble dryers. Gas-heated tumble dryers use as much energy as electrically-heated dryers but, because gas is a primary fuel, they generate less carbon dioxide. Gas-heated tumble dryers can also be expensive to install if a new gas supply is needed. Heat pump dryers are up to 30% more energy efficient than conventional electric tumble dryers but they are also approximately double the price and consequently have only a small share in the market.

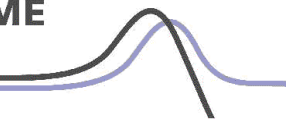
Other laundry-drying devices either awaiting development or awaiting uptake by the market include: a drying cupboard powered by a dehumidifier, a heat pump dryer using the Peltier effect, a high-pressure air-jet dryer, a high pressure condenser dryer and airing cupboards with mechanical ventilation and heat recovery (MVHR). There is also the possibility that a waterless washing system could be developed that would avoid the need to dry laundry altogether.

The amount of energy required to dry laundry is influenced by the amount of water remaining in it after the wash cycle, which in turn is dictated by the spin speed of the washing machine and the hydrophilic properties of the fabrics. Washing machines with higher spin speeds are becoming more widely available and affordable. Fabrics with hydrophobic properties are becoming more widely used. Both these factors are helping to reduce the energy requirement for drying.



The EU energy label has helped to drive some improvements in energy efficiency in electrically-heated dryers. Currently the majority of tumble dryers are rated 'C' for energy efficiency, so some incentive still exists for improving efficiency. The energy label applies to heat pump dryers (which are rated 'A' for energy efficiency) but gas-heated tumble dryers are excluded from the energy label scheme.

The Energy Saving Recommended (ESR) scheme promotes energy efficient tumble dryers. It is not yet known what impact this scheme has had on the market. Gas-heated tumble dryers are now included in this scheme.



## 1.1 Actions

Energy consumption and carbon dioxide emissions associated with laundry drying could be reduced through the following measures:

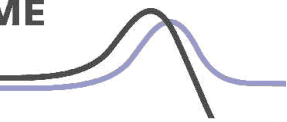
- Improve the efficiency of electrically-heated tumble dryers using more sophisticated heating programmes and programmes that are controlled by moisture sensors rather than timers.
- Boost sales of heat pump tumble dryers by cutting prices through more efficient production methods, the use of cheaper technologies such as Peltier systems or through subsidies.
- Boost sales of gas-heated tumble dryers by promoting them by subsidising installation costs. It should also be a requirement that newly built homes are equipped with a gas supply and ventilation in a suitable location for a tumble dryer.
- Where it can be shown that laundry can be washed and dried more efficiently at commercial laundries than at home, without excessive costs and inconvenience to the consumer, growth in the commercial laundry business should be encouraged.
- New homes should be required to have accommodation for efficient laundry drying facilities including where possible, space for outdoor drying, and an airing cupboard served by MVHR.
- New cleaning technologies could be developed that avoid the need for water and drying.

All these actions should be subjected to life-cycle analysis to check that they do not generate more carbon dioxide emissions than they are intended to save.

These measures could be promoted by:

- The European Commission making changes to the Energy Label scheme by 2008.
- The Department for Business Enterprise and Regulatory Reform (BERR) supporting the development of cheaper technologies for producing heat pump tumble dryers and other novel drying systems, such as the dehumidifier cabinet, the high pressure condenser dryer and high-pressure air-jet systems.
- BERR encouraging the development and use of commercial laundries by 2010.
- The Department for Communities and Local Government making changes to the Building Regulations.
- BERR supporting the development of new waterless cleaning technologies.

If no action were taken, energy demand would grow in line with the increase in the number of households and the increased level of ownership predicted up to 2020. It is estimated that, as a result of these proposed actions, the energy demand for laundry drying will decrease by 25% between 2006 and 2020.



## 2 Sector profile

### 2.1 Introduction

Domestic tumble dryers in the UK are currently (2007) consuming an estimated 4.25 TWh electricity annually. This is equivalent to 37% of home laundry energy consumption or 4.3% of all domestic energy consumption<sup>1</sup>. In line with the increase in the number of homes and tumble dryer ownership expected by 2020, clothes dryer energy consumption is expected to increase to 4.53 TWh unless consumers start to use dryers that are more efficient or use more efficient means of drying.

Government policy is to reduce carbon dioxide (CO<sub>2</sub>) emissions to 40% of the 1999 levels by 2050 and to make significant progress towards this target by 2020. Based on the 1999 annual energy consumption figures for tumble dryers of 3.2 TWh, the 2050 target is 1.28 TWh, assuming the bulk of this energy is still generated by fossil fuels and translates into CO<sub>2</sub>. On this basis, further reductions in tumble dryer energy consumption need to be achieved over the next twelve years. This paper explores the technological and lifestyle changes that could be made to bring about the required reductions.

### 2.2 Current technologies

**2.2.1 Air-vented tumble dryer** – air heated by an electrical heating element dries the clothes. Warm, moist air from the dryer is vented outdoors. This is technically simple and offers little scope for significant energy improvements. The majority of dryers sold in the UK (60%) are air-vented. There is a hidden added cost to running vented tumble dryers during cold weather, in that the air from the room is vented outside and this has to be replaced with cold air from outside.

**2.2.2 Condenser tumble dryer** – air heated by an electrical heating element dries the clothes. The warm air is expelled through an air condenser that cools the air and condenses the moisture. These dryers are slightly more expensive to buy than air-vented tumble dryers, but they offer the versatility of not needing to be located next to an external wall as the air-vented dryers do. Also, any 'wasted' heat is lost to the home rather than being vented outside. This is a benefit on cold days but a drawback on hot days. Condenser dryers are growing in popularity, taking an increasing share of the tumble dryer market in recent years.

**2.2.3 Gas tumble dryer** – operates in the same way as the air-vented dryer, but the electrical heating element is replaced with a gas burner. The warm moist air is vented outdoors together with the combustion products. Gas tumble dryers require as much energy as electrically-heated dryers but they are twice as efficient in terms of carbon dioxide emissions because gas is a primary fuel<sup>2</sup>. Gas tumble dryers are more expensive than the average electrically-heated dryer and installation costs can also be higher, especially if a new gas supply has to be installed. However, running costs for gas tumble dryers are generally much lower than for electrically heated dryers.

<sup>1</sup> Sustainable products 2006: Policy analysis and projections.

<http://www.mtprog.com/PolicyBriefs/pdf.aspx?intPolicyBriefID=113&strPolicyBriefTitle=UK Energy Consumption of Tumble Dryers&intPolicyBriefSector=7>

<sup>2</sup> MTP BNXS01: Carbon emission factors for UK energy use.

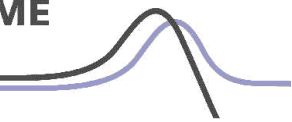
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**2.2.4 Heat pump (HP) dryer** – operates like a condenser dryer, but the heating and condensing is effected by the hot and cold plates of a heat pump. HP dryers can be up to 30% more efficient than electrically-heated dryers but they are also the most expensive type of tumble dryer to buy.

**2.2.5 Washer dryer** – combination washing machine and tumble dryer, operates in a similar way to condenser dryers but cold water is used to condense out the moisture instead of cold air. Energy efficiency is similar to that of condenser dryers but the water consumption of some models is substantial. Water consumption for the drying cycle can vary from 4 to 20 litres/kg of load.

**2.2.6 Outdoor air-drying** – this is obviously the most energy efficient option but its drawbacks are:

- Each item has to be hung up individually.
- It is not possible during wet or very cold days.
- Drying is often very slow.
- Not every home has outdoor drying space.

**2.2.7 Indoor air-drying** – relies on the space heating in the home and ventilation through open windows and consequently it requires at least as much energy as vented tumble-drying. Where the space heating is gas fuelled, this may work out to be more efficient (in terms of carbon dioxide) than electrically-heated tumble dryers.

**2.2.8 Drying cabinet** – air is circulated through the cabinet and passed through a dehumidifier to remove the moisture. This device is more efficient than the heat pump tumble dryer, having an energy consumption of 0.4 kWh/kg. However, it is not widely available in the UK.<sup>3</sup>

**2.2.9 Compression condenser dryer** – operates like a normal condenser dryer except that a portion of the recirculated air is diverted into a compressor where compression precipitates the water. The water is expelled from the compression chamber and the heat generated by the compressor is used to heat the air feed to the drum. The compression condenser dryer is as energy efficient as the heat pump dryer, it dries laundry faster than a heat pump dryer and it involves fewer specialised components.<sup>4</sup>

<sup>3</sup> Design by Colin Booth. colinbooth@tiscali.co.uk

<sup>4</sup> Comparison of Heat Pump Dryer and Mechanical Steam Compression Dryer - Lionel Palandre, Denis Clodic: Ecole des Mines de Paris, Center for Energy Studies.

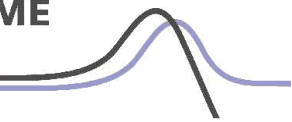
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## 2.3 Factors influencing the drying process

**2.3.1 Moisture sensors** – the programme duration of many of the cheaper tumble dryers is set by the operator using a timer. Estimating the drying time is not easy and errors lead to over-drying. Over-drying reduces energy efficiency. Dryers fitted with moisture sensors that detect when the laundry is dry and switch off the dryer, ensure that energy is not wasted on over-drying.

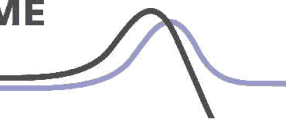
**2.3.2 Spin extraction** – water can be removed far more efficiently by mechanical means than by heating. It is therefore important that the laundry is as dry as possible when it leaves the washing machine. Older and cheaper washing machines typically have spin speeds of 800 to 1000 rpm, which leave the laundry with a residual moisture content of about 60 to 70%. Washing machines are available with spin speeds of up to 2000 rpm.<sup>5</sup> These are capable of reducing the residual moisture content to 45%. This saves approximately 25% of the energy required for heated drying.

**2.3.3 Airtight buildings** – a significant proportion of the homes now being built are designed to be airtight. These homes can be ventilated using a mechanical ventilation heat recovery (MVHR) system. MVHR systems use the heat from the outgoing stale air to warm up the incoming fresh air. These systems can have an efficiency of up to 77%<sup>6</sup>. The use of vented tumble dryers in this type of home is liable to disrupt the MVHR system and increase the space heating costs of the home. In airtight homes, the MVHR system can be coupled to the airing cupboard and provide an efficient laundry drying system.

**2.3.4 Requirement for ironing** – most fabrics can become highly creased during washing and spin-drying, especially if high spin speeds are applied. Ironing consumes approximately 1.5 TWh per year in UK homes. If the tumble dryer has sufficient capacity in the drum and if it includes a sufficiently long cool-down cycle, creasing, and the consequent need for ironing, can be reduced. Dryers fitted with sensors and an 'iron-dry' programme can end the drying cycle when the laundry is still damp, saving some energy from the drying process and leaving the laundry in a condition that is easier to iron. The need for ironing can be avoided altogether using treated fabrics that do not crease.

<sup>5</sup> <http://www.gorenje.co.uk/default.asp?id=3609&page=1>

<sup>6</sup> The Electric Heating & Ventilation Association: <http://www.tehva.org.uk/newsItem.asp?id=30>



## 2.4 Tumble dryer energy label

The tumble dryer energy label rates energy efficiency on a scale of A to G, where A is the most efficient and G is the least efficient. A-rated appliances consume approximately half the energy that G-rated dryers use.

Over the past ten years, the energy label has driven improvements in design so that most appliances now have an energy efficiency rating of C. With tumble dryers having a lifespan of approximately 13 years,<sup>7</sup> there is still a large stock of less efficient tumble dryers in use.

Refinements made possible with electronic programme controllers are now beginning to enter the market with B-rated energy efficiency. Only two A-rated tumble dryers are currently available in the UK - the heat pump dryer manufactured by Electrolux and an electrically-heated, vented dryer with a very long programme manufactured by Crosslee. The heat pump dryer has been too expensive for general market acceptance but significant recent price reductions may lead to increased take-up. The Crosslee dryer with the long programme has also not sold in large volumes – possibly because of the length of the programme – it can take up to seven hours to dry a full load.

Gas-heated tumble dryers are not currently included in the energy label scheme. This needs to be rectified, as they have the potential to provide a carbon-efficient alternative to electrically-heated tumble dryers.

## 2.5 Textiles

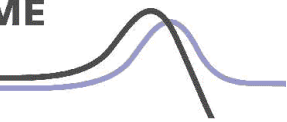
Textiles that are water repellent, or have other properties that reduce the amount of water remaining in the fabric after spin-drying, can reduce the energy required for drying. Also, as noted above, fabrics that don't need to be ironed after they are tumble-dried save the energy normally used for ironing. The overall benefits of these textiles need to be assessed using full life-cycle analysis to ensure that the energy savings on drying are not outweighed by the costs of production and disposal.

## 2.6 Commercial laundries

Only a very small proportion of consumers use commercial laundries rather than their own washing machine and tumble dryer. Apart from specialist services such as nappy washing, commercial laundries have not penetrated the domestic market significantly. This is probably due to the inconvenience of delivery and collection as well as the high prices charged by laundries due to the high cost of labour.

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<sup>7</sup>BNW06: Assumptions underlying the energy projections for domestic tumble driers  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=207>



## 3 Drivers

### 3.1 Number of households and garden size

The number of households in the UK is increasing and expected to continue to do so for the foreseeable future. Currently, 40% of UK homes own a tumble dryer. The current trend towards dwellings with no garden, or a very small garden means that fewer homes will have the option of outdoor air-drying and this could lead to a further increase in the use of tumble dryers. Sales of tumble dryers and ownership are therefore expected to increase year-on-year up to 2020.

### 3.2 Tumble dryer Energy Label and ESR

The Energy Label has been the prime driver bringing about improvements in energy efficiency. Most conventional tumble dryers on the market now have an energy rating of C. The Energy Label is providing an incentive to manufacturers to refine their designs to achieve an energy efficiency rating of B, which is probably the theoretical limit for conventional dryers. A step change will be needed to develop dryers with an energy efficiency rating of A that meet the user's expectations of price and drying time. An incentive still exists therefore for industry to tackle the technological challenges of improving energy efficiency further at a price that consumers are willing to pay.

Although sensor dryers offer clear energy saving advantages over timer dryers, the energy label does not specifically promote them in favour of timer-controlled dryers.

As gas tumble dryers are excluded from the Energy Label, they receive no promotion at the point of sale and there is no incentive for manufacturers to improve energy efficiency.

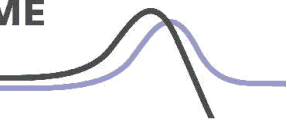
The Energy Saving Recommended (ESR) scheme, operated by The Energy Saving Trust, focuses attention on the most efficient and effective tumble dryers. Currently tumble dryers can qualify for ESR status if they have an Energy Label with C-rated energy efficiency and if the programme duration is controlled by a moisture sensor. Dryers with A and B-rated energy efficiency also qualify for ESR status whether or not they are sensor-controlled.

The ESR scheme also promotes washing machines with A-rated spin-drying performance, which helps reduce the amount of energy used for drying.

Gas-heated tumble dryers have recently been included in the ESR scheme.

### 3.3 Textiles

More widespread use of stain-repellent and self-cleaning textiles could lead to energy savings through reduced frequency of washing. Wider use of crease-resistant textiles and textiles with hydrophobic properties could help to reduce the amount of energy needed for drying and ironing. It is claimed by the textile industry that the use of these treated textiles in work wear and leisurewear has been shown to be very popular with the consumer. It is therefore likely that the use of these textiles will increase in any case and will contribute to savings in carbon emissions arising from laundry drying.



### **3.4 Commercial laundries**

Energy savings through economies of scale and the use of primary fuel (gas) could make commercial laundries an attractive alternative to domestic washing and drying in terms of energy and water efficiency. This benefit would need to exceed the additional costs of delivery and collection. Expansion of the commercial laundry into the domestic sector could be driven by new higher-density housing with small kitchens having no space for tumble dryers. However, the culture change required and issues of cost to the consumer need to be addressed first. Furthermore, a set of policies setting requirements for energy efficiency in commercial laundries needs to be established.

## **4 Suggested goals**

### **4.1 Technology**

- Develop cheaper HP dryers that use alternative heat pump systems (such as solid-state Peltier heat pumps) by 2010.
- Adapt high-pressure air-jet systems used in hand dryers for use in conventional tumble dryers by 2010.
- Develop the compression condenser tumble dryer by 2010.
- Make moisture sensors standard equipment on all tumble dryers by 2010.
- Develop and market the dehumidifier drying cabinet by 2008 as an alternative to tumble dryers.
- Develop cost effective resource efficient waterless washing processes by 2020 in order to avoid the need for drying altogether

### **4.2 Infrastructure**

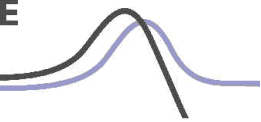
From 2008 onwards, provision should be made for energy efficient laundry drying facilities in all newly built homes, especially those with no access to outdoor drying. Provisions should include a gas supply and a ventilation point to allow easy installation of a gas tumble dryer and/or an airing cupboard fitted with MVHR.

Encourage the establishment and widespread use of neighbourhood commercial laundries by 2010 in place of domestic washing machines and tumble dryers. This could be encouraged through government-funded small business start-up schemes. Only businesses with energy efficient systems would qualify for the scheme.

### **4.3 User habits**

Raise awareness among consumers of the energy efficiency benefits of:

- Using high-speed spin extraction.
- Using the iron-dry setting on the tumble dryer.
- Choosing garments made with easy-iron or non-creasing fabrics.
- Air-drying outdoors when possible.



## 5 Effect of MTP scenarios

Based on the scenario given in Section 3, using data available in 2006, Table 1 shows the predicted energy consumption profile.

**Table 1 Predicted energy consumption profile**

Date	Annual energy consumption (TWh)
2006	4.1
2008	4.2
2010	4.3
2015	3.7
2020	3.0

## 6 Critical issues

### 6.1 Pure research to be carried out before new products can come to market

This includes research into completely novel designs of waterless washing machines.

### 6.2 Applied research to be carried out before new products can come to market

This involves research into systems for improving the efficiency of tumble dryers and other drying devices such as Peltier systems, high-pressure air-jet dryers, compression condenser dryers and dehumidifier cabinets.

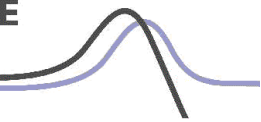
### 6.3 Legislative changes required

Changes to EU Energy Label to include:

- A minimum requirement of C-rated energy efficiency by end 2008.
- An incentive to encourage the sales of sensor-controlled dryers or exclude timer-controlled dryers.
- The inclusion of gas-heated tumble dryers in the energy label scheme.

Amend the Building Regulations to require the provision of efficient laundry drying features such as services for gas tumble dryers, outdoor drying space and/or heat exchanger ventilated airing cupboards.

Provide start up packages for commercial laundry businesses serving the domestic sector.



## 7 Actions

Energy consumption and carbon dioxide emissions associated with laundry drying could be reduced through the following measures:

- Improve the efficiency of electrically-heated tumble dryers using more sophisticated heating programmes and programmes that are controlled by moisture sensors rather than timers.
- Boost sales of heat-pump tumble dryers by cutting prices through more efficient production methods, the use of cheaper technologies such as Peltier systems, or through subsidies.
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- BERR encouraging the development and use of commercial laundries by 2010.
- The Department for Communities and Local Government making changes to the Building Regulations.
- BERR supporting the development of new waterless cleaning technologies.

## Related MTP information

- Briefing Note BNW06: Assumptions underlying the energy projections for tumble dryers.  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=207>
- Briefing Note BNW09: Energy and performance test methodologies for domestic tumble dryers.  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=224>
- Briefing Note BNW18: EC energy labelling of domestic tumble dryers.  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=345>
- Policy Brief on UK energy consumption of tumble dryers.  
<http://www.mtprog.com/PolicyBriefs/pdf.aspx?intPolicyBriefID=113&strPolicyBriefTitle=UK Energy Consumption of Tumble Dryers&intPolicyBriefSector=7>

## Changes from version 1.2

Updated.

## Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email [info@mtprog.com](mailto:info@mtprog.com) quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

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