

# **BNCK07: Comparing energy use in microwave ovens with traditional electric fuelled methods**

**Version 1.1**

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.

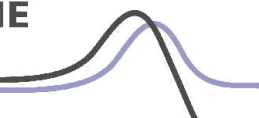
## **1 Summary**

This Briefing Note presents some test results that compare microwave oven and traditional electric oven and hob cooking methods. It discusses the potential to inform consumers of the most energy efficient way of cooking different foods. The level of savings potential is difficult to calculate without further detailed information about user habits but it is estimated to be in the region of 10%.

## **2 Introduction**

Within the area of domestic cooking appliances product area there is potential for carbon reduction by switching the fuel source from electricity to gas ovens and hobs. However, because ovens and hobs have a long lifespan, there would need to be a long-term policy to promote this change. It would also require a confirmed test method to allow comparison between different models of gas oven and hob to identify the most efficient.

Currently, the test method for gas oven energy consumption is in development and there is no test method that allows comparison between hob types. However, there are some activities that could be adopted which can lead to lower levels of carbon emissions in domestic cooking. A high percentage of households in the UK have a microwave oven. These are generally not used as the main cooking appliance and people often find them difficult to use successfully. This Briefing Note gives data from some tests that show there are some foods which can be cooked in a more energy efficient way in the microwave than the electric hob or oven. It estimates that 10% of cooking energy could be saved by changing cooking methods.



## 3 Background

In early 2006, Defra's Market Transformation Programme (MTP) commissioned Intertek to undertake some tests to compare the energy used in cooking a range of standard food products using a traditional electric hob and oven and microwave oven methods<sup>1</sup>. There is very little publicly available data on this subject and MTP undertook this work to contribute to the debate.

The foods were selected on the basis that they were suitable for cooking in a microwave oven by microwave-only or combination<sup>2</sup> microwave and convection methods. The foods were cooked according to manufacturers' instructions for the portion sizes and for the chosen cooking methods which included on the hob, in the oven or in the microwave oven, as appropriate.

### 3.1 Foods cooked and methods used

Foods were selected that were suitable for cooking in a microwave oven and that carried microwave oven instructions. The exception was for the children's meal of fish fingers and chips, where the microwave oven was tested on convection setting only without using the microwave function. A range of portion sizes was also cooked; where appropriate, one, two and four portions were cooked simultaneously or successively. Table 1 shows the foods cooked and the range of methods used for each. All performance tests were carried out at 240 V and under controlled ambient conditions of  $20 \pm 2^\circ\text{C}$  and  $65 \pm 15\%$  relative humidity.

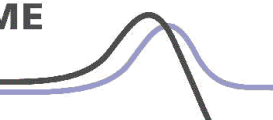
**Table 1 Foods and cooking methods**

Food type	Combination microwave oven	Basic microwave oven	Electric hob	Electric oven
Milk	✓	✓	✓	✗
Porridge	✓	✓	✓	✗
New potatoes	✓	✓	✓	✗
Frozen vegetables	✓	✓	✓	✗
Baked beans	✓	✓	✓	✗
Fresh salmon fillet	✓	✓	✓	✗
Fish fingers and chips	✓	✗	✗	✓

<sup>1</sup> The full test report can be found at:

[http://www.mtprog.com/ReferenceLibrary/A63837%20MTP%20Cooking%20Energy%20Use%20Report%20\(Issue%201\).PDF](http://www.mtprog.com/ReferenceLibrary/A63837%20MTP%20Cooking%20Energy%20Use%20Report%20(Issue%201).PDF)

<sup>2</sup> A combination oven has both microwave and convection cooking methods, which can be used separately or together to reduce cooking time.



Food type	Combination microwave oven	Basic microwave oven	Electric hob	Electric oven
Whole chicken	✓	✗	✗	✓
Baked potatoes	✓	✓	✗	✓
Lasagne	✓	✓	✗	✓
Indian ready meal	✓	✓	✗	✓
Frozen ready meal for one	✓	✓	✗	✓
Frozen pizza	✓	✓	✗	✓

## 3.2 Ovens and cooker used for tests

A free standing electric oven with fan and convection cooking methods was selected for the tests. It had ‘touchpad’ digital temperature control for the oven and control settings for the ceramic hob.

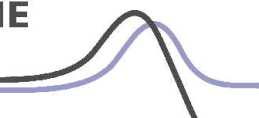
The oven was EU Energy Label A-rated and this was checked before any comparative testing was undertaken. The oven cavity was medium sized. An A-rated oven was chosen because if savings could be demonstrated using the most energy efficient type on the market, they could also be assumed for less efficient ovens. The oven was not preheated prior to cooking, so all the energy consumed was recorded.

When cooking on the ceramic hob, a set of non-stick saucepans with copper coated bases was used. A pan and cooking zone were selected of an appropriate size for the task and the power settings adjusted once the food had started to boil. Pan sizes and cooking zones were adjusted as the number of portions increased. Lids were used on saucepans when cooking new potatoes and frozen vegetables. Changing the type of saucepan, the cooking zone, the amount of liquid and whether or not the lid was used, could all change the results.

Two types of microwave were also selected, a combination microwave oven and basic microwave oven. The ovens were checked for microwave leakage prior to testing and also for the IEC Power Output Test to ensure they were operating correctly. Table 2 lists the oven and microwave ovens used for tests.

**Table 2 Oven and microwave ovens used for tests**

Product	Brand	Model
Freestanding electric cooker	Electrolux	Insight EXT6045X
Combination microwave oven	Panasonic	NN-A725 MBBPQ
Basic microwave oven	Panasonic	NN-T553WF



## 4 Results

The Appendix gives the detailed results for all products in the order shown in Table 1. It gives the portion sizes, cooking times and energy consumption for each test. Each result is the average of three runs. The Appendix also gives summary comments for each test.

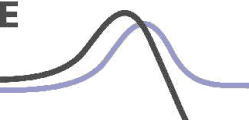
The results (see Table 3) show that for some foods and in some circumstances, using a microwave oven was more energy efficient and takes less time than cooking by traditional methods in an EU Energy Label A-rated medium electric oven or on a ceramic hob.

**Table 3 Energy saving results**

Food	Circumstance	Energy-saving range*
Milk	Up to 800 g cooked in 200 g portions in mugs in microwave vs a saucepan on the hob	25 - 50%
New potatoes	Cooked with little water, in microwave vs more water, on hob	70 - 75%
Frozen vegetables	Cooked with little water, in microwave vs more water, on hob	65%
Fresh salmon fillet	Cooked without water, in microwave vs poached in water, on hob	63 - 78%
Whole chicken	Cooked using convection and microwaves in a combination microwave oven vs electric oven	23%
Baked potatoes	Cooked using convection and microwaves in a combination microwave oven and microwave only methods vs electric oven	21 – 61%
Lasagne	Cooked using microwave only vs electric oven	40 - 81%
Indian 'ready meal'	Cooked using microwave only vs electric oven	38 – 63%
Frozen 'ready meal' for one	Cooked using microwave only vs electric oven	55 – 73%
Frozen pizza	Cooked using convection and microwaves in a combination microwave oven vs electric oven	22%

\* energy-saving range varies with number of portions and microwave function.

For other foods the microwave oven used the same energy or more than the EU Energy Label A-rated medium electric oven or on a ceramic hob.



These were:

- Porridge – cooked in a bowl in the microwave vs a saucepan on the hob.
- Baked beans - cooked in a bowl in the microwave vs a saucepan on the hob.
- Fish fingers and chips – cooked in a combination microwave using convection heat only vs electric oven.

## 5 Energy savings

There is potential for energy savings to be made by changing cooking methods and transferring from traditional methods to cooking with a microwave oven. However, because little is known about what the preferred methods are for cooking different foods, it is difficult to calculate what those savings might be. The following sections give the current assumptions made by MTP for the amount of energy used during cooking and calculate the benefits on the basis of a 10% energy saving made by transferring 20% of cooking from electric hobs and ovens to the microwave oven and a saving of 50% of that energy being possible. Further work is necessary to identify how much of the cooking could be transferred and what savings could be made. To give a better understanding of fan-oven use, user habits with fan ovens should also be investigated. This would help towards understanding whether consumers do typically preheat their fan ovens and whether they reduce the cooking times as a result.

### 5.1 MTP estimates

MTP models<sup>3</sup> currently assume that 85% of households have a microwave oven, and that they are used 96 times per year and consume 0.945 kWh per use, giving an annual consumption of 91 kWh per year. For modelling purposes, MTP assumes that electric ovens in UK households consume 1.2 kWh per use and are used 223 times per year, giving an annual consumption of 267 kWh per year. Electric hobs are estimated to consume 0.725 kWh per use, and to be used 424 times per year, giving an annual consumption of 307 kWh per year.

### 5.2 Potential savings

The amount of energy that could be saved in the UK is difficult to calculate but could be estimated as a proportion of the annual consumption of electric ovens and hobs; a reduction of 10% is proposed in the following paragraphs.

#### 5.2.1 Electric ovens

If 20% of the cooking energy used by electric ovens was transferred to microwave ovens and 50% of that was saved, then the overall reduction in cooking energy would be 10%.

Cooking energy used by electric ovens = 267 kWh per household

Transfer 20% =  $267 \times 0.2 = 53.4$  kWh

Save 50% =  $53.4 \times 0.5 = 26.7$  kWh

<sup>3</sup> MTP assumptions for models can be found in Briefing Note BNCK01: Assumptions underlying the energy projections for cooking appliances.

<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=204>

Cost saving at 10.41p/kWh<sup>4</sup> = £2.78

Electric ovens are estimated to use 3,304 GWh in 2006<sup>5</sup>. Reducing this by 10% would therefore save 330 GWh per year.

### 5.2.2 Electric hobs

If 20% of the cooking energy used by electric hobs was transferred to microwave ovens and 50% of that was saved, then the overall reduction in cooking energy would be 10%.

Cooking energy used by electric ovens = 307 kWh per household

Transfer 20% = 307 x 0.2 = 61.4 kWh

Save 50% = 61.4 x 0.5 = 30.7 kWh

Cost saving at 10.41p/kWh<sup>6</sup> = £3.20

Electric hobs are estimated to use 3,364 GWh in 2006<sup>7</sup>. Reducing this by 10% would therefore save 336 GWh per year.

## 6 Consumer views of microwaves

### 6.1 Cooking habits

Of the consumer research commissioned by MTP<sup>8</sup>, some of the results showed that most people are probably aware that microwave ovens can use less energy than other means of cooking. However, consumers may assume that this is because microwave ovens cook more quickly and are smaller than conventional ovens.

A recent study of cooking habits found that microwave ovens were used for 20% of cooking operations, not including drinks. Other work carried out to record which foods were commonly cooked in microwave ovens, found that they are most commonly used for heating drinks, cooking or reheating vegetables, cooking cereals and meat. Chilled and frozen 'ready meals' were cooked infrequently in the microwave oven<sup>9</sup>. As well as this study, the market research company Mintel also found that 44% of people claimed to use them to reheat left-overs, but only 13% to cook fresh vegetables<sup>10</sup>.

<sup>4</sup> 10.41p/kWh is the figure The Energy Saving Trust uses to calculate cost savings for efficiency measures see [http://www.energysavingtrust.org.uk/energy\\_saving\\_assumptions](http://www.energysavingtrust.org.uk/energy_saving_assumptions)

<sup>5</sup> From the What-If Tool 21 August 2006. <http://whatif.mtprog.com/>

<sup>6</sup> 10.41p/kWh is the figure The Energy Saving Trust uses to calculate cost savings for efficiency measures see [http://www.energysavingtrust.org.uk/energy\\_saving\\_assumptions](http://www.energysavingtrust.org.uk/energy_saving_assumptions)

<sup>7</sup> From the What-If Tool 21 August 2006. <http://whatif.mtprog.com/>

<sup>8</sup> See section 4 in MTP Cooking Energy Use Project

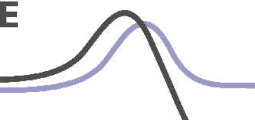
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<sup>9</sup> For more information see MTP Briefing Note BNCK05: Historical microwave oven use and options to increase oven use in future

<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=417>

<sup>10</sup> Mintel *Microwave Ovens Market Intelligence Report* April 2006.





Mintel found that only 16% of people claimed to be regular microwave users, saying that they regularly used the microwave to cook their evening meal, but Mintel assume that people are cooking other items such as vegetables in it, if not the whole meal. The regular microwave users tended to be older and less affluent people<sup>11</sup>.

## 6.2 Ownership

In the UK, the majority of sales of microwave ovens are of the basic type and without the convection option<sup>12</sup>, so most owners, for example, cannot be using them for browning meat or cooking baked potatoes. As a low-cost item, microwave ovens are probably seen by consumers as a small appliance similar to a toaster or kettle, but not part of the integral, key cooking appliances within design of the kitchen. They may be seen as an add-on item, and often not positioned within the layout of the kitchen in an optimum position for easy and frequent use.

## 6.3 Barriers to further use

While the majority of households have a microwave oven, the research shows that consumers do not generally regard them as primary cooking appliances, except for specific tasks. The MTP consumer research showed there are a number of barriers to be overcome before people would consider using their microwave more often. These included findings related to:

- The food itself: eg that the food was unappetising, it was difficult to learn how to use the microwave oven well, that the food cooked unevenly, that it's easier to use the hob, that it's not possible to cook everything in a microwave oven.
- Oven-design: eg that the cavity is too small, the controls are too difficult to use, the handbooks are too complicated, the microwave oven may be unsafe, that it is not possible see the food inside the oven.
- Other aspects: eg that using a microwave oven is unnatural, that microwavable food products are just 'fast food' or 'convenience food' and thus unhealthy.

In addition, the cost savings demonstrated above may not be sufficiently significant to encourage greater microwave use. Raising awareness of the cost savings associated with this method may not be the best way to convince owners to use their microwave ovens more than they do.

## 6.4 Overcoming barriers

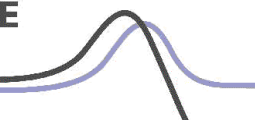
There are a number of ways that the barriers described above could be overcome. These include

- Making available improved, simple instructions on packaging, in cookbooks, magazines and online.
- Changing the perception that food cooked in the microwave is unhealthy and that convenience does not always mean an unhealthy option. Some convenience food manufacturers have already begun marketing frozen foods as being additive free and full of natural vitamins ie showing that these foods are as healthy as freshly prepared ones or even more so.

<sup>11</sup> Mintel *Microwave Ovens Market Intelligence Report* April 2006.

<sup>12</sup> For more information see MTP Briefing Note BNCK05: Historical microwave oven use and options to increase oven use in future

<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=417>



- Providing improved instructions for combination microwave ovens for use on a wider range of foods.
- Improving user handbooks and controls to make the products easy to use
- Developing the range of oven sizes so that users are not restricted to cooking one item at a time.

To increase the level of microwave oven use and to decrease the amount of energy used in domestic cooking by electric ovens and hobs, the food supply industry would need to be both engaged and involved.

## 7 Gas ovens and hobs

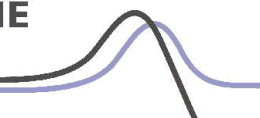
This Briefing Note and the test project have not discussed gas ovens and hobs. Without an energy label to rate an oven, it is difficult to know whether the appliance chosen for testing is representative of the stock average or is more or less efficient than the stock average. For the purposes of MTP models, gas ovens and hobs are assumed to use more delivered energy than their electric equivalents, however they use less primary energy and therefore produce lower carbon emissions<sup>13</sup>. A test project to measure the amount of gas used to cook foods would give useful comparative data that would suggest whether there are any carbon savings to be made from switching gas cooking to microwave ovens and fuel switching from electricity to gas cooking overall.

### Related MTP information

- Briefing Note BNCK01: Assumptions underlying the energy projections for cooking appliances  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=204>
- Briefing Note BNCK05: Historical microwave oven use and options to increase usage in the future  
<http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=417>

<sup>13</sup> See Briefing Note BNCK01: Assumptions underlying the energy projections for cooking appliances  
<http://www.mtprog.com/ApprovedBriefingNotes/PDF.aspx?intBriefingNoteID=204>



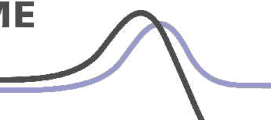


## Appendix 1

Appendix 1 gives the detailed test results for all products tested in the order shown in Table 1 above. Each result is the average of three runs.

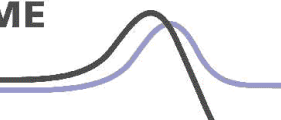
Milk	Combi microwave oven	Basic microwave oven	Electric hob
Food temperature at start	3 ± 2°C	3 ± 2°C	3 ± 2°C
Quantity 1 portion	200 g full-fat milk	200 g full-fat milk	200 g full-fat milk
Average time taken (min:sec)	01:40	01:50	11:13
Average energy consumption (kWh)	0.0456	0.0429	0.0837
Quantity 2 portions	400 g full-fat milk	400 g full-fat milk	400 g full-fat milk
Average time taken (min:sec)	03:40	04:00	16:59
Average energy consumption (kWh)	0.0948	0.0951	0.1235
Quantity 4 portions	800g full-fat milk	800g full-fat milk	800g full-fat milk
Average time taken (min:sec)	08:05	08:10	15:07
Average energy consumption (kWh)	0.1966	0.1931	0.1921
<p>The milk was heated in the microwave ovens in mugs. Up to four mugs were used simultaneously. The energy use increased in a linear fashion, doubling each time the quantity of milk was doubled. When milk was heated in a saucepan and the appropriate size of pan was used, the energy used increased by about half each time the quantity of milk doubled.</p> <p><b>Conclusion:</b> For larger quantities of milk, over 800 g, heating on the hob is likely to be more energy efficient than using the microwave oven.</p>			

Porridge	Combi microwave oven	Basic microwave oven	Electric hob
Food temperature at start	Oats: 20 ± 2°C Milk: 3 ± 2°C Water: 20 ± 2°C	Oats: 20 ± 2°C Milk: 3 ± 2°C Water: 20 ± 2°C	Oats: 20 ± 2°C Milk: 3 ± 2°C Water: 20 ± 2°C
Quantity 1 portion	45 g Quaker porridge oats 160 g full-fat milk 160 g water	45 g Quaker porridge oats 160 g full-fat milk 160 g water	45 g Quaker porridge oats 160 g full-fat milk 160 g water
Average time taken (min:sec)	02:40	03:00	10:20
Average energy consumption (kWh)	0.0707	0.0710	0.0766



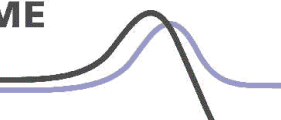
Porridge	Combi microwave oven	Basic microwave oven	Electric hob
Quantity 2 portions	90 g Quaker porridge oats 320g full-fat milk 320 g water	90 g Quaker porridge oats 320g full-fat milk 320g water	90 g Quaker porridge oats 320 g full-fat milk 320g water
Average time taken (min:sec)	05:00	05:00	10:50
Average energy consumption (kWh)	0.1253	0.1190	0.1307
Quantity 4 portions	180 g Quaker porridge oats 640 g full-fat milk 640 g water	180 g Quaker porridge oats 640 g full-fat milk 640 g water	180 g Quaker porridge oats 640 g full-fat milk 640g water
Average time taken (min:sec)	11:00	11:00	13:30
Average energy consumption (kWh)	0.2636	0.2578	0.2357
<p>The porridge was cooked in a single bowl in the microwave ovens and in an appropriately sized saucepan on the hob. There was little difference in the energy used between either microwave or hob. Cooking four portions of porridge on the hob was slightly slower but used slightly less energy than the microwave oven.</p> <p><b>Conclusion:</b> Some time was saved using the microwave oven, but no method was more efficient than the others.</p>			

New potatoes	Combi microwave oven	Basic microwave oven	Electric hob
Food temperature at start	Potatoes: 20 ± 2°C Water: 15 ± 2°C	Potatoes: 20 ± 2°C Water: 15 ± 2°C	Potatoes: 20 ± 2°C Water: 15 ± 2°C
Quantity 1 portion	150 ± 2 g new potatoes 5 g water	150 ± 2 g new potatoes 5 g water	150 ± 2 g new potatoes 500 g water
Average time taken (min:sec)	03:00	02:45	19:22
Average energy consumption (kWh)	0.0782	0.0630	0.2833
Quantity 2 portions	300 ± 2 g New potatoes 5 g water	300 ± 2 g New potatoes 5 g water	300 ± 2g New potatoes 700 g water
Average time taken (min:sec)	04:00	04:00	19:32
Average energy consumption (kWh)	0.1014	0.0926	0.3617



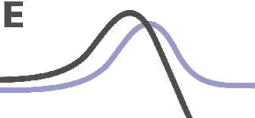
New potatoes	Combi microwave oven	Basic microwave oven	Electric hob
Quantity 4 portions	600 ± 2 g New potatoes 10 g water	600 ± 2 g New potatoes 10 g water	600 ± 2 g New potatoes 1000 g water
Average time taken (min:sec)	06:30	06:30	24:30
Average energy consumption (kWh)	0.1587	0.1502	0.5031
<p>The new potatoes were cooked in the microwave ovens using very small amounts of water, but in a saucepan there was considerably more. In all cases using the microwave oven was more energy efficient and quicker than the hob.</p> <p><b>Conclusion:</b> Using small amounts of water and a microwave oven to cook potatoes saves energy compared to the hob. Reducing the amount of water in the saucepan may also reduce the energy consumption. Other low water methods such as steaming may also reduce energy consumption.</p>			

Frozen vegetables	Combi microwave oven	Basic microwave oven	Electric hob
Food type	Asda frozen cauliflower florets, peas and carrots.	Asda frozen cauliflower florets, peas and carrots.	Asda frozen cauliflower florets, peas and carrots.
Food temperature at start	Frozen Veg: -18 ± 2°C Water: 15 ± 2°C	Frozen Veg: -18 ± 2°C Water: 15 ± 2°C	Frozen Veg: -18 ± 2°C Water: 15 ± 2°C
Quantity 1 portion	113 g frozen veg 15 g water	113 g frozen veg 15 g water	113 g frozen veg 600 g water
Average time taken (min:sec)	04:00	03:00	12:00
Average energy consumption (kWh)	0.1012	0.0711	0.2064
Quantity 2 portions	226 g frozen veg 15 g water	226 g frozen veg 15 g water	226 g frozen veg 800 g water
Average time taken (min:sec)	05:00	04:00	15:00
Average energy consumption (kWh)	0.1244	0.0949	0.2567
Quantity 4 portions	452 g frozen veg 25 g water	452 g frozen veg 25 g water	452 g frozen veg 1,500 g water
Average time taken (min:sec)	07:00	06:00	17:00
Average energy consumption (kWh)	0.1703	0.1429	0.4065

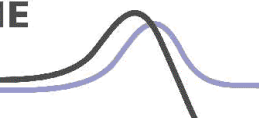


Frozen vegetables	Combi microwave oven	Basic microwave oven	Electric hob
<p>The frozen vegetables were cooked with small quantities of water in the microwave ovens and larger quantities on the hob. In all cases the microwave oven was more energy efficient and quicker than the hob.</p> <p><b>Conclusion:</b> Using small amounts of water and a microwave oven to cook frozen vegetables saves energy when compared with the hob. Reducing the amount of water in the saucepan may also reduce the energy consumption. Other low-water methods such as steaming may also reduce energy consumption.</p>			

Baked beans	Combi microwave oven	Basic microwave oven	Electric hob
Food temperature at start	20 ± 2 °C	20 ± 2 °C	20 ± 2 °C
Quantity 1 portion	200 g Heinz baked beans	200 g Heinz baked beans	200 g Heinz baked beans
Average time taken (min:sec)	02:00	02:00	06:20
Average temperature (°C)	83.8	82.0	80.5
Average energy consumption (kWh)	0.0541	0.0462	0.0478
Quantity 2 portions	400 g Heinz baked beans	400 g Heinz baked beans	400 g Heinz baked beans
Average time taken (min:sec)	04:20	04:00	09:15
Average temperature (°C)	91.2	90.2	79.6
Average energy consumption (kWh)	0.1090	0.0943	0.0689
Quantity 3 portions	800 g Heinz baked beans	800 g Heinz baked beans	800 g Heinz baked beans
Average time taken (min:sec)	08:00	08:00	08:45
Average temperature (°C)	86.9	88.9	82.1
Average energy consumption (kWh)	0.1938	0.1883	0.1132
<p>The beans were cooked in a bowl within the microwave ovens and in a saucepan on the hob. For one portion there was very little difference between the microwave oven and the hob. However, with larger quantities the microwave oven used more energy than the hob. The temperature of the microwave-cooked beans was higher than that of the hob-cooked beans for all of the tests.</p> <p><b>Conclusion:</b> Following manufacturer's instructions and increasing cooking time by multiplying from a single portion to two or four portions may heat the product to a higher temperature than required and use more energy.</p>			



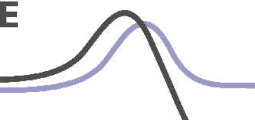
Fresh salmon fillet	Combi microwave oven	Basic microwave oven	Electric hob
Food temperature at start	$3 \pm 2^{\circ}\text{C}$	$3 \pm 2^{\circ}\text{C}$	Salmon: $3 \pm 2^{\circ}\text{C}$ Water: $15 \pm 2^{\circ}\text{C}$
Quantity 1 portion	1 salmon fillet (~125 g)	1 salmon fillet (~125 g)	1 salmon fillet (~125g) 750 g water
Average time taken (min:sec)	03:00	03:00	18:00
Average energy consumption (kWh)	0.0557	0.0555	0.2384
Quantity 2 portions	2 salmon fillets (~250 g)	2 salmon fillets (~250 g)	2 salmon fillets (~250 g) 800 g water
Average time taken (min:sec)	04:30	04:30	17:40
Average energy consumption (kWh)	0.0835	0.0831	0.2810
Quantity 4 portions	4 salmon fillets (~500 g)	4 salmon fillets (~500 g)	4 salmon fillets (~500 g) 1,000g water
Average time taken (min:sec)	06:30	06:30	18:00
Average energy consumption (kWh)	0.1217	0.1208	0.3372
<p>The salmon was cooked in the microwave oven without any water. The salmon cooked on the hob was poached in water. The amount of water affects the amount of energy used to cook the salmon. Using the microwave was both quicker and more energy efficient.</p> <p><b>Conclusion:</b> Unless the liquid that the salmon is cooked in is to be used for another purpose, there would seem to be no benefit to cooking in liquid, the energy used to pan fry should be tested to compare the energy consumption of this method.. The volume of liquid could also be reduced to lower the energy consumption.</p>			



Fish fingers and chips	Combi microwave oven	Electric oven
Food temperature at start	-18 ± 2°C	-18 ± 2°C
Quantity 1 child's portion	2 Birds Eye cod fish fingers + 125 g McCain oven chips	2 Birds Eye cod fish fingers + 125 g McCain oven chips
Average time taken (min:sec)	18:00	15:00
Average energy consumption (kWh)	0.7596	0.5965
Quantity 2 child's portions	4 Birds Eye cod fish fingers + 250 g McCain oven chips	4 Birds Eye cod fish fingers + 250 g McCain oven chips
Average time taken (min:sec)	21:00	18:00
Average energy consumption (kWh)	0.8399	0.7001
<p>The microwave oven was set on the convection setting, and the electric oven on a fan setting. Neither was preheated prior to the food being placed in the cavity. The electric oven was both quicker and used less energy than the microwave oven.</p> <p><b>Conclusion:</b> This test may indicate that microwave ovens that have convection heating may not be as well-insulated as standard EU Energy Label A-rated ovens. There is no standard test to measure energy consumption in microwave ovens using the convection setting. This may be an area where improvements can be made in microwave oven technology.</p>		

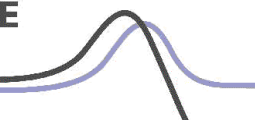
Chicken	Combi microwave oven	Electric oven
Food temperature at start	3 ± 2°C	3 ± 2°C
Average time taken (hr: min:sec)	00:26:46	01:30:00
Average energy consumption (kWh)	1.0169	1.3205
<p>The oven was not preheated prior to the start of the test. The combination microwave oven used less energy and was quicker than the standard oven. The skin of the chicken cooked in the microwave was less crispy than that cooked in the oven, but the chicken was cooked to an acceptable level.</p> <p><b>Conclusion:</b> For cooking single chickens, the combination microwave oven offers a quicker and more energy efficient option than the electric oven. However, to cook a complete meal it may be more energy efficient to use the electric oven, depending on the vegetables and accompaniments that are chosen.</p>		





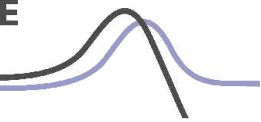
Baked potatoes	Combi microwave oven	Basic microwave oven	Electric oven
Food temperature at start	20 ± 2°C	20 ± 2°C	20 ± 2°C
Quantity 1 portion	Potato approx 250 g	Potato approx 250 g	Potato approx 250 g
Average time taken (hr:min:sec)	00:11:33	00:05:24	01:00:00
Average energy consumption (kWh)	0.5059	0.1256	0.8558
Quantity 2 portions	2 potatoes 500 g	2 potatoes 500 g	2 potatoes 500 g
Average time taken (hr:min:sec)	00:15:57	00:10:06	01:00:00
Average energy consumption (kWh)	0.6911	0.2319	0.9156
Quantity 4 portions	4 potatoes 1,000 g	4 potatoes 1,000 g	4 potatoes 1,000 g
Average time taken (hr:min:sec)	00:19:21	00:17:24	01:00:00
Average energy consumption (kWh)	0.7692	0.3884	0.9759
<p>The fan oven was not preheated before introducing the potatoes. The combination and basic microwave oven both cooked the potatoes more quickly and used less energy than the traditional electric oven for all the portion sizes. The basic microwave oven did not crisp the skins, but the combination microwave oven did lightly crisp the skins. The electric oven crisped the skins.</p> <p><b>Conclusion:</b> For when baked potatoes accompany a light meal, using a combination microwave oven is a good option, however, if the potatoes are to accompany an item which could also be cooked or reheated in the oven, it is likely that combining the items in the oven would be a more efficient option than cooking them separately.</p>			

Lasagne	Combi microwave oven	Basic microwave oven	Electric oven
Food temperature at start	3 ± 2°C	3 ± 2°C	3 ± 2°C
Quantity 1 portion	Asda lasagne (400 g)	Asda lasagne (400 g)	Asda lasagne (400 g)
Average time taken (min:sec)	04:30	05:00	30:00
Average energy consumption (kWh)	0.1124	0.1157	0.5779
Quantity 2 portions	Medium Asda lasagne (800 g)	Medium Asda lasagne (800 g)	Medium Asda lasagne (800 g)
Average time taken (min:sec)	08:00	08:30	30:00
Average energy consumption (kWh)	0.1934	0.1953	0.6214
Quantity 4 portions	Large Asda lasagne (1.5 kg)	Large Asda lasagne (1.5 kg)	Large Asda lasagne (1.5 kg)



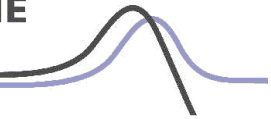
Lasagne	Combi microwave oven	Basic microwave oven	Electric oven
Average time taken (min:sec)	22:00	23:00	45:00
Average energy consumption (kWh)	0.5012	0.5016	0.8486
<p>The lasagna was cooked according to the instructions on the packaging. The fan oven was not preheated prior to the test. In the microwave ovens the film was not pierced or removed and the cheese on the top did not go brown. The instructions do not give an option for combination ovens, although using the convection function might give a more appealing result. In the electric oven the film was removed. Cooking the microwave was both faster and more energy efficient than using the oven, although the microwave results might not appeal to consumers.</p> <p><b>Conclusion:</b> Microwave ovens can produce an acceptable result for cooking this kind of food. They are likely to be faster and use less energy than an electric oven.</p>			

Indian ready meal	Combi microwave oven	Basic microwave oven	Electric oven
Food temperature at start	3 ± 2°C	3 ± 2°C	3 ± 2°C
Quantity 2 portions	Marks & Spencer Indian menu for two (1 kg)	Marks & Spencer Indian menu for two (1 kg)	Marks & Spencer Indian menu for two (1 kg)
Average time taken (min:sec)	09:00	09:30	30:00
Average energy consumption (kWh)	0.2164	0.2172	0.5746
Quantity 4 portions	Marks & Spencer Indian menu for two (1 kg) X2	Marks & Spencer Indian menu for two (1 kg) X2	Marks & Spencer Indian menu for two (1 kg) X2
Average time taken (min:sec)	18:00	19:00	30:00
Average energy consumption (kWh)	0.4135	0.4173	0.6621
<p>The fan oven was not preheated prior to the start of the test. The microwave ovens were quicker and used less energy than the electric oven when cooking one and two large packs of food.</p> <p><b>Conclusion:</b> For foods like this where the final appearance does not require browning, the microwave oven offers the opportunity to save both time and energy over the electric oven. This is the case for quite large quantities, although the advantage of time and probably energy would be lost if more than two packs of food were heated.</p>			



Frozen ready meal for one	Combi microwave oven	Basic microwave oven	Electric oven
Food start temperature	$-18 \pm 2^{\circ}\text{C}$	$-18 \pm 2^{\circ}\text{C}$	$-18 \pm 2^{\circ}\text{C}$
Quantity 1 portion	Birds Eye roast lamb dinner (frozen) 1 meal (340 g)	Birds Eye roast lamb dinner (frozen) 1 meal (340 g)	Birds Eye roast lamb dinner (frozen) 1 meal (340 g)
Average time taken (min:sec)	07:00	07:30	40:00
Average energy consumption (kWh)	0.1717	0.1778	0.6527
Quantity 2 portions	Birds Eye roast lamb dinner (frozen) 2 meals (340 g each)	Birds Eye roast lamb dinner (frozen) 2 meals (340 g each)	Birds Eye roast lamb dinner (frozen) 2 meals (340 g each)
Average time taken (min:sec)	14:00	15:00	40:00
Average energy consumption (kWh)	0.3289	0.3471	0.7155
<p>The fan oven was not preheated prior to the start of the test. The microwave ovens were quicker and used less energy than the electric oven when cooking one and two meals.</p> <p><b>Conclusion:</b> For households where foods of this kind are regularly consumed by one or two people at a time, the microwave oven would save both time and energy.</p>			

Frozen pizza	Combi microwave oven	Electric oven
Food temperature at start	$-18 \pm 2^{\circ}\text{C}$	$-18 \pm 2^{\circ}\text{C}$
Quantity 1 portion	1 Marks & Spencer Mozzarella, provolone cheese & tomato pizza - purchased chilled and frozen in blast freezer.	1 Marks & Spencer Mozzarella, provolone cheese & tomato pizza - purchased chilled and frozen in blast freezer.
Average time taken (min:sec)	11:00	16:00
Average energy consumption (kWh)	0.3645	0.4664
<p>The fan oven was not preheated prior to the start of the test. The combination microwave oven was quicker and used slightly less energy than the electric oven when cooking one pizza. However, if more than one pizza were cooked it is unlikely that the energy efficiency would be maintained, and the oven would use less energy.</p> <p><b>Conclusion:</b> For cooking snacks the combination microwave oven was more efficient than the electric oven.</p>		



## Changes from version 1.0

Minor typographical changes after internal proof reading.

## 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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