



## Crops Grown For Bioenergy in the UK: 2017



### About this release

This release contains statistics on the area of non-food crops grown in the UK in 2017 and their usage in bioenergy applications. This data includes:

- Areas of oilseed rape, sugar beet and wheat used for producing biofuels and maize for use in anaerobic digestion.
- Areas of miscanthus, short rotation coppice and straw crops grown as plant biomass.
- Trends in bioenergy use and generation from crops, including statistics from road transport fuel, electricity, and biogas sectors.

### Key Messages for 2017

- 129 thousand hectares of agricultural land in the UK were used to grow crops for bioenergy.
- The area of crops grown for bioenergy equated to just over 2% of all arable land in the UK.
- 48% of land used for bioenergy was for biofuel (biodiesel and bioethanol) for the UK road transport market.
- 217 million litres of biofuel for the UK road transport market were produced from UK grown crops.
- Over 5.5 million tonnes oil equivalent of plant biomass were used to produce electricity and heat in the UK.

A dataset has been published alongside this statistics release and is available [here](#).

The next update to this statistical release is anticipated in winter 2019 and will be published [here](#).

### Revisions

Section 1: volumes of biofuels supplied to the UK road transport market in 2016/17 have been revised to reflect the final estimates.

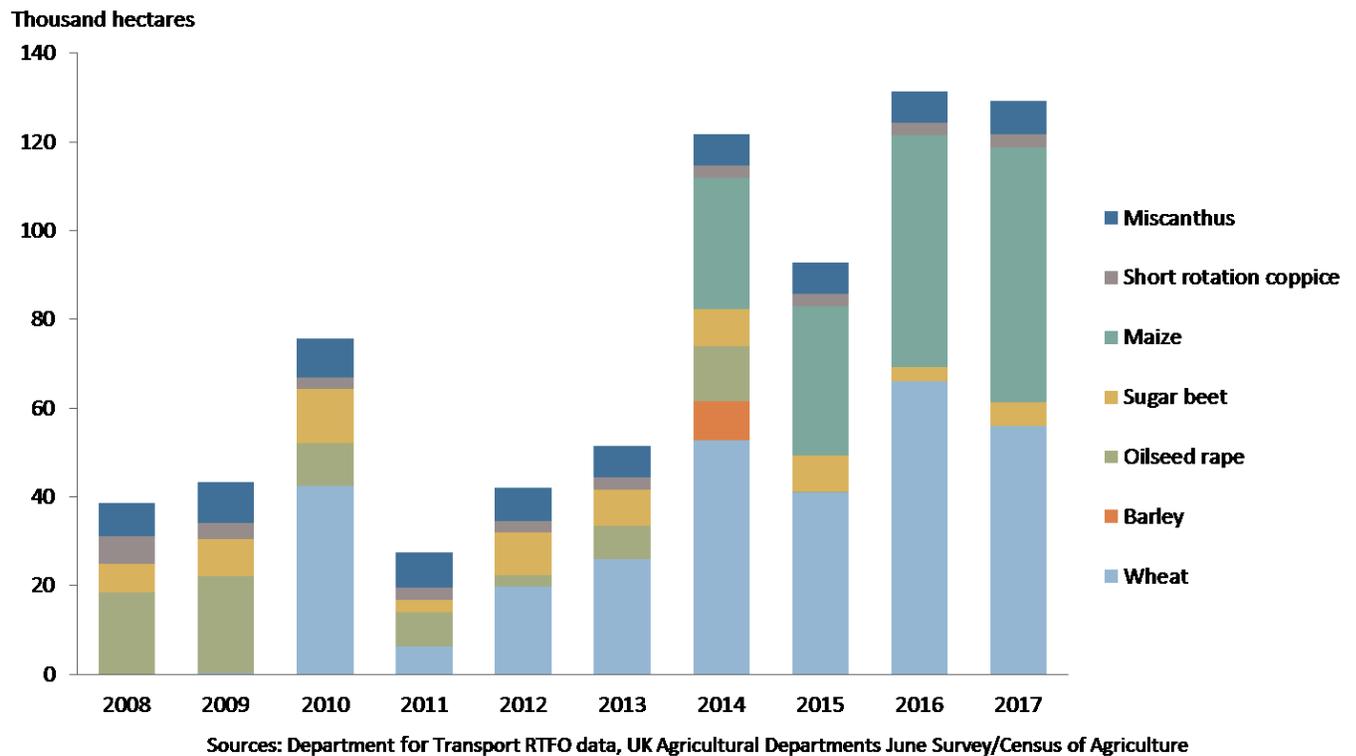
Table 1: implied area and tonnage data altered to reflect revised sugar beet yield data.

## Contents

About this release .....	1
Key Messages .....	1
Contents .....	2
Overview of agricultural area used for bioenergy crops.....	3
1. Biofuels.....	4
1.1 UK grown crops used for production of biofuels for supply to the UK road transport market .....	4
1.2 Implied crop areas based on supply of biofuel to the road transport market.....	5
1.3 Biofuels from crops supplied to the UK for the road transport market 2017/18.....	8
1.4 Comparison of biofuels to all fuels used for road transport.....	9
1.5 Renewable Energy Statistics (RESTATS) Questionnaire .....	11
2. Plant biomass: miscanthus, Short Rotation Coppice and straw.....	13
2.1 Miscanthus areas.....	13
2.2 Miscanthus yields / production .....	13
2.3 Miscanthus usage.....	14
2.4 Short Rotation Coppice (SRC) - willow or poplar areas .....	15
2.5 Short Rotation Coppice yields/production .....	16
2.6 Short Rotation Coppice usage .....	17
2.7 Straw availability and usage.....	18
2.8 Power station usage of straw .....	21
2.9 Volumes of biomass used in the UK for energy.....	23
3. Anaerobic digestion .....	25
3.1 Energy produced from anaerobic digestion.....	25
3.2 Crops as feedstocks for AD .....	27
3.3 Types of crops used as feedstocks .....	28
Annex A: Glossary of terms and conversion factors .....	30
Annex B: Background information on key data sources .....	31
B.1 Use of the statistics.....	31
B.2 Data sources.....	31
B.2.1 The June Survey of Agriculture and Horticulture .....	31
B.2.2 Renewable Transport Fuels Obligation (RTFO) .....	32
B.2.3 Renewable Energy STATistics (RESTATS) Questionnaire .....	33
B.2.4 Cereal and Oilseed Rape Production Survey .....	33
B.2.5 Energy crops scheme .....	34
B.2.6 Ofgem Renewable Obligation Annual Report - Biomass Sustainability Dataset .....	34
B.2.7 RHI Deployment data.....	34
B.2.8 NNFFC Anaerobic Digestion Deployment in the United Kingdom .....	34
Annex C: Background information on sugar beet used for bioenergy .....	35

## Overview of agricultural area used for bioenergy crops

Figure 1: Total area of crops grown for bioenergy, 2008 - 2017<sup>(a)</sup>



(a) Data for maize used as feedstock for anaerobic digestion only available from 2014.

- 129 thousand hectares of agricultural land was used for bioenergy crops in the UK in 2017 comprising: 56 of wheat, 57 of maize<sup>1</sup>, 6 of sugar beet, 7 of miscanthus, 3 of short rotation coppice.
- Arable land<sup>2</sup> used for bioenergy crops in the UK decreased by 12% in 2017, remaining at the second highest level so far recorded. It equated to 2.2% of the total arable area. This decrease was largely due to the substantial drop in the quantity of arable land used to grow wheat for bioethanol production.
- Just under half (48%) of land used for bioenergy in 2017 was for biofuel (biodiesel and bioethanol) crops for the UK road transport market, with the remainder used mostly for heat and power production.
- In terms of the crop area used for biofuel, the sugar beet area increased by over 70% in 2017 compared to 2016, while the area of wheat decreased by 15% in the same period.

A detailed breakdown of all figures for 2008 to 2017 is in Table A of the [crops for bioenergy dataset](#).

<sup>1</sup> Maize used as a feed stock for anaerobic digestion.

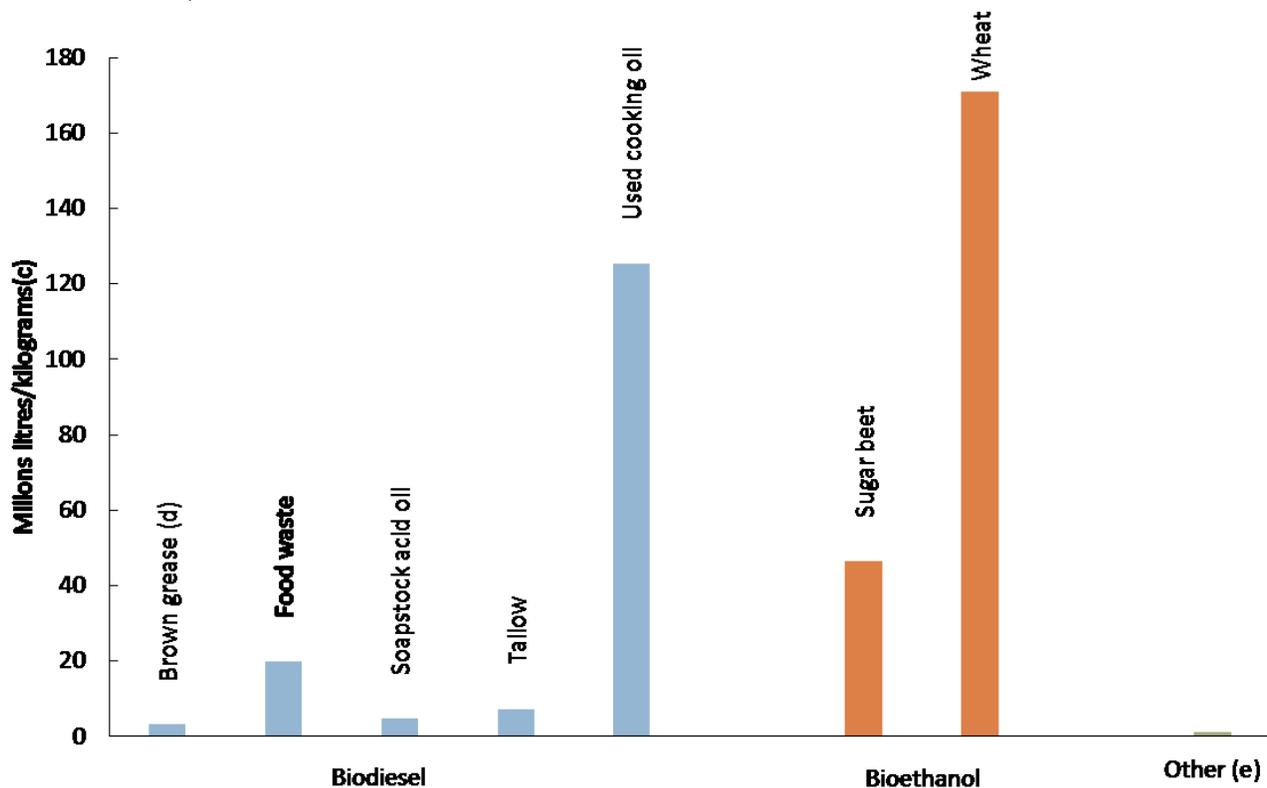
<sup>2</sup> Arable area is defined as the area of arable crops, uncropped arable land and temporary grassland.

# 1. Biofuels

## 1.1 UK grown crops used for production of biofuels for supply to the UK road transport market

Figure 2 summarises UK sourced biofuels reported under the Renewable Transport Fuels Obligation (i.e. the biofuels used in the UK that are made from UK feedstocks). Crops and by-products have been included to show differing proportions of feedstocks. Figures relating to biofuel used for road transport in 2017/18 (year runs mid-April to mid-April) are provisional based on data currently available; for more information on the Renewable Transport Fuels Obligation (RTFO) see [Annex B](#).

Figure 2: Volume of UK sourced biofuels supplied to the UK road transport market by crop type and waste / residue, 2017/18<sup>(a)(b)</sup>



Source: Department for Transport RTFO data

- (a) 2017/18 figures are as of 17th September 2018 and are subject to revision.
- (b) Year relates to 15th April 2017 - 14th April 2018.
- (c) Biodiesel and bioethanol volumes are reported in litres and biogas volumes are reported in kilograms.
- (d) Brown grease is fat and oil removed from grease traps and sewers.
- (e) "Other" is biomethane, biomethanol and biopetrol.

- The total volume of UK sourced biofuels used in the UK in 2017/18 was 379 million litres / kilogrammes. This was a decrease of 8% compared to the volume of UK sourced biofuels in 2016/17.
- Compared to 2016/17 the volume of UK sourced biodiesel for UK road transport decreased by 17% to 161 million litres, the lowest value since 2011/2012. This decrease was mainly driven by decreases in the use of tallow and cooking oil, while the use of food waste continued to rise. For bioethanol there was no change, remaining constant at 217 million litres, with the increase in the use of sugar beet counteracted by a decrease in the use of wheat.

A detailed breakdown from 2008/09 is in Table B of the [crops for bioenergy dataset](#).

## 1.2 Implied crop areas based on supply of biofuel to the road transport market

Table 1 and Figures 3 to 5 focus on the arable crops used as feedstocks and convert the biofuel volumes reported under the Renewable Transport Fuels Obligation (RTFO) into equivalent UK crop areas. These crop areas are only based on biofuel from UK grown crops sold into the UK road fuel market, and therefore do not include UK grown crops which are processed into biofuels and then exported (and not re imported), those which go to markets other than road transport, or are exported to be processed into biofuels elsewhere.

Conversion factors for litres to tonne of crop are in [Annex A](#).

Table 1: Total UK crop areas used for biofuels (biodiesel and bioethanol) supplied to the UK road transport market, 2008/09 - 2017/18

All UK crops used as biofuels (RTFO Year: 15 <sup>th</sup> April - 14 <sup>th</sup> April)	Total volume of biofuels from UK grown crops (million litres)	Implied tonnage of crop ('000 tonnes) <sup>(a)</sup>	Implied area '000 ha	% of UK total arable area <sup>(b)</sup>
Year 1: 2008/09	67.7	470	25.0	0.4%
Year 2: 2009/10	95.5	701	30.5	0.5%
Year 3: 2010/11	202.9	1 039	64.4	1.1%
Year 4: 2011/12	52.5	295	16.8	0.3%
Year 5: 2012/13	111.8	733	32.0	0.5%
Year 6: 2013/14	138.2	784	41.7	0.7%
Year 7: 2014/15 <sup>(c)</sup>	271.4	1 223	82.4	1.3%
Year 8: 2015/16 <sup>(d)</sup>	195.4	960	49.3	0.8%
Year 9: 2016/17 <sup>(d)</sup>	217.4	757	69.2	1.2%
Year 10: 2017/18 prov. <sup>(e)</sup>	217.0	921	61.5	1.0%

(a) Based on conversions from the Department for Transport and The National Non-Food Crops Centre (details provided in Table 1) and Defra crop yield statistics.

(b) UK arable area is defined as the area of arable crops, uncropped arable land and temporary grassland. Data from the 2008 June Survey of Agriculture have been used in conjunction with RTFO year 1 (2008-2009). Subsequent years follow the same pattern.

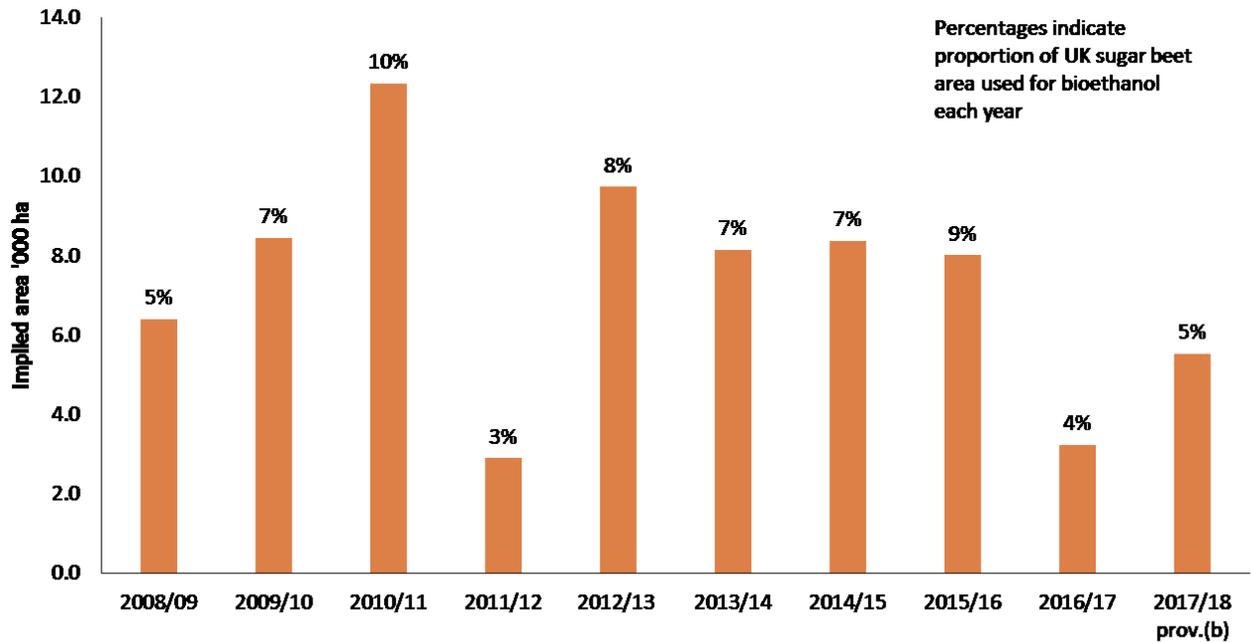
(c) Includes bioethanol from UK grown barley and maize processed as part of a trial.

(d) Includes bioethanol from UK grown maize.

(e) 2017/18 figures (Year 10) are as of 17th September 2018 and are subject to revision.

- In 2017/18 just over 60 thousand hectares of UK crops were used for biofuels supplied to the UK road transport market which equates to 1.0% of the total arable area of the UK.
- The area of crops for biofuels saw a decrease of 11% between 2016/17 and 2017/18 although this translated to virtually no change in the volume of biofuel produced. This disparity reflects a change in the balance of sugar beet and wheat used and higher crop yields in 2017, with a particularly large increase in sugar beet yields in comparison to 2016/2017 (71 t/ha in 2016/2017 to 83 t/ha in 2017/2018).

Figure 3: UK sugar beet area<sup>(a)</sup> used for bioethanol supplied to the UK road transport market 2008/09 - 2017/18



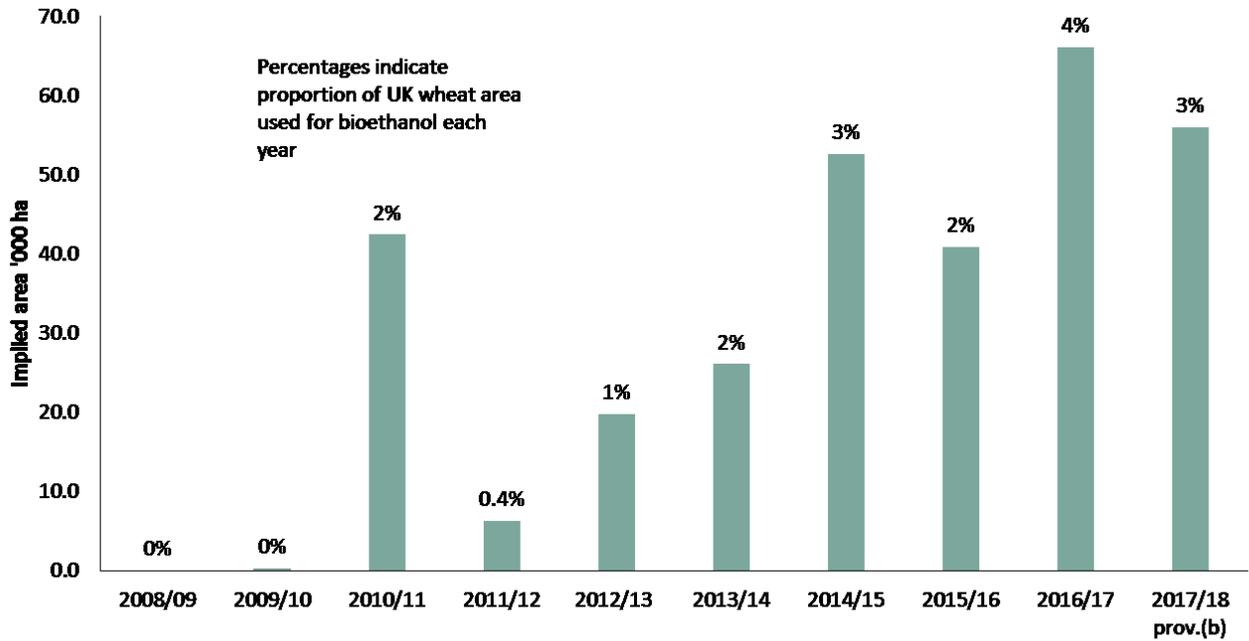
Sources: Department for Transport RTFO data, Agriculture in the UK

(a) Source: yield data and total crop areas, Defra, Agriculture in the United Kingdom and June Survey of Agriculture. Data from the 2008 survey / publication have been used in conjunction with RTFO year 1 (2008-2009). Subsequent years follow the same pattern.

(b) 2017/18 figures (Year 10) are as of 17th September 2018 and are subject to revision.

- Around 5.5 thousand hectares of sugar beet were used in the production of bioethanol for the road transport market in 2017/18, an increase in area of over 70% compared to 2016/17. This is in line with a general increase in the area of sugar beet grown across the UK in that time, following an end to the EU sugar beet quotas in 2017. More background on the sugar beet industry and its use for bioenergy can be found at [Annex C](#).
- An estimated 56 thousand hectares of wheat was used for bioethanol in 2017/18. This was a decrease in area of 20% compared to 2016/17, with intermittent closures of both UK cereal bioethanol plants during this time likely impacting the amount used.

Figure 4: UK wheat area<sup>(a)</sup> used for bioethanol supplied to the UK road transport market 2008/09 - 2017/18

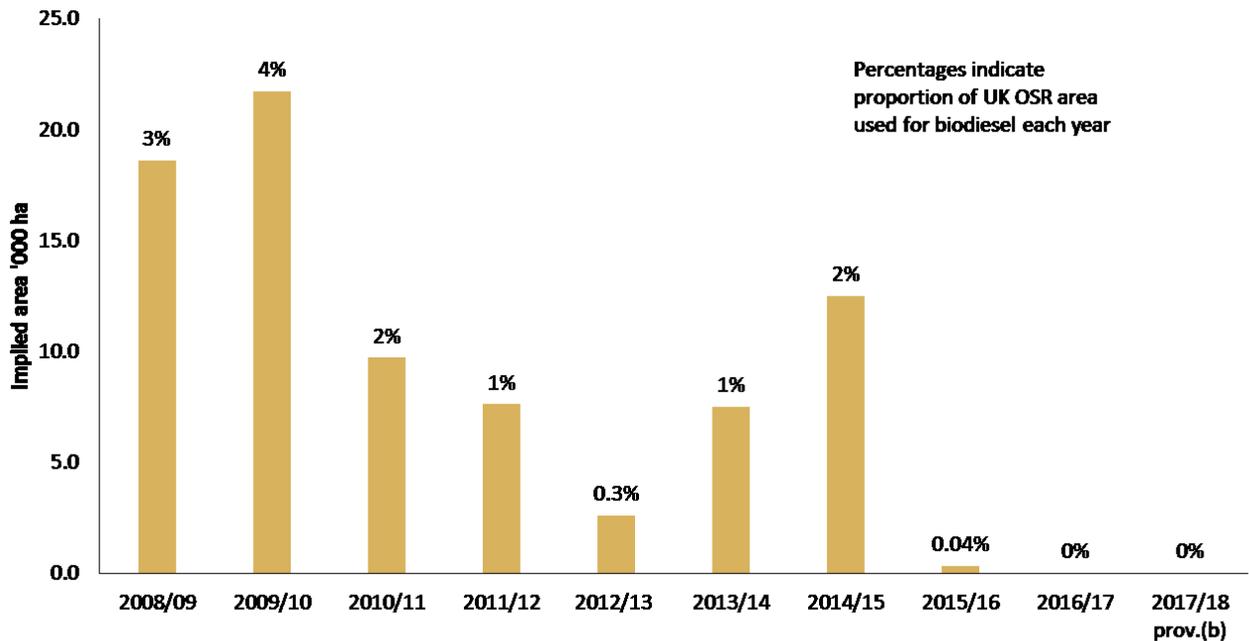


Sources: Department for Transport RTFO data, Agriculture in the UK

(a) Source: yield data and total crop areas, Defra, Agriculture in the United Kingdom and June Survey of Agriculture. Data from the 2008 survey / publication have been used in conjunction with RTFO year 1 (2008-2009). Subsequent years follow the same pattern.

(b) 2017/18 figures (Year 10) are as of 17th September 2018 and are subject to revision.

Figure 5: UK oilseed rape area<sup>(a)</sup> used for biodiesel supplied to the UK road transport market, 2008/09 - 2017/18



Sources: Department for Transport RTFO data, Agriculture in the UK

(a) Source: Defra June Survey of Agriculture. Data from the 2008 survey have been used in conjunction with RTFO year 1 (2008-2009). Subsequent years follow the same pattern.

(b) 2017/18 figures (Year 10) are as of 17th September 2018 and are subject to revision.

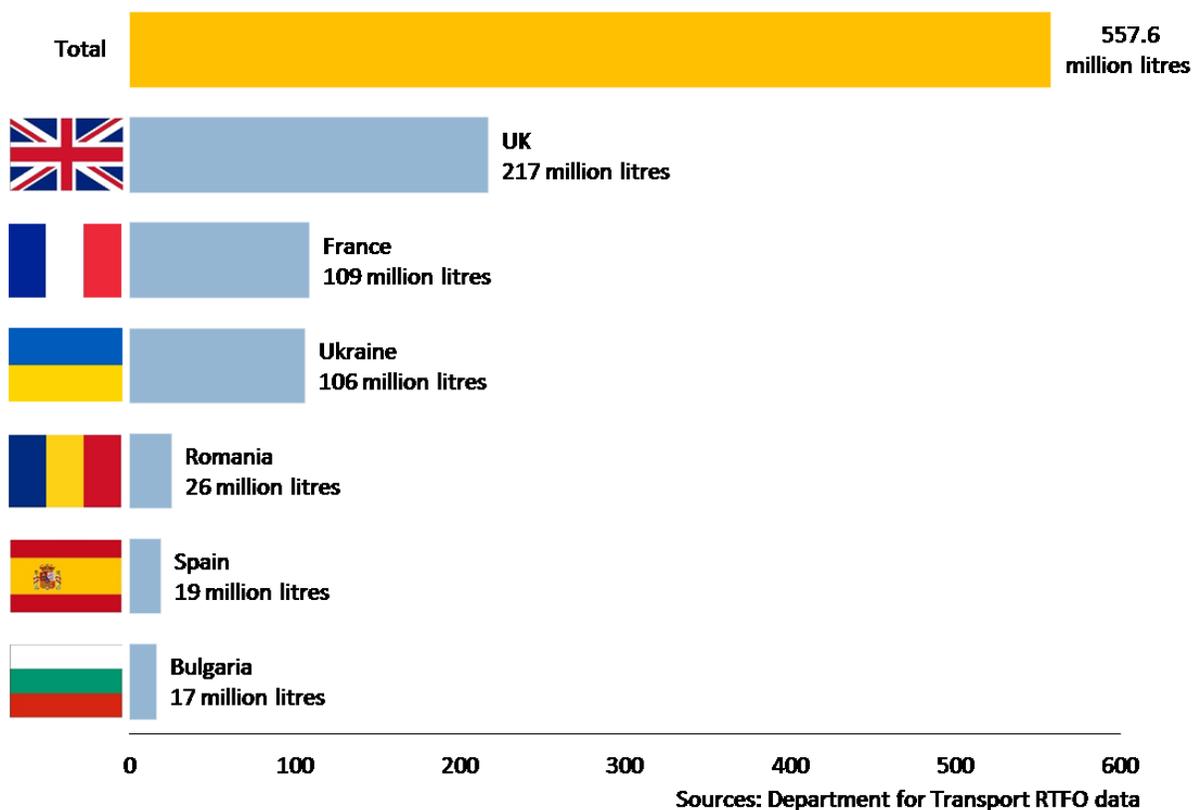
- Provisional RTFO data indicates that no oilseed rape grown in the UK was used to produce biodiesel for the UK road transport market in 2017/18. This reflects a longer term shift in feedstock type with increasing use of wastes and less crop biodiesel compared to the early years of the RTFO.
- The most widely reported UK sourced feedstock for biodiesel in 2017/18 was used cooking oil (Figure 2).

A breakdown of wheat, sugar beet and oilseed rape is in Tables C, D and E of the [crops for bioenergy dataset](#).

### 1.3 Biofuels from crops supplied to the UK for the road transport market 2017/18<sup>3</sup>

- In 2017/18, estimates indicate over 60% of the crop-derived bioethanol for road transport originated from crops grown outside the UK. An estimated 39% originated from crops grown in the UK, which was a decrease on the 2016/17 percentage, largely driven by a decrease in the volume of bioethanol derived from UK grown wheat.
- Figure 6 shows the top 6 countries supplying crop derived bioethanol to the UK. Volumes for all countries and types of crop feedstock can be found in Table F of the [crops for bioenergy dataset](#).

Figure 6: Top 6 countries supplying crop derived bioethanol to the UK 2017/18<sup>2</sup>



<sup>3</sup> 2017/18 figures (Year 10) are as of 17<sup>th</sup> September 2018 and are not final.

- As in 2016/2017, the largest providers of crop-derived bioethanol to the UK after domestic production are France and the Ukraine. The amount of crop-derived bioethanol from these two countries increased by nearly 60% from 2016/2017 (from 131 to 207 million litres).
- There was no biodiesel produced from crop feedstocks supplied to the UK 2017/18. This is in line with the longer term trend of a decline in biodiesel derived from crops and an increasing use of waste feedstocks.

#### 1.4 Comparison of biofuels to all fuels used for road transport

Tables 2 and 3 compare the volume of biofuel used in UK road transport to the total of all fuels supplied for road transport for the last 2 years (data for RTFO years 1 to 8 can be found in previous releases of these statistics at: <https://www.gov.uk/government/collections/non-food-crops>). They also show the proportion of biofuels that are UK sourced. The years run 15<sup>th</sup> April to 14<sup>th</sup> April.

Table 2: RTFO Year 9 (2016/17) verified figures for biofuel from UK feedstocks

Fuel type	Million litres or kg <sup>(a)</sup>			UK sourced biofuels as a proportion of total biofuels supplied to UK	Biofuels as a proportion of total road transport fuels supplied to UK
	Volume UK sourced biofuels 2016/17	Total volume biofuels supplied to UK 2016/17 <sup>(b)</sup>	Total volume of road transport fossil fuels supplied to UK 2016/17		
Biodiesel of which:	193	721	29 246	27%	2.46%
Brown grease <sup>(c)</sup>	6				
Food waste	15				
Tallow (by-product)	30				
Used cooking oil (by-product)	141				
Other <sup>(d)</sup>	1				
Bioethanol of which:	217	758	16 228	29%	4.67%
Maize	3				
Sugar beet	23				
Wheat	192				
Biomethane	0	1		0%	
Biomethanol	0	57		0%	
HVO	0	1		0%	
Off road biodiesel	2	3		78%	
<b>Total</b>		<b>1 540</b>	<b>52 307</b>	<b>25%</b>	<b>2.94%<sup>(e)</sup></b>
Annual target <sup>(f)</sup>					<b>4.75%</b>

(a) Biodiesel, bioethanol and pure vegetable oil volumes are reported in litres and biogas volumes are reported in kilograms.

(b) Includes volumes of biofuel from other feedstocks in addition to those listed here e.g. palm oil.

(c) Brown grease is fat and oil removed from grease traps and sewers.

(d) "Other" is rapeseed residue and soapstock acid oil contaminated with sulphur.

(e) The difference in the percentage shown and the annual target is due to some Renewable Transport Fuel Certificates (RTFCs) being issued to double counting feedstocks. Biofuels produced from wastes, non-agricultural residues, non-food cellulosic material, and ligno-cellulosic material receive two RTFCs per litre/kg meaning suppliers using these feedstocks only have to supply half the volume to meet their obligation.

(f) Rising from 2.5% in 2008/09 to 4.75% from 2013/14 onwards. From 15 April 2013, the end uses covered by the Renewable Transport Fuels Obligation were amended to include non-road mobile machinery (including inland waterways vessels), agriculture and forestry tractors and recreational craft when not at sea (known collectively as NRMM). To keep the supply of biofuel broadly consistent the biofuel target level was changed from 5% to 4.75% based on data supplied by industry on the volume of low sulphur gas oil used for NRMM end uses.

- In 2016/17, 1,541 million litres of biofuel were supplied to the UK which is 2.9% of total road and non-road mobile machinery fuel. 99.95% of this renewable fuel has been demonstrated to meet the sustainability requirement<sup>4</sup>.
- Of the 1,540 million litres meeting sustainability requirements<sup>4</sup>, bioethanol comprised 49% of supply, biodiesel 47% and biomethanol 4%. There were also small volumes of biodiesel HVO, biogas and off road biodiesel.

Table 3: RTFO Year 10 (2017/18) provisional figures<sup>(a)</sup> for biofuel from UK feedstocks

Fuel type	Million litres or kg <sup>(b)</sup>			UK sourced biofuels as a proportion of total biofuels supplied to UK	Biofuels as a proportion of total road transport fuels supplied to UK
	Volume UK sourced biofuels 2017/18	Total volume biofuels supplied to UK 2017/18 <sup>(c)</sup>	Total volume of road transport fossil fuels supplied to UK 2017/18		
Biodiesel of which:	161	793	29 346	20%	2.70%
Brown grease <sup>(d)</sup>	3				
Food waste	20				
Tallow (by-product)	7				
Used cooking oil (by-product)	125				
Other <sup>(e)</sup>	5				
Bioethanol of which:	217	744	15 745	29%	4.75%
Maize	0				
Sugar beet	46				
Wheat	171				
Biomethane	0.003	6		0%	
Biomethanol	0.1	64		0%	
Biopetrol	0.2	4		7%	
HVO	0	1		0%	
Off road biodiesel	1	1		55%	
<b>Total</b>		<b>1 540</b>	<b>50 329</b>	<b>25%</b>	<b>3.06%<sup>(e)</sup></b>
<b>Annual target<sup>(g)</sup></b>					<b>4.75%</b>

(a) 2017/18 figures (Year 10) are as of 17<sup>th</sup> September 2018 and are not final.

(b) Biodiesel, bioethanol and pure vegetable oil volumes are reported in litres and biogas volumes are reported in kilograms.

(c) Includes volumes of biofuel from other feedstocks in addition to those listed here e.g. palm oil.

(d) Brown grease is fat and oil removed from grease traps and sewers.

(e) "Other" is rapeseed residue and soapstock acid oil contaminated with sulphur.

(f) The difference in the percentage shown and the annual target is due to some Renewable Transport Fuel Certificates (RTFCs) being issued to double counting feedstocks. Biofuels produced from wastes, non-agricultural residues, non-food cellulosic material, and ligno-cellulosic material receive two RTFCs per litre/kg meaning suppliers using these feedstocks only have to supply half the volume to meet their obligation.

(g) Rising from 2.5% in 2008/09 to 4.75% from 2013/14 onwards. From 15 April 2013, the end uses covered by the Renewable Transport Fuels Obligation were amended to include non-road mobile machinery (including inland waterways vessels), agriculture and forestry tractors and recreational craft when not at sea (known collectively as NRMM). To keep the supply of biofuel broadly consistent the biofuel target level was changed from 5% to 4.75% based on data supplied by industry on the volume of low sulphur gas oil used for NRMM end use.

<sup>4</sup> The EU Renewable Energy Directive and Fuel Quality Directive sustainability criteria are:

Biofuels must achieve at least a 35% GHG emissions saving (this threshold will rise over time);

Biofuels may not be made from raw material obtained from land with high biodiversity value in or after January 2008.

Biofuels may not be made from raw material obtained from land with high carbon stock such as forests or land that was undrained peatland in January 2008 unless strict criteria are met.

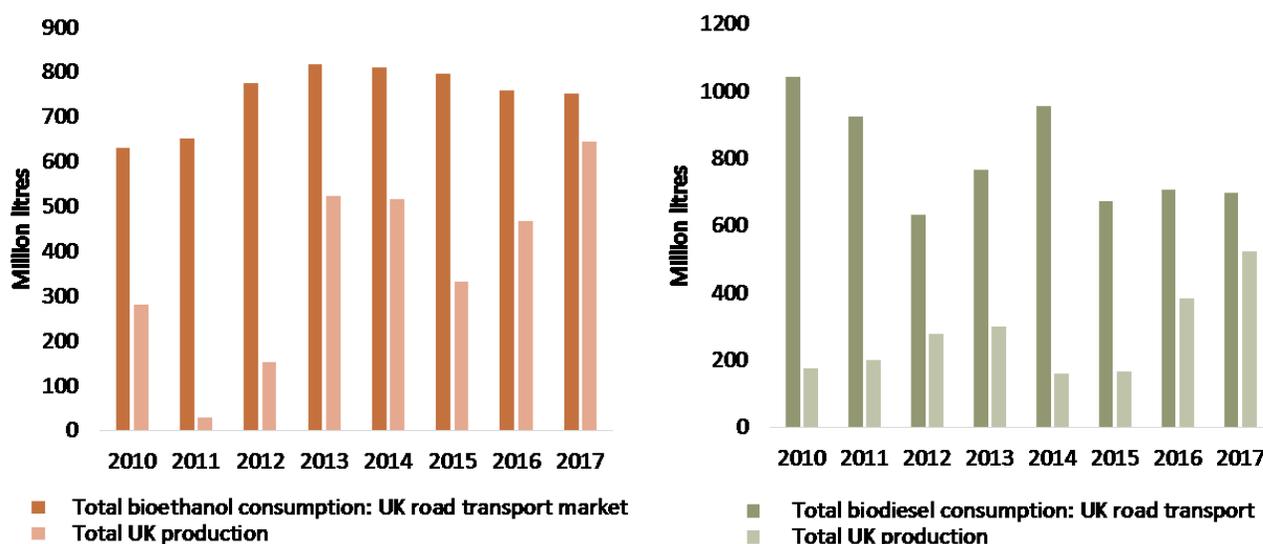
- Provisional figures for 2017/18 indicate that 1,624 million litres of biofuel were supplied to the UK which is 3.1% of total road and non-road mobile machinery fuel. 99.4% of this renewable fuel has been demonstrated to meet the sustainability requirement<sup>4</sup>.
- Of the 1,615 million litres meeting sustainability requirements<sup>4</sup>, bioethanol comprised 46% of supply, biodiesel 49% and biomethanol 4%. There were also small volumes of biodiesel HVO, biopetrol, biogas, and off-road biodiesel.

### 1.5 Renewable Energy Statistics (RESTATS) Questionnaire

The Department for Business, Energy and Industrial Strategy conduct an annual survey of large scale biofuel production (see [Annex B](#) for more details). The survey aims to determine total UK production of biofuels and, from 2012, included questions on the quantity and origin of crops used in UK biofuel production.

Because the survey covers all biofuel production (including that subsequently exported and for markets other than road transport) the data can help build a more complete picture of usage of UK crops for biofuel. Figure 7 compares total UK biofuel production to total biofuel supplied to the UK road transport market. Figure 8 gives an estimate of the proportion of biofuel supplied by end use. The survey is based on calendar years.

Figure 7: UK biofuel production and biofuel supply to UK road transport market, 2010 – 2017

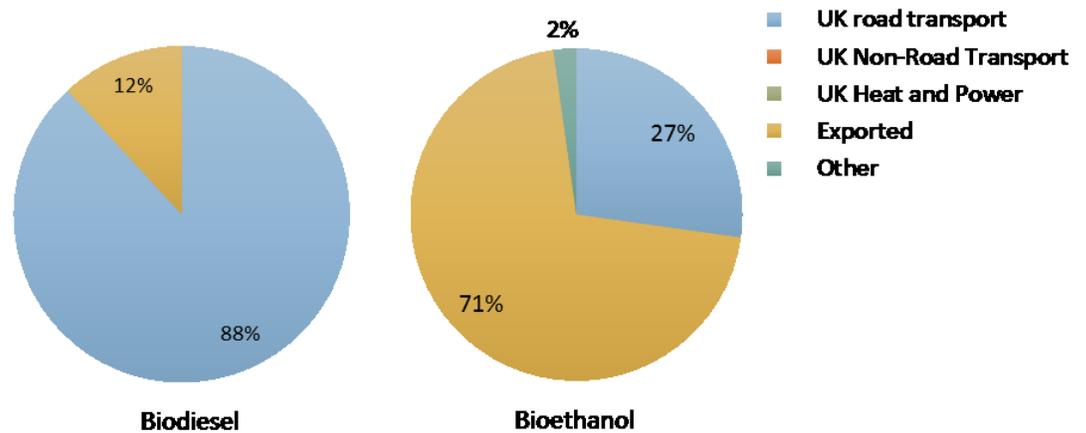


Sources: Digest of UK Energy Statistics

- At 524 million litres, UK production of biodiesel increased by 36% between 2016 and 2017. This volume was around 81% of the estimated UK production capacity for biodiesel (648 million litres in 2017).
- Bioethanol production increased by 38% to 645 million litres in 2016, 71% of the estimated UK production capacity of 910 million litres.

Data from 2010-2017 are available in Table G of the [crops for bioenergy dataset](#).

Figure 8: Estimated UK biodiesel and bioethanol supply (from UK production) 2017



Sources: Renewable Energy Statistics (RESTATS) Questionnaire

- In 2017, 100% of UK-produced bioethanol was derived from crop feedstocks, as has been the case since 2012. Of this, 79% was known to be produced from UK grown crops.
- There was no UK-produced biodiesel derived from crop feedstocks in 2017/18. This is in line with the decline in crop-derived biodiesel previously discussed.
- Supply of UK produced biofuels to various markets is also recorded in the survey (Figure 8). In 2017, almost 90% of biodiesel produced in the UK was supplied to the UK road transport market, with only 12% being exported. In contrast, over 70% of bioethanol produced in the UK was supplied to the export market, with less than 30% being used for the domestic road transport market, and only 2% being used for domestic heat and power.

Production and supply data from 2012-2017 are available in Tables H and I of the [crops for bioenergy dataset](#)

## 2. Plant biomass: miscanthus, Short Rotation Coppice and straw

Miscanthus and Short Rotation Coppice (SRC) are bioenergy crops grown primarily for use in the heat and electricity energy markets. They are burnt in power stations, combined heat and power units or heating systems.

### 2.1 Miscanthus areas

Table 4: Total area of miscanthus in England

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Area (ha)	7 465	9 213	8 657	8 075	7 517	7 078	7 012	6 905	7 057	7 366
95% confidence interval	±1 097	±2 348	±950	±807	±475	±486	±555	±514	± 526	±1 097
Number of growers	335	394	404	398	422	393	569	409	361	787

Source: Defra June Survey of Agriculture and Horticulture. Defra analysis to produce numbers of growers.

Figures prior to 2008 are only available through subsidy scheme information (see below). The Defra experimental stats release published in 2009 gives further details of these historic areas:

<http://webarchive.nationalarchives.gov.uk/20130315143000/http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-landuselivestock-nonfoodcrops-latestrelease.pdf>

Currently no data is available regarding UK-wide planting areas of miscanthus, however from 2008, official area estimates of miscanthus grown in England are available from the Defra June Survey of Agriculture<sup>5</sup>. A region breakdown for 2010, 2013, 2016 and 2017 is available in Table J of the [crops for bioenergy dataset](#).

- Miscanthus is grown on around 0.1% of the total arable area in England.
- Subsidy schemes provide a secondary source of area statistics. Under the Energy Crops Scheme (ECS) farmers could claim subsidies to assist with the establishment of miscanthus as part of the Rural Development Programme for England. The Energy Crops scheme closed in 2013 although planting for the scheme could be undertaken in 2013, 2014 and 2015 (more background can be found at [Annex B](#))
- The total area of new plantings claimed under the subsidies since 2000 was around 10,000 hectares. This includes miscanthus being grown at locations other than traditional farms (for example, country parks, and universities). These locations may not be covered by the June Agricultural Survey, which recorded 7,366 hectares of miscanthus in 2017.

Full details of the areas of Miscanthus plantings under the Energy Crops Scheme in England are in Table K of the [crops for bioenergy dataset](#).

### 2.2 Miscanthus yields / production

Although research has been done on miscanthus yields, as yet no official estimates of achieved yields are available. Yields vary greatly depending on a number of factors such as planting method, species, site conditions, as well as the standard variations of region and annual weather conditions. The first

<sup>5</sup> The apparent decrease in area from 2009 should be treated with caution as this may be due to the sampling variation in the survey (indicated by the confidence intervals), rather than a genuine decreasing area.

year's growth is not suitable to harvest; annual harvesting takes place from the second year and can continue for 15-20 years. Some industry experts estimate that current miscanthus yields average between 12-15 oven-dried tonnes (odt) per hectare (equating to 15-18 fresh tonnes per hectare) although other industry bodies suggest a lower figure of 10 odt per hectare.

Table 5: Miscanthus production based on upper and lower yield estimates<sup>(a)</sup>

	Thousand oven dried tonnes									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lower estimate	75	92	87	81	75	71	70	69	71	74
Upper estimate	112	138	130	121	113	106	105	104	106	110

Source: Yield information taken from National Non-Food Crops Centre (NNFCC) miscanthus fact sheet at: <https://www.nnfcc.co.uk/publications/factsheet-miscanthus> and on direct conversations with growers and end users.

(a) Estimates based on areas from the June Survey of Agriculture and Horticulture and yields of 10 and 15 oven dried tonnes per hectare

- The estimated annual volume of miscanthus produced in England based on both the upper and lower yield estimates from industry sources should be treated as broad estimates because of the yield uncertainties and the assumption that the whole of the area planted is productive, which will not be the case for recently planted crops<sup>6</sup>.
- Miscanthus production in England in 2017 was 74 thousand oven dried tonnes, based on the lower end assumption of yield.

### 2.3 Miscanthus usage

Usage data are collated by Ofgem as part of sustainability requirements under the Renewables Obligation. There are other outlets for using miscanthus including horse and livestock bedding, in small scale combined heat and power plants directly on farms for heating buildings and for domestic uses such as wood burners and open fires. Unfortunately, quantitative information on these end uses is not available.

- Approximately 55 thousand tonnes of miscanthus were used in UK power stations for electricity in 2016/17 (Figure 9) which was around three quarters of all miscanthus produced in England in 2017, based on low end assumptions of yields.
- The 2016/17 volume was a 57% increase on the previous year, and the highest volume recorded since 2009/10. This continues a trend of increases since 2013/14, and is reflective of a general trend of existing power stations adapting infrastructure towards increased biomass capacity,<sup>7</sup> and the opening of new biomass power stations.<sup>8</sup>
- The decrease in usage in 2013/14 reflects the Renewables Obligation Amendment Order which came into force in April 2013 and introduced a number of changes that reduced the incentive for power stations to use energy crops<sup>9</sup>.

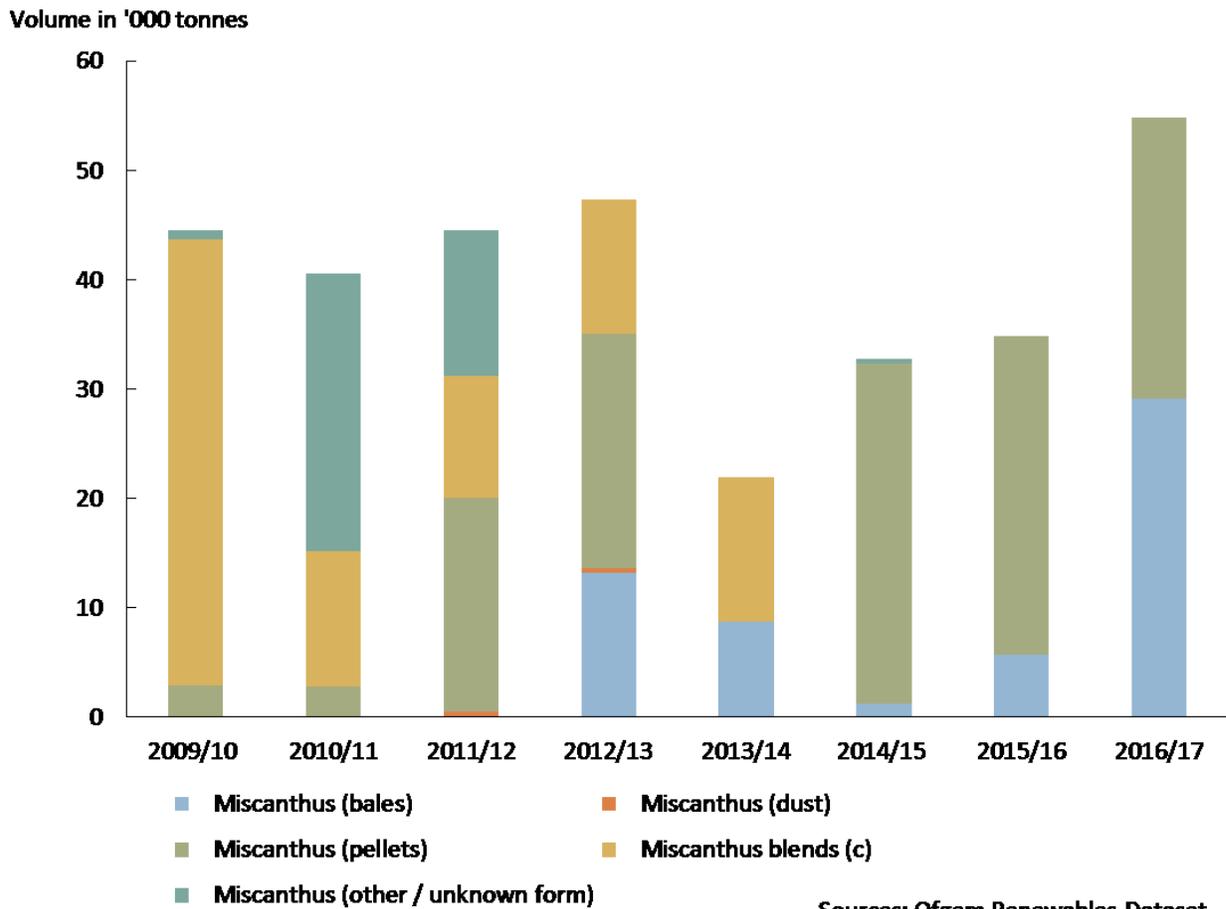
<sup>6</sup> The first year's growth is not suitable to harvest; annual harvesting takes place from the second year and can continue for 15-20 years.

<sup>7</sup> [https://www.drax.com/press\\_release/drax-given-green-light-complete-biomass-upgrade-saving-12-million-tonnes-carbon-every-year/](https://www.drax.com/press_release/drax-given-green-light-complete-biomass-upgrade-saving-12-million-tonnes-carbon-every-year/)

<sup>8</sup> <https://www.snettertonbiomass.com/>

<sup>9</sup> Section 4, Renewables Obligation Annual Report 2013/14 <https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-ro-annual-report-2013-14> Further information on energy crops can be found in chapter 2 and appendices 3 and of the fuel measurement and sampling guidance: <https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-fuel-measurement-and-sampling-guidance-0>

Figure 9: Miscanthus usage in UK power stations<sup>(a)(b)</sup>



(a) Tonnes are reported directly by the generating stations so it is not known whether these are fresh weight or oven dried equivalents.

(b) Only categories where the proportion of miscanthus was greater than 90% are included.

(c) Blended with either cereal residues or wood.

See [Annex B](#) for details of the Ofgem Renewables Obligations dataset.

A breakdown of all figures for 2009/10 to 2016/17 is in Table L of the [crops for bioenergy dataset](#).

## 2.4 Short Rotation Coppice (SRC) - willow or poplar areas

Table 6: Total area of Short Rotation Coppice grown in England

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Area (ha)	6 216	3 721	2 591	2 720	2 551	2 650	2 849	2 885	2 962	2 966
95% confidence interval	±2 839	±1 349	±416	±768	±702	±218	±503	±656	±665	±593
Number of growers	373	381	251	228	186	230	182	361	437	379

Source: Defra June Survey of Agriculture and Horticulture Defra analysis to produce regional figures and numbers of growers.

Currently no data is available regarding UK-wide planting areas of SRC, however from 2008, official area estimates of SRC grown in England are available from the Defra June Survey of Agriculture. A regional breakdown of SRC areas for 2010, 2013, 2016 and 2017 is available in Table M of the [crops for bioenergy dataset](#).

- SRC (since 2009) represents less than 0.1% of the total arable area in England.
- Since 2009, the picture has been relatively stable. It is suspected that the apparent large fall in area between 2008 and 2009 is due to reduced data robustness in 2008, the first year of this data collection.
- Subsidy schemes can provide a secondary source of area statistics. The Energy Crops Scheme closed in 2013 although planting for the scheme could be undertaken in 2013, 2014 and 2015. More background can be found at [Annex B](#).
- Comparing the total area of new plantings claimed under subsidies since 2000 (around 2,500 hectares) to the 2017 Defra June Survey area (2,966 hectares) suggests that the vast majority of SRC has been grown within the subsidy payment scheme.
- Full details of the areas of SRC plantings under the Energy Crops Scheme in England can be found in Table N of the [crops for bioenergy dataset](#).

## 2.5 Short Rotation Coppice yields/production

Much research has been done on SRC yields but as yet, no official estimates of achieved yields are available. SRC is harvested every 2-3 years and yields vary greatly according to the number of years since planting, site conditions, type of planting method, crop type (willow or poplar) as well as the standard variations of region, annual weather conditions etc.

Table 7: Short Rotation Coppice production based on upper and lower yield estimates<sup>(a)</sup>

	Thousand oven dried tonnes									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lower estimate	50	30	21	22	20	21	23	23	23	24
Upper estimate	93	56	39	41	38	40	43	43	44	44

Source: National Non-Food Crops Centre SRC factsheet <https://www.nnfcc.co.uk/publications/factsheet-src-willow>, M.J. Tallis, E.Casella *et al*, *GCB Bioenergy*, 2013, 5;1, 53-66, <https://doi.org/10.1111/j.1757-1707.2012.01191.x>

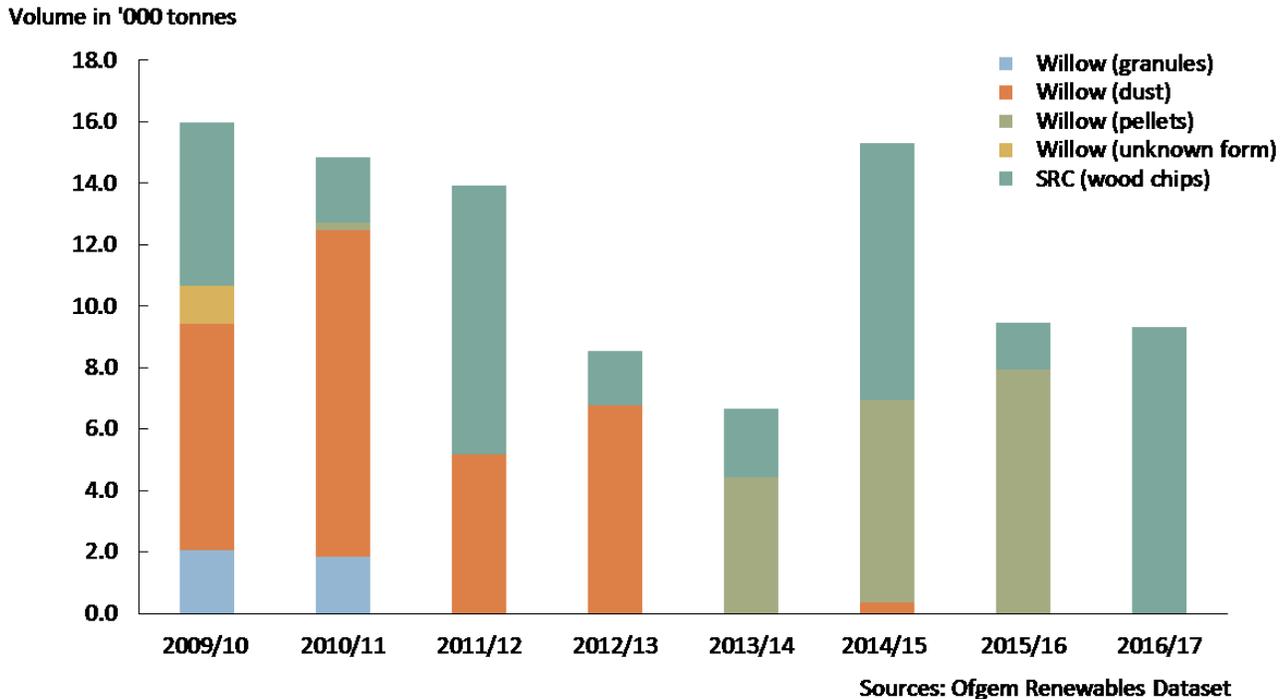
Estimates based on areas from the June Survey of Agriculture and Horticulture and yields of 8 to 15 oven dried tonnes per hectare.

- Industry experts at the National Non Food Crops Centre (NNFCC) estimate an average SRC yield of 8-17.5 oven dried tonnes (odt)/ha/yr (taking into account the 2-3 year harvesting period) while the Forestry Commission ForestGrowth-SRC model predicts average yearly yields at 9.0 odt/ha/yr and 10.3 odt/ha/yr for willow and poplar respectively.
- Table 7 shows the estimated volume of SRC produced in England each year based on both the upper and lower yield estimates of 15 odt/ha and 8 odt/ha. These figures should be treated as broad estimates rather than definitive figures as there is much uncertainty behind the estimates
- Total SRC production in England was around 24 thousand tonnes in 2017, based on low end assumptions of yields.

## 2.6 Short Rotation Coppice usage

The volume of UK produced SRC Willow used in power stations is collated by Ofgem, as part of sustainability requirements under the Renewables Obligation. SRC is suited to a range of heat and power generation systems down to domestic level (not captured here). There are few other end uses.

Figure 10: Short Rotation Coppice usage in UK power stations<sup>(a)</sup>



(a) Tonnages are reported directly by the generating stations so it is not known whether these are fresh weight or oven dried equivalents.

A breakdown of all figures for 2009/10 to 2016/17 is in Table O of the [crops for bioenergy dataset](#).

- Approximately 9 thousand tonnes of SRC were used in UK power stations for electricity in 2016/17, approximately the same volume used in the previous year (Figure 10). 2014/15 was the first year when solid biomass and biogas stations with a total installed capacity (TIC) of 1MW or greater had to submit a sustainability audit which may have influenced the increase seen then<sup>10</sup>. Since then, there have been almost no changes in the quantity of SRC used, however this year was the first year in which all of the SRC burned was in the form of wood chips rather than pellets.
- The decrease between 2012/13 and 2013/14 reflects the Renewables Obligation Amendment Order which came into force in April 2013 and introduced a number of changes that reduced the incentive for stations to use energy crops<sup>11</sup>.
- The volume of SRC used in UK power stations was around 40% of all the SRC produced in England in 2017, based on low end assumptions of yields.

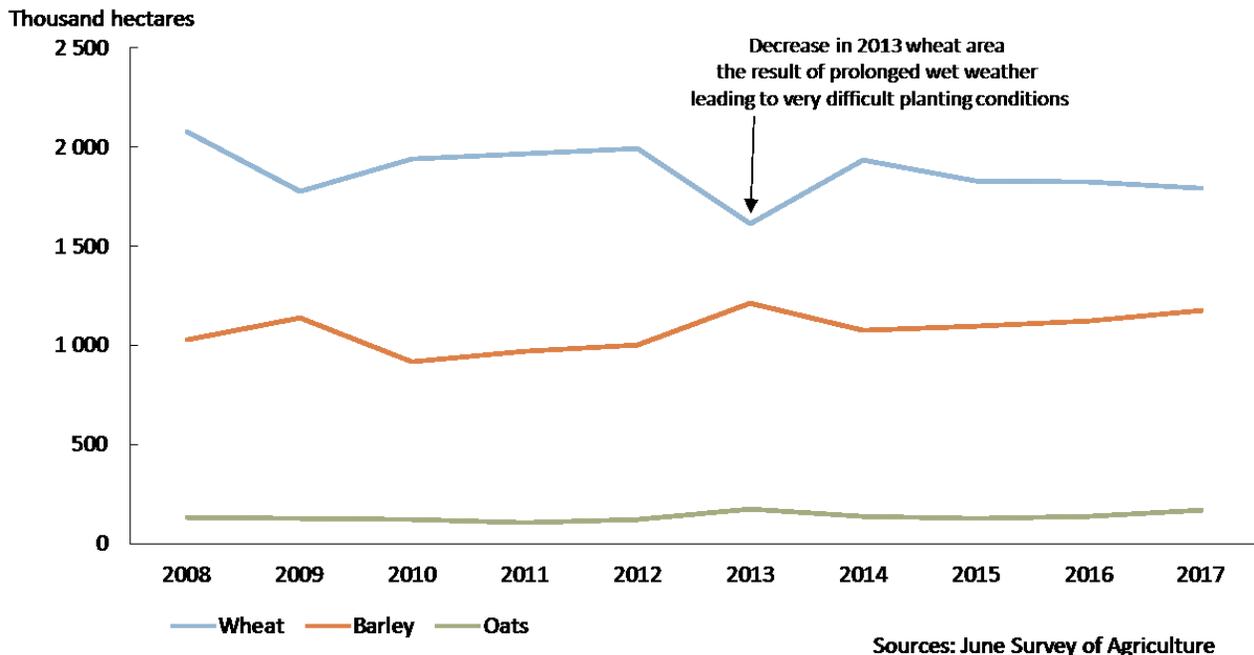
<sup>10</sup> Section 4, Renewables Obligation Annual Report 2014/15 <https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2014-15>

<sup>11</sup> Section 4, Renewables Obligation Annual Report 2013/14 <https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-ro-annual-report-2013-14> Further information on energy crops can be found in chapter 2 and appendices 3 and 4 of the fuel measurement and sampling guidance: <https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-fuel-measurement-and-sampling-guidance-0>

## 2.7 Straw availability and usage

Unlike SRC and miscanthus, straw is not grown specifically as a bioenergy crop, and is instead a by-product of the cereals industry. It is used for animal bedding, as animal feed and, to a small extent, as an energy crop to be burnt for heating and electricity in power stations and combined heat and power units. The Defra June survey records UK cereal areas for wheat, barley and oats on a yearly basis (Figure 11). As straw is a by-product of these cereals, these areas give a good indication of hectares of straw produced.

Figure 11: Areas of selected UK cereals at June each year



Since 2014, Defra’s Cereal and Oilseed Production Survey has collected data on straw yield for England only. The results for 2017 are shown in Table 8.

Table 8: Estimates of cereal and oilseed rape straw production in 2017, England

	Wheat	Oats	Barley	Oilseed rape
Area ('000 hectares)	836	591	59	40
% change from 2016	11%	4%	7%	3%
Production ('000 tonnes)	3 262	2 072	208	102
% change from 2016	5%	-2%	-13%	-4%
Yield (tonnes per hectare)	3.9	3.5	3.5	2.6
% change from 2016	-7%	-5%	-20%	-4%

Source: Defra Cereal & Oilseed Production Survey

- In 2017, there was a decrease in the yield of all straw types in England, from a modest 4% decrease in oilseed rape yield, to a significant 20% drop for barley. This reduced yield was attributed to the poor weather conditions throughout 2017, making both growing and bailing of straw to be more challenging than in previous years, with many farmers choosing to chop and

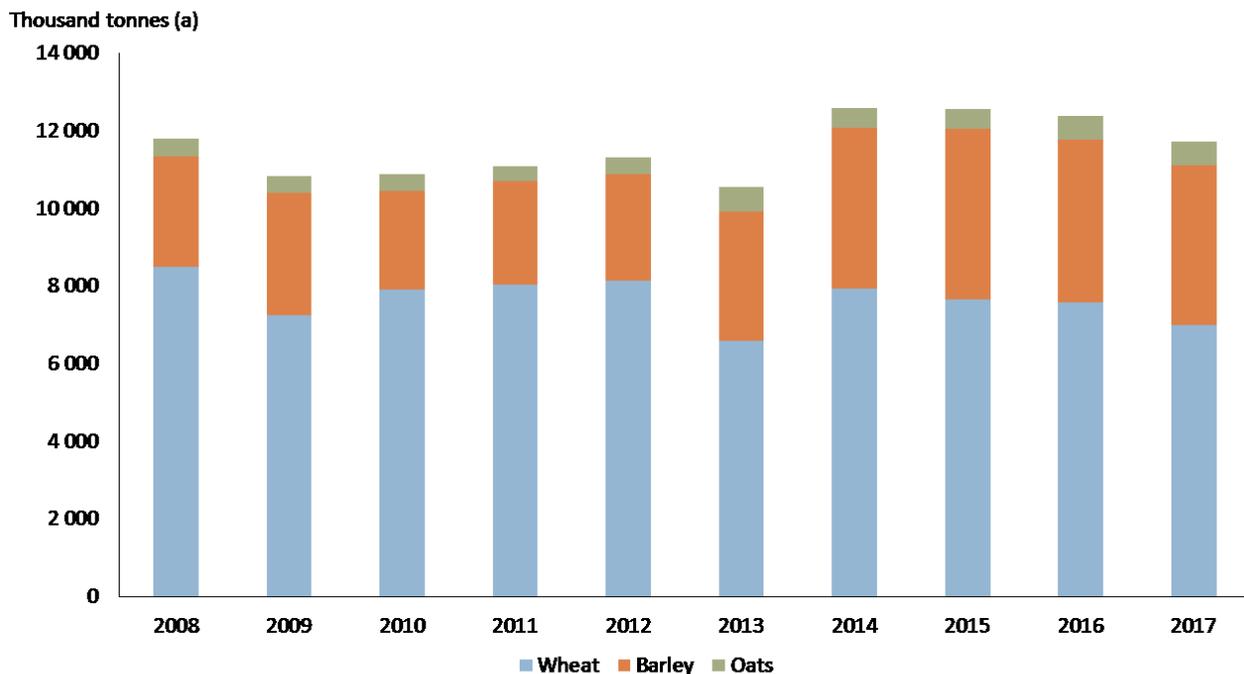
incorporate a greater percentage of their straw back into the soil. Despite this, the change in production was minimal in comparison to 2016 due to increased planting areas for all straw-producing crops.

- Over half of all straw grown in England in 2017 was wheat straw, with over 3.2 million tonnes produced. This is an increase of 5% from 2016, as a result of a large increase in planting area.
- All other straw types saw an overall decrease in production in comparison to 2016, caused by reduced yields and minimal changes to growing areas.

A longer time series from 2014-2017 of cereal areas and estimated yields for England is in the [crops for bioenergy dataset](#), Table P.

UK production of straw is estimated by applying the yield for England to the total UK area (figure 12). A breakdown of cereal areas and estimated yields is in the [crops for bioenergy dataset](#), Tables Q and R.

Figure 12: UK estimates of cereal straw production based on survey areas and typical straw yields



Sources: June Survey of Agriculture

(a) Production for 2014 onwards is based on recorded UK area and England yields for that year. Prior to 2014, recorded yields for straw are not available, and production is based on recorded UK area for that year and the average England yield for 2014-2017.

- Figure 12 gives annual estimates of UK production based on cereal straw yields for England and area of wheat, barley and oats in the UK.
- UK cereal straw production is generally around 11 to 12 million tonnes per year with typical yields of 4.0 tonnes/ha for wheat, 3.9 tonnes/ha for oats and 3.8 tonnes/ha for barley. These yields are based on an average of the England straw yields since 2014.

- This data shows an estimated decrease in cereal straw production in 2017 to under 11,800 thousand tonnes, in comparison to over 12,300 thousand tonnes produced in 2016. This is a decrease of around 5%, caused by decreases in yields for all straw types as seen in table 8, while crop areas remained largely unchanged from 2016 to 2017.

Table 9: Estimates of cereal straw supply and demand in the UK, 2017.

UK Supply/Demand	Thousand tonnes	% of cereal straw production	Implied cereal area ('000 ha) <sup>(a)</sup>
Cereal straw availability	11 720		3 142
Cereal straw usage:			
Animal bedding <sup>(b)</sup>	5 800	49%	1 554
Animal feed <sup>(b)</sup>	2 000	17%	536
Mushroom industry <sup>(c)</sup>	40	0.3%	11
Carrots <sup>(c)</sup>	250	2%	67
Power stations <sup>(d)</sup>	730	6%	196
Export	39	0.3%	10
Surplus cereal straw resource available in the UK for other markets	2 871	24%	769

(a) Area of wheat, barley and oats. Implied areas are calculated as the % of cereal straw production multiplied by the 2017 cereal area.

(b) Tonnages sourced from AEA, 2010: AEA 2010 UK and Global Bioenergy Resource. Annex 1 report: details of analysis <http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/policy/1465-aea-2010-uk-and-global-bioenergy-annex.pdf>

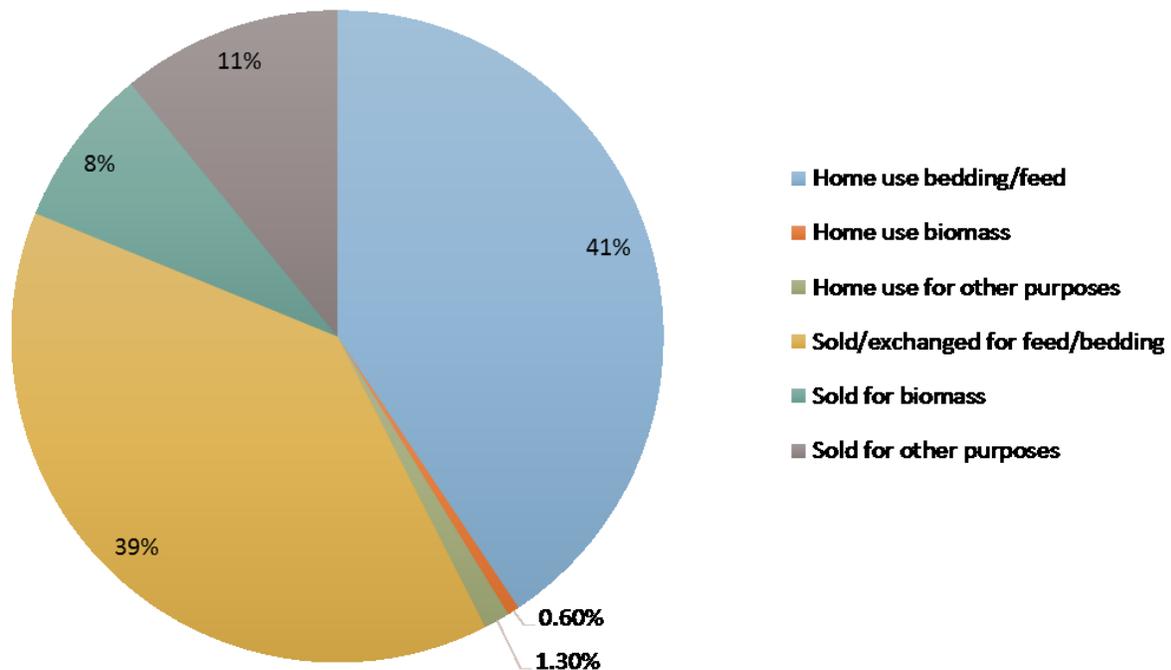
(c) Tonnages sourced from H. Stoddart and J. Watts, "Energy Potential from UK Arable Agriculture Straw: Straw- what is it good for?", *20th European Biomass Conference and Exhibition*, 2012, DOI: 10.5071/20thEUBCE2012-1BO.11.5.

(d) Tonnages sourced from Ofgem: <https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2016-17>

- Approximately 11.7 million tonnes of baled cereal straw was produced in the UK in 2017. This figure represents around 60% of total straw grown; as not all straw can be baled and used, the remaining stubble is incorporated back into the soil. The two main uses of baled straw are livestock bedding and feed.
- Around 730 thousand tonnes of straw (6% of total straw production) was used as fuel in biomass power stations in England in 2016/17. This comprises the largest use category after bedding and feed, with all other end uses making up less than 5% of UK straw usage.
- The figures suggest a net surplus of straw availability in the UK. However, as straw is bulky and costly to transport, much straw usage occurs close to the source so there can be much greater regional variation in the supply/demand balance<sup>12</sup>.

<sup>12</sup> Regional surpluses of straw occur in the largely arable Eastern regions of the UK. The Western, and typically livestock regions need to bring in straw to meet local demand. More details of regional variation can be found in Section 3.2 at : <https://www.gov.uk/government/statistics/area-of-crops-grown-for-bioenergy-in-england-and-the-uk-2008-2012>

Figure 13: End use of cereal and oilseed rape straw England 2017 <sup>(a)</sup>



Sources: Defra Cereal and Oilseed Production Survey

(a) End usage includes a small number of holdings with rye straw tonnage

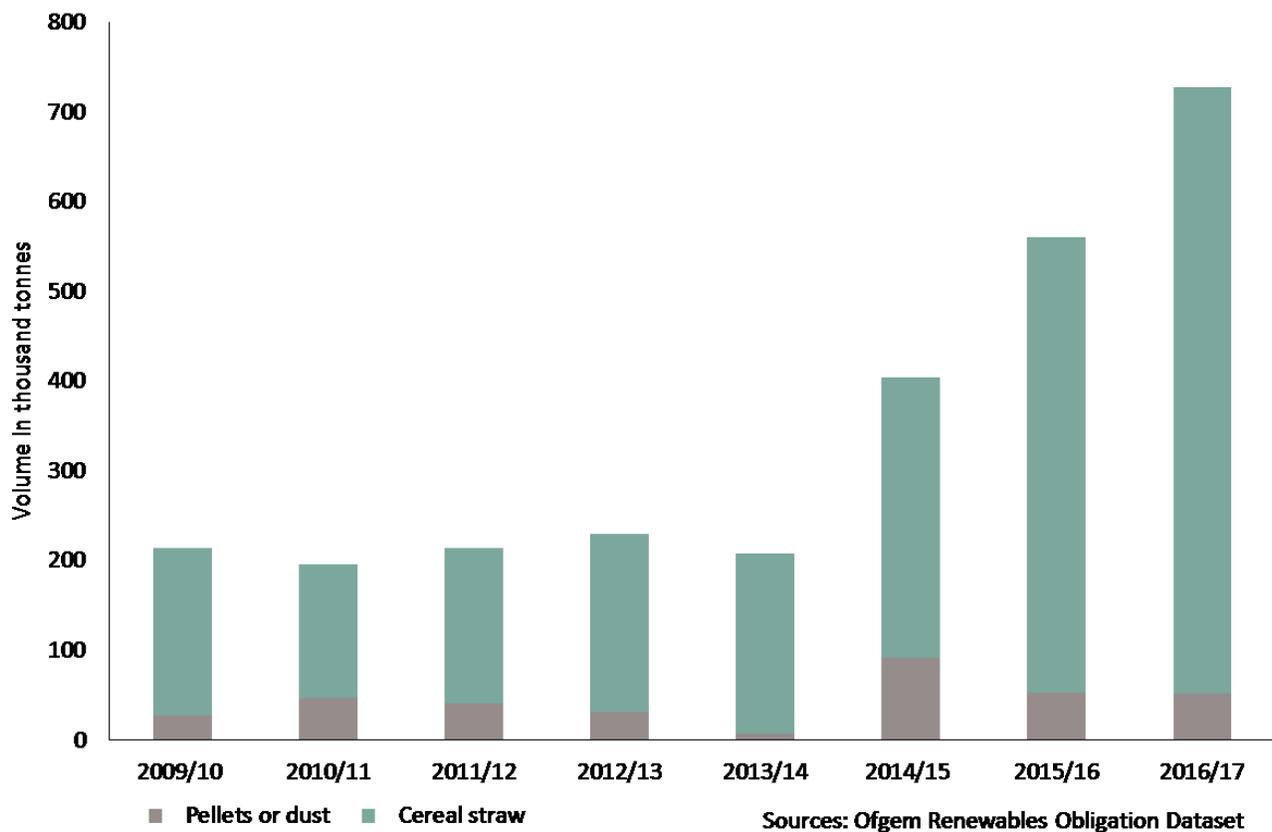
- Since 2014, Defra’s Cereal and Oilseed Production Survey has collected data on the end use of straw. Figure 13 shows the proportion of straw by end use for 2017. Whilst these figures cover England only, they are broadly in line with the UK estimates in Table 12.
- As for the UK estimates, by far the largest end use of straw is in animal bedding and feed, with approximately equal quantities going into home use and being sold. It is also worthy of note there is a small but growing percentage of straw used in on-farm biomass purposes, which will not be captured in other estimates of energy production from biomass.

A longer time series of all figures for 2014-2017 is in Table S of the [crops for bioenergy dataset](#).

## 2.8 Power station usage of straw

A detailed breakdown of all figures for 2009/10 to 2016/17 can be found in Table T of the [crops for bioenergy dataset](#).

Figure 14: Straw usage in UK power stations<sup>(a)</sup>



(a) Tonnages are reported directly by the generating stations so it is not known whether these are fresh weight or oven dried equivalents.

- Data collated by Ofgem as part of sustainability requirements in the Renewables Obligation indicate that in 2016/17 727 thousand tonnes of straw were used by power stations (these were all in England). This was a 30% increase on 2015/16 reflecting increasing straw-fired plant capacity including a new plant (Snetterton biomass) which opened in 2017.<sup>13</sup>
- This continues an ongoing trend of increasing straw use in power plants since 2013/14, influenced by a number of factors including: new power plants, conversion of previously coal-fired capacity to biomass and the new requirement that solid biomass and biogas stations with a total installed capacity (TIC) of 1MW or greater had to submit a sustainability audit<sup>14</sup>
- Despite this, the future of straw usage in power plants is likely to be uncertain for 2017/2018 and beyond. Changes to the Renewable Heat Incentive (RHI) tariffs have already been blamed for a decline in interest across the industry, and several plans to build straw-pelleting plants have reportedly been put on hold as a result.<sup>15</sup> In addition, challenging weather conditions during 2017 and 2018 have led to severe shortages in supply and extremely high prices for straw during this

<sup>13</sup> <https://www.snettertonbiomass.com/>

<sup>14</sup> Section 4, Renewables Obligation Annual Report 2014/15 <https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2014-15>

<sup>15</sup> <https://www.fwi.co.uk/business/diversification/farm-energy/policy-changes-dampen-new-straw-power-potential>

time, which may have limited its long-term appeal for energy purposes in comparison to other bioenergy crops.<sup>16</sup>

- For more details of the Ofgem Annual Sustainability dataset and report see [Annex B](#).

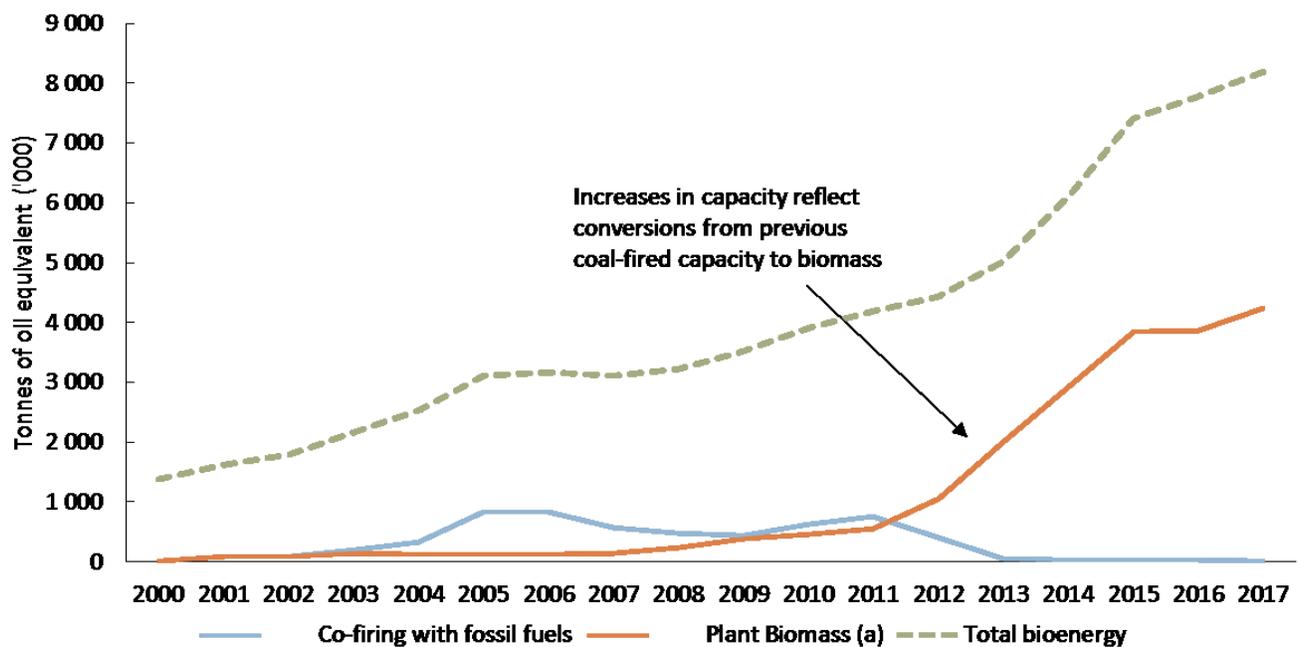
## 2.9 Volumes of biomass used in the UK for energy

Data from the Department for Business, Energy and Industrial Strategy (BEIS) in the Digest of UK Energy Statistics (DUKES) publication show the volumes of plant biomass used in the UK for energy, with the figures representing the energy content of the fuel used. These figures cover all plant biomass, which includes, but is not restricted to, miscanthus, SRC and straw.

As plant biomass comprises a variety of materials, it is not possible to convert these DUKES values from tonnes of oil equivalent to volumes or raw materials in tonnes. Nevertheless, these data are useful for showing trends in plant biomass usage over time.

A detailed breakdown of all UK heat and electricity biomass-derived fuel figures from 2009 to 2017 can be found in Table U in the [crops for bioenergy dataset](#).

Figure 15: Volume of plant biomass used for electricity: 2000 to 2017



Sources: Digest of UK Energy Statistics

- In 2017, over 5.5 million tonnes of oil equivalent of plant biomass was used to produce electricity and heat in the UK, a 10% increase since 2016.

<sup>16</sup> [http://www.npa-uk.org.uk/Straw\\_burning\\_plants\\_contributing\\_to\\_severe\\_straw\\_shortages.html](http://www.npa-uk.org.uk/Straw_burning_plants_contributing_to_severe_straw_shortages.html)

- Just under 80% of plant biomass (4.3 million tonnes oil equivalent) is used for generating electricity. This percentage has shown a slight decline since 2014, with volumes used to generate heat increasing at a more rapid rate.
- There was a 9% increase in the volume of plant biomass used to generate electricity in 2017 compared to 2016, (Figure 15). This continues a general slow upward trend in both plant biomass and total bioenergy volumes, and follows more rapid increases between 2011-2015, which reflected significant conversions from previously coal-fired capacity to biomass.
- The quantity of biomass co-fired with fossil fuels continues to fall, reaching the lowest quantity since this data series began.

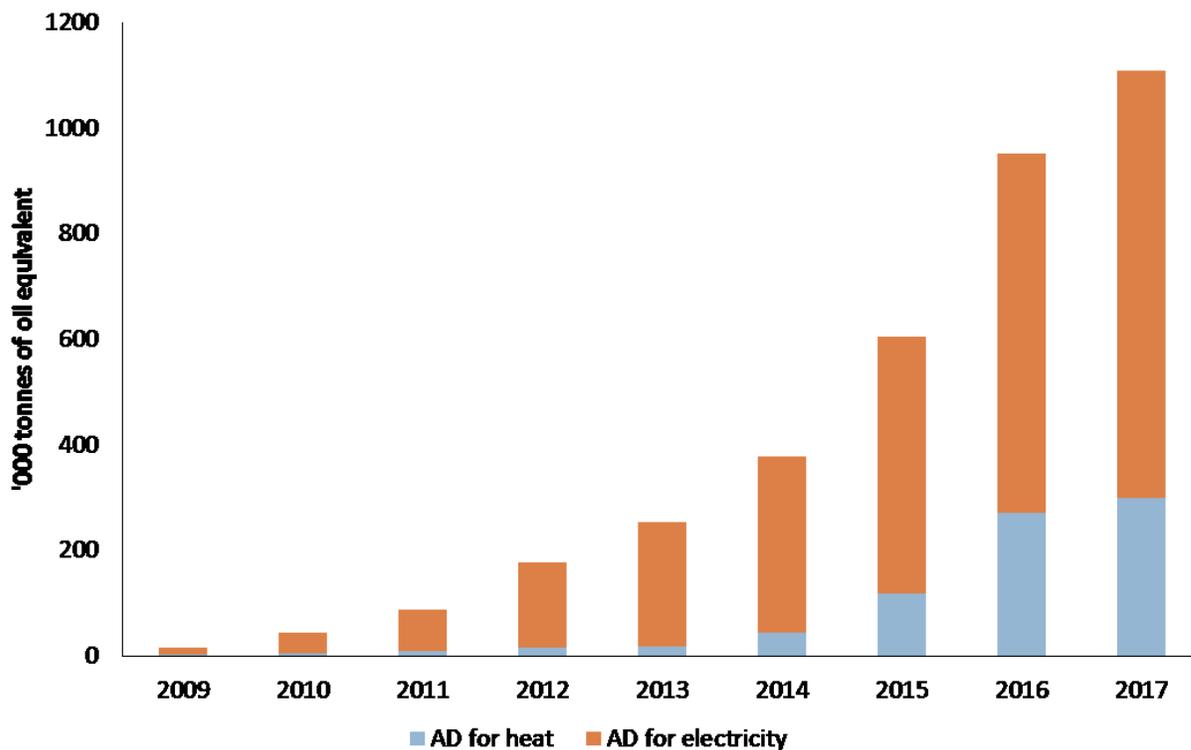
### 3. Anaerobic digestion

Waste and purpose-grown crops can be used to produce bioenergy through the process of anaerobic digestion. Anaerobic digestion (AD) is a natural process in which plant and animal materials are converted into useful products by micro-organisms in the absence of air. The process releases biogas, (mainly a mixture of around 60% methane and 40% carbon dioxide) which can be used directly to provide heat, power or transport fuel. Biogas can also be purified by removal of the carbon dioxide to produce biomethane, which can be fed directly into the public natural gas grid in the same way as natural gas, or used as a vehicle fuel. The types of materials suitable for AD include food waste, slurry and manure, crops and crop residues.

#### 3.1 Energy produced from anaerobic digestion

Data from the Department for Business, Energy and Industrial Strategy (BEIS) in the Digest of UK Energy Statistics (DUKES) publication show the use of AD in the UK for energy, with the figures representing the energy content of the fuel used. These figures cover both electricity and heat produced from anaerobic digestion of crops and non-water waste feedstocks, in tonnes of oil equivalent (Figure 16). While this dataset does not separate energy contributions from crop and waste feedstocks, it can be used to indicate general trends in the use of anaerobic digestion.

Figure 16: volume of energy produced from anaerobic digestion in the UK 2009-2017



Sources: Digest of UK Energy Statistics

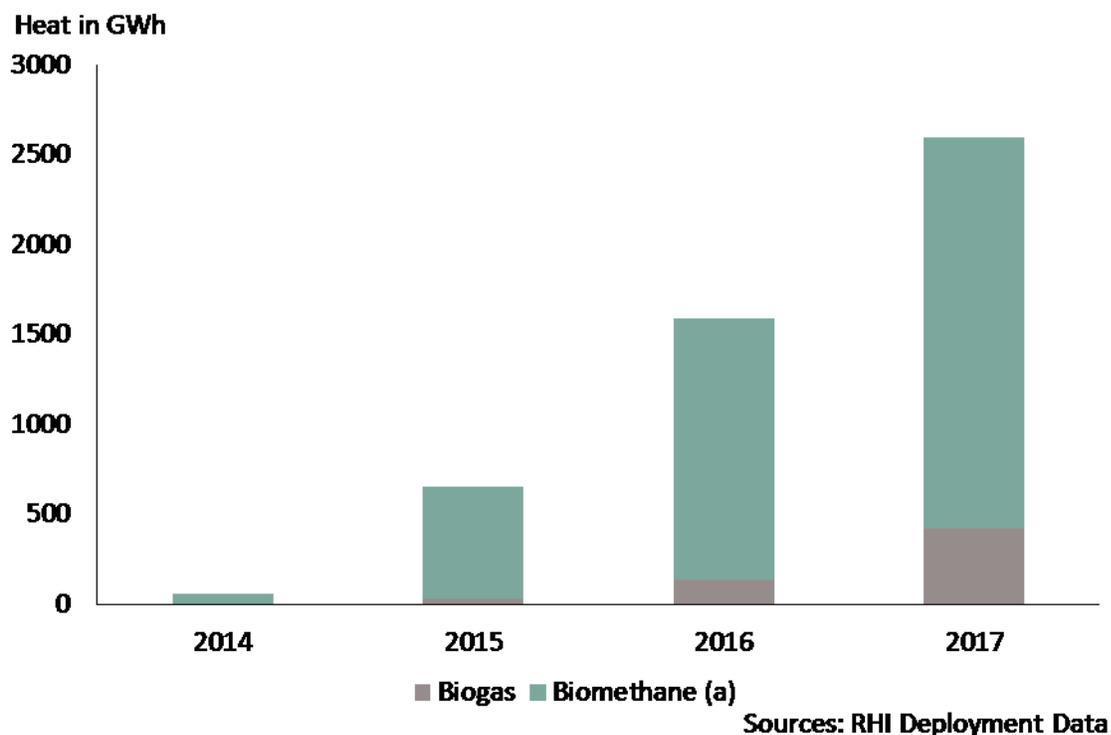
- In 2017, total energy produced from anaerobic digestion was 1,109 thousand tonnes of oil equivalent, a 16% increase on 2016 (953 thousand tonnes). Energy production from AD followed a rapidly growing upward trend from 2009-2016, a result of rapidly expanding capacity for AD in the UK in this time. This was supported in part by schemes such as the Renewables Obligation (RO), which was a major support mechanism for large-scale renewables projects. Following RO closure

to new generating capacity in March 2017, it is unsurprising that growth slowed for the first time ever between 2016 and 2017, and it is likely that it will slow further in future years.

- Electricity produced by AD made the most significant contribution to total energy production in 2017 at 810 thousand tonnes of oil equivalent, a 19% increase on 2016 (683 thousand tonnes). This corresponds to 2.5 TWh of electricity produced. At 299 thousand tonnes of oil equivalent, heat produced by AD makes up approximately 25% of the total energy contribution, in 2017, an 11% increase on 2016.
- A breakdown of all figures for 2009 to 2017 is in Table V of the [crops for bioenergy dataset](#).

Much of the significant increase in energy produced from AD over recent years is attributed to several support mechanisms designed to provide financial incentives to bridge the cost gap between conventional and renewable energy sources such as AD. One such example is the non-domestic Renewable Heat Incentive (RHI), which provides payments to encourage renewable heat production. Applications to this scheme are recorded in a monthly deployment dataset, along with the amount of energy produced. This data can be used to examine heat-energy produced by AD covered by this scheme in detail, including yearly production and proportions of heat produced from biogas and biomethane injected to the gas grid (figure 17).

Figure 17: Energy produced from anaerobic digestion in the UK under the RHI scheme 2014-2017.



(a) Biomethane is equivalent heat generated by biomethane injected into the gas grid.

- By the end of 2017, there were 82 registered producers of biomethane in the non-domestic RHI, producing almost 5000 GWh of heat from AD between 2011-2017.
- Biomethane generated from AD is generally injected into the mains gas grid rather than being burned directly to produce heat, and as a result is given as equivalent heat generated when this gas is burned. As in 2014-2016, this contribution makes up the most significant proportion of heat

generated from AD, totalling 2,175 GWh in 2017. This comprises 28% of the total heat produced under the non-domestic RHI for 2017, and is a 50% increase in the quantity produced in 2016 (1453 GWh).

- Heat produced directly by biogas combustion, typically through a combined heat & power (CHP) system or a biogas boiler, makes up a much smaller proportion of the heat generated from AD for all years recorded, totalling 420 GWh in 2017. This is just 5% of the total heat produced under the non-domestic RHI for 2017. However, this is a significant increase of over 200% in comparison to the amount produced in 2016 (134 GWh), and is consistent with similarly rapid growth in previous years.
- Changes to the tariffs available under the RHI scheme introduced in 2017 will likely have impacts on heat-energy production from AD, and also on feedstocks used. One of the most significant changes is that from May 2018, all AD plants producing biomethane or biogas were subject to feedstock restrictions, with payments limited where more than 50% of feedstocks come from crops or other non-waste sources.<sup>17</sup> This is likely to lead to declining production of biogas from crops and increased use of waste feedstocks in the future.

Further breakdown of all figures for 2014 to 2017 is in Table W of the [crops for bioenergy dataset](#).

### 3.2 Crops as feedstocks for AD

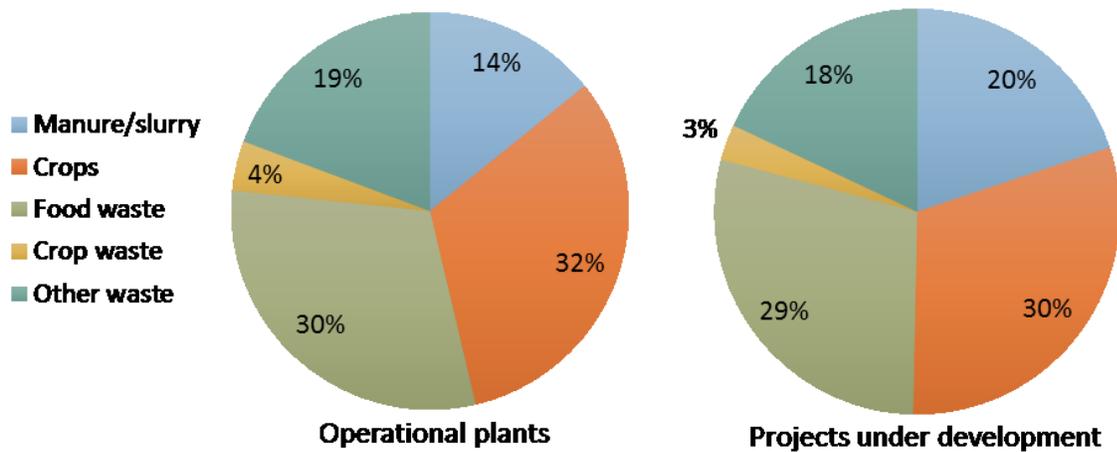
Anaerobic digestion uses both waste and crop feedstocks to produce biogas and biomethane. The annual NNFCC Anaerobic Digestion Deployment in the United Kingdom<sup>18</sup> report records the annual usage of feedstocks in operational plants and estimates for proposed developments in the UK (figure 18). These figures include a breakdown into a number of farm and non-water waste feedstocks in tonnes per annum, including contributions from crops, and also from crop wastes; which includes both crop residues (such as straw) and waste crops (such as vegetable outgrades).

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<sup>17</sup> Non-domestic RHI guidance volume 2: ongoing obligations and payments, <https://www.ofgem.gov.uk/publications-and-updates/non-domestic-rhi-main-guidance>

<sup>18</sup> <https://www.nnfcc.co.uk/publications/report-anaerobic-digestion-deployment-in-the-uk>

Figure 18: use of feedstocks in operational and planned AD plants by feedstock tonnage per annum, 2016/17.



Source: NNFCC Anaerobic Digestion Deployment in the UK

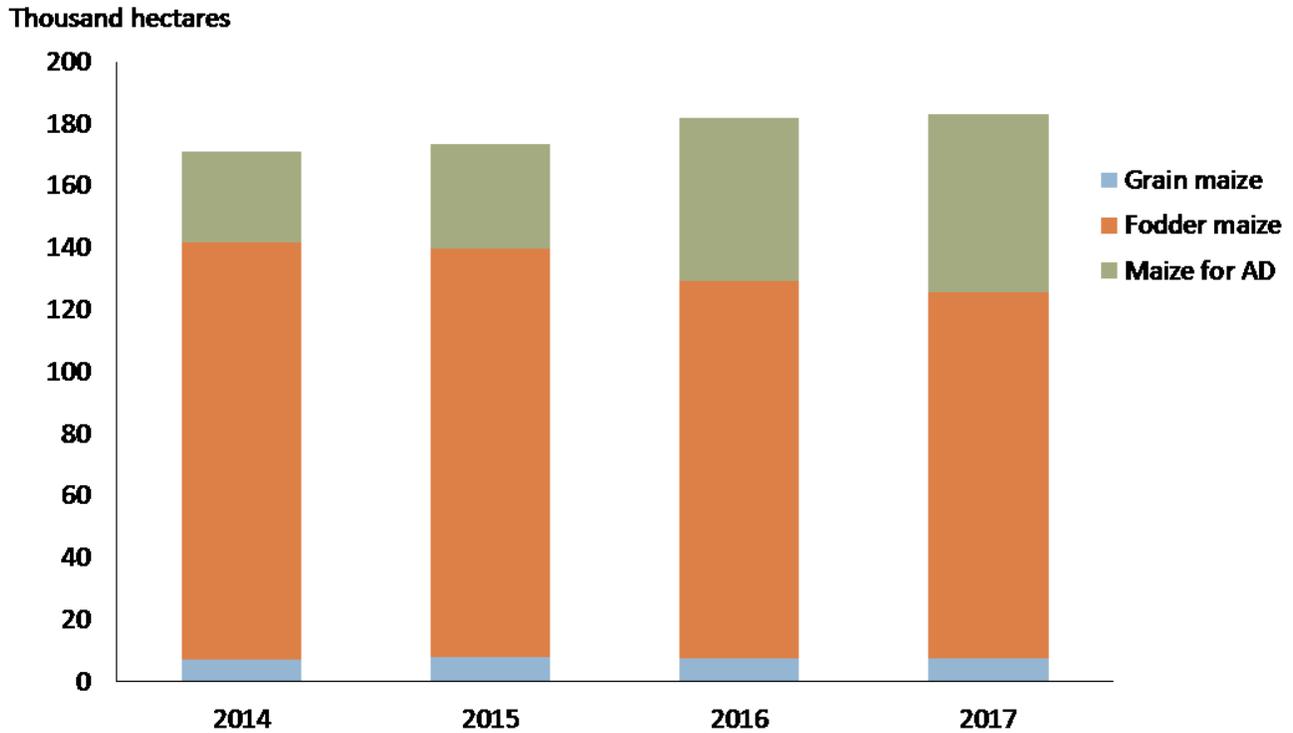
- In the UK in 2016/2017 there were 401 operational plants, with a cumulative installed capacity of 363 MWe. Of these, 277 were farm fed (cumulative installed capacity 160 MWe) with the remainder being waste fed. A further 420 AD projects were under development in this time, with a proposed cumulative installed capacity of 326 MWe. Of these, 309 were farm fed (cumulative installed capacity 160 MWe) with the remainder being waste fed.
- Of the feedstocks used in operational plants in 2016/2017, 36% were crop derived (approximately 3.8 million tonnes). The vast majority of this (3.3 million tonnes, 32% of total feedstocks) was crops purpose grown for AD, while crop waste made up only 425 thousand tonnes (4% of total). The remaining 64% of feedstocks tonnage comprised non-crop wastes.
- It is estimated that crop feedstocks required a cropping area of 75 thousand hectares in the UK in 2016/2017.
- A similar distribution is expected for AD plants under development in 2016/2017. 33% of feedstocks are crop derived (3.0 million tonnes), made up of 2.8 million tonnes of purpose-grown crops (30% of the total) and 258 thousand tonnes of crop waste (3% of the total). It is estimated that these feedstocks would require a cropping area of 61 thousand hectares in the UK.

A more detailed breakdown of these figures is in Table X of the [crops for bioenergy dataset](#).

### 3.3 Types of crops used as feedstocks

Types of crops suitable for use as feedstocks include maize, grass and oilseeds. Official statistics on the amount and type of crops grown used for AD are currently limited to maize. We will be exploring possible ways to gather crop feedstock data in the future.

Figure 19: Maize by intended usage, England



Sources: June Survey of Agriculture

- Currently, no data is available for the UK-wide area of maize produced for AD, however, the June Survey of Agricultural and Horticulture asked farmers in England to specify the end purpose of their maize for the first time in 2014.
- At June 2017 the area of maize being grown for AD was 57 thousand hectares. This was an increase of 10% on 2016 and equates to 31% of the total maize area in 2017 and 1% of the total arable area.

## Annex A: Glossary of terms and conversion factors

### Definition of biodiesel and bioethanol (Source: Chapter 6, paragraph 6.115 and 6.116 of DUKES 2017)

In the UK biodiesel is defined for taxation purposes as diesel quality liquid fuel produced from biomass or waste vegetable and animal oils and fats, the ester content of which is not less than 96.5 per cent by weight and the sulphur content of which does not exceed 0.005 per cent by weight<sup>19</sup>. Biodiesel can be blended in low proportions with fossil diesel for use in diesel engines. Diesel fuel currently sold at retail outlets in the UK can contain up to 7 per cent biodiesel.

Bioethanol a liquid fuel consisting of ethanol produced from biomass. Bioethanol can be blended with petrol at low proportions for use in petrol engines. Petrol currently sold in at retail outlets in the UK can contain up to 5% bioethanol. Since March 2013 a revised petrol standard (EN228) allows retailers to sell petrol containing up to 10% ethanol by volume (E10), if appropriately labelled<sup>20</sup>.

### Conversions

- Tonnes of oil equivalent to gigajoules  
1 tonne of oil equivalent=41.868 gigajoules.

Source DUKES Chapter 1 (Energy) paragraph 1.28.

<https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>

- Calorific values of fuels to convert gigajoules to tonnes are available at Annex A of DUKES, A.1 and A.2:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/642725/Annex\\_A.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/642725/Annex_A.pdf)

Megajoules to litres

Bioethanol= 23.6 megajoules per litre,

Biodiesel= 34.4 megajoules per litre.

Source: Direct from DECC Energy Statistics team

- Litres to tonnes  
429 litres biodiesel = 1 tonne oilseed rape  
101 litres bioethanol = 1 tonne sugar beet  
367 litres bioethanol = 1 tonne wheat grain  
317 litres of bioethanol = 1 tonne of barley  
418 litres of bioethanol = 1 tonne of maize

Source: Department for Transport <https://www.gov.uk/government/publications/rtfo-guidance>  
and [The National Non-Food Crops Centre](#)

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<sup>19</sup> <https://www.gov.uk/government/publications/excise-notice-179e-biofuels-and-other-fuel-substitutes/excise-notice-179e-biofuels-and-other-fuel-substitutes>

<sup>20</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/232126/petrol-protection-extention-ia.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/232126/petrol-protection-extention-ia.pdf)

## Annex B: Background information on key data sources

### B.1 Use of the statistics

Annual estimates of crop areas of oilseed rape, sugar beet, wheat, maize, miscanthus, short rotation coppice and straw crops grown in the UK for use as bioenergy are used by government policy advisors, non-food crop promoters and processors.

Blended in small quantities with fossil fuels, bioethanol (used in petrol) and biodiesel (used in diesel) can be used in today's road vehicles. These biofuels play an important role in the UK plan to meet the target set in the European Renewable Energy Directive 2009 (EU Directive 2009/28/EC [http://ec.europa.eu/energy/renewables/biofuels/biofuels\\_en.htm](http://ec.europa.eu/energy/renewables/biofuels/biofuels_en.htm)) for 10% of final energy consumption in the transport sector to be supplied from renewable sources by 2020.

The Renewable Transport Fuels Obligation (RTFO) is one of the Government's main policies for reducing greenhouse gas emissions from road transport in the UK by encouraging the supply of renewable fuels. Obligated suppliers must supply a certain percentage<sup>21</sup> of their road transport fuel as biofuel, or purchase Renewable Transport Fuel Certificates or pay in to the buy-out fund for the shortfall. Further details can be found at: <https://www.gov.uk/renewable-transport-fuels-obligation>

The use of biofuels also supports other Government objectives to improve security of energy supply and rural development<sup>22</sup>.

### B.2 Data sources

These statistics, which are from a range of sources, are a secondary analysis of data that have already been published. Although much of the source data are published as National Statistics, there are limitations to these statistics and these are described within each section.

#### B.2.1 The June Survey of Agriculture and Horticulture

The June Survey of Agriculture and Horticulture collects information from farmers on the area of crops grown in the UK at the 1st June each year. In general farmers are not asked about their intended end use for the crops. For crops such as oilseed rape, wheat and sugar beet, where there are multiple end uses, reference has been made to other existing data sources on usage in order to try and establish the crop production and area associated with crops grown for bioenergy by applying appropriate conversion factors to the data collected on biofuel production. From 2014 the June Survey asked farmers to indicate the intended end use of their maize to help determine the proportion intended for used as an anaerobic digestion feedstock.

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<sup>21</sup>Rising from 2.5% in 2008/09 to 4.75% from 2013/14 onwards. From 15 April 2013, the end uses covered by the Renewable Transport Fuels Obligation were amended to include non-road mobile machinery (including inland waterways vessels), agriculture and forestry tractors and recreational craft when not at sea (known collectively as NRMM). To keep the supply of biofuel broadly consistent the biofuel target level was changed from 5% to 4.75% based on data supplied by industry on the volume of low sulphur gas oil used for NRMM end uses.

<sup>22</sup> <https://www.gov.uk/government/policies/maintaining-uk-energy-security--2> <https://www.gov.uk/government/news/15m-fund-for-rural-energy-projects-opens-to-applications>

The latest June Survey UK results can be found at:

<https://www.gov.uk/government/statistics/farming-statistics-provisional-crop-areas-yields-and-livestock-populations-at-1-june-2018-united-kingdom>

## B.2.2 Renewable Transport Fuels Obligation (RTFO)

The Department for Transport (and the Renewable Fuels Agency pre-2011) produce statistics on the volumes of biofuels supplied to the UK road market under the Renewable Transport Fuels Obligation (RTFO). Published reports include information on the volumes of fuel supplied to the UK road market:

- by fuel type (e.g. biodiesel, bioethanol);
- by feedstock (e.g. oilseed rape, used cooking oil, sugar beet);
- by country of origin (e.g. UK); and
- whether it meets sustainability standards and the lifecycle greenhouse gas savings of fuels.

Therefore it is possible to derive information on the volumes of UK grown crops and equivalent crop areas which have been used to supply biofuel to the UK road transport market.

Prior to December 2011 these data were supplied monthly to the RTFO Administrator by fuel suppliers and were verified annually. Reports are released quarterly. Verified year 1 (April 2008 to March 2009), verified year 2 (April 2009 to March 2010) are available and verified year 3 (April 2010 to March 2011) data are all available on the Department for Transport website at: <https://www.gov.uk/renewable-transport-fuels-obligation>.

Since the implementation of the Renewable Energy Directive<sup>23</sup> in December 2011 data must be verified prior to submission to the RTFO Administrator. The verified data are available as follows:

2011/12 (Year 4) <https://www.gov.uk/government/statistics/biofuel-statistics-year-4-2011-12-report-5>

2013/12 (Year 5) <https://www.gov.uk/government/statistics/biofuel-statistics-year-5-2012-to-2013-report-6>

2013/14 (Year 6) <https://www.gov.uk/government/statistics/biofuel-statistics-year-6-2013-to-2014-report-6>

2014/15 (Year 7) <https://www.gov.uk/government/statistics/biofuel-statistics-year-7-2014-to-2015-report-6>

2015/16 (Year 8) <https://www.gov.uk/government/statistics/biofuel-statistics-year-8-2015-to-2016-report-6>

2016/17 (Year 9) <https://www.gov.uk/government/statistics/biofuel-statistics-year-9-2016-to-2017-report-6>

The RTFO data include:

- Biofuels from UK grown and imported crops (these are presented separately in the tables)

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<sup>23</sup> This is a European Directive which sets out sustainability criteria which biofuels must meet in order to count towards Member State's targets. These criteria cover protection of land (carbon stocks and biodiversity) and set minimum greenhouse gas savings that increase over time <https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive>

- Biofuels supplied to the UK road transport sector
- Data from organisations that supply more than 450,000 litres of road transport fuel in a given year. These obligated companies supply more than 95% of the biofuels in the UK market.
- Data from suppliers of less than 450,000 litres a year where they have chosen to apply for Renewable Transport Fuel Certificates.

The RTFO data exclude:

- UK biofuel or biofuel feedstock production which may subsequently be exported.
- Producers of less than 450,000 litres of road transport fuel per year who do not claim Renewable Transport Fuel Certificates (RTFCs). However it is not expected that there are many small producers excluded from the RTFO statistics.
- Prior to the implementation of the Renewable Energy Directive<sup>23</sup> (RED) in December 2011, biofuel producers who did not use any fossil fuels (i.e. only supplied biofuels) and did not claim Renewable Transport Fuel Certificates were excluded. For the same reason as above, it is not expected that there were many of these excluded from the RTFO statistics. Following the implementation of the RED only biofuel producers who supply less than 450,000 litres are excluded.

### B.2.3 Renewable Energy STATistics (RESTATS) Questionnaire

From 2010, to estimate the volume of biofuels produced in the UK, an annual renewable energy survey has been carried out by The Department for Business, Energy and Industrial Strategy (formally The Department for Energy and Climate Change). Neither HMRC or RTFO figures can be used for this purpose since they include both UK produced fuels and imports. The survey is carried out by Ricardo Energy & Environment on behalf of BEIS. The production companies are contacted directly in combination with a survey of UK biofuels production capacity that is required by the EU (Reg. 833/2010). The data include estimates for very small scale production (for personal use), though this makes a very small contribution to the totals.

The reports include UK production of biodiesel and bioethanol, the proportion supplied to the UK road market and the percent of biofuel from UK sources together with information on production capacity.

Further details on the Liquid Biofuels survey are available on page 7 at:

<http://www.decc.gov.uk/assets/decc/statistics/source/renewables/60-renewable-statistics-methodology.pdf>

Data from the renewable energy survey also feeds into the Digest of UK Energy Statistics (DUKES) which is again produced by The Department for Business, Energy and Industrial Strategy. The digest is a comprehensive source of energy information and can be found at:

<https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>

### B.2.4 Cereal and Oilseed Rape Production Survey

The Cereal and Oilseed Rape Production Survey gathers data on production tonnages and moisture content for various cereal and oilseed crops. It also verifies data gathered from the June Survey of Agriculture on planted areas for these crops. These data are then used to calculate average yield estimates for each crop type. These were used in calculations of the areas of crops used for biofuel production. In 2014 questions were on straw production and usage where introduced. The latest

results from the cereal and oilseed rape production survey can be found at:

<https://www.gov.uk/government/statistics/farming-statistics-provisional-crop-areas-yields-and-livestock-populations-at-1-june-2018-united-kingdom>

### B.2.5 Energy crops scheme

Farmers were able to claim subsidies under the Energy Crops Scheme (ECS) to assist with the establishment of miscanthus and short rotation coppice as part of the Rural Development Programme for England (RDPE). This scheme was administered by Natural England and comprised two rounds:

- ECS1 (2000-2006/7) which paid a flat rate to help farmers establish new plantings of the crop.
- ECS2 (2007-2013) which pays 50% of all costs incurred in establishing the crop.

The second Energy Crops scheme closed in 2013 although planting for the scheme could be undertaken in 2013, 2014 and 2015.

### B.2.6 Ofgem Renewable Obligation Annual Report - Biomass Sustainability Dataset

The concept of sustainability was introduced into the Renewables Obligation (RO) in April 2009 and required operators to submit information on the sustainability of their fuels to Ofgem. The report contains profiling information submitted by the operator regarding the sustainability characteristics of their fuel such as: type of biomass, form of biomass, country of origin and whether it conforms to any environmental quality assurance standards. Datasets for each year are available as follows:

<http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=318&refer=Sustainability/Environment/RenewableObligation/FuelledStations/ro-sustainability> (2010/11 data)

<http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=248&refer=Sustainability/Environment/RenewableObligation/FuelledStations/ro-sustainability> (2009/10 data)

<https://www.ofgem.gov.uk/publications-and-updates/annual-sustainability-report-2011-2012> (2011/12 data)

<https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2012-13> (2012/13 data)

<https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2013-14> (2013/14 data)

<https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2014-15> (2014/15 data)

<https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2015-16> (2015/16 data)

<https://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2016-17> (2016/17 data)

### B.2.7 RHI Deployment data

The Department for Business, Energy and Industrial Strategy publish a monthly statistical series regarding deployment of the non-domestic Renewable Heat Incentive (RHI) scheme, introduced in November 2011, and the domestic RHI scheme introduced in April 2014. This dataset includes information regarding applications, installations and heat generated under the scheme, and can be found at:

<https://www.gov.uk/government/collections/renewable-heat-incentive-statistics>

### B.2.8 NNFCC Anaerobic Digestion Deployment in the United Kingdom

This report is produced annually by the NNFCC, and collects data for existing and planned anaerobic digestion facilities across the UK. The report contains information regarding feedstock, estimated

cropping area and installed capacity for all anaerobic digestion plants contained in the NNFCC anaerobic digestion deployment database. The data contained in the 4<sup>th</sup> annual report (April 2016-April 2017) was used in this publication.

## Annex C: Background information on sugar beet used for bioenergy

Production of sugar from beet in the UK has been governed by EU regulations, collectively known as the EU sugar regime. In 2006 there was substantial reform of the EU sugar regime, aimed at reducing EU sugar production to more sustainable levels. Key changes included reductions in beet sugar production quotas and changes in the rules applying to any sugar made in excess of the quotas. British Sugar are the sole quota holder in the UK and the reforms led to significant restructuring of their business, with closure of the Allscott and York factories after the 2006/07 campaign and contract tonnage re-allocated to growers closer to the remaining four factories. Furthermore, the UK's first bioethanol plant was constructed at the Wissington factory. Opening in November 2007, it provided an outlet for sugar beet produced above the quota. From 2008/9 onwards the quota was 1,056,474 tonnes of sugar (equivalent to around 6 million tonnes of sugar beet). This quota applied until 30 September 2017, after which sugar production quotas were abolished.

Data reported under the RTFO have been used to estimate the equivalent tonnage and crop area of sugar beet used to produce bioethanol (Figure 3).