







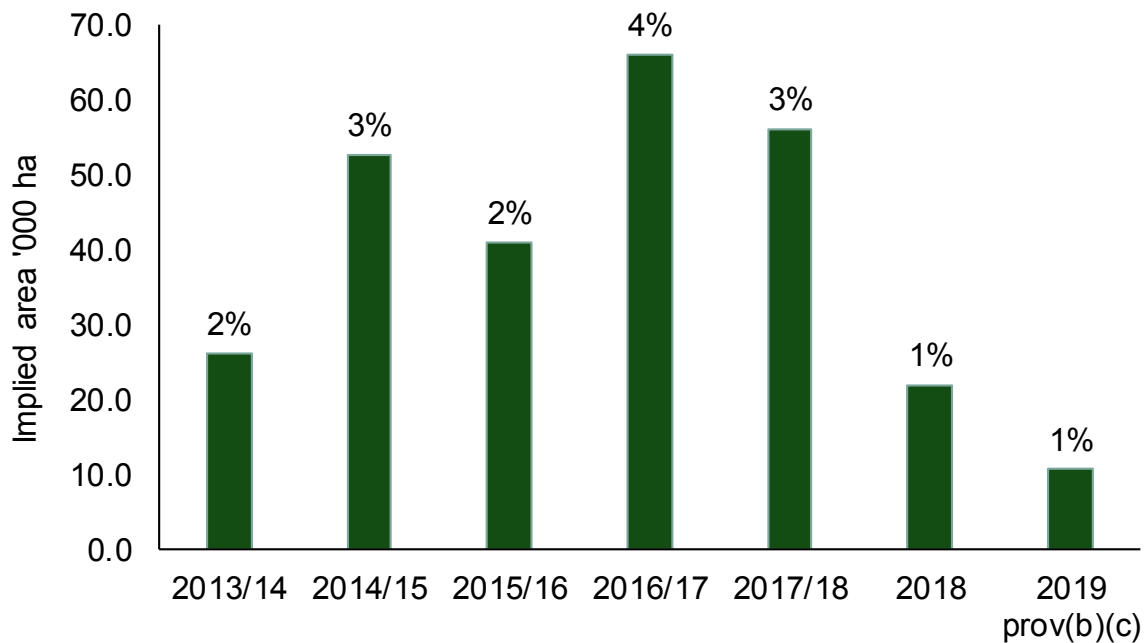








**Figure 4: UK wheat area<sup>(a)</sup> used for bioethanol supplied to the UK road transport market 2013/14 ± 2019**



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

Percentages indicate proportion of UK wheat area used for bioethanol each year

(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 apart from 2018 (see point (c)).

(b) 2019 figures (Year 12) are as of 14th October 2020 and are subject to revision.

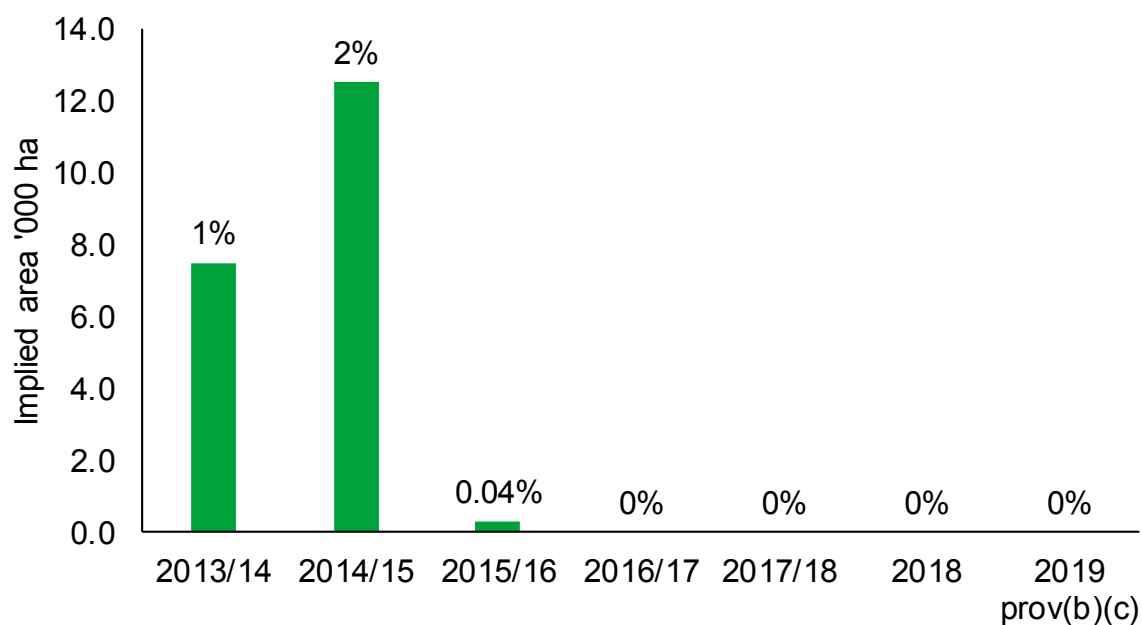
(c) Due to changes to the RTFO dataset, 2018 covers 15th April to 31st December 2018 and is not directly comparable to previous years which covered a time period from April to April. From 2019 onwards RTFO data is representative of full calendar years

An estimated 11 thousand hectares of wheat was used for bioethanol in 2019, intermittent closures of UK cereal bioethanol plants during this time likely contributing to the decline compared to previous years.



**Figure 5: UK oilseed rape area<sup>(a)</sup> used for biodiesel supplied to the UK road transport market, 2013/14 – 2019**

Percentages indicate proportion of UK OSR area used for biodiesel each year



Source: 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 apart from 2018 (see point (c)).

(b) 2019 figures (Year 12) are as of 14th October 2020 and are subject to revision.

(c) Due to changes to the RTFO dataset, 2018 covers 15th April to 31st December 2018 and is not directly comparable to previous years which covered a time period from April to April. From 2019 onwards RTFO data is representative of full calendar years

Provisional RTFO data indicates that no oilseed rape grown in the UK was used to produce biodiesel for the UK road transport market in 2019. 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 2019 was used cooking oil (Figure 2).

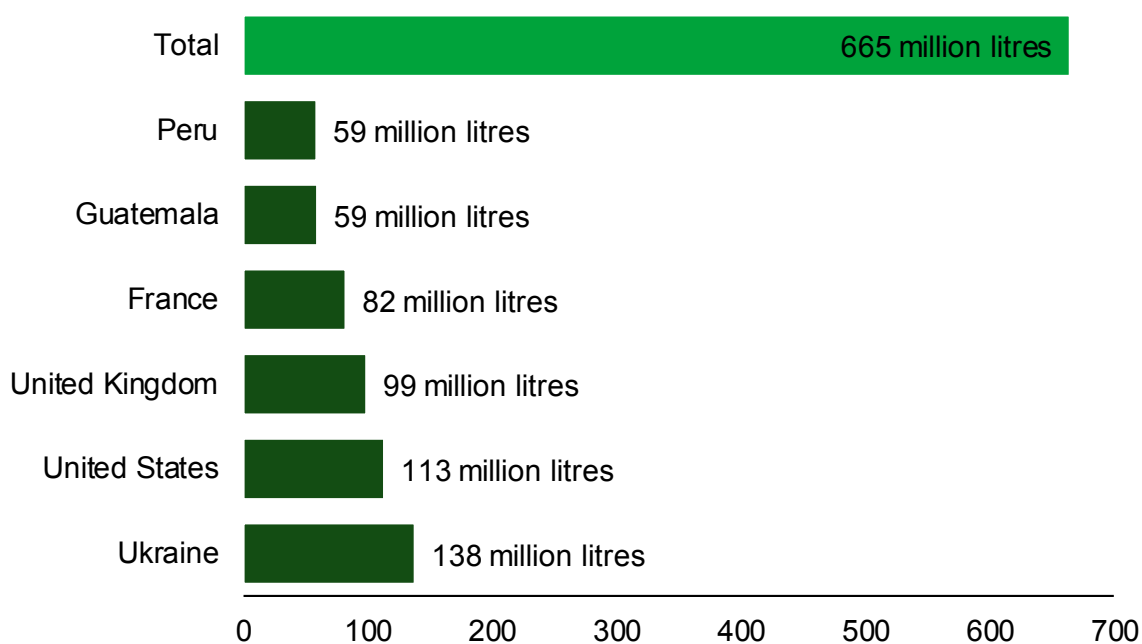
A breakdown of wheat, sugar beet and oilseed rape is in Tables C, D and E of the [crops for bioenergy dataset](#).

### 1.3 Biofuels from crops supplied to the UK for the road transport market 2019<sup>3</sup>

In 2019, estimates indicate over 85% of the crop-derived bioethanol for road transport originated from crops grown outside the UK. An estimated 15% originated from crops grown in the UK, which was mainly made up of bioethanol derived from UK grown sugar beet.

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 2019 (a)**



(a) Due to changes to the RTFO dataset, 2019 covers the calendar year and is not directly comparable to previous years which covered a time period from April to April

There was no biodiesel produced from crop feedstocks supplied to the UK in 2019. 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

Table 2 compares the volume of biofuel used in UK road transport to the total of all fuels supplied for road transport (data for RTFO years 1 to 8 can be found in previous releases of these statistics found [here](#). They also show the proportion of biofuels that are UK sourced. Due to changes to the RTFO dataset the data for 2019 covers a time period from the 1<sup>st</sup> January to the 31<sup>st</sup> of December and hence is not directly comparable to previous year's data which ran from April to April.

**Table 3: RTFO Year 12 (2019) provisional figures <sup>(a)</sup> for biofuel (million litres or Kg <sup>(b)</sup>) from UK feedstocks**

Fuel Type	Volume UK sourced biofuels 2019	Total volume biofuels supplied to UK 2019 <sup>(c)</sup>	Total volume of road transport fossil fuels supplied to UK 2019	UK sourced biofuels as a proportion of total biofuels supplied to UK	Biofuels as a proportion of total road transport fuels supplied to UK
Biodiesel of which:	168	1452	28 451	12%	5.10%
Brown grease <sup>(d)</sup>	3.0				
Food waste	28				
Tallow (by-product)	15				
Used cooking oil (by-product)	118				
Other <sup>(e)</sup>	2.2				
Bioethanol of which:	99	654	16 008	15%	4.24%
Maize	0				
Sugar beet	64				
Wheat	35				
Biomethane	5.4	17		33%	
Biomethanol	0.3	32		1.1%	
Biopetrol	0.0	25		0.0%	
HVO	0.5	7.1		6%	
Off road biodiesel	7.6	78		10%	
<b>Total</b>		<b>2 265</b>	<b>49 497</b>	<b>24%</b>	<b>4.58%<sup>(f)</sup></b>
<b>Annual target<sup>(g)</sup></b>					<b>4.75%</b>

(a) 2019 figures (Year 12) are as of 14th October 2020 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. In 2018 the obligation rose from 4.75% to 7.25%.

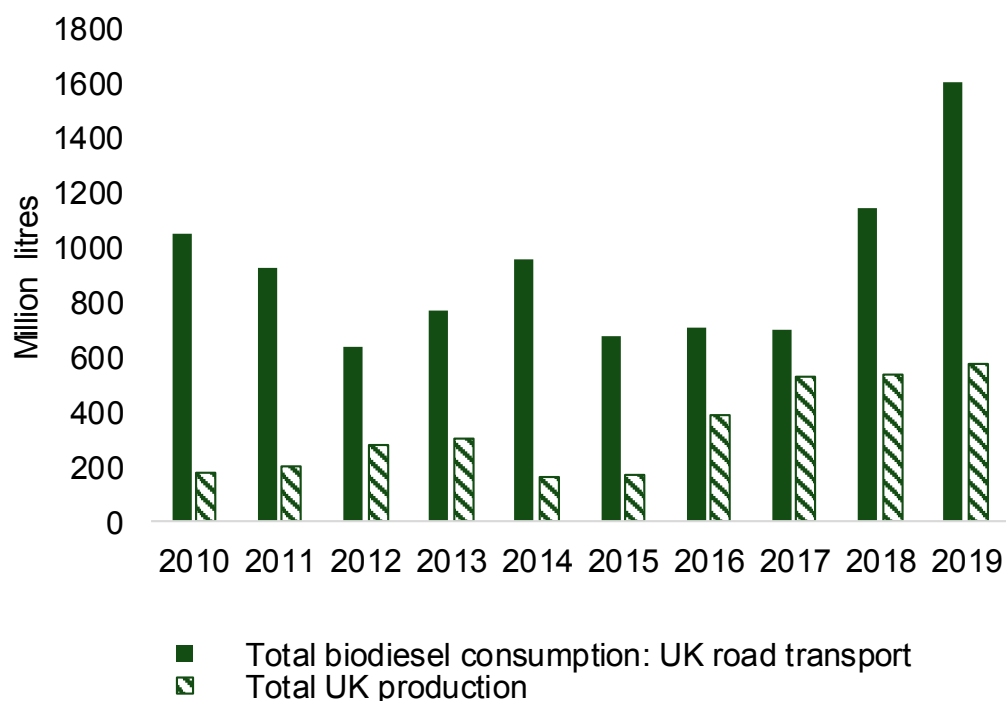
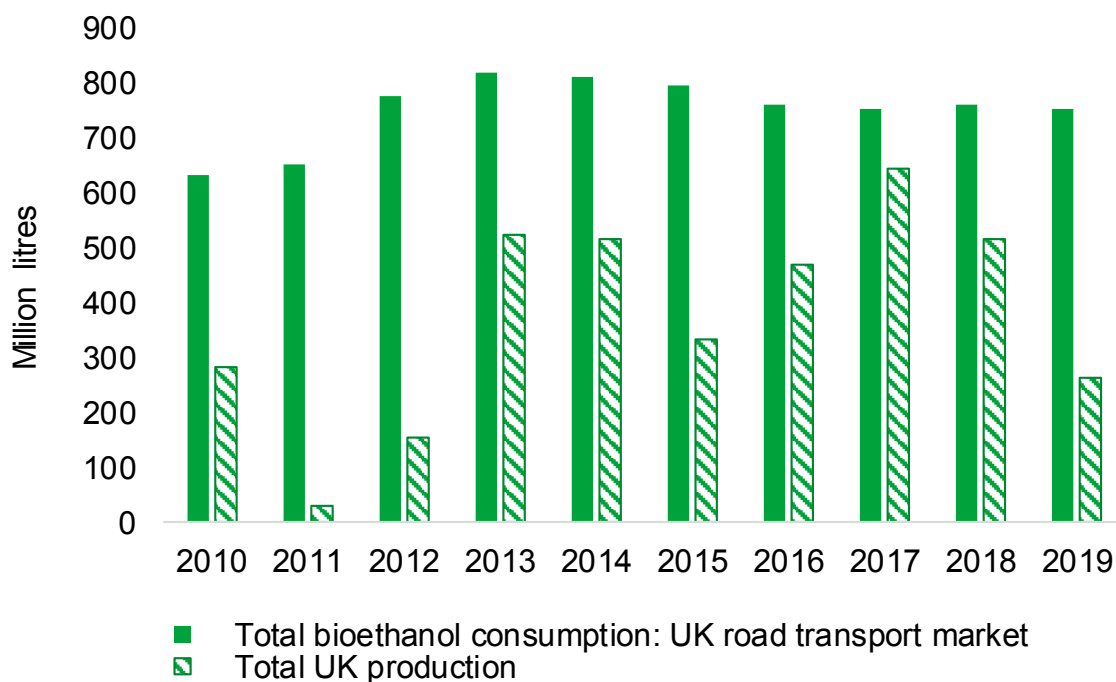
Provisional figures for 2019 indicate that 1,479 million litres of biofuel were supplied to the UK which is 4.5% of total road and non-road mobile machinery fuel.

## 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 – 2019**



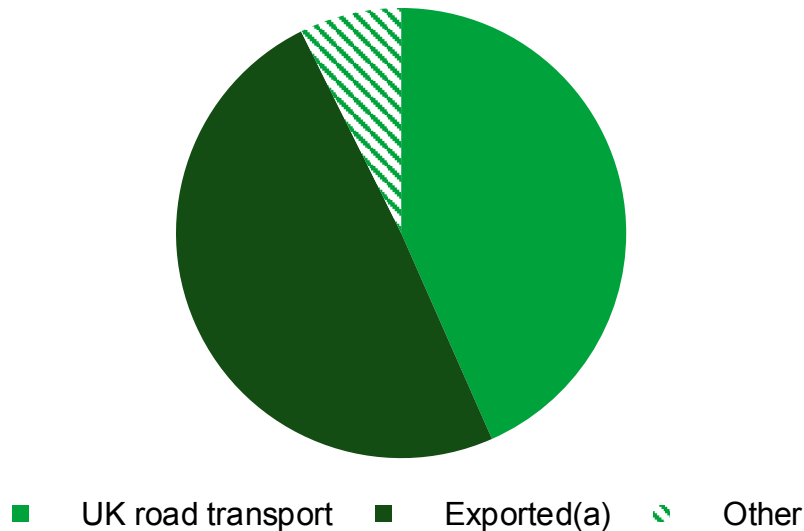
Source: Digest of UK Energy Statistics

At 573 million litres, UK production of biodiesel increased by 7.1% between 2018 and 2019. This volume was around 83% of the estimated UK production capacity for biodiesel (689 million litres in 2019).

Bioethanol production decreased by 49% to 262 million litres in 2019, 29% of the estimated UK production capacity of 905 million litres.

Data from 2010-2019 are available in Table G of the crops for bioenergy dataset.

**Figure 8: Estimated UK biodiesel supply (from UK production) 2019**



Source: Renewable Energy Statistics (RESTATS) Questionnaire

In 2019, 100% of UK-produced bioethanol was derived from crop feedstocks, as has been the case since 2012. Of this, 61% was known to be produced from UK grown crops.

There was no UK-produced biodiesel derived from crop feedstocks in 2019. 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 7). In 2019, almost 43% of biodiesel produced in the UK was supplied to the UK road transport market, with 49% being exported. In contrast, just less than 100% of the bioethanol supply was used in UK road transport in 2019.

Production and supply data from 2012-2019 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**

	2014	2015	2016	2017	2018	2019
Area (ha)	7 012	6 905	7 057	7 366	7 149	8 171
<i>95% confidence interval</i>	$\pm 555$	$\pm 514$	$\pm 526$	$\pm 1 097$	$\pm 1 290$	$\pm 1 275$
Number of growers	569	409	361	787	767	731

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 [here](#).

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>4</sup>. A regional breakdown for 2010, 2013, 2016, 2017, 2018 and 2019 is available in Table J of the [crops for bioenergy dataset](#).

Miscanthus is grown on around 0.1% of arable land 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 8,171 hectares of miscanthus in 2019.

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 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(a)**

	2014	2015	2016	2017	2018	2019
Lower estimate	70	69	71	74	71	82
Upper estimate	105	104	106	110	107	123

Source: Yield information taken from [National Non-Food Crops Centre \(NNFCC\) miscanthus fact sheet](#) 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 indicative 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>5</sup>.

Miscanthus production in England in 2019 was 82 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.

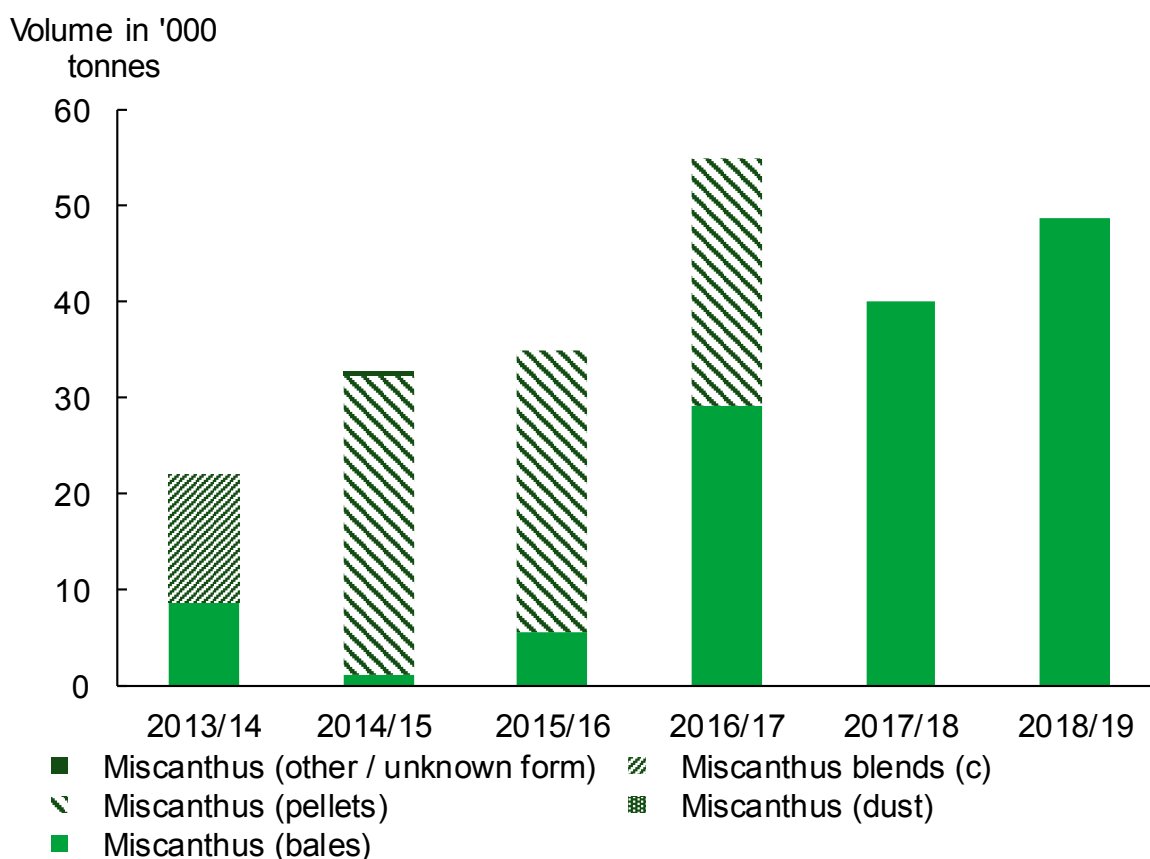
Approximately 49 thousand tonnes of miscanthus were used in UK power stations for electricity in 2018/19 (Figure 9) which was just under half of all miscanthus produced in England in 2019, based on low end assumptions of yields.



The 2018/19 volume was a 22% increase on the previous year. This is a return to the trend of increases since 2013/14, which is reflective of a general trend of existing power stations adapting infrastructure towards increased biomass capacity, <sup>6</sup> and the opening of new biomass power stations.<sup>7</sup> The volume in 2018/19 is an increase of 122% since 2013/14.

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>8</sup>.

**Figure 9: Miscanthus usage in UK power stations(a)(b)**



Source: Ofgem Renewables dataset

(a) Tonnages 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 2018/19 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**

	2014	2015	2016	2017	2018	2019
Area (ha)	2 849	2 885	2 962	2 966	2 826	2 233
<i>95% confidence interval</i>	$\pm 503$	$\pm 656$	$\pm 665$	$\pm 593$	$\pm 1045$	$\pm 1019$
Number of growers	182	361	437	379	305	271

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, 2017, 2018 and 2019 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.

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 2019 Defra June Survey area (2,233 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(a)**

Thousand oven dried tonnes

	2014	2015	2016	2017	2018	2019
Lower estimate	23	23	23	24	23	18
Upper estimate	43	43	44	44	42	33

Source: [National Non-Food Crops Centre SRC factsheet](#), [M.J. Tallis, E.Casella et al, GCB Bioenergy, 2013, 5;1, 53-66](#)

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.

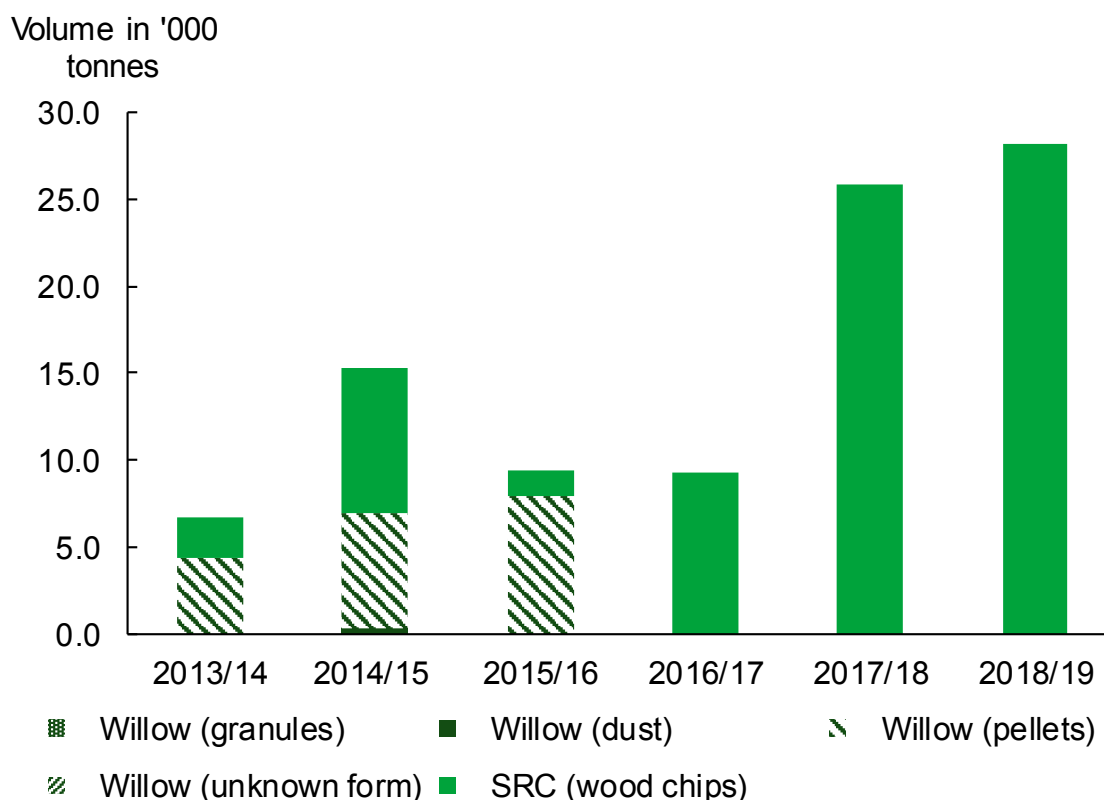
Table 7 shows the estimated volume of SRC produced in England each year based on both the upper and lower yield estimates of 15 odt/ha and 8 odt/ha. These figures should be treated as broad estimates rather than definitive figures as there is much uncertainty behind the estimates

Total SRC production in England was around 18 thousand tonnes in 2019, based on low end assumptions of yields.

## 2.6 Short Rotation Coppice usage

An estimate of 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(a)**



Source: Ofgem Renewables dataset

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

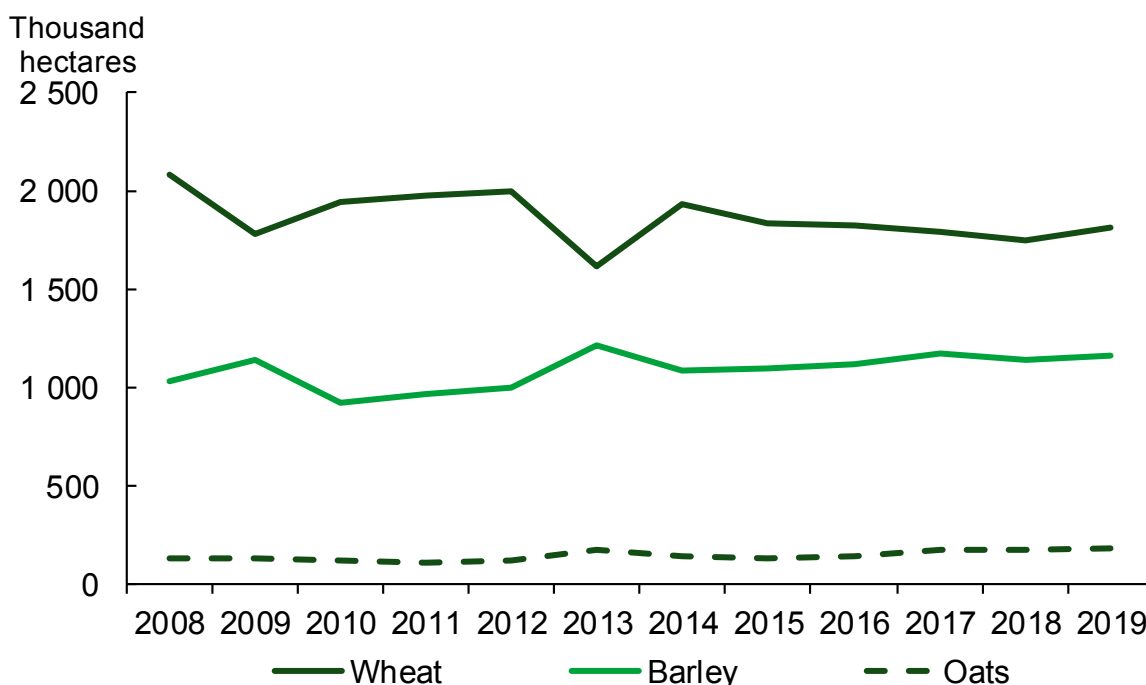
A breakdown of all figures for 2009/10 to 2018/19 is in Table O of the [crops for bioenergy dataset](#).

Approximately 28 thousand tonnes of SRC were used in UK power stations for electricity in 2018/19, a slight increase from the 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>9</sup>.

## 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**



Source: June Survey of Agriculture

The decrease in 2013 wheat area was the result of prolonged wet weather leading to very difficult planting conditions.

From 2014 to 2019, Defra's Cereal and Oilseed Production Survey has collected data on straw yield, production and area for England only. The results for 2019 are shown in Table 8. In 2019 data was only collected for production, with questions on yield and area removed from the survey. Historic yield and area data can be found in the [crops for bioenergy dataset](#) in table S.

**Table 8: Estimates of cereal and oilseed rape straw production in 2019, England**

	Wheat	Oats	Barley	Oilseed rape
Production ('000 tonnes)	3,100	1,926	261	89
% change from 2018	-18%	+1%	+9%	-62%

Source: Defra Cereal & Oilseed Production Survey

In 2019 75% of the cereal area was baled which was a decrease from 88% in 2018, this a rebalance to slightly more 'normal' levels following the high levels seen in 2018. Winter oilseed rape yields were affected by pest damage which led to reduced yields. The biggest increase when compared to 2018 was from barley, increasing by 9% in 2019.

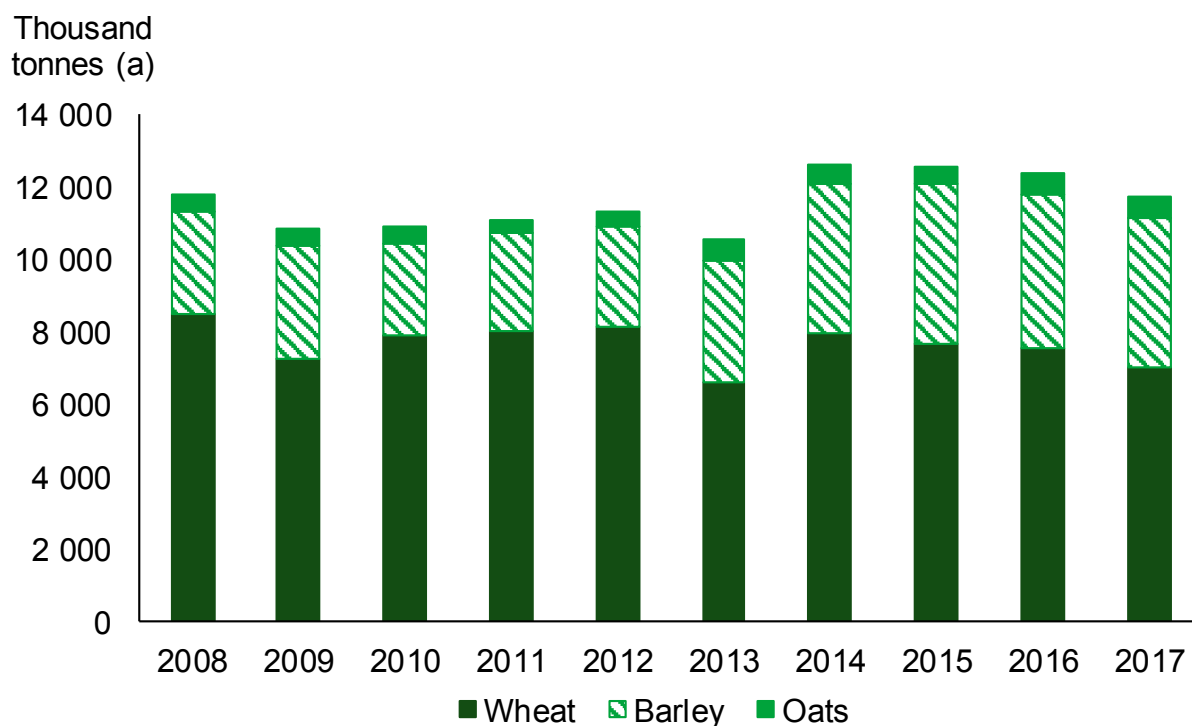
Over half of all straw grown in England in 2019 was wheat straw, with 3.1 million tonnes produced. This is a decrease of 18% from the figure in 2018.

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.

Due to straw crops yields and areas not being collected in 2018 Figure 12 and Table 9 are retained from the 2017 report

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



Source: June Survey of Agriculture

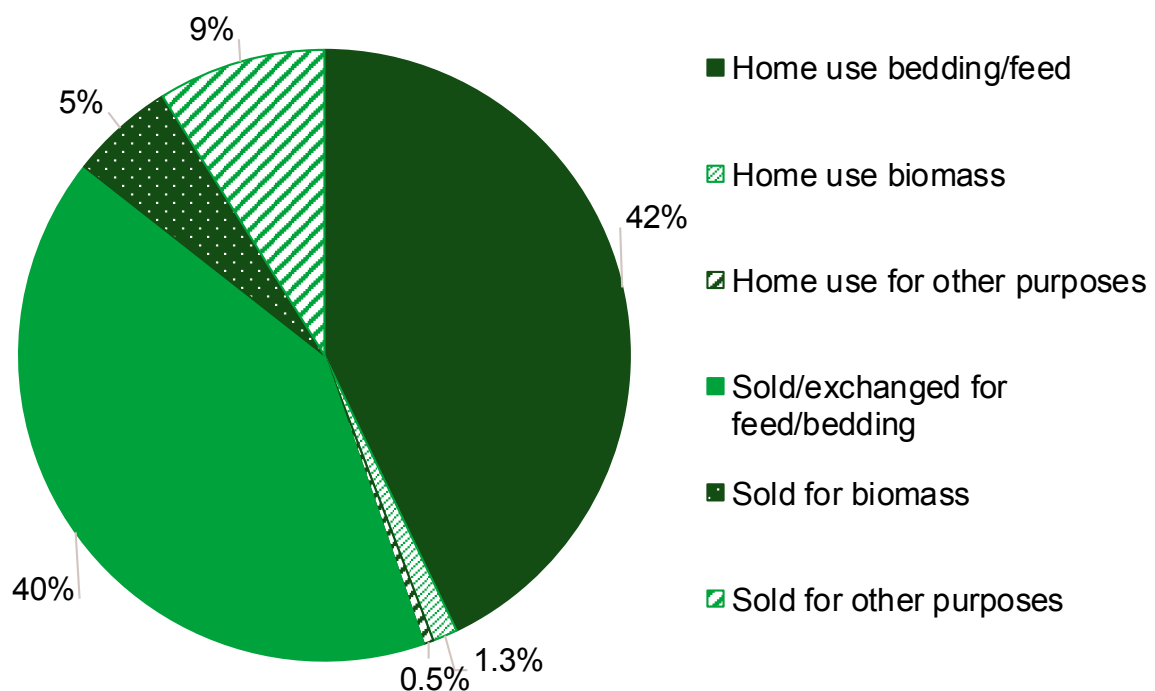
(a) Production for 2014 onwards is based on recorded UK area and England yields for that year. Prior to 2014, recorded yields for straw are not available, and production is based on recorded UK area for that year and the average England yield for 2014-2017

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.

**Figure 13: End use of cereal and oilseed rape straw England 2019 (a)**



Source: 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 2018. 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

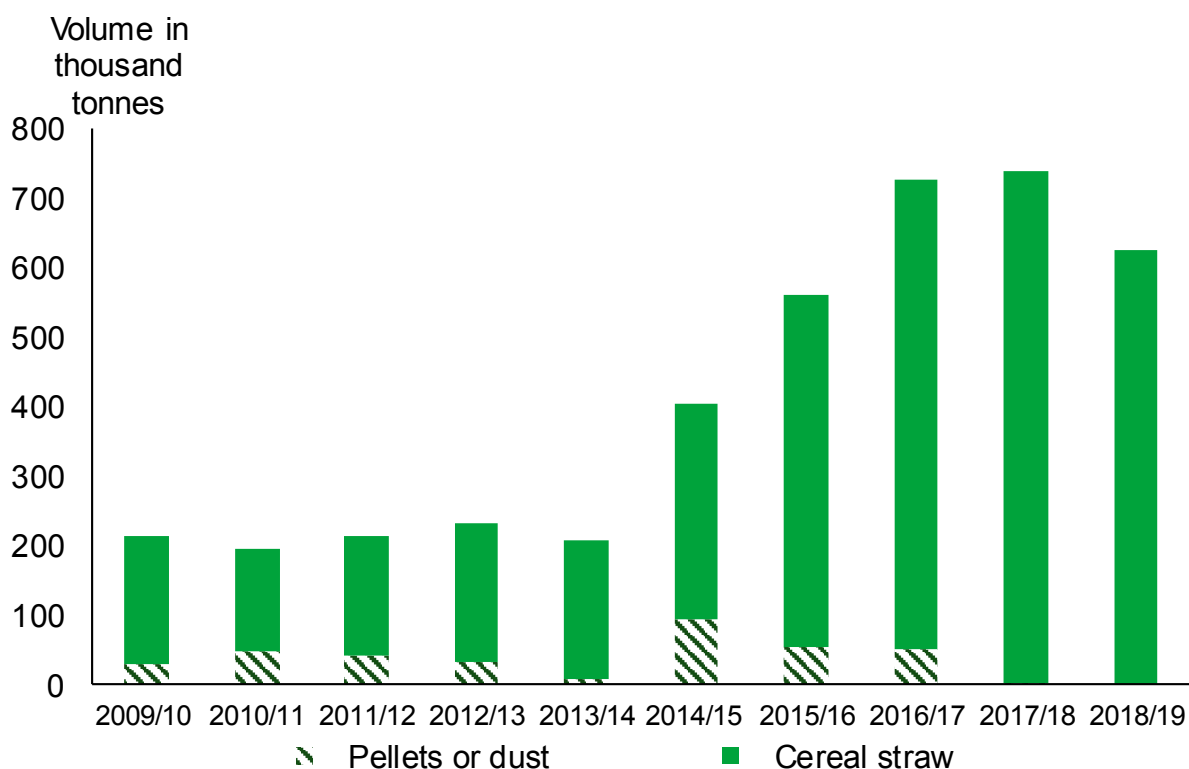
biomass purposes, which will not be captured in other estimates of energy production from biomass.

A longer time series of all figures for 2014-2019 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 2018/19 can be found in Table T of the [crops for bioenergy dataset](#).

**Figure 14: Straw usage in UK power stations(a)**



Source: Ofgem Renewables Obligation dataset

(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 2018/19 625 thousand tonnes of straw were used by power stations (these were all in England). This was a decrease when compared to 2017/18 when the figure was at 735 thousand tonnes.

This trend of increasing straw use in power plants since 2013/14 has been 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>10</sup>.



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>11</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 time, which may have limited its long-term appeal for energy purposes in comparison to other bioenergy crops.<sup>12</sup> During the spring of 2018 there was also a significant increase in demand for straw due to cold weather conditions caused by the ‘Beast from the East.’<sup>13</sup>

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

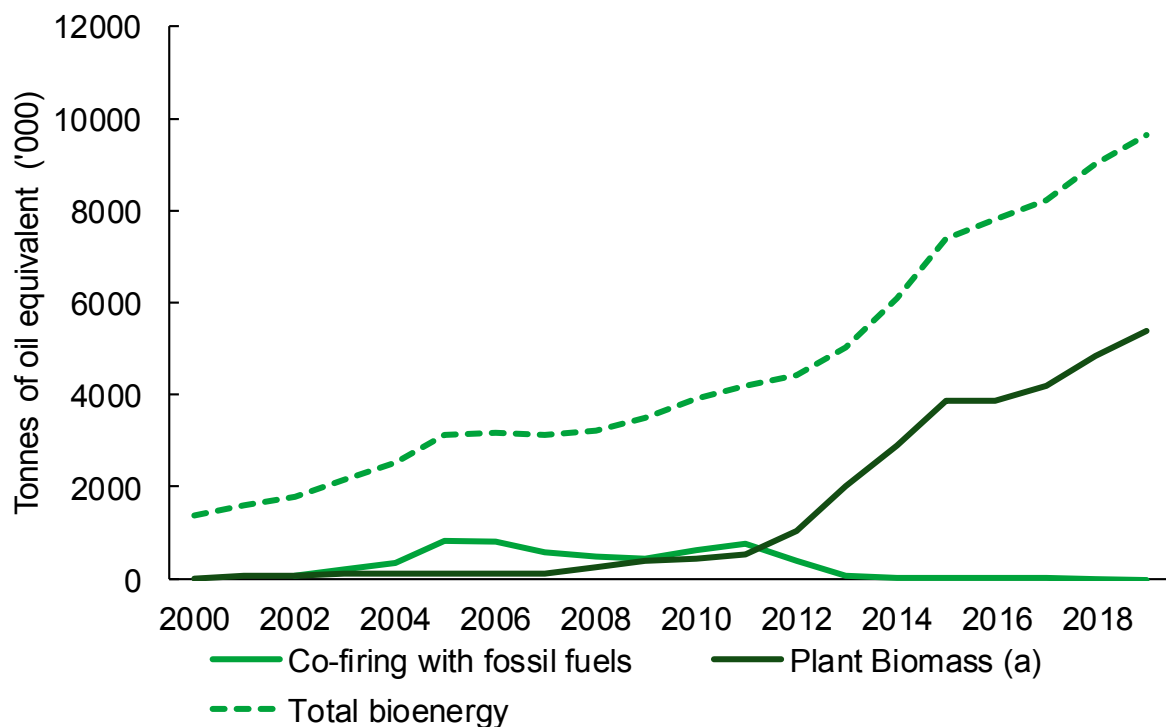
## 2.9 Volumes of biomass used in the UK for energy

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 2019 can be found in Table U in the [crops for bioenergy dataset](#).

**Figure 15: Volume of plant biomass used for electricity: 2000 to 2019**



Source: Digest of UK Energy Statistics

(a) Increases in capacity reflect conversions from previous coal-fired capacity to biomass.

In 2019, around 6.7 million tonnes of oil equivalent of plant biomass was used to produce electricity and heat in the UK, a 10% increase since 2018.

81% of plant biomass (5.4 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 14% increase in the volume of plant biomass used to generate electricity in 2019 compared to 2018, (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 is at similar level as last year when it reached its lowest quantity since this data series began.

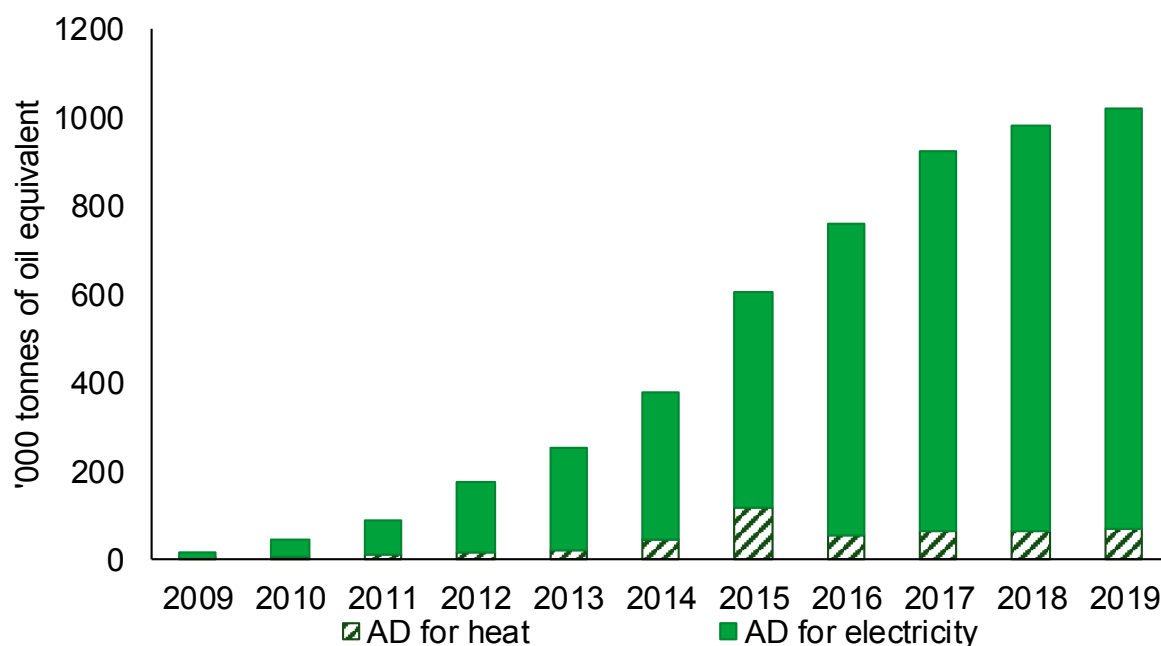
### 3. Anaerobic digestion

Certain types of organic 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 the in use of anaerobic digestion.

**Figure 16: volume of energy produced from anaerobic digestion in the UK 2009-2019**



Source: Digest of UK Energy Statistics

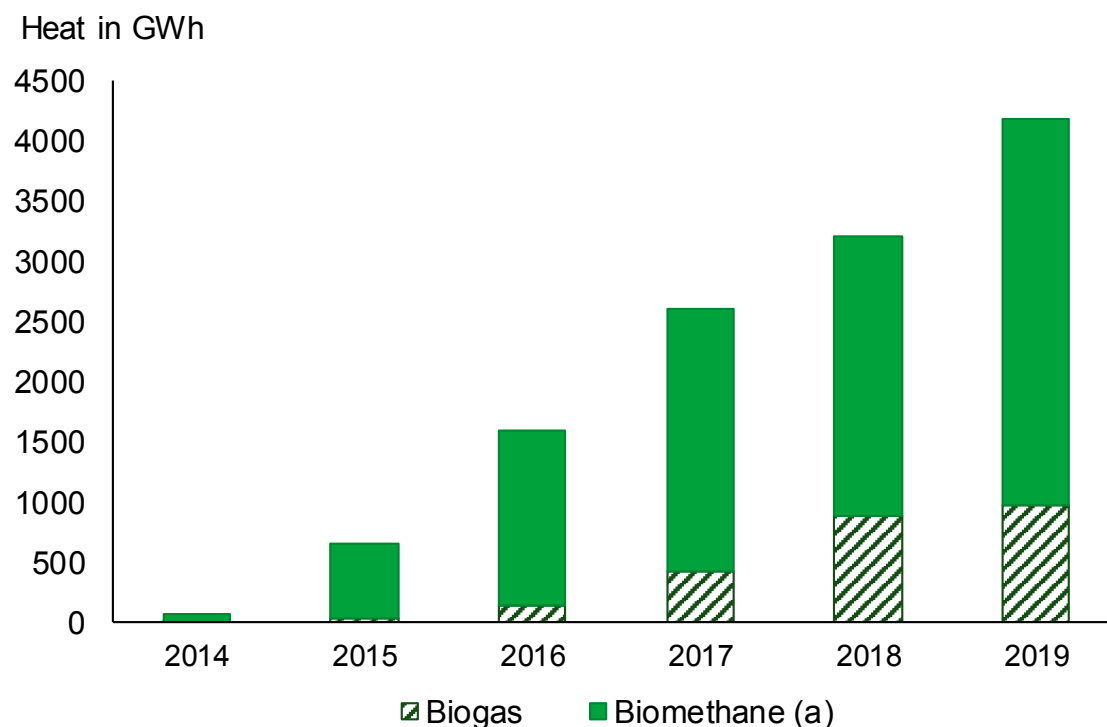
In 2019, total energy produced from anaerobic digestion was 1,018 thousand tonnes of oil equivalent, a 4% increase from 974 thousand tonnes in 2018. Energy production from AD followed a rapidly growing trend from 2009-2016, a result of rapidly expanding capacity for AD in the UK over this time. This 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 growth slowed and continued this trend up to 2019.

Electricity produced by AD made the most significant contribution to total energy production in 2019 at 950 thousand tonnes of oil equivalent, a 4% increase on 2018 (914 thousand tonnes). At 69 thousand tonnes of oil equivalent, heat produced by AD makes up approximately 6.7% of the total energy contribution in 2019, a similar proportion as in 2018.

A breakdown of all figures for 2009 to 2019 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 2014-2019.**



Source: RHI Deployment data

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

By the end of 2019, there were 94 registered producers of biomethane in the non-domestic RHI, producing over 9800 GWh of heat from AD between 2011-2019.

Biomethane generated from AD is generally fed 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 2014-2018, this contribution makes up the most significant proportion of heat generated from AD, totalling 3,202 GWh in 2019. This comprises 26% of the total heat produced under the non-domestic RHI for 2019, and is an increase in the quantity produced in 2018 (2,324 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 973 GWh in 2019. This is 8% of the total heat produced under the non-domestic RHI for 2019 and an increase of 10% from 2018 (889 GWh).

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>14</sup>

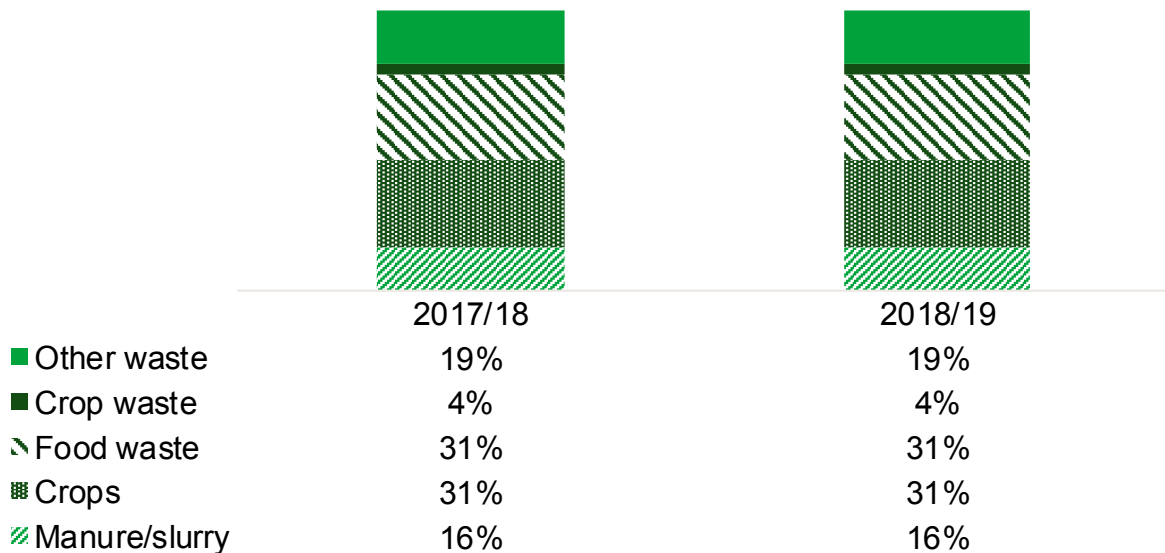
This is likely to lead to declining production of biogas from crops and increased use of waste feedstocks in the future.

Further breakdown of all figures for 2014 to 2019 is in Table W of the [crops for bioenergy dataset](#).

### 3.2 Crops as feedstocks for AD

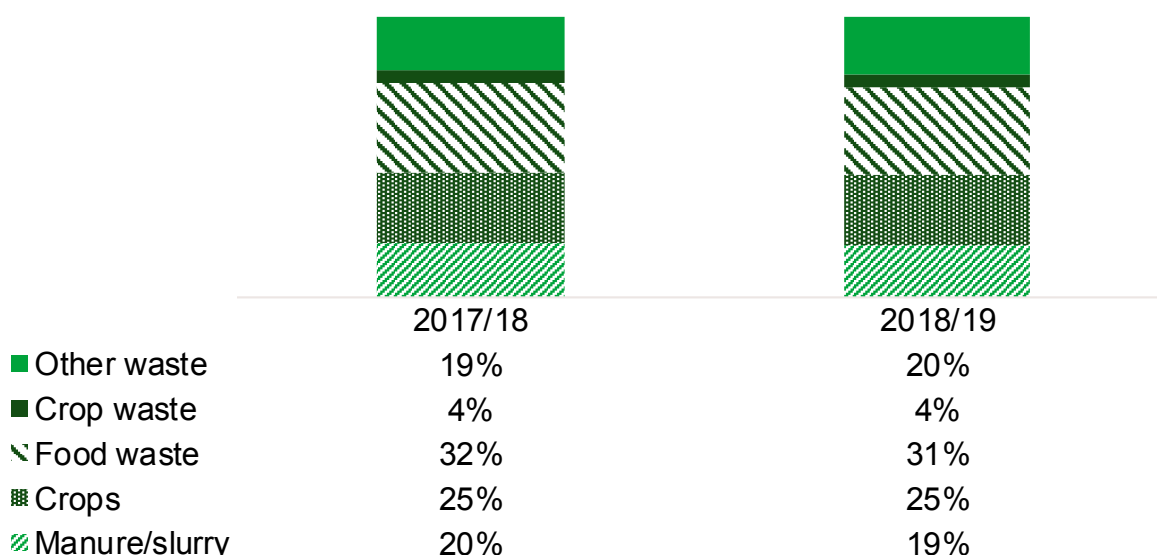
Anaerobic digestion uses both organic waste and crop feedstocks to produce biogas and biomethane. The annual NNFCC Anaerobic Digestion Deployment in the United Kingdom report<sup>15</sup> records the annual usage of feedstocks in operational plants and estimates for proposed developments in the UK (figure 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).

**Figure 18: use of feedstocks in operational AD plants by feedstock tonnage per annum, 2017/18 and 2018/19.**



Source: NNFCC Anaerobic Digestion Deployment in the UK

**Figure 19: use of feedstocks in planned AD plants by feedstock tonnage per annum, 2017/18 and 2018/19.**



Source: NNFCC Anaerobic Digestion Deployment in the UK

In the UK in 2018/2019 there were 486 operational plants, with a cumulative installed capacity of 429 MWe. Of these, 338 were farm fed (cumulative installed capacity 194 MWe) with the remainder being waste fed. A further 343 AD projects were under development in this time, with a proposed cumulative installed capacity of 255 MWe. Of these, 239 were farm fed (cumulative installed capacity 111 MWe) with the remainder being waste fed.

Of the feedstocks used in operational plants in 2018/2019, 35% were crop derived (approximately 4.3 million tonnes). The vast majority of this (3.8 million tonnes, 31% of total feedstocks) was crops purpose grown for AD, while crop waste made up 460 thousand tonnes (4% of total). The remaining 65% of feedstocks tonnage comprised non-crop wastes.

It is estimated that crop feedstocks required a cropping area of 85 thousand hectares in the UK in 2018/2019.

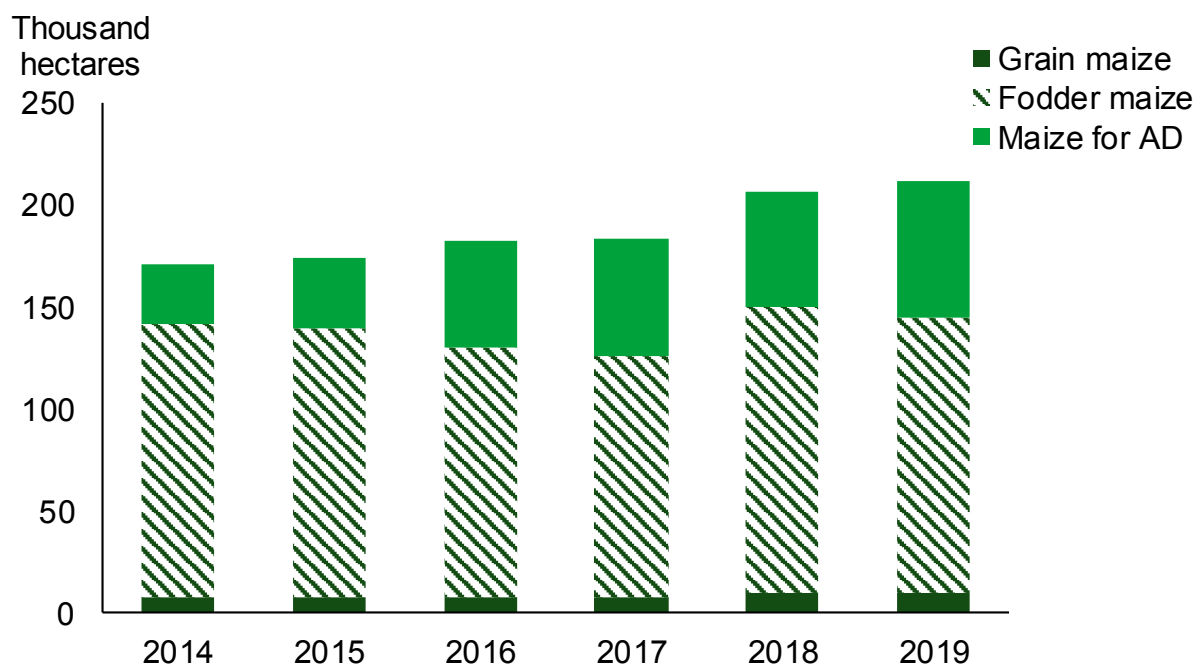
A similar distribution is expected for AD plants under development in 2018/2019. 29% of feedstocks are crop derived (2.3 million tonnes), made up of 2.0 million tonnes of purpose-grown crops (25% of the total) and 349 thousand tonnes of crop waste (4% of the total). It is estimated that these feedstocks would require a cropping area of 44 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 20: Maize by intended usage, England**



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 2019 the area of maize being grown for AD was 67 thousand hectares. This is an increase of 17% compared to 2018 and equates to 31% of the total maize area in 2019 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>16</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>17</sup>.

### Conversions

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

Source: [DUKES Chapter 1 \(Energy\) paragraph 1.28](#).

- Calorific values of fuels to convert gigajoules to tonnes are available at [Annex A of DUKES](#)

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](#) and [The National Non-Food Crops Centre](#)



## 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](#)) 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>18</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 [here](#).

The use of biofuels also supports other Government objectives to improve security of energy supply and rural development<sup>19</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.

The latest June Survey UK results can be found [here](#).

## 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 found [here](#).

Since the implementation of the Renewable Energy Directive<sup>20</sup> in December 2011 data must be verified prior to submission to the RTFO Administrator. The verified data are available as follows:

[2011/12 \(Year 4\)](#)

[2013/12 \(Year 5\)](#)

[2013/14 \(Year 6\)](#)

[2014/15 \(Year 7\)](#)

[2015/16 \(Year 8\)](#)

[2016/17 \(Year 9\)](#)

[2017/18 \(Year 10\)](#)

[2018 \(Year 11\)](#)

[2019 \(Year 12\)](#)

The RTFO data include:

- Biofuels from UK grown and imported crops (these are presented separately in the tables)
- 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 (BEIS), formally The Department for Energy and Climate Change). Neither HMRC nor 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 [here](#).

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 [here](#).

## 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. From 2014 questions on straw production and usage were asked, however in 2018 only questions on production were included with area and yield excluded. The latest results from the cereal and oilseed rape production survey can be found [here](#).

## 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:

[2009/10 data](#)

[2010/11 data](#)

[2011/12 data](#)

[2012/13 data](#)

[2013/14 data](#)

[2014/15 data](#)

[2015/16 data](#)

[2016/17 data](#)

[2017/18 data](#)

[2018/19 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 [here](#).

### 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 5<sup>th</sup> annual report (April 2017-April 2018) 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 Wisington 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).

## References

---

<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.

<sup>3</sup> 2018 figures (Year 11) are as of 28<sup>th</sup> October 2019 and are not final

<sup>4</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.

<sup>5</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>6</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>7</sup> <https://www.snettertonbiomass.com/>

<sup>8</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>

<sup>9</sup> Section 4, Renewables Obligation Annual Report 2014/15

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

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

<sup>12</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)

<sup>13</sup> <https://ahdb.org.uk/farm-costs-at-a-glance>

<sup>14</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>15</sup> <https://www.nnfcc.co.uk/publications/report-anaerobic-digestion-deployment-in-the-uk>

<sup>16</sup> <https://www.gov.uk/government/publications/excise-notice-179e-biofuels-and-other-fuel-substitutes/excise-notice-179e-biofuels-and-other-fuel-substitutes>

<sup>17</sup>

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

<sup>18</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. In 2018 the obligation rose from 4.75% to 7.25%.

<sup>19</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>

<sup>20</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>