

# Bioenergy

Some reflections on the UK experience

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# What is bioenergy?

- Fuel that is made from living things or their waste
- A form of **renewable** energy
- Energy generated by combusting solid, liquid or gas fuels made from biomass feedstocks which may or may not have undergone some form of conversion process.
- UK Bioenergy Strategy 2012
- [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48337/5142-bioenergy-strategy-.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf)

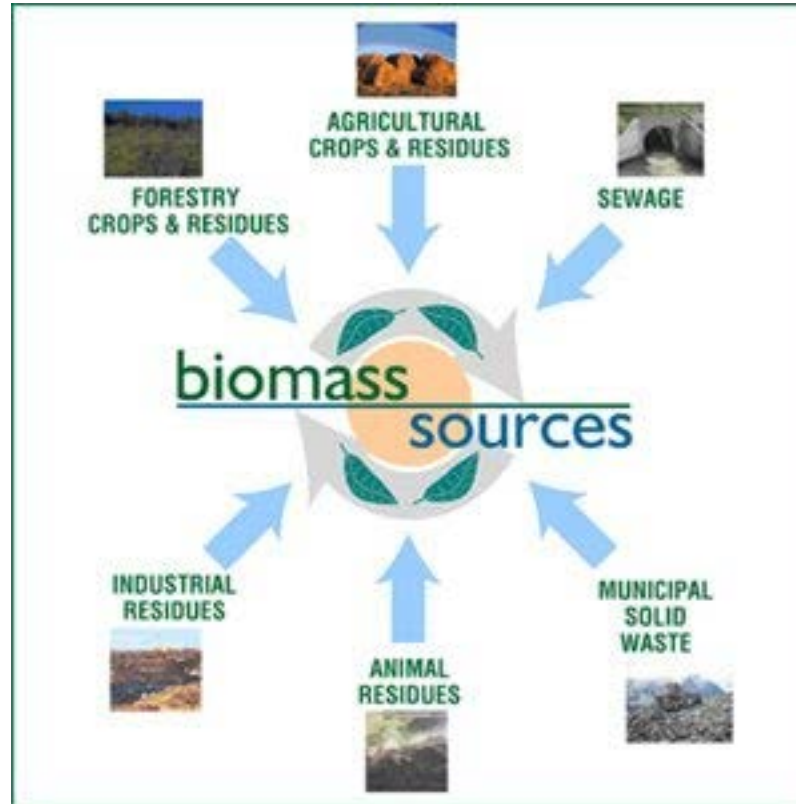
# Bioenergy

- All forms of heat and power from organic materials
- Friends of the Earth
- <https://friendsoftheearth.uk/sites/default/files/downloads/felled-fuel-46611.pdf>

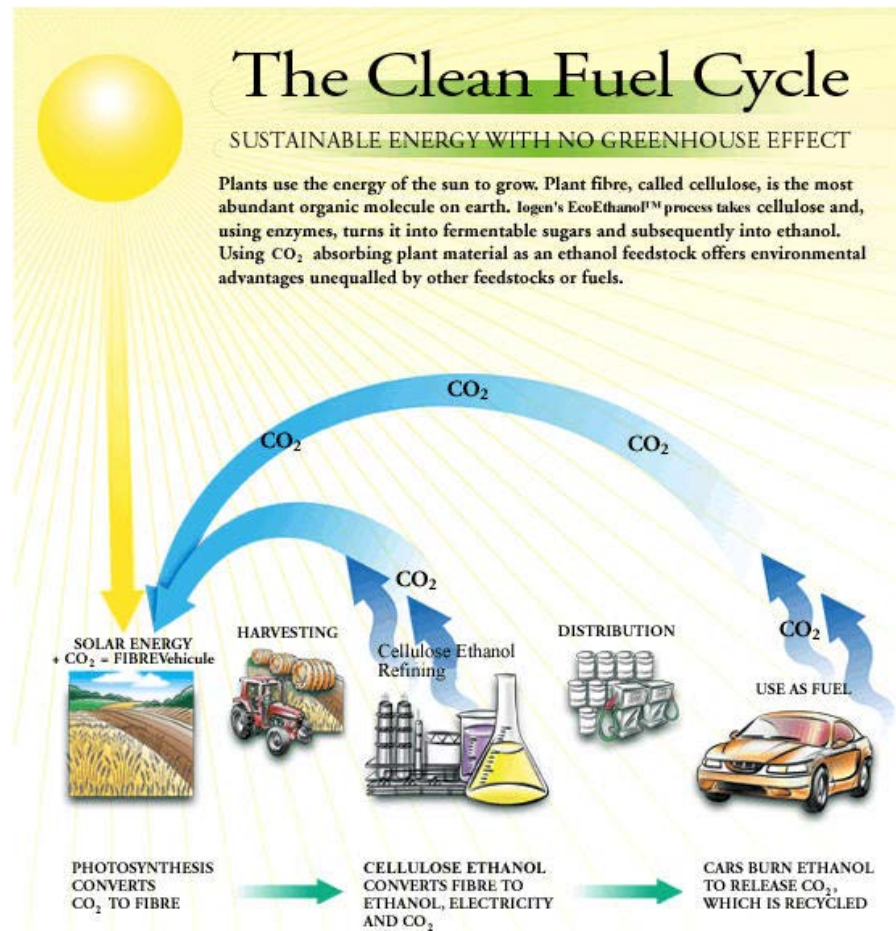
# What will be considered in this lecture?

1. Background issues
2. UK electricity generation from bioenergy sources

# Potential feedstock for bioenergy



# The claimed advantages of bioenergy



# The use of bioenergy is not new



“The earliest evidence for fire associated with humans comes from Oldowan hominid sites in the Lake Turkana region of Kenya. The site known as Koobi Fora is dated approximately 1.6 million years old.

The earliest evidence for controlled use of fire outside Africa is Geshert Benot Ya'akov in Israel, where charred wood and seeds were recovered from a site dated 790,000 years old.

Beeches Pit in Suffolk is the UK's oldest Site at about 400,000 years old.

[http://archaeology.about.com/od/ancientdailylife/qt/fire\\_control.htm](http://archaeology.about.com/od/ancientdailylife/qt/fire_control.htm)

# The role of wood (or waste wood products) as an energy source

- Wood is the most important source of energy for 66% of the world's population for cooking and/or heating.
- More than two billion people depend on wood energy for cooking and/or heating
- 9% of the global total primary energy supply
- The majority in the Global South
- **Private households' cooking and heating with wood fuels represents 33.3% of the global renewable energy consumption,**
- But often results in rapid deforestation
- The UK has a long history of deforestation
- (Forests 4.7% land area : 1919; 13%: 2011).
- (Italy: 35%; France 37%; Japan: 67%)



# The main users of woodfuel globally



Typically, improved stoves reduce wood use by between 20% and 60% compared to open fires. <http://www.ashden.org/wood-stoves>

# Suppliers of wood in Uganda



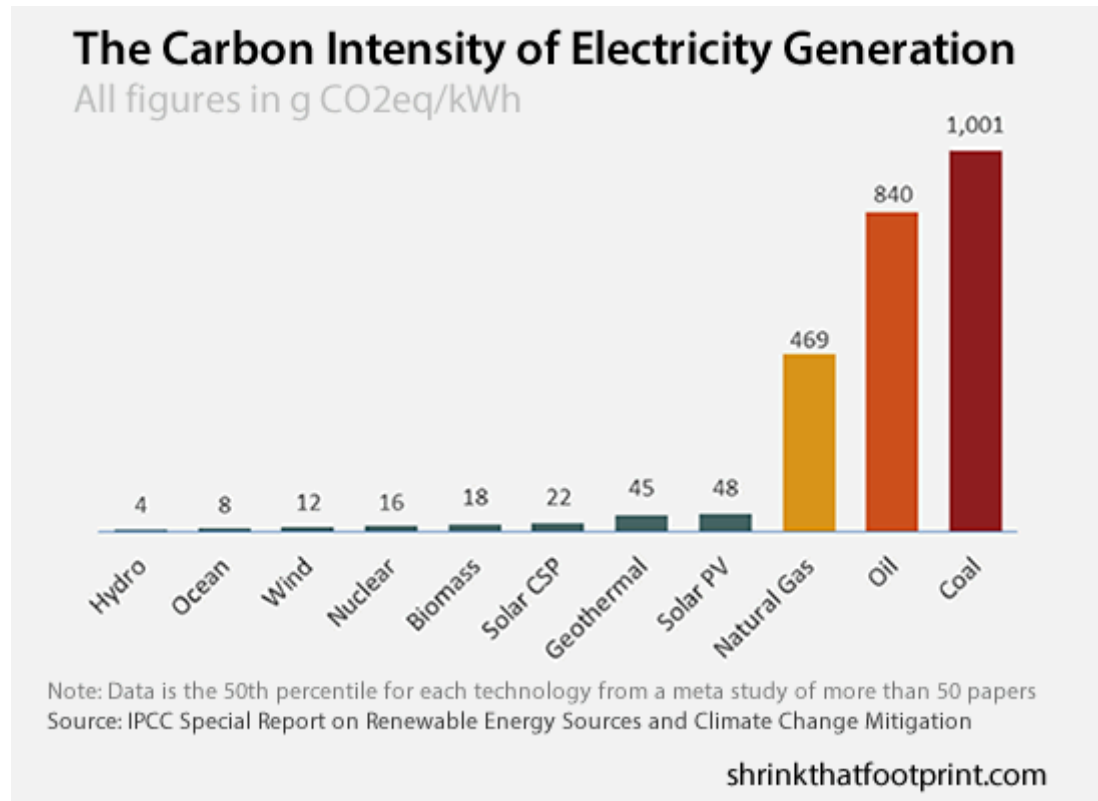
What is the UK committed to achieving to combat human induced climate change?

- The UK was the first country in the world to set a long-term, legally binding target for emission reduction.
- The Climate Change Act (2008) commits the UK to reduce emissions by at least 80% by 2050, and sets a framework for the setting of rolling five-year carbon budgets.
- Parliament has recently approved the Fifth Carbon Budget, for the period 2028–32, at a 57% reduction on 1990 levels.

# Doesn't burning organic matter release CO<sub>2</sub> into the atmosphere?

- Yes!
- Bioenergy is NOT Carbon neutral
- CO<sub>2</sub> is a greenhouse gas.
- So how can burning organic material help reduce our inputs of CO<sub>2</sub> into the atmosphere?

# The case for bioenergy



Biomass is being used because it is a low carbon source of energy compared to fossil fuels

# UK Government bioenergy principles

- Bioenergy should deliver carbon reductions that help meet UK carbon emissions objectives to 2050 and beyond.
- Support for bioenergy should be cost effective.
- Support for bioenergy should aim to maximise the overall benefits and minimise costs (quantifiable and non-quantifiable) across the economy.
- Policy makers should assess and respond to the impacts of this use of bioenergy on other areas, such as food security and biodiversity.
- [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48337/5142-bioenergy-strategy-.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf)

# Risks and uncertainties associated with bioenergy:

1. Whether it genuinely contributes to carbon reductions;
2. The availability and price of sufficient sustainably-sourced biomass;
3. The relationship between bioenergy and other uses of land, such as
  - (i) food production,
  - (ii) other uses of biomass, such as for construction materials;
4. The environmental impacts on air quality, biodiversity and water resources.

UK Bioenergy Strategy 2012: Introduction

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48337/5142-bioenergy-strategy-.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf)

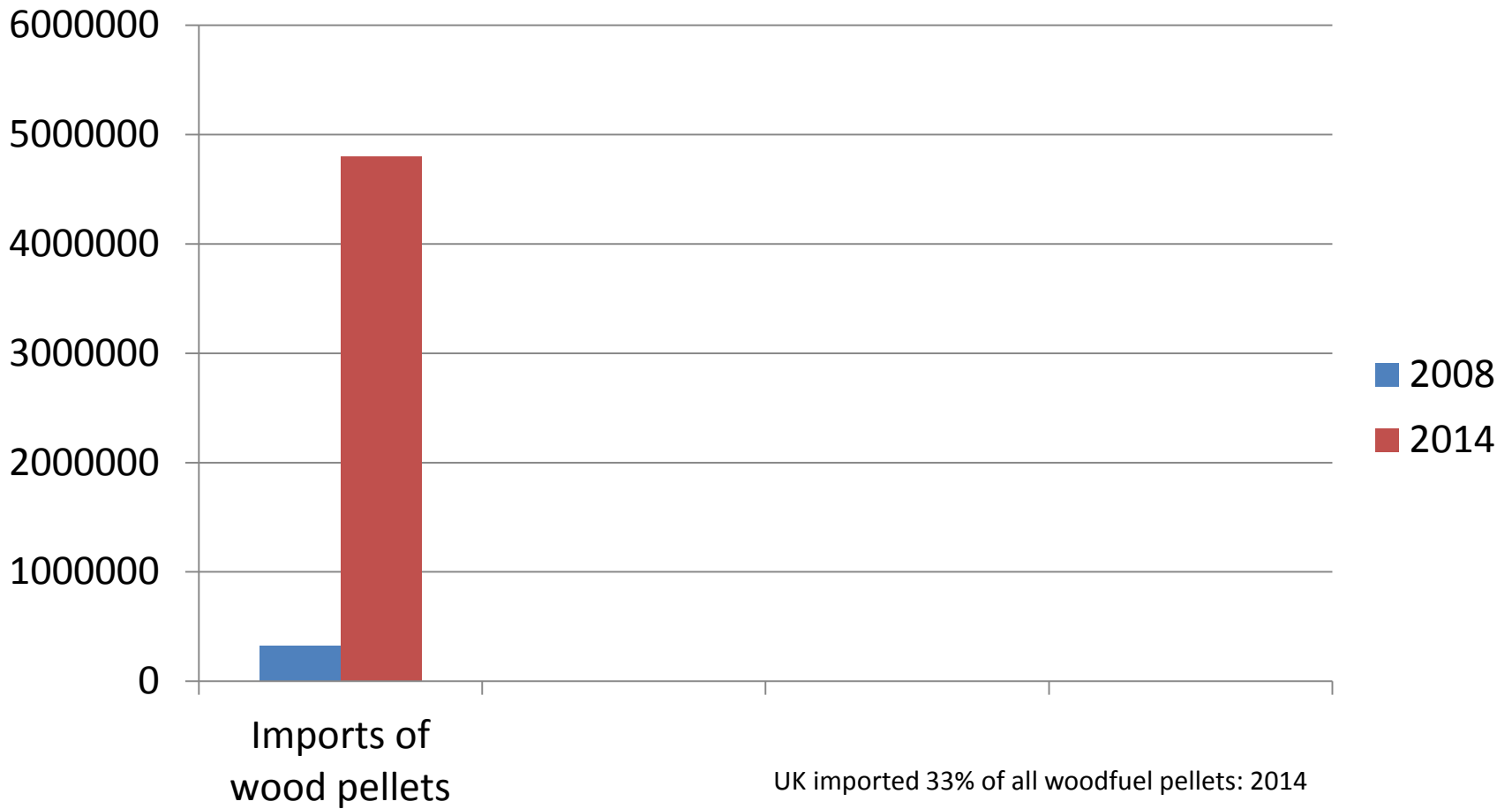
# The potential of bioenergy in the UK

1. Highly uncertain
2. sustainably-sourced bioenergy could contribute 8-11 % to UKs TOTAL primary energy source by 2020
3. 12% by 2050 (within a wide range of 8%-21%).
4. Much of this would be imported

UK Energy Strategy 2012



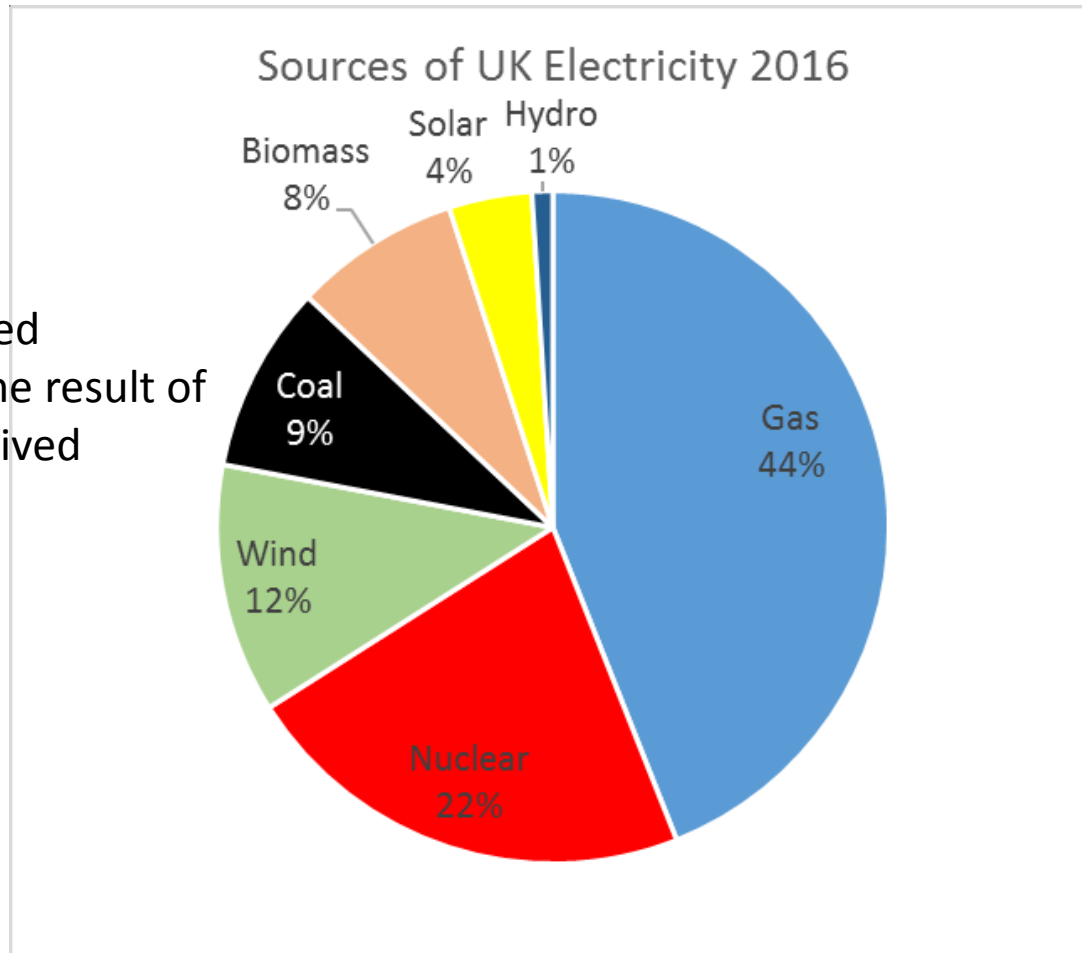
# Rate of increase in use of woodfuel tons



[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/462361/Trade\\_of\\_wood\\_pellets.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/462361/Trade_of_wood_pellets.pdf)

<https://www.carbonbrief.org/uk-now-burning-33-of-worlds-wood-pellet-imports>

The majority of electricity produced from biomass is the result of burning wood derived products.



# Wood use in the UK Renewables Obligation

- Increasing demand for wood met by imported biomass.
- Significant increase in imports from 2012 coincides with development of coal-to-biomass conversions
- Relatively stable UK supply base (1.1-1.5 modt for last five years)
- 66% of solid biomass imported 34% UK-sourced
- [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/490572/Woodfuel Disclosure Survey 2015.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/490572/Woodfuel_Disclosure_Survey_2015.pdf)

# What is driving this move from coal to biomass?

- Legislation (EU and UK)
- Subsidies
- In 2015, energy companies received **£817 million** in UK subsidies for burning solid biomass for electricity, the vast majority of it wood.
- <http://www.biofuelwatch.org.uk/end-biomass-subsidies/>

# Where does most of this imported wood fuel end up?



Drax power station, Yorkshire: Once conversion is complete, expects to burn up to 7 million oven dried tonnes of wood each year, making it the biggest biomass-burning power station in the world.

# Where does most of the woodfuel come from?

**INCREDIBLE JOURNEY: HOW PRECIOUS U.S. FORESTS KEEP OUR LIGHTS ON**

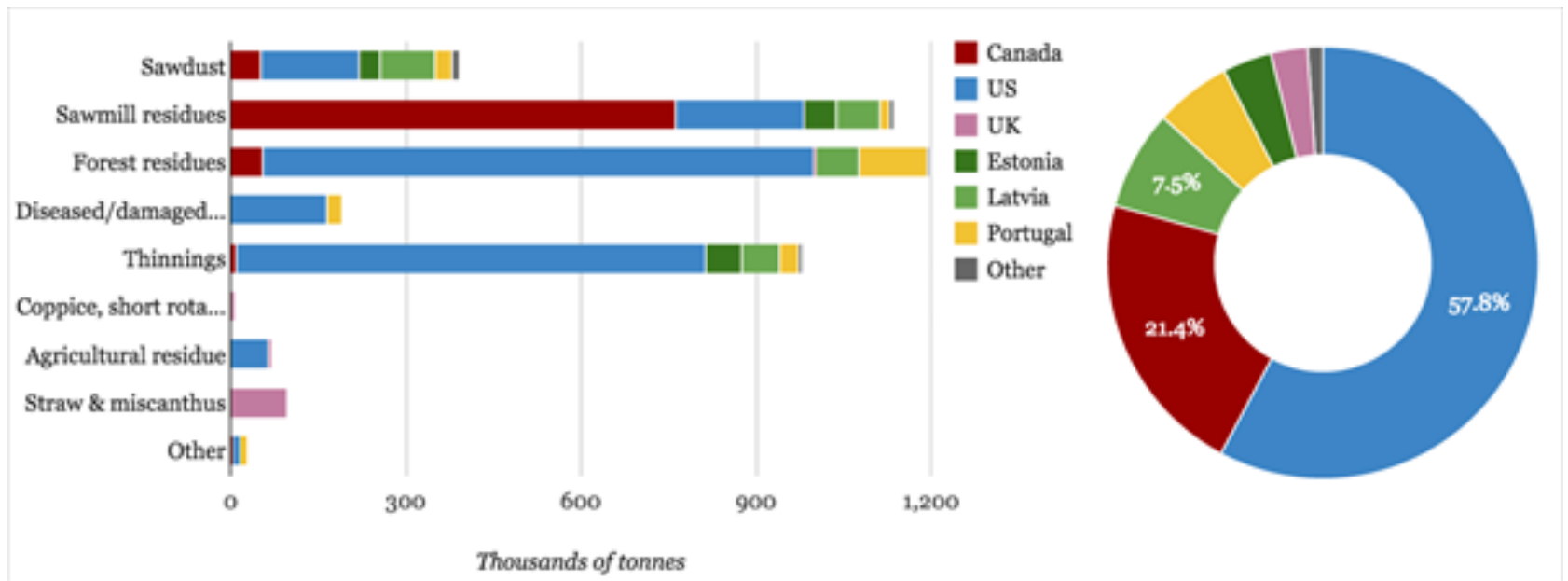
**1** Seen from the air, a huge scar where acres of timeless American wetland forest were 'clear cut' and their trees partly turned into power-station wood-pellet fuel.

**2** A handful of the wood pellets produced from the vast pile of tree trunks delivered to the Ahoskie factory. They will be burnt as 'biomass' fuel at Drax. By 2016, the power station will need seven million tons per year.

**3** The pellets' 3,800-mile journey from North Carolina to Immingham and Hull, and on by train to Drax power station.

**4** Part of the huge Drax power plant, whose wood-pellet fuel is officially classed as 'carbon-neutral'.

# In more detail



# Truck delivering whole tree trunks to Enviva wood pellet plant in the USA





The US is the world's largest exporter of wood pellets



Total 12.6 Mt, 2013 data

Drax says 80% of its wood pellets come from these sources



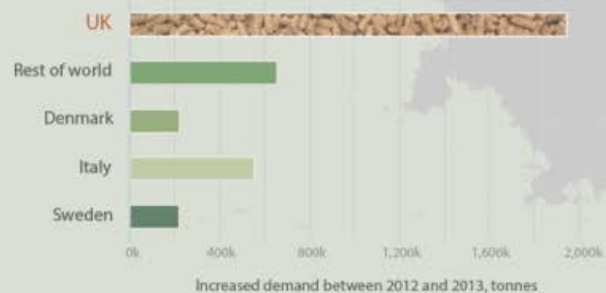
2014 data

The UK is the largest wood pellet importer



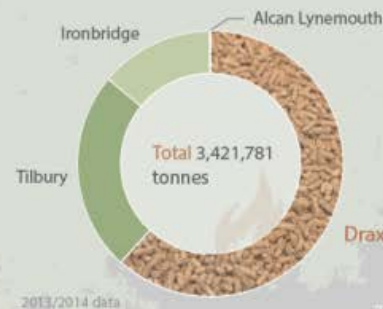
2013 data

The UK is driving increased demand for pellets



Increased demand between 2012 and 2013, tonnes

Drax is the largest power station user of wood pellets in the UK



2013/2014 data

# BIOMASS IN BRITAIN

Sources: FAOSTAT, Ofgem, Drax [bit.ly/biomassinbritain](http://bit.ly/biomassinbritain)



The Carbon Brief

# Drax's claim for its carbon budget

- 122 kilogrammes of carbon dioxide was emitted for each megawatt hour of electricity generated in its biomass units.
- Coal emissions of around 1,018 kgCO<sub>2</sub>/MWh
- Between 2013-2014 reduced its coal burn by a third and reduced its emissions by 6 million tonnes of CO<sub>2</sub>

# How was this calculated?

- It includes lifecycle emissions from the cultivation, harvest, processing and transport of wood pellets from the forest to Drax's plant.
- But
- It ignores potentially large changes in forest carbon stocks and indirect effects caused by increased demand for wood products.

# How is bio-mass impact on climate assessed?

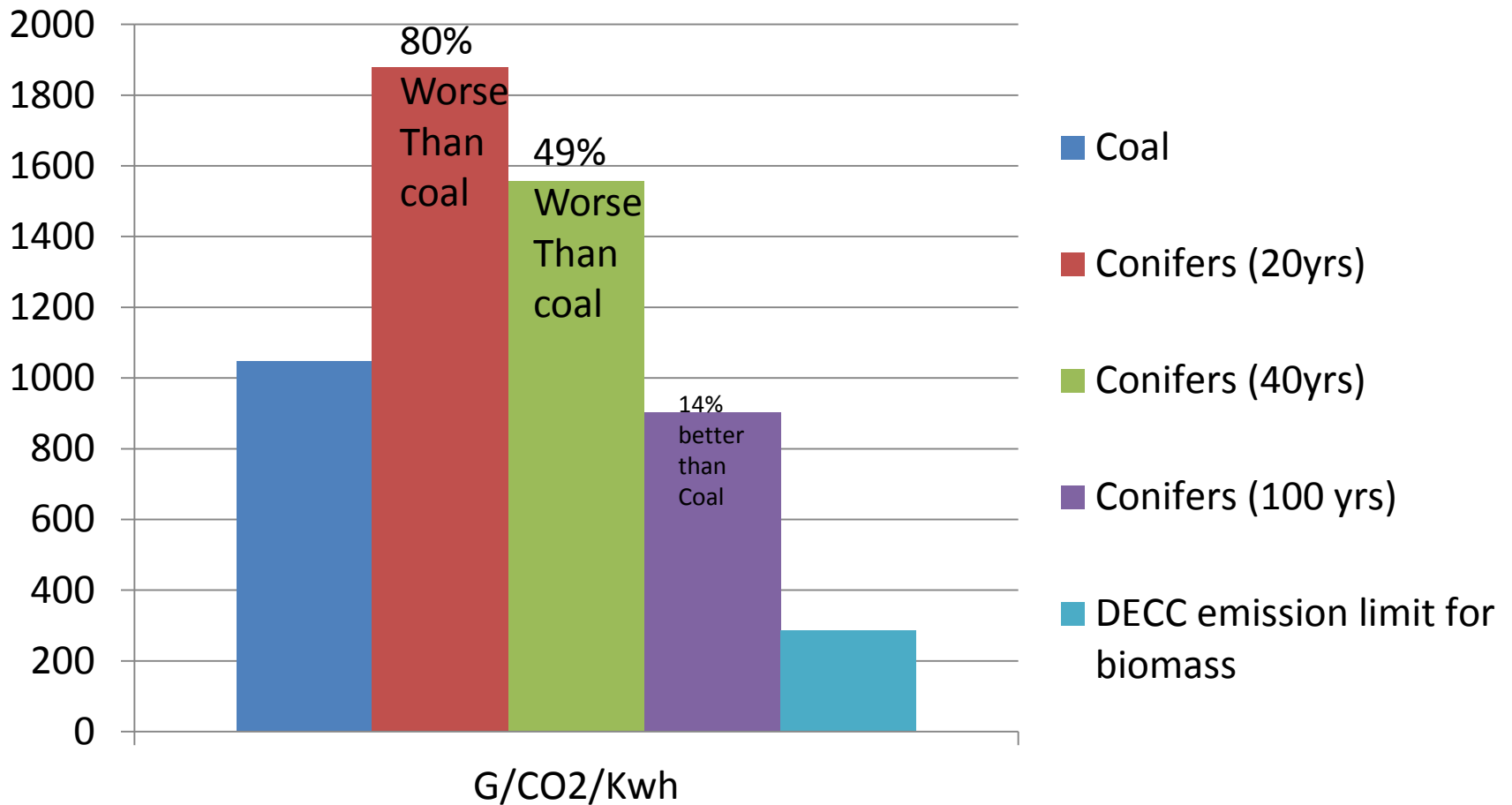
- CO2 emissions from burning biomass are ignored by operators and the Government, on the assumption that future growth will sequester the emitted CO2.
- <http://www.biofuelwatch.org.uk/wp-content/uploads/uk-end-biomass-subsidies.pdf>

# Why might this be a flawed practice?

1. The time lag between CO2 emissions from power stations on the one hand and CO2 sequestration by future tree growth;
2. Indirect impacts, including the use of waste and residues for bioenergy resulting in other industries relying on more extensive or intensive logging;
3. long-term reductions in soil and vegetation carbon stocks due to more extensive or intensive logging as well as the conversion of natural forests to monoculture plantations.
4. The climate impacts of biomass electricity are even worse when the substantial methane emissions from woodchip storage are taken into account.

<http://www.biofuelwatch.org.uk/wp-content/uploads/uk-end-biomass-subsidies.pdf>

# The carbon debt within specific years of burning conifer wood



# Other impacts

1. Loss of biodiversity in the USA
2. Negative impact on watersheds in USA
3. Possible reduction in air quality in the UK
4. Indirect land use changes in other regions caused by diversion of wood waste to UK pellet market that once served other purposes
5. Eg where displaced demand has knock-on impacts in Brazil this can lead to emissions higher than coal of up to 1,761 kgCO<sub>2</sub>/MWh.

# Conclusion

- Use of large-scale bioenergy for electricity production has the potential to reduce carbon emissions if the correct sources are used.
- In practice, it probably fails to reach UK Government's own bioenergy principles when all issues are considered.
- The use of burning of whole trees is unable to meet greenhouse gas emission targets in the timescale necessary.