Chris Malins and
Stephanie Searle

UK Department for Transport
December 1, 2014

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

EUROPE'S UNTAPPED RESOURCE

Context and goal

Context:

- Concerns about indirect land use change and competition between food and fuel
- Ongoing policy debate in Europe
- Technologies are available to convert cellulosic material to liquid biofuels
- Lack of concrete, effective incentives to commercialise advanced biofuels in Europe

Goal:

- Demonstrate potential for cellulosic fuel from wastes and residues
- Establish potential for significant carbon savings on a comprehensive lifecycle analysis

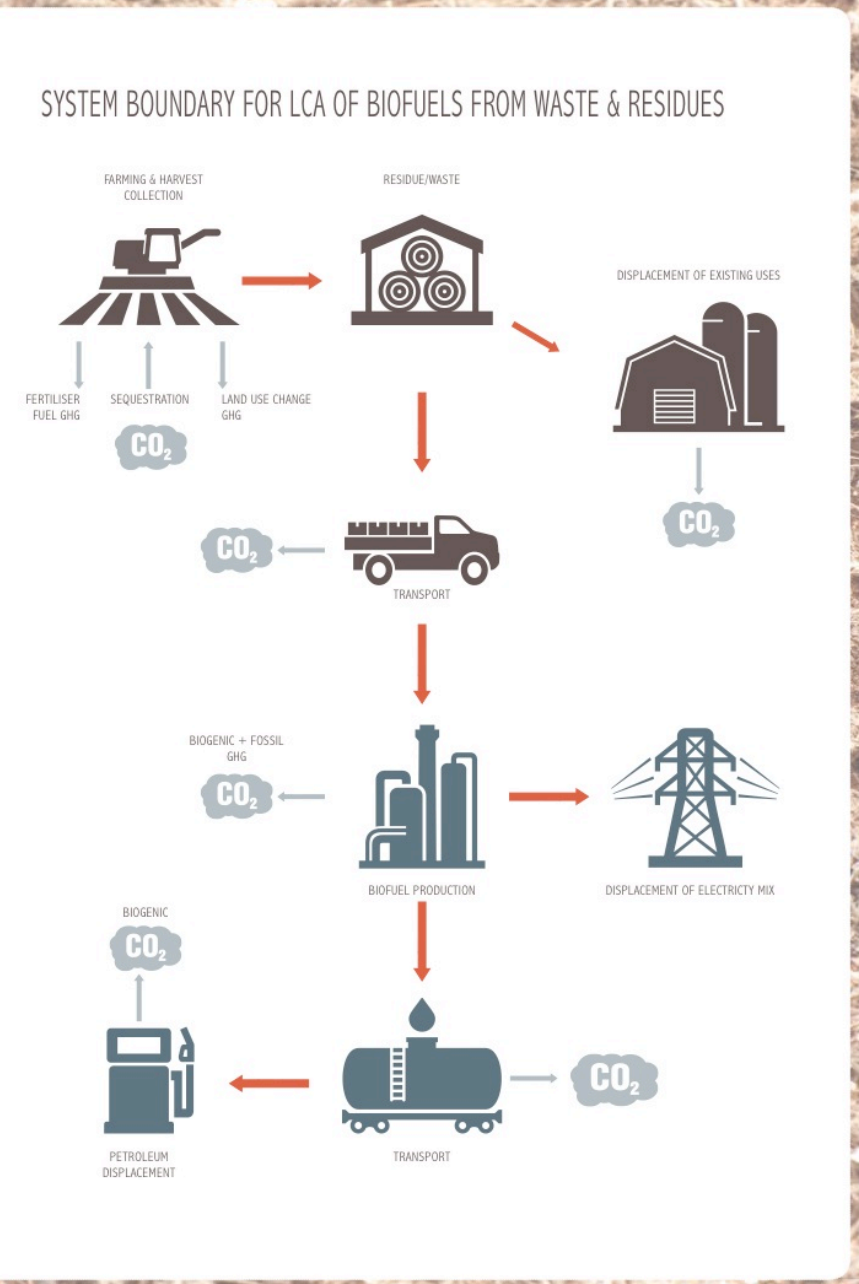
LCA

Lifecycle analysis

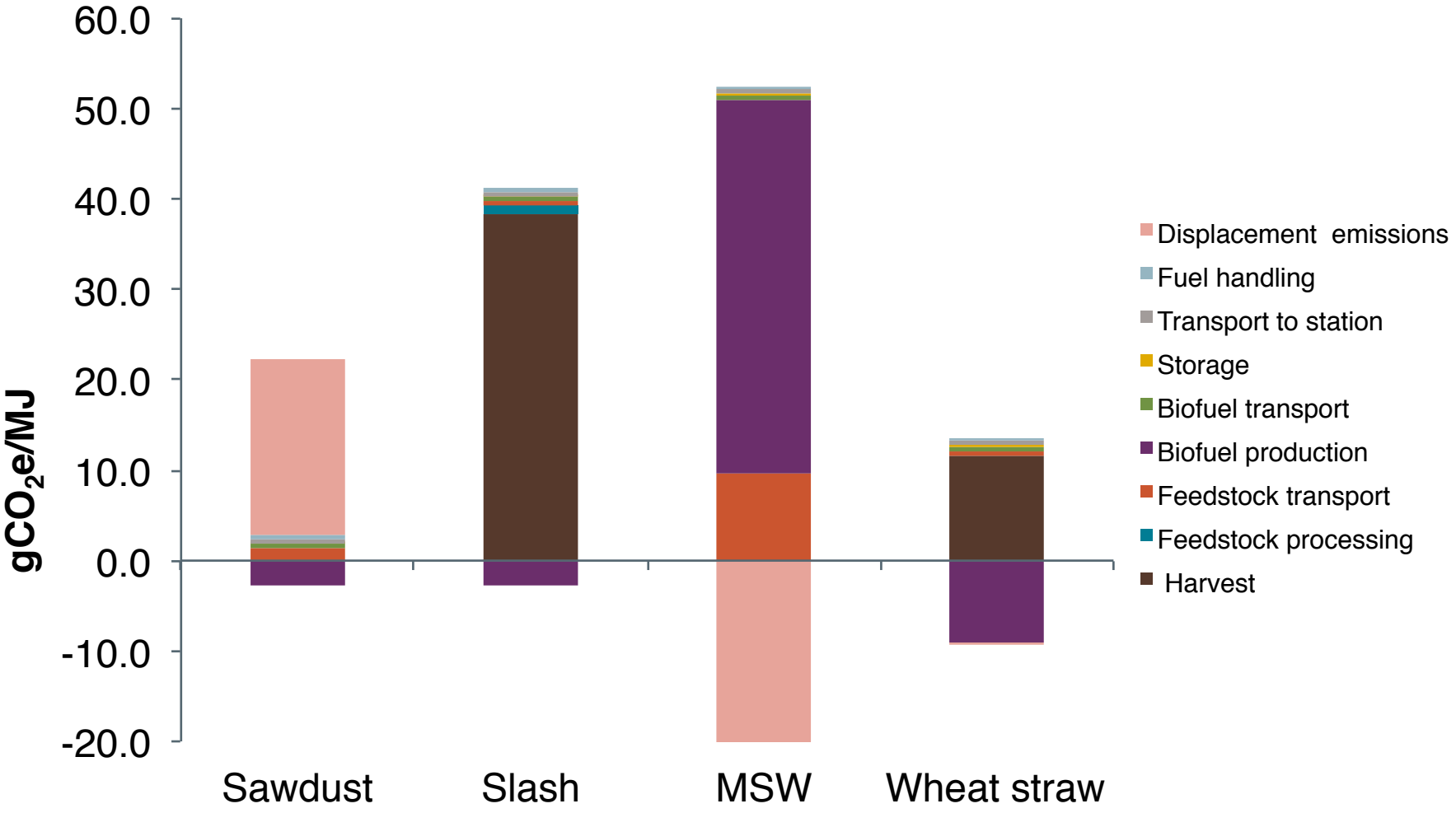
- Wastes and residues are a potential source of bioenergy feedstock
  - Past studies show that they can offer significant GHG savings with minimal environmental impact
- However, understanding true GHG reduction potentials also requires consideration of:
  - Additional fertilizer requirements due to residue removal
  - Soil carbon loss from residue removal
  - Displacement (indirect) effects
- Conducted using the DfT carbon calculator

System boundary

- Adopt wide boundary to give confidence of benefits
- Displacement effects assessed based on Ecometrica methodology

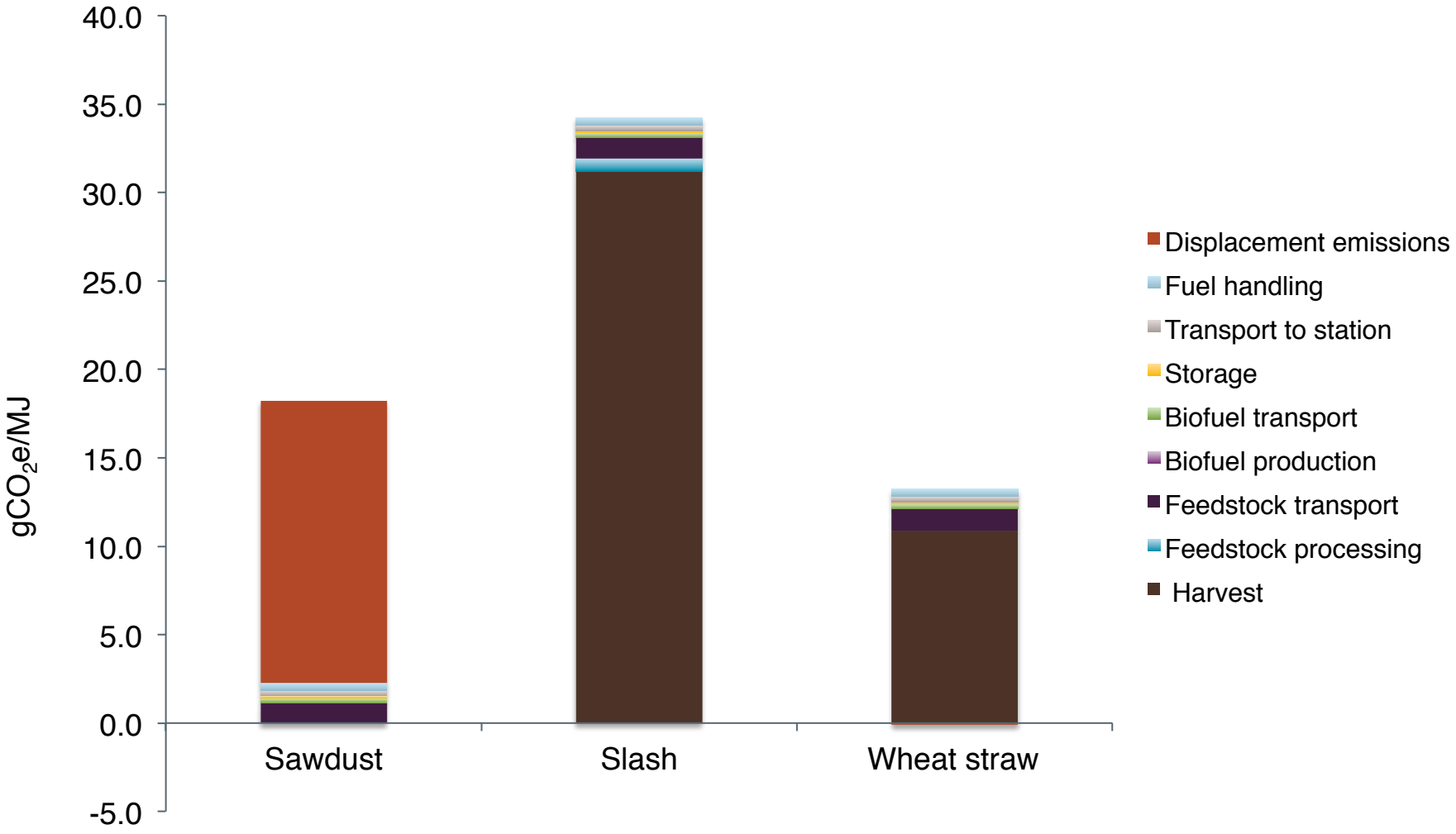


GHG emission profiles: Biochemical ethanol pathway



Note: Displacement emissions for MSW are -225 g CO_2e/MJ

GHG emission profiles: FT-diesel pathway



Availability

Sustainable feedstocks covered

- Agricultural residues
  - Field residues of 12 main crops
  - Process residues (chaff, husk, cob)
- Forestry residues
- Cellulosic fraction of waste
  - Paper and cardboard
  - Wood
  - Waste food

We consider wastes and residues to be available if:

- Their removal does not harm the environment
- They do not have existing higher order uses

Agricultural residues

Agricultural residues

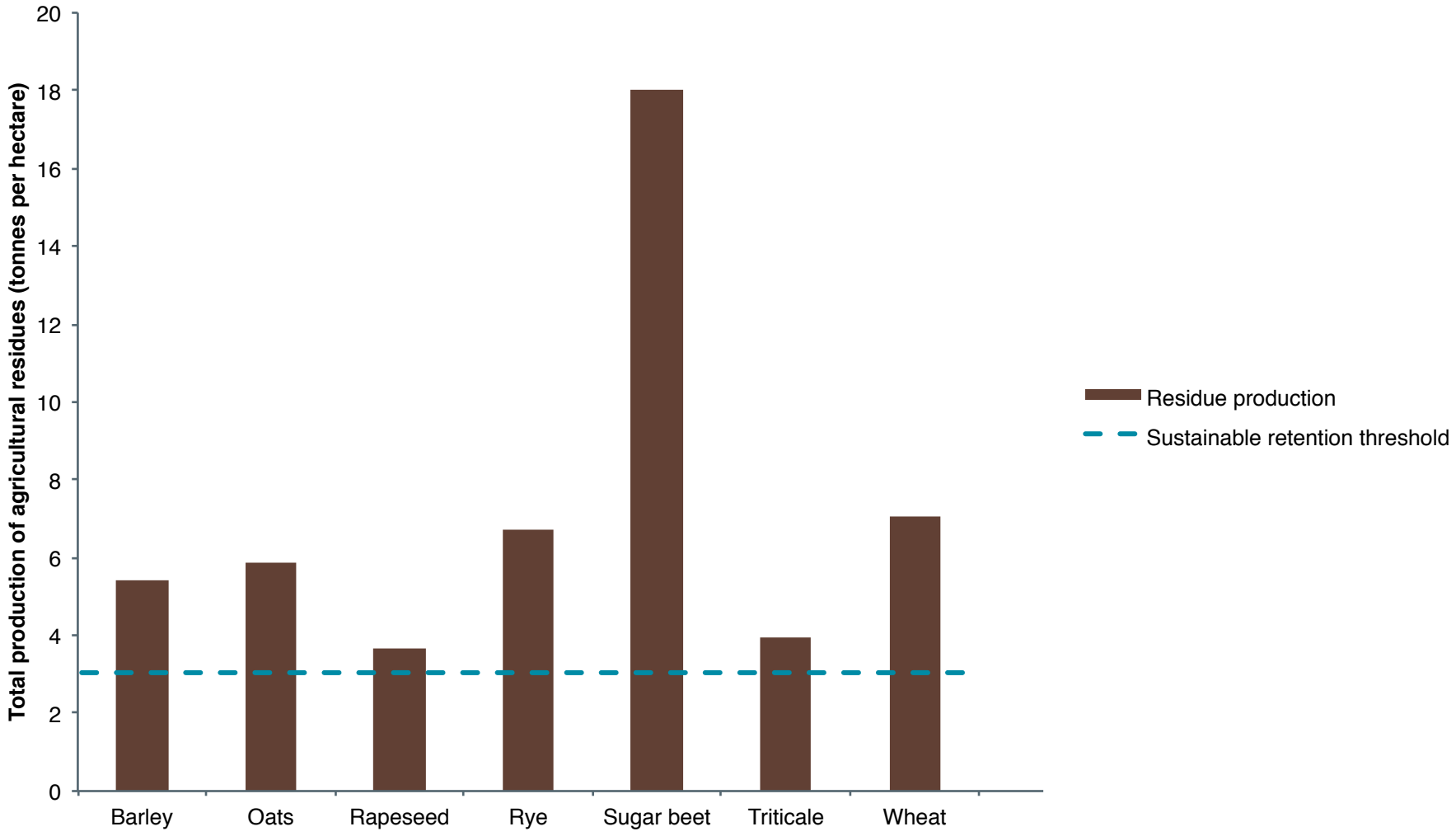
- Agricultural residues are any part of the plant that is not eaten: stem, leaves, husk, etc.
- Some residues are more desirable for cellulosic biofuel production

BEST QUALITY	POTENTIALLY USABLE	POOR QUALITY
Barley (straw + husk)	Rapeseed (straw)	Sugarbeet (shoots)
Oats (straw + husk)		
Rye (straw + husk)		
Triticale (wheat x rye) (straw + husk)		
Wheat (straw + husk)		

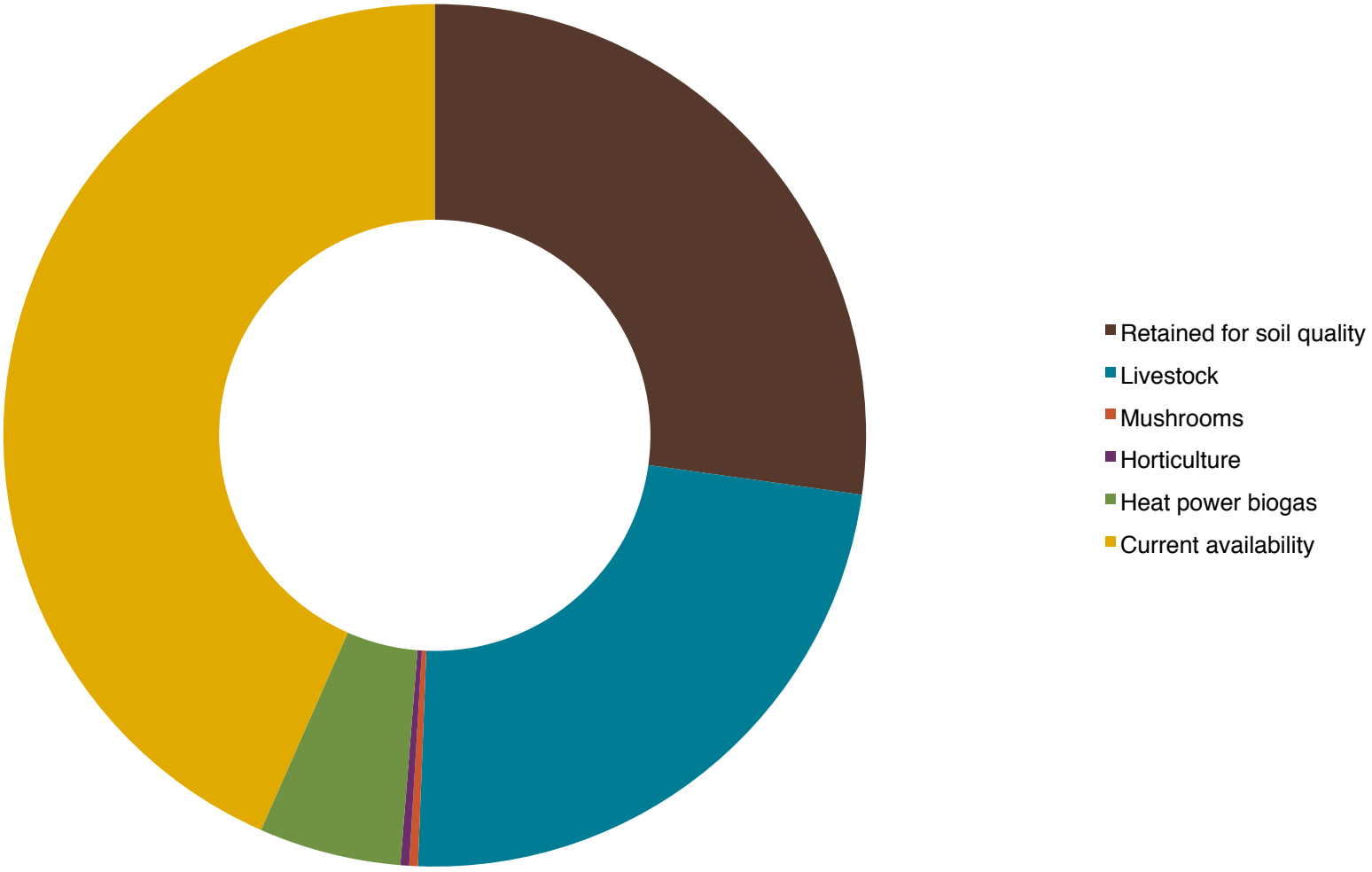
Sustainable harvesting rate of agricultural field residues in the UK

- Some amount of residues should be left in the field to protect against erosion and soil carbon loss
  - Estimated at 3 t/ha for UK based on erosion rate, soil carbon concentration, and tillage practices
- Some amount of residues is already used in other industries
  - Livestock
  - Mushrooms and horticulture
  - Heat, power and biogas (potentially available)
- Remainder of residues can be sustainably harvested for biofuel with limited adverse impacts

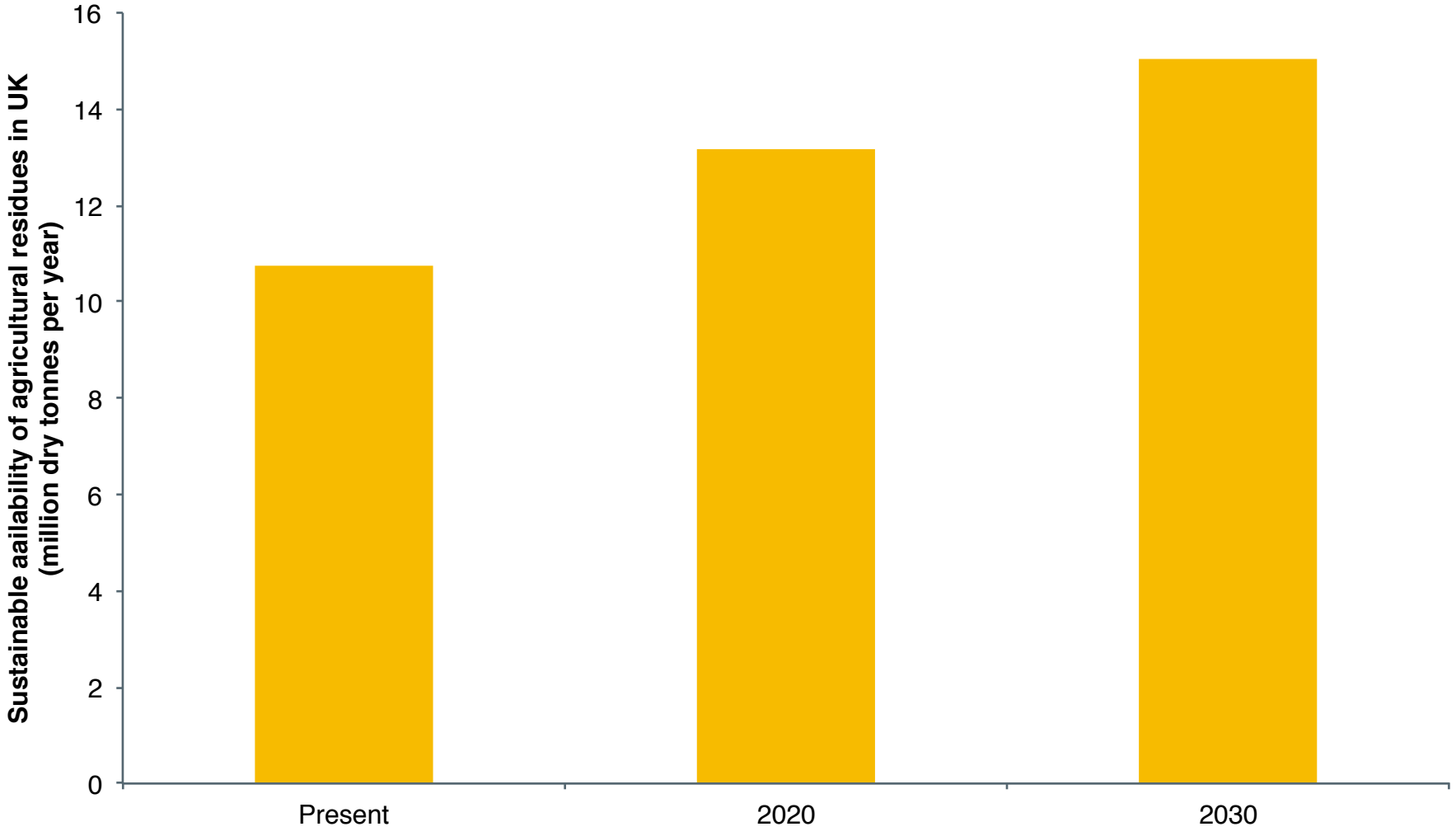
Residue production and sustainable collection level in UK by crop



Sustainable availability of agricultural residues after allowing for soil retention and other uses



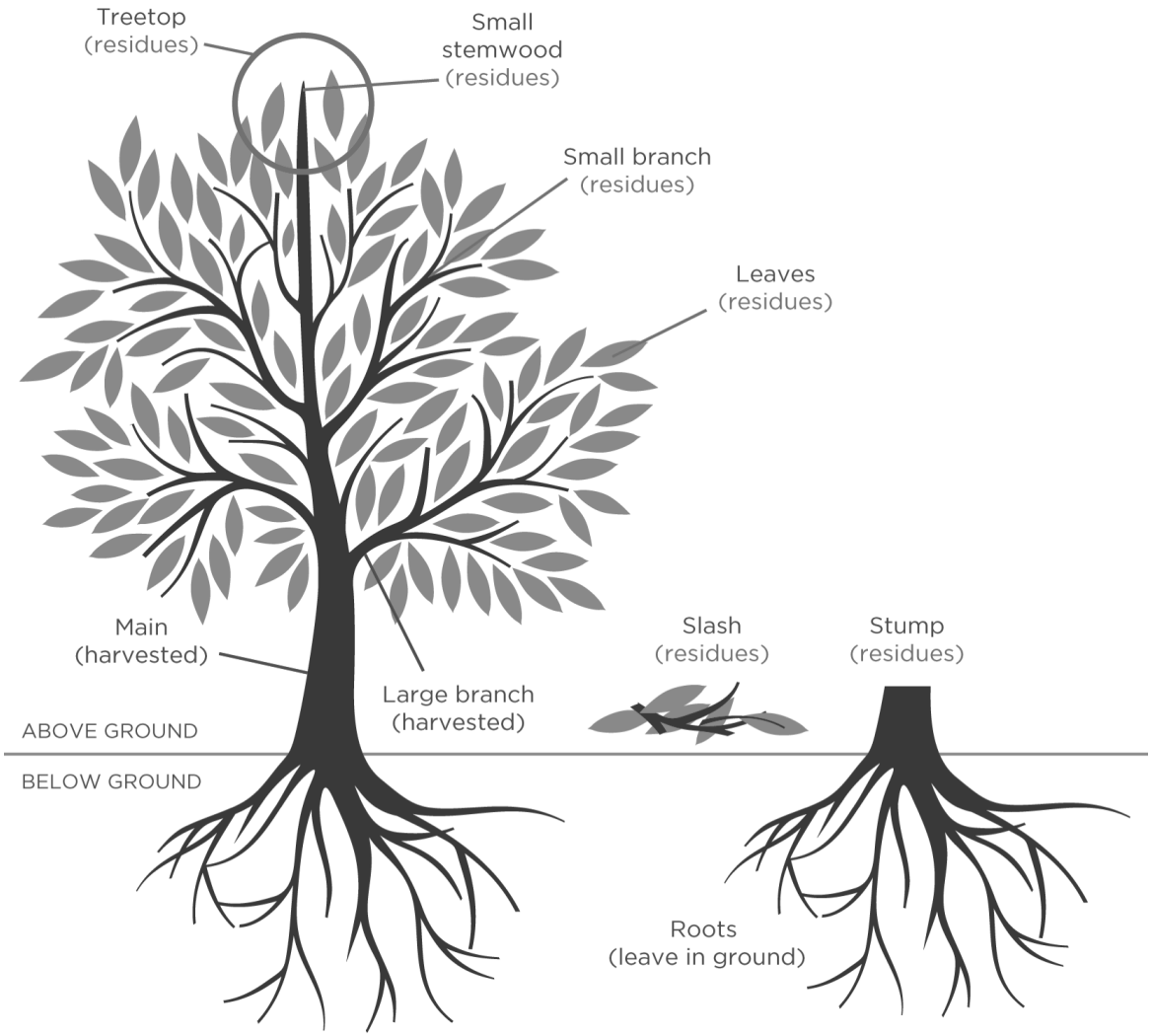
Sustainable availability of agricultural residues in UK will likely increase as crop production grows



Forestry residues

What are forestry residues?

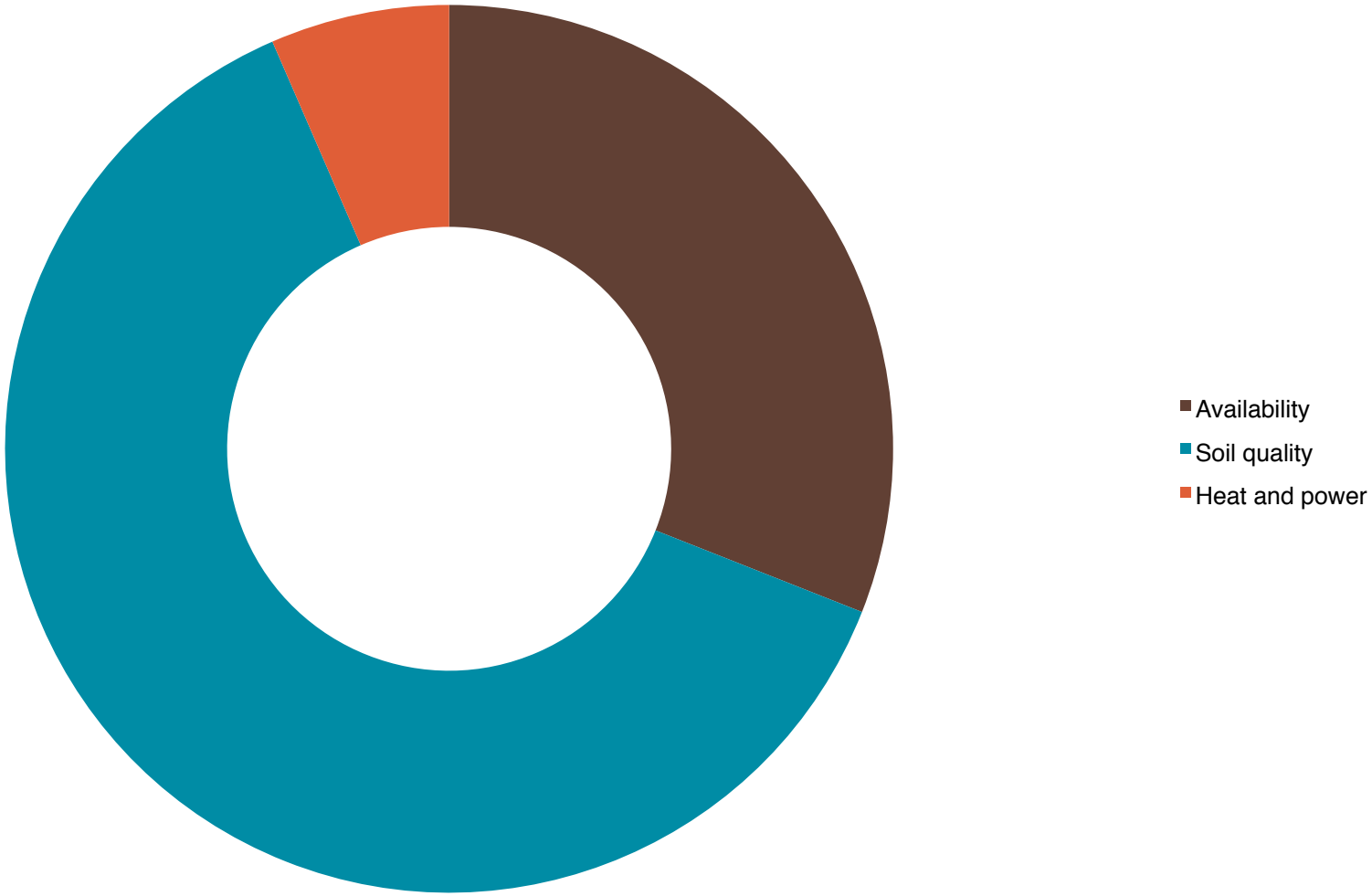
- About 24% of total above-ground tree is residues



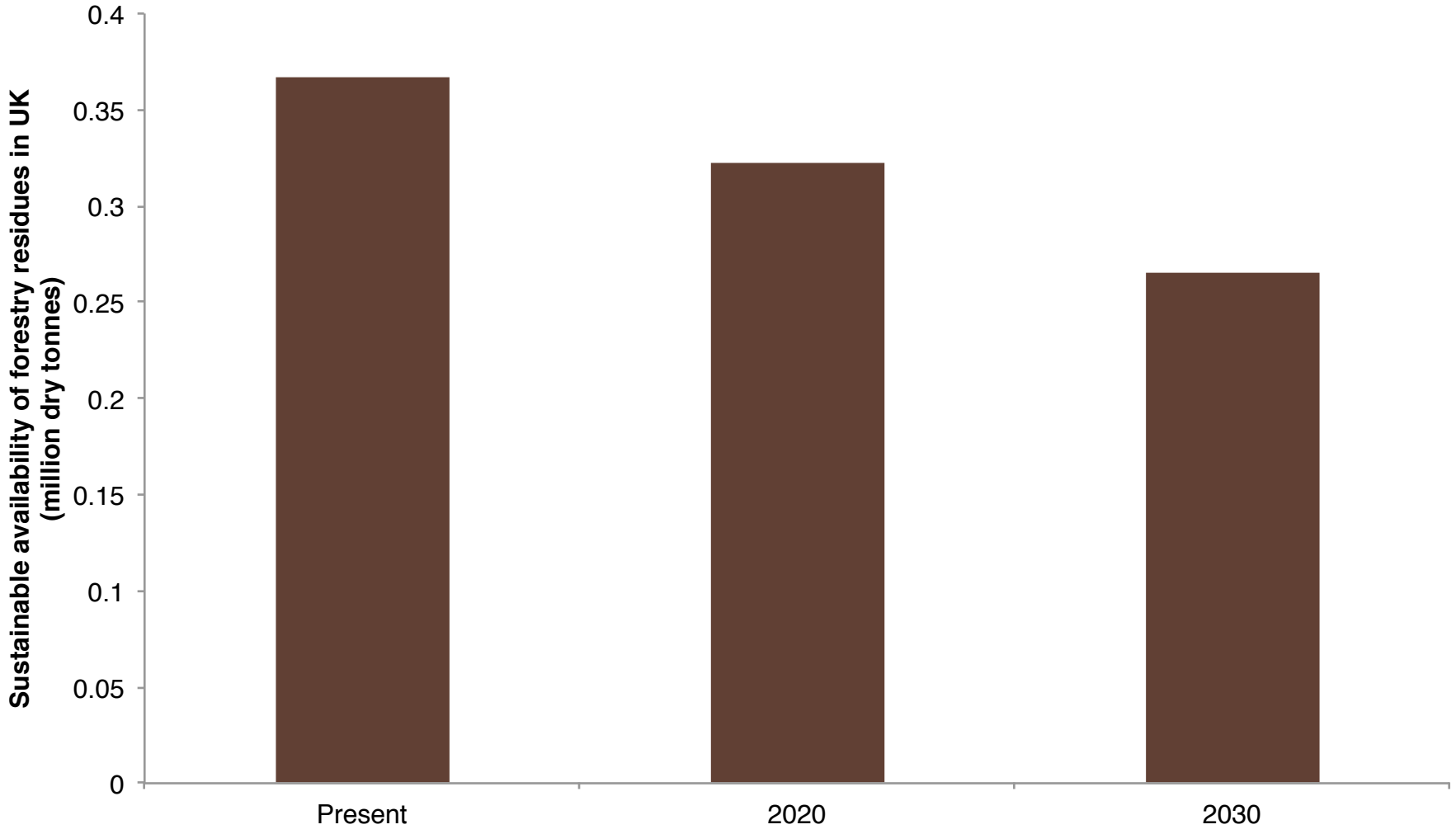
Forestry residues: Sustainability

- Removal of forestry residues negatively impacts soil nutrients, soil carbon, erosion, and biodiversity – for these reasons, not all residues should be removed
- In reality, the amount of residues that can be removed depends on local conditions (soil type, slope, etc.) and varies by location
- We estimate on average 38% of forestry residues can be removed in UK based on erosion rates and soil carbon concentrations
- Some residues are already collected and used for heat and power – may potentially be available
- Processing residues (sawdust, woodchips) included later under wood wastes

Availability of forestry residues in the UK



Sustainable availability will decrease as UK plans to use more forestry resource for heat and power

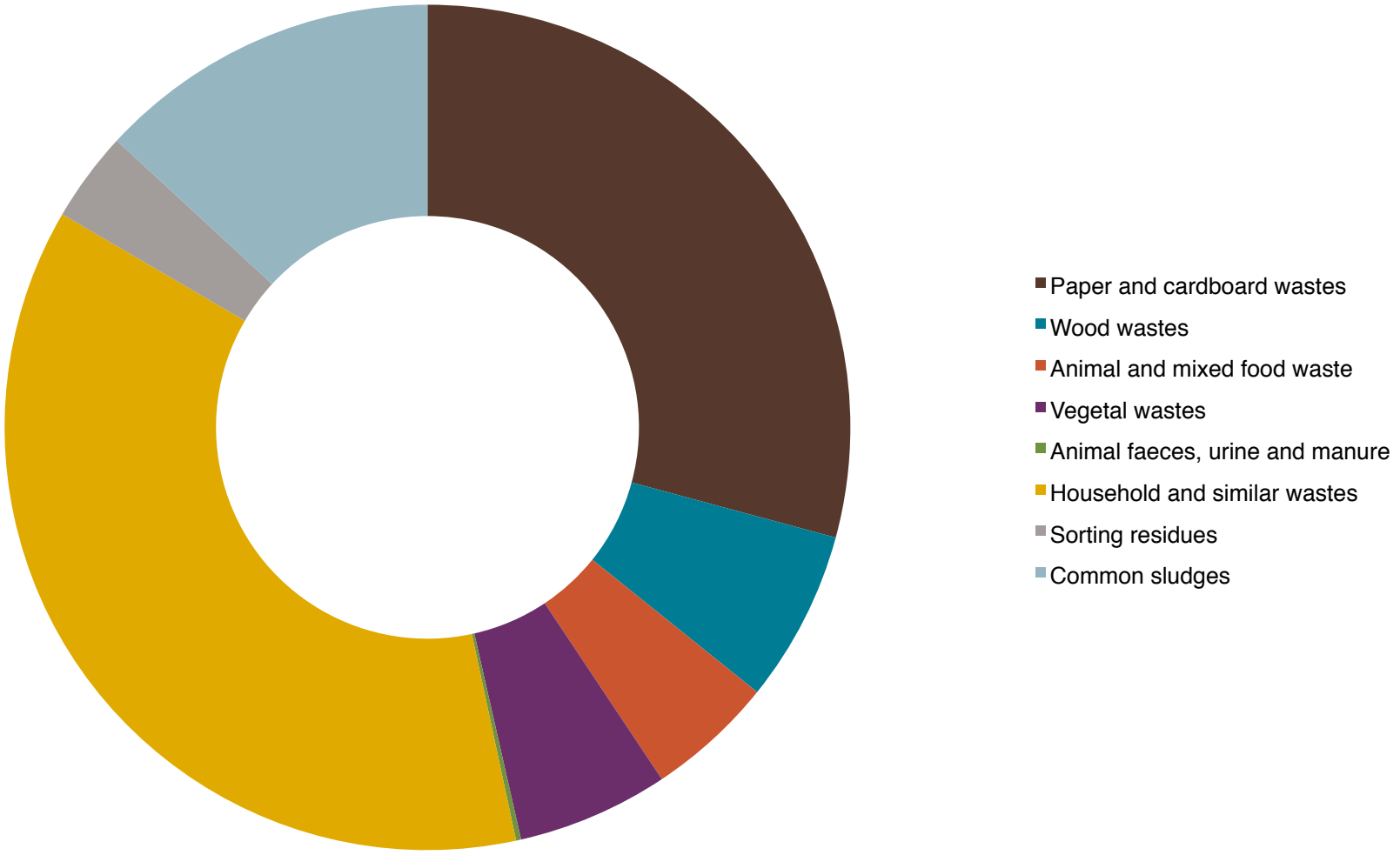


Cellulosic fraction of waste

Waste availability

- We consider all types of biomass-based waste produced in the UK
- Don’t include waste that is recycled, composted, or utilized for a useful purpose
- Waste that is landfilled or incinerated without energy recovery is available
- Waste that is incinerated with energy recovery may be considered potentially sustainable

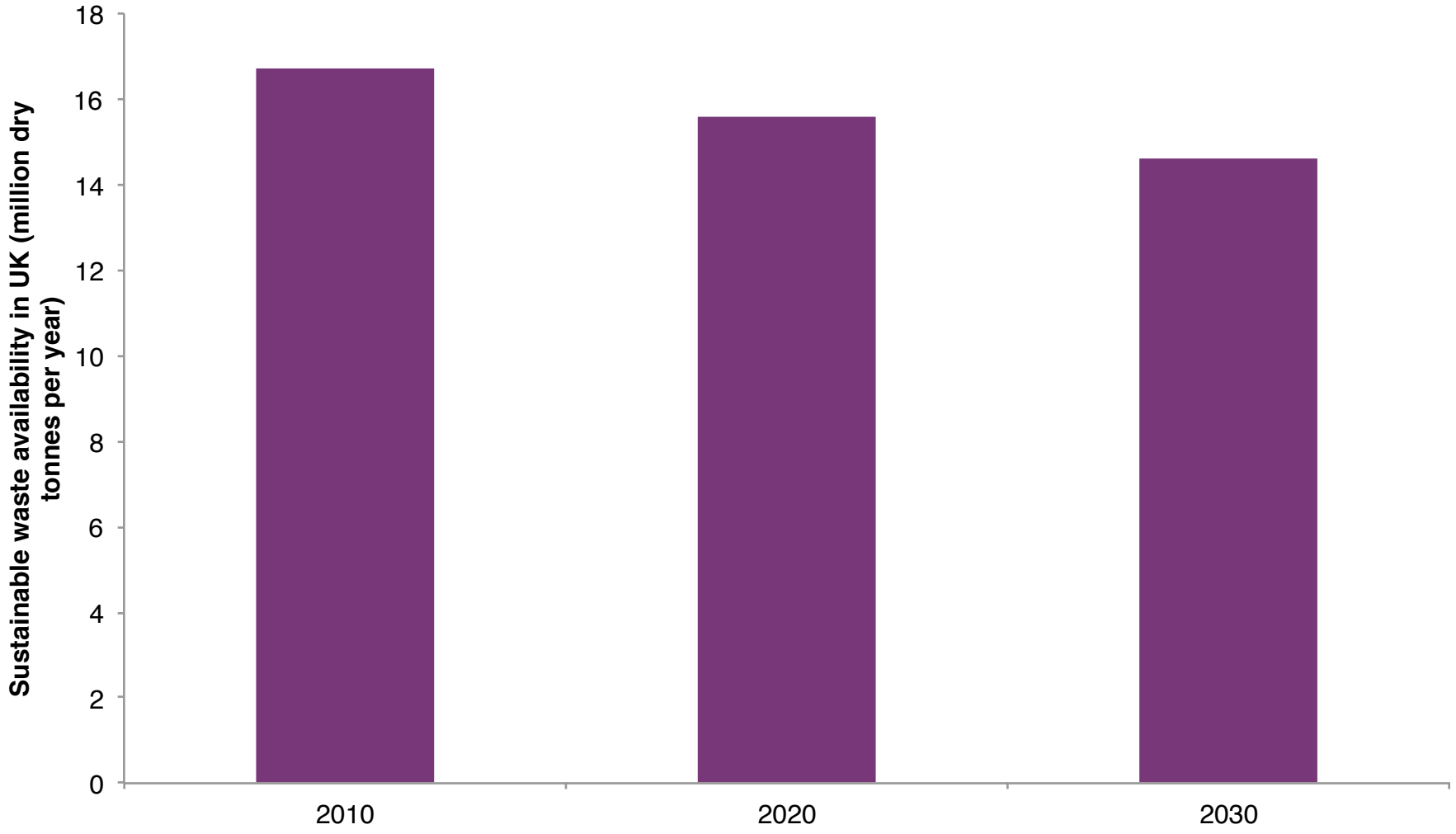
Types of biogenic waste produced in UK



Current end uses of waste in UK

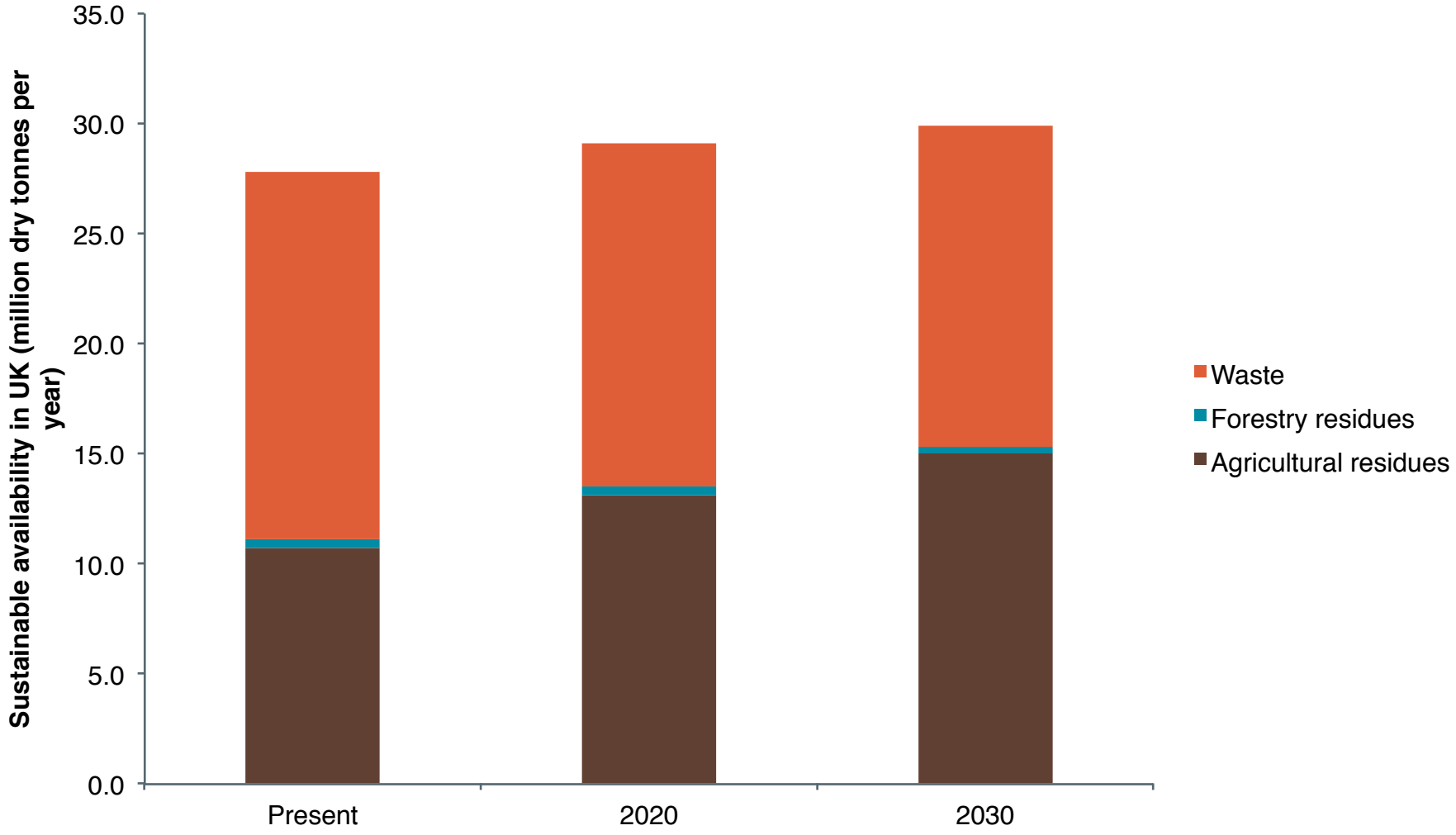
Waste that is currently landfilled or incinerated without energy recovery is sustainably available for biofuel

Sustainable waste availability in UK will decrease as recycling increases

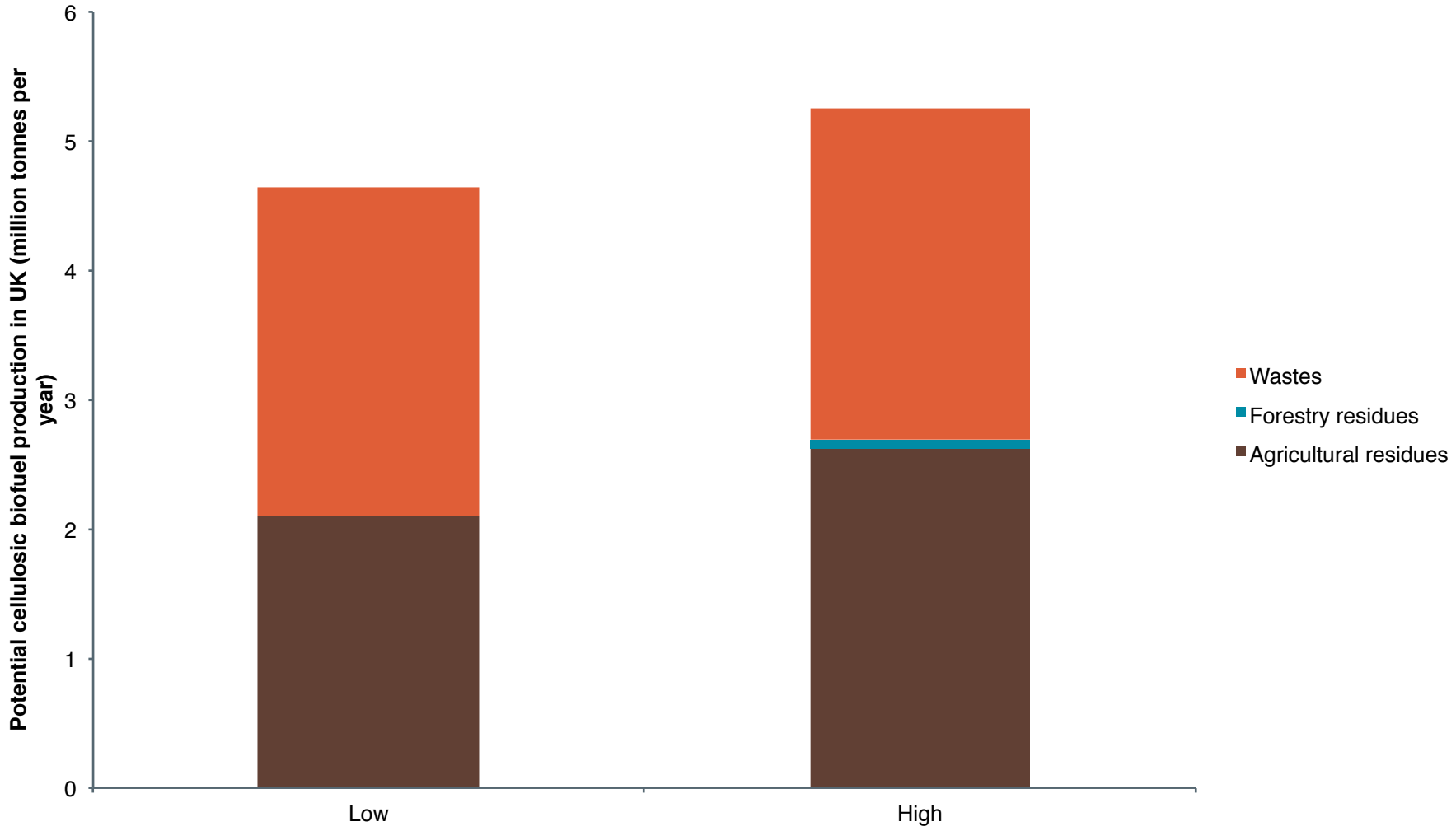


Economic opportunity

Total sustainable availability of wastes and residues in UK at present, in 2020, and in 2030



Potential volumes of cellulosic biofuel that could be produced in the UK with current resource availability

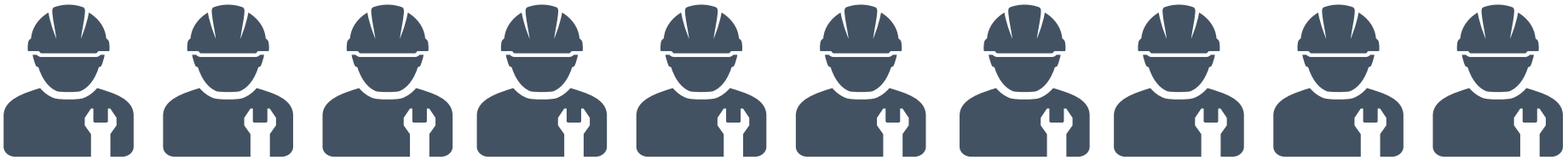


Employment opportunity across Europe

Agricultural residue collection up to 83,000 permanent jobs

Plant operations up to 13,000 permanent jobs

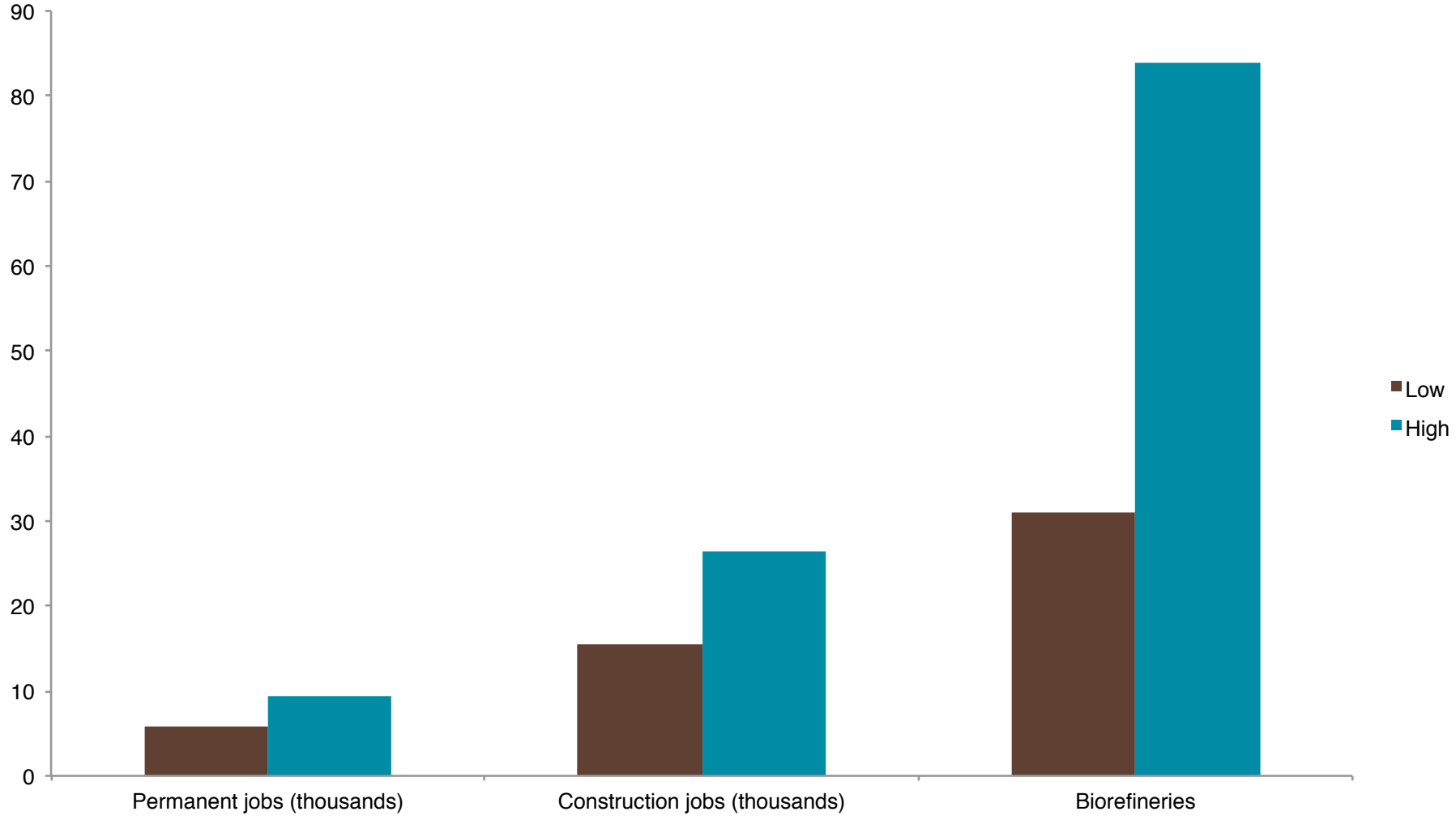
Forest residue collection up to 50,000 permanent jobs



Plant construction up to 162,000 temporary jobs

icct THE INTERNATIONAL COUNCIL ON Clean Transportation

UK biorefineries and jobs that could be supported on 100% utilization of available cellulosic resource



Conclusions

- There is a major resource in wastes and residues in Europe in general and in the UK in particular
- The UK has a particularly large waste resource
- Cellulosic biofuels from wastes and residues offer significant carbon reductions
- The cellulosic industry could be a source of economic growth and jobs

Thanks!

chris@theicct.org

stephanie@theicct.org