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Rural Economy and Land Use Programme

Energy Balances and Emissions for Farm Based AD

Dr. Andrew Salter

RELU Farm based AD
Final dissemination event 28th September 2010

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Outline

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- Energy balances
- Potential methane yields
- Greenhouse gas emissions
- The AD tool
- Some examples

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ENERGY BALANCES

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Energy balance

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- What is meant by an energy balance?
  = *Energy out - Energy in*

- Energy
  - Direct energy
  - Indirect energy
- Beneficial outputs
- System boundaries

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Positive or negative?

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- Need to identify what energy goes in
- What energy comes out

Three phases of fuel production

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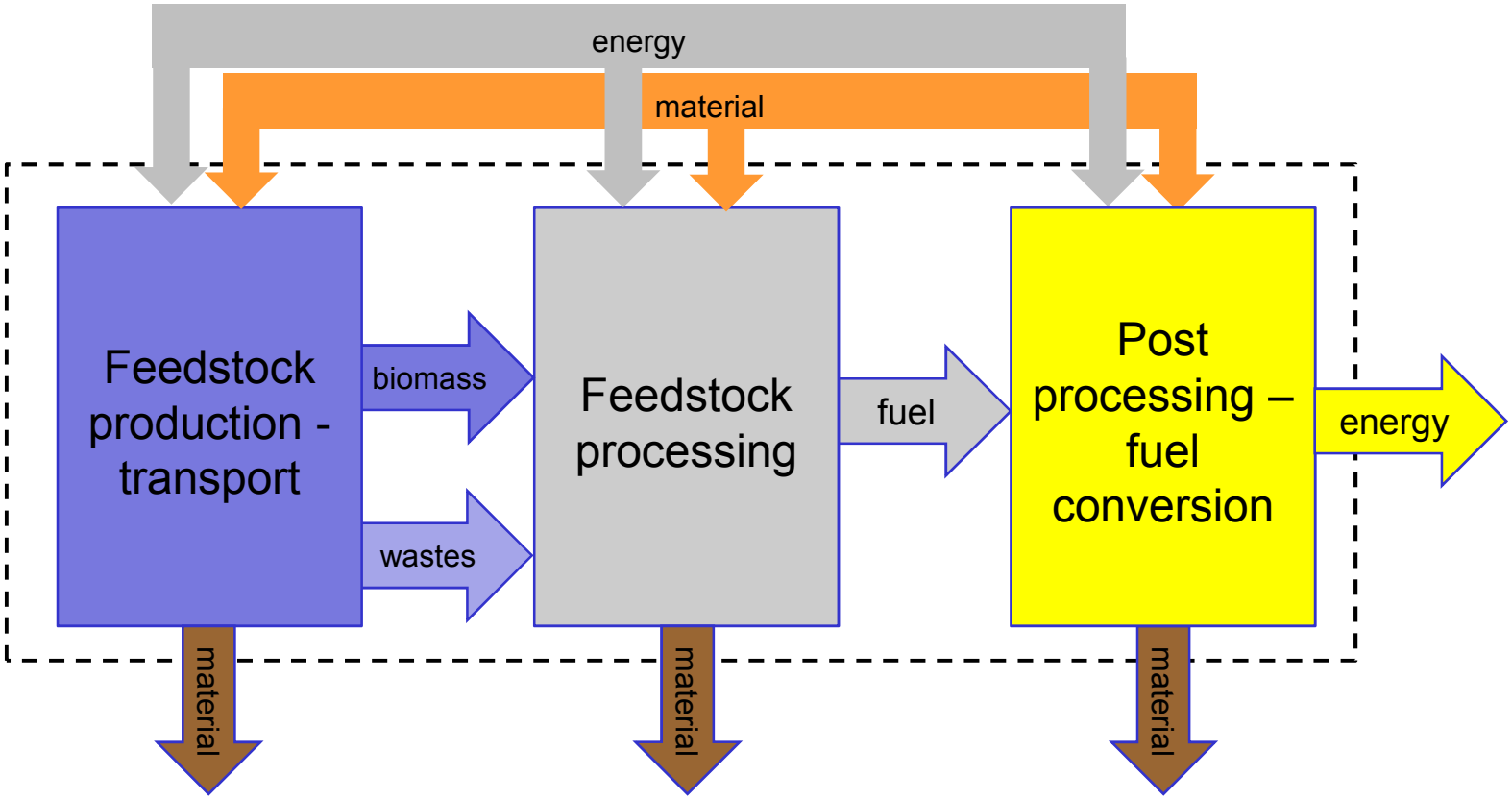

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An example system (AD)

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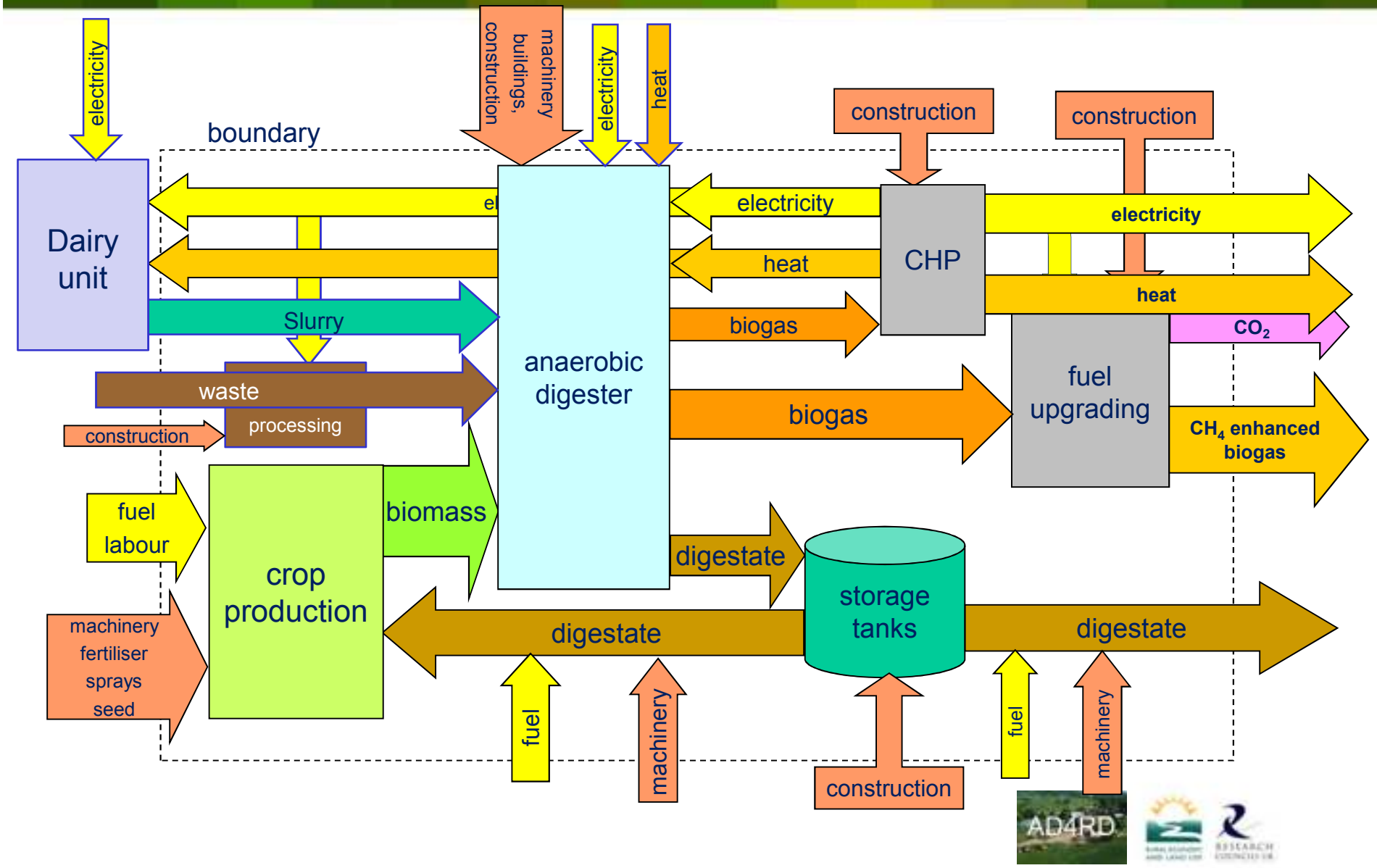

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METHANE POTENTIALS

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Potential crops for biogas -

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- Barley
- Cabbage
- Carrot
- Cauliflower
- Clover
- Elephant grass
- Flax
- Fodder beet
- Giant knotweed
- Hemp
- Horse bean
- Jerusalem artichoke
- Kale
- Lucerne
- Lupin
- Maize
- Marrow kale
- Meadow foxtail
- Miscanthus
- Mustard
- Nettle
- Oats
- Pea
- Potato
- Oilseed rape
- Reed canary grass
- Rhubarb
- Ryegrass
- Sorghum
- Sugar beet
- Triticale
- Turnip
- Verge cuttings
- Vetch
- Wheat

Methane yields

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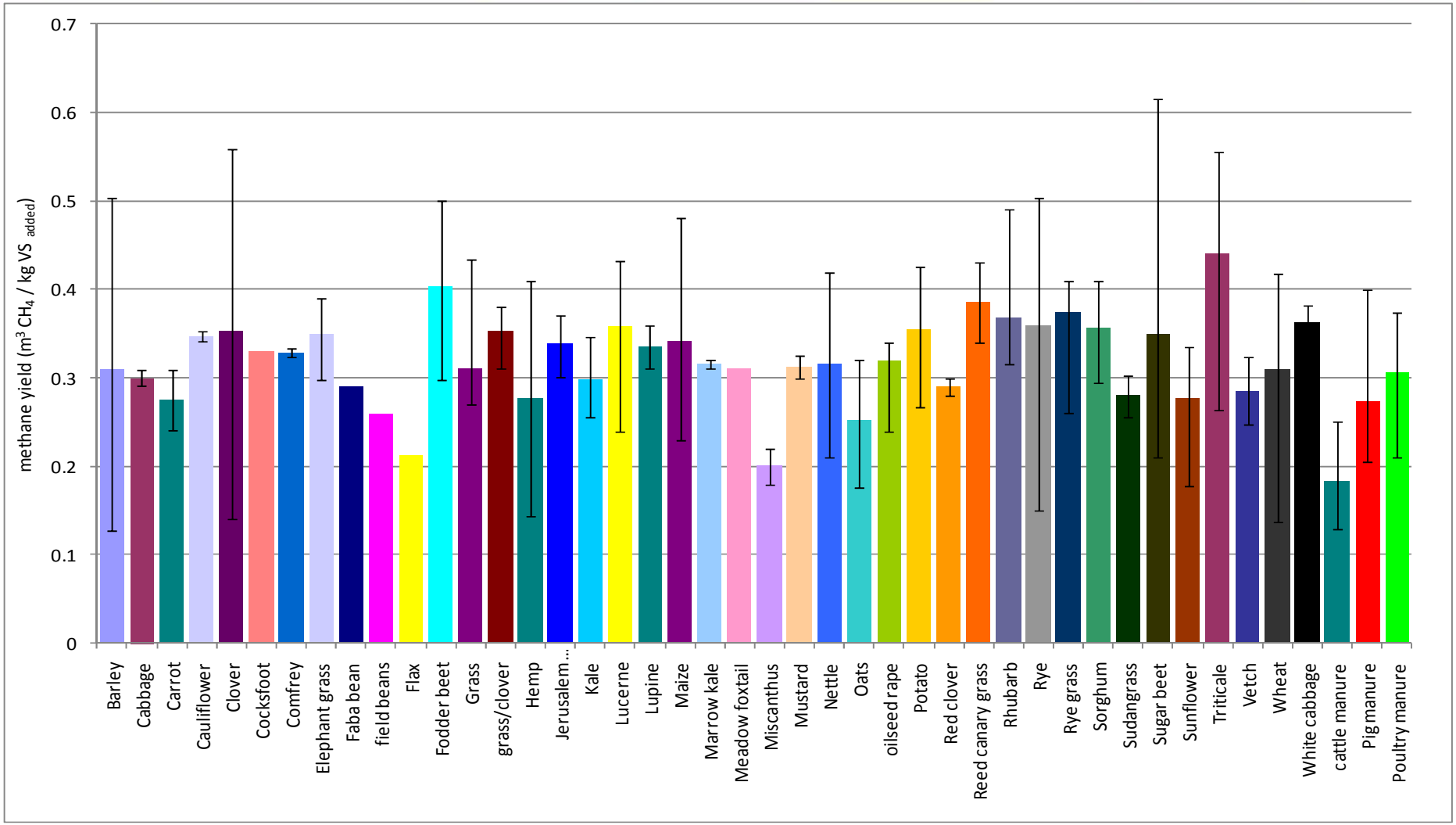

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Effect of harvest date

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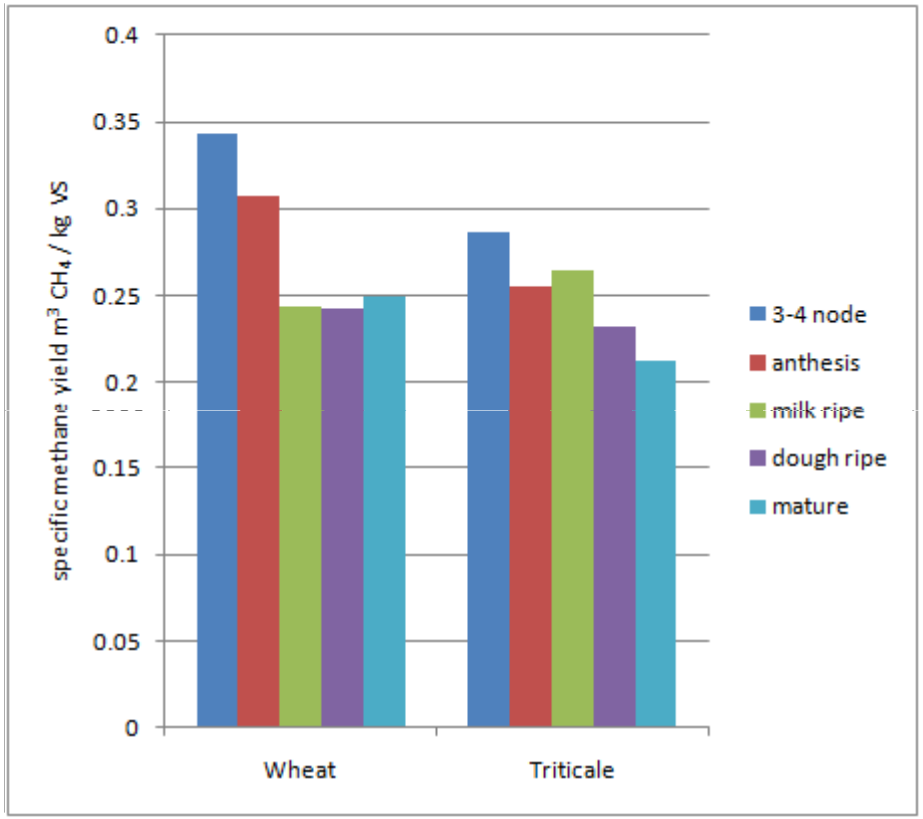

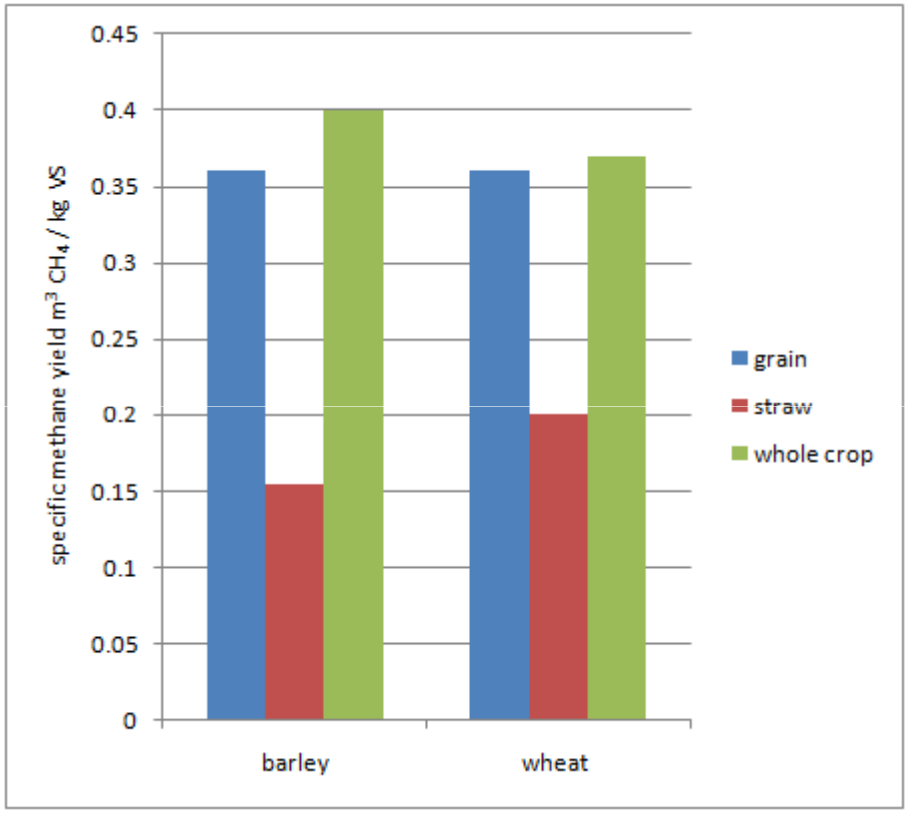

Amon, T., Amon, B., Kryvoruchko, V., Machmüller, A., Hopfner-sixt, K., Bodiroza, V., Hrbek, R., Friedel, J., Pötsch, E., Wagentristl, H., Schreiner, M. & Zollitsch, W. (2007) Methane production through anaerobic digestion of various energy crops grown in sustainable crop rotations. *Bioresource Technology, 98, 3204-3212.*

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GREENHOUSE GAS EMISSIONS

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Sources of GHGs

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- Arable farms
  - Mineral fertilisers
  - Diesel fuel use
- Dairy farms
  - Manure management
  - Mineral fertilisers
  - Diesel fuel use

Sources of emissions

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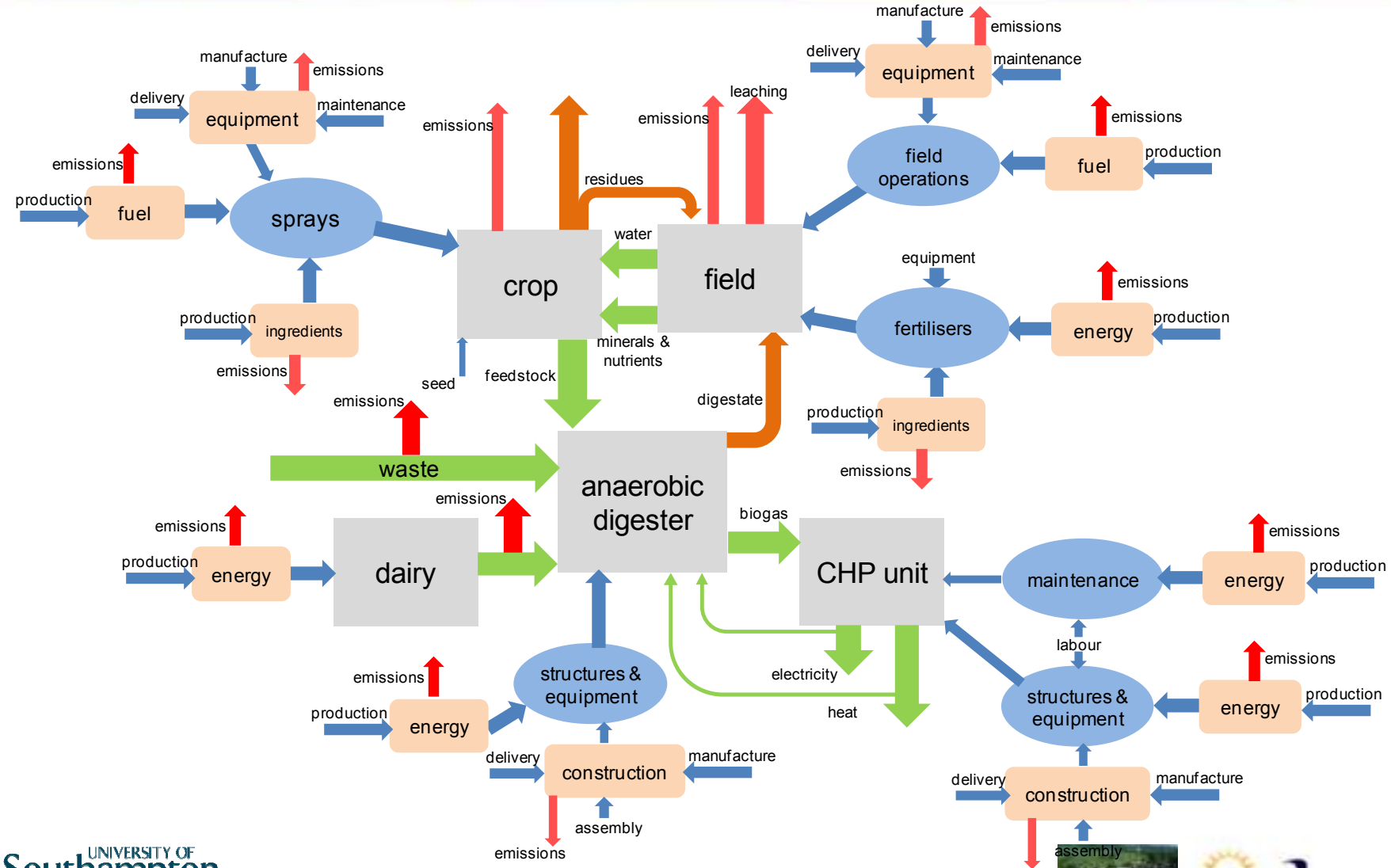

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THE AD TOOL

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EXAMPLE RESULTS

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Energy balance - dairy

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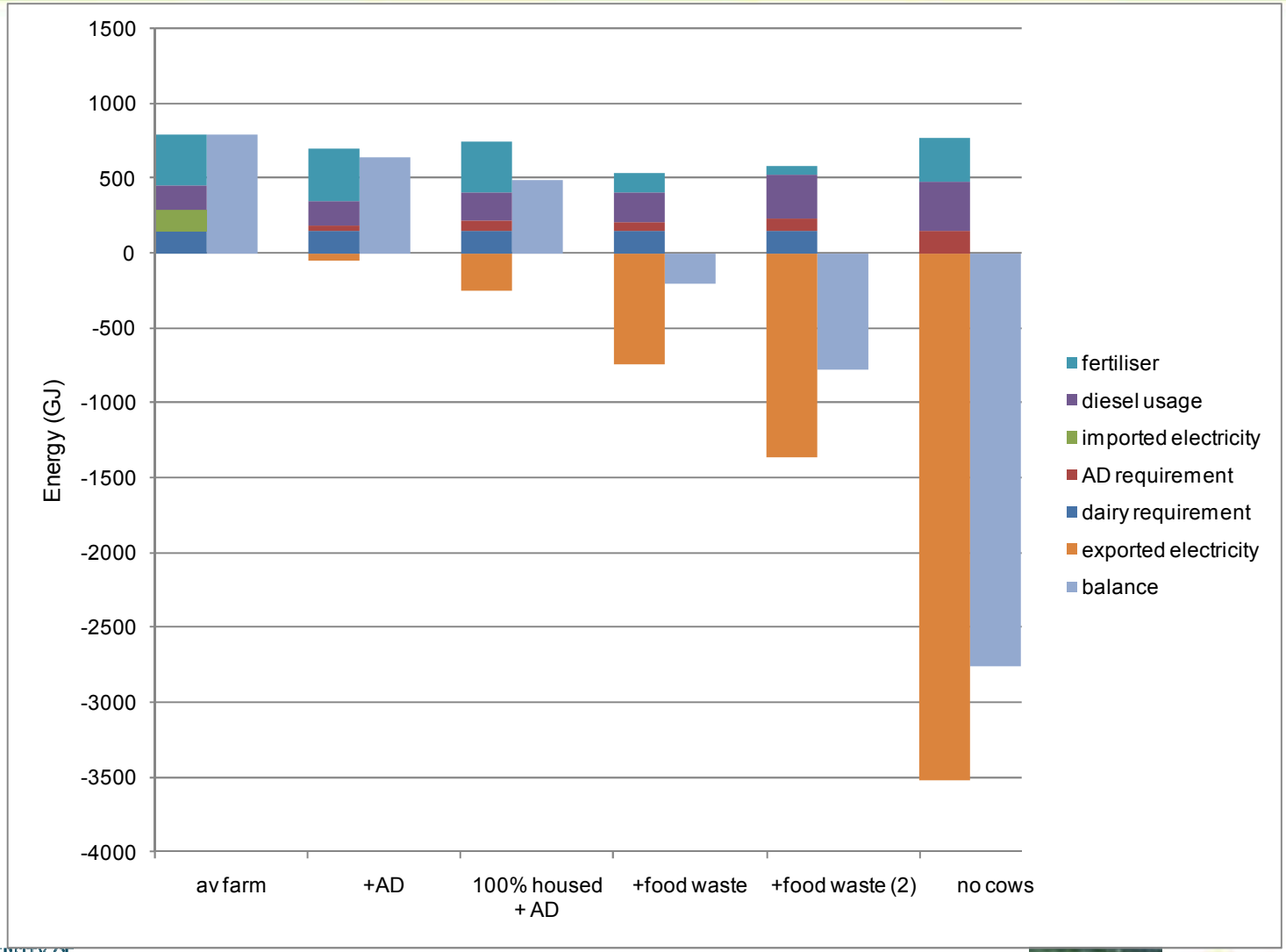

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GHG emissions - dairy

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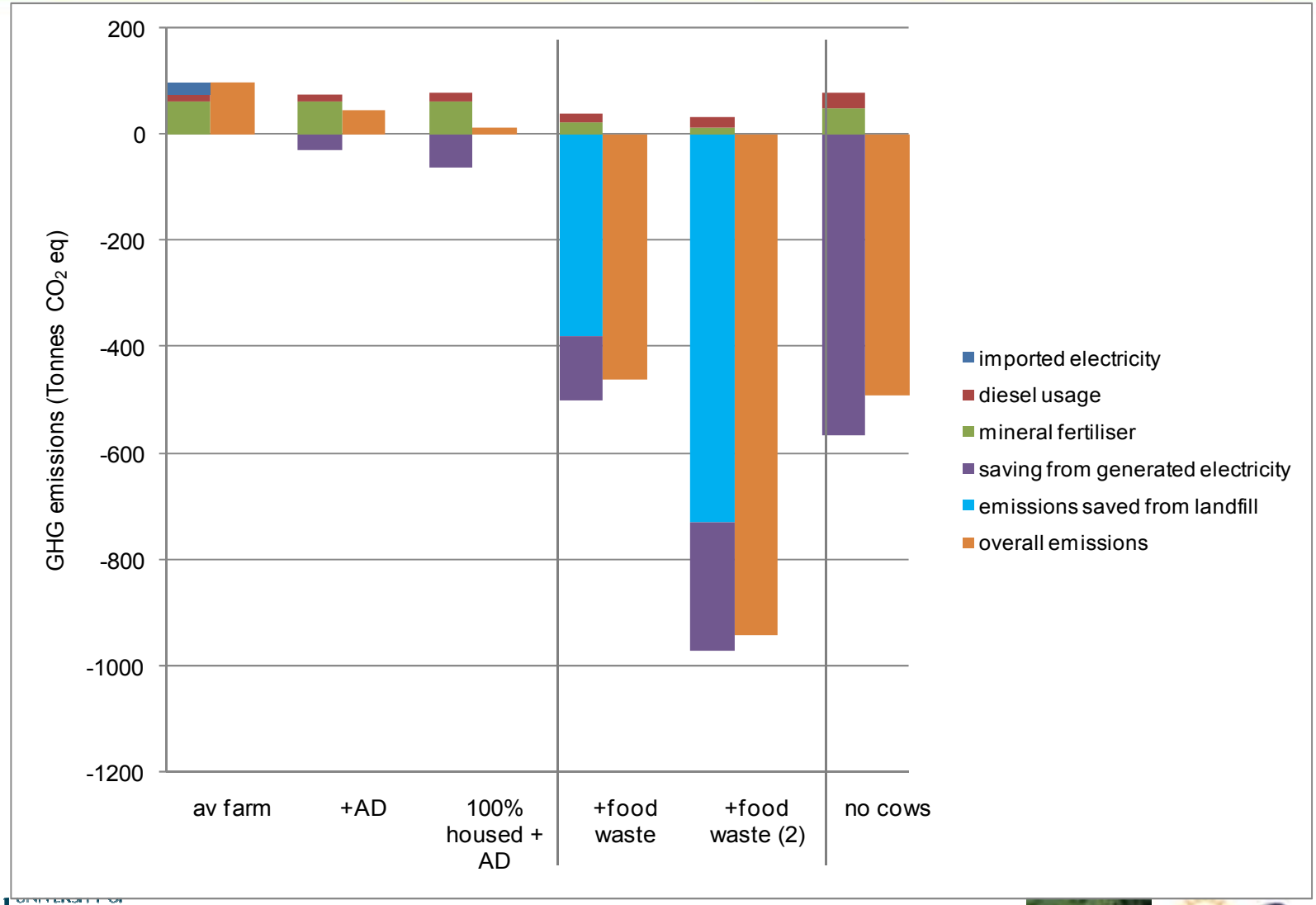

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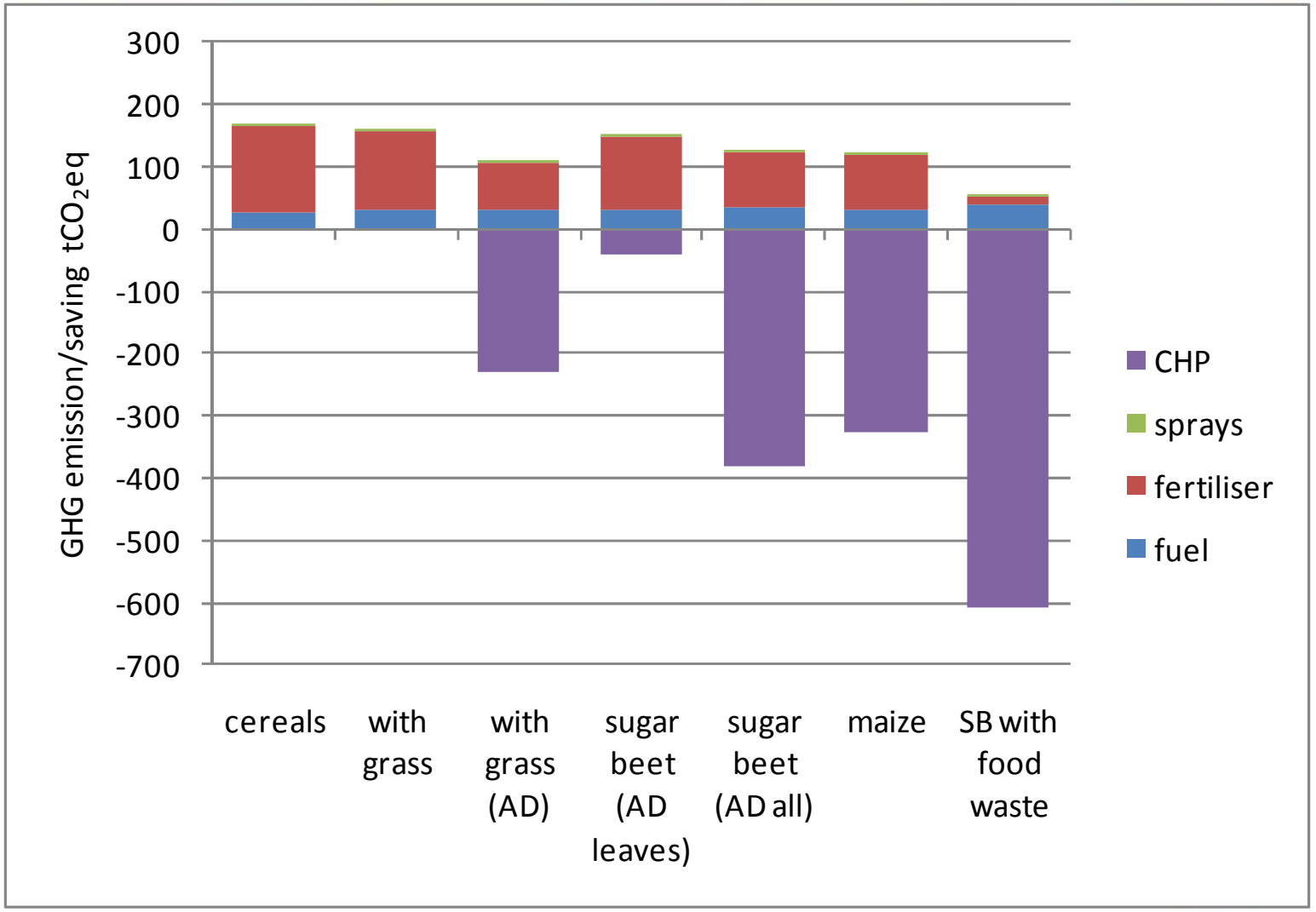
GHG emissions - arable



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Conclusion

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- Many different agricultural materials and residues can be digested
- Nutrient management on farms is vital and feedstocks can be adjusted to optimise digester efficiency and crop requirements
- Digestate can make a large contribution to mineral fertiliser replacement
- Biogas and digestate can be used to reduce energy requirements and greenhouse gas emissions

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Thank you

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