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SUstainable **P**ow**ER GEN**eration from **Bioenergy:** The **SUPERGEN** Bioenergy Hub

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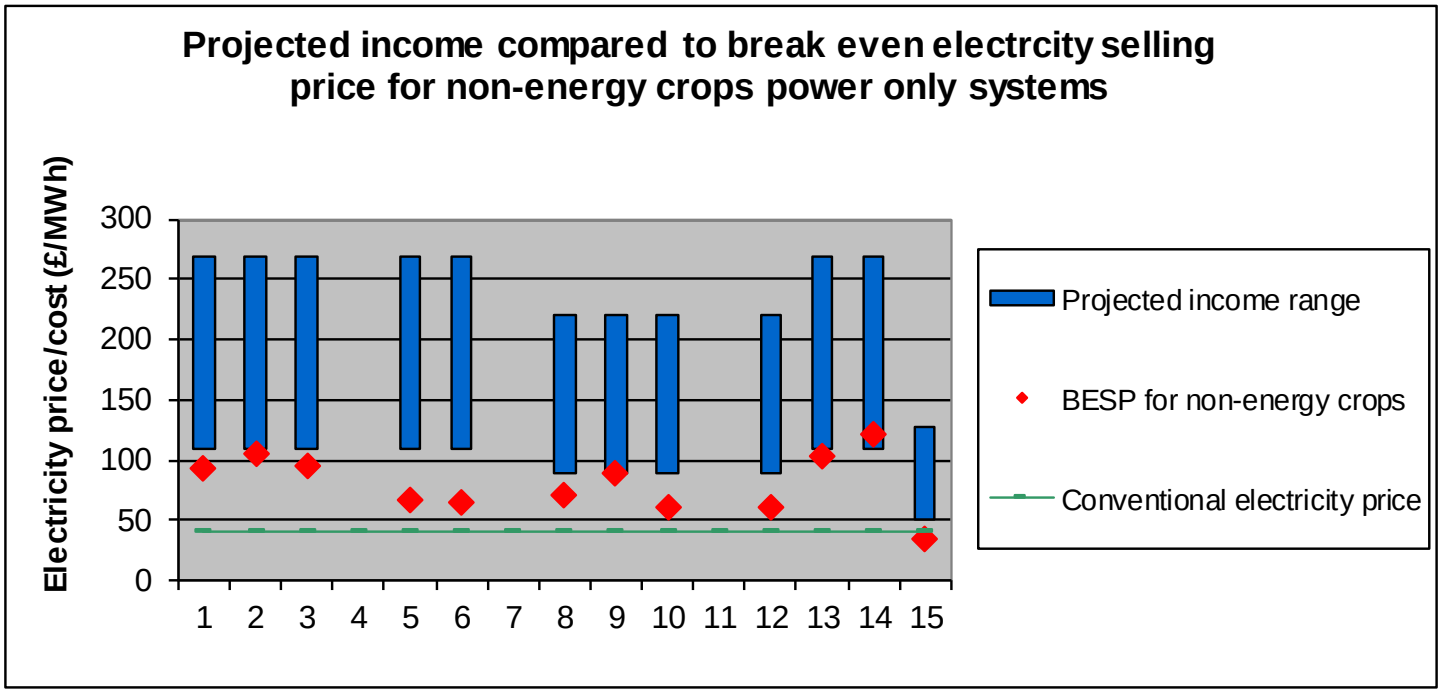
Large scale biomass co-firing is dominant in the UK's renewable electricity portfolio because it has made commercial sense for several years



Thornley et al., "Making bioelectricity economic in the UK", European Biomass Conference, Berlin, 2009

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Large scale biomass to electricity delivers cost effective carbon savings compared to other ways of using the same biomass resource

	Carbon emissions per unit of energy delivered (g CO2eq/MJ)	Carbon savings per unit of energy delivered (%)	Cost effectiveness of carbon savings (£/tCO2)
Ethanol	44	48	207
DH[1]	4	94(62)	25(40)
Med elec	11	93	62
Large elec	27	84	31

"Cost effective carbon reductions in the bioenergy sector", Thornley, P., Gilbert, P., BIOTEN Conference, 20-22 September 2010, Birmingham, U.K.

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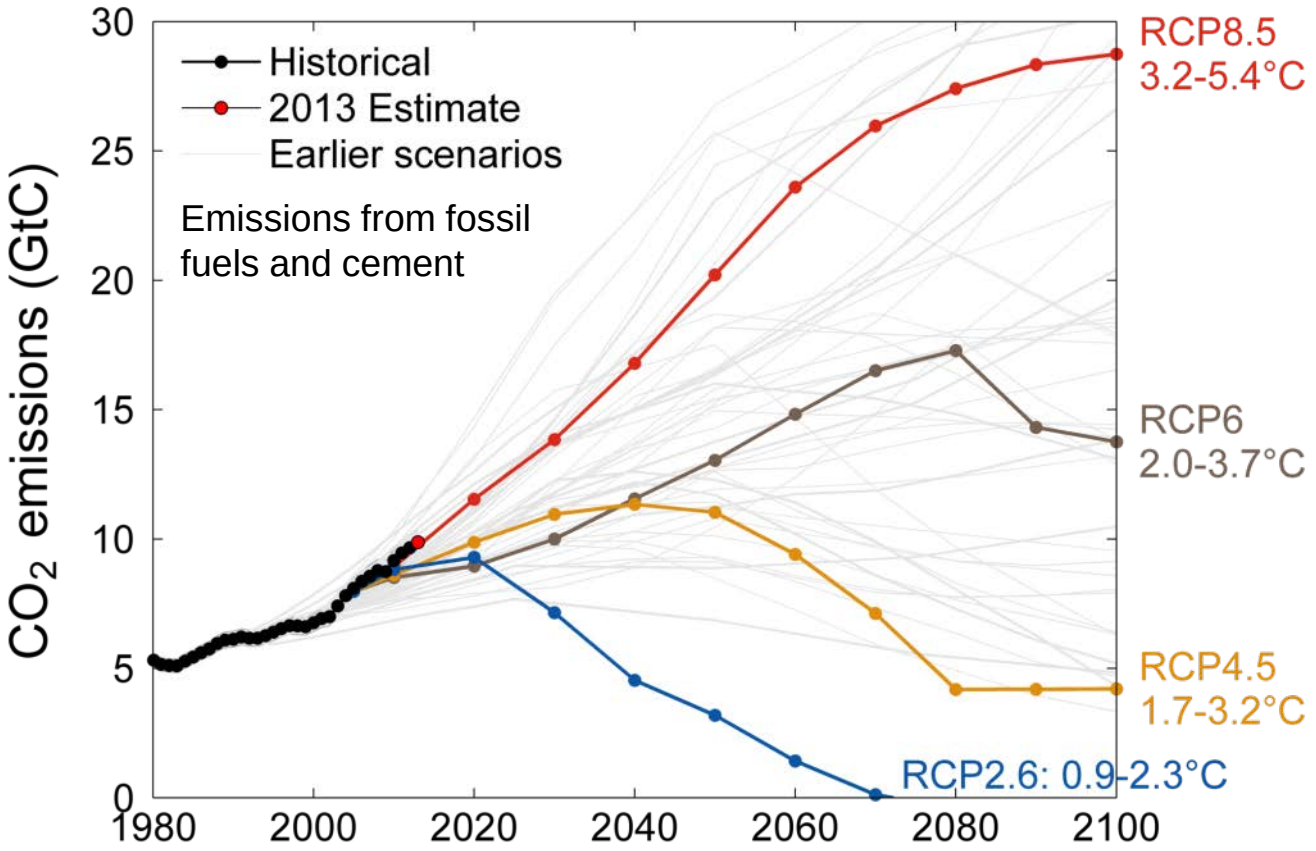
We need carbon savings

Large and sustained mitigation is required to keep below 2ºC



Source: Peters et al. 2012a; CDIAC Data; Global Carbon Project 2013

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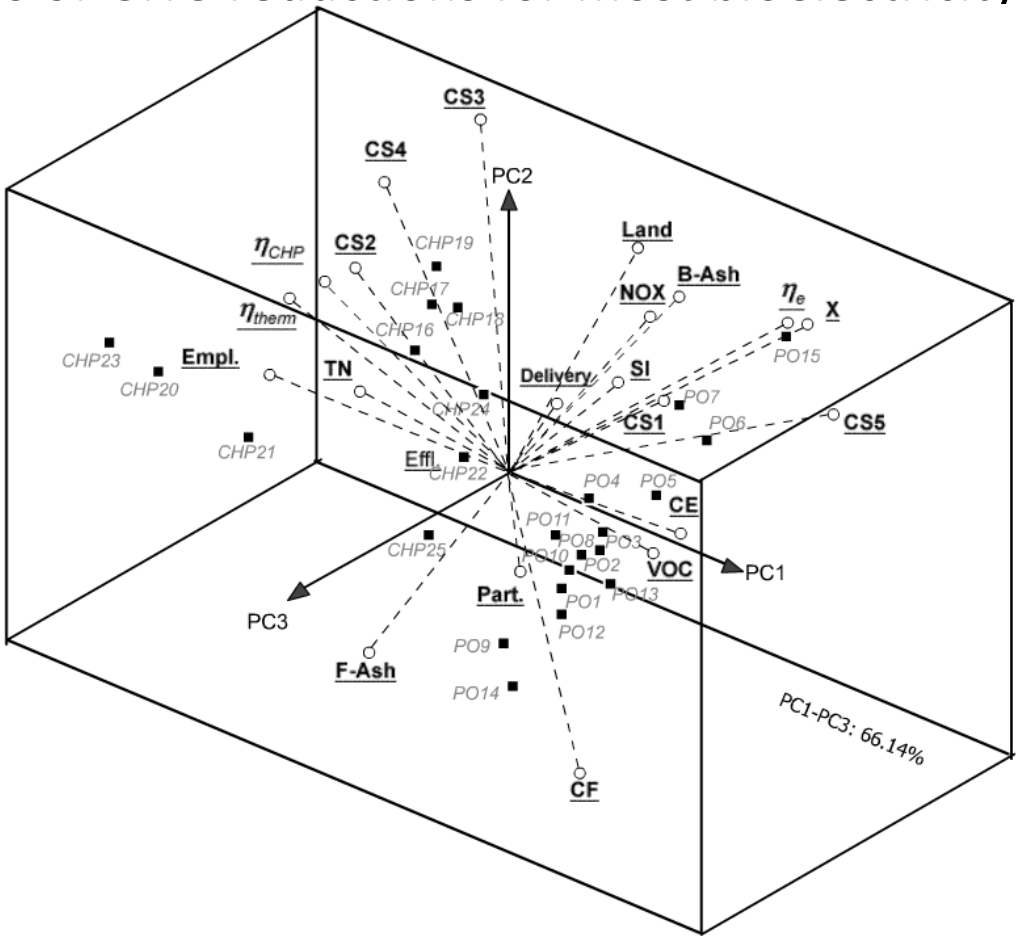
High efficiencies for power generation plants **do not correlate** with high levels of GHG reductions for most bioelectricity systems



"Integrated assessment of bioelectricity technology options", Thornley et al., Energy Policy, 2009 and *http://www.sciencedirect.com/science/article/pii/S0301421508005740*

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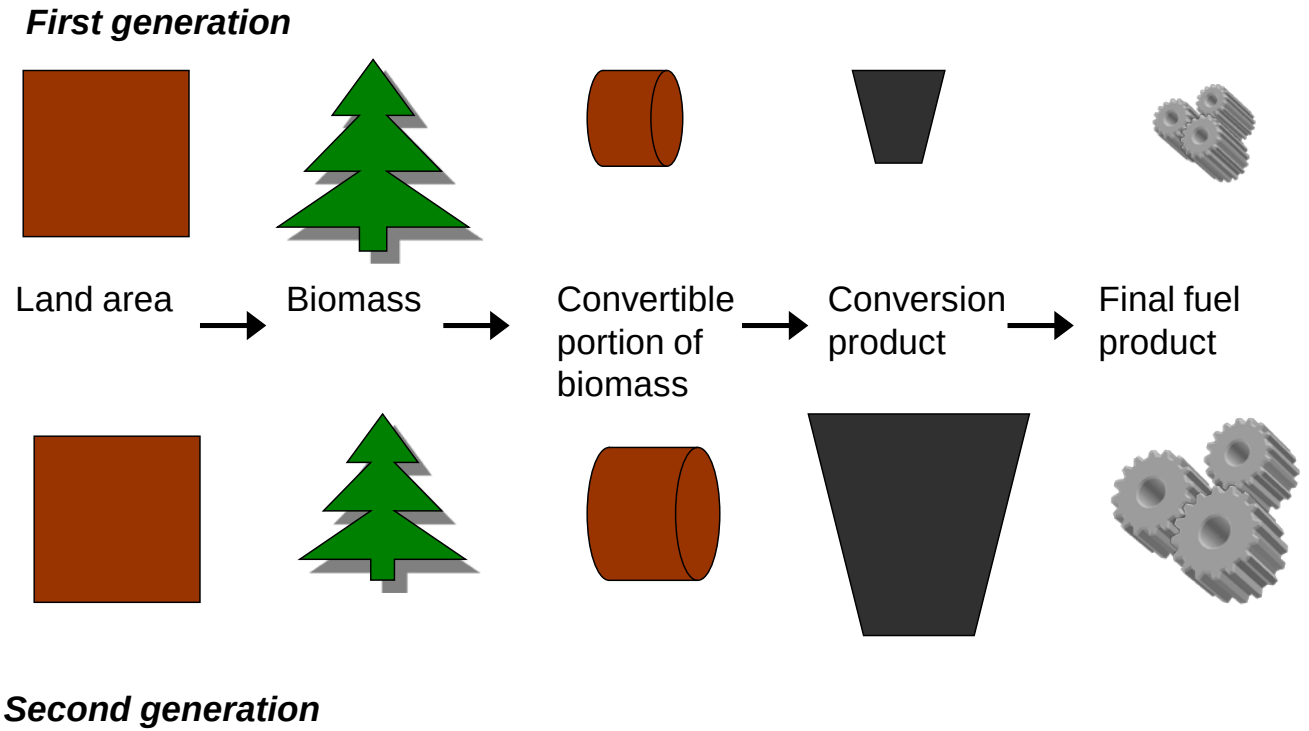
However, **resource efficiency** along the whole length of the bioenergy chain is important



Thornley, P., "Biofuels Review", Report for Government Office for Science, prepared as part of the Foresight Programme, June 2012

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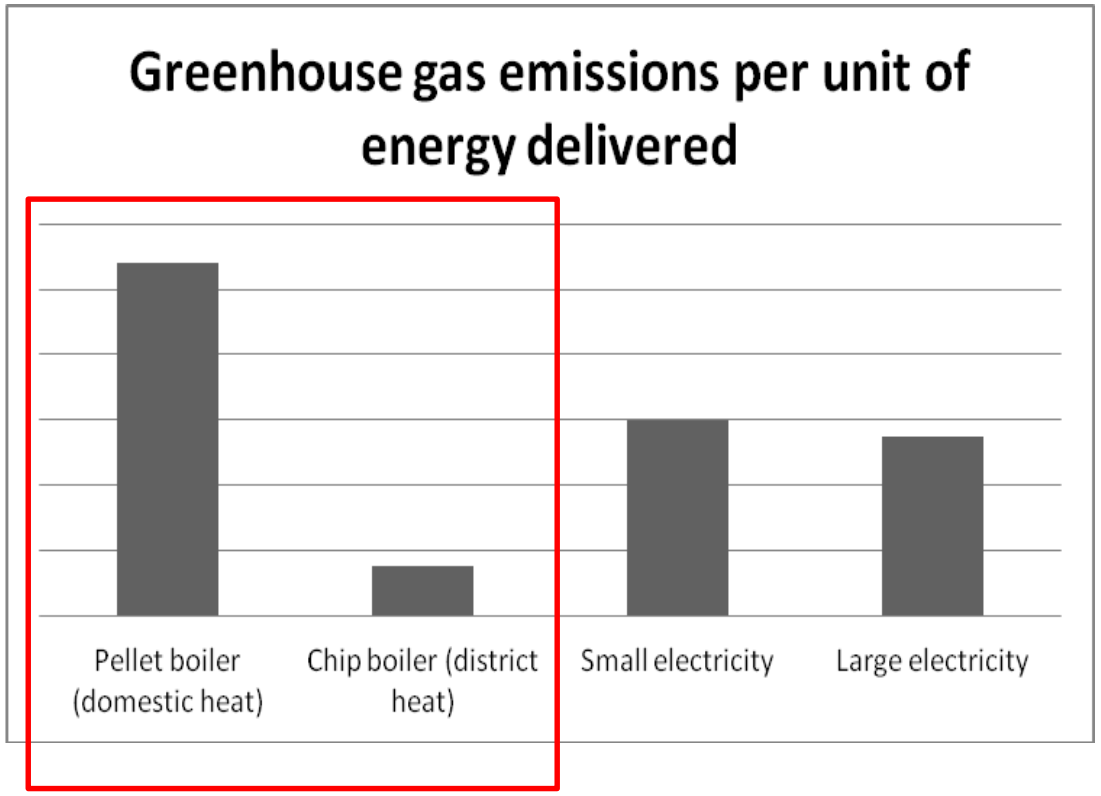
In trying to obtain carbon savings it is important to avoid generating new sources of emissions



"Identifying the best use of biomass resources", Thornley et al., European Biomass Conference, 2013

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When we look at the supply chain we see different factors are important for different chains

	Embodied emissions associated with agrochemical inputs	Land emissions	Role of co-products	Carbon stocks	Land-use change emissions	Indirect land-use change emissions	Accessible yield of crop
Annual crops	++	++	++	-	+	+	++
Perennial crops	-	-	-	+	++	++	-
Forestry systems	-	-	+	++	-	-	-
Waste and residue systems	-	++	++	++	-	-	-

(+ = relevant factor, ++ = can be a key determining factor, -= usually not a dominant factor)

SUPERGEN Bioenergy Hub, "Understanding greenhouse gas balances of bioenergy systems", 2013

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Understanding Greenhouse Gas Balances of Bioenergy Systems

- Greenhouse gas savings per unit of product produced are very high for electricity systems e.g. 80-90% reductions are possible.
- It is important to be clear on GHG objectives e.g. Imported feedstocks do not enhance sequestration reported by the UK under the IPCC framework
- There are significant uncertainties, which need to be managed e.g. How the bioenergy system interfaces, with other sectors.
- If a “supply chain” accounting approach is adopted bio-CCS could be a key element of meeting 2050 GHG reduction targets

SUPERGEN Bioenergy Hub, “Understanding greenhouse gas balances of bioenergy systems”, 2013

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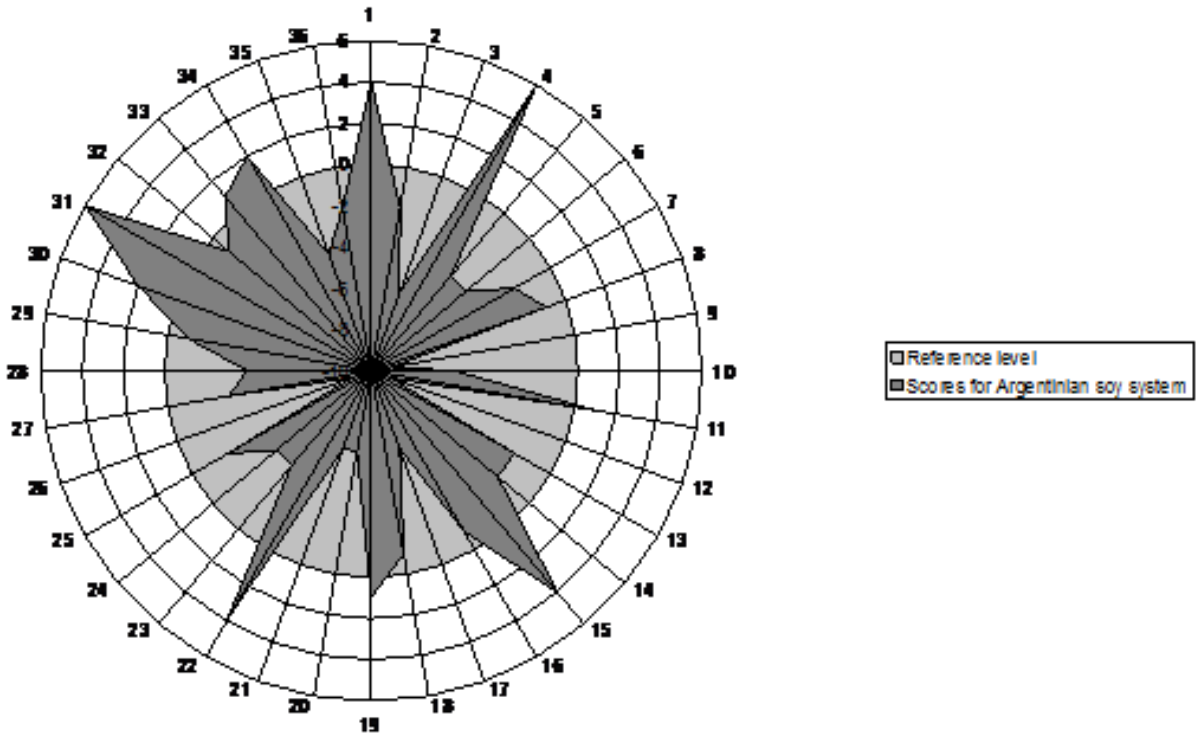
Beyond carbon

Radar diagram showing overall sustainability assessment of biodiesel from Argentinean soy compared to mineral diesel



Thornley & Gilbert, “Biofuels: Balancing risks and rewards”, Interface Focus, 2013

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Hub projects relevant to advanced power generation

1. Emissions from solid biomass
2. **Impact of feedstock parameters on airborne emissions**
3. Evaluation of substitute natural gas
4. **Streamlining the supply chain**
5. **Carbon uncertainties in the supply chain**
6. **Gasification integration**
7. **Torrefaction integrated assessment**
8. **Carbon capture & storage enabling technologies**
9. Bio-oil upgrading
10. Whole systems analysis of novel biofuel technologies

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Research and knowledge transfer opportunities

1. **Forthcoming hub funding for small projects and collaboration between academia and industry**
   - **Sign up on our website to receive notification**

2. **EPSRC Challenge Call in 2014 to address grand challenges in bioenergy**
   - **Workshop to help identify the challenges and form consortia drawn from academia and industry to address them**
   - **http://www.epsrc.ac.uk/funding/calls/2014/Pages/bioenergychallenge.aspx**

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Hub Objectives

- Act as a **focal point** for sharing and dissemination of scientific knowledge and engineering understanding to **facilitate near-term deployment** of technologies
- Investigate and develop **new approaches** for dealing with the very significant engineering challenges associated with deployment of more novel technologies
- Improve scientific understanding of the **fundamental aspects** of different forms of biomass and its conversion
- Take **a whole-systems perspective** to comprehensively evaluate the potential of future technology options
- Adopt an **interdisciplinary approach** to look beyond the engineering and technical aspects of bioenergy and ensure adequate consideration of the impacts on ecosystems, social responses to technology deployment and the economic context of policy development

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Hub Aim

– Increasing the contribution of UK bioenergy to meet strategic environmental and energy security targets in a coherent, sustainable and cost-effective manner.

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Further information

www.supergen-bioenergy.net

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