

FREQUENTLY ASKED QUESTIONS

1 Who can apply for funding and what is the contractual framework you propose?

To find out who can apply and get more information about our proposed contractual framework, please refer to the *ABC Commercial Framework and Contract Guidelines*, which can be downloaded from the same webpage as these FAQs (www.carbontrust.co.uk/technology/directedresearch/algae.htm).

2 Why do you say that the Phase 2 test and demonstration plant is likely to be sited overseas?

It is likely to be difficult to economically justify building a dedicated algae biofuel feedstock production facility in regions, such as the UK, where seasonal climatic factors related to insolation (available solar energy) and temperature will negatively affect annual oil yields. As a result, the principal market to realise value from UK innovation is likely to be overseas.

At this stage, no decision has been made as to where the Phase 2 test and demonstration plant will be sited. However, the Carbon Trust will be consulting in the coming year to determine a suitable site, based on a set of stringent selection criteria, which will include sustainability criteria associated with environmental, ecological, and societal impacts (e.g. land use change, water use, effects on biodiversity, and carbon savings). If the outputs from Phase 1 indicate that the UK could be an economically attractive location for producing algal biofuels, then a UK site would be considered.

3 What is the Carbon Trust's position on photobioreactors?

The Carbon Trust has decided to focus on the large scale production of algal biofuels in open ponds rather than in photobioreactors, as the final process step.

This decision was based on a thorough assessment of both technologies over several months. In December 2007, The Carbon Trust identified microalgal biofuels as a potentially significant R&D opportunity for the UK and then spent much of 2008, reviewing the state-of-the-art, consulting with algal experts, and attending conferences in order to try and understand what could realistically be achieved by the different types of cultivation systems. The Carbon Trust has yet to find substantiated evidence that photobioreactor technology can produce algal biofuels at the low costs and GHG emissions that will be needed in order to make them competitive with conventional fuels and other biofuels.

Open pond technology is mature and is used for the majority of commercial microalgae applications that require high volume outputs. In comparison to photobioreactor technology, it requires fewer inputs, and consequently has lower costs and GHG emissions, associated with it.



Whilst the Carbon Trust does not anticipate photobioreactors will be a low cost, low GHG emission algal biofuel production system in the near term, it is anticipated that photobioreactor technology will be very important in Phase 1, for carrying out fundamental R&D, and in Phase 2 for growing starter cultures (algal inoculum) for open pond production.

Although the Carbon Trust has made efforts to find out the real costs and GHG emissions associated with algal biofuel production in photobioreactors, there may be organisations developing photobioreactor technology who believe that they can meet the goals of low GHG emissions and low costs. If you can provide independently verifiable empirical evidence to this effect, you can apply for Applied Research funding from the Carbon Trust. Up to £500,000 funding is available through the Applied Research programme. More information about the Applied Research scheme can be found online at: www.carbontrust.co.uk/technology/appliedresearch.

4 Won't R&D topic 1 have to be done before the other R&D topics?

There is a great deal of complementarity between the R&D topics and therefore the different research groups will need to work closely with one another. For example, the inputs to the modelling that will be carried out in R&D topic 5 will depend heavily on the research outputs from the other topics. However, for logistical reasons, the call for applications for all topics was launched at the same time. Therefore, you are invited to put forward your expressions of interest, outlining how you will approach the R&D topic you are applying for, and where you will be expecting input from other R&D topics. The intention is that all researchers working on Phase 1 of the ABC will work together in a collaborative and constructive way, so that all teams have all the information they need to carry out their research efficiently.

5 In topic 1, do you mean that you intend for strains to be transported abroad?

No. It is not the Carbon Trust's intention that strains developed in the UK will be transported abroad and introduced into new habitats during Phase 1. However, one favourable route that researchers may take in topic 1 is to collect algae from environments where a commercial pond may be likely to be situated, and take those strains back to laboratories in the UK. It is expected that researchers will then develop tools for identifying the optimal algal strains (for example, those that produce a reasonable amount of oil) and techniques for optimising growth in mass culture. The Carbon Trust will endeavour to give researchers the earliest possible insight into likely locations for Phase 2 to assist with this process.

A potential output of topic 1 is therefore not an algal strain to be transported back to its original location and grown at scale in a pond, but instead an understanding of which algae strains from the original location are most suitable to achieve the objectives of the ABC. The intention is that the know-how and associated processes and tools will be transferable to different global locations and will therefore have commercially exploitable value.



6 Will you be supporting R&D the development of genetically modified organisms?

No. The Carbon Trust will not be supporting R&D to develop genetically modified organisms (GMOS, as defined by regulatory bodies) during Phase 1. Current legislation and treaties in place for GMOS within the European Union and elsewhere present a significant barrier to commercial deployment of GM algae. Therefore, at this early stage, the focus of any R&D effort should be on collecting, isolating and screening strains that already exist and understanding the conditions needed to optimise the growth of algae with high oil yields and high productivity, in an open pond.

However, if you believe that the development of GMOs would confer advantages that would enable you to more effectively achieve the objectives of the research proposed in your application, and would like to make us aware of these advantages, please highlight them in your application form. You should also highlight any associated legislative implications.

7 Why are you specifically focusing on microalgae?

The Algae Biofuels Challenge is focused on the production of oil from microalgae, as microalgae produce substantially more oil than macroalgae.

However, if you have a macroalgae project that you believe will reduce greenhouse gas emissions, you may be eligible for up to £500,000 of funding via the Carbon Trust's Applied Research scheme. More information about this scheme can be found online at: www.carbontrust.co.uk/technology/appliedresearch.

8 Why are you focusing on the production of algal oil rather than other fuels?

The focus of the Carbon Trust's Directed Research Advanced Bioenergy Accelerator (of which the ABC is a part) is the production of next generation liquid transport biofuels. The main reason for the focus on the production of algal oil is that the technology for converting algal oil to biodiesel is already well known and understood and also relatively simple and cheap.

Technologies for converting wet algal biomass to liquid transport are instead not currently available, thereby adding further technology risk. However, these alternative fuel routes do hold potential. For example, the wet algal biomass itself could be hydrothermally upgraded to a diesel product. Whilst this could be an attractive route, the hydrothermal upgrading part of this process is not commercial and has technology risk associated with it, unlike the trans-esterification process in which biodiesel is produced.

Through the Pyrolysis Challenge the Carbon Trust is already funding a thermal upgrading route which could potentially use algal biomass as a feedstock. Any future synergies between these two challenges would therefore be welcome. For more information about the Pyrolysis Challenge visit:

www.carbontrust.co.uk/technology/directedresearch/pyrolysis_challenge.htm.



Some of the objectives of the R&D topics may have applications for more than one algal biofuel production route. For example, R&D topic 2 focuses on maximising the solar conversion efficiency in mass culture, which would be useful for increasing algal growth for the production of biomass as well as for the production of algal oil. Therefore, whilst the aim at this stage is to grow algae for the oil that they produce, the Carbon Trust will continue to review other routes and be aware of other potential applications of the technology being developed.

9 Can you provide some example scenarios for background IP?

For more information about IP and related issues, please refer to the *ABC Commercial Framework and Contract Guidelines*, which can be downloaded from the same webpage as these FAQs (www.carbontrust.co.uk/technology/directedresearch/algae.htm). If you have any concerns about IP and the contractual framework proposed, please highlight them in Section 3.6 of your application form.

Some example scenarios for background IP, based upon feedback we have received so far, are provided below. They are circulated without prejudice and are subject to contract. Therefore, the actual contract terms agreed may result in outcomes that differ from those set out below:

- You are the applicant and a research organisation. You have know-how that specifically relates to the foreground IP that you intend to develop using an ABC grant:
 - You must create and maintain a written record of the relevant know how
 - This summary must be made available to the Carbon Trust on a confidential basis
 - The Carbon Trust has the right to pass this information to Algae Co which can use it for commercial purposes without paying a royalty
 - You cannot make the same information available to a third party without first offering the Carbon Trust or Algae Co the opportunity to pay you for exclusive rights to the know how
- You are a small business and a lead partner on a bid. You own a patent that specifically relates to the foreground IP that you intend to develop using a portion of the ABC grant awarded to your project team:
 - As a condition of the ABC grant to your project team the Carbon Trust will need to be granted a non-exclusive royalty-free licence to your patent for the end use of algae-derived fuels
 - The Carbon Trust has the right to assign this licence to Algae Co which can use it for commercial purposes
 - If you have not previously licensed the patent to a third party, you cannot subsequently award such a licence without first offering the Carbon Trust or Algae Co the opportunity to pay you in cash and/or shares for an exclusive licence
 - If you have previously licensed the patent to one or more third parties then Algae Co may or may not wish to restrict the issue of further licenses. A

financial consideration will be negotiated for any such restrictions on your freedom to licence

- You are a university with links to another university outside of the UK that you think has a valuable contribution to make due to its existing IP and facilities:
 - You can use money from the ABC grant to fund 100% of the costs of research carried out in the foreign university under a sub-contract from your own university
 - You do not need access to any background IP owned by the foreign university, although the availability of such access may be a significant factor in deciding whether to award the sub-contract
 - It must be a condition of the sub-contract that the arising foreground IP is owned exclusively by your own university
 - The Carbon Trust will treat this foreground IP in the same way as any foreground IP developed in your own university under ABC funding
- You are a university with know-how that specifically relates to the foreground IP that you intend to develop using an ABC grant. There have not yet been any patents filed on this IP but your technology transfer office is considering doing so in the near future:
 - You must create and maintain a written record of the relevant know how before the ABC funded work commences. This summary must be made available to the Carbon Trust on a confidential basis
 - The Carbon Trust has the right to pass this information to Algae Co which can use it for commercial purposes without paying a royalty. However, the Carbon Trust will be sensitive to issues of prior disclosure
 - If a patent is subsequently filed to cover the IP disclosed at the start of the programme, then the Carbon Trust will need to be granted a non-exclusive royalty-free licence to this patent for the end use of algae-derived fuels
- You are a research organisation which continues to fund work after the ABC grant has been completed and develops new IP in an area that would be valuable to Algae Co:
 - The new IP is owned entirely by you. However, if it relies on background IP which has subsequently been exclusively licensed to Algae Co then you may need to pay royalties to Algae Co before you can exploit the new IP
 - Algae Co may make you an offer in cash and/or shares to acquire rights (exclusive or otherwise) to the new IP

