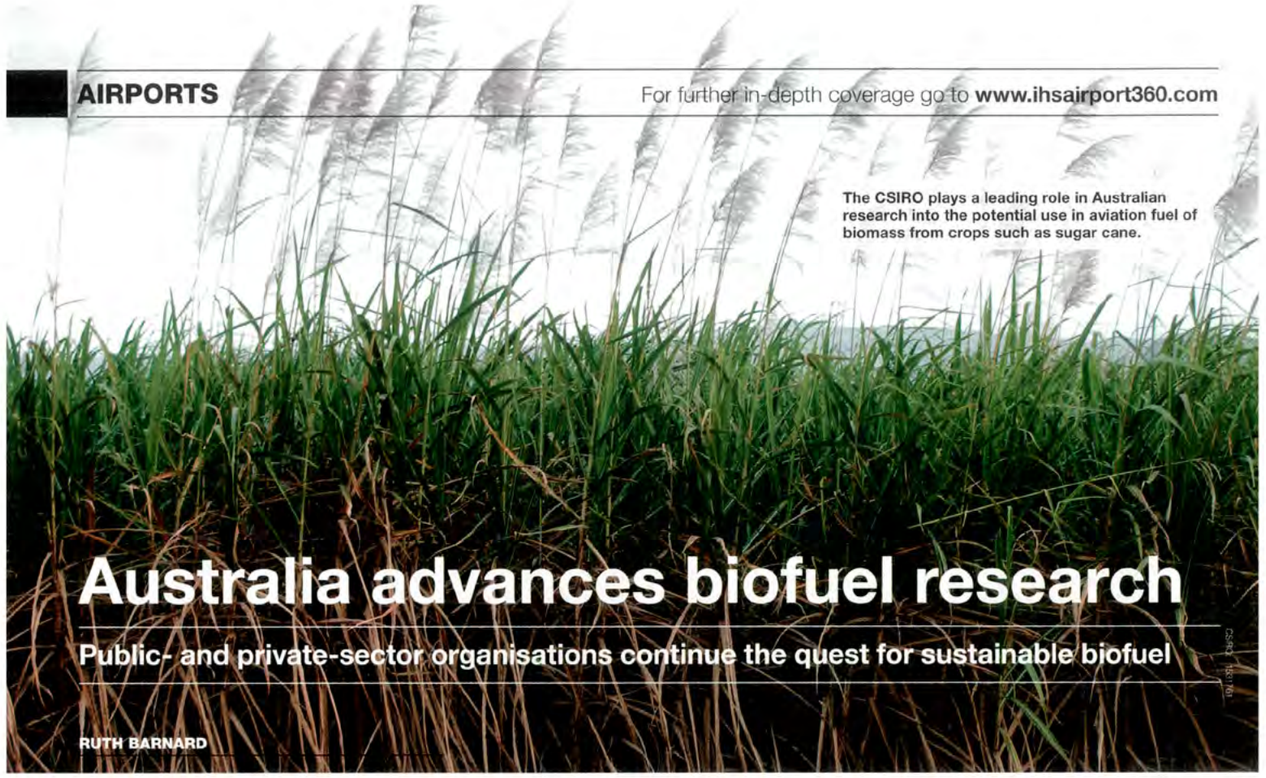

The CSIRO plays a leading role in Australian research into the potential use in aviation fuel of biomass from crops such as sugar cane.

Australia advances biofuel research

Public- and private-sector organisations continue the quest for sustainable biofuel

RUTH BARNARD

Australia began to look closely at making sustainable aviation fuel in 2011 with the publication of the 'Sustainable Aviation Fuel Road Map' (SAFRM). It was initiated by the Sustainable Aviation Fuel Users Group (SAFUG) including Air New Zealand, Boeing, Qantas, and Virgin Australia, together with the Defence Science and Technology Organisation (DSTO) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), which was invited to facilitate the study.

A broad range of stakeholders from the aviation and biofuel industries, the New Zealand and Australian governments, and non-government organisations were also invited to co-fund and participate in the study.

SAFRM is the first cohesive approach to examining the prospects for building a sustainable aviation fuel industry in Australia. "Even though background work had been done in assessing biomass – how much there was, how much could be sustainably harvested and turned into fuel, and how much that would replace fossil fuels – looking at the situation for aviation fuels was different because an assessment had to be made on technologies that were not fully developed at the time," said Dr Victoria Haritos, CSIRO team leader in energy biotechnology.

According to a study conducted by LEK Consulting on behalf of the Australian government and published in December 2011, advanced biofuels could enable Australia to build a significant and sustainable new industry that could increase national fuel security, assist in reducing greenhouse gas emissions, and stimulate regional development. The study noted that the aviation industry could benefit strongly from advanced biofuels and concluded that Australia could make a large contribution in feedstocks.

The Australian Initiative for Sustainable Aviation Fuels (AISAF) group was formed in July 2012 as a key outcome from SAFRM. The group aims to shepherd and foster recommendations from SAFRM and to help develop the pathway to aviation biofuels. Rather than directly commission research and development (R&D) projects, AISAF is involved in getting the framework right by promoting relationships to stimulate the production of aviation biofuels in Australia. AISAF also monitors international developments to place Australian research in a global context.

AISAF was formed under an intergovernmental memorandum of understanding with the United States "to use what we know about aviation biofuels in Australia to benefit both countries", said Haritos. The Commercial Aviation Alternative Fuels Initiative (CAAFI) – AISAF's sister group in the United States – has a similar makeup and has steered approvals for alternative fuels from global certification body ASTM. CAAFI also co-ordinates much of the US government's R&D in aviation biofuels. "Through CAAFI, AISAF has direct access into their work to assist in the adoption of similar approaches in Australia, with Australia benefiting from leveraging the deeper and longer-term R&D that is taking place in the US," added Haritos.

Viable feedstocks

Before SAFRM, CSIRO had already assessed Australia's current and future feedstocks and concluded that lignocellulose is a potential fuel source that would not consume acreage needed for food production, because it takes the form of grasses, stubble from cropping, and woody residues.

SAFRM also looked at alternative feedstocks and prospects for increasing their cultivation in Australia. "Fatty acid oils is a subgroup that is very desirable from the point of view of conversion into renewable jet fuel because the technology has been developed," said Haritos. "The problem is the availability of non-food sources of this feedstock is very low."

Microalgae is another source that could expand greatly. An abundance of large open ponds in cheap, non-productive land with good sunlight makes Australia one of the few countries where microalgal fuels could be produced in large amounts. However, the technology to grow microalgal oils at scale to make fatty acid oils is currently very expensive and still faces technical hurdles. Pongamia – or the *Millettia pinnata* tree – is an alternative oil feedstock, but requires a lot of crop development work to become a viable option.

Choosing how and where to source an alternative sustainable fuel hinges on: availability of land; an assured future supply of it; and the availability of technology that can turn a feedstock into renewable fuel. Lignocellulose can already be made into an ASTM-certified aviation fuel via biomass gasification coupled with Fischer-Tropsch hydrocarbon synthesis.

"However, the technology for this process is currently too expensive to produce fuels at a competitive cost and requires a very high density of biomass, unlike the situation we have in Australia," said Haritos.

Other work on aviation biofuels in Australia includes a project CSIRO undertook with Boeing in 2012-13 on novel feedstocks. This study investigated existing and potential feedstocks in the Fitzroy Basin region in Queensland. Modelling tools re-enacted the supply chain and estimated the costs and logistics of production.

The Fitzroy Basin is used predominately for animal grazing, and the study addressed whether this type of farming can work alongside bioenergy production to deliver a diversified income for graziers. Another feedstock in the region is short-rotation forestry (growing trees for fuel).

CSIRO and Boeing's modelling included a 20-year forecast. CSIRO assessed the likely costs and production volumes of aviation fuel and other fuels that could be produced using technology for fast pyrolysis and super-critical water conversion.

The ultimate goals are achieving price parity between aviation biofuel and crude-oil derived fuel and replacing about 5% of predicted aviation fuel use by 2020, a SAFRM target. CSIRO's modelling suggests this is achievable against the cost of standard crude oil, which is expected to keep rising. The next phase in the study is to better understand the economics of growing, harvesting, and transporting biomass and the technical hurdles in its conversion to fuels by bringing together all the likely partners in a successful aviation biofuels supply chain.

Advanced biofuels is a potential new industry in Australia but its future hinges on economics and the international oil price. On 4 December 2013, Qantas and Shell released a biofuel report underwritten by the Australian government's Australian Renewable Energy Agency. This comprehensive investigation into the economic viability of producing biofuel on a commercial scale in Australia concludes that an Australian aviation biofuel industry is technically feasible, modelling a plant capable of producing 1.1 billion litres annually of renewable fuels, including biojet fuel.

"When the cost of oil is high, it ends up being a theoretical argument," said Haritos. "Everyone will be asking, 'Why aren't we building a biofuels plant?' Businesses in Australia are already developing technologies to convert feedstocks into fuels and therefore it is a natural progression for them to move upscale from pilot facilities where they are currently located because it's in their business interest to do so. There is a lot of uncertainty over the long-term price of oil and what our future oil security is. What is certain is that an alternative needs to be made available soon." ■