Submission
2016 National Research Infrastructure Roadmap
Capability Issues Paper

Name	**Professor Ian O'Hara**
Title/role	**Principal Research Fellow**
Organisation	**NCRIS Mackay Renewable Biocommodities Pilot Plant, Queensland University of Technology**

Introduction

Queensland University of Technology (QUT) is a highly successful Australian university with an applied emphasis in research. Based in Brisbane, the university is a recognised leader in research and demonstration of technologies for the production of biofuels and bioproducts.

QUT owns and operates the NCRIS Mackay Renewable Biocommodities Pilot Plant (MRBPP) to develop and demonstrate processes for biofuels production using a wide range of biomass feedstocks. With grant funding awarded in 2007 through NCRIS Capability 5.5 Biotechnology Products: Biofuels, and operational since 2010, the MRBPP and has built an international reputation for high quality research into biofuel technologies.

The MRBPP is focussed on research, development and demonstration of technologies to convert agricultural non-food residues to biofuels. With ongoing operational funding through NCRIS, the MRBPP is accessible to the research community providing discounted access for meritorious research. Access is provided in accordance with the principles of the NCRIS Program and the intent of the access guidelines established by the NCRIS 2006 Biofuels Access and Strategy Committee.

The following responses are provided to Questions 21-23 in relation to the proposed future NCRIS programs and capabilities from this perspective.

<u>Advanced Physics, Chemistry, Mathematics and Materials</u>

Question 21: Are the identified emerging directions and research infrastructure capabilities for Advanced Physics, Chemistry, Mathematics and Materials right? Are there any missing or additional needed?

One of the great challenges of our generation is to address human society's overreliance on the use of fossil resources for the production of energy and products by transition to a more sustainable and renewable base. Advances in many fields of science, including industrial biotechnology, green chemistry and bioprocess engineering, are providing opportunities to produce our future energy and chemical requirements from renewable bio-based feedstocks. Biorefineries, converting biomass from agricultural and forestry residues and wastes into higher-value chemicals, fuels, feeds, and fibre products, are a key opportunity to contribute to this global challenge.

In 2014, QUT commissioned a report by Deloitte Access Economics and Corelli Consulting to investigate the economic potential of establishing a tropical biorefinery industry in Queensland as a case study of the opportunities more broadly for Australia. The study investigated a scenario in

which potential new biorefinery opportunities were developed in regional Queensland and assessed the state-wide economic impact that would result from this development.

The results of the economic modelling showed that the development of a tropical biorefinery industry as identified in this scenario would result in an increase in gross state product by over A$1.8 billion per year and create over 6,600 new full time jobs in Queensland alone by 2035. The benefits in economic output and jobs accrued broadly across the economy resulting not only in economic uplift in the expected sectors of agriculture and manufacturing, but also in trade, transport and services industries. While this modelling considered a Queensland state scenario, the potential opportunities for establishing a biorefinery industry across Australia would likely be correspondingly greater.

Australia has a comparative advantage in biorefining – the climate and agriculture sector ensure a large supply of biomass material that can be used to produce chemicals, plastics and fuels. Biorefineries in Australia are likely to be viable sources of economic growth and diversification. Their output can be used as inputs to domestic industries as well as generate export earnings. In addition, biorefinery industries can significantly value-add agricultural outputs, diversifying agricultural producers' revenue base.

In the original NCRIS 2006 funding for Capability 5.5 Biotechnology Products, the majority of the funding was dedicated to research infrastructure to support the development of recombinant proteins for human therapeutics with a smaller quantum going to biofuels technologies. While NCRIS 2006 delivered pilot scale infrastructure based on cellulosic ethanol technology (Queensland node – QUT) and algal cultivation (South Australian node – SARDI), there was limited investment in pilot scale infrastructure to support the scale-up and demonstration of a broader range of chemical, biochemicals and other industrial biotechnology products.

Over the past decade, there have been significant advances in technology and commercialisation of industrial biotechnology products with an increasing focus on advanced bioprocesses that go beyond biofuels into the production of other valuable platform and specialty chemicals, biopolymers and high value bioproducts. Laboratory scale research infrastructure for the most part is well established to support research in this field although there are limited capabilities in some areas of bioprocess purification and upgrading technologies.

Of particular concern for the production of industrial biotechnology products, is the lack of high quality research infrastructure across Australia for scale-up. The ability to access high quality research infrastructure in Australia is a key impediment to technology adoption and adaptation for Australia.

New capabilities and upgrading of existing capabilities are required to meet research and industry demand in this area. In relation to the MRBPP, new investment is required in bioseparations and biopurification technologies capable of supporting a wide range of product opportunities.

In particular, infrastructure is required to enable scale-up development in advanced high-performance bioprocesses and associated downstream purification to be conducted including upgraded bioreactor capability for advanced fermentations, cell recovery and lysis and small molecule purification. This equipment will enable expanded capability from production of biofuels to

the production and purification of biochemical, enzyme, cosmetic, nutraceuticals and higher value coproducts.

There is also increasing demand for larger scale GMP facilities for the production of industrial products through recombinant microbial technologies to facilitate early stage demonstration and contract production of high value molecules and bioproducts.

Question 23: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Advanced Physics, Chemistry, Mathematics and Materials capability area?

On-going operational funding for the NCRIS Biofuels capability is essential to continue to support utilisation through discounted access to the facility for meritorious research and SMEs. Given the costs of operation of facilities such as the MRBPP, and the financial constraints experienced by SME and public sector research users, utilisation is critically dependent on cost. Continued operational funding will ensure that the facilities remain available to a wide range of users.