

Project report: Commercial demonstration of lignocellulosics to (unique) stable Bio-Crude Oil



Lead organisation: Licella Pty Ltd

Project partners: University of Sydney and Ignite Energy Resources Ltd

Project commencement and completion date: December 2009 – June 2012

Project summary

Licella's commercial demonstration of converting inedible plant materials (known as lignocellulosics) to a stable bio-crude and its Australian-based production of Bio-Crude oil, is targeted at assisting Australia with energy security goals and greenhouse gas reduction targets. There may also be future export potential for the Bio-Crude oil.

The project was funded with assistance from the Second Generation Biofuels Research and Development (Gen 2) Program, which supported the research, development and demonstration of new biofuel technologies and feedstocks that address the sustainable development of an advanced biofuels industry in Australia.

The project has included the design, construction and successful operation of a commercial demonstration facility for the production of Bio-Crude oil that can be blended with traditional fossil crude and then upgraded at existing refineries. Licella's Commercial Demonstration Plant was opened in December 2011 in Somersby, one hour north of Sydney.

Licella undertook extensive feedstock and processing testing to determine the optimal operating environment for the production of Bio-Crude oil using Licella's Catalytic Hydrothermal Reactor (Cat-HTR) and to test the commercial assumptions of the technology.

Licella, through this project, has proven that the underlying economic assumptions of its technology are sound, paving the way for the next stage in the commercialisation process.

Following the completion of the project, \$5.4 million of ARENA funding was announced for Licella to undertake a \$8.2 million feasibility study into the construction of its first pre-commercial biofuels plant. If constructed, it is estimated that the plant could produce 125,000 barrels of Bio-Crude per annum, which could be used as a drop-in fuel.

Project scope

The commercial demonstration of lignocellulosics to a (unique) stable Bio-Crude called for the design, construction and operation of a commercial demonstration plant at Licella's site in Somersby, New South Wales. The project addressed issues including scale-up, determining an optimum operating environment and identifying viable input feedstocks.

ARENA



Australian Government

Australian Renewable
Energy Agency

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The key aim of this project was to demonstrate a 10-times scale up of Licella's pilot facility to fully explore, test and prove the soundness of, the commercial assumptions behind Licella's Cat-HTR technology. Licella also aimed to determine the optimal operating environment for the Cat-HTR suitable feedstocks for conversion to Bio-Crude oil.

Outcomes

The key project outcomes achieved include:

1. Commercial demonstration plant (CDP) design

The Cat-HTR had been proven at Licella's pilot plant, operating successfully since 2008.. As part of this project, a 10-times scale-up plant was designed as the next step in the commercialisation path.

2. Waste biomass feedstock testing – radiata pine, miscanthus (banna grass) and macro algae.

Testing has demonstrated that the technology is highly flexible with respect to feedstock. Given a consistent supply of any biomass based feedstock the process can be tuned to convert this to stable Bio-Crude oil.

3. Construction of the CDP

Commissioning of major plant units commenced in the final quarter of 2011, with the CDP being formerly opened by the Minister for Resources and Energy, The Hon Martin Ferguson AM MP on 14 December 2011.

4. Joint venture agreement with Norske Skog signed

During the design of the plant, Licella entered into negotiations with Norske Skog resulting in the establishment of a joint venture company, Licella Fibre Fuels (LFF). This resulted in an expansion of the test program to address specific areas of interest to Norske Skog as part of a feasibility study looking at establishing a commercial facility. This study is moving forward.

5. Operation of the CDP

Licella has successfully operated the CDP in a variety of operating conditions and achieved the desired outcomes of the program, including the proof that underlying economic assumptions for scale-up were sound.

Products, patents (applied/granted) and publications produced as part of the project

The key product in this project is Licella's ground-breaking technology – the Catalytic Hydrothermal Reactor (Cat-HTR) and its low-carbon, refinery-ready Bio-Crude oil..

Licella and parent company, Ignite Energy Resources Ltd (IER), have applied for six patents during the project, including:

No	Title	Application No	Filing Date	Applicant(s)
1	Bio-oil production method	PCT/AU2009/001312	1.10.2009	Licella
2	An assembly for reducing slurry pressure in a slurry processing system	Australian provisional application no. 2009904499	16.09.2009	Ignite
3	Methods for biofuel production	7.04.2010	Licella	Australian provisional application no. 2010901473
4	Ballistic heating process	1.07.2010	Ignite	Australian provisional patent application no. 2010902938
5	Processing of organic matter	PCT/AU2011/001624	15.12.2011	Ignite; Licella
6	Methods for producing hydrocarbon products from bio-oils and/or coal-oils	PCT/AU2010/000215	27.10.10	Ignite

One publication has been produced by Gody, G.; Rossner, C.; Moraes, J.; Vana

Ancillary benefits

Partnerships

As a result of the project's outcomes, in 2011 Licella established a joint venture with Norske Skog for the continued development and commercialisation of the Cat-HTR technology. Norske Skog operates two paper mills in Australia.

This partnership has enabled the CDP to be further developed with the design and installation of a further 10-times scale-up in the reactor capacity. This is a 100-times scale up from the pilot and only requires a further five-times scale-up for the envisaged first 50,000 oven-dry tonne facility at a customer site, which could produce approximately 125,000 barrels of Bio-Crude per annum.

Memoranda Of Understanding have been signed with Virgin Australia and Air New Zealand to explore the potential of the technology to create an alternative, sustainable source of jet aviation fuel.

Further partnerships are being explored.

Licella's job creation during the period of this project includes three engineers, one business development manager, three in finance and administration and one scientist.

Effectiveness

Licella's Bio-Crude oil with its energy density of 34 to 36 MJ/kg, which is double that of competing pyrolysis oil technologies, has been demonstrated that it can be blended with crude oil and processed through traditional refineries to deliver sustainable transportation and potentially aviation fuels through existing distribution infrastructure.

The project also enabled the production of a similar stable, high energy density Bio-Crude oil from the smaller scale pilot plant.

Transferability

Benefits of working with a JV partner

Licella's joint venture with Norske has given the company the opportunity to work with a significant industrial partner with skills used for building and commissioning plants and transforming biomass into higher value products.

As a JV partner in LFF, Licella and Norske engineers have been working together on the construction and ongoing operation of Licella's CDP. Having been interested in emerging technologies for the production of biofuels for some time Norske is a good industrial partner to help the commercialisation of Licella's Cat-HTR.

Value chain

Understanding the components of a renewable Bio-Crude oil value chain has been a key learning area for Licella. The company has proactively consulted with feedstock providers, oil refineries, distributors and potential users in order to build relationships and understand key cost drivers.

The Memorandum Of Understanding (MOU) Licella has with Virgin Australia to jointly explore the possibility of a future commercial off-take agreement for sustainable jet fuel, refined from Licella's Bio-Crude oil, is a good example of this. Licella also has a similar MOU with Air New Zealand.

Consultation

Broader consultation, beyond the value chain, has enabled Licella to better understand the renewable fuels landscape and pursue the development of Cat-HTR. Consulting with government departments and organisations, including the Department of Resources, Energy and Tourism and the Australian Renewable Energy Agency (ARENA) has not only led to financial support, but relationships that are integral to the success of Licella's future.

Conclusion and next steps

The next steps for Licella in the path towards commercialisation include, optimising the CDP to maximise Bio-Crude oil production yield while minimising the related costs of production, and

conducting a de-risked feasibility study in order to produce an investment case for the construction of Licella's first commercial plant in Australia.

This study is being supported through ARENA's Australian Biofuels Investment Readiness (ABIR) program and will evaluate the best locations in Australia in terms of cost and availability of biomass. In addition further work on refining pathways, associated engineering and access to markets will also be conducted..

Licella is hopeful that with this information there will be a sound investment case to facilitate the construction of the first commercial facility in Australia, which will prove the technology at commercial scale and enable its global deployment.

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