

Red Rock Biofuels: A breakthrough for wood-based jet fuel or another doomed cellulosic biofuel project at public expense?

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Red Rock Biofuels (RRB), a company recently acquired by biofuel developers Joule Unlimitedⁱ, are poised to construct a 14-16 million gallon wood-to-biofuels plant in Lakeview, Oregon, one which is to produce jet fuel as well as biofuels with similar properties as conventional diesel for road transport.

RRB has already received \$74.1 in grants from the Department of Energyⁱⁱ and \$2.1 in tax credits from the State of Oregonⁱⁱⁱ. They are just waiting for the Navy to approve their final environmental assessment^{iv} before construction can start – and getting the Navy's permission seems a foregone conclusion given that \$70m of their grant funding was made available under the Defense Procurement Act^v.

Environmentalists in Oregon oppose the facility^{vi} because it would require 175,000 tons of wood every year from nearby forests. Those would include the nearby Klamath-Siskiyou ecoregion, which is considered a global center of biodiversity and IUCN Area of Global Botanical significance^{vii}. Campaigners are also concerned about the impacts on local residents because Lakeview's levels of fine particulates – linked to respiratory and heart problems as well as strokes – already exceed federal standards^{viii}.

Experience with comparable schemes, including others also funded by federal grants and involving companies partnering with RRB suggest that the chances of such a refinery ever operating successfully may be very slim. This would be good news for nearby forests, but it is not necessarily good news for resident's health: Unsuccessful attempts to operate a plant of this type can cause particularly high toxic air emissions and carry risks of explosions and fires.

What would RRB's technology involve?

RRB's technology consists of three main stages: First of all, the wood would undergo **gasification**. Biomass gasification involves exposing the wood to high temperatures with a controlled oxygen stream, which produces a very dirty gas, mixed with small particulates and many other pollutants. It then has to be cleaned up until it is an almost pure mix of hydrogen and carbon monoxide. This mix is called syngas. The second stage is called **Fischer-Tropsch reforming**. It involves a series of chemical reactions to transform the syngas into liquid hydrocarbons. The third stage involves **refining those hydrocarbons** into jet fuel and other types of fuel. The first two stages, i.e. biomass gasification and Fischer-Tropsch reforming, are extremely challenging.

Other companies trying similar technologies have failed:

No company has ever managed to produce commercial quantities of biofuels using gasification and Fischer-Tropsch reforming. RRB's plans closely resemble those by a former biofuel company: KiOR. KiOR received a \$75m interest free loan from the State of Mississippi^{ix} and were poised to receive a \$1 billion federal loan guarantee when they declared bankruptcy in 2014. They never managed to make the technology work. In Germany, Choren attracted investments from Shell, Daimler and Volkswagen to build such a refinery. They, too, failed to commercialise the technology and had to declare bankruptcy^x. In Austria, an EU-funded Research and Development project has been trying to use gasification and Fischer-Tropsch reforming to make biofuels. That project started in 2004 and has still not moved beyond laboratory-scale^{xi}.

The companies that are to provide the gasification and Fischer-Tropsch technologies have no track record to show that they can do so:

The company slated to deliver a gasifier to Red Rock Biofuel is called **TCG Global**. On their website^{xii}, TCG say that they built their first demonstration plant in Denver and then dismantled and moved it to Toledo, Ohio. In Toledo, their gasifier formed part of a demonstration project for turning agricultural residues and wood into diesel fuels. That project attracted a grant of nearly \$20m from the Department of Energy^{xiii}. According to the final report about this government funded project^{xiv}, written by the Desert Research Institute (DRI), DRI had originally tried to collect and analyse syngas from TCG's gasifier in Denver, but did not succeed "due to several logistical and operational problems" with that plant. After the gasifier was reassembled and re-engineered in Toledo, samples of syngas could be taken but there were major problems with tars clogging up filters and other essential parts of the gasifier, as well as other technical problems with the gasifier. Eventually, after very significant investments and modifications, sufficiently clean syngas was finally obtained over four days. ***There is no published information to suggest that TCG has had more than four days experience of producing syngas clean enough to be turned into liquid fuels via Fischer-Tropsch***

The Fischer-Tropsch system for Red Rock Biofuel is to be provided by **Velocys, who belong to the Oxford Catalyst Group**. Oxford Catalyst Group ***has never delivered even a small pilot Fischer-Tropsch plant, let alone a commercial-scale one***. Their only experience with biomass Fischer-Tropsch technology came from laboratory-scale experiments in the Austrian town of Güssing in 2010/11. The company claimed that this project would "lead to the Oxford Catalyst Group's first commercial orders". The companies currently involved in the Austrian research projects have stated that, during 2016, they intend to move beyond laboratory scale and to start producing a (very small) amount of one barrel of fuel per day^{xv}. But Oxford Catalyst Group no longer appears on the list of companies involved, nor is the project mentioned on their own website – which suggests that another company must have been chosen to supply this technology. In 2010, a company called Solena announced plans to build large refineries which would turn biomass and municipal solid waste into jet fuel, using Oxford Catalyst Group's Fischer-Tropsch technology. In the UK, British Airways partnered with Solena to build the first such refinery in London^{xvi} - suggesting that they must have believed Oxford Catalyst Group's promises regarding this technology. However, neither this project nor any similar ones proposed could be delivered, forcing Solena into bankruptcy^{xvii}.

Public health risks of such a scheme remain, even technical success appears highly unlikely:

Biomass gasification – the first stage of the process RRB want to use – is not an established technology but one associated with serious operational risks. European Commission Guidelines for Biomass Gasification warn:

"During operation of a biomass gasification plant there is an increased hazard potential due to the fact that a potentially explosive, toxic and combustible gas mixture is produced and consumed. The producer gas and residues (ash, liquids, exhaust gases) may cause the following major hazards/risks:

- + an explosion and/or fire;*
- + health damage to humans (poisoning, danger of suffocation, noise, hot surfaces, fire and explosion); and*
- + pollution of the environment and plant vicinity."^{xviii}*

- i <http://www.businesswire.com/news/home/20151112006421/en/Joule-Red-Rock-Biofuels-Announce-Intent-Merge>
- ii http://www.velocys.com/press/ppt/ppt141028_Gasification_Technologies_Council.pdf, page 4
(presentation by Velocys, who are to supply the Fischer-Tropsch unit for Red Rock Biofuels' refinery.
- iii <https://newcoic.files.wordpress.com/2015/12/summary.pdf>
- iv <http://www.wpafb.af.mil/afrl/rx/>
- v <http://www.biofuelsdigest.com/bdigest/2015/07/20/red-rock-biofuels-the-digests-2015-5-minute-guide/>
- vi <http://www.counterpunch.org/2016/01/12/scorched-earth-military-forest-to-fuels-in-oregon/>
- vii <http://www.worldwildlife.org/ecoregions/na0516>
- viii http://www.lakecountyexam.com/news/state/deq-air-quality-hearing-praises-lake-success/article_46d71a6e-7d9a-11e5-b091-e72f84129e90.html
- ix <http://www.kior.com/content/?s=2>
- x <http://www.renewablesinternational.net/choren-files-for-bankruptcy/150/515/31463/>
- xi http://www.irena.org/EventDocs/IRENA_REmap_presentation_biofuel_webinar_Weber_2015.pdf
- xii <http://www.tcgenenergy.com/>
- xiii <https://www.dieselnet.com/news/2009/12doe.php>
- xiv www.dri.edu/images/stories/editors/eafeditor/Hoekmanetal2010DRIRreportGridleyBiofuelsDilutionSample.pdf
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- xvii <http://www.iii.co.uk/investment/detail/?display=discussion&code=cotn%3AVLS.L&it=le&action=detail&id=11781739>
- xviii https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/gasification_guide_final_guideline_for_safe_and_eco_friendly_biomass.pdf