

## Success Stories of Advanced Biofuels for Transport

### RELIANCE CATALYTIC HYDROTHERMAL LIQUEFACTION

<b>Year of plant start-up:</b>	2016
<b>Location:</b>	Gagva, Jamnagar, India
<b>Technology:</b>	Reliance Catalytic Hydrothermal Liquefaction (RCAT-HTL)
<b>Plant capacity:</b>	The plant has been upgraded for continuous run in 2018. Currently at 0.5 barrel per day of drop-in liquid biofuel.
<b>Operational experience achieved:</b>	1100 hours
<b>Total Capital Expenditure:</b>	USD 4.0 million
<b>Principle feedstocks:</b>	Algae, wet organic biomass, Bio-waste (Food waste, ETP Sludge, Agricultural Crop Residue etc.), ETP sludge, oily sludge from refinery and petrochemicals
<b>Feedstock Capacity:</b>	2 ton per day (10-20% solids)
<b>Products/markets:</b>	Transport fuel
<b>Technology Readiness Level (TRL):</b>	TRL 8 for algae, food waste and ETP sludge

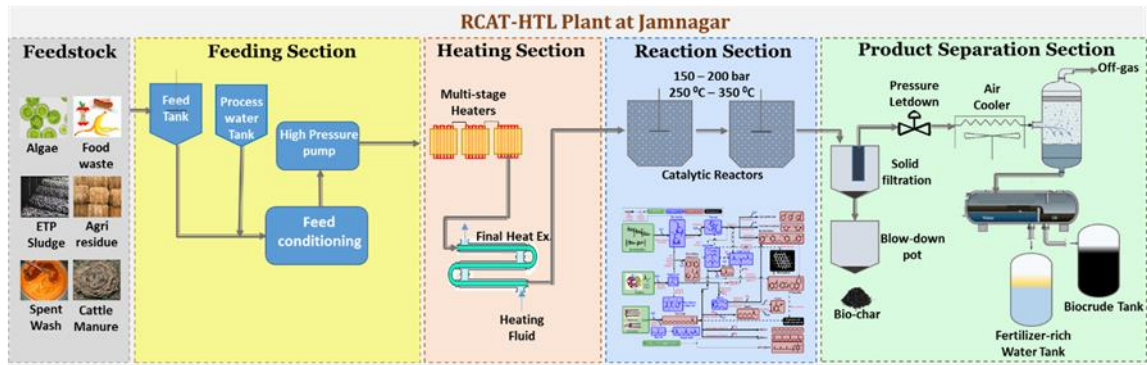
#### DESCRIPTION

Reliance Catalytic Hydrothermal liquefaction – ‘RCAT-HTL’, a catalytic thermochemical process developed by Reliance Industries Ltd. (RIL), converts biomass, biowaste and organic waste into energy-rich drop-in liquid biofuel and recovers fertilizer-rich water and biochar. This environmentally sustainable process overcomes the limitations of the existing technologies and offers a green solution to the hazard of wet waste and agro-residues disposal. RIL’s RCAT-HTL is also more feed-flexible – it can handle both dry as well as wet bio-waste, organic waste, mixed waste by co-processing or independently.

Research on RCAT-HTL process at RIL began as part of Algae to Oil (A2O) program in 2011, aimed to convert algae to biofuel. In due course, it has been realized that RCAT-HTL has a huge potential for processing not only algae but also various wet organic biomass and bio-waste to produce biofuel. Biggest advantage of RCAT-HTL over other thermo-chemical technologies is in case of wet waste. The process uses water in the wet waste as a reactant thereby avoiding the energy-intensive drying of wet biomass; and improving the overall energy recovery. By avoiding the drying, water which is otherwise lost is recovered along with the nutrients that are available in the wet feedstock.

Reliance’s catalytic HTL (RCAT-HTL) process, not only improves the yield and quality of the energy-dense liquid biofuel but is also kinetically tunable to produce the desired bio-product mix, to suit the market demand. RIL has accomplished significant milestones in developing catalytic hydrothermal liquefaction within a short span. We have designed, engineered, commissioned and operated RCAT-HTL process at various scales in batch (Lab scale) and

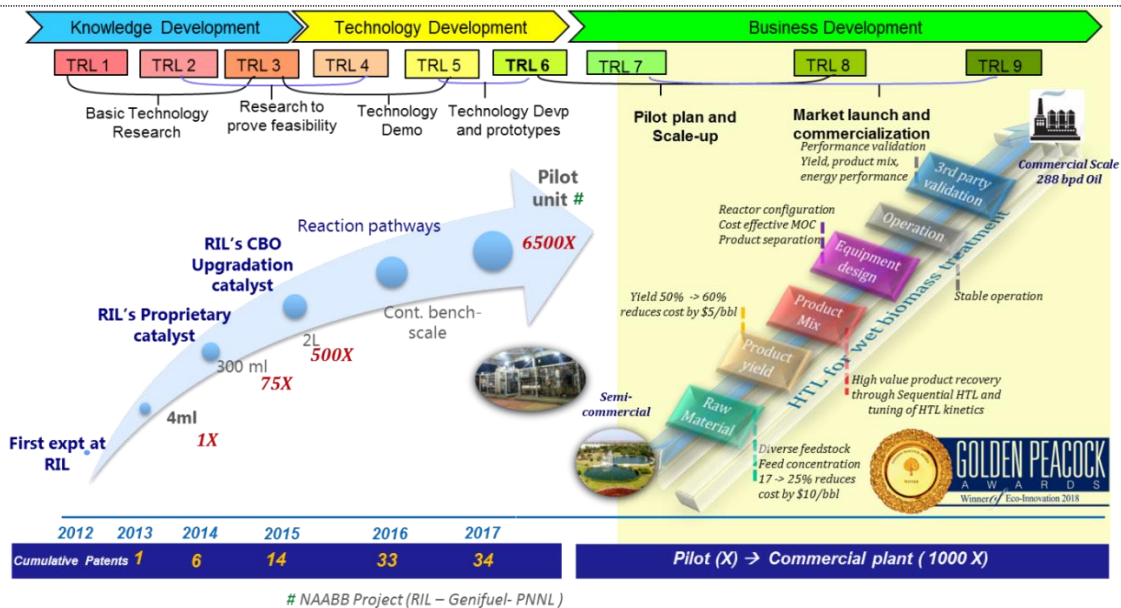
continuous (Bench and Pilot scale) mode of operation. With over 30 patents and concept to commissioning experience of running a pilot plant, RCAT-HTL is at an advanced Technology Readiness Level (TRL), towards commercialization of this climate friendly technology. Recently, Reliance received coveted 'Golden Peacock Eco-Innovation Award - 2018' for our RCAT-HTL technology. This coveted award is conferred by IOD ([www.iodglobal.com](http://www.iodglobal.com))



Pilot plant of RCAT- HTL in operation at Jamnagar



Visit by Mr. Y.B. Ramakrishna, Chairman, Working Group on Biofuels (WGB), MoP&NG



# NAABB Project (RIL - Genifuel- PNNL)

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<b>Stakeholders involved:</b>	RIL manufacturing locations, Bulk food waste generators such as restaurants, malls, catering business, food processing industries, Urban municipalities, Farmers etc.
<b>Financing Support:</b>	The project is entirely financed by RIL
<b>Contribution to Sustainable Development Goals:</b>	<p>Over 1.3 billion tons of food waste is generated per annum across the globe (UN FAO Report, 2011). India generates close to 68 Million tons of Municipal Solid Waste (MSW) and more than 190 million tons of agricultural crop residue. RCAT-HTL offers sustainable solution to the bio-waste disposal with resource recovery by converting these wastes to biocrude.</p> <p>RCAT-HTL strongly aligns with Government of India's Swachh Bharat mission to treat waste in sustainable manner and recovering resources. This will be RIL's significant contribution to Swachh Bharat mission.</p> <p>Life cycle assessment of RCAT- HTL shows exceptionally positive results. Offsetting fossil crude with renewable biocrude can achieve reduction in GHG emissions as much as 85%.</p>
<b>Contribution to GHG emission reduction in transports:</b>	<p>Disposing wastes at open dumps and landfill generates huge amounts of methane. Treating waste by RCAT-HTL reduces greenhouse gases and contributes to environmental benefit</p> <p>Reliance Industries has publicly declared its commitment towards reduction of greenhouse gases intensity of the energy mix by strengthening actions and investments in the areas of carbon capture and storage, renewable energy, and low GHG research and development. RIL's Commitment has been recaptured in RIL's sustainability Report 2015-16, where, it identifies reduction of GHG emissions intensity by increased use of clean energy as one of the primary targets.</p> <p>For every barrel of oil that RCAT- HTL produces, it saves about 0.5 tons CO<sub>2</sub>e in GHG emissions by offsetting fossil crude with greener biofuel from waste. Consequently, treating just 10-15% of food waste available in India can help RIL achieve 50% reduction in its GHG emissions.</p>
<b>Employment:</b>	Realizing the full potential of RCAT-HTL technology and by establishing several modular plants more than 50000 jobs can be generated
<b>Replicability and scale-up potential:</b>	RCAT-HTL plants are proposed to be of modular design. Capturing just 10% of untreated market of Food processing waste and Agri-residue will require 600 such modular plants with potential assets value of over \$12 billion, and estimated to generate annual profits of \$4-5 billion
<b>Success factors:</b>	RCAT-HTL is a sustainable technology that not only utilizes moisture present in the wet waste as reaction medium but also recovers clean water. With its rapid conversion capability, RCAT-HTL converts wet bio-waste to biocrude in few minutes. It is a very economical process with a short payback period. RIL's

proprietary 3rd Gen catalyst provides higher biocrude yield and carbon recovery compared to conventional technologies. By tuning RCAT-HTL kinetics, a product mix of biofuel and bio-products can be achieved. In addition to these, Concept to Commissioning expertise developed by RIL will be of immense value in scaling up RCAT- HTL to a successful commercial technology

**Constraints:**

RIL has built and operated First-of-its kind RCAT-HTL plant with full-fledged automated operation. World is not yet conversant with RCAT-HTL Technology as it has not been listed in waste treatment/conversion technologies hierarchy. Additional efforts are required to make stakeholders acquainted with RCAT-HTL. Drop in fuels pricing is not incorporated in Biofuel policy. This necessitates more clarity on pricing from policy makers and government

**Info provided by:**

Ramesh Bhujade, Vice President-R&D, Reliance Industries Limited

**More information:**

[https://ec.europa.eu/info/sites/info/files/28\\_rajaram\\_ghadge.pdf](https://ec.europa.eu/info/sites/info/files/28_rajaram_ghadge.pdf)



The ART Fuels Forum brings together 100 experts and leaders representing the alternative transportation fuels Industry to facilitate discussions, elaborate common positions on policy issues and identify market penetration opportunities and barriers for these fuels. The Forum is established and financed by the European Commission under the project name “Support for alternative and renewable liquid and gaseous fuels forum (policy and market issues)”.

[www.artfuelsforum.eu](http://www.artfuelsforum.eu)



Technology Collaboration Programme

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