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BIOFUEL DAY: IAF'S CONTRIBUTION

(NATIONAL BIOFUEL POLICY & IAF)

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"You can swim without technology, but you can't fly without technology"

ACM BS Dhanoa

Every year, Aug 10 is celebrated as the world Bio fuel day. On this day 125 years ago, Sir Rudolf Diesel[1] successfully operated an internal combustion engine on Peanut oil. This experiment by the inventor of diesel engines established that vegetable oils are interchangeable with crude based fuel without incorporating many design changes. This day is dedicated towards creating awareness about the economic, social and strategic benefits of promoting use of non-fossil fuel as an alternative to conventional fossil fuels.

India has been a late entrant into this arena of biofuels; this year's celebrations were held at Vigyan Bhawan, New Delhi, with the Prime Minister inaugurating the event. Mr Modi said that the country saved over 4,000 Crore of forex last year and targets to save 12,000 Crore this fiscal due to bio-fuel blending[2]. According to him this was possible due to the rolling out of the National Bio-fuel Policy-2018[3] in June this year. The new policy, amongst many things, incentivises use of second generation (2G) bio-refining techniques, expands the list of feedstocks and sets new targets for Oil Public Sector Undertakings, for dispensing biofuel-blended fuel in India. The policy also focuses on creation of a robust supply chain mechanism for sustainable bio-fuel production from non-edible oil, farm waste and short gestation crops.

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Biofuels have the benefits of reducing India's import dependency on crude oil, cleaner environment, additional income to farmers, business opportunities and employment generation in rural areas. The biofuels programme also synergises various Government initiatives like Make in India, Swachh Bharat and skill development towards enhancing farmers' income.

IAF's bio-fuel vision

Interestingly, two weeks before this historic day, i.e. on July 27, 2018, the Chief of the Indian Air Force, Air Chief Marshal BS Dhanoa, spelt out the blue print of IAF's biofuel plans. While delivering the keynote address at the Society of Indian Defence Manufacturers (SIDM) seminar on Technology Infusion and Indigenisation Plans of the IAF, in New Delhi, he said: "IAF is planning to develop Bio-jet fuel with the Indian Institute of Petroleum (IIP), Dehradun, Defence Research & Development Organisation's (DRDO) Centre for Military Airworthiness & Certification (CEMILAC) and Directorate General of Aeronautical Quality Assurance (DGAQA) with an intention to fly the first military aircraft, an An-32, with 10% blended bio-jet fuel on 26 January 2019. The technology, once proven, will usher in a revolution in the country, and more importantly, augment farmers' income." If all efforts of the developers/sponsors succeed and test results from the experiments synchronise, a few months from now, the IAF and Indian aviation industry would join the select group of nations who have flown military and commercial aircraft on indigenous bio-jet fuel.

IAF's An-32 aircraft

The Air Chief has offered IAF's aircraft and entire range of in-house testing facilities- along with the expertise of CEMILAC and DGAQA- for developing, testing and proving the indigenous product. He has also offered finance support to the project under IAF's indigenisation (Research and Development) fund.

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Once proven, the technology can be commercialised across the country to augment farmers' income. Farm waste and few more forest products may soon have to be re-classified as 'cash crops' in lieu of 'non-edible waste'. This would herald a new era in economics of Indian aviation industry, which aligns with the Prime Minister's vision on biofuels. Since January 2018, the IAF has been spearheading this project which was aimed at testing and certifying 'drop-in'[4] Bio-jet fuel as fit for use on military aircraft. The venture endeavours to use fuel produced from a wide variety of feed stocks and process and test it for use on aircraft. The ultimate aim is to fly fighter aircraft with bio-jet fuel just as the United States Air Force (USAF) did in 2010, the difference being that unlike the US case, the fuel would be sourced from non-food produces, harvested from non-agriculture land holdings and produced using indigenous technology.

Three reasons India needs to do this

In the last few years, demand for cleaner aviation fuel has gained centre stage globally, more for environmental concerns rather than economic considerations. Globally, bio-jet fuel is marginally more expensive than petroleum-based fuel, but it causes much lesser pollution. Bio-jet is produced from inexpensive non-edible vegetable oil but the high cost of hydrogen gas and electric power used in the process makes it expensive. Experts from the bio-fuel industry opine that the cost of indigenous bio-jet can be brought down with technology refinement, policy support[5] and increase in demand from aviation sector. Notwithstanding all this, for India- which imports 82% of its crude oil- the strategic gains are much more than the cost offset for a number of reasons.

Firstly, unlike global bio-jet fuel production techniques, bio-jet fuel planned to be produced in India is sourced from non-edible vegetable oil, therefore, negating the 'Food vs Fuel' debate. Till date the non-edible oil seeds like Jatropha, Karanj, Salvadora Persica (Pilu), Kusum, etc. had limited or no economic value. With the testing and certifications of indigenous 2G technologies for these varieties

of feed-stock, India has a chance to significantly reduce the cost differential.

Secondly, most non-edible oil plants grow in arid, semi-arid land not suitable for conventional food grain farming. Further, these oil seeds are to be predominantly sourced from forest/tribal belts, therefore, an increased demand for seeds will not only attract better collection but also build up a sustainable supply chain. The maturing of the supply chain of 'Ayurvedic' ingredients which now drive the multi-crore ayurvedic medicine market, needs to be remembered. The increased demands for certain farm/forest products and good remuneration has enhanced availability and helped optimise the supply chain.

Concurrently, low cost 2G technologies being developed by various Indian institutes would produce biofuel from farm wastes, like rice and wheat straw, cotton stalk, etc. These technologies would not only produce low cost bio-fuel but also prevent unsolicited burning of farm waste that adds to pollution across major cities in North India.

Thirdly, International Civil Aviation Organisation's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)[6] is set to limit total CO_2 emissions of the aviation sector from year 2020. The organisation wants International Air Transport Association (IATA) to encourage commercial airliners to use cleaner fuel and more efficient aero-engines so as to reduce pollution. Once implemented in totality, aircraft flying without green fuel would require to compensate for causing pollution when operating over complying nations. If India does not acknowledge the initiative, foreign trips by Indian carriers could become expensive. Conversely, long haul international flights (of other countries) would prefer refuelling in neighbouring airports (in India) if they were to provide them with cheaper green fuel.

Economic and Strategic Consideration

According to Ministry of Petroleum, India consumes over 7.5 Million Metric Tonnes (MMT) of ATF annually, which is priced differentially for national and international flights. At 10% blending benchmark, over 5700 crore worth of bio-jet fuel would be required at present consumption level. This largely unexploited aviation biofuel market, coupled with a right mix of policy incentives, should be able to motivate investors to energise rural economy. Lucrative supply side pricing by oil companies and regulatory support as 'green policies' by government will definitely provide the required 'demand side' pull for the perspective 'supply side' push by farmers to reach an equilibrium for sustained availability.

The Technology Barrier

Aviation fuel is a flight critical component, the quality norms are exponentially tough, therefore, just producing bio-jet fuel will not ensure it is 'fit-to-fly' in aircraft. Aircraft systems, equipment and consumables have to undergo exhaustive and precise tests before they can be cleared for use on any airborne platform, especially those which are manned like military/ civil aircraft.

According to Dr Anjan Ray, Director IIP, a number of international studies have established that bio-jet fuel produced in compliance with approved global standards can be blended with conventional jet fuel upto 50% without affecting engine performance. He said that some studies have also demonstrated improvement in aero-engine efficiency and increased thrust in comparison to petroleum-derived fuel.[7] Concurrently, with Bhabha Atomic Research Centre (BARC) sharing its technical know-how on low cost solution for hydrogen production, the cost of bio-jet would reduce significantly.

Nevertheless, producing bio-jet fuel is one thing and ensuring its quality is another big challenge. Aviation sector is a highly regulated sector, interlaced with very tight and strict safety norms. Any item used in aviation industry has to pass through very stringent quality checks. Aviation fuel is a flight critical component, the quality norms are exponentially tough, therefore, just producing bio-jet fuel will not ensure it is 'fit-to-fly' in aircraft. Aircraft systems, equipment and consumables have to undergo exhaustive and

precise tests[8] before they can be cleared for use on any airborne platform, especially those which are manned like military/ civil aircraft. Testing and certification processes are extremely expensive and largely dictated by the foreign Original Equipment Manufacturers (OEM) like Airbus, Boeing, Pratt & Whitney, Rolls-Royce *et al* for use in their equipment / aircraft. Indigenous technologies, thus, would face a herculean task to get themselves accredited by these OEMs and aviation administrators as airworthy. The testing and certification fees are also exorbitant for start-ups to afford. These aspects have been discouraging Indian technologies from venturing into the aviation sector.

This is where the IAF figures in the national narrative. The CAS offered the facilities available with the IAF for testing and certification of bio-jet fuel including aero-engines and aircraft. The idea is to prove the airworthiness of the product (bio-jet fuel), which meets the characteristics and specification of conventional kerosene-based ATF. On acceptance, the product, process and technology can be commercialised for strategic and financial gains. Will January 26, 2019 mark a new beginning for the IAF, Indian aviation sector and the domestic biofuel industry? We will have to wait and watch.

Notes:

[1] Sir Rudolf Diesel i nvented efficient, compression ignited, internal combustion diesel engines in 1890, but were utilised for commercial vehicle application only in 1920.

[2] "PM Modi targets Rs 12,000 Cr saving in oil import bill from ethanol use",*Economic Times*, August 10, 2018,https://economictimes.indiatimes.com/industry/energy/oil-gas/earlier-govts-not-serious-on-ethanol-output-now-it-will-save-rs-12000-crore-pm/articleshow/65350732.cms, accessed on August 10, 2018

[3] Press Information Bureau, GoI, "Cabinet approves National Policy on Biofuels-2018",*PIB*, May, 16, 2018,http://pib.nic.in/newsite/PrintRelease. aspx?relid=179313, accessed Jul 20, 2018

[4] Drop-in fuel is defined as any fuel produced from Biomass, MSW, etc which meets the Indian standards for MS, HSD and Jet fuel, in pure or blended form, for its subsequent utilization in engines without any modifications to the system and can be distributed through the existing dispensing system, "National Policy on Biofuels-2018", *The gazette of India*, No 202, June 04, 2018, http://petroleum.nic.in/sites/default/files/biofuelpolicy2018_1.pdf, accessed on August 09, 2018.

[5] Pricing of Biofuels, ibid para 5.29, pg 20

[6] ICAO, Environment, "What is CORSIA and how does it work?", https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ2.aspx, accessed on August 10, 2018

[7] M Hanafi, Mark Savill, Centre for Propulsion, Cranfield University, UK "Comparative Study of alternative Biofuels on Aircraft Engine Performance", *Journal of Aerospace Engineering*, Vol 231, 2017,

[8] ASTM D 4054-14 defines the standard practice for qualification and approval of new ATF and fuel additives. This is an American National Standard recognised by UK MoD, FAA, USAF, EASA, etc.

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