Indian Railways Organisation for Alternate Fuel (IROAF)
Ministry of Railways
Govt. of India
OBJECTIVE OF IROAF

IROAF is the single window on Indian Railways for dealing with work related to use of Alternate fuels i.e. other than conventional traction.

- To introduce Bio Diesel in Indian Railways
- To convert Diesel Powered Multiple Units (DEMU) into duel fuel using Compressed Natural Gas (CNG)
- Promoting use of Solar Energy in Rolling Stock and Mechanical Assets
- To serve as single window entity for knowledge development on GHG emissions
ACTIVITIES OF IROAF ON BIO-DIESEL

- Use of Bio-diesel for traction purpose in Locomotives
- Bio-diesel Policy formulation for Zonal Railways
- Setting up of Pilot Bio-diesel manufacturing plant
- Setting up of portable Bio-diesel plant
SHATABDI EXPRESS TRIAL

- Indian Railways tried a 5% blend of bio diesel on ALCO locomotive to haul Shatabdi Express on 31st Dec, 2002.(DLI-ASR)

- Hauling Capacity: No adverse effect was observed during the run in terms of haulage capacity etc.

- Filters: No unusual deposits were noticed on the filter surface.

- Fuel Injection System: The fuel injection pumps and injector nozzles were also found in satisfactory condition.

Ministry of Railways, Government of India
WHAT IS BIO-DIESEL?

- Technical Definition for Biodiesel

- (ASTM D 6751):

Biodiesel, is a fuel comprising mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM D 6751.

CONVERSION TO ESTER REDUCES VISCOSITY TO SAME LEVEL AS DIESEL FUEL AND POTENTIALLY INCREASES CETANE NUMBER TO BE THE SAME OR EVEN HIGHER THAN DIESEL FUEL
WHAT ARE THE ADVANTAGES OF BIO-DIESEL FUEL?

- Renewable
  - carbon neutral
- Biodegradable
  - benefits environment
- Domestically grown
  - reducing imported oils
- Low emissions
  - except maybe Nox
- No engine modifications required
  - except replacing some fuel lines for older engines
- Safer
  - less flammable
- Non-toxic

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ADVANTAGES OF BIO-DIESEL (CONT.)

- Very favorable energy balance, 3.2 to 1
- Can be blended in any proportion with petroleum diesel fuel
- High cetane number and excellent lubricity
- Very high flashpoint (>300°F)
- Can be made from waste restaurant oils and animal fats
Approx. 2.8 Billion Litres of Diesel Fuel is consumed annually by nearly 4,800 Freight and Passenger Locomotives in the Indian Railway fleet.

The Annual Expenditure of Indian Railways on Diesel Fuel is approx. US $ 3.0 Billion
### SAVINGS OF HSD WITH USE OF BIODIESEL

<table>
<thead>
<tr>
<th>Annual consumption of HSD (in million litres)</th>
<th>Savings in HSD (in million litres) by blending Bio-diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2800</td>
<td>5%</td>
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<td>140</td>
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</table>

Thus if B10 blend is used by IR, then **280 million litres** of diesel shall be replaced by Bio-diesel annually.
ENERGY CONTENT

- Energy content of neat biodiesel is 1 to 10 percent less than petro-diesel, depending on raw material sources.

- Calorific value obtained for pure bio diesel was 10777 as against 10900 calories/ gm for petro-diesel.

- Thus the energy content of biodiesel was 1.13 % below that of petro-diesel

- Locomotive operating range, therefore, could be slightly less than with blended diesel.
- **CO Emissions**-
  - CO emissions show a downward trend when biodiesel is used. Presence of Oxygen atom in the ester helps in better combustion.

- **Smoke Opacity**-
  - Smoke Opacity decreases with higher blends of Biodiesel.
CHARACTERIZATION OF ALCO DLW 16 V 3100 HP ENGINE WITH DIFFERENT BLENDS (B 10/B 20/B 50/B 100)

- No loss of power with B100 Blend.
- Brake Specific Fuel Consumption increased by 11% with B100 Blend due to 10-12% Lower Heating Value of Bio-Diesel.
- Nitrogen Oxide (NOx) increases with higher Blends.
- Hydrocarbon (HC) decreases with higher Blends. There is reduction of 44% with B100 Blend.
- Carbon Monoxide (CO) decreases with higher Blends. There is reduction of 89.3% with B100.
- Smoke Opacity decreases with higher Blends.
- Exhaust Temperatures/Firing Pressures are within the limits.
WASTE RECYCLING AND BIO MASS

- Biomass encompassing-Bio-gas, wood gassifier, fuel wood, crop residue, dung (& human excreta) etc.

- Railway is a big source of recyclable waste- paper, plastic

- Railway also a big source of bio mass- human waste in toilets in trains and station, waste food.

- Such waste is increasingly being used to generate power or fuel for use elsewhere

- Serves dual purpose of disposal of waste and renewable energy generation
USE OF BIO-DIESEL IN RAILWAYS

- The trial of Bio-diesel for use in traction purposes was started by RDSO in year 2002

- First commercial use of Bio-diesel in Railway commenced on 5.06.2015, World Environment Day

- In the first phase of procurement of Bio-diesel, Railways purchased about 12000 KL of Bio-diesel. These were successfully consumed

- In the second phase of procurement indents for about 50000 KL of Bio-diesel

- Another indent for procurement of 50000 KL of Bio-diesel has been placed at Railway Board recently
USE OF BIO-DIESEL IN RAILWAYS

- Railways have mandated 5% blending of Bio-diesel for traction use
- As a policy it is being explored to procure 5% blending HSD for use in Railway traction
# Use of Bio-Diesel in Railways

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Rlys.</th>
<th>RCD’s</th>
<th>Qty. Indent (KL)</th>
<th>Received (KL)</th>
<th>Consumed (KL)</th>
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<tbody>
<tr>
<td>1</td>
<td>CR</td>
<td>Pune, Wadi, Daund</td>
<td>4100</td>
<td>312</td>
<td>312</td>
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<tr>
<td>3</td>
<td>NR</td>
<td>SSB, TKD Shed</td>
<td>570</td>
<td>504 (short closed)</td>
<td>504</td>
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<tr>
<td>4</td>
<td>NER</td>
<td>Gonda Shed</td>
<td>100</td>
<td>24</td>
<td>24</td>
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<tr>
<td>5</td>
<td>NFR</td>
<td>NGC Shed</td>
<td>200</td>
<td>44</td>
<td>27</td>
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## USE OF BIO-DIESEL IN RAILWAYS

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<tr>
<td>6.</td>
<td>SR</td>
<td><strong>Erode, Erode Shed Trichy Shed Mr. Parsad 7401156984</strong></td>
<td><strong>ED/DSL: 142</strong></td>
<td>142</td>
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<td>168</td>
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<td>112.3</td>
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<td><strong>Total: 427</strong></td>
<td><strong>Total: 424.6</strong></td>
<td>417.667</td>
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<td>7</td>
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<td>KGP</td>
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<td>59.29</td>
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<td>9</td>
<td>WR</td>
<td>Vatva</td>
<td>320</td>
<td>288</td>
<td>160</td>
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<tr>
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## USE OF BIO-DIESEL IN RAILWAYS

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<tr>
<td><strong>11</strong></td>
<td><strong>ECoR</strong></td>
<td><strong>Vizag, RGDA</strong></td>
<td><strong>150</strong></td>
<td><strong>150 (Completed)</strong></td>
<td><strong>150 (Completed)</strong></td>
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<tr>
<td><strong>12</strong></td>
<td>NCR</td>
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<td>1121 negotiation (04.03.2016)</td>
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<td>nil</td>
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<td><strong>13</strong></td>
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<td>410</td>
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<tr>
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<td>SBC, UBL, HPT</td>
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<td>1175</td>
<td>1175</td>
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<tr>
<td><strong>16</strong></td>
<td>SECR</td>
<td>Raipur, Raipur-Shed, Gondia</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td>12392</td>
<td>4186</td>
<td>3900.767</td>
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Thanks