Technology Fact Sheet for Mitigation

J. Biodiesel / Internal Combustion Technology [i]

1. Introduction	
1.1. Historical	- Due to the discovery of petroleum resources and their thermal and fuel characteristics or properties, electric generators driven by an engine based on internal combustion became popular just after the coal-based technologies - Thus, since the first decades of the 20th century, internal combustion and steam boiler started to play role in industrial development - This technology became more and more popular when fuels like ethanol, methane and biogas were found suitable for use in the Internal Combustion Engines
1.2. Location of Resources	- Up to now, oil is imported by Rwanda - Alternatives of replacing oil/petroleum in IC engines by biofuels, biodiesel
1.3. Variability of Resources	- Fossil fuels are imported - But biodiesel based among others on vegetal oils can be locally produced
2. Brief Description	
2.1. Conditions	- Considering the option of replacing Gasoline/diesel by vegetable oils for driving engines generators; - Production of vegetable oils and bio-fuels without any competition susceptible of affecting food security and agriculture sector

2.2. Characteristics	- Fuels for a diesel engine: oil (light/residual) palm , coconut oils (biodiesel), - Internal combustion results in rotation of the electrical generator in fact driven by a shaft output of the gasoline/diesel engine - Range of power capacity: 2 kW up to 20 MW - Electrical efficiency (up to 45%) is higher than the case of gas-fired combustion turbine (34%) - Capacity factor: 80% for the high capacity - Lifespan = 20 years for a range of 100 kW to 20 MW; 10 years for lower capacity
3. Applicability and Potentialities in Rwanda	
3.1. Applicability	- This technology is already operational at very small scale for demonstration at IRST (National Institute of Research, Science and Technology) in Huye district.
3.2. Potentialities	Limited due to low availability of land for cultivating appropriate trees for generating vegetal oils/biodiesel
3.3. Limitations	- biodiesel fuel is facing a serious constraint of lack of large lands for its potential plantation and sustainability
4. Status of the Technology in Rwanda	
4.1. Local Production	- Still at preliminary steps
4.2. Shared Power Plants	- NA
4.3. Projects	- NA

5. Benefits to Development	
5.1. Social	Energy security at different scales
5.2. Economic	-Promotion of artisanal industry, non-agricultural incomes, -Option of hybrid systems with solar, wind and biomass
5.3. Environmental	-Application of techniques for lowering the carbon emissions is a prerequisite condition for environmental benefit -In case of biodiesel fuel, mitigation and environmental requirements are fulfilled
6. Climate Change Mitigation Benefits	
6.1. Reduction GHG Emissions	Optional biodiesel and blends diesel are expected to contribute in mitigation scenario Its emission factor is quite low and hence it can result in an important rate of decreasing GHG emissions: 94% compared to the oil power plants
6.2. Low Carbon Credits	Development of options based on engine driven by biodiesel fuels is suitable for benefitting from the carbon credits
7. Financing Requirements and Costs	
7.1. Private Sector Involvement	- It is obvious that specific funds for supporting private sector interested in developing technologies based on biodiesel and on techniques of lowering carbon emissions can result in wider involvement of smaller companies
7.2. Capital Cost	- For a 5 MW: about 600 USD/kW and 550 USD/kW respectively in years 2005 and 2015

7.3. Generating Costs	- For the case of a 5 MW base-load, the generating cost (the sum of levelized capital cost, O & M costs and fuel cost) is 9.25 US cents/kWh and 17.7 US cents/kWh respectively in the years 2005 and 2015 with 38% for the O & M costs and 53% for the fuel cost
7.4. GHG Emissions	- Emission factor of biodiesel: only about 43 kg/MWh - Replacing the gasoline and diesel fuels by the biodiesel can contribute in avoiding the below emissions; - Gasoline engine: ✓ Very small emission of SO_2 ✓ High emission of CO_2: about up to 1900 kg/net MWh ✓ High emission of NO_x: about 1 400 mg/Nm^3, while the standard acceptable NO_x is 460 mg/Nm^3 in case of oil fuel (ESMAP, 2007)[1] - Diesel Engine: ✓ Up to 2 000 mg/Nm^3 of NO_x ✓ Up to 4 700 mg/Nm^3 of SO_x while 2000 mg/Nm^3 are acceptable standard ✓ Up to 650 kg/net MWh of CO_2 -Compared to above scenarios of diesel/gasoline, biodiesel and vegetal oils are renewable and very low-carbon fuels
7.5. Capability Building	- Given that such a technology is requiring a large diffusion within both

[1] ESMAP is a World Bank Program

	rural areas and urban cities, a high number of skilled technicians is recommended

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment and Technology Action Plans For Climate Change Mitigation– Rwanda. You can access the complete report from the TNA project website http://tech-action.org/**