Technology Fact Sheet for Mitigation

G. Biomass-Steam Power Technology [i]

1. Introduction	
1.1. Historical	- Photosynthesis by vegetal and forests: absorption of CO_2 and solar heat flux and production of biomass fuel and oxygen - Combustion: Release of energy and CO_2 - Traditional source of energy (wood fire and charcoal) - Emission of CO_2 (116 g/kWh of electricity)
1.2. Location of Resources	- Biomass fuel resources are mainly available over the whole rural areas - One ton of mass can generate 18 000 MJ, i. e. 0.25 t.e.p (heat capacity) - Solid waste in urban areas
1.3. Variability of Resources	- Biomass fuels are limited in Rwanda; large deforestation has been also recorded; pressure on forest ecosystems is in fact the most factor of decrease in availability of biomass
2. Brief Description	
2.1. Conditions	- Granular form of biomass fuel is recommended - Mixing with oxygen from air - Avoidance of temperatures resulting in NO_x emissions - Direct firing in a steam boiler
2.2. Characteristics	- Biomass fuel (wood, waste) is directly fired in a combustion boiler

	- Through a heat exchange, water in pipes is heated and resulting steam reaches a conventional steam turbine connected to a generator - Remark: emission of NO_x is avoided due to the injection of air and oxygen in the boiler and thus the temperature of combustion becomes lower than that of emitting the NO_x - About 1.5 kg of biomass fuel can result in an electric generation of 1 kWh (i.e. 4 000 kcal/kg) - Capacity: Commercial type up to 50 MW - CF = 80% - 1.5 kg/kWh of electricity
3. Applicability and Potentialities in Rwanda	
3.1. Applicability	- Biomass-Steam is a proven technology and 1.2 tons of dry biomass produce 1MWh of electricity
3.2. Potentialities	- Wood, forests, wood waste and vegetal residues can be collected accordingly - Municipal solid waste in urban areas - Benefit from external experience like for the case of the Netherlands - Reforestation of national dry lands: in fact about 90% of them are not yet afforested (REMA, 2011)
3.3. Limitations	- Biomass steam power can just be applicable for small scale capacity; among others demand covered by biomass is large
4. Status of the Technology in Rwanda	

4.1. Local Production	- Technology based on Direct-fired Biomass Combustion for generation of electricity via a steam turbine is not yet applied in Rwanda
4.2. Shared Power Plants	
4.3. Projects	- Not yet, apart from the strategies and policies towards Biogas-steam at small scale
5. Benefits to Development	
5.1. Social	- Small scale biomass- steam technology is quite feasible in rural and sub-urban areas
5.2. Economic	- Promotion of artisanal industry and non-agricultural incomes
5.3. Environmental	- Sequestration of CO_2 being possible and NO_x being avoidable, this technology is considered as non-pollutant
6. Climate Change Mitigation Benefits	
6.1. Reduction GHG Emissions	- We consider that Biomass-steam technology can be associated to carbon capture and sequestration for minimizing the CO_2 emissions - GHG emission factor: not more than 58 kg/MWh - Contribution rate in reduction of emissions: 92%, compared to oil used for power generation
6.2. Low Carbon Credits	- Eligible to carbon credits if above conditions (paragraph 6.1) are fulfilled
7. Financing Requirements and Costs	
7.1. Private Sector Involvement	- Investment in small scale options of biomass can be facilitated by

	microfinance institutions; cooperatives can also be involved
7.2. Capital Cost	- About 1 700 USD/kW in year 2005 and 1520 USD/kW - Generation cost: about 6 US cents/kWh
7.3. Generating Costs	- 50% of above generating cost
7.4. Environmental,	- Biomass technology can be easily a low carbon emissions - Natural sequestration is playing a key role and huge amount of CO2 are absorbed by the forests
7.5. Capability Building	- Demonstrative pilot projects are expected to greatly contribute in practical «training by doing ».

[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/**