SUMMARY EVALUATION EFW TECHNOLOGIES

Technology	Capacity kt/y	Waste input Waste preparation	Energy recovery		Operat-ing hours/ year	Envt impact emis-sions	Fundability & bankability	CAPEX in M€	Costing in €/t over 25 years		Gate fee €/t	Conclusion
			100% Electricity	CHP					OPEX fix + var	Revenues		
DIRECT TREATMENT OF RESIDUAL MSW: ADVANCED MOVING GRATE TECHNOLOGY												
Advanced Grate Combustion	**150** **500**	**Residual MSW** **No preparation required**	22 to 30% 22 to 30%	33 to 50% 33 to 50%	8 000+ 8 000+	Most stringent Regulation	+++	**150** **300**	**40 to 50** **30 to 40**	**20 to 30** **20 to 30**	**80 to 100** **50 to 80**	**Basically the only proven and fundable technology**
Comments	Range 50 kt/y to 2 Mt/y	Hundreds of plants in operation with **residual MSW**	450 to 650 kWhe/t of MSW (depending on LHV)					For info, order of magnitude of costs in **Eastern Europe** based on compliance with WID emission limits - no specific ar-chitecture - no land cost - 100% electricity production @ 40-50 €/MWh				
Since no figures are available due to the very limited number of plants in operation or in development, only comments related to advanced grate combustion are reported.												
Alternatives / other treatment technologies												
Fluidised Bed	Range 50 kt/y to 500 kt/y	Need to have maximum particle size 200 mm => shredding + Fe removal + treatment 10% rejects	Reduced efficiency due to high parasitic load + energy to prepare waste		+/-7 500 h due to bed mainte-nance	Most stringent regulation	Possible due to no. of plants in operation but lack of EPC contractors	Higher than Adv Grate due to preparation required	No. of plants in operation Limited figures available but OPEX also > Adv Grate due to more labour (preparation), high qualification required (BFB) and more APCR			**No advantage com-pared with Adv Grate except when large quantities of sludge to be burned in the same plant**
PYROLYSIS												
Burgau	**1 plant < 100 kt/y**	Need to have maximum particle size 200 mm (screw feeder) => shred-ding + Fe removal + treatment 10% rejects	Reduced efficiency due to poor thermal conversion + losses (coke) + energy to prepare waste		+/- 7 000 h/y TBC	Comply with stringent emissions	In principle not possible since only one unit and stopped	No references	No real figures available			**Not available to developing countries due to plant com-plexity and lack of references**
ETIA	Only small capacity **max 25 kt/y-25 plants (none in MSW)**	Need to have **maximum particle size 30 mm** + LCV min 16 MJ/Kg, moisture < 20% => double shredding + Fe removal + treatment 50% rejects => **not well suited to MSW**	High thermal conversion due to high input LCV but much reduced when compared with MSW + losses (char) + energy to prepare waste		+/- 7 000 h/y	Does not supply FGT	Possible when very attractive electricity selling price + small units	Available on request but only partial scope. Containerised	Overall higher costs due to small capacity but can be economical when high electricity prices			**Available to develop-ing countries for spe-cific streams, reduced capacities and very high electricity prices (islands)**
GASIFICATION												
Valmet - CFB	1 plant in operation (Lahti FIN) **mainly burning biomass**	Need to have **maximum particle size 50 mm** => shredding + Fe and non Fe removal + treatment 20% rejects	Good energy recovery ef-ficiency due to high steam characteristics possible with CFB, but reduced by the energy required for parasitic load, fuel prepara-tion and syngas cleaning		Lahti ref. plant **+/- 7000 h (TBC)** but burns mainly biomass	Most stringent emissions with APC	In principle limited since no unit in operation burning 100% municipal waste	CAPEX > Adv Grate due to prepara-tion and sophisticated non-standard technology	No figures available but OPEX also > Adv Grate due to more labour (preparation), high qualification required (CFB) and more APCR			**Initially indicated as suitable for MSW, but in practice biomass is much more suitable**
Japanese Techno BFB or Shaft Furnace (SF)	Many plants only in Japan & Korea	**Extensive preparation (BFB)** Need to have maximum particle size 100 mm => shredding + inerts, Fe and non Fe removal + treatment 20% rejects	Poor energy recovery (often **around 15%**) due to fuel preparation and vitrified slag required in Japan		Poor availability acceptable in Japan	Most stringent emissions with APC	Possible thanks to bankable large Japanese companies	CAPEX > Adv Grate due to prepara-tion and sophisticated non-standard technology	No figures available (**reports mention +/- 150 €/t**) but OPEX also > Adv Grate due to more labour (preparation and process complexity), high qualification required and gasification reagents cost (coke, limestone, oxygen for SF)			**No plants successfully in operation outside Japan & Korea despite many years of com-mercial development**
Enerkem	**1st plant** in commission-ing in Canada	Need to have **maximum particle size 50 mm** => shredding + Fe and non Fe removal + treatment 30% rejects	Potential high energy recovery with **production of methanol or ethanol**, but reduced by the energy required for parasitic load and preparation		**Very poor availabil-ity** after several years of commis-sioning	Most stringent emissions with APC	Not possible since 1st demo plant not yet in full operation	No figures available but likely >> Adv Grate due to preparation and very sophisticated process	No figures available but OPEX also > Adv Grate due to more labour (preparation and process complexity), high qualifi-cation required (FB) and refuse disposal cost			**1st demo plant still in commissioning**
CO-COMBUSTION												
Cement kilns		Need to have **maximum particle size 30 mm**, strong **limitation in chlorine and mercury and minimum LCV 12 (preferred 18) MJ/kg** => shredding + Cl, Hg, Fe and Inon Fe removal + treatment 50% + rejects	100% energy recovery for the high calorific fraction burned in kiln, but addi-tional separate treatment required for the low calorific fraction so overall not attractive		Good avail-ability of the prepa-ration plant and cement kilns	Cement kilns have thair specific regulation	Possible in principle for the prepa-ration but solution for low calorific fraction?	Relatively lim-ited CAPEX for the prepa-ration but solution for low calorific fraction?	Overall costs mainly depends on solution for low calorific fraction			**It is virtually impossi-ble to generate 18 MJ/kg SRF from 6 to 9 MJ/kg MSW or this will represent such a small fraction of incoming stream that it does not make sense**