Technology Fact Sheet

Technology Name	**Short term small scale Combined heat and power plants of small capacity, up to 500 kW of technical capacity**[i]
Subsector GHG emission (megatonnes CO2-eq)	**7,7248 Million t CO2 from energy sector in 2005**
Background/Notes, Short description of the technology option	The principle behind cogeneration is simple. Conventional power generation, on average, is only 35% efficient – up to 65% of the energy potential is released as waste heat. More recent combined cycle generation can improve this to 55%, excluding losses for the transmission and distribution of electricity. Cogeneration reduces this loss by using the heat for industry, commerce and home heating/cooling. Cogeneration is the simultaneous generation of heat and power, both of which are used. It encompasses a range of technologies, but will always include an electricity generator and a heat recovery system. Cogeneration is also known as 'combined heat and power (CHP)' and 'total energy'. In conventional electricity generation, further losses of around 5-10% are associated with the transmission and distribution of electricity from relatively remote power stations via the electricity grid. These losses are greatest when electricity is delivered to the smallest consumers. Through the utilization of the heat, the efficiency of cogeneration plant can reach 90% or more. In addition, the electricity generated by the cogeneration plant is normally used locally, and then transmission and distribution losses will be negligible. Cogeneration therefore offers energy savings ranging between 15-40% when compared against the supply of electricity and heat from conventional power stations and boilers. Because transporting electricity over long distances is easier and cheaper than transporting heat, cogeneration installations are usually sited as near as possible to the place where the heat is consumed and, ideally, are built to a size to meet the heat demand. Otherwise an additional boiler will be necessary, and the environmental advantages will be partly hindered. This is the central and most fundamental principle cogeneration. When less electricity is generated than needed, it will be necessary to buy extra. However, when the scheme is sized according to the heat demand, normally more electricity than needed is generated. The surplus electricity can be sold to the network or supplied to another customer via the distribution system (wheeling). As co-generation is the combined production of useful thermal energy and electricity from the same primary fuel it can take on many forms and encompasses a range of technologies, but will always be based upon an efficient, integrated system that combines electricity production and heat recovery. By using the heat output from the electricity production for heating or industrial applications. Small CHP will be defined here as power plants using small internal combustion engines with typically less than 1MW (≈ 500 kW electrical) of technical capacity. Using such small power units results in a range of benefits, including reduced congestion in the electric networks, air pollution and greenhouse gases and better service for end user. Its main drawback compared to large conventional power plants, less capital intensive, is that its efficiency depends greatly of the heat load and good knowledge of the heat and electric load result in good performance of such technology and larger per unit investments. **(source: www.energymanagertraining.com/CHPMaterial/12-V-EDUCOGEN_Cogen_Guide.pdf; climatetechwiki.org).**
Implementation assumptions, How the technology will be implemented and diffused across the subsector? Explain if the technology could have some improvements in the country environment.	The potential of implementation of such technology is estimated at about 10000 kW. Such technology may be implemented at dairy products factories, in hotels, campuses and may be at multi-apartment buildings. It is assumed that the this technology will be implemented at sites with both heat and electricity demands during the whole year. It is envisaged that this technology will use natural gas as fuel.

Implementation barriers	Lack of information regarding benefits, lack of experience in this field and skepticism to implement such a technology. Of course one psychological impediment is the centralized heat supply system in the capital, based on CHPs of old design that is considered inefficient and with high tariffs.
Reduction in GHG emissions (megatonnes CO_2-eq)	If implemented the technology will result in annual reduction of 10000 tones of CO_2 for 2030
Impact Statements - How this option impacts the country development priorities	Increase country energy security
Country **social** development priorities	Increased efficiency of energy conversion and use; • Lower emissions to the environment, in particular of CO_2, the main greenhouse gas; • Large cost savings, providing additional competitiveness for industrial and commercial users, and offering affordable heat for domestic users; • An opportunity to move towards more decentralized forms of electricity generation, where plant is designed to meet the needs of local consumers, providing high efficiency, avoiding transmission losses and increasing flexibility in system use. This will particularly be the case if natural gas is the energy carrier; • Improved local and general security of supply - local generation, through cogeneration, can reduce the risk that consumers are left without supplies of electricity and/or heating. In addition, the reduced fuel need which cogeneration provides reduces the import dependency - a key challenge for Europe's energy future; • An opportunity to increase the diversity of generation plant, and provide competition in generation. Cogeneration provides one of the most important vehicles for promoting liberalization in energy markets; • Increased employment - a number of studies have now concluded that the development of cogeneration systems is a generator of jobs. a. Using this technology there will result in at least 10 % less fuel used to use the same quantity of electricity from the grid and hest produced by heat only boilers. b. Less fuel used means less natural gas imported and less paid for it as well as the decrease of energy dependency.
Country **economic** development priorities **–** economic benefits	A well-designed and operated cogeneration scheme will always provide better energy efficiency than conventional plant, leading to both energy and cost savings. A single fuel is used to generate heat and electricity, so cost savings are dependent on the price-differential between the primary energy fuel and the bought-in electricity that the scheme displaces. However, although the profitability of cogeneration generally results from its cheap electricity, its success depends on using recovered heat productively, so the prime criterion is a suitable heat requirement. As a rough guide, cogeneration is likely to be suitable where there is a fairly constant demand for heat for at least 4,500 hours in the year. The timing of the site's electricity demand will also be important as the cogeneration installation will be most cost effective when it operates during periods of high electricity tariffs, that is, during the day.
Country **environmental** development priorities	In addition to direct cost savings, cogeneration yields significant environmental benefits through using fossil fuels more efficiently. In particular, it is a highly effective means of reducing carbon dioxide (CO_2) and sulphur dioxide (SO_2) emissions. Oxides of nitrogen (NO_x) are also generally reduced by the introduction of modern combustion plant. CO_2 savings The assessment of the carbon savings from a cogeneration project is hotly debated, as it is very difficult to prove what electricity it displaces. This issue has been at the heart of a long running discussion in European markets, with no agreement. Does the cogeneration scheme displace: a. The mix of electricity production in the country? b. The most marginal power plant on the system? c. The next power plant to be built by the power industry?

	d. The best theoretical power plant available? Depending on the answer the savings in carbon dioxide can vary from 100 kg per MWh to more than 1000 kg MWh. The same issue faces all projects that displace other electricity generation. It is reasonable to assume that most new cogeneration will be gas-fired at least in the next 10 years. For example, a gas turbine with waste-heat-boiler is used here to demonstrate the savings: • Increased efficiency of energy conversion and use; • Lower emissions to the environment, in particular of CO2, the main greenhouse gas; Reduced air pollution: By replacing of 50 million kWh of electricity to be produced in conventional thermal power plant it will result in reduction of about 10000 tons of CO2.		
Other considerations and priorities such as market potential	Possible opportunities for application of cogeneration Industrial • Pharmaceuticals & fine chemicals • Paper and board manufacture • Brewing, distilling & malting • Ceramics • Brick • Cement • Food processing • Textile processing • Minerals processing • Oil Refineries • Iron and Steel • Motor industry • Horticulture and glasshouses • Timber processing Buildings • District heating • Hotels • Hospitals • Leisure centres & swimming pools • College campuses & schools • Airports • Prisons, police stations, barracks etc • Supermarkets and large stores • Office buildings • Individual Houses • Poultry and other farm sites Market potential is estimated to be about **10000 kW.**		
Costs			
Capital costs	The typical investment costs in the small internal combustion engines based CHPs is about 1150 $/kW.		
Operational and Maintenance costs	Operational and maintenance costs excluding fuel internal combustion engines is about 168 $/kW per year. The cost of fuel component depends on the natural gas price.		
Cost of GHG reduction	The cost of electricity produced by such CHP is lower than the cost of electricity produced by thermal power plant electricity of which will be replaced, using the same fuel. In such a case the GHG reduction does not have any cost.		
Lifetime	Economic lifetime is 15-20 years. Technical lifetime is 20-25 years.		
Other	Total energy efficiency is approximately 80-85 %.		
		Old	New
Efficiency	%	36	50
Fixed O&M costs	$/kW*month	2	168

Variable O&M costs	$/MWh	3	0
Investments	$/kW	0	1150
Fuel price	$/tcc	552	552
Time of use of rated capacity	h/an	6000	5000
Fuel consumption	gcc/kWh	341.67	246
Fuel price	$/kgcc	0.552	0.552
Fuel used	kgcc/kWh	0.34	0.246
Cost of used fuel	$/kWh	0.189	0.136
Annual capital costs	$/kW*an		76.667
Per unit fixed O&M costs	$/kWh	0.004	0.015
Per unit variable O&M costs	$/kWh	0.003	0.034
Total costs	$/kWh	0.196	0.185

[i] This fact sheet has been extracted from TNA Report - Technology Needs Assessment for climate change mitigation - Republic of Moldova. You can access the complete report from the TNA project website **http://tech-action.org/**