

## EXECUTIVE SUMMARY

### BUSINESS SCOPE



Cortus provides cost efficient and innovative renewable energy solutions to energy intensive industries based upon the patented gasification technology WoodRoll®. This opportunity, to commercialize renewable energy where it will have the most significant impact on cost efficiency and environmental sustainability, is the driver.

Cortus thermal efficient gasification technology makes it feasible and profitable to build on- site plants as the fuel flexibility opens for most locally available biofuels. The clean high calorific biogas produced substitutes fossil fuel in any process. Cortus process is built upon subsystems proven in other industrial processes put together in a new fashion – WoodRoll®.

### BACKGROUND

Cortus AB was founded in 2006 to develop and commercialize a Swedish inventive technology in biomass gasification, allowing energy-intensive industries such as steel and pulp and paper to green their activities without sacrificing their productivity. The process is developed and patented by Cortus founder and CEO, Rolf Ljunggren (MSc).

The energy demand in the global market is expected to grow at 1.5 % per annum however “The use of biofuels grows more than four-fold between 2008 and 2035” based upon “Cumulative investment in renewable to produce electricity is estimated at \$5,7 trillion over the period 2010 to 2035” (IEA, World Energy Outlook 2010). Due to financial and political initiatives aimed at mitigating climate change, the renewable energy segment will be the fastest growing market amongst all energy sources. Gasification of biomass is identified by the UN and the IEA etc. as one of the key technologies in enabling this growth of renewable fuels.

### BUSINESS FOCUS

Selected customer segments are in priority:

1. Process Industries – producers within mineral, pulp and paper, metallurgical and chemical industries.
2. Power Industries – suppliers of electricity, district heating and cooling.
3. Waste management industries – suppliers of waste handling and treatment.
4. Transport sector – fuel providers, distributors and their partners.

Primary markets are the forest rich countries in the Nordic region, the EU, North America and emerging markets like Brazil, China, South Africa and India.

### BUSINESS AND REVENUE MODEL

Cortus Business and Revenue Model includes licensing of technology, Front End Engineering & Design (FEED), turn-key projects, build-operate-transfer-projects, performance services, supply of key components and after sales of spare parts as well as build-own-operate-projects.

Cortus will build, own and operate the first plant on each market and segment. Onwards, sales will be done by or in cooperation with selected partners.

In the case of a build-own-operate project, Cortus would sell the biogas to the process industry on a long-term take-or-pay agreement (e.g. 10 years). The price for the biogas would be 10 - 25 % lower than the industry's present fuel cost. Individual industrial operations with an energy consumption of 160 GWh could reach annual cost savings of more than 1 M€. From such an example Cortus has projected earnings of 2 M€ per year (for a single ten year contract).

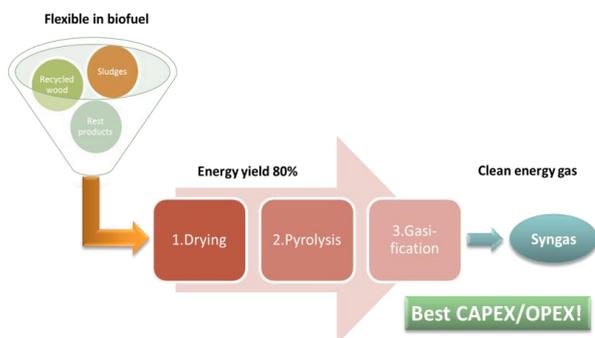
## MARKET

The renewable energy market is booming:

- Global market is forecasted to grow at 15% p.a. to cover 23% of the global energy demand in 2030 (IEA 450 PPM scenario) at a yearly investment demand of 500 billion US\$
- 40% growth in biomass based energy will be needed in the OECD countries (to fulfill the IEA 450 PPM scenario) driven by financial and political initiatives
- Industrial operators need to have environmentally sustainable technologies and operations.

Cortus has received an order to build a plant in Sweden (Nordkalk), a basic engineering study in Spain and several inquiries from customers based in the Nordic countries, the Baltics, Spain, Italy, Poland, Croatia, Czech Republic, North America, India and China.

## PRODUCT DEVELOPMENT



The WoodRoll process is divided into three separate steps, namely drying, pyrolysis and gasification. Heat input is indirectly giving a separation of the heat flows from the solid material and gasification reaction. The biogas purity, the elimination of the polluting elements and the integration of incineration of impurities into the heat flow are three fundamental differences. Relevant

comparison of technologies and benchmarks for the WoodRoll technology show that fuel flexibility, thermal efficiency, gas quality and economic feasibility (CAPEX/OPEX) are the main advantages that puts Cortus ahead of the competition.

Nordkalk Group, the leading producer of high quality limestone-based products in Northern Europe, and Cortus began a co-operation in 2007 and signed a LOI in 2008 for renewable energy gas supply. The project plan for a demonstration plant has been finalized and required permits have been granted by the Swedish authorities. A +50 M€ long term supply contract was signed in June 2010. The project is planned to start in 2012 and be operational within 12 months from finalized financing.

Successful process development has been performed in laboratory scale at the Division of Chemical Technology at KTH (Royal Institute of Technology in Stockholm). More than 100 tests of relevant fuels for gasification has been performed since 2007. A test program in 2009 and 2010 of the process

has been performed in co-operation with AGA Gas AB, ScanArc AB and Torkapparater AB has shown excellent performances for a variety of fuels, from fuel chips to sludges.



In 2011 a 500 kW gasification prototype has been commissioned. Test results from two campaigns shows a cleaner syngas, with higher H<sub>2</sub>/CO content and lower methane, than ever reported. The project was financially supported from The Swedish Energy Agency (Energimyndigheten) and The Swedish Iron and Steel Society. The prototype was built in cooperation with Torkapparater AB, Concordance AB, AGA Gas AB, ÅF Process AB and Sandvik AB - Heating Technology, Siemens among others. This project is the first step in a planned collaboration on the production and supply of gasification plants, where the above parties see a great potential.

## PATENTS AND AWARDS



The first technology patent for Cortus gasification process was granted in Sweden in 2008. Patents regarding hydrogen production from the process and an indirectly heated gasification reactor have been granted in Sweden in early 2010. Patent Cooperation Treaty (PCT) applications have been applied for internationally. Further patents related to the injection technology and char production have been applied for in 2010.

Cortus has been acknowledged by the following awards:

- Best startup in Stockholm Innovation and Growth competition 2006
- Part of the Swedish American Green Alliance (former US Ambassador to Sweden Michael Wood's One Big Thing list)
- Runner up in Swedish Environmental Innovations 2008
- Nominee for the Globe Forum Innovation Award 2009.
- WWF Climate Solver 2009 (<http://www.climatesolver.org/show.php?id=1263453>)
- Listed among the 25 best companies in Nordic Clean Tech Open, 2010
- Member of Cleantech Inn Sweden, 2010
- 25 Cleantech companies for the Cleantech Summit in Geneva, 2011.

## COMPETITION AND COMPETITIVE EDGES

Competition can be found for the biomass feedstock in combustion, anaerobic digestion and other thermal gasification processes. Typically they need a specific type of biomass for each application.

Biomass combustion is a simplistic way of getting energy out of biomass. The water content and the ash composition are the main constraints which make biomass combustion best suitable for water heating applications. Power generation efficiency from biomass combustion is always lower than fossil because of its lower steam pressure. High temperature combustion applications require fuels purer than biomass. Using biomass will lower the productivity in such applications partly because of the increased off gas volume. Low grade biomasses are not used for commercial biomass combustion. State-of-the-art thermal gasification technologies address these shortcomings but to a higher cost level than WoodRoll®.

Anaerobic digestion is a well-established process for getting biogas out of organic rest products. The cellulose part of the organic is digested while lignin or other complex organic compounds can't be processed. These rest products are usually used for feeding or fertilizing but lowers the yield of the process or requires additional investment in upgrading technologies. The process is fairly slow and even at elevated temperature needing 21 to 30 days for completion, compared to one hour in WoodRoll. For this reason there is no distinct scaling advantage in anaerobic digestion. The consequence is that the production cost will stay above natural gas pricing even for a very large scale installation. For this reason anaerobic digestion, considering the amount of untreated feedstock and lack of scalability is hardly applicable for industrial scale operations. State-of-the-art thermal gasification technologies in combination with methanation offer a solution to treating organic material completely in an industrial scale.

Thermal gasification technology projects are under development all over the world. State-of-the-art processes for gasification can be divided into two main groups, air-based gasification in unit reactors or pressurized gasification with oxygen. Several of the new technologies are developed for transport fuel or chemical production. Often implying a high investment and production cost unlike WoodRoll.

Biomass for gasification can be a variety from wood chips to rest products and sludges as long as the biomass is considered renewable and of organic nature. The availability of biomass needs to be thoroughly studied for each and every project on a local scale. Feed stock competition comes from other technologies and methods for green energy.

The WoodRoll technology has been identified as "beyond state-of-the-art" in technology assessment studies by Jaakko Pöyry (Pöyry Sweden AB; 2009), German Consulting Company (Germany 2010) and Gas Technology Institute (GTI in Chicago; IL; USA 2011).

## RAMPING UP



Cortus is ready to go from development stage to commercialization. The first step is to realize a 5 MW plant in commercial scale at Nordkalk AB in Köping, Sweden. Operations are forecasted to turn profitable in 2013 and by 2016 margins are expected to reach a level of 40% (EBIT) with a turnover of +100 M€.

Basic engineering studies are on its way for WoodRoll projects in Spain, Estonia and the USA. Other prospects include a LOI that has been signed with a major steel producer. Sales processes are ongoing with several potential customers in the Nordic countries, the Baltics, North America, India and China from the 5 MW design (same as the Nordkalk plant). Various applications of the WoodRoll technology in high temperature combustion for process industries, combined heat and power and waste processing are analyzed.



Engineering resources have been incorporated in Cortus. An engineering company, GEP Group, was acquired at the beginning of 2011 in order to meet present and coming customer orders. Their capacities and expertise is in project management for industrial projects from engineering, procurement, safety, commissioning and much more. Their abilities have been proven in projects in the EU, the USA and

Asia.