implications behind biochar. Our goal is simple: to open up carbon markets to biochar and pyrolysis technologies. Information can be found at www.biocharprotocol.org.This presentation will address:

- Basics of GHG Protocols and Available Markets
- GHG Emission Reduction Mechanisms and Available Science

The BlackCarbon Project: Pyrolysis/Stirling Engine Co-generation at micro scale (250-500 kW)

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BlackCarbon has commissioned and financed a pilot plant that combines ScrewPyrolysis and StirlingEngine technology to create a cost-effective, robust and resource efficient multifunctional biomass energy unit. The unit is the first of its kind anywhere in the world to combine these technologies.

It has now run for 1000 hours and has produced 25.000 kW of electricity and 20 tonnes of Biochar. A small number of technical questions need to be resolved before the unit can enter into commercial use. These will be dealt with over the next 3 months.

The expected annual production of BioChar is 20 kg/h for 7.500 hrs, equal to 150 tonnes of Biochar per annum.

The test runs have confirmed this performance.

Quality of Char:

The main concern has been whether the char would meet the strict standards in Denmark with regard to heavy metal and PAH content. Early lab tests and recent tests of an actual char batch from the unit have confirmed that the char easily meets the standard.

Energy economics:

The expected Turn-Key delivery cost of a 350 kW unit is 250.000 €.

If the feedstock (dry (15%) wood chip) is valued at 50 € per tonne the annual cost is: 37.500 €

Annual Capital costs (i=8 and n=10) 37.500 €

Maintenance and personnel costs 60.000 €

Overhead 25 % 15.000 €

Total annual costs 150.000 €

Value of electricity at a feed-in-tariff of 20 €-cent 52.500 €

Value of heat at 10 €-cent per kWt 91.500 €

Production Cost of Bio-char 6.000 €

Production cost per tonne of Bio-char 40 €

Production cost per tonne of CO_2 equivalents in char 11 €

Challenges:

- In order to reach stable hour-on-hour energy output and high quality Bio-char production the unit has to achieve a fine calibration of feed-stock input, residence time, and re-use of exhaust heat. Presently, the use of exhaust gas to heat the pyrolysis screw is not delivering enough heat to make the entire unit fully exothermic. If we force more wood-chip through the screw, the char contains too much tar.
- The syn-gas contains a lot of tar - at the tar sometimes combines with char-dust, which clogs up the gas pipe leading from the screw to the combustion chamber. Right now it is still necessary to “burn-out” the pipe every 24 hours.
- Other feed stocks: We need to ascertain whether other feed stocks than wood chip can be used: straw, corn stover, rice husks, olive pits.
- Safe cooling of biochar - we have experienced reignition of biochar- even when it has been stored at ambient temperature for a number of days.
- Agricultural use of bio-char-the rules in Denmark are quite strict - especially on land which is certified organic. The rules specifically state that biomass waste with a residual energy content (ie. biochar) need aspecial permit.

Treatment of greywater and wastewater with char coal

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Char coal has been used for millennia to clean liquids and air from certain elements or compounds. Recently, biochar as a soil improver and simultaneously a carbon sink has been acknowledged. To balance the high carbon content of biochar, its application as a soil improver may need an additional nitrogen application. One way to obtain a favorable carbon/nitrogen ratio of the biochar would be to expose the biochar to household effluents rich in nitrogen.Here we present results on different qualities of char coal exposed to grey water, nitrogen solution, human urine, and wastewater, respectively. Nitrogen sorption and transformation were studied in laboratory and field in order to evaluate the potential of char coal as a means for treating greywater and wastewater in robust treatment plants based on principles of nutrient cycling.

Charvester development for a sustainable biomass production

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In recent years, the usage of biomass for heating purposes of houses has increased in Sweden as a means to replace burning of fossil fuels. However, this will lead to decreased content of soil organic matter, being important for maintaining soil fertility. A sustainable approach would be to insulate the houses better so less heating will be needed and use excess biomass for biochar production and apply to productive soils. Technology used for gathering branches and straw for biomass could be used also for gathering biomass to pyrolysis, while suitable equipment for pyrolysis needs to be developed.

The current state of the Swedish ’Charvester’ project is described. The goal of this project is to create a prototype for a mobile pyrolyser autonomously moving using the pyrolysis heat for movement as well as internal energy needs for biomass processing, as chipping and drying. Possibly, a surplus fraction of the pyrolysis gases/liquids will be converted into biodiesel or other products in the synthetic industry. The produced char will be optimized for biological virtues, length of heating time, and pyrolysis temperature. As improving biological virtues may increase machinery size and process time, an optimization will be found, using specific surface area (BET analyses) and micrography methods as proxys for biological virtue.