Bioenergy in Sweden

- Bioenergy is very important in Sweden.
- 1972 - 2005 bioenergy increased from 40 to 112 TWh.
- Now about 25% of the total energy based on bioenergy.
- The former Swedish government stated that Sweden should be free from dependence on oil by 2020.
- "The Oil Commission", led by the Prime Minister said "future potential for bioenergy can be 228 TWh" (=50% of primary energy supply).
Agriculture bio crops

♦ Most of the bioenergy in Sweden is forest fuel. Agriculture bio crops give about 1%.
♦ Rapeseed on about 2000 hectare. Can be increased to 25000 – 50000 hectare.
♦ We get 3 ton rapeseed per hectare and that gives 1.2 ton rape oil.
♦ Most of the rape oil is used for RME - Rape Methyl Ester or biodiesel.
♦ The purchase of RME is increasing. In 2004 10160 m³ of RME was purchased in Sweden.
♦ 21 filling stations for RME were established until December 2005.

Rape-oil co-generation in Falkenberg

♦ 19 months test with a small scale cogeneration plant.
♦ The project is supported by the local utility company.
♦ Heat has mainly to water for the drying process for seeds and space heat in an office.
♦ “Electricity Certificates” - a support system for green electricity gives 2.5 eurocent/kWh.
♦ The increasing interest in rape oil is caused by the high oil prices. An estimation indicates that the current rape-oil price is about the same as the diesel-oil-price.
Technical description

♦ Volvo 7.4 liter marine engine, 178 kW.
♦ Closed internal circulating system for cooling with a heat exchanger.
♦ Synchronous generator, 120 kVA.
♦ The generator can balance the active/reactive power during varying loads.
♦ Half automatic operation. Start and stop was initiated manually.
♦ The rape oil was quite newly pressured oil transported by a pump through a filter unit.
♦ For start and stop a tank with diesel fuel was used. A small problem was that the diesel oil was mixed with some rape oil, but this did not cause any disturbances in operation.
♦ To give the rape oil the right viscosity for the engine, the rape oil was heated to about 90°C.

Data collecting

Automatic data collecting:
♦ Temperature of cooling water in and out into the engine,
♦ Exhaust gas temperature.
♦ Temperature in the environment.
♦ Temperature on the rape oil before injection pump.
♦ Temperature to the first and sixth oil distributor on the engine.

Manual data collecting:
♦ Temperature of cooling water in and out, flow of cooling water, produced heat, MWh.
♦ Active and reactive electric power delivered to the grid.
♦ Filling of rape-oil and diesel-oil.
♦ Operation time.
Experience of the operation

♦ The cogeneration plant has been running for 1850 hours at normal office time, which has resulted in more than 180 cold startups. They were made with ordinary fossil diesel-oil.
♦ The specially developed control system tried to minimize the operation time with diesel but had a side effect of mixing rape oil in the diesel tank. About 15% of rape oil was mixed into the diesel during a great part of the operation time.
♦ The consumption of cold pressured rape oil has been about 25 litres per hour and total 42 m³ during the operation period.
♦ Energy delivery has been 102 000 kWh of heat and 82 000 kWh of electrical energy.

Conclusions

♦ No critical influences on the engine have been found.
♦ The operation with a lot of starts and stops has not given any bad impact.
♦ The total efficiency during the operation time has been about 50%.
♦ 20% of the energy value of the rape oil has been electricity and 30% has been heat energy.
♦ We have not captured much of the heat in the exhaust gases.
Next step

- Develop a new system for preheating the oil, that prevents the mixing of rape-oil in the diesel tank.
- Measurement of emissions.
- Control the operation by means of the needed heating power.
- Developing an optimizing system for controlling the power factor.
- Making a concept for a commercial co-generation plant usable for a country estate.
- Will “rape-electricity” be a new part in the “green electricity mix” in Falkenberg?