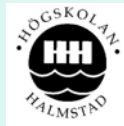




PLANZENÖL IN EUROPA  
Gleisdorf 25.4.2007

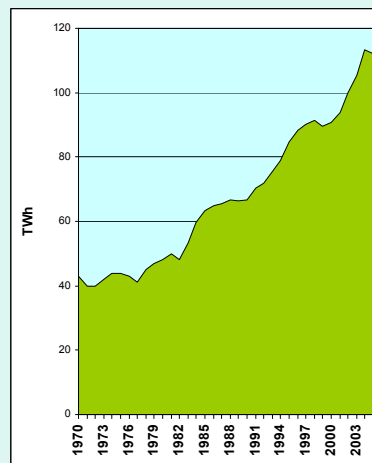
## Rape oil technology in Sweden

MSc. Göran Sidén  
Halmstad University



## 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 m<sup>3</sup> 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.



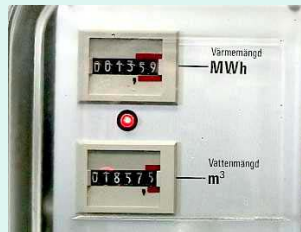
## Data collecting

### 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.



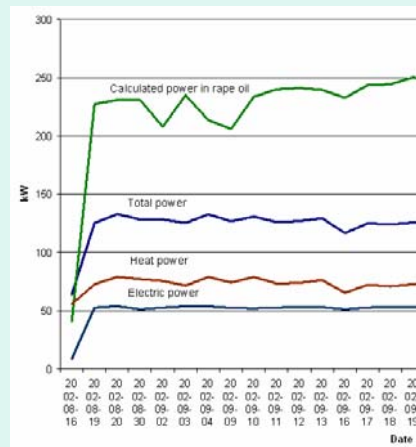
## Experience of the operation

- ◆ 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 m<sup>3</sup> 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?

