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THERMALLY DRIVEN HEAT PUMP BASED ON DOUBLE RANKINE CYCLE

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Author and Coauthors	J. Demierre, D. Favrat, J. Jakubowski
Company / Institution	EPFL, STI-IGM-LENI
Address	EPFL, LENI, Bât. ME A2, Station 9, CH-1015 LAUSANNE
Phone, e-mail, Internet	++41 21 693 67 29, jonathan.demierre@epfl.ch, http://leni.epfl.ch
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SFOE-Project Coordinator	Th.Kopp, Head of R&D Program ‚Heat Pumping Technologies, Cogeneration, Refrigeration' of SFOE
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SUMMARY

Single combustion in boilers is a very inefficient way of heating. The higher cost of fuels and pollution concerns are likely to put more and more political pressure to prevent the use of boilers for most heating purposes. Alternatives are all linked to heat pumps allowing the upgrading of renewable heat from the environment. Thermally driven heat pumps from a variety of fuels including wood pellets or natural gas are usually realized using an absorption heat pump or by a combination of heat engine cycle with a compression heat pump cycle or a combination of both.

The concept studied in this project is a low power ORC-ORC system (about 20 kW heat at the condenser) which is composed of an ORC engine cycle driving a reversed ORC heat pump cycle, both using the same fluid. The radial compressor and turbine are directly coupled on the same shaft rotating on refrigerant gas bearings. This gives the system the advantage of being oil-free, fully hermetic and with low maintenance costs in spite of the more complex circuitry. The objectives of this project are the theoretical study of such systems and the conception and test of a prototype.

A first theoretical study of a residential ORC-ORC thermally driven heat pump is done. An ORC-ORC model has been developped and coupled with an energy integration software and a multiobjective optimization tool to generate optimal designs. Preliminary calculations show that COP's higher than 1.6 could be expected which would be competitive with absorption heat pump alternatives. The turbine rotor for the ORC-ORC ptototype has been designed and machined.