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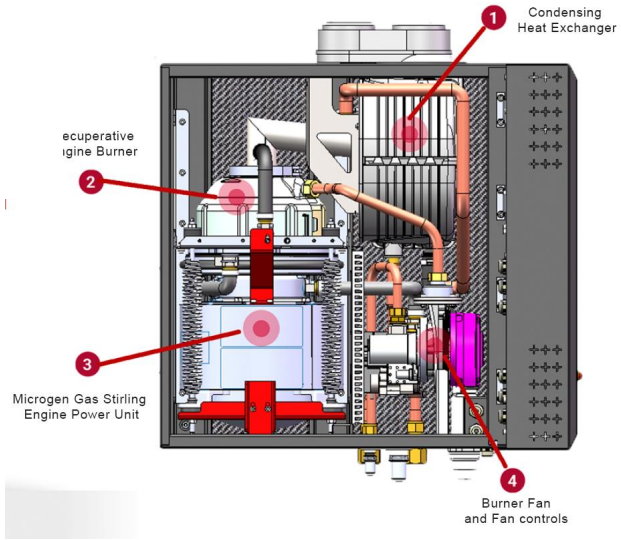
Examples of Systems Available

- System overview
- Some technical details
- Heat Power Ratio Issues
- Some conclusions



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Commercial System Overview

Company	MicroGen	Kaymacor	ÖkoFen	MicroGen	MicroGen	"Inresol"	Comments
Product	TermoGen 1.0 kW	Morgana 4 kW	ÖkoFEN 3-16	BioGen WL Power&Heat	BioGen CP Power&Heat	"Genius"	
Technics	Stirling	ORC/Expander	Stirling	Stirling	Stirling	Stirling	Morgana: ORC, oil based closed circle, low temperature (90-150 °C) and low pressure
Technical Readiness Level	6-7	5-7	6-7	6-7	6-7	3-4	Kaymacor: about 15 installation (farmers, hospital, lab. Collaboration with WoodCo, Ireland), most of them demo/test facilities, "few" H-CHPs; ÖkoFen > 30?
Engine	Microgen Stirling engine	n.a.	Microgen Stirling engine	Microgen Stirling engine	Microgen Stirling engine	Inresol	
Heat Source	Gas / "Clean" BioGas	Any	Pallet Burner	Wood logg gasifier	Chips/Pallets gasifier		Morgana: ORC, oil based closed circle, low temperature (90-150 °C) and low pressure.
Electric Power	1 kW	4 kW	1 kW	1 kW	1 kW	(2 kW)	High uncertainty for the data - little actual proof
Heat Power	6 kW	40 kW	16 kW	20 kW	6 KW	(12 kW)	High uncertainty for the data - little actual proof
Price	€14-17,000	€ 25,000	€ 35,000	€ 12,000	€ 16,000	No price available	Observe: Additional installation and adaptions is not included
Size [m]	0.7X0.6X0.5*	0.6X0.45X1.8*	0.7X0.7X1.7	1.2x0.8x2	1.5x2.5x2.5	0.7X0.6X0.5	*Burner not included
Activity	High	Low-Med	Medium	High	High	Low	
Company Size	>50	2-5	>300	>50	>50	(>30) 1-2	Inresol was closed down early 2019 - some continues development in a small company - focused on engine development

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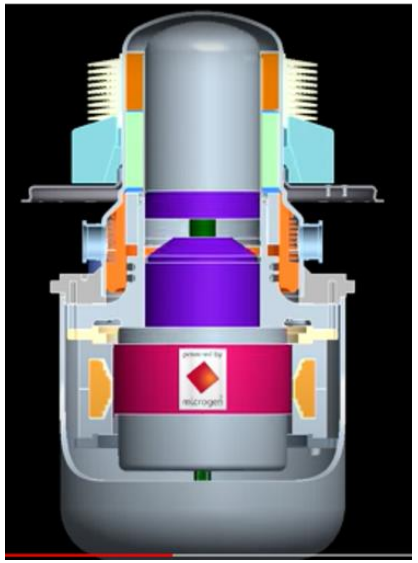
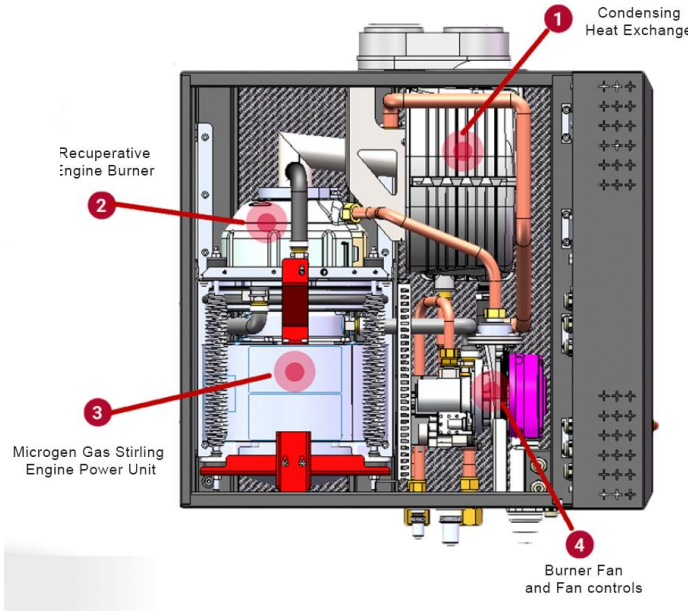
Technical Details - Stirling

Source: Oekofen.com

Source: Microgen-engine.com





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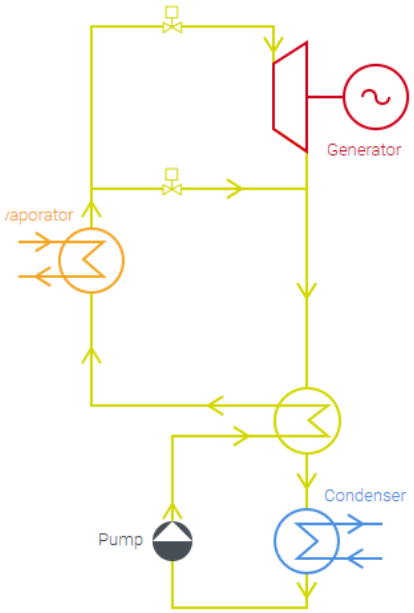
Technical Details – ORC



Source: Kaymacor.com
Source: Kaymacor.com

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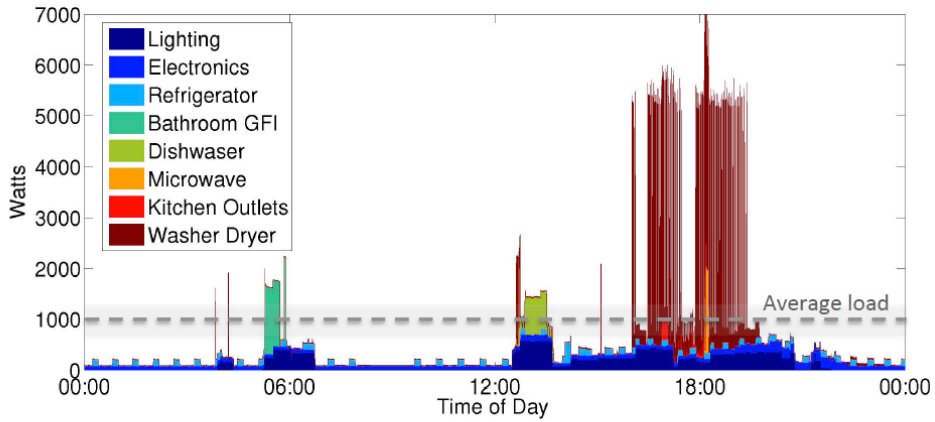
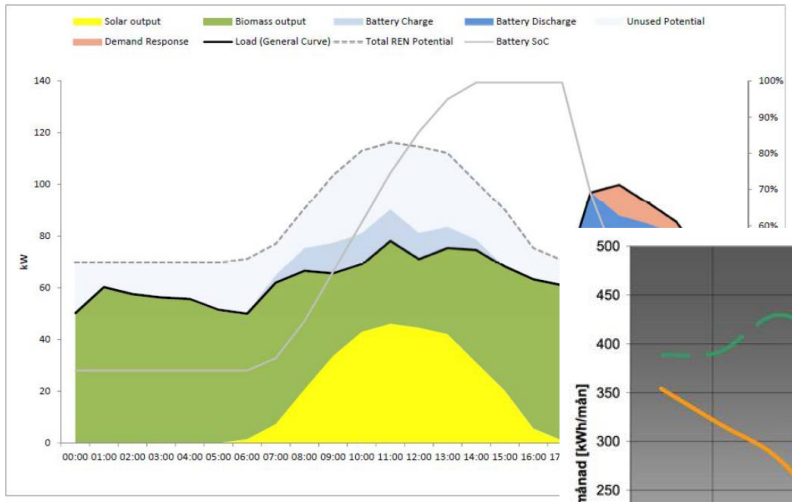
Heat Power ratio Issues

Daily energy use in buildings

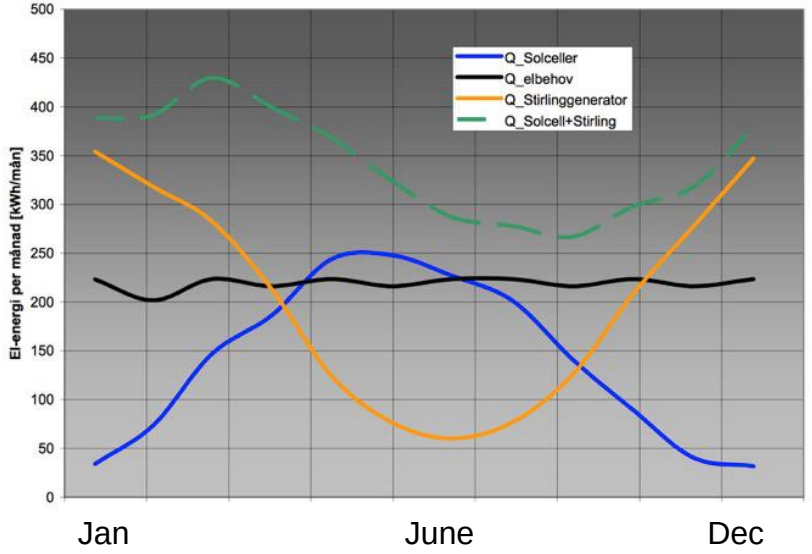


- The average load in a single family building are 0,8 – 1,2 kW
- Peak loads occur in the evenings in residential and mid day in commercial (buildings)
- Major loads as washer, dryer, microwave etc, are small in energy and high in power
- The peak power is up to around 7kW in a majority of single family buildings
- Hot water are typically 2-3kW in water heaters and 3-12 kW of room heating

Daily energy output CHP system



Source: Inresol.se



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Conclusions

- Limited market with very few actors/suppliers
- Stirling most common
- Few micro CHPs user feedback/references
- Requires a pioneer mind-set in many cases
- Feasible energy supply requires two sources (mCHP+; Solar panels; Grid connected …
- The heat power ratio is a challenge/risk for low efficiency

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