Calor Technologies LLC

# Micro-CHP: Avenues for greater market penetration

FESC 2015: Stephen Welty

# Micro-CHP External Engines

VIESMANN

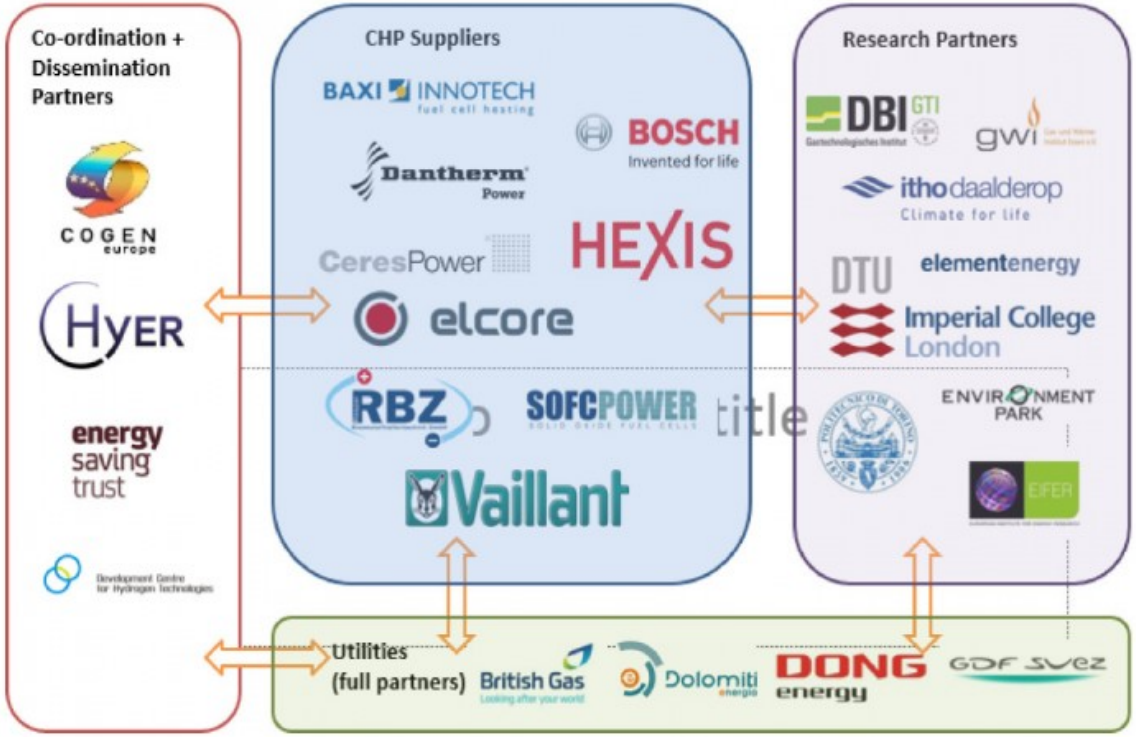

- Stirling
- Rankine
- Brayton

NextGrid

remeha

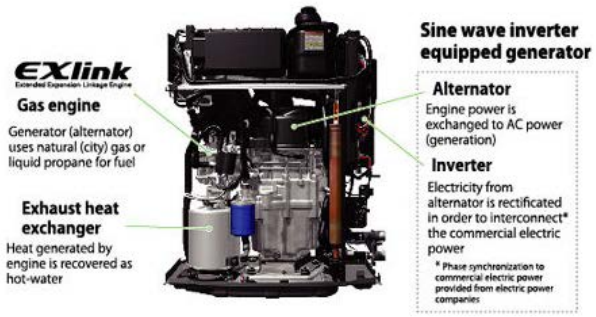
BAXI

# Micro-CHP: IC and Fuel Cell




Source: enefield.eu


Marathon

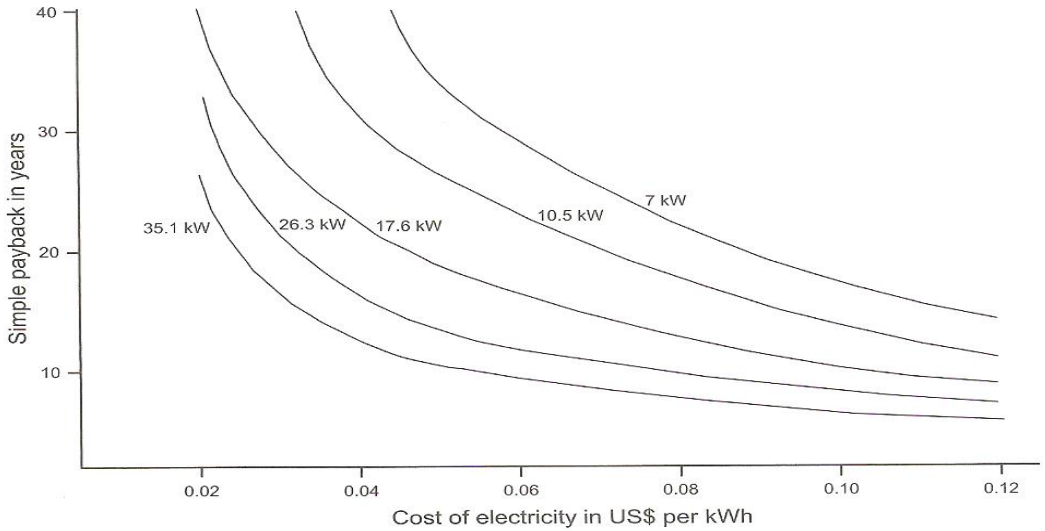


# Overcoming Limitations

- Policy and Incentive (RHI) – more favorable to renewable heat (biomass CHP).
- Providing income to micro-CHP operator/owners for dispatchable power to avoid building dirty peaking plants.
- Increasing Heat Demand by using Heat Driven Cooling.
- Technology breakthroughs that can provide micro-CCHP.

# Heat Driven Cooling

Simple Payback for Absorption Chillers



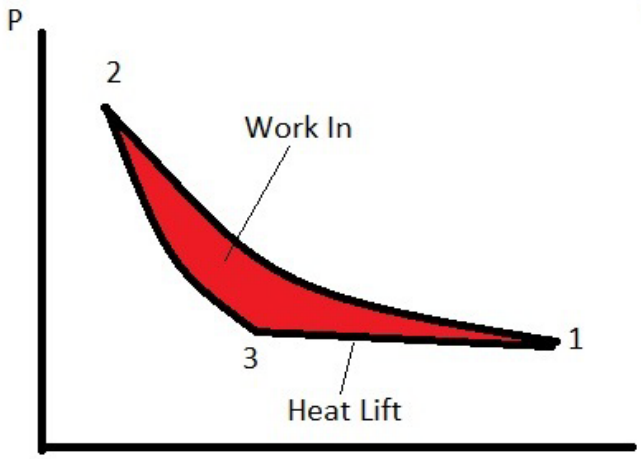

Source: Dickson, 2012

Yazaki Li Br Chillers
5 RT Chiller is smallest


-Single-Stage system use lower temperature
-Dual – Stage can perform better but require higher temperatures.

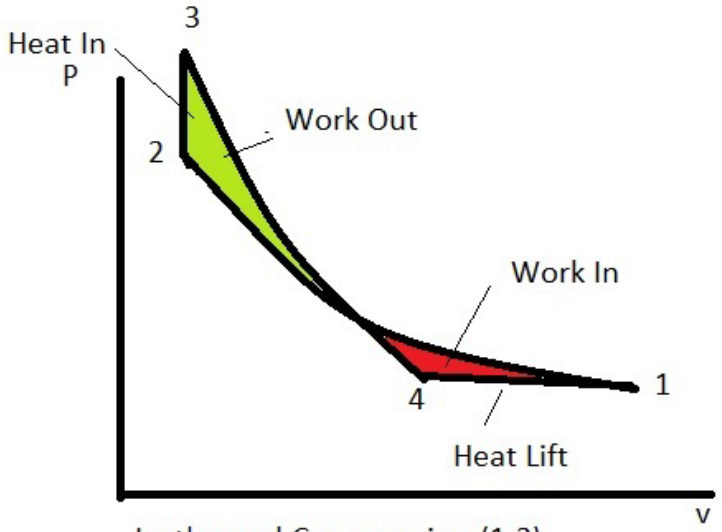
# Novel Thermodynamic Cycle

Cooling Mode




Isothermal Compression (1-2)
No Heat Addition
Isentropic Expansion (2-3)
Constant Pressure Heat Addition (3-1)

Cooling & Generation: Alternative CV




Isothermal Compression (1-2)
Constant Volume Heat Addition (2-3)
Isentropic Expansion (3-4)
Constant Pressure Heat Addition (4-1)

This cycle could also have process 4-1 as a constant volume process if closed cycle is used which may be advantageous in many instances.

# Expansion and Compression

Conventional Expanders and Compressors like reciprocating pistons, scrolls and vanes do not yield the >90% isentropic efficiency required to simultaneously generate power and cooling.

This leaves bellows and diaphragms as options but bellows have very large dead volumes in convolutions which would require fillers.