

# Micro-CHP: Avenues for greater market penetration

FESC 2015: Stephen Welty



# Micro-CHP External Engines

### VIESMANN





- -Rankine
- -Brayton







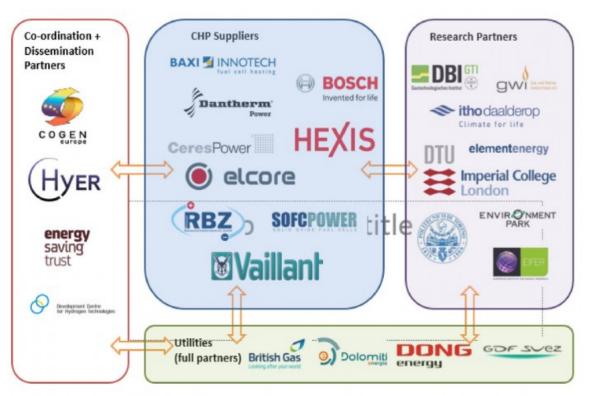








## Micro-CHP: IC and Fuel Cell





Marathon

Source: enefield.eu



Exlink

Extended Expansion Unitarya Engine

Gas engine

Generator (alternator) uses natural (city) gas or liquid propane for fuel

Exhaust heat exchanger

Heat generated by engine is recovered as hot-water



Sine wave inverter equipped generator

Alternator

Engine power is exchanged to AC power (generation)

Inverter

Electricity from alternator is rectificated in order to interconnect\* the commercial electric power

\* Phase synchronization to commercial electric power provided from electric pow companies



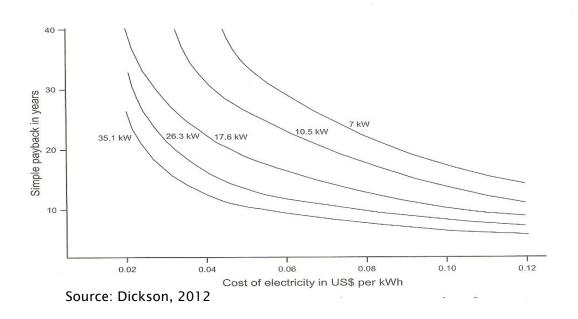
## **Overcoming Limitations**

- 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



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

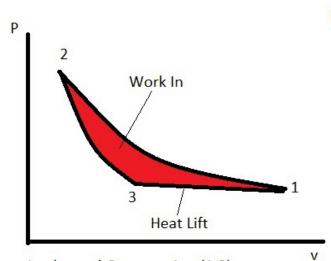
## Yazaki Li Br Chillers 5 RT Chiller is smallest





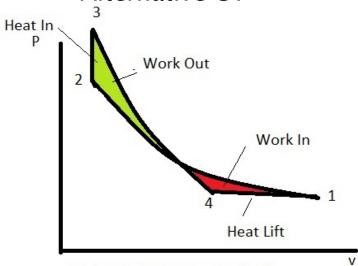
# Novel Thermodynamic Cycle

#### **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.

5/27/2015 6



# **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.

