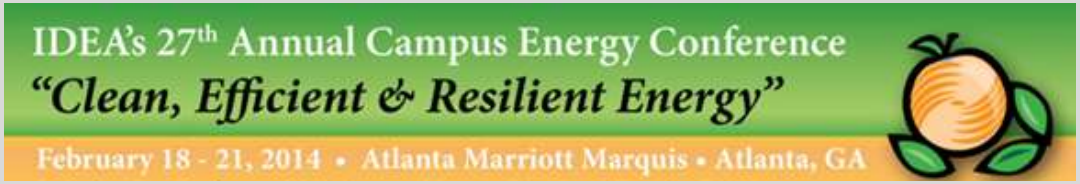
LOW TEMPERATURE HEATING DISTRIBUTION SYSTEMS

David W. Wade, P.E.



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Centratherm, Inc.

- **Toward 4th Generation District Heating – Annex X Final Report IEA 2014**
- **District Heating Guide - ASHRAE**

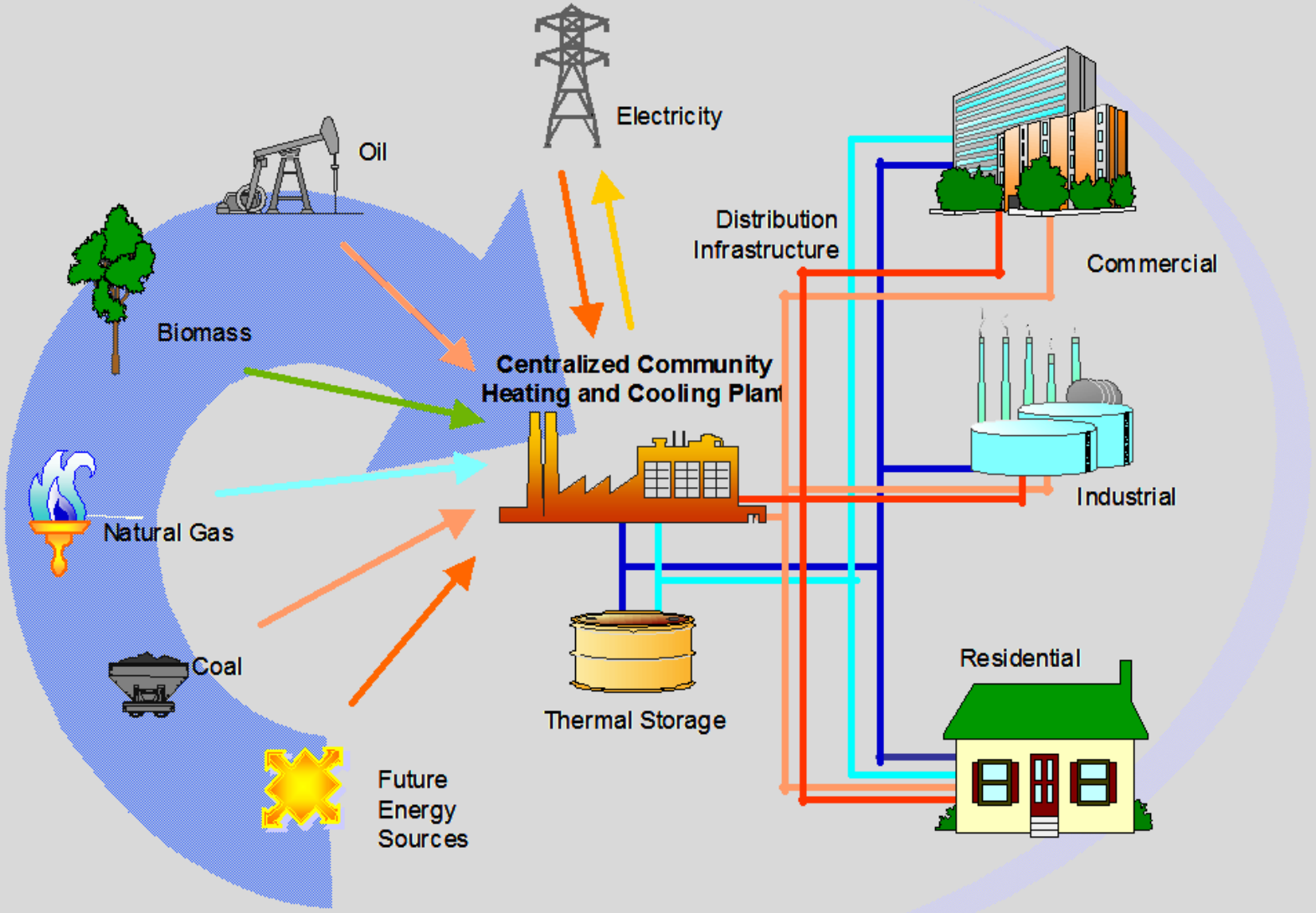
<u>Photographs</u>

Rehau **Logstor**
Rovanco **Uponor**
Centratherm/Isoplus
Campbell & Associates, Inc.

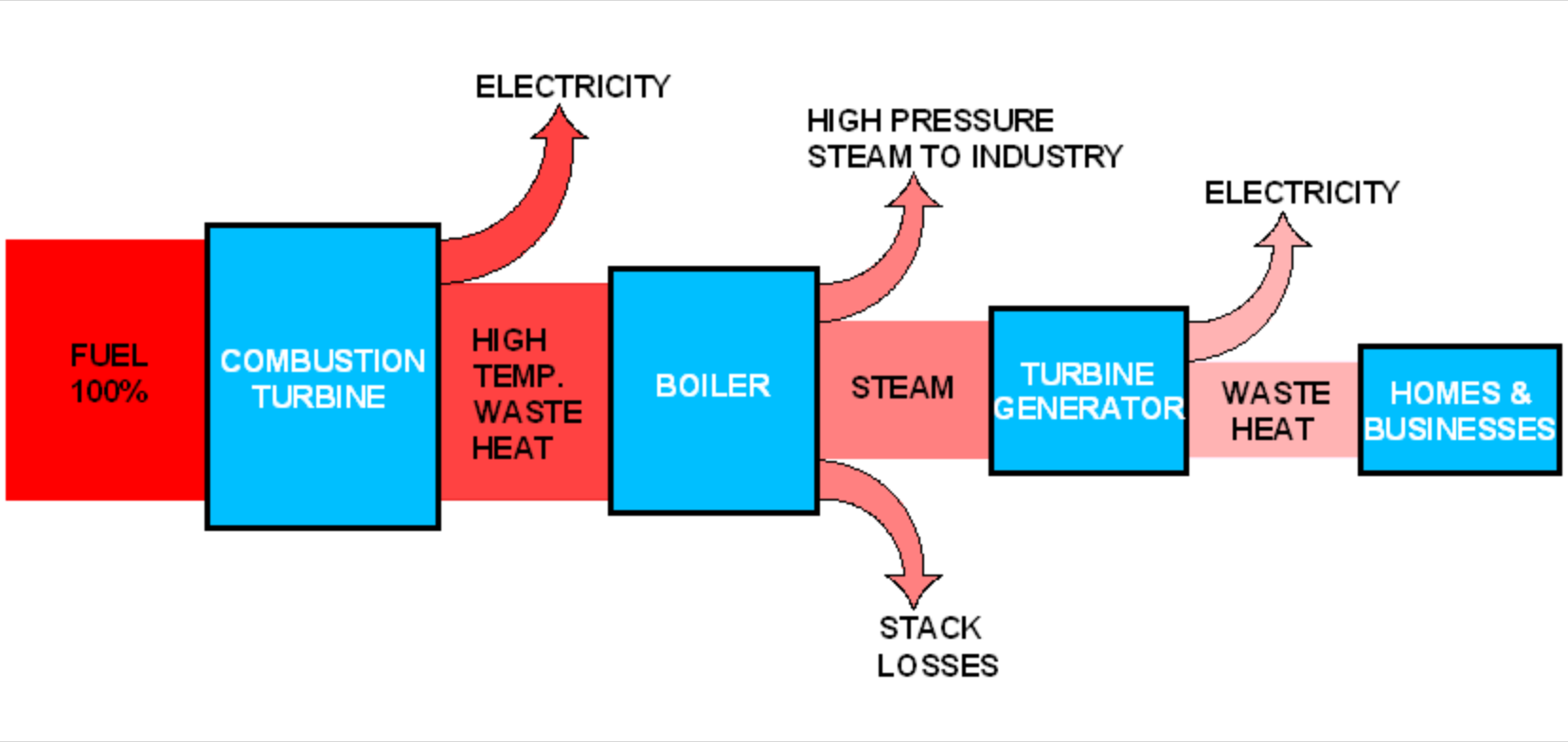
ACKNOWLEDGEMENTS

OBJECTIVES

- Define low temperature district heating
- Describe low temperature systems
- Illustrate low temperature distribution techniques
- Identify benefits and drawbacks


Electricity
Oil
Distribution
Infrastructure
Commercial
Biomass
Centralized Community
Heating and Cooling Plant
Industrial
Natural Gas
Coal
Residential
Thermal Storage
Future
Energy
Sources

ENERGY CASCADE



COMMON DISTRICT SYSTEM DISTRIBUTION TEMPERATURES

High Temperature	**Steam 250 psi**	**406° F**
	High Temperature Water	**350° F - 450° F**
Medium Temperature	**Steam 15-30 psi**	**250° F - 275° F**
	Hot Water	**250° F - 350° F**
Low Temperature	**Hot Water**	**Below 250° F**
Other Systems	**Tempered Water**	**Below 90° F**
		Geothermal

CONVENTIONAL LOW TEMPERATURE SYSTEMS

180° F - 210° F Supply
20-30° Delta T
Pressure 50-80 PSIG

- **Applied with conventional 80% efficient natural gas and oil boilers**
- **Industry accepted coils and radiators**
- **Easy interface with steam systems**

THE NEW PARADIGM
LOW TEMPERATURE HEATING SYSTEMS

140° F - 150° F Supply
Max Pressure 90 PSIG – 125 PSIG

- **Compatible with condensing boiler**
- **Compatible with input from heat pumps**
- **Compatible with solar or geothermal**
- **Many sources of waste heat**

TRENDS SUPPORTING LOWER DISTRIBUTION TEMPERATURES

- More efficient buildings
- Need for lower life cycle costs
- Diversified heat sources
- Availability of new piping materials

MORE EFFICIENT BUILDINGS

- **Current codes have reduced unit energy demand by 50% compared to 1974**
- **Planned codes will continue to reduce unit energy demand**
- **Quest for “net zero” buildings**

NEED FOR LOWER LIFE CYCLE COSTS

- **To compete, district systems must have lower life cycle costs than independent building systems**

  This means high first costs for distribution must result in:
  - **Long life**
  - **Low losses**
  - **Low maintenance**

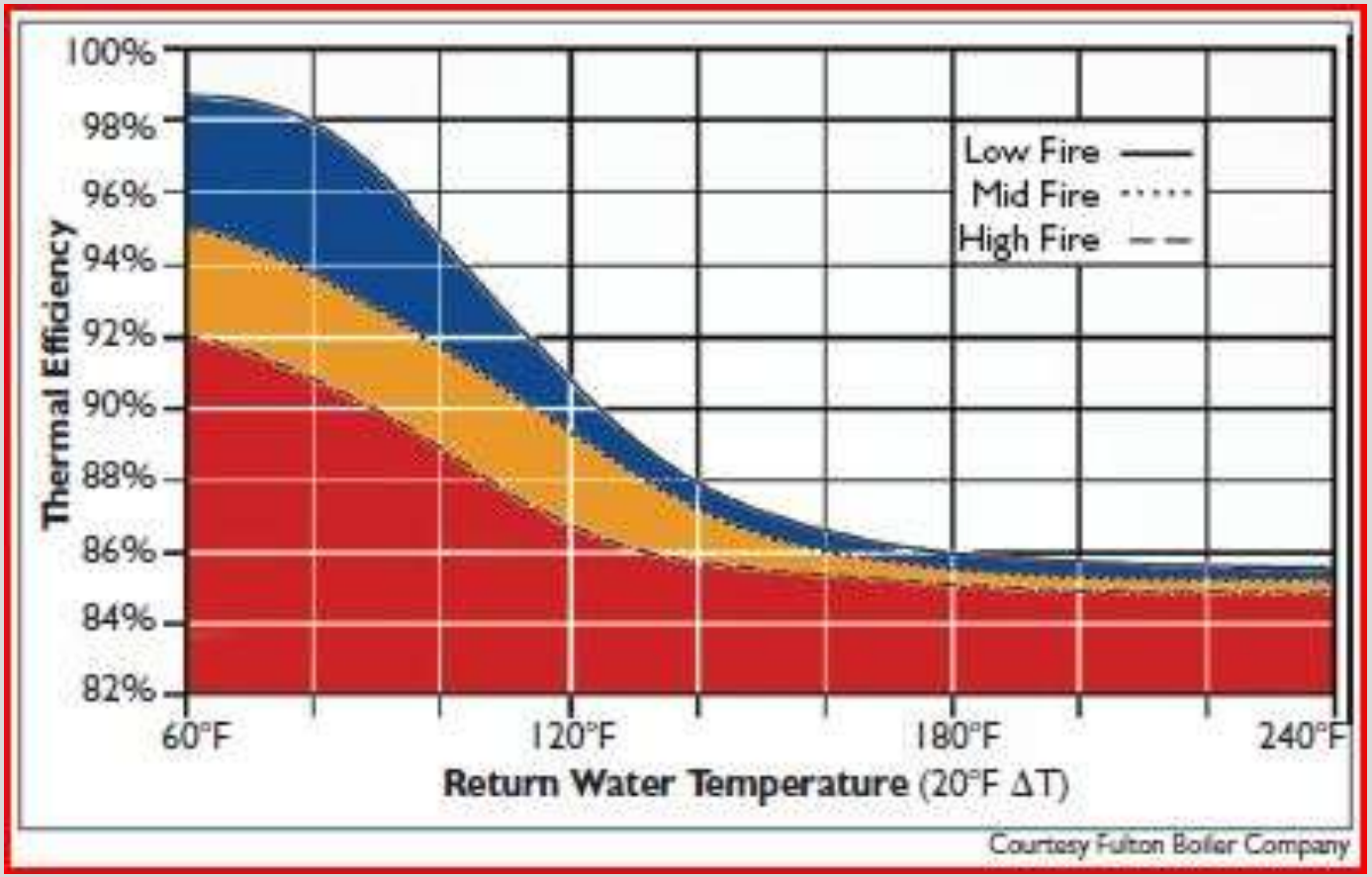
HEAT LOSS
HIGH V. LOW TEMPERATURE

- **Heat loss is proportional to Delta “T”**
- **Low temperature systems encourage optimized network design using PUR insulation**
- **Variable supply temperature**
- **Twin pipe geometry reduces loss**

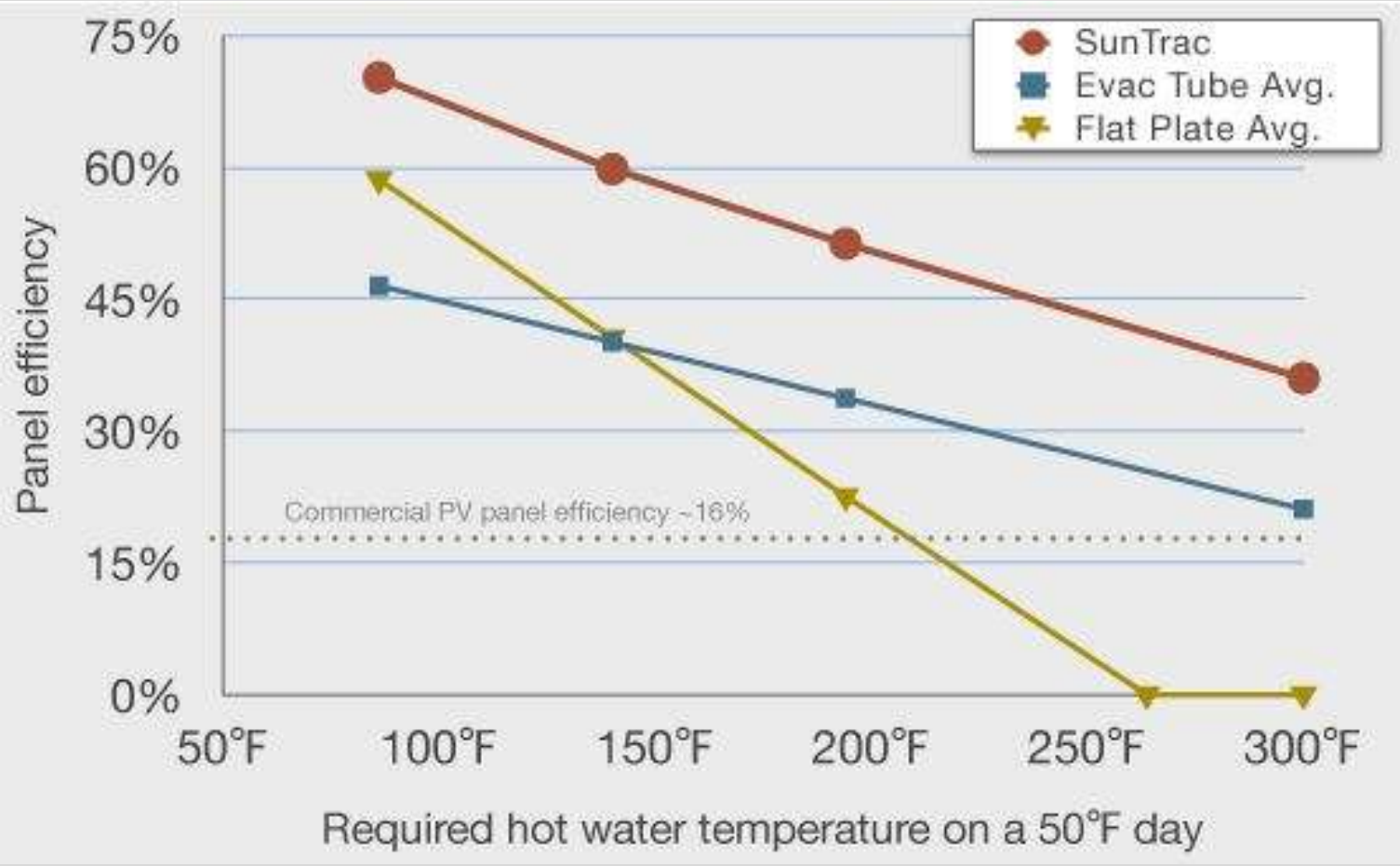
DIVERSIFIED HEAT SOURCES

- **Natural gas condensing boilers**
- **Solar**
- **Heat pumps**
- **Waste heat from power generation**
- **Waste heat from industrial processes**

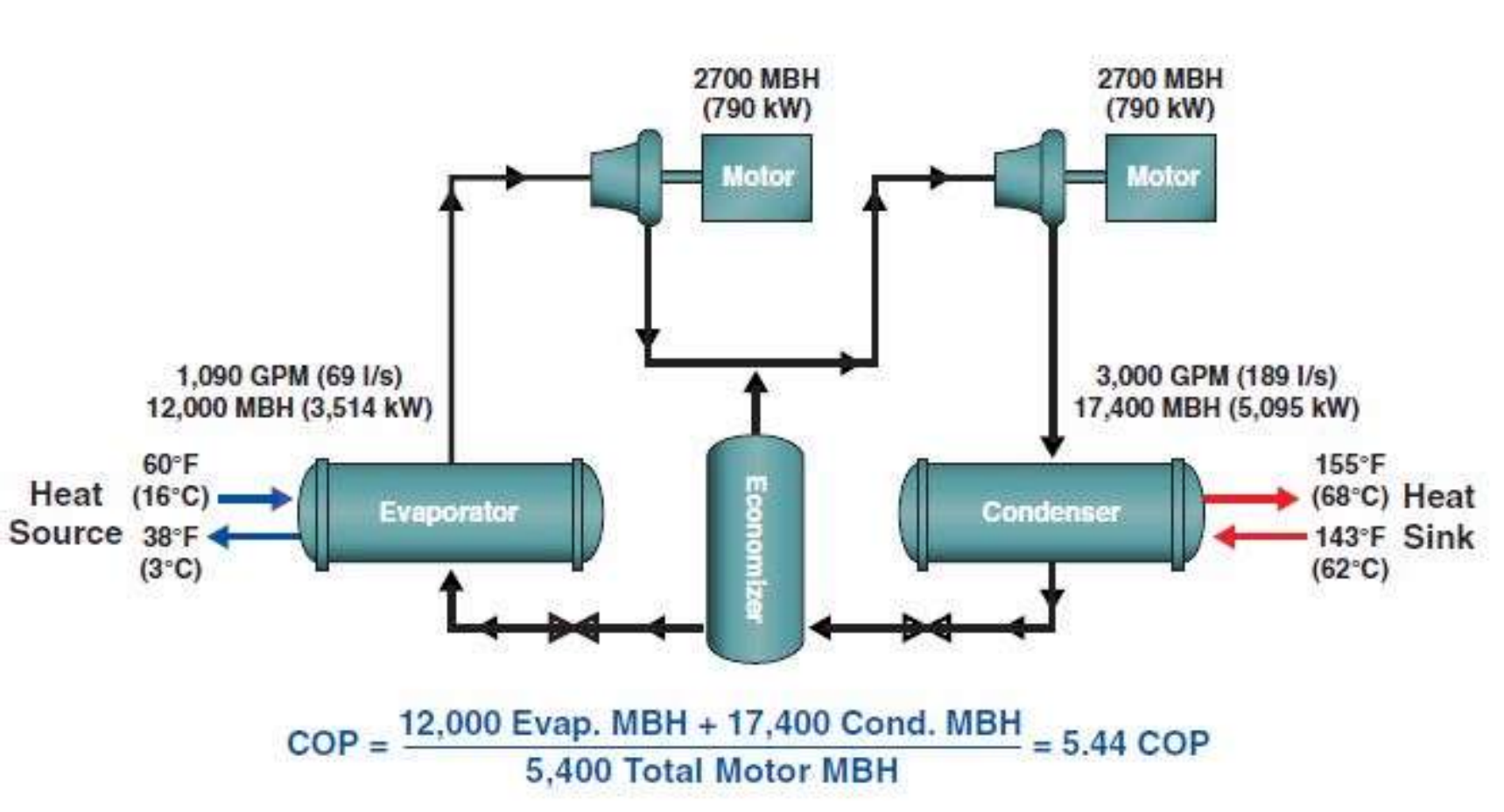
CONDENSING BOILERS



SOLAR

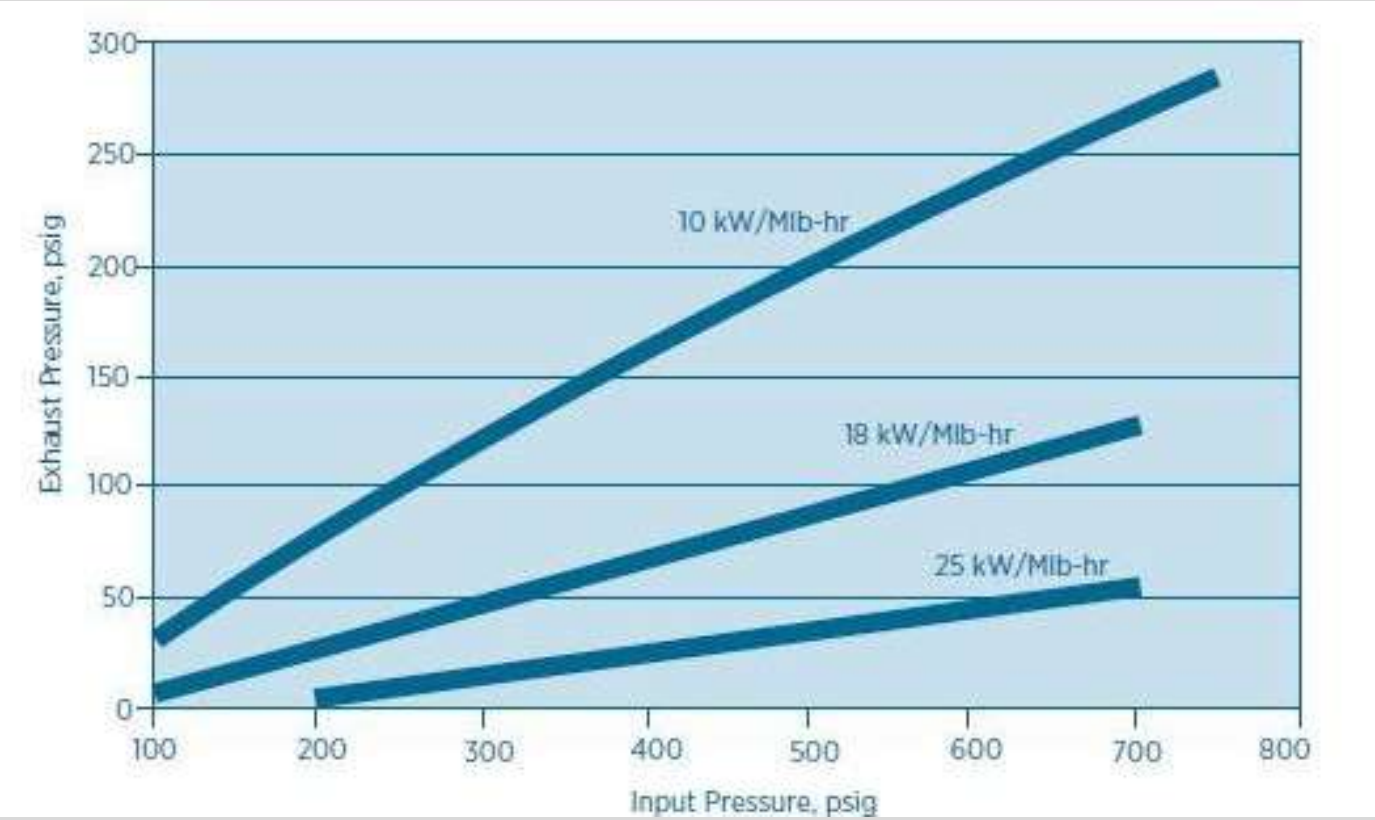

75%
60%
45%
30%
15%
0%
Panel efficiency
SunTrac
Evac Tube Avg.
Flat Plate Avg.
Commercial PV panel efficiency ~16%
50°F
100°F
150°F
200°F
250°F
300°F
Required hot water temperature on a 50°F day

HEAT PUMPS


2700 MBH
(790 kW)
Motor
2700 MBH
(790 kW)
Motor
1,090 GPM (69 l/s)
12,000 MBH (3,514 kW)
3,000 GPM (189 l/s)
17,400 MBH (5,095 kW)
Heat
Source
60°F
(16°C)
38°F
(3°C)
Evaporator
Economizer
Condenser
155°F
(68°C)
143°F
(62°C)
Heat
Sink
COP = 12,000 Evap. MBH + 17,400 Cond. MBH / 5,400 Total Motor MBH = 5.44 COP

POWER GENERATION

Estimating Power Output Using Steam Inlet and Exhaust Pressures



INDUSTRIAL PROCESSES

Waste Heat Recovery

- Kilns/ovens
- Process dryers
- Hot water bath discharge

LOW TEMPERATURE PIPING SYSTEMS

- **Bonded piping systems**
  - **Steel carrier pipe**
  - **PUR insulation**
  - **HDPE jacket**

<250° F
< 350 psi
Sizes up to 36“
Welded joints

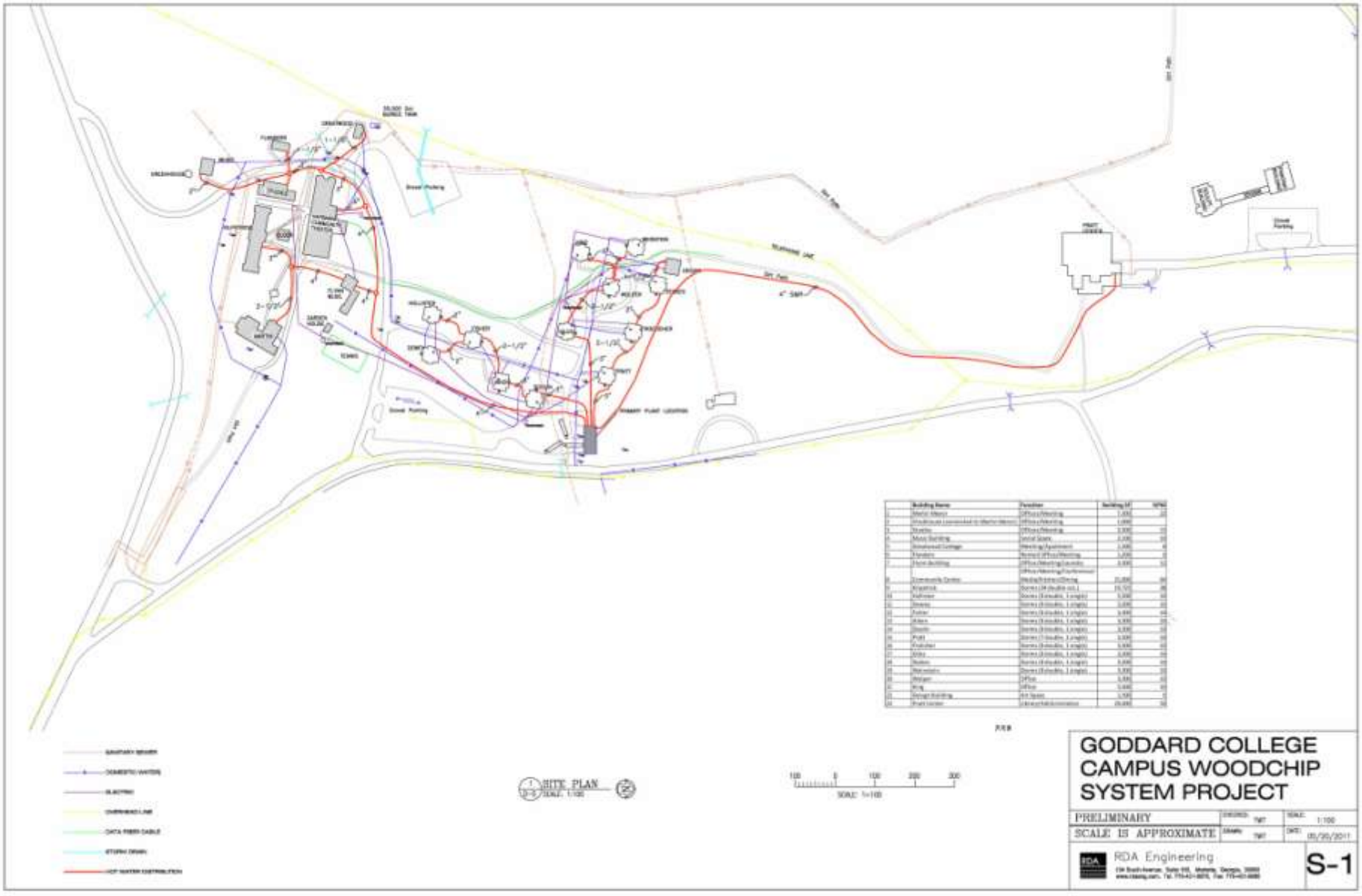
- **PEX piping systems**
  - **PEX**

<200° F
< 85 psi
Sizes up to 4“
Mechanical joints


DEERE

PROJECT EXAMPLES

- **Chattanooga State Community College**
- **Goddard College**


SITE PLAN
SCALE: 1:100
SCALE: 1=100
GODDARD COLLEGE
CAMPUS WOODCHIP
SYSTEM PROJECT
PRELIMINARY
SCALE IS APPROXIMATE
RDA Engineering
S-1

LOW TEMPERATURE SYSTEM ADVANTAGES

- Reduced heat loss
- Increased system life
- Interface with renewable resources
- Increased potential for CHP
- Higher efficiency interface with heat pumps and solar collectors
- Easier interface with thermal storage

LOW TEMPERATURE SYSTEM DISAVANTAGES

- **Not appropriate for process needs**
- **Can require additional heat transfer surface**
- **Unit heat transport less for given pipe diameter**
- **Low temperature limited by domestic water heating**

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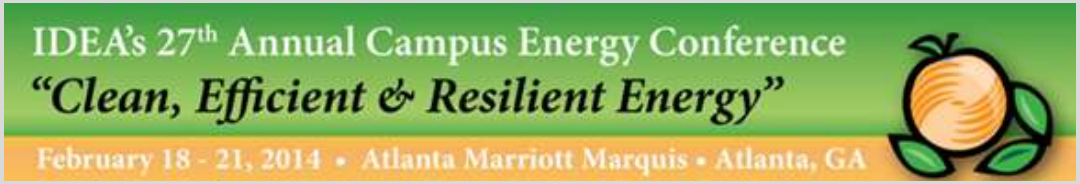

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