Big Green Machines

2010 Workshop

Reducing Energy Costs
Effluent-Source Heat Pump

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Facility overview

- McMinnville population 32,000
- Facility constructed 1995
- Secondary effluent - winter
- Tertiary effluent - summer
- Design capacity
  - 5.6 mgd dry weather
  - 32 mgd wet weather

Conservation project checklist

- Multiple benefits (sustainable)
- Direct energy savings
- Environmental benefits
- Equipment / process improvements
  - Reduced maintenance
  - Improved control
  - Appropriate scale
- Utilize existing assets
- $ Cost (incentives?)
- Staff / organization acceptance

Project Development

- Prior successful energy saving projects – additional possibilities?
- Brainstorming with staff & engineers
  - Identified heating, ventilation & air conditioning (HVAC) problems / improvement opportunities in Administration building
  - Heat Pump option seemed viable but more expensive than other options

Project objectives

- Utilize effluent plant water as a resource
- Use existing assets if possible to reduce $$
  - Pumps (plant water system)
  - Air conditioning chilled water loop
- Improve Building Automation System (BAS)
- Solve HVAC issues within Administration building (inefficiencies, staff comfort)
- Retain existing systems for redundancy / extra capacity

Considerations / risks

- History of frustrations w/ HVAC
- Leading vs “bleeding edge” technology
- Utility incentives based on verified electrical savings
  - Bonneville Power Administration
  - McMinnville Water & Light
  - Business Energy Tax Credit

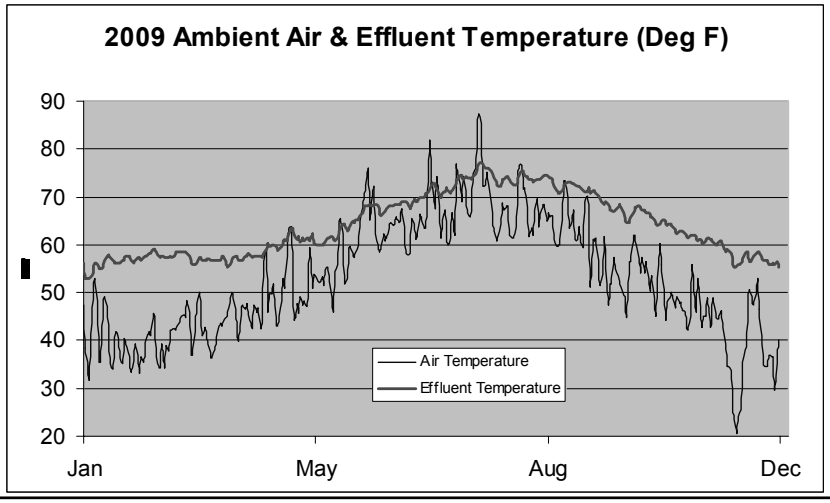
Heat pump history

- 1853 - The heat pump was first proposed by Lord Kelvin.
- 1946 - First ground-source heat pump - Commonwealth Building (Portland Oregon) National Historic Mechanical Engineering Landmark.
- 1970s - Technology became popular in Sweden, and has been growing slowly in worldwide acceptance.
- 2004 - Over a million units installed worldwide providing 12 GW of thermal capacity. Each year, about 80,000 units are installed in the USA.

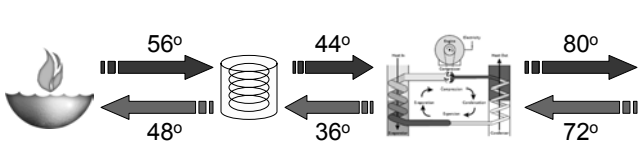
Heat pump types

- Conventional (ambient air exchange)
- Ground source (geothermal)
- Water source (>200% efficiency)
  - Dependant on water temperature
  - Closed / Open loop
  - Wastewater effluent / plant water systems

Effluent temperature advantage



Moves and amplifies heat

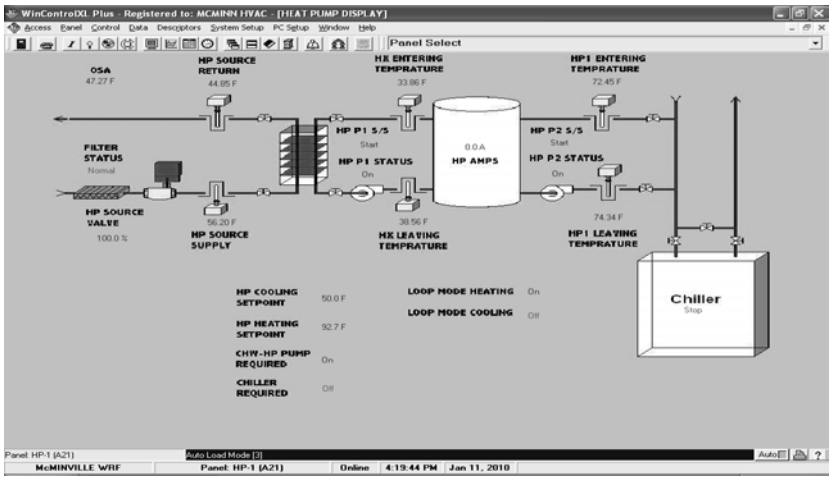


Effluent Exchanger Heat Pump

Air Handler

Heating mode

Instrumentation - complexity



Results

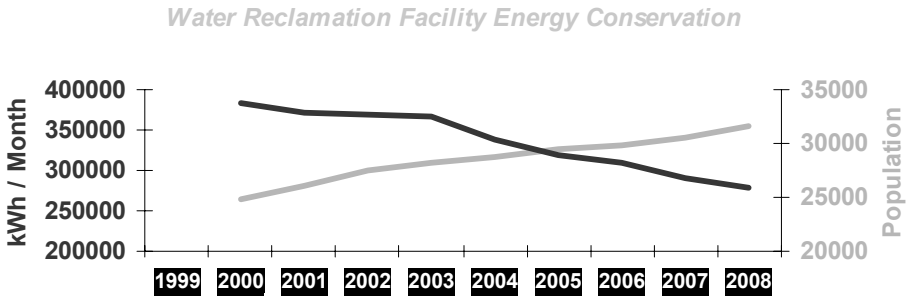
35 Ton Heat Pump

- Energy savings
- “Green & sustainable” features
- Excellent utility & tax incentives
- Improved staff comfort
- Enhanced controls and interface
- Precise temperature control in laboratory
- Reliability

Savings

- Heat Pump project cost $ 217,000
  - BPA incentives (Bonneville Power Administration) -$ 95,000
  - BETC (Oregon Business Energy Tax Credit) -$ 43,500
  - Total cost (after incentives/credits) $ 78,500
  - Annual electrical savings $ 27,000
- 3 year pay-back period
- 400 tons annual CO_2 reduction

9 Year electric kWh trend

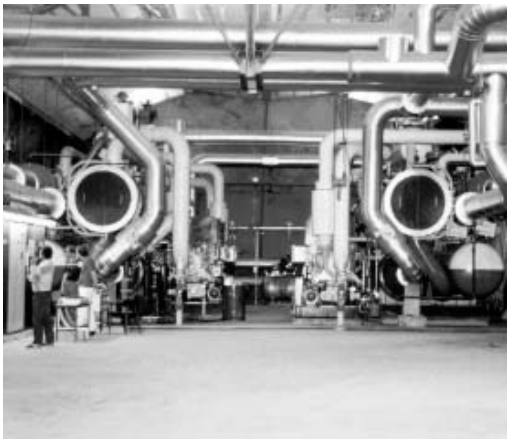


- 26% kWh reduction
- 25% Population increase

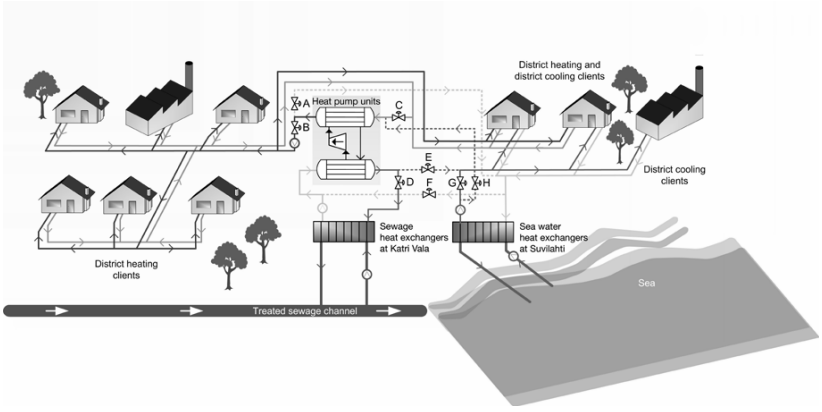
Worldwide installations

	Megawatts Produced
● Sweden	160
● Helsinki Finland	28
● Koraku Japan	25
● Oslo Norway	13
● Williamsport PA	0.2
● McMinnville OR	0.2
● 2010 Olympics Vancouver	?

Oslo Norway - 13 MW installation



Helsinki Finland - 28 MW system



Future uses?

- Effluent temperature mitigation
- 1 MGD reduced 5^{o} F = ~ $250,000 (per year)
- Requires demand for heat load produced
  - Near facility location – planning necessary
  - Industrial uses for heat
  - Wastewater facility uses
    - Heating facilities
    - Digester heat
    - Sludge drying
- Thermal energy storage may be required
- Development of new markets?

Questions??