

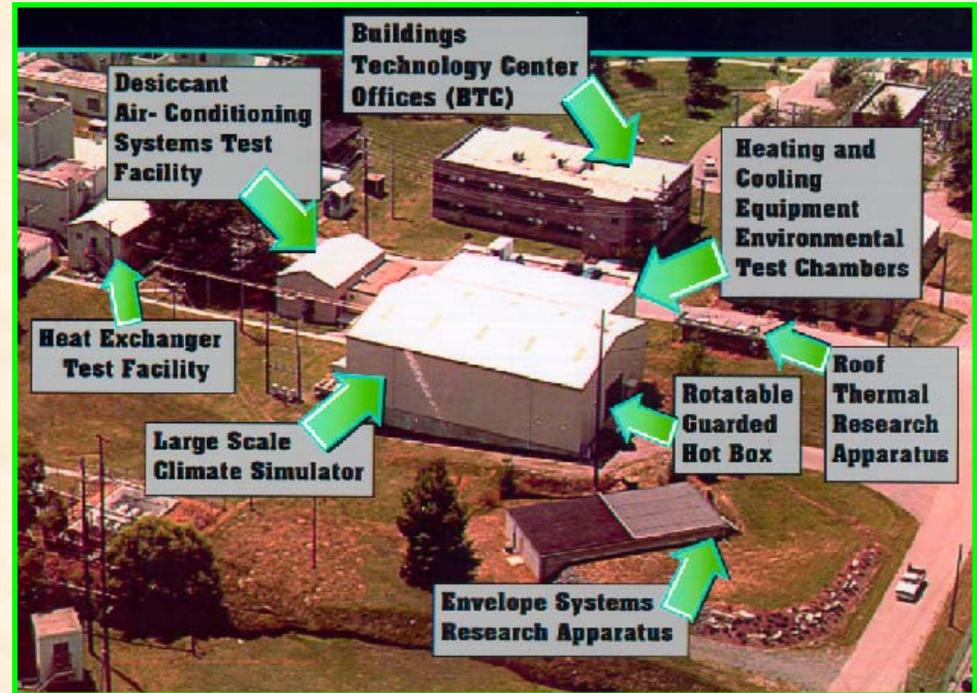
Energy Efficient Building Technologies

-Collaboration Opportunities-

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ORNL – Major DOE Laboratory Performing Buildings Research

- Facilities, onsite, offsite
- Building Envelope
(roofs, walls, floor, foundation systems)
- Building Equipment
(HVAC, water heating, appliances, lighting)



Collaboration Opportunities

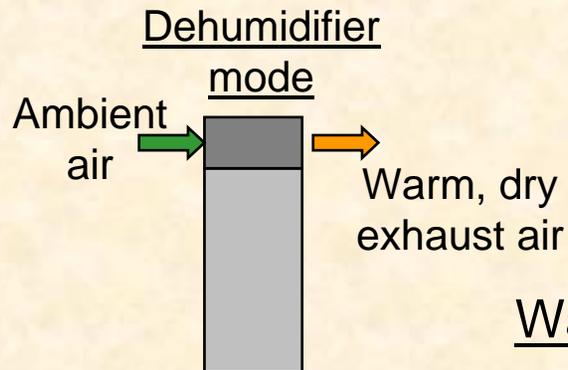
– *Building Equipment* –



Frostless Heat Pump



Heat Pump Water Heater



Water-Heating Dehumidifier

Frostless Heat Pump - Background

- **Heat pump market**
 - **U.S.: 1.49 million heat pumps shipped in 2002**
 - **TVA region: 2.5 million in homes**
- **Heat pump issues**
 - **Contribute to winter peak in NC/SC/TVA region**
 - **Comfort during heating season**
 - **Cold blow**
 - **Defrost cycle**

Frostless Heat Pump - Technology

- **Add small heated accumulator to heat pump**
 - Internal component
 - Control heated accumulator to operate between 32° to 40°F
- **What happens?**
 - Raises average operating temperature of outdoor coil
 - Accumulator provides evaporator function (partially)
 - Decreases frost formation rate
- **Comfort benefits**
 - Higher supply air temperature
 - Less defrosting cycles
 - Indoor blower off during defrosting



Frost Accumulation with Time

(a) Baseline operation at 35°F and 80%RH



20 minutes

40 minutes

60 minutes

80 minutes

100 minutes

(b) Frostless operation at 35°F and 80%RH; 1kw accumulator heating



20 minutes

40 minutes

60 minutes

80 minutes

100 minutes



120 minutes

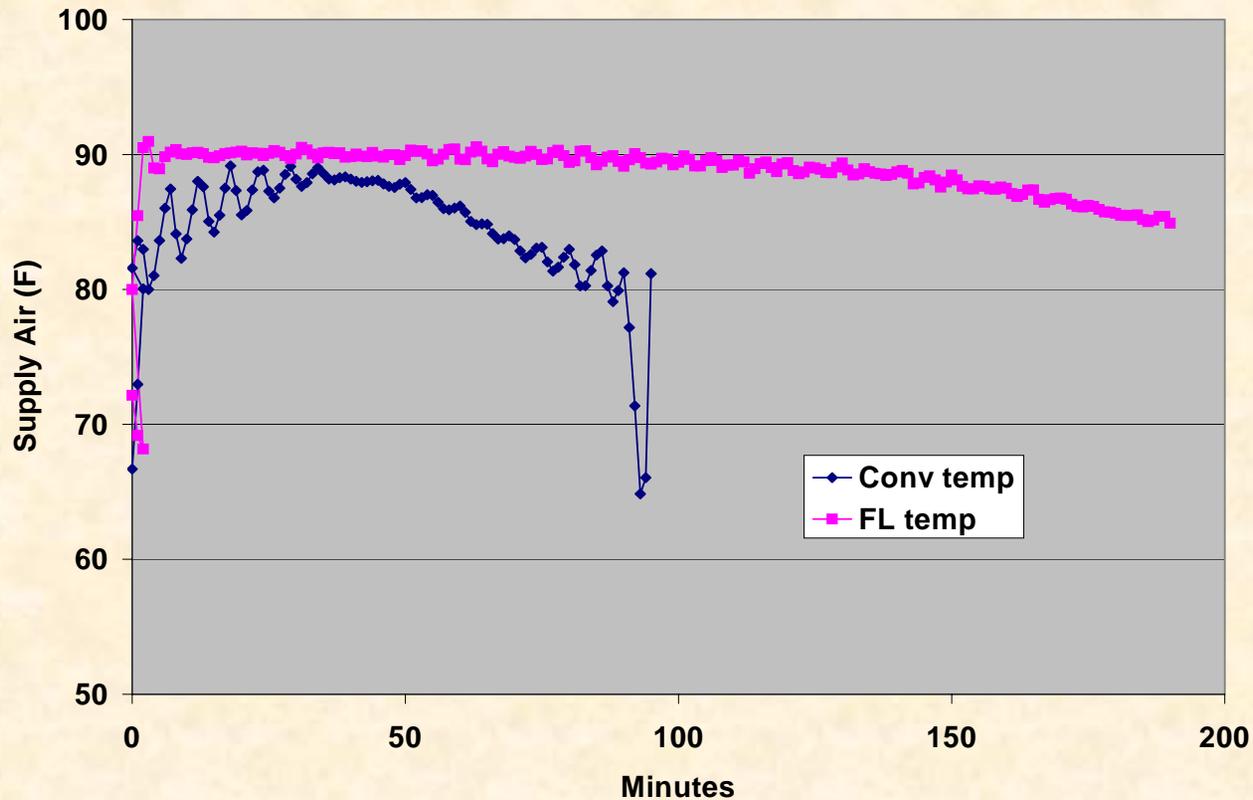
140 minutes

160 minutes

180 minutes

200 minutes

Frostless Benefits: Higher Supply Air Temperature; Extended Defrost Intervals

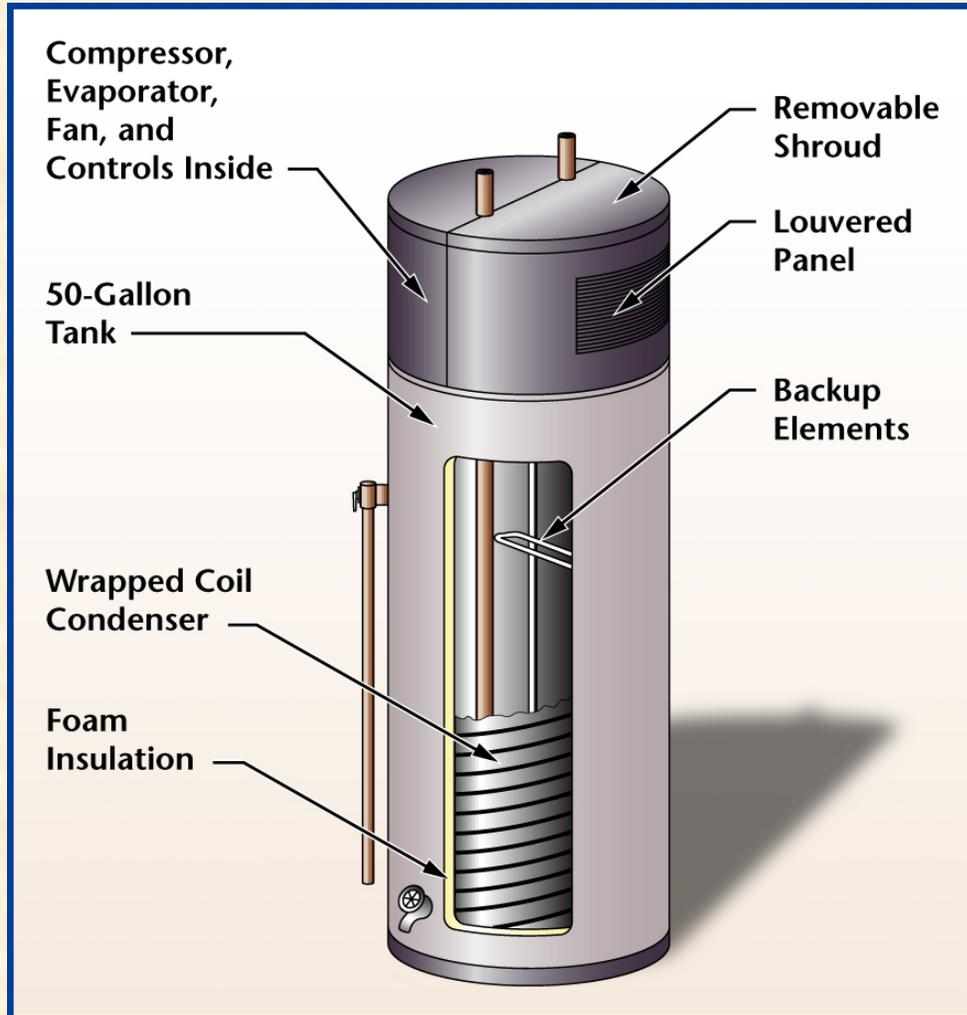


Ambient = 35F

Potential ERCWC Collaboration on Frostless Heat Pump

- **Field evaluation demonstration**
 - Identify regional partners and sites
 - Utilities
 - Contractors
 - Potential sites
 - Provide support to produce units (~5)
 - Site units through contractors
 - Conduct field evaluation (through regional engineering program)
 - Share findings
- **Build regional market**
 - Outreach efforts
 - With partners
 - Regional contractors (economic growth)

Residential Heat Pump Water Heater Development



Technical Development, Laboratory and Field Testing

- **Technical improvements**
 - “Efficiency” of conventional electric water heater = 90%
 - Efficiency of HPWH = 240%
- **Durability testing**
 - Accelerated life testing underway
 - Simulates 10-years of real world use
- **Field testing**
 - In conjunction with 10 utilities across U.S
 - Evaluation completed (<http://web.ornl.gov/sci/btc>)
 - 55% energy savings (average)
- **Now on market (ECR International)**



The Hot-Rod HPWH – Next Generation

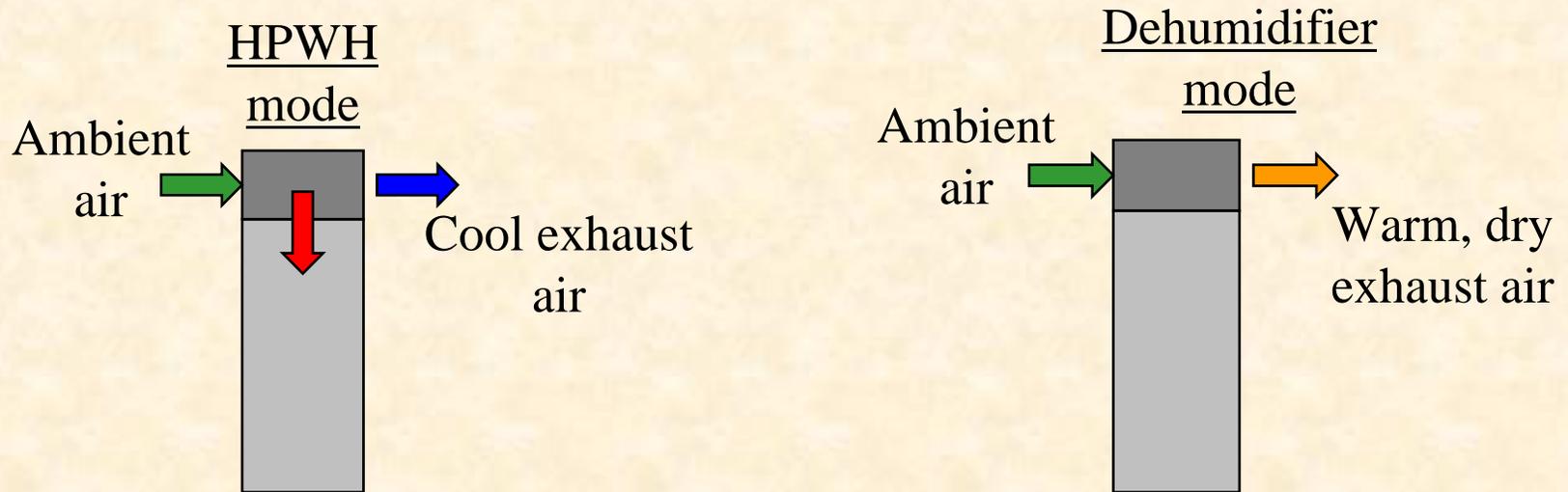
- **ORNL patented**
- **Condenser**
 - Internal, double-wall
 - Configuration designed to defeat temperature stratification
- **Easily adapted to manufactured tanks**
 - Retrofittable
 - Meets WH manufacturer needs
- **Partners:**
 - Manufacturer interest/assistance: A.O. Smith
 - Support: TVA/DOE
- **Field study initiated**



Potential ERCWC Collaboration on “drop in” and “hot rod” HPWH

- **Regional demonstration/evaluation**
 - “drop-in” design
 - University monitoring/ORNL collaboration
 - Market transformation activity
- **Manufacturing**
 - Identify regional manufacturer for “hot rod” production
 - Prototype development/testing

The Water Heating Dehumidifier - Integrated Appliance

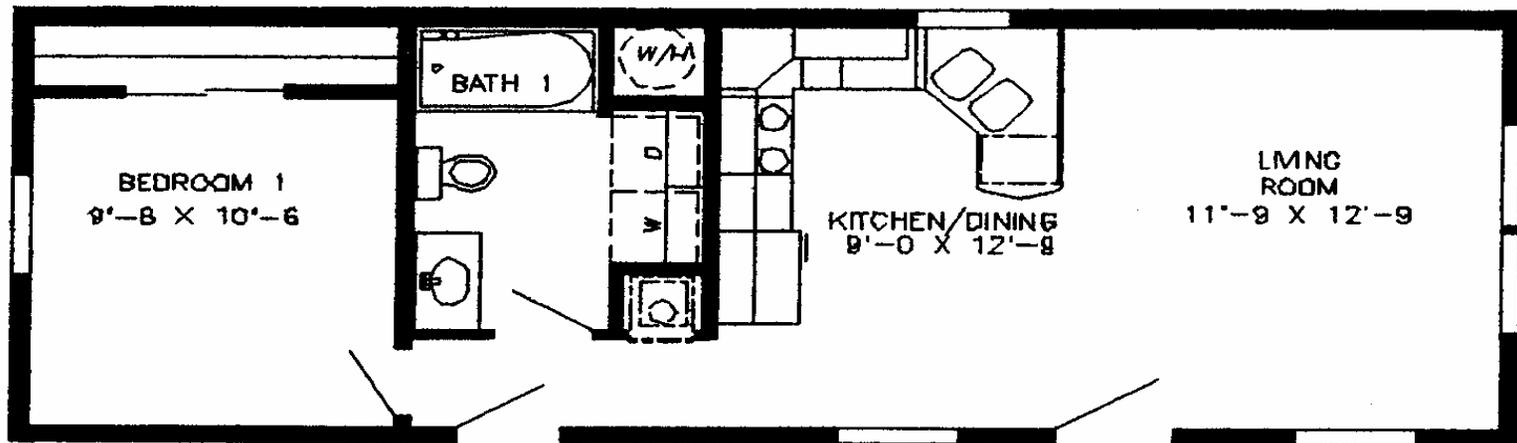


The Water-Heating Dehumidifier + HUD Housing (“Mobile” Homes)

- **Proposed by ORNL**
- **Attractive technology for south**
 - **Cooling**
 - **Dehumidification**
- **HUD housing**
 - **NC: 2nd in shipments (~12,000 in 2002)**
 - **SC: 8th in shipments (6,000 in 2002)**
 - **Attractive for Water-heating dehumidifier**

Why HUD Housing?

- Water heaters on outside wall – access to outside air/inside air
- Proximity to hot water uses, dehumidification needs
- Integrated product to perform water heating and dehumidification
- Meets need for region



1440 OAKHILL (560 SQ.FT.)

Potential ERCWC Collaboration on Water Heating Dehumidifier

- **Cooperative R&D with university**
- **Prototype development**
 - Duplex heat exchanger – key component
 - Laboratory testing
 - Field testing
- **Development Partnership**
 - Regional manufacturer
 - EnergyStar product
 - Work with HUD home industry to grow market