XDOBS Renewable cooling

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Air conditioning with 95% less power

Cool off grid locations

Keep cooling even during power outages

XDOBS Introduction

- Founded in 2003 by Silicon Valley Entrepreneur.
- Privately funded by founders
- Energy, Water, Greenhouse emissions research.
- Joe Ellsworth –
  - CTO 25 years in software and embedded systems.
  - Led VC-funded startup in silicon valley.
  - Long term renewable energy research.

Products & Technologies

- Water from air without electricity
- Air conditioning with dramatically less power
- Wind powered freezer
- Solar thermal powered air conditioning
- Wave powered desalination

Portions patent pending

(AC) Air Conditioning Challenges

- A/C is largest consumer of summer electricity
- AC requires lots of power.
- PV (Photo Voltaic) is expensive per watt.
- A/C electricity demand is leading cause of summer blackouts.
- A/C electricity requires larger grid
- A/C requires more larger generation capacity
- A/C is largest demand growth for electricity.
- Local generators to provide air conditioning must be large, Are expensive and entail risk of leakage of large amounts of fuel.
- Many HVAC use refrigerants that are toxic

Environmental Impact

We reduce indirect HVAC emissions for on grid buildings by over 80% even more in some regions.

- Average HVAC average 3.5 4 ton per 1,000 square foot.
- 1 Ton = 1KW per hour at EER 10. (DOE)
- 1KWH = 1.2 pounds of indirect Greenhouse gas emissions.
- Average home emission 3.6 pounds per HVAC hour
- Wal-Mart super center 540 pounds per HVAC hour.

XDOBS renewable cooling technology can move USA much closer to compliance with Kyoto protocols.

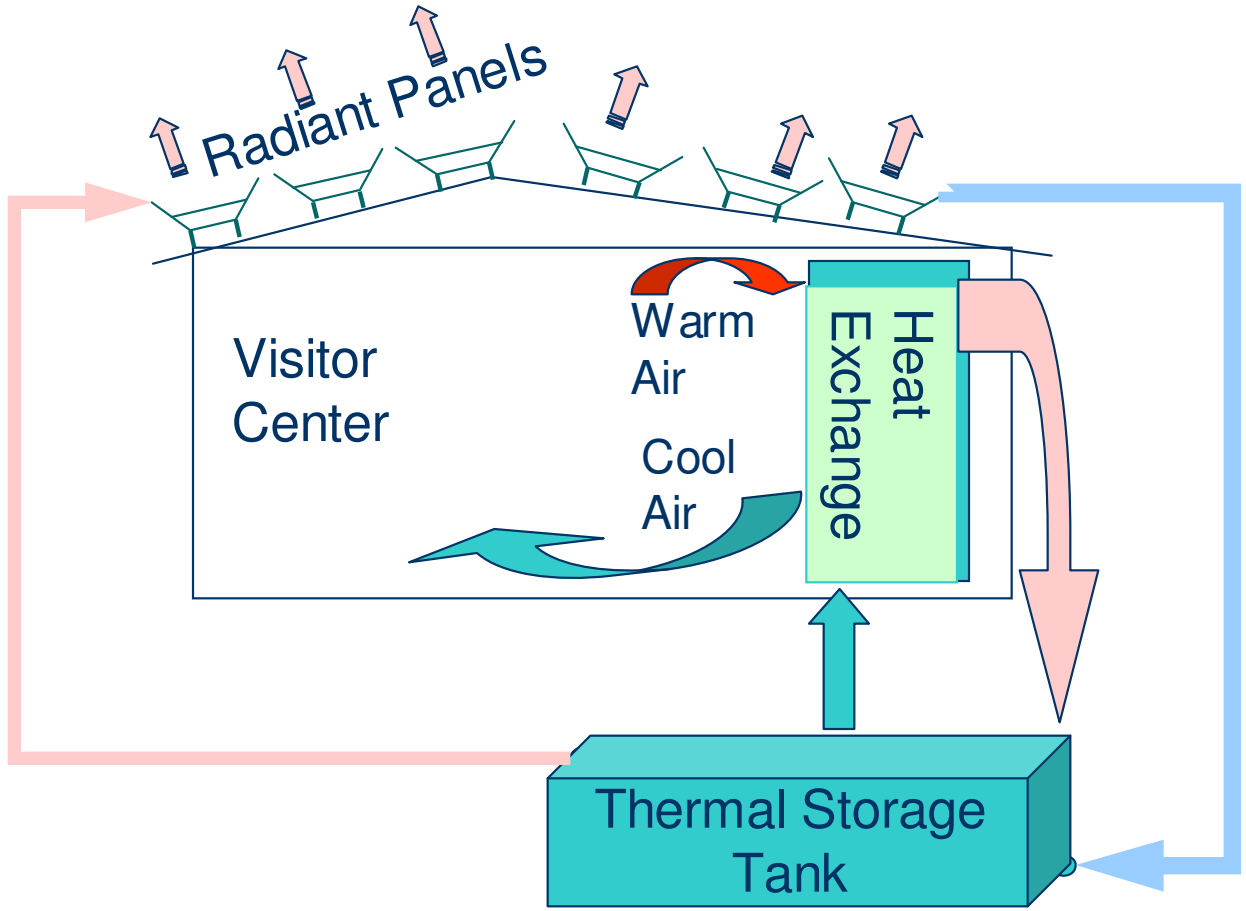
Purpose of this meeting

- Introduce an ideal way to cool off-grid buildings.
- Offer early access to test technology on low risk test program.
- We need test partners
  - Who have invested in renewable solutions in the past
  - Who manage buildings that are off grid and need cooling.
  - Who may have larger needs pending successful test outcome.
  - Who would help publicize the results of the tests.
- Some state park buildings represent ideal test locations with strong benefits to the State.

Benefits to State (Natural Resources)

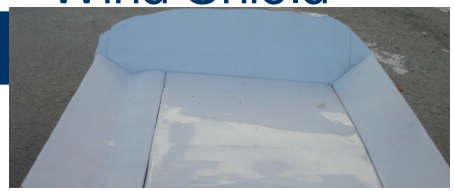
- Most feasible strategy for cooling off-grid buildings.
- Cheaper than PV.
- Better than large generators
- Makes opening new visitor centers in off-grid locations feasible.
- Strong environmental benefits that can be publicized.
- Helps demonstrate a Utah grown technology
  - Dramatically reduces roof wear due to solar exposure
  - Dramatically reduces heat gain through roof
  - Dramatically reduces attic temperatures.

How it works

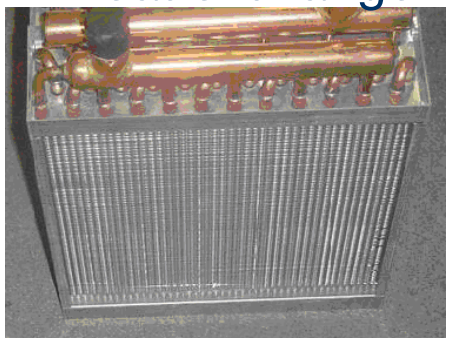


Radiant Panel

Wind Shield



Heat exchanger



Thermal Chimney

Thermal storage can be used for fire fighting.

No Refrigerants Needed

Primary renewable cooling uses

- Off grid guard shacks.
- Expensive power such as Diesel or propane generators.
- High human cost when cooling is lost such as nursing homes and hospitals.
- Critical operation buildings such as police and fire stations.
- Areas with high risk of Peak Demand caused grid failure.
- Areas where large scale grid upgrades are needed to meet increasing demands.

Costs

1,000 square foot would cost $14,000 which is less than 1/10th Of what it would cost to provide refrigerated air conditioning using photo voltaic solar panels.

- $14 per square foot installed.
  - Includes panels, thermal storage, internal air exchange, installation.
  - Considering test sites from 350 to 3500 square foot.
- Thermal storage tanks require excavation. Can be insulated and left above ground but requires additional cost housing.
- Budget 7% per year for maintenance. 1 year maintenance included.
- Designed for 15 year life but should last longer.
- Easy to maintain and moving components such as pumps can be replaced with off-the-shelf equipment.

Summary

1. **Choose a Test Site**
2. **Agree on goals**
3. **Arrange for funds**
4. **Set target for installation date**
5. **Arrange for installation**

- Great solution for cooling off grid locations.
- Possible application in broader range of conditions.
- Works where swamp coolers fail.
- Can substantially reduce amount of PV power needed for a given building.
- Ideal in locations where loss of power can could affect critical operation due to building heat.
- Subsidized installation in exchange for early adoption.

XDOBS Radiant Cooling

Background Slides Start Here

Major system components
XDOBS Renewable Cooling

- **Radiant Panels** – Shed heat to night sky or day sky when shaded 100 to 400 watts per sq meter. Chills thermal storage fluid. Reach 10F to 20F below nighttime ambient.
- **Thermal storage fluid** – Absorbs heat from building during day and carries that heat to panels at night to be shed**.** Normally chilled to 8F below 2 hour low nighttime average.
- **Wind Shield** – Prevents convective warming of panel surface which allows extra chilling. Creates horizontal stagnant insulating area which increases efficiency and minimizes thermal gain from surface dew.
- **Thermal Storage** – A tank's) of fluid which contain the chilled fluid until needed for cooling purposes. Normally insulated and buried to retain cold. Average is 3,000 gallons per 1,000 square foot per day of storage.
- **Micro controller, Valves, Blower –** Controls circulation of fluid to maximize chilling to panels and circulation of fluid to heat exchangers to maintain desired room temperatures.
- **Heat Exchanger** – Transfers cold from the thermal storage fluid to indoor air. Several different types but cheapest is basically a set of 280,000 BTU radiators.
- **Indoor panels** (optional) - A different kind of heat exchanger. Great for new construction.
- **Thermal Chimney** (optional) – A different kind of heat exchanger looks like a chimney uses diffusion type cold air release at floor runs completely silent uses convention to drive air flow and eliminates need for most HVAC ducts. Ideal for retrofit installs.
- **Wind Assist** (optional) – Directs wind away from panels while using wind energy to provide up to 70F of additional chilling. Ideal in areas with 5 ours per day of 8 MPH winds.
- **Geo-exchange pump** (optional) – areas Uses electricity to boost chilling from radiant panels.

Radiant cooling background

Easy to understand, hard to optimize.

- NASA uses it to cool space craft.
- Used to cool large telescopes world wide.
- Used to chill large scale cryogenics.
- Several DOE funded studies on various aspects.
- Successful tests in Pacific islands and Egypt.
- Radiant panels shed heat to night sky.
- Optimized to minimize heat gain from convection.
- Stored cold used to cool air during the day.
- Special design maximizes cold production
- Optional wind assist increases available chilling.
- Optional geo-exchange heat pump allows 72F comfort level in worst case conditions Las Vegas during late July.

XDOBS Radiant Cooling versus Solar Thermal cooling

Radiant cooling

- Almost no moving parts.
- High precision not required.
- Tracking collectors not required.
- No dangerous chemicals needed.
- Low maintenance.
- Field repair with inexpensive hot air welder.
- Pumps and blowers can be replaced with off the shelf components.

Solar Thermal cooling

- Requires tracking parabolic collectors
- Requires dangerous refrigerant.
- Repetitive of maintenance due to large number of tracking collectors.
- Highly specialized replacement parts
- Low differential Absorption chillers needed.

Example of air conditioning in a cold region (Peaking demands worse in areas of higher or longer heat)

Basin Electric in North Dakota

- Buying 400MW for base load
- Buying 700MW for summer peaking.
- http://basinelectric.com/Commerce/WhatWeBuy/RFP.htm

- Relatively cold region
- Double generating requirements when HVAC active
- Double grid capacity when HVAC active
- Double the greenhouse emissions

XDOBS renewable cooling can provide overall 95% reduction in HVAC Electricity consumption during peaking hours and in this region 90+% reduction overall.