Solar & Thermal Systems, Inc.

What? Why? How?

Differences & Comparisons

Solar Energy & Solar Power

- Sunlight is clean, is free, is everywhere
- Sunlight can be converted to other energy
- Sunlight formed coal, oil, gas we use today
- Sunlight bathes your roof with free energy

Electricity is Valuable

- Electricity is the most versatile energy
- Electricity is available on demand
- Electricity is expensive to store
- Electricity must be generated as needed
- Electricity does everything we ask it to do
- Electricity drives the modern economy
- Electricity will get more expensive

Solar Electricity

- Does not pollute, no greenhouse gasses
- Can be deployed on small or large scale
- Turns a free resource into an economic one
- Can produce more energy than we could use
- Inexhaustible supply available
- One time capital investment, no fuel costs
- A technology whose time has come

Solar Technologies

- Photo-Voltaic or PV, a.k.a. solar-cells
- Solar Thermal -- Rankine Cycle
  - Heliostat array
  - Parabolic concentrators
  - Flat panel collectors
- Passive Solar – Thermal Storage
  - Hot water tanks, space heating

Photo-Voltaic

- High capital cost -- $5 / Watt (April ’06)
- Low conversion efficiency 8% to 15%
- Heavy load on roof > 2 lb/sq.ft
- Added inverter cost -- $0.86 / Watt peak
- Labor & materials to install – 4 man days
- Total Installed Cost -- ~ $8000 / kilowatt

The Rankine Cycle

- Identify a “good” boiler heat source
  - Burning: coal, oil, wood, bagasse, etc…
  - Modern: nuclear, heliostat, geothermal, etc…
- Fluid absorbs *heat* to boil(water→steam→superheat)
- Turbine extracts *work* (hot steam→cool steam)
- Condense steam waste *heat*(cool steam→water)
- Pump liquid back to boiler, and repeat

Solar & Thermal Systems – Improved Rankine Cycle

- Identify a “better” heat source
  - Futuristic: concentrating solar collector
  - Existing: waste heat from the previous page
- Fluid absorbs *heat* to boil(water→steam→superheat)
- Engine extracts *work* (hot steam→cool steam)
- Engine extracts more *work* (steam→condensate)
- Pump liquid to collector, and repeat

Differences

System ➔ / Attribute	Conventional Rankine turbine	Solar &Thermal Organic Rankine
Working Fluid(s)	R-718 (OH_2) Water & Steam	R-717 (NH_3) Ammonia (anhyd)
Expansion ratio limiting factor	Condensation destroys blades	None, ambient temperature OK
Latent Heat of Vaporization	Wasted -- loss	Utilized -- gain

Solar & Thermal

- Low capital cost -- $2.00 / Watt
- Good conversion efficiency > 30%
- Light load on roof < 1 lb / sq.ft
- Generator has 300% overload capacity
- Labor & materials to install – 4 man days
- Total Installed Cost -- ~ $2000 / kilowatt

Who We Serve

- Residential – 10 to 25KW (120-240V, single phase)
- Commercial – 25 to 100KW (120 to 480V, 3 phase)
- Agricultural – 100KW to 1MW (110 to 5KV, any)
- Municipal – 50KW & up (110 to 5KV, any)
- Industrial – 250KW & up (110 to 14KV, any)

Comparison

- **Utility Status Quo**
- Monthly electric bill
- Expense increases yearly
- No capital expenditure
- Blackouts hurt business
- Pay *polluters tax*
- Missed opportunity cost
- You're a follower

- **Solar & Thermal System**
- Monthly electric check
- Benefit increases yearly
- Zero down financing
- Blackouts go unnoticed
- Sell your *REC*s
- Real ROI, and depreciable
- You're a leader

Solar & Thermal Systems, Inc.

Let us be your energy solution.

www.SolarAndThermal.com