Solar Thermal Energy in Delaware

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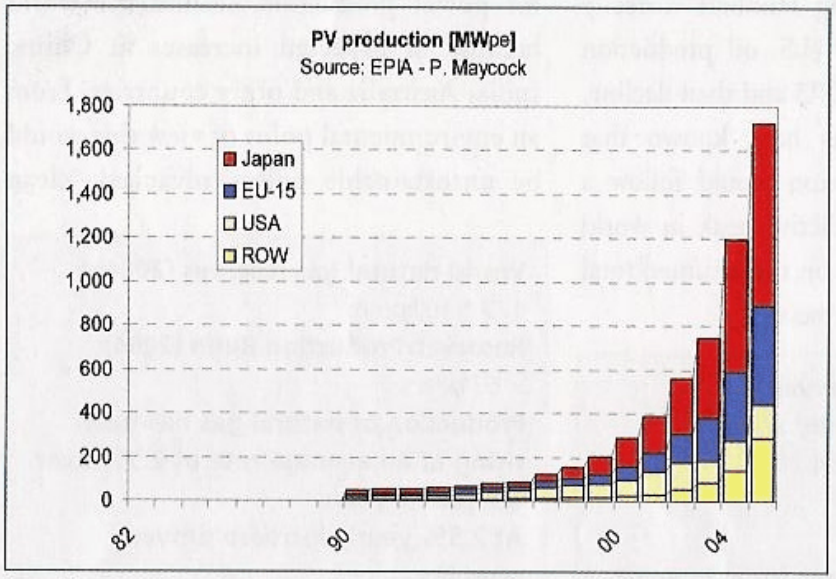
SAME FUEL

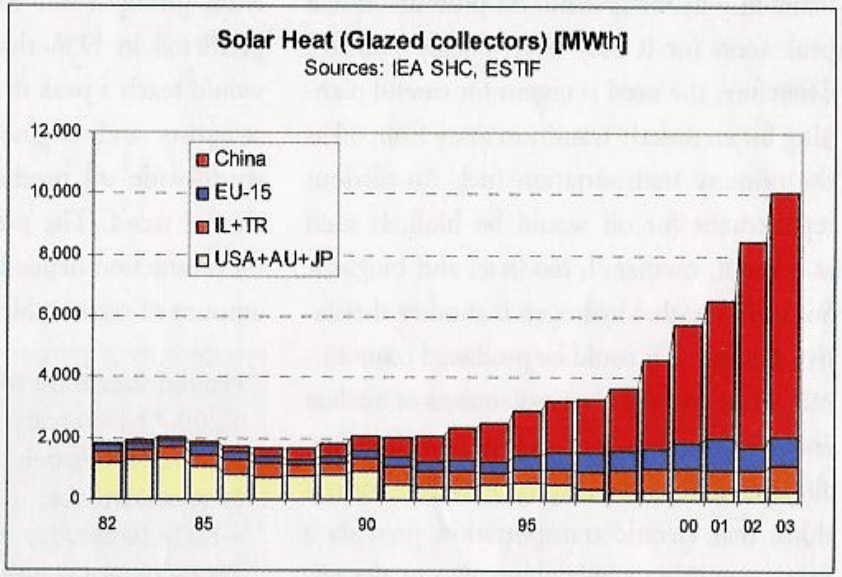
What is the difference between Solar Thermal and Solar Electric/Photovoltaic?

- **Solar Thermal**
  - Heats Water, Antifreeze, or Air
  - Plumbing or HVAC system
  - Uses a collector to convert sunlight to heat energy
  - Storage (water tanks) is part of most applications
- **Photovoltaic (PV)**
  - Produces electricity
  - Electrical system
  - Uses a module to convert sunlight to electricity

PV & Solar Thermal Capacity Worldwide



World Solar PV Production 1990 – 2005 (MWp) (Source: Paul Maycock, PV News Annual Review of the PV Market, 2006)



Deployment of Solar Heat (glazed) Collectors, MWth

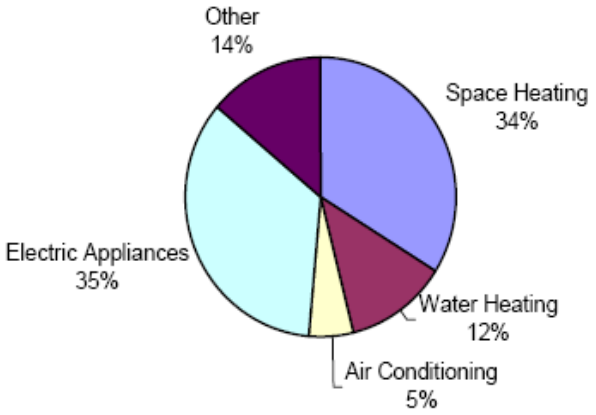
- 90% of Israeli households use the sun's energy to heat their water
- In Barcelona, Spain, all new and remodeled buildings must incorporate solar thermal technology

Solar Thermal Potential for Residential Energy Sector in Delaware

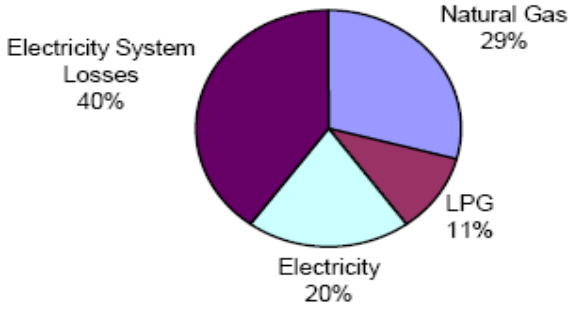
Supply up to 25% of Energy Use*

*Assuming solar thermal supplies 50% of the energy used for water heating, space heating and cooling by Delaware residences -- based on *"Bright Ideas for Delaware's Energy Future, DE Energy Task Force Report, September 2003"*

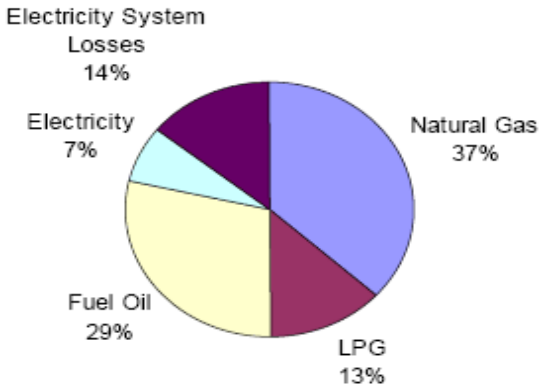
Delaware Residential Sector Major Energy End Uses
(including electricity system losses)



Delaware Residential Water Heating Energy Sources



Delaware Residential Space Heating Energy Sources

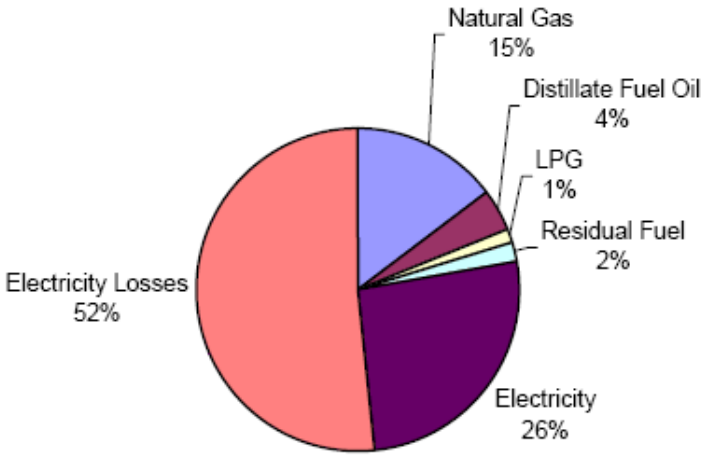


Solar Thermal Potential for Commercial Energy Sector in Delaware

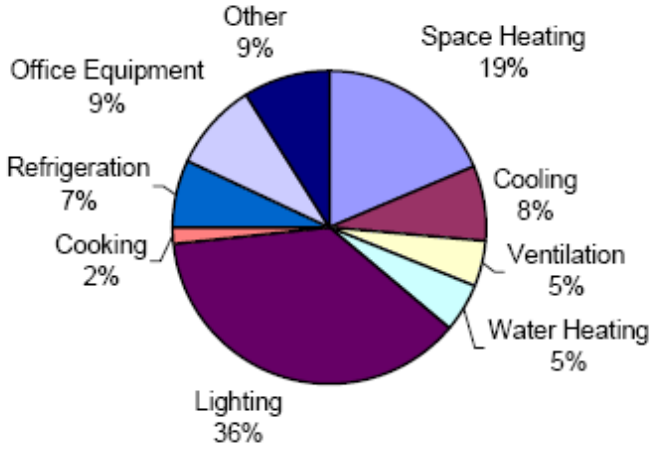
Supply up to 24% of Energy Use*

*Assuming solar thermal supplies 50% of the energy used for water heating, space heating and cooling, refrigeration by Delaware commercial users -- based on *"Bright Ideas for Delaware's Energy Future, DE Energy Task Force Report, September 2003"*

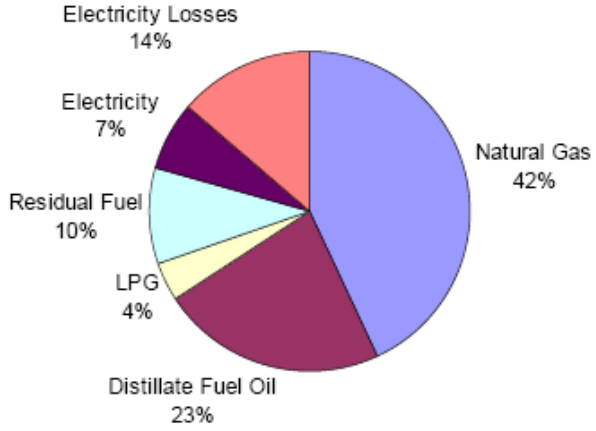
Delaware Commercial Sector Energy Input



Delaware Commercial Sector Major Energy End Uses
(including electricity system losses)



Delaware Commercial Sector Heating Energy Sources

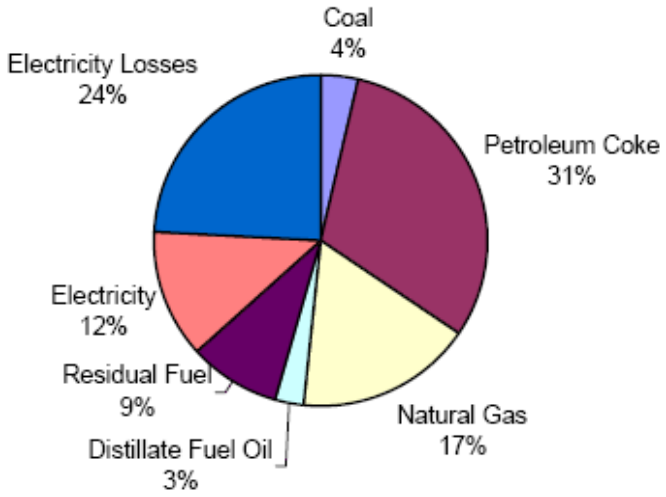


Solar Thermal Potential for Industrial Energy Sector in Delaware

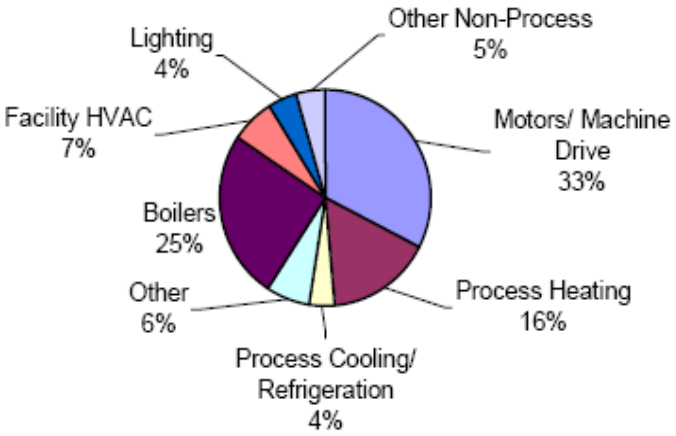
Supply up to 22% of Energy Use*

*Assuming solar thermal supplies 50% of the energy used for process heating, process cooling/refrigeration, space heating and cooling by Delaware industrial users - - based on *"Bright Ideas for Delaware's Energy Future, DE Energy Task Force Report, September 2003"*

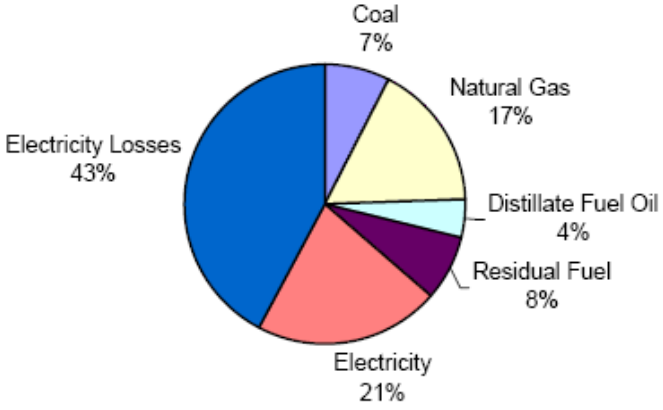
Delaware Industrial Sector Energy Input (All End Users)



Delaware Industrial Sector Major Energy End Uses
(Excluding Refinery and Chlor/Alkalai End Users)
(including electricity system losses)



Delaware Industrial Sector Energy Input
(Excluding Refinery and Chlor/Alkalai End Users)



Economics of Solar Thermal vs. PV

- Solar Thermal is Usually Less Expensive Per Delivered Energy Unit than PV
  - Thermal requires 5x less area
  - Thermal requires 4 to 6x less investment dollars
- Typical Energy Delivered per Area
  - Thermal (32 Square feet) = 8.3kWh per day
  - PV (162 sq ft., 2000 Wp) = 8 kWh per day

Solar Thermal Applications

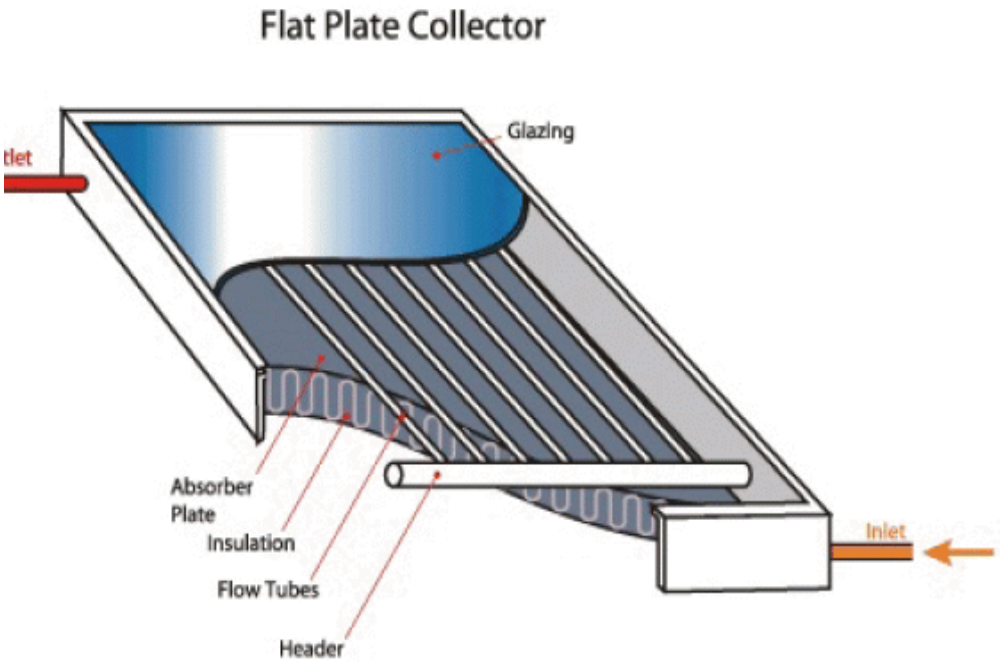
- Domestic Hot Water Heating
- Boiler Make-Up Water Heating
- Boiler Combustion Air Heating
- Process Water or Air Heating
- Ventilation Air Pre-Heating
- Building Heating, Ventilating and Air Conditioning
- Cooling Applications Including Ice Making

Low Temperature Solar Thermal Collectors

- Can heat water up to ~120°F
- *Less expensive* than other solar collectors but not effective in cold weather because no insulation
- Very cost-effective for certain applications, e.g., seasonal businesses
- Most often used for swimming pool water heating, but financial incentives are not appropriate or needed for this application

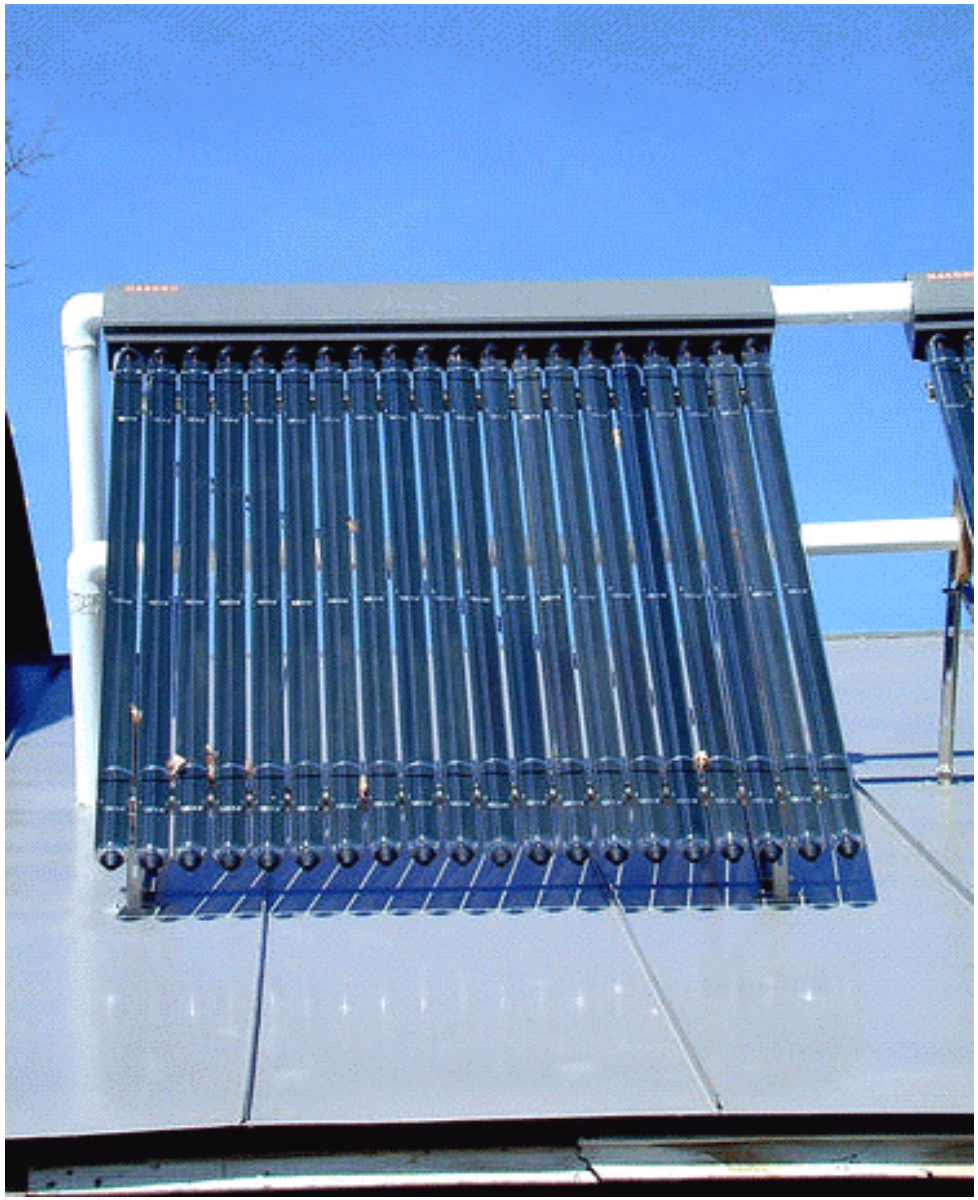
Flat Plate Collectors

- Can heat water to operating temperatures of 120° to 140°F, although some highly efficient models can perform reasonably well at temperatures above 200°F
- The most common use is for heating domestic hot water, but there are numerous preheat applications for industrial process heat as well as for space heating



Evacuated Tube Collectors

- Good for high temperature applications – can heat water to over 170°F
- Are usually more expensive than flat-plate collectors
- Applications often include commercial and industrial process hot water heating, steam production, and solar air conditioning

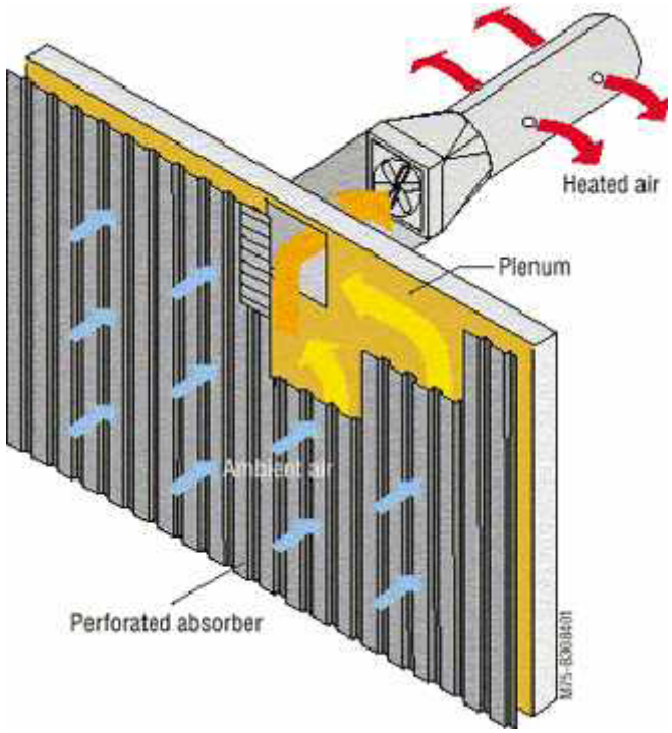


Solar Cooling

- *Absorption* cooling is not the familiar vapor compression cooling
- *Absorption* cooling is the first and oldest form of air conditioning and refrigeration and is commonly used in large industrial facilities where waste process heat is available
- Scable for all uses from residential to industrial
- Solar absorption cooling is more cost-effective than using PV to power vapor compression systems and can compete with conventional cooling technologies especially when time-of-use rates and peak-demand price spikes are taken into consideration

Solar Air Collectors

- A fan or blower draws ventilation air into the building through hundreds of tiny holes in the collectors and up through the air space between the collectors and the south wall
- The solar energy absorbed by the collectors warms the air flowing through them by as much as 40°F
- Preheat air for building heating, residential or commercial
- Industrial applications such drying air timber and agricultural products



Building-Intregated Solar Thermal

Barracks, Camp Lejeune, NC

Application: Domestic Hot Water Heating

Example of Industrial Application

"Solar Thermal Applications in the Delmarva Poultry Industry"
Sponsored by the Delaware Energy Office; Maryland Energy Administration; Virginia Department of Mines, Mineral and Energy; and U.S. Department of Energy

Report can be downloaded at http://www.delawaresolar.org/Reports.htm

Two systems modeled for poultry processing plant -- large and small

Large System

- Delivers 7020 MWh/year providing 46% of the energy needed to preheat 200,000 gpd annually
- *Simple payback of less than 6 years and an internal rate of return (IRR) of 18%*

Small System

- Modeled to maximize a 50% grant capped at $250,000 available in Delaware
- Delivers 1535 MWh/year providing 10% of the energy needed to heat 200,000 gpd annually
- *Simple payback of less than 3 years and an internal rate of return (IRR) of almost 40%*

Solar Thermal a Good Match for Rental Housing and Leased-Commercial Space

- Hot water is often included in rent for commercial and residential leases -- landlords have an incentive to lower this energy usage
- Solar thermal provides a hedge against flucuating fuel costs
- Marketing advantage -- using “Green” energy
- Multi-tenant buildings, particularly lower-income, are a good fit for solar hot water because of the diversity of load and the stable and predictable bills that solar energy provides

Purchased Power Agreements

An emerging trend in solar thermal and PV installations

- Solar company takes 100% of the responsibility to build, own and operate the PV system, including all up-front purchase and installation costs
- Customer pays for the solar energy produced, at prices equal to or below (or possibly slightly above) current retail energy rates
- Monthly energy bills are predictable because the systems have no fuel costs
- Good option for government or non-profit institutions that cannot take advantage of federal tax credits
- Larger installations are the current target market
- *Solar thermal offers a hedge to unpredictable fuel prices*

Recent Solar Thermal ESCO/PPA Project

- 2006 installation on 172-unit senior housing building residence in Toronto
- 10-year contract to provide heat domestic hot water at a price less than natural gas
- Live monitoring on website -- yesterday at 11:00 am the system was producing 47 kW
- Produced almost 3 MWh of energy in a cold Canadian February, 2007

Barriers to Increased Use of Solar Thermal

- Higher capital costs than traditional fossil fuel technologies
- History of inferior installations from late 1970s and early 1980s
- Lack of awareness of today's higher quality and varied applications
- Allure of PV compared to solar thermal for many consumers interested in solar/renewable energy
- Currently not an eligible resource under Delaware Renewable Portfolio Standards (RPS)

Solar Thermal in Delaware RPS

Not Eligible Under Current RPS

- Should solar thermal be an eligible resource in RPS revisions? -- *Yes!*
- Issues:
  - Solar thermal often replaces natural gas, fuel oil, or propane instead of electricity
  - Metering energy production not as straightforward as PV
- Recommendations:
  - All solar thermal applications (except pool heating) are eligible under RPS
  - No extra incentive in RPS for solar thermal like there is for PV
  - Require metering in kWh/MWh for eligiblity

Possible SEU Activitives for Solar Thermal Applications

- Market identification and assessment
- Buying pool/aggregation of small users
- Low-interest loans
- Lease-to-buy for small users