Building America Case Study

Solar Water Heating in Multifamily Buildings

Greenfield, Massachusetts

PROJECT INFORMATION

Construction: Gut rehab

Type: Multifamily

Builder: Olive Street Development

Partner: Consortium for Advanced Residential Buildings, *carb-swa.com*

Size: 372 ft² evacuated tube, 330 gallons storage

Price: $31,000 before incentives

Incentives Used:

- Commonwealth Solar Hot Water Program
- 30% Federal tax credit
- Modified Accelerated Cost Recovery System (MACRS)
- MassSave New Construction program

Date Completed: 2014

Climate Zone: Cold

PERFORMANCE DATA

Measured energy savings:

- 450 therms/year
- $630 per year
- 48% of domestic hot-water load

The Consortium for Advanced Residential Buildings (CARB) is a U.S. Department of Energy Building America team that has worked with builders across the country to assess the most practical cost-effective means to reduce home energy consumption and approach zero energy. Especially in multifamily applications, CARB has seen more developers explore solar domestic hot-water (SDHW) systems as part of the least-cost pathway to zero energy.

Scale is the key cost advantage for solar thermal in multifamily buildings (when compared to single-family buildings). Hard costs for collectors scale fairly linearly with system size; however, balance-of-system components (e.g., piping, valves, pumps, and controls) and labor do not scale linearly.

In spring 2014, Olive Street Development completed a major renovation project —converting an old school building in Greenfield, Massachusetts, into 12 high-performance apartments. The developer installed SDHW to reduce fossil-fuel consumption, and CARB has been monitoring the system since its completion.

The initial installed cost of the system ($31,000) is hard to justify by water-heating savings alone ($600–$700/year), but the developer took advantage of several financial incentives. The 30% federal tax credit and the Commonwealth Solar program combined to reduce costs by more than $15,000, and the present value of MACRS depreciation benefits was about $6,000. The SDHW system also helped the project achieve the highest-tier incentives in the local utilities' MassSave program (an additional $24,000). Clearly, these financial incentives helped make the SDHW system economically viable.

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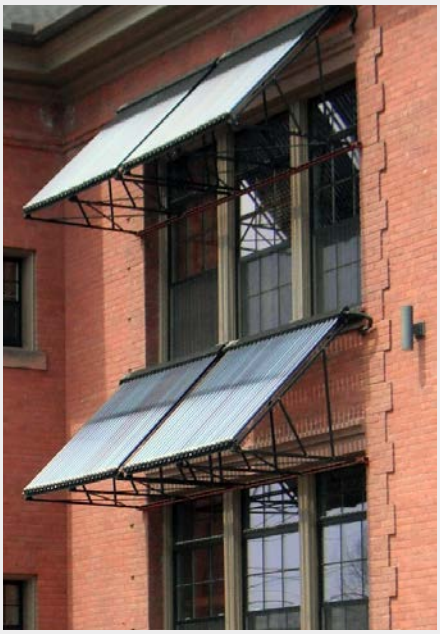
Key Energy-Efficiency Measures

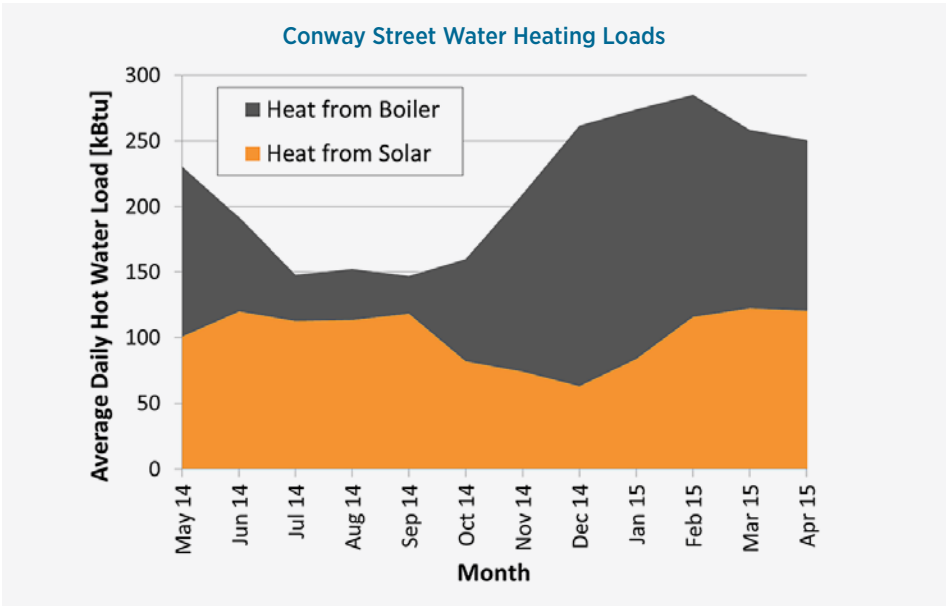
Space is at a premium in many buildings, and available space for solar thermal storage can be a deal-breaker in some applications. More solar-storage volume might have improved performance slightly, but there was only room for these three 110-gallon tanks in the crowded mechanical room.

Many multifamily buildings have space for collectors on flat roofs. Without this luxury, Olive Street Development chose to install collectors as awnings over south-facing windows.



For more information see the Building America report *Role of Solar Water Heating in Multifamily Zero Energy Homes* at *buildingamerica.gov*.

Image credit: All images were created by the CARB team.



The system has worked well over the first 12 months that were monitored. The SDHW system has contributed 102 kBtu/day to the water-heating loads and has offset about 450 therms of natural gas for a savings of $630.

Lessons Learned

- System costs in multifamily buildings are typically between $90 and $160 per square foot of collector area. Collector areas are 3–30 ft² per dwelling unit.
- Federal and state incentives for solar thermal systems are substantial and can help justify upfront installation costs in some applications.
- Compared to single-family buildings, economies of scale and consistent diverse water-heating loads make solar water heating more cost-effective.
- Because heating water with electric resistance is quite costly, solar thermal can be appealing in all-electric buildings.

Looking Ahead

Although several state programs have evaluation efforts under way, CARB was surprised at the lack of published performance data of SDHW on multifamily buildings. CARB believes that performance monitoring and evaluation are important to assess how well measured performance matches predictions—to allow designers to optimize design or sizing and to assess long-term reliability and identify (and remedy) common performance problems. Finally, CARB believes more evaluations and case studies can help developers and building owners make informed decisions about SDHW when designing buildings to achieve zero net energy.

U.S. DEPARTMENT OF ENERGY
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