

## small homes case study



# Burlington, Vermont – Zero Energy Modular (ZEM) Cottage

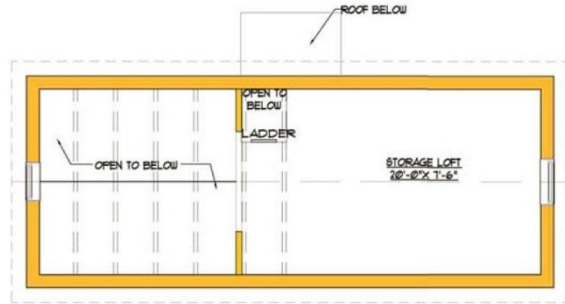
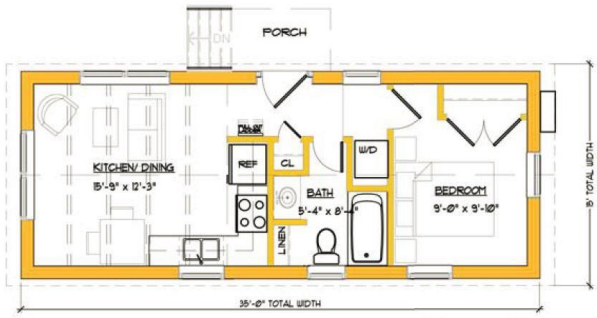
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## Small zero energy home provides an affordable infill solution

Efficiency Vermont’s ZEM program partners with Vermod Homes (a local ZEM builder) and affordable housing organizations across the state. Over the past four years, the ZEM program has placed 70+ homes around Vermont, the majority of which serve low-income homeowners and tenants. While the program’s focus is on mobile home replacement and affordable housing opportunities, program staff work with prospective buyers from all backgrounds.

The ZEM cottage was designed and built for a small vacant lot in the North Avenue Co-op, a cooperatively owned community in Burlington, VT. While it is the first “cottage” style home that Vermod has built, it was built using the same techniques and materials and meets the same ZEM standard as all other homes.





### Cost/Design:

- 1 bed/1 bath 490 sf house measures 14'x35' with a 14'x19' storage loft.
- Base cost of the house, including finishes and appliances, was \$111,000 (\$227/sf excluding loft, \$147/sf including loft).
- Total cost of the house, including base cost, sales tax, foundation, delivery, set, utility hookup, and 4.5 kW solar PV was \$142,246 (\$290/sf excluding loft, \$188/sf including loft)
- Vermod subcontracted Techno Metal Post to complete the foundation; all construction, finish work, electrical, plumbing, and solar installation was done in-house.
- House Specifications: R-43 double stud 2x4 walls, R-60 ceiling, R-40 floor, all dense-packed with blown-in fiberglass; triple pane Earthwise casement and awning windows; 20-gallon electric hot water heater; 6,000 BTU minisplit heat pump; and Paul Focus heat-recovery ventilation system.
- Vermod typically schedules construction two to four months out; a home can be built in 5-6 weeks and installed in 1-2 days.

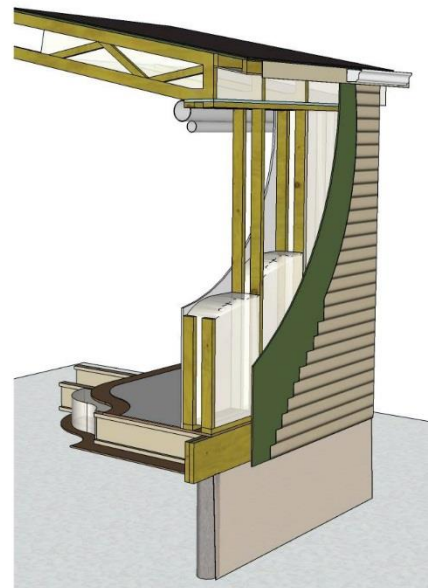
Cost of home: Vermod Cottage	
Base cost of home	\$111,000
Sales tax (6% of 60% of base cost)	\$3,996
Site work (frost-protected piers and hookup of utilities)	\$6,850
Delivery and crane set	\$8,400
4.5 kW solar package	\$12,000
Solar incentive	-\$4,000
Burlington Electric Department incentive	-\$8,500
Champlain Housing Trust deferred loan	-\$35,000
<b>FINAL COST TO FINANCE</b>	<b>\$94,746</b>
Contribution to closing costs	\$2,500
Interest rate (VSECU)	3.75%
Term	30 years
<b>MONTHLY MORTGAGE PAYMENT</b>	<b>\$427</b>

Note: Deductions listed are for this specific unit in Vermont

### ZERO-ENERGY MODULAR HOME

FLOOR	R-40
WALLS	R-43
ROOF	R-60

- 14" roof truss
- Airtight ducts inside house
- 1 foot overhang
- 5/8" sheetrock & low-VOC paints
- Double stud walls, 10" cavity
- Formaldehyde-free plywood decking and sheathing
- 9.5" floor system
- Moisture-tight underbelly
- Frost protected foundation



## **Financing:**

- ZEM homes are typically financed through the USDA Rural Development Direct Loan program (3.25% for 30 years, no down payment required).
- Because of the location of this home outside Rural Development territory, it was financed through Vermont State Employees Credit Union (3.75% for 30 years, 20% down payment required).
- \$35,000 silent second mortgage through Champlain Housing Trust reduces cost to buyer and covers any down payment requirement.
- Immediate return on investment in ZEM home: homeowners have lower monthly costs (mortgage + energy) when compared to a new manufactured (mobile) home.

## **Regulatory:**

- No restrictions in VT on placing modular homes in mobile home parks and co-ops
- Project aligned with City of Burlington progress towards zero energy goals and mandate to maintain affordable housing stock within the North Avenue Co-op

## **Lessons Learned**

- Ladder access to the loft proved unattractive to the vast majority of visitors – middle-aged people were thinking ahead to the aging process, and elderly people were simply uninterested.
- The roof/loft module proved to be more expensive than anticipated, due to the complexity of design and added labor costs post-delivery to button the roof/loft and first floor modules together. The base cost of this design could be cut by \$20-30,000 by eliminating the roof/loft and sticking with a contemporary, one-story design that can be delivered in one piece. (see accompanying case study: ZEM Contemporary)
- This is the most expensive home per square foot that Vermod has ever built due to its very small size and added costs for roof/loft module.
- Despite the relatively high cost, the cottage style has been popular with affordable housing developers looking for designs to complement historic buildings in village centers
- Note: in order to maintain the integrity of the building envelope and reap the full financial benefit of modular construction, ZEM construction (and most other high-performance building) is not conducive to extensive homeowner DIY involvement or use of salvaged materials. The best parts of the process for volunteer/DIY involvement include site prep, post-delivery stoop/deck construction, and landscaping.

## **Learn More:**

Vermod Homes: <http://vermodhomes.com/>

Press release for this project: <http://vermodhomes.com/first-zem-home-burlington-delivered-north-ave-community/>

Techno Metal Post: <https://www.technometalpost.com/en-US/>

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