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Contact Us

Open Rivers | Institute for Advanced Study,
University of Minnesota
Northrop
84 Church Street SE
Minneapolis, MN 55455

Telephone: (612) 626-5054
Fax: (612) 625-8583
E-mail: openrvrs@umn.edu
Web Site: https://openrivers.umn.edu

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TEACHING AND PRACTICE

BUILDING A SMALL, SOLAR-POWERED WORK SHED

By Joseph Underhill

What does resistance to the current set of unsustainable, unjust, and unhealthy practices look like? In the face of large-scale, daunting problems—climate change, the morass of social media, addiction, obesity, other mental and physical health challenges, and so on—we need to begin to explore alternatives through small-scale social experiments using available materials,

Dedication ceremony for the "unit of resistance" with members of the Augsburg University community. The shed is now used for student-led construction projects and for work on repairing the boats used for the River Semester program. Image courtesy of Joseph Underhill.

resources, and technologies. Given the challenges of bringing about change at the systemic level in the near term, one approach is to plant seeds of an alternative future in the form of small "units of resistance." These units of resistance can enable a range of responses to systemic problems, including the opportunity to imagine ways of "living otherwise," transitioning to a post-carbon economy, obtaining skills relevant for green jobs, and giving students a set of healthy, outdoor, hands-on learning opportunities. The units of resistance project aims to chip away at the Anthropocene infrastructure on university campuses (land, buildings, culture, and curriculum) as a form of "rewilding" and rethinking curriculum and pedagogy. Drawing inspiration from Robin Wall Kimmerer's call to "become Indigenous" to place, rewilding here implies a way of rethinking our relationship to the wider world that minimizes our entanglement in the multiple forms of violence of the current carbon-intensive, consumerist, militarized systems.[1] It is a form of subversive experimentation and diffusion that aims to bring about social and political change.

At Augsburg University, we followed these practices of resistance by building a solar shed to use as an outdoor woodworking shop. Below is a rough set of plans for building this small autonomous outdoor work shed, which serves as a way to provide tools and space for building things on campus. The shed is currently used for building boats, benches, paddles, and other outdoor structures to facilitate outdoor experiential education. A solar energy system powers the tools needed for this work. The shed itself serves as a storage container and power source. It also functions as a visible manifestation of an alternative to large, energy-intensive buildings that isolate students from the world around them. This set of plans and specifications for building a simple, low-cost, 8′ X 8′ work shed with a self-contained solar power system is based on the shed we built at Augsburg. This kind of shed could be used in a range of settings, such as resistance camps, community gardens, college campuses, urban encampments, tiny home sites, and more.

The work shed at Augsburg was built by a professor and a small group of students with funds from Augsburg's Environmental Action Committee (EAC), a campus greening fund supported by an annual "green fee" charged to students. The building uses local materials, and building it cultivates skills such as design, basic construction, woodworking, and setting up solar power systems. The process of designing and building the solar shed gave students an opportunity to experiment with building simple, low-cost, and low-carbon structures.

The idea draws inspiration from the "Structures of Resistance" project organized by Molly Reichart, John Kim, and others, which focused on the production of low-cost shelters or "Tarpees" for various uses. It likewise aspires to reclaim spaces and technologies in ways that have a minimal impact on the land, build community through shared construction projects, and reconnect students to the land by getting them outside to work with their hands.

The solar shed unit on the Augsburg campus, built in summer 2022, houses tools and is currently being used as an outdoor maker space and teaching resource. One of the first projects built at the shed was a mobile outdoor classroom cart, which consisted of a mobile whiteboard and a storage cart for supplies and seating for outdoor classes. The shed's energy supply comes from six 320-watt solar panels from Renogy Solar. The panels power a 24-volt battery bank and an inverter that creates the alternating current needed to run power tools. Solar sheds like this are most useful and versatile when their design is simple, modular, and accessible for folks with limited carpentry skills. They are self-contained and off the grid, powered by renewable energy, and resilient in the face of increasingly severe weather. On a practical level, they are secure and low maintenance.

Rough Construction Details

The dimensions of the solar shed are roughly eight feet by eight feet with a solar roof. These measurements are based on the most readily available material, namely four-by-eight foot sheets of plywood and eight-foot, two-by-four-inch lumber used for framing. One consideration in designing the shed was the need for grounding the electrical system. Per local electrical codes, this required sinking two eight-foot copper rods into the ground adjacent to the shed. In order to deploy this shed on campus, it could not be permanently located. This would have required significantly more approvals and funding. Instead, the unit had to be set up in a temporary location in an out-of-the-way spot on campus. Even in this location, the shed raised some concerns about its appearance and purpose. The solar shed can be moved by trailer, so it can be brought to different locations. Given the countercultural nature of these structures, they are generally best located in liminal spaces on the less regulated margins.

The solar shed's roof is angled at 45 degrees to match the average angle of the sun in Minneapolis (which is at 45 degrees latitude). Further north, the roof's angle should be made proportionately steeper. The solar power system is mounted on top of an asphalt shingle roof, with the charger, batteries, and inverter located inside the shed. The interior of the shed has shelves and workbenches for storing the power system, tools, and supplies.

As noted, the main purpose of the solar shed at Augsburg is for students to do outdoor wood-working projects, but other units of resistance can be used for any combination of outdoor construction, community gardening, workshops, or powering a modest sound system/projector for outdoor events. Building one on a trailer would also make sense in terms of mobility, and for future builds I plan on looking into that option.

The Solar Shed Under Construction

The floor and one wall of the solar shed as it is being framed. The shed sits on two four-by-four-inch wooden beams. Image courtesy of Joseph Underhill.

The solar shed is located on the edge of a parking lot on the Augsburg campus by the I-94 freeway wall. Image courtesy of Joseph Underhill.

The solar shed, now framed and covered with tar paper on the roof, sits on the edge of a parking lot at Augsburg University. Image courtesy of Joseph Underhill.

The solar shed is now fully painted and the solar panels are partially installed. Image courtesy of Joseph Underhill.

The shed's interior shows two batteries (grey boxes on the lower left), a charger and inverter (on the wall on the upper left), and various tools, flags, and supplies. Image courtesy of Joseph Underhill.

Cost

The materials for this work shed or unit of resistance cost approximately U.S. $9,000 with donated labor. The solar energy system was ordered from Renogy, although there are a growing number of small-scale solar package vendors.

The solar system consists of the following components:

- 1200 WATT 12 VOLT Monocrystalline Solar Kit (premium kit with mounting brackets and four 320-watt solar panels) plus two additional 320-watt solar panels = U.S. $4,175 (prices are in flux, as the cost of solar panels continues to drop)

Deep Cycle AGM Battery 12 Volt 200Ah = U.S. $880

- 24V Pure Sine Wave Power Inverter 4000-Watt = U.S. $400 – $1,000 (These are available through a variety of online vendors.)

- Miscellaneous wiring, grounding rods, etc. = U.S. $100

Total cost for 1800w solar system: U.S. $5,500 – $6,100

Lumber & Materials List for the Solar Shed

Total cost of materials is about U.S. $3,000–$3,500. Using salvaged or reused material would lower the cost and the project's environmental impact if you have the time and wherewithal to acquire them.

Floor	# of Units	Length
2" x 6" treated lumber	10	8'
3/4" plywood	2	4' x 8'
4" x 4" treated lumber (base for shed)	4	10'
16d sinker nails	a few boxes	
8d sinker nails	a few boxes	
Walls	**# of Units**	**Length**
2" x 4" lumber	40	8'
1/2" sheathing plywood	8	4' x 8'
T1-11 siding plywood	10	4' x 8'
hinges	2	
door handle	1	
lock	1	
caulk	4 tubes	
primer	3 gal.	
paint	3 gal.	
trim	10	1" x 4" x 8'
Roof 10' X 12'	**# of Units**	**Length**
rafters	14	2" x 6" x 12'
tar paper	1 roll	
shingles	1.33' squares	
flashing	50'	
5/8" plywood	5	4' x 8'
soffit	3	4" x 8'
Interior Workbench and Shelves	**# of Units**	**Length**
5/8" plywood	3	4' x 8'
2" x 4"	10	8'

Footnote

[1] Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants,* Minneapolis, MN: Milkweed Press, 2013, p. 9.

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About the Author

Joseph Underhill received degrees in Interdisciplinary Studies from UC Berkeley and San Francisco State University and a doctorate in Political Science from the University of Michigan. He has been working at Augsburg University in Minneapolis, MN since 1998 and from 2010–12 served as Batalden Faculty Scholar in Applied Ethics. In 2016–18 he was Program Director of the Nobel Peace Prize Forum. He is a founding member of Augsburg's Environmental Stewardship Committee and helped create and currently directs the Environmental Studies Program. Prof. Underhill also created and now directs the River Semester program, the nation's only full semester program offered on the Mississippi River. He has been teaching and researching the political, cultural, and psychological dimensions of environmental and security issues for the last twenty years and has written and presented on the intersection of political psychology, security, and the environment, and is the author of *Death and the Statesman* (Palgrave, 2001). Dr. Underhill teaches courses in environmental and river politics, research methodology, political movements, and a range of topics in environmental politics. In his courses, he emphasizes experiential, critical, democratic, place-based pedagogy, regularly engaging students in fieldwork and service projects, including courses in New Zealand, Costa Rica, Nicaragua, Egypt (2012), Tanzania (2013), and now regularly on the Mississippi River.