Allentown EAC Recommendation to Install and Operate a Solar Kiln in the City of Allentown
January 18, 2023

1. Executive Summary

The Allentown Environmental Advisory Council recommends that the City install and operate a solar kiln that will enable the City to put valuable waste wood to a higher use than chipping it for mulch as the City is currently doing. The kiln design is described in Attachment A. It can be designed, built, and installed by qualified community members at an appropriate City location (chosen by the City) similar to the way in which community members have installed bluebird houses and chimney swift towers in the City's parks. The community members who would design and build the kiln would be Lehigh University students working under the guidance of AEAC member and Lehigh University professor, Jennifer Swann. If possible, the students would work in partnership with Promise Corps members (who are providing community service under an AmeriCorps-based program) under the guidance of Promise Neighborhoods Lehigh Valley. If this is not possible, they would work independently of Promise Corps. Once the students have completed designing, building, and installing the kiln, the City would own the kiln and be responsible for the milling and drying of the lumber. The kiln is a passive system, so it will not require the City to operate it.

The Allentown EAC proposes that the City allocate a budget of $2,800 for the purchase of the kiln materials. See the cost estimate prepared by Lehigh University students and a quote from Easton Dykes Lumber Company in the Appendix. Please note that the $850 referenced in Figure B of the Appendix is outdated and does not include all costs. As the solar kiln is a passive system, no manpower needs to be budgeted to operated it. The only operations would relate to milling, drying and storing the lumber. The Allentown EAC believes that the City (either within the Department of Parks and Recreation and/or the Bureau of Recycling and Solid Waste) can incorporate the lumber operations into their existing operations so that budgeting for additional manpower should not be required.

2. Importance / Potential Benefits of Solar Kilns for City of Allentown

A. ***Environmental****:*

Solar kilns are self-sustaining and energy-efficient. Introducing them in the City would ideally spur awareness and education about the environmental benefit of solar-powered kilns.

Solar kilns allow the drying process to be emission-free, as opposed to drying using conventional fossil fuels. To the extent it reduces commercial tree harvesting, it reduces the carbon footprint associated with those activities and possibly even reduces deforestation. Emitted carbon is also sequestered for longer periods, to the extent that the lumber is used for long-lived products.

B. ***Economic****:*

The City of Allentown could potentially save substantially on lumber purchases. The City of Allentown could also save on the costs of the energy it currently uses for running the diesel-powered wood chipper it currently has.

C. ***Community***:

Should the City choose to use the solar kiln as a workforce development vehicle, the City could work with Promise Neighborhoods' Promise Corps program. For the Corpsmembers to learn the system and operations under this program, they will gain many transferable skills that can lead to careers in important areas; county, city, or federal environmental spaces, DCNR, forestry service, land management, the National Park Service, the Bureau of Reclamation, Parks and Recreation, recycling centers, landscaping, and tree farms just to name a few.

The lumber could also be used to create community goods. Through surveying community organizations, the wood could be utilized for benches, workspaces, community gardens, and much more.

D. ***Historic Preservation***:

In the Lehigh Valley area, there is an abundance of ash trees that could be used for lumber which will become increasingly valuable as ash trees will be extinct over the next several decades due to the invasive emerald ash borer, a beetle native to northeastern Asia. This is an opportunity to repurpose their rich history for additional uses. Preservation of this wood is lucrative, as ash becomes more scarce, the price and demand will increase. There is also a unique essence of respect and beauty in woodworking projects that are accomplished using locally sourced products.

3. The Context for the Project / Where it Works

Our project takes a creative approach combining aspects of community enrichment and workforce development with sustainable practices and conservation. Our research and development for this project have identified numerous other programs with similar goals. The two most prominent case studies are The Baltimore Wood Project and the Promise Corps of Philadelphia.

A. Baltimore Wood Project

The Baltimore Wood Project does not involve the use of kilns to dry wood, as our project does, but rather focuses on redistributing wood from dilapidated buildings back into the community. Their mission is to "build a networked regional economy around wood and land restoration that is rooted in reclaiming wood, reclaiming lives, and reclaiming neighborhoods in urban and rural areas"(http://baltimorewoodproject.org/). Their organization is partnered with numerous non-profits, including Humanim, an organization facilitating workforce development in the State of Maryland. As well, the Baltimore Wood Project is partnered with the United States Forest Service Department of Agriculture, the City of Baltimore, and the Maryland Department of Natural Resources, all of which are government entities.

The Baltimore Wood Project Parallels our project in one key way, in that it is partnered with a non-profit that assists and promotes workforce development. Our key partner, Promise Neighborhoods of the Lehigh Valley, is the organizational entity with which we are partnering on this program.

B. PowerCorpsPHL

PowerCorpsPHL in Conjunction with the Philadelphia Parks and Recreation Department has run a program very similar to ours with one exception – they used steam-powered kilns using diesel generators instead of solar kilns. In this regard, our project is superior in that it uses renewable energy with a lower carbon footprint.

4. Proposed Project Details

A. Kiln Design

See the appendix for the kiln schematic. Each solar kiln operates passively through radiative solar heat transfer. Solar radiation is incident on a semi-transparent vinyl roof that absorbs and traps heat in the kiln. The wood is then heated at an ideal humidity, with solar-powered fans circulating the air inside.

We are basing the design for the pilot kiln on the schematics provided by Dr. Brian Bond, Assistant Professor, and Extension Specialist, Department of Wood Science and Forest Products, at the Virginia Polytechnic Institute and State University. These schematics were compiled based on 25 years of research, and have been used by hundreds of individuals constructing solar kilns. The same schematics were used by our contact Rob Hammill, who constructed a solar kiln based on these same schematics ten years ago. These schematics are also consistent with those published by the US Department of Agriculture:

Examples:

https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs134.pdf

https://news.virginia.edu/content/class-2020-students-project-will-make-sun-dried-lumber-available-grounds

Our rationale for building the kiln utilizing these schematics is that they have been widely and successfully used to efficiently dry wood. Virginia Tech has produced numerous documents outlining the details of construction. Virginia Tech also offers a course on solar kiln building.

B. How We Will Measure Success for Allentown

In addition to measuring cost savings to the City in reduced lumber purchases and/or reduced energy usage, we are evaluating the following additional metrics of success:

- Total reduction in carbon footprint associated with Allentown's handling of felled trees and reduction of lumber purchases
- Number of Corps members from Allentown who complete the program and learn woodworking and forestry skills (if the City incorporates workforce development in the program)
- Number of products and amount of wood from the kiln put to use in the Allentown community

5. Conclusions

As lumber prices continue to soar and certain native species of trees are plagued by invasive species, there needs to be an appreciation of preserving this forestry in the Lehigh Valley. Instead of chipping these beautiful logs as is currently done in Allentown, an environmentally friendly alternative is available to upcycle and keep these pieces of history in the community while incorporating workforce development in the program.

A simply constructed structure that takes no more than 10 by 15 feet of space can impact multiple layers that need to be addressed. The community has a stated need for the products that will be created from this wood. The people of Allentown will have an opportunity to be educated about forestry, construction, and lumber - micro-credentials that can be used to propel themselves in this lucrative field. The solar-powered drying of these logs will limit the amount of fossil fuel energy currently used to chip up these logs. There is a simple solution to preserve and reuse this lumber. We simply need $2,800 to purchase the solar kiln materials.

6. Appendix

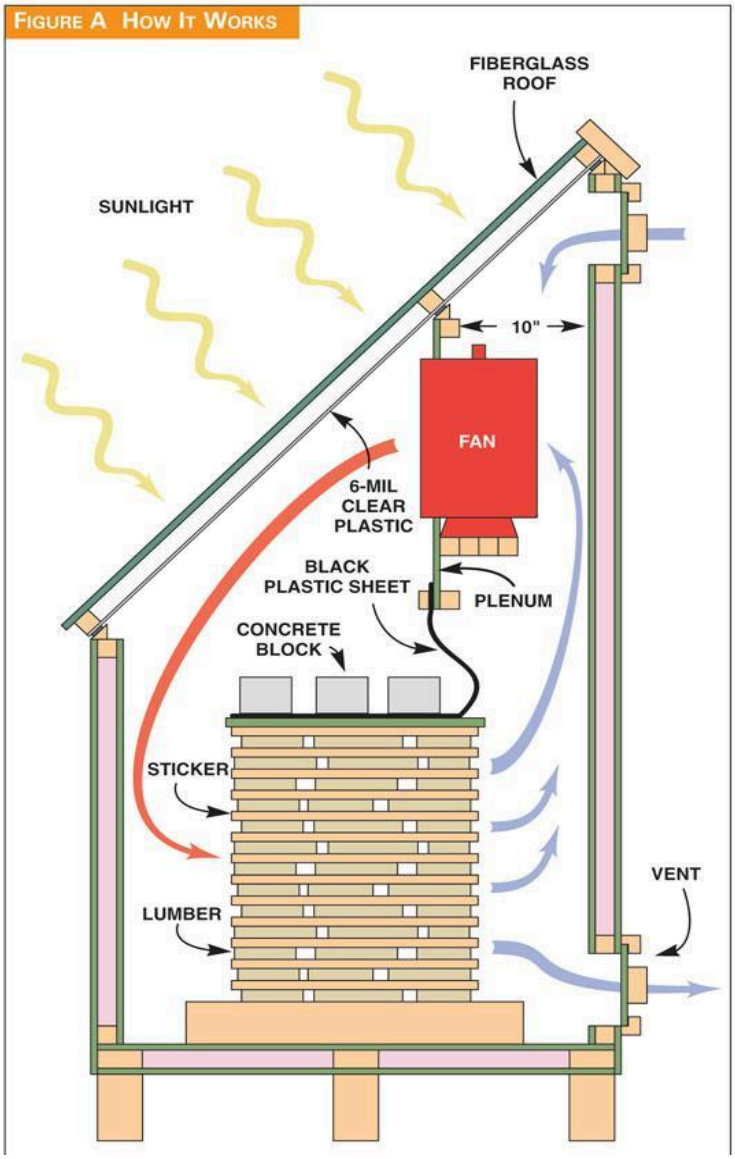
Virginia Tech Detailed Kiln Schematics
https://vtechworks.lib.vt.edu/bitstream/handle/10919/98866/420-030_pdf.pdf?sequence=1
https://sbio.vt.edu/content/dam/sbio_vt_edu/kiln-plans.pdf

Solar Lumber Drying Workshop Through Virginia Tech
https://sbio.vt.edu/for-the-community/solar-kiln-multi.html

A. How a Solar Kiln Works (Figure A).

Solar energy enters the kiln through the fiberglass roof. The sun's radiant energy hits the dar4k interior and heats the kiln. A time runs the fan for about an hour after sunrise to about an hour before sunset. As the kiln heats up during the day, the fn circulates warm air through the lumber stack. A plastic sheet forms a baffle that forces air through the stack. The moving air picks up moisture from the wet wood and vents it out the back.

Note:Opening the vent allows you to release moist air more rapidly. The kiln is not airtight, so moisture-laden air can escape with the vents closed. At night, the fan shuts down, the kiln cools and the moisture from the air condenses, wetting the boards. This conditions the wood. and eases any drying stresses that accumulated during the day. this process provides good results without monitoring. It dried 4x4 red oak boards in 6 weeks.



B. Project Requirements (figure B)

PROJECT REQUIREMENTS AT A GLANCE

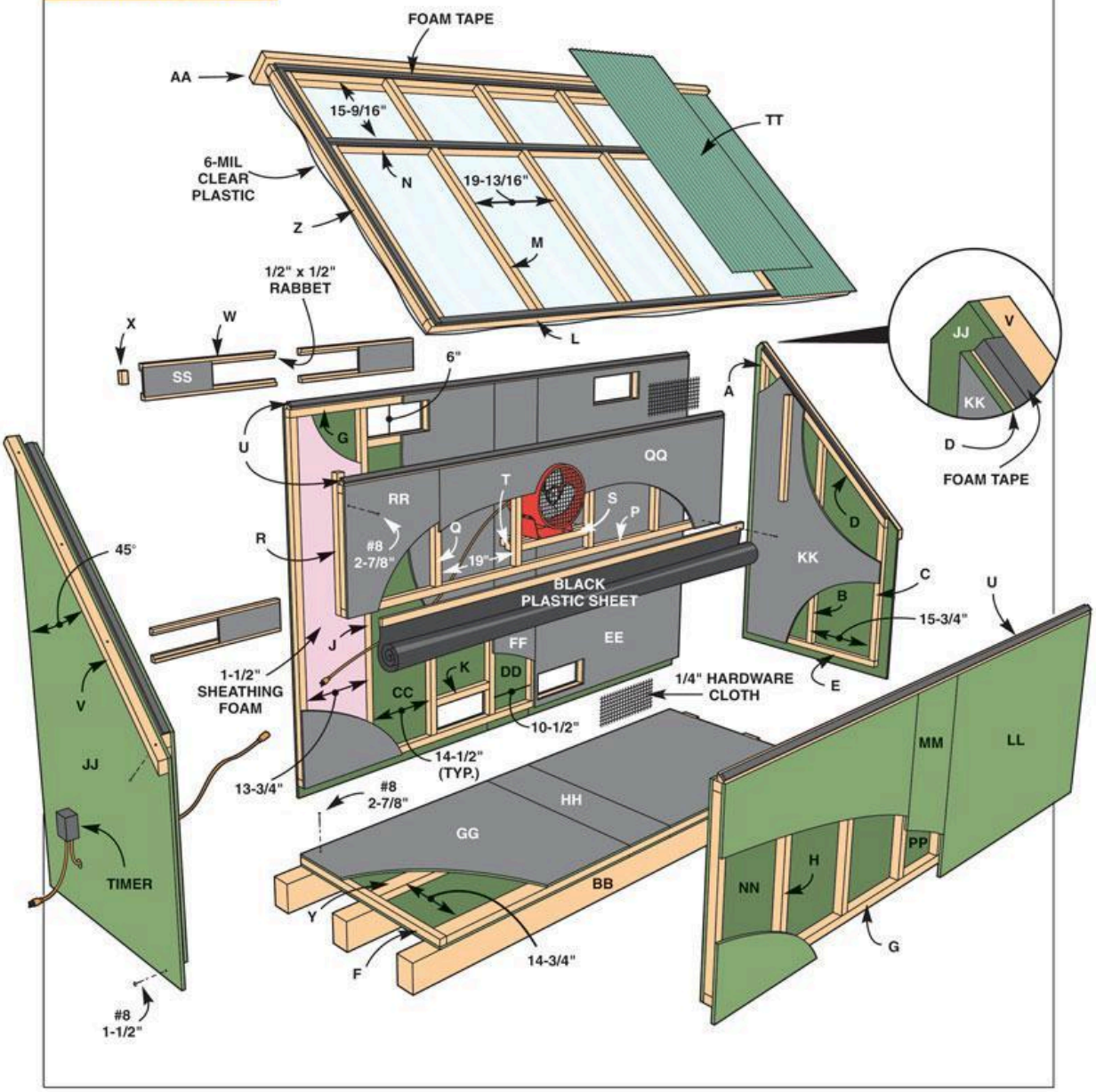
Materials
28 2x2 x 8' treated
10 2x4 x 10' treated
One 2x6 x 10' treated
Three 4x6 x 10' treated
Seven 1-1/2" x 4' x 8' sheathing foam
14 1/2" x 48" x 96" treated plywood
One 12" ventilation fan
One multiple-outlet timer
Five 25-1/2" x 120" corrugated fiberglass panels

Hardware
Eight 7/16" x 1-1/4" x 10' black foam tape
No. 8 x 2-7/8" corrosion-resistent screws
No. 8 x 1-1/2" corrosion-resistent screws
Sealing washers
One fan timer
One 1,000-cfm fan
1-gal. flat black oil-based paint

Tools
Tablesaw and/or circular saw
Miter saw
Drill
Framing square
4-ft. level

Cost $850

FIGURE B EXPLODED VIEW



C. Rough Price Estimate

Rough Estimated Price

					Total		

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D. ***Virginia Tech Schematics: note these can be adapted***

Material	**Quantity**	**Price**
8 foot 2x4	58	4.78 - HD (277)
10 foot 2x4	14	7.38 - HD (103)
14 foot 2x4	12	15.98 - HD (191)
14 foot 2x8	2	27.78 - Lowes (55)
8 foot 4x4 treated	6	10.68 - HD (64)
8 foot 2x8 treated	15	13.98 - HD (210)
14 foot 2x8 treated	5	27.78 - Lowes (139)
¾ ext grade plywood	4	60 - HD (240)
⅜ ext grade plywood	20	29.98 - Lowes (600)
26x12 PVC panel	7	26.98 - HD (188)
insulation	300 sq ft	300 bucks maybe
Tar type interior paint	5gal	45 - HD
Exterior paint	5gal	25 - Lowes (125)

Framing nails	1 box	5
Barn hinges	4pcs	20
Staples	1 box	5
Polyethylene sheet	1	15
Solar panel + fan kit	Enough to have 1000cfm	300
vents	4-8	tbd

$2700 - $2800 Rough Estimate