Compost Power: Final Report

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Executive Summary

Through the University of Vermont course CDAE 295 entitled Local Community Initiatives, the Compost Power team assessed avenues for disseminating the Compost Power technology throughout the Mad River Valley community. Our tasks were four-fold: conducting background research on other projects similar to Compost Power across the U.S. and Canada; designing and disseminating a survey instrument to gauge interest of community members in adopting the Jean Pain method; create marketing materials; and to make recommendations for Compost Power moving forward.

Background research suggests there are few projects similar to Compost Power's that are well documented. Most projects exist within permaculture communities, and were built for heating water for showers or for greenhouses. We conclude from this research that a good online source of information through the Compost Power network could serve to make this technology accessible to a broad audience.

The survey results, although non-representative of the farming community in the Mad River Valley, demonstrated great interest in the Jean Pain method for greenhouse and other potential uses. One respondent indicated interest in using the technology to heat the soil around his grape vines in order to extend his growing season. Some concerns in adopting the technology included not having enough information, or the time to build a mound. This information can help inform future marketing materials in terms of addressing these concerns. The contact information of those interested in the survey is included in survey section below so Compost Power can get in touch to discuss their participation further.

I. Research on Compost Heating Projects in America and Canada

Formal studies on compost heating experiments proved scarce in our research of previous literature. Online permaculture forums and independent farms were the only sources of any appreciable amount of information, suggesting that the Jean Pain method, as well as other compost heating schemes, is still at the fringe of alternative energy research. However, the Diamond Hill composting system described at the end of this section points to the energy potential and commercial viability of compost heating systems. We must stress that all of the designs and experiments summarized below have not been peer reviewed and only one was sponsored by a research institute. Hence, we have taken efforts to provide contact information where possible in an effort to expand the Compost Power Network's information base and allow for follow up. While the Jean-Pain method may be primarily employed by independent practitioners, their first-hand experience may not be wholly discounted, as there are patterns of success among the various case studies listed. We wholly encourage the Compost Power

Network to pursue the contacts listed herein for they represent the body of knowledge amassed since Jean Pain.

Inspiration Farm: *Compost-heated Showers*

Brian Kerkvliet, owner and operator of Inspiration Farm in Bellingham, Washington, reports of using compost mounds for up to two months to produce 500 hot showers for his family and farm interns. His compost mound was part of a more dynamic water system that utilized runoff from outdoor showers to moisten mycorrhizal fungi with the purpose of soil building. Kerkvliet reports using poly pipe in coil design, similar to that demonstrated in Compost Power Network workshops, in his mounds. He claims he was able to attain water temperatures of 160 degrees, which later fell to 90 degrees at the end of the two month period. Kerkvliet does not disclose the composition or dimensions of his compost piles however they appear to be comparable in size to projects undertaken by the Compost Power Network. Kerkvliet does not he specify the volume or rate of hot water output.

Kerkvliet, B. (Dec 2009): "500 showers hated from one small compost pile." Retrieved from http://youtu.be/-Jm-c9B2_ew.

Contact
Brian Kerkvliet
360-398-7061
http://www.inspirationfarm.com/newif/welcome.html (email via website)

Verge Permaculture: *Compost-heated Showers*

Verge Permaculture is a company based in Calgary, Canada that offers courses in low-impact residential design, with an emphasis on holistic food production, alternative energy and water management. Like Inspiration Farm, Verge reports using compost piles to heat outdoor showers. Their piles consist of a mixture of cow, sheep and goat manure and straw, and they claim to have reached water temperatures of 159 degrees Fahrenheit, which they sustained for approximately four weeks. In total, Verge claims six weeks of usable hot water, with declining temperatures in the last two weeks. The company does not report the volume of water heated, claiming only that the pile produces enough hot water for a five minute shower and a recharge time of five minutes. Verge also did not state a rate of discharge. Compost pile dimensions were not provided but are similar in scale to the pile documented by Inspiration Farm and the CPN.

Avis, R. (Apr 2010). "Compost Heated Shower at PRI." Retrieved from http://youtu.be/wYXJaFNDutA

Contact
Verge Permaculture
+1 (403) 770-9789
http://www.vergepermaculture.ca (email via website)

The New Alchemy Institute: *Composting Greenhouse*

In 1983 the New Alchemy Institute and the Biothermal Energy Center (both since defunct) began a two year research project on composting greenhouse design at NAI's research and educational farm in Cape Cod, Massachusetts. Unlike the other designs summarized in this report, the one employed by the NAI and the BEC did not use flexible poly pipe and water for heat exchange, constituting a distinct departure from the Jean Pain method. Instead, the design called for a blow-off system that captured water vapor from the compost chamber (see picture below). Fans sent the vapor through perforated piping. As the water condensed in the piping, as well as in the suspended garden beds above, thermal energy (due to phase change) was distributed to the structure. In addition to circulating heat, the blowers also circulated carbon dioxide given off from the compost. It is important to note that the time schedule of the blowers was calculated not to provide maximum heat output but also to provide specified volumes of carbon dioxide to indoor garden.

The 25 cubic yard compost chamber was regulated to prevent overheating the garden beds so internal temperatures were never allowed to rise above 130 degrees Fahrenheit. At these temperatures, the NAI and BEC were able to maintain garden bed temperatures of 62 and 75 degrees for the lower and upper beds, respectively. The air temperature at the top of the greenhouse remained significantly cooler, dropping to 28 degrees Fahrenheit at night during the winter, though the NAI and BEC report no instances of frost damage. The design called for constant additions of compost materials—specifically horse manure/sawdust mixture—as frequently as five cubic yards every five days. The 576 square-foot greenhouse produced over 100 tons of compost in its first year of operation.

The full report can be found at:

Fulford, B. (1986). "The composting Greenhouse at New Alchemy Institute: A Report on Two Years of Operation and Monitoring." New Alchemy Institute. Retrieved from http://www.thegreencenter.net/pdf/compost.pdf

Kaliash Ecovillage: *Composting Greenhouse*

The Kailash Ecovillage is a sustainable urban community located in Portland, Oregon. The permaculture-based village built a composting greenhouse with a straw bale foundation in 1994. Measuring 16x30 feet, the greenhouse contained approximately 28 cubic yards of compost (3x12x21 ft), which was composed of woodchips, food wastes, garden debris, and manure. Kailash claims the greenhouse provided "continuous" hot water to a household of five people for

18 months until it was deconstructed. It is worth noting that Kailash added more compost material "several times" to the greenhouse over the 18 month period. Kailash reports water temperatures ranging from 90-160 degrees Fahrenheit. The greenhouse was multi-purpose; in addition to providing hot water it was also used to cultivate mushrooms and protect plants during the winter. Using a loop design akin to the Jean Pain method, the greenhouse had a hot water storage capacity of 9.17 gallons.

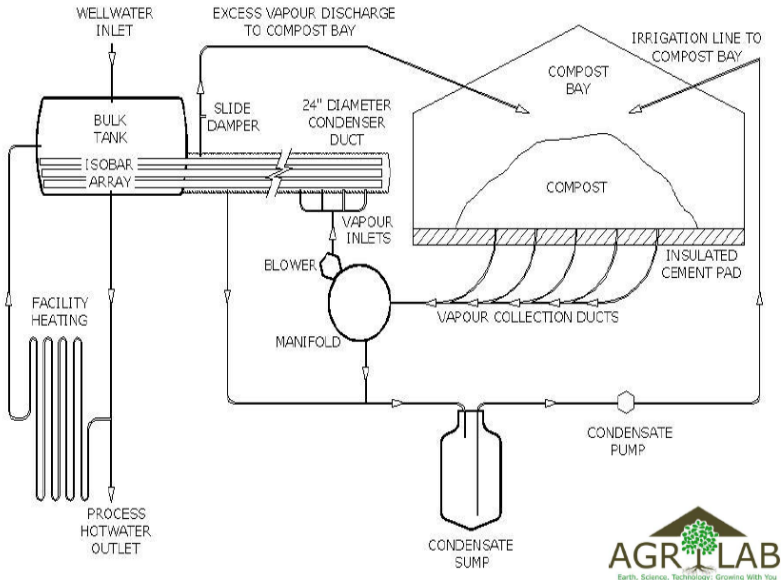
More pictures and details of the design are available online at:

Kaliash Ecovillage. (Dec. 2009). "Compost Greenhouse with Straw Bale Foundation." Retrieved from http://kailashecovillage.com/experiments/greenhse.htm

Contact
http://kailashecovillage.com
kailashevovillage@gmail.com

Diamond Hill Custom Heifers: *Commercial Compost Water Heating Prototype*

Located in Sheldon, VT, Diamond Hill Custom Heifers completed the design of a compost "barn" in 2006. Capturing thermal energy from the manure on a 2,000 heifer capacity farm, it is reputed to be the first "commercial-scale" compost heating plant by BioCycle Magazine. The system's design greatly differs from Jean Pain method as it requires a significant amount of technological investment (see design below). The system has a compost load capacity ranging from 150-800 tons and captures thermal energy ranging from one to five million BTU's per day. Using vapor capturing technology, Diamond Hill reports output temperatures of 131 to 149 degrees Fahrenheit, with compost pile temperatures reaching as much as 160 degrees. While this system obviously represents a significant capital investment on the part of the farmer, Diamond Hill has been able to experiment at a large scale with varying composting mixtures—information which could useful to any scale compost-heating system. As of 2006, the farm maintained 25:1 ratio of carbon the nitrogen in their



compost recipes. "The wood chips will be 10 to 20 percent of the mix by volume," reports Brain Jerose, co-owner of WASTE NOT Resource Solutions, a consulting firm that has helped design Diamond Hill's system. Liquid and solid cattle manure make up the remainder of the compost mixture. It is worth noting that in addition to woodchips, Diamond Hill also substitutes sawdust and straw.

Tucker, M. (Aug 2006). "Extracting Thermal Energy from Composting." BioCycle. Retrieved from http://www.jgpress.com/archives/_free/001052.html

Contact

Brian Jerose, WASTE NOT Resource Solutions
802 933 8336
jerose@together.net
www.farmcomposting.com

Terry and Joanne Magnan, Diamond Hill custom Heifers
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Conclusion:

When projecting the Compost Power Network's own efforts into the context compost power systems across North America, two things become clear. Firstly, CPN's achievement in attaining water temperatures of 160 degrees Fahrenheit is indicative of the success reported by other projects across the country and in Canada. But, unlike these other projects, CPN has been able to sustain higher output temperatures for longer periods of time without repeated additions of biological matter. Secondly, compost power systems are highly adaptable for specific projects. Variations on the Jean-Pain method shows that a compost heating system can be used for supplying hot water in a semi-closed loop agricultural system as well as heating residential buildings, greenhouses, and garden beds. Such innovative designs could inform CPN's marketing strategy, as it looks to expanding the applications of the Jean-Pain method.

II. Survey Results

Introduction

Compost Power is in its beginning stages in terms of disseminating information to engage all farmers in the Mad River Valley that have interest in using the Jean Pain Method. A survey was conducted to understand how interested farmers in the MRV are in this method, and to understand the barriers to using the method. The Compost Power team sent out a survey to a list of 53 farmers in the Mad River Valley and 6 people responded to the survey. All respondents were interested in learning more about using Compost Power for on-farm and home-heating needs. Interest in this method was expressed primarily for the use of organic compost; the low relative cost; and the provision of a cleaner, safer alternative to conventional heating. Others cited the convenience of building a mound given easy access to materials, and the reliability of heat generation compared to passive solar. Time and information were cited as the barriers to building a Jean Pain compost mound. Based on the survey results of this non-representative sample, the Compost Power UVM team suggests that Compost Power reach out to community members by email to provide more information on how to get involved and learn how to build and use the Jean Pain Method.

Methods

This survey served two purposes: one was to educate people about the Jean Pain Method, and two was to gauge interest in using the method on the potential respondents' farms. A list of 53 farms in the Mad River Valley region was gathered from the Mad River Localvore database. IRB exemption was acquired to conduct the survey as the survey did not target at-risk populations. The survey was comprised of ten questions that aimed to educate and understand interest and the barriers to using this technology. A free online survey tool, Zoomerang was used. Two emails were sent to potential respondents. The first email explained the purpose of the survey, the connection between the UVM Community Initiatives course and Compost Power, and that IRB approval had been granted to conduct the survey. A link to the survey tool was provided at the end of the email. Attached to the email was the IRB approval letter (see appendix) and the Compost Power flier (see marketing materials). To keep responses confidential and separate from contact information of the respondent, a second link was provided, separate from the first survey link, where respondents could provide their contact information if they were interested in being contacted to learn more about Compost Power.

Results

Table 1 summarizes survey questions and responses.

Table 1

Survey questions and responses (n=6)

	Question	Response				
1	Do you own a greenhouse?	Yes (4)	No (2)			
2	Do you have other areas like barns, etc. that require low-level heating during the winter?	Yes (4)	No (2)			
3	What type of heating system do you have for your greenhouse or other structure indicated in the previous question? Check all that apply	Electric (2)	Gas (1)	Oil (0)	Radiant in ground heating loops (3)	Other (3: no greenhouse; no heat source; switching from electric to radiant in ground)
4	Would the organic compost created using the Jean Pain Method be useful to you on your farm?	Yes (6)	No (0)			
5	Would you consider heating your greenhouse with the Jean Pain Method sometime over the next 3 years?	Yes (3)	No (0)	Need more information (3)		
6	What factors would drive you to build a Jean Pain compost mound yourself, provided you were given engineering and design assistance. Select all that apply.	If the cost to build and maintain the compost mound was below what I normally pay in fuel to heat my greenhouse (3)	If it provided a source of organic compost for my farm (4)	If it was a cleaner and environmentally safer alternative to using conventional fuel for heating (3)	Other (4: Easy access to wood-chips; Could be used in vineyard; Partner hesitant about using it; More reliable than passive solar)	
7	Which of the following may be a reason you would NOT want to construct a Jean Pain compost mound to generate heat for a greenhouse, or other structure? Check all that apply	I don't have enough time (1)	I prefer my current heating methods (0)	I plan on heating my greenhouse through a different method in the future (0)	I don't have enough information (1)	Other (1: Convincing partner to use it)
8	The Compost Power concept has been proven to work, but it is still experimental in terms of predicting exactly how much heat a system will produce over it's 12-month heating-phase. The system requires about 20 yards of fresh-shredded bark mulch which typically costs around $25/yard (~$500). Another possibility is to mix wood-chips, saw dust and manure, which if you have these things available, can cut costs.Are you interested in trying this method with design and construction help from Compost Power, even though it's still partially experimental?	Yes (4)	No (0)	Need more information (2)		
9	If you would like to be contacted about using the Jean Pain method on your farm, please follow the other link in your email to fill in your contact information.Would you like to be contacted about using the Jean Pain Method on your farm?	Yes (4)	No (0)	Need more information (2)		
10	Comments*					

Additional comments included the following:

- Can the heat be used to help heat our home? How far does the mound need to be from the greenhouse or building we are attempting to heat? How much do the pipes (tubes that carry the water) cost for one mound system?
- First I need to show the information to my husband and see what he thinks.
- I am VERY interested in this.
- Vineyards are highly sensitive to growing degree days and we have no way to control the weather. I see this process as a possibility to support the growing cycle and also to protect the vines at critical points in time. Soil temperature control could be used to accelerate growth during periods of usually cool days. If a thermal heat sink such as a warm water insulated tank was used, this source of water could possibly be used for vineyard management. Do you think this makes sense?
- My requirements are related to field structure and heat or hot water distribution. I'm not sure how one would proceed, but the concept seems promising. I presently use wood chips, manure and compost, so the combination of materials makes sense. I need to understand the control functions and the possibility to use the heat on demand.

Of the six respondents, all were interested in using the Jean Pain method either for on-farm use or for home-heating purposes, and five provided contact information to be contacted further. Interest was primarily expressed on account of the generation of organic compost material to use on the farm, and secondarily an environmentally friendly heating alternative and cost were cited as other points of interest. The barriers cited include time to set up a mound and the need for more information.

Discussion

Of the respondents surveyed, there was 100% interest in the Jean Pain technology. This sample however is not necessarily representative, as those that were interested were the only people that responded. Further research should focus on engaging those that are not necessarily interested in using Compost Power to understand the barriers or preconceptions about using and implementing the technology.

Given those that did respond, it is clear that there is some interest, and more people would like to make use of the technology than are currently in touch with Compost Power. Next steps would include emailing the Mad River Valley list, and any other farmer lists about the benefits and materials needed for building a Jean Pain Mound. The flier and marketing video are quick, easy ways to do this, and contact information on the website and on the marketing materials should be apparent so people can easily get in touch, or find a demonstration near them. If Compost Power does not have the capacity or bandwidth to handle an influx of customized designs for different farming needs, then it may be wise to set up a schedule on the website and a network of farmers that are also interested, planning on building, or already using the Jean Pain Method, such that all may use the method that are interested without the individualized attention from the Compost Power team.

Contact information of those interested in being contacted about the Jean Pain method

1. Joseph Klimek: "Vineyards are highly sensitive to growing degree days and we have no way to control the weather. I see this process as a possibility to support the growing cycle and also to protect the vines at critical points in time. Soil temperature control could be used to accelerate growth during periods of usually cool days. If a thermal heat sink such as a warm water insulated tank was used, this source of water could possibly be used for vineyard management. Do you think this makes sense?"

Email: klimek@madriver.com

2. Stan Ward: "Can the heat be used to help heat our home? How far does the mound need to be from the greenhouse or building we are attempting to heat? How much do the pipes (tubes that carry the water) cost for one mound system?"

Three Springs Farm of Vermont,
PO Box 1493
152 Old County Road
Waitsfield,VT
Telephone: 802-595-3232
E-mail: stan@stanward.com

3. Email: DanaForestFarm@gmail.com

4. Email: ttownfarm@yahoo.com

5. Aaron Locker: "I am VERY interested in this"
Kingsbury Market Garden
284 rt 100
Warren ,VT
Telephone: 802 496 6815
Email: kingsburymktgarden@live.com

III. Next Steps

Based on the survey results, and after attending a mound-building on Russel Street in Burlington, we feel that the high level of enthusiasm for the technology is something that can be spread throughout the community using a variety of methods and tools. Based on the time constraints on the Compost Power team, we feel dissemination of the technology could grow exponentially by empowering those looking to get involved with more information. By doing this, Compost Power can engage the community through providing a network, and still maintain a role as consultants when participants run into engineering and design problems.

Our main recommendation is to empower potential participants with information in, and outside of the MRV:

a. **YouTube** instructional videos can allow those beyond the Mad River valley access to information about how to construct a mound in addition to the materials found on the website regarding engineering and designing a mound. To promote the videos, they can be posted on the website, through Facebook or other social media methods.

   YouTube, is a starting place for CPN to raise awareness and serve as a free video archive for internal CPN use. However, it should be noted that there are many YouTube search responses to, "Jean Pain Method," and videos can also be used on the CPN web site, Facebook and through personal emails.

b. Use of the **CPN Online Forum** should be promoted as an existing resource for conversations about building and using compost mounds. The open conversation style forum could also be created via a Facebook page or group, a Google group or a list-serve. This is a decision to make depending on usability, user preferences, and user comfort.

   Through an online forum, community members could contact CPN to post a demonstration meeting time and place, or to offer or ask for materials from community members in touch with the forum. As one of the barriers to using this technology is material cost, there may be opportunities for those that have building materials available from other activities to offer up these materials. Time is another barrier to building the Jean Pain mound, and the forum could give volunteers an opportunity to offer their help whether they are interested in learning the method or simply want to see the technology spread. This forum would offer a powerful way of getting the technology out there, and to get people talking about it and connecting with one another.

c. **Facebook page** could help spread the idea of the technology and can allow a space for people to spread the idea easily while having reference of the CPN website

available. Facebook posts can additionally serve to broadcast demonstrations and available materials.

A Facebook page would facilitates communication between homeowners and others interested in compost heating, however it should supplement other methods of communication as it may not be the most effective way to reach farmers.

All of our recommendations are suggestions for using a community based approach while developing the compost power network. For those that are not inclined towards online resources and social media, the CPN website can post and promote mound-buildings throughout the community. From the demonstration the UVM team attended in Burlington, those that are using the technology are happy to share their knowledge and help others make use of the technology. By holding demonstrations, those interested can see how a mound is built, and can use the demonstration as a resource. This will create a self-perpetuating model where people can get in touch with community members to share and learn about the Jean Pain method without necessarily relying on the Compost Power team to build the mound.