HANDMADE INSTITUTE

Solutions For Creative Economies

Landfill Gas: Recycling Refuse for Creative Enterprises

A Case Study of EnergyXchange

HANDMADE IN AMERICA

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Solutions For Creative Economies

About HandMade in America

HANDMADE *in* AMERICA

In 1993, a citizen founded organization called HandMade in America gave birth to an idea that linked the making and selling of craft objects to the economic and social renewal of Western North Carolina. The desire to create sustainable local economies based on the region's craft heritage sparked the idea for a craft "heritage corridor" with the Blue Ridge Parkway, a federally-designated All American Road as the corridor spine. A landmark guidebook, *The Craft Heritage Trails of Western North Carolina*, debuted in spring 1996 with seven driving trails linking these assets together on and off the Blue Ridge Parkway and encouraging visitors and residents to explore the rich craft heritage of the region.

There are more than 600 other landfills across the country are potentially available for project development.

After a decade in the marketplace, HandMade in America has become a national leader in demonstrating the economic and social impact of creative communities. The third edition of *The Craft Heritage Trails of Western North Carolina* – along with its companion guide *The Farms, Gardens and Countryside Trails of Western North Carolina* – are available in bookstores.

HandMade understands that growth in the craft industry, especially in Western North Carolina, depends on strong entrepreneurial programs, training, marketing and local economic development. The organization's Small Towns Project has expanded to include 12 communities. Its tourism program now includes business, marketing and interpretive training for farmers and craftspeople. Educational programs are expanding into new markets – architecture and design – with the construction of two new craft homes, an affordable housing project and furnishing two new townhouses in downtown Asheville as a HandMade showroom for architectural elements and decor. Demonstrating the scope and breadth of the craft industry to America's economic vitality continues to be a driving mission for the organization.

PROFILE OF LANDFILLS

Since the first modern landfill was created in Fresno, California, the sites have been controversial. Where to locate them? How to maintain them? How to safeguard them against methane buildup and possible explosion? Yet landfills continue to be as much a part of our life as the waste we create and discard.

Americans throw away an average of 4.5 pounds of trash per person each day. What happens to this waste? It decomposes and releases methane gas into the atmosphere. Simply burning methane gas converts it to carbon dioxide and water vapor, which results in a 21-fold *decrease* in the impact of the gas on global warming.

What do most communities do when their landfills close? Some experiment with landfill-to-energy projects. The US Environmental Protection Agency's Landfill Methane Outreach Program (EPA's LMOP) estimates that approximately 380 landfill gas (LFG) energy projects are currently operational in the United States. These facilities generate approximately nine billion kilowatt hours of electricity per year and deliver 200 million cubic feet per day of LFG to direct use applications. More than 600 other landfills across the country are potentially available for project development.

Tapping a Biomass Energy Source

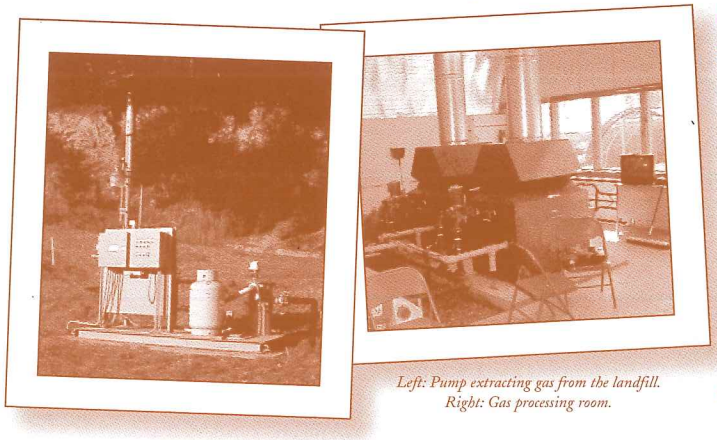
There are traditionally two kinds of landfill energy conversions. The first model is adding on and adapting commercial projects at large landfills. The second model is for conversion of the entire energy source generated from small to medium landfills, as is the case with the Yancey-Mitchell landfill.

The Yancey-Mitchell County Landfill encompasses six acres and accommodated 350,000 tons of garbage during its operation from 1972 to 1994. With six vertical wells and two horizontal wells, the landfill has a 3-HP blower with flare to handle the exhaust fumes generated from over a million pounds of garbage. Nearby Avery County's landfill is of equal size, with eight vertical wells and a 1.5-HP blower.

How Landfill Conversions Work

Solid waste landfills are responsible for about 34% of all human-related methane emissions in the United States. As solid waste decomposes, landfill gas (LFG) is created. LFG is made up of about 50% methane (CH 4), the primary component of natural gas, about 45% carbon dioxide (CO_2), and a small amount of non-methane organic compounds. Unfortunately, methane emissions are often overlooked as an opportunity to capture, convert and use as an energy source. According to the EPA, "using LFG helps to reduce odors and other hazards associated with LFG emissions, and it helps prevent methane from migrating into the atmosphere and contributing to local smog and global climate change."

Gas is extracted from landfills using a series of wells and a blower/flare (or vacuum) system. The gas is then redirected to a central location for processing and treatment, depending on its ultimate use. From this point, the gas can be simply flared (burned) or used to generate electricity, replace fossil fuels in industrial and manufacturing operations, fuel greenhouse operations, or be upgraded to pipeline quality gas. *Electricity generation* is the most popular purpose for landfill gas conversion, used by about 2/3 of current energy renewal projects, for use with various technologies including microturbines and internal combustion engines. The remaining projects directly use the gas to offset another fuel such as natural gas, coal, or fuel oil. Innovative *direct uses* include firing pottery and glass blowing kilns; powering and heating greenhouses; for refrigeration or an ice rink; and heating water for an aquaculture (fish farming) operation. Less widely used applications include *cogeneration* (also known as combined heat and power or CHP) and alternate fuels, converting landfill gas to the natural gas pipeline system as both a high-Btu and medium-Btu fuel.



Left: Pump extracting gas from the landfill.
Right: Gas processing room.

The EPA's LMOP is designed to assist local public and private entities in determining viability of landfill conversion. The voluntary assistance program was launched by EPA as part of United States' commitment to reduce greenhouse gas emissions under the United Nations Framework Convention on Climate Change. LMOP streamlines project development by helping local organizers to assess project feasibility, find financing, and market the benefits of project development to the community.

CASE STUDY

EnergyXchange

Nestled in the Black Mountain Range of Western North Carolina, Yancey and Mitchell are two of the state's most rural counties. The area is rich in cultural, natural and historic assets including the legendary Penland School of Craft, Mayland Community College and numerous artists' studios. Burnsville, Yancey County's seat, anchors the area with its quaint, historic square full of interesting galleries, restaurants and specialty shops. The town of Spruce Pine serves a similar function for adjacent Mitchell County.

Residents are concerned about conservation and economic prosperity. When the landfill faced closure in 1993, many community leaders sought out conversion examples. Extensive research and a lot of brainstorming generated a host of ideas for reuse. As one board member said, "no idea was too ridiculous ... we could have branched out a thousand different ways." This flexibility allowed local leaders to create and customize an appropriate energy reuse for the landfill. As home to some of America's most creative artists and native plants, the Yancey-Mitchell landfill seemed the perfect place for developing craft incubator studios and a greenhouse to cultivate endangered flora.

EnergyXchange has become one of the nation's model energy recovery projects. Methane gas from the decomposing trash powers ovens for glass blowers and kilns for pottery makers, saving an estimated $1 million in energy costs over the landfill's 20-year reuse cycle. The complex includes four greenhouses, three cold frames, a retail craft gallery, visitor center, and fish farm for sustainable revenue generation. According to the EPA's LMOP feasibility study, the environmental impact of the Yancey-Mitchell County Landfill Reuse Project is equivalent to planting 14,000 acres of trees or taking 21,000 cars off the road in North Carolina.

Mission of EnergyXchange:
To demonstrate the responsible use of landfill gas as an energy source for small enterprise in craft and horticulture, and to meet local energy needs.

The EnergyXchange Complex

"This is one of those rare projects that doesn't have a negative side to it.

Every other project has some detractor. But how can you argue with something that takes a pollutant and turns it into a positive, making fuel that provides jobs, educates children and creates beautiful objects?"

Stan Steury,
board member of
EnergyXchange

Organization

A nonprofit corporation was formed September 13, 1999 out of a partnership of three organizations – Blue Ridge Conversation and Development Council, HandMade in America, and Mayland Community College –recognized for their strong track record for education, community development and environmental protection in Western North Carolina. The local Agricultural Extension office was initially, and continues to serve as, a strong partner organization providing technical assistance, training and an extensive funding network. An attorney specializing in non-profit law and organizational structures helped navigate the processes. The US Forest Service funded the initial legal/administrative fees required to create the organization. A copy of the organization's bylaws and other programmatic information is available.

A 12-member Board of Directors comprises public officials, business and civic leaders, and representatives of the area. Terry Woodruff was the first project manager, presiding over day-to-day operations from its inception in 1999 until June 2005. Stan Steury, coordinator of Blue Ridge RC &D – one of the original sponsors of the landfill – joined the board in November 2005. An administrative coordinator, administrative assistant, and two greenhouse coordinators help with special programs, marketing and administration. There are currently six craftspeople in residence in the craft studios.

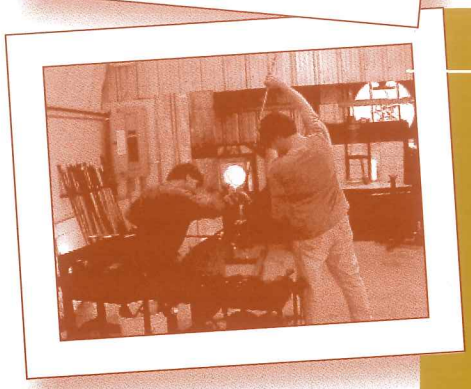
EnergyXchange Timeline

Dates	Benchmark Activities
1994	Mitchell and Yancey County landfills close.
1996	Council asked to investigate use of landfill gas at Yancey-Mitchell. County Commission sponsors project, and asks Blue Ridge RC&D to conduct research, investigation of other examples. Found out about new project US EPA Landfill Methane Outreach Program Spring 1997
1997	Mayland Community College begins planning for the Project Branch Out Initiative. Excited about opportunity of its potential location at landfill.
May 1, 1997	First meeting with EPA at Yancey County Courthouse to begin planning for the Blue Ridge Landfill Gas Initiative. EPA agrees to conduct feasibility study (at no charge.)
Sept. 1997	EPA completes feasibility study. Determines that Blue Ridge Landfill is a commercially viable project.
Late 1997	Landfill Methane Task Force created; first director hired.
1998	HandMade in America joins as a partner to implement craft business incubators.
1998	EPA awards $50,000 grant to hire Project Branch Out coordinator at landfill.
1998	Community Foundation of Western North Carolina awards $10,000 for greenhouse construction
Apr. 22, '99	(Earth Day) Activated landfill gas system for the first time.
Sept. 13, '99	EnergyXchange Incorporated as a separate organization.
April 2000	EnergyXchange receives tax exempt status.

Key Programs

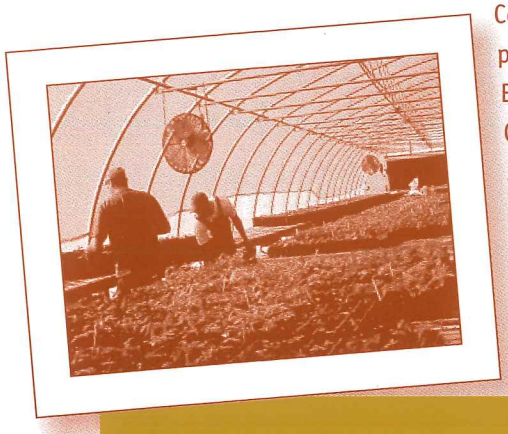
Craft Incubator Program:

The program supports entrepreneurs in starting, managing and operating new businesses in the crafts of glass blowing and pottery. Craft residencies are available to potters and glass-blowers who are competitively selected by media-specific juries for the opportunity to work in group studios on the site at a nominal cost. Participants in the program may stay as long as three years and receive training in business practices from HandMade in America, Inc. and Mayland Community College. The clay kiln and glass furnaces are fired with landfill gas at no additional cost to the residents with a projected savings over the life of the project estimated at over a million dollars.



Plant Propagation Program:

Project Branch Out began as an initiative of Mayland Community College in partnership with the Blue Ridge RC&D Council. As a strategy to nurture small agricultural activities in rural Western North Carolina, Project Branch Out helps diversify local crops and propogates endangered species. While the area has a rich agricultural history found in burley tobacco, Christmas trees, woody and herbaceous ornamentals, beef cattle and vegetable production, these two counties have experienced declining availability of indigenous plants – such as rhododendron and native azaleas – that are a cash crop for local nurseries and export.



Key elements of the program include practicing integrated pest management at facilities and reintroducing native rhododendrons and azaleas to the landscaping and horticulture industries.

Schedule for Growing the Garden

Fall	Collect seeds
Winter	Clean seeds; begin seeding in nursery flats
Early Spring	After three months in flats, transplant into 72-cell trays
June-July	After additional three months, transplant into 24-cell trays. (This is also a good time to prune plants to get multiple breaks.)
September	Move plants out to winter in shade houses

EnergyXchange has employed (with pay) over 20 student greenhouse interns who spend one semester learning greenhouse management and business practices. This ongoing outreach program gives local high school students an opportunity to "grow their own jobs" in the local area after graduation.

Project Branch Out planted a special poinsettia crop as a fundraising program for Mountain Heritage High School's Future Farmers of America club. This outreach project served two purposes: 1) an educational program for students; 2) community awareness building as local residents purchased the poinsettias to support the high school club. More recently, aquaponic production has been added to diversify the crops. Aquaponic production is a perfect marriage for plant propagation as the fish generate nitrates and manures that in turn fertilize the seedlings. Nutrient rich water is pumped from fish tanks to the planted growbeds. This water is then filtered by the plants and recycled back into the fish tanks where the process begins again. Extraordinary plant growth and healthy fish are the result.

Mission of Project Branch Out is to propagate rare and native flora of Western North Carolina and provide a variety of educational opportunities for students, growers and plant enthusiasts.

CYCLE OF SUCCESS:

Seven Critical Factors for Converting Landfills to Creative Enterprises

Seven critical factors are integral to converting landfills into creative enterprises. The process, which evolved at EnergyXchange over the past nine years, emanated from a set of core values and guiding principles that describe the creative partnership philosophy of HandMade in America.

1. Gain Political Support

Early on, officials knew that the landfill had outgrown its original use and sought alternative plans for the site after its closing. A local Council member on vacation in Florida read about a new concept in landfill conversion, and brought home the idea for further exploration. Unfortunately, the county didn't have the money or the manpower to investigate so the local RC & D office was asked to research best practices and examples around the country.

During this time (1996-1998), the local college was also exploring new programs in plant propagation. Philip Johnson at Mayland Community College expressed interest and excitement that Project Branch Out could be housed at the landfill. These two ideas converged when local officials and agency representatives met with Shelley Cohen and other members of EPA at the Yancey County Courthouse. The greenhouse concept fit perfectly with EPA's desire for a quality end use with quantifiable gas needs.

Political support was necessary at concept inception, and continues to be a key driver in the consistent funding and operation of the landfill as it matures as a small business incubator.

2. Secure Early Funding Partners

Funding traditionally comes from interested parties. EPA's initial partnership was formed through a mutual desire for new landfill use. Their generous donation of a feasibility study provided the necessary foundation for development of the project. With their endorsement, and additional

Over the past decade, EnergyXchange has diversified its funding to include federal, state, public and private sources.

Key partners include:

- Blue Ridge Resource Conservation and Development Council, Inc. (Blue Ridge RC & D)
- HandMade In America
- Mayland Community College
- Mitchell County Government
- Yancey County Government
- EPA's Landfill Methane Outreach Program

Private Partners

- Z. Smith Reynolds Foundation
- Marion Stedman Covington Foundation
- Wal-Mart Foundation
- OMC Foundation
- Golden Leaf Foundation
- Cannon Foundation
- W.T. Grant Foundation
- Carolina Power and Light (CP&L)
- Community Foundation of Western North Carolina

State Partners

- North Carolina Technological Development Authority
- NC, DENR, Solid Waste Section
- NC Cooperative Extension Service
- NC State Energy Office

Federal Partners

- USDA Natural Resources Conservation Service
- US EPA Divisions of Pollution Prevention
- USDA Rural Development
- Southeast Regional Business Energy Program
- US Department of Energy
- US Forest Service

financial contributions from public and private partners, EnergyXchange was able to hire staff and focus resources on building the desired facility.

Energy conversion is not free, though. Organizers champion local investment, especially from public agencies, to include more than just land transfers, administration and in-kind contributions. Cash investment by local government agencies is important seed money often necessary/required to match state and federal, or other private granting, agencies. Without this assistance, the development process takes longer, or can fail.

The first two grants were huge milestones for the fledgling operation. EPA awarded an initial $50,000 to hire the first Project Branch Out coordinator. This enabled the operation to move ahead with dedicated full-time staff. An additional $10,000 grant from the Community Foundation of Western North Carolina bolstered support for the project – the first grant for the greenhouse, even before the system to collect the landfill gas was funded. These monies have been leveraged many times over to generate over $1.5 million for construction and operation of the facilities.

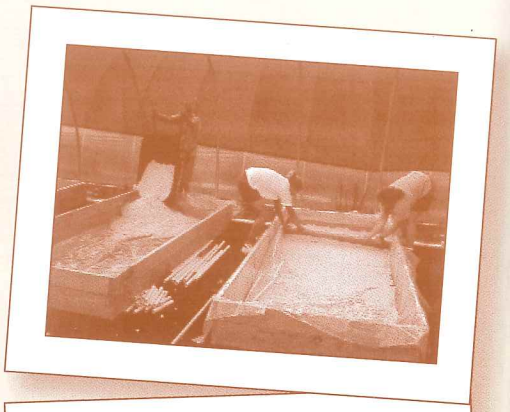
3. Quality Tenants

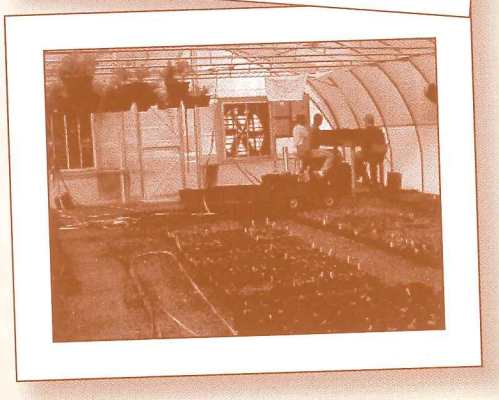
Selecting the right tenants is vital for sustainable growth and potential diversification. The individuals need to accept and embrace the philosophy and concept of the landfill, be flexible enough to work "in progress" – an independent worker with initiative to adapt and utilize a remote rural setting that was not fully developed and staffed – and champion the process by providing organizers with constructive comments and marketability. The artists were called upon to creatively excel, and demonstrate their talent through works of art that add to the unique appeal of a product generated from the first methane-powered craft studio. The first group of individuals established the bar of excellence for future applicants.

What did EnergyXchange offer? In addition to a unique environment, three-year residencies were available at a nominal cost to two glassblowers and four potters. Selected through a competitive application process, the artists receive numerous benefits, including the use of fully equipped studios at highly subsidized prices. Special incentives offered the entrepreneurs include business classes taught by HandMade in America and Mayland Community College, a portion of product sales from the retail gallery, marketing assistance and creative mentoring.

4. Provide Public Access

A pro-active task force representing major segments of business and civic interests in the county generated extensive community support. More than 140 individuals from over 40 agencies and groups were engaged in the development process. This local network brought the right people to the project, and enlisted support from expert partners including HandMade in America, Penland School of Craft, US Forest Service, and others. These partners in turn recruited the appropriate tenants, tapped key funding sources, and leveraged support and credibility for the project.





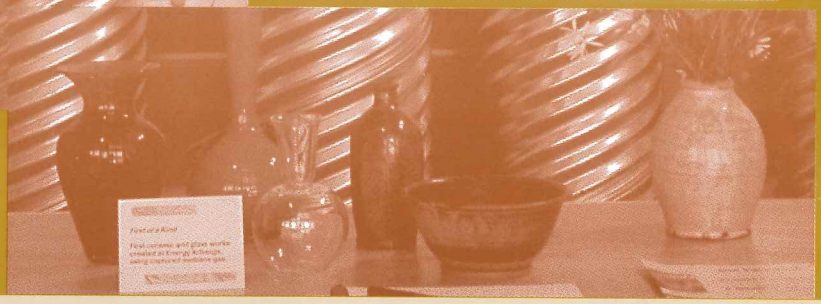
Through public access, the community participated in all phases of development. They championed the project to friends and colleagues. Government officials celebrated success on Earth Day when the landfill gas was turned on for the first time. Nurserymen visited and purchased items at the greenhouse. These individuals committed time and energy, which translated into visionary leadership that explored new horizons with positive results for the community and region.

5. Marketable Reuse

The foundation of any quality landfill reuse project is validation from EPA of its commercial viability. The Yancey-Mitchell project did not meet the EPA "rule of thumb" which says that to be commercially viable a landfill should have a minimum of a million tons of existing waste. The success of EnergyXchange has shown that smaller rural landfills can be developed for landfill gas successfully, given adequate local support. Considered a small project in comparison to other models – Raleigh, North Carolina was the most similar at 150 acres – the Yancey-Mitchell landfill demonstrated how a rural

"This is the first glass shop in history that hasn't been harmful to the environment."

John Geci,
EnergyXchange's first
resident glassblower



Tips for Converting Landfills

- Assess and use your resources
- Develop partnerships
- Identify unique needs and uses
- Think big to maximize opportunities for energy reuse
- Create a plan for self-sufficiency
- Implement and measure programs
- Celebrate successes

community could reuse its resources for economic development. The reuse project satisfied a number of immediate needs: access to available energy, entrepreneurial opportunity to grow the regional craft industry, and regenerate endangered plants for use by local nurseries.

6. Earned Income Potential

Because of early successes, EnergyXchange planned and implemented on a scale far larger than originally anticipated. As Becky Anderson, Executive Director of HandMade in America, said when viewing initial architectural drawings for the complex, "You need a bigger parking lot."

Local organizers quickly realized the potential for success and sought funding to expand educational programming, diversify products, create a visitor experience, and increase revenue generation through retail craft gallery and wholesale plant sales. EnergyXchange was able to leverage local funding as a match for federal, state and private grants. Product sales from the gallery and greenhouse supplement administrative costs. Local nurseries seek out EnergyXchange as a supplier for rhododendron and other endangered plants and seedlings. Additional end uses include local utility companies that buy power generated by the microturbines; the Avery EnergyXchange site has a lumber kiln powered by the landfill gas and Wilkes County uses the gas to power a regional fire training facility.

7. Measurable Results

Perhaps the greatest achievement for EnergyXchange is the physical presence of the campus that people can experience first hand. Viewing the flame upon entrance to the complex signifies the distinctive environment that has fostered creativity, from the actual conversion of the landfill gas to the byproducts of quality handmade objects and healthy plants. A recently added feature is the anemometer tower, an educational partnership with Appalachian State University to demonstrate wind power generation.

EnergyXchange has directly created four new full- and part-time jobs and provided business opportunities for 12 artists, several of whom have become permanent residents in the area. The retail gallery generates approximately $25,000 annually from sales. More than 5000 visitors – school children, technical experts, and regional travelers – annually seek out this remote attraction to learn about the unique process that turns gas into glass. The availability of plants has expanded income opportunities for local nurserymen and farmers. In addition EnergyXchange has employed (and paid) over 20 greenhouse interns selected from the two local high schools. These students spend one semester learning greenhouse management and business practices, with the goal that after graduation they can "grow their own jobs" in the region.

Perhaps most importantly, this small landfill has been a model for the rest of the nation and demonstrates how visionary partnerships and local leadership can generate programs that are good for the economy and environment.

Expanding EnergyXchange: New Landfills Under Development

Alleghany County
Investigating use of LFG for County Buildings

Ashe County
Under Investigation

Avery County
Greenhouse, lumber kiln, wood business incubator

Buncombe County
New Craft Campus for University of North Carolina, Asheville Campus

Watauga County
Heat and electricity for county buildings, crafts, cold storage, ice production

Wilkes County
Cold storage, fire training facility, commercial CO_2 production, greenhouses

Jackson County
Greenhouses, arts and crafts

Catawba County
Greenhouses, electricity

Small rural communities hardly ever dream of greatness. But when a few people in our community had a dream, we found plenty of believers right here at home. Our success is due to one factor: people combining their skills and talents, working together to build something that none of us could have achieved alone. I'd call it citizenship at its best.

Jon Ellenbogen
Chairman of the Board
EnergyXchange

Resources/References

Blue Ridge Resource Conservation
and Development Council
1081-2 Old US Hwy. 421
Sugar Grove, NC 28679
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Fax: (828) 297-5928

Mayland Community College
PO Box 547
200 Mayland Drive
Spruce Pine, NC 28777
Tel: (828)765-7351
Toll Free: 1-800-4-Mayland

U.S. Environmental Protection Agency (6207J)
Landfill Methane Outreach Program
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Toll Free Hotline: 1-888-782-7937
Fax: (202) 343-2202

HANDMADE INSTITUTE

Solutions For Creative Economies

The HandMade Institute offers a diverse collection training products and custom solutions for communities interested in developing their creative economies. With over a decade of experience in Western North Carolina, HandMade in America – the parent organization of the Institute – now offers its wealth of lessons learned, innovative practices and technical expertise to communities near and far. Tapping more than 120 leaders in economic development, tourism, marketing, craft development, retailing, agritourism, interpretation, business and community management, The HandMade Institute aims to elevate the recognition and sustainability of creative communities worldwide.

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ISBN 0-9651905-8-7