Modular Carpet Recycling, Inc.
A business plan to build small plants to recover nylon from waste carpet
Auburn University, AL

A business plan submitted to the
Alabama Launchpad Business Plan Competition, 2007
Team number 137
(One of eight finalists out of 61 entries invited to present in May 2007)

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Postscript: Four days after the presentation at the Launchpad Competition at the Auburn University Hotel and Conference Center, May 2007, Auburn University received an offer to license the technology to form a company. Consequently, in about four weeks, Auburn University signed an agreement to license the technology for commercial exploitation.

This business plan case was prepared by Dr. Paul M. Swamidass, Professor of Operations Management with contributions from Dr. Brian Wright, Dr, Chris Roberts, and a group of Technology Transfer Interns working at the Thomas Walter Center. This version of the business plan is solely intended for classroom discussion and analyses; it is not intended to illustrate good or bad practices.

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MCRI: A business to build small plants to recover nylon from waste carpet

Contents

1. Executive Summary

The businesses covered by this proposal have the potential to grow and produce several hundred million dollars in sales over time. The proposal is based on a "green" technology that could create two successful businesses; one to manufacture portable plants and another to use the portable plants to recover nylon from waste carpets going to landfills around the country.

Auburn University team is in discussion with more than one investor group about a patented technology capable of producing (1) *high-purity (99+%)* recycled nylon, (2) at a *competitive cost,* and (3) in distributed *plants that are smaller than plants* using conventional technologies. Each plant using this technology could be successful in capacities of one million pounds of nylon per year at an investment of about $1 million each. Over four to five billion pounds of post-consumer carpet end up in landfills each year, and today, nylon (originally produced from crude oil) is recovered from about five percent of the carpets headed to landfills. If businesses grow to the point of recycling a billion pounds of carpets/year in the US using this technology over the next 25 year; at today's price of $1/pound for recycled nylon, recycled nylon produced by this process could reach one billion dollars in sales/year. It would require 1,000 plants that would cost a total of $1 billion. The scaling-up opportunities are extremely attractive.

The goal of this team is to successfully complete an agreement with an investment group to form **MCRI** that would (1) license the technology from Auburn University for royalty/equity, (2) build a **pilot plant** with about 6,000 pounds/year capacity to obtain engineering specifications and provide viability data and to verify the quality of the hi-purity nylon, (3) engage a company to engineer and build (on skids), commercial-size portable plants of 1 million pounds/yr capacity for distribution by trucks to any location inside or outside the US, (4) license the patented process to several customers, who are businesses or franchisees who purchase the modular plants to generate a steady royalty income per pound of recycled nylon, and (4) create an infrastructure to purchase nylon produced by customers (who do not want to build the sales force to sell recycled nylon).

Customers will produce steady income from recycling carpets near metropolitan areas. The option to let MCRI buy the nylon and resell nylon from The Customers of MCRI may encourage cities to buy or lease the plant for recycling without the need to market the nylon. The business idea looks like this:

Technology for recovering nylon → licensed to MCRI for the manufacture of modular recycling plants in Alabama → several customers/businesses (or city governments) purchase modular recycling plants from MCRI and operate small recycling businesses near big cities inside/outside the US and pay royalty to the university for every pound of nylon sold → sell nylon in the open market or sell to MCRI whose second line of business is to buy and sell nylon from their customers.

1.1. Overview of Idea

Our business will commercially exploit a patented chemical process (US patent for the process was issued to Auburn University) that inexpensively recovers nylon from post-industrial or post-consumer waste carpets that now end up in landfills. This recycling technology can recover millions of pounds of usable nylon each year for use in many industries including carpet making, textile, automobile components (low purity nylon), and other polymer using industries.

1.2. Mission

Mission of MCRI would be to be the first company to implement a sustainable business solution to nylon carpet recycling through the use of trailer-sized, distributed, modular (portable) recycling plants placed near metro locations where post-consumer carpets are generated. Its mission is also to eliminate the need for shipping to large centralized carpet recycling facilities such as the Evergreen facility in Georgia, which was shut down in 2001 for not being a commercial success.

1.3. Keys to Success

1. Raising initial capital sufficient to cover the cost of designing and building a pilot plant.
2. Using the pilot plant as a model to prove recycling efficiency and purity of nylon.
3. Start up of a business to sell skid-based modular plants that are centrally manufactured
4. Selling 13 modular plants within three years from the Launchpad award
5. In the current green consciousness environment, convincing investors, cities and businesses to invest in this business to reduce carbon footprint, to increase recycling of products that consume non-renewable resources such as crude oil, and to reduce carpets going to landfills.

2. Products/Services and Key Problem to Solve

Over five billion pounds of post-consumer carpet is ending up in US landfills each year. The nylon in the carpets, originally produced from crude oil, is recoverable. However, there is no viable process to produce high-purity nylon in plants near the various cities in the country. Conventional process for making pure nylon requires large centralized facilities requiring the shipment of millions of pounds of waste carpet from cities around the country. The purity of the nylon dictates the price it commands in the market. The Auburn University process is capable of producing high purity nylon in smaller plants. These are products and services offered:

1. MCRI: Modular nylon plants sold to businesses (The Customers of MCRI) around the country and abroad
2. Customers of MCRI: Recycling of used carpets to recover hi-purity nylon, reduce waste going to landfills
3. MCRI buys nylon from Businesses B for resale. Economy of scale helps MCRI and it creates another stream of income (this income stream is not included in Appendix C).

2.1. Product/Service Overview

Modular Carpet Recycling, Inc. will operate as a virtual manufacturing firm. It will sell modular nylon recycling plants, contract with a supplier for manufacture and delivery of the plants to customers, handle customer service and pay royalty to Auburn University for each plant sold. The 1 million pound plant will fit on a tractor trailer. This will allow for transport by ground from the manufacturing location to final destination. Each plant will have an annual output of 1 million pounds off 99% pure nylon/yr. This level of output requires input of two million pounds of nylon waste.

2.2. Relevant Technology or Expertise

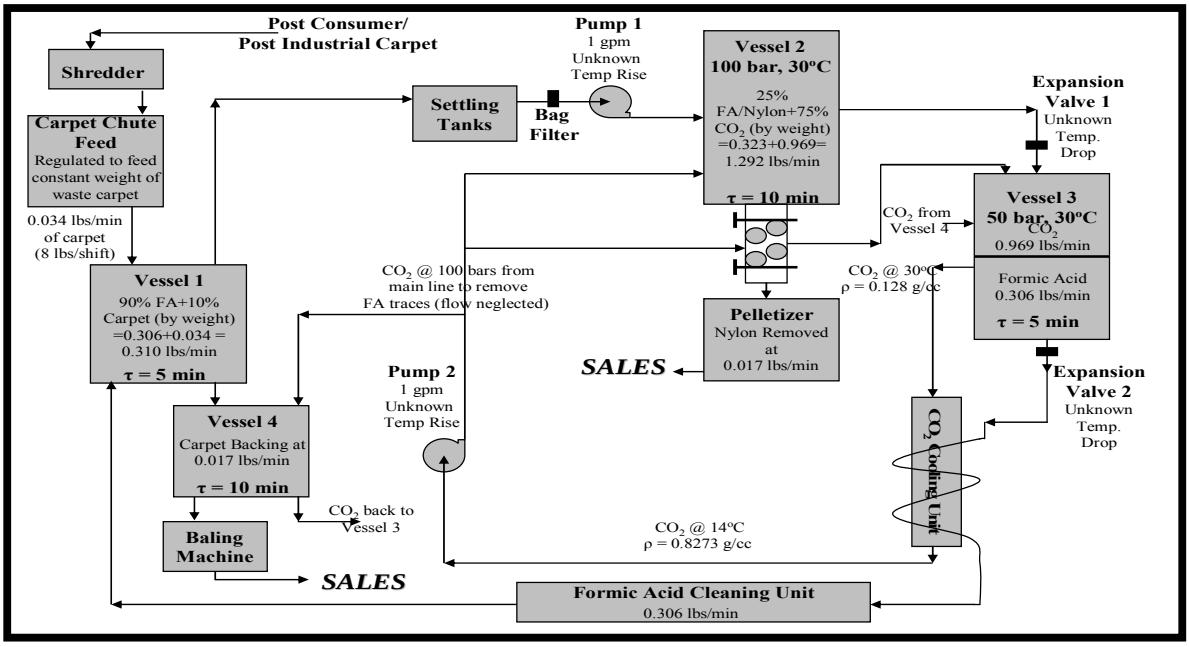
Auburn University invention (patent 5, 994, 417) was successfully tested in the laboratory and reported in papers and a masters thesis. The lab process has been converted for commercial purposes, and the process diagram for pilot investigation is shown Figure 1.

Nylon carpet is commonly manufactured in two chemical forms. These are Nylon 6 and 66. While the Auburn technology can process the mixture of Nylon 6 and 66, nylon produced is more valuable when unmixed. The once-difficult task of distinguishing unmarked carpet made of Nylon 6 and Nylon 66 is now easier because of new inventions in the market (patent number 5,952,660).

2.3. Key Opportunity

Green consciousness is now everywhere. Cities are trying to reduce the waste going to landfills. Nylon carpets are one of the largest recyclable waste that cities want to keep away from landfills—see Due Diligence section below, which explains our contact with several cities to investigate their interest and status of carpet recycling in cities. The cost of crude oil makes the recycling processes for waste carpet more attractive today than it was three years ago. This technology will reduce the “carbon footprint,” and reduce global warming which are creating new businesses each day. With higher crude prices, the time has arrived for this invention to go to market.

Figure 1: Process Outline for the 6000 lbs/Year Nylon Output Plant



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3. Market Analysis

See 3.1, 3.2 and 3.3

3.1. Market Overview (Current size, growth rate, etc.)

The United States generates over 5 billion pounds of waste carpet each year. This staggering amount of nylon represents enough hydrocarbons to produce 108 million gallons of gasoline to drive 2.7 billion miles. However, only 7% of used carpet is recycled today in the US primarily because of the lack of a commercially viable process; for example, the Evergreen Nylon Recycling plant, which used a different technology and operated by major manufacturers such as Honeywell and DSN, was shut down in Georgia in 2001. Today, there is a need for a cost efficient process to recover nylon from waste carpet because: 1) the manufacture of virgin polymers/nylon requires the use of increasingly expensive natural resources such as crude oil; and 2) waste carpet in landfills degrades the environment.

There are two markets; one for the modular plants, and the other for carpet recycling. There are over four/five billion pounds of carpets ending up in landfills today in the US. If all of them are recycled using our plants of 1 million pounds capacity/year, about 2000 new plants will be needed in the US alone (each plant takes in 2 million pounds of waste carpet to make 1 million pounds of pure nylon).

3.2. Target Market

The target market for nylon recycling plants will be metropolitan areas with populations of over 500,000. An US citizen, on average, produces almost seventeen pounds of carpet waste per year. Cities with 500,000 population produce 8 million pounds of carpet waste each year. This is enough waste carpet for four modular plants of 1 million pounds of nylon capacity/year. According to census estimates in 2005, there are currently 97 metropolitan areas in the United States with a minimum population of 500,000.

Another outlet for the modular plants is the number of private recyclers who currently collect and supply waste carpet. Research has shown that there are over thirty carpet reclamation centers in the United States. Our contacts with private carpet waste collectors indicates that they want to recycle the carpets themselves if they can find small plants that are commercially viable; the margins are better in nylon..

Projected market size: In 2002, the global demand for virgin nylon fiber (high purity) was 8.6 billion pounds. The North American auto industry's demand for nylon (low purity) in 2006 was 4.7 billion pounds. For want of a better process, only about 350 million pounds of carpet waste is recycled to produce about 175 million pounds of recycled nylon from carpets (2:1 ratio). At a growth rate of 10 percent/year, the market for recycled carpets is estimated to grow at about 17.5 million pounds a year. However, with the successful introduction of our technology, this rate could grow dramatically.

3.3. Main Competitors

The current technologies are not sufficiently cost competitive. Further, existing processes for high-purity nylon need very large plants to be commercially viable. At this point, there are no direct competitors using a process with similar commercial possibilities. Our technology has several advantages. First, it enables a small recycling plant to be profitable without the need for large-scale production. Second, the process is inexpensive because it does not depolymerize and repolymerize the nylon. Third, the operating costs are lower because the proposed process occurs at relatively lower pressure and temperature. Fourth, the process produces nylon that is 99+% pure. Finally, the closed-loop process recovers and reuses all the chemicals used in the process.

Table 1 gives a comparison of competing recycling technologies.

Company	Closed Loop?	Nylon type	Process	Qty (nylon output)	Comments/Criticism
Honeywell / DSM	Yes	N-6	Depolymeri-zation & purification	100 million lbs/yr	Expensive investment, $90 million; expensive process; high operating costs; plant shut down in 2001; Needs a large plant
Dupont	Partially	N-6/N66	Ammonolysis	90 million lbs/yr	More waste, process costlier; large plant
BASF	Yes	N-6	Repolymeri-zation	12,000 lbs//yr	Low purity of nylon, recycles only BASF carpets
Our Proposal	Yes	N-6/N66	Selective absorption & Pelletization	Plants of 1 million lbs/yr and above	High purity (>99%), low temp, low operating expenses, can be made in smaller profitable plants

3.4. Distribution Strategy

MCRI: The product will reach the consumer through direct sales using a sales staff and representatives. Information on the product will also be available on the company website and printed in Appendix A. Modular plants will be limited to the shipping size 25' (L) x 8'(W) x 8'9" (H)—standard outside dimension. With this size, it could be shipped abroad also.

Customers of MCRI: May sell the nylon in the open market to wholesalers or to nylon processors. MCRI could offer to purchase the nylon produced by its customers. MCRI will build the infrastructure to pickup, transport, warehouse nylon, and sell nylon in large quantities. This may attract cities to buy the plants.

3.5. Implementation Strategy (Sales Strategy)

MCRI: In the year before production starts, the sale of the million-dollar plants and ensuing business startups will be through direct sales by one sales person and the president of the company once the pilot is tested and established (see Appendix B). The sales force will work with investors and cities convincing them of: (1) the profitability of the ensuing business—see Appendix B for cash flow, IRR, payback period, and profitability, and (2) the benefits of keeping waste carpets from reaching landfills. Please see Appendix.

Customers of MCRI: Wholesalers of nylon or MCRI would purchase recycled nylon from these businesses with the need for a marketing and sales staff.

3.5.1. Market Entry

There are small businesses that are now collecting and separating waste carpets in large cities such as Boston and Dallas. We have received interest from waste carpet dealers to invest in modular plants proposed here. They want to convert waste carpets to nylon because, in their words, the margins are better for nylon than for waste carpet. Our research shows that city governments are interested in recycling carpets but they do not know how. They are an untouched market according to our research. MCRI will tap into this market.

3.5.2. Pricing Strategy

MCRI: The pricing of the plants is based on known costing practices and estimates obtained from manufacturers. See Appendix B which shows the profitability of MCRI for the selling price assumed. Each plant sells for $1 million; startup cost $100,000 in the first year.

Customers of MCRI: The selling price for pure nylon and not-so-pure nylon is freely accessible on the web. It is $1 or more for 1lb of higher quality nylon; less for lower quality nylon. Virgin nylon sells closer to $2/lb or more. We have used $1/lb, a conservative estimate for hi-purity nylon.

3.5.3. Scalability of MCRI (Potential for growth)

Scalability is one of the attractions of the businesses proposed here. Today, there is a need for about 2,000 modular plants to process all the carpets sent to landfills—as Appendix B shows, MCRI will start with sale of 3 plants after two years, 10 plants a year later, and expands thereafter. The cash flow is very attractive at these levels as shown in Appendix B. MCRI can expand after the third year based on market reception. Purchase of nylon for sale from their customers offers immense growth opportunities for MCRI. As MCRI sells more plants, its nylon buying and selling business will grow also. In twenty years, potentially, the recycled nylon could reach a billion pounds a year.

Customers of MCRI could start with one modular plant at a given site, and add more. A potential customer in Dallas wants to buy one plant of Dallas, Houston and Austin, all cities in Texas.

4. Management Summary

4.1. Organizational Structure and responsibility

MCRI to be incorporated as a corporation with or without equity participation of the university. The university may take up to 20% equity participation as a function of initial capital invested. The said technology will be licensed to MCRI. The royalty is negotiable. Currently, management has a Project Management structure. The three-person management team from Auburn University will coordinate and manage the project. The team will market and negotiate with the future MCRI. The team's qualifications are in 4.2. The primary responsibilities of this team are to: 1) negotiate with potential investors who wish to invest in MCRI using a license from AU to use the technology; 2) enable the pilot plant to be built and tested before or after MCRI is created; and 3) ensure the success of the investors investing in MCRI.

4.2. Current Management Team

The combined experience of the team is over 100 years. The team is strong in business and engineering knowledge and skills.

Project leader: Dr. Paul Swamidass, Professor of Operations Management and Director of Thomas Walter Center for Technology Management, Auburn University. Has a degree in mechanical engineering, a MBA and doctorate in management. Before entering academic career, he was a middle manager with seven years experience in fabrication, heavy manufacturing, and production management. Has three years of experience in technology commercialization of inventions from university labs. He led the team that converted the batch process for this technology into a continuous process suitable for commercial size scale up. He will coordinate with Applied Chemical Technology Company, AL, in process development and in the coordination between the Company, Office of Technology Transfer, and the inventor.

Project Co-leader: Henry Burdg, Acting Associate Dean, College of Business and Director of ATAC, Auburn University. Has an engineering undergraduate degree and an MBA with 33 years of management consulting experience to all types of business and industry. He has been involved in the start-up of several organizations and has specific expertise in strategic planning and technical project management. A faculty

member at the university's College of Business. He has worked with several teams in the transition of bench technology to operating pilot plants primarily on the business aspects to insure that the outcome is commercially viable. The Project Co-Leader will focus on the business issues and assist with startups.

Project team: Dr. Brian Wright, Associate Director for Commercialization, Office of Technology Transfer, Auburn University. Dr. Wright has doctoral degree in chemical engineering from Cornell University and an undergraduate degree in chemical engineering from Auburn University. He worked in industry before joining Auburn University's Office of Technology Transfer.

Others: The inventor, Dr. Chris Roberts, Professor and Head of Chemical Engineering, Ginn College of Engineering, Auburn University.

4.3. Future Management Team

MCRI Management Team: The above team under the leader of Dr. Paul Swamidass is in active discussion with three potential investors. To run MCRI, a new business and new management team will evolve and take shape with input from the investors/equity partners such as Auburn University.

4.4. Board of Directors (Proposed BOD if applicable)

The Board for MCRI is TBD. Auburn University will request representation in the Board.

4.5. Personnel Plan

MCRI: A tentative plan is assumed in Appendix B. In year two, the personnel will include a CEO, a sales manager and one office staff. In year three, one more sales person is added. In year 4, in full operation, add more sales personnel as needed. (A wholesale business to purchase/resell nylon pellets form customers of MCRI is not included in the cash flow in Appendix B; it would need additional staff).

Customers of MCRI: These businesses are small nylon recyclers near the source of waste carpets near metropolitan areas. We have assumed one operator per shift (3 shifts), and plant manager, one sales person, and one office staff working in day shift

5. Intellectual Property and/or "Know-how"

5.1. Patents

Auburn University was assigned a utility patent (patent number 5, 994, 417) on November 30, 1999. The patent will expire on June 4th, 2017. Auburn University will vigorously defend its intellectual property with the vast recourses of the university, and would assist licenses in defending their AU patent rights. Once the pilot is completed, additional patents will be filed in the US and abroad. Auburn University monitors and protects all its patents. The pilot may give rise to trade secrets that are vital to the business.

5.2. Expert Knowledge/Trade Secrets

The inventor Dr. Chris Roberts has the expert knowledge about the science behind the process and he has successfully tested it in the lab. The Thomas Walter Center under the leadership of Dr. Paul Swamidass has developed the commercial process in Figure 1. It will be refined and improved during the pilot trials. The pilot will provide trade secrets.

5.3. Competitive Advantage and Defensibility

As our experience shows, this patent takes time to turn into a commercially viable plant. The competitive advantage comes from owning the invention, the commercial process, and the trade secrets gained from commercializing it through a pilot. The patent is easily defendable.

6. Financial Information

6.1. Current Sources of Funding

Auburn University is in discussion with investors. The university may be an equity partner. The university is making this proposal available to selected, potential investors. The current management team will carefully evaluate all investment proposals from teams interested in forming MCRI with a license to use AU technology. At least three potential investor groups are now interested. The team management has had multiple meetings with one investment team leader, who sold his multi-million dollar chemical company to a multi-billion dollar chemical conglomerate, and is now active in private equity placement. His partner is a

VP of a multi-billion dollar chemical firm. Dr. Swamidass, the leader this Auburn team, will discuss the investment with two other interested carpet recyclers at the Carpet America Recycling National Conference at Charleston, SC during May, 2007. These investors are located in Boston and Dallas, respectively.

6.2. Funding Needs

MCRI (See Appendix C): Investment of $800,000 over two years; internal rate of return 81.5%. It includes a generous estimate of $600,000 intended for design, building and testing of a pilot plant. We have received a bid from Applied Chemical Technology Company, Alabama, with extensive experience in building pilot scale and full scale chemical plants. MCRI would pay royalty to Auburn University.

Customers of MCRI: Customers who purchase portable nylon plants would need investments of about $1.1 million to purchase one plant (Appendix B); internal rate of return 31% and payback in 2.39 years.

6.3. Breakeven Analysis

MCRI (Appendix C) – year 4 breakeven = 1.24 modular plants when output is 10 units in year 3.

Customers of MCRI (Appendix B) – year 1 breakeven = 549,000 pounds of nylon when output is 1,000,000 pounds.

6.4. Milestones (MCRI)

Step 1: Get investors to invest in MCRI; anytime. The investors would be asked to form a corporation with appropriate agreement with the university. The management team has presented a confidential proposal that includes a business plan and technical summary to investment groups.

Stage 1: First 12 months (Engineering and proof-of-concept stage): Investors have requested a pilot demonstration plant to provide data and specification, and proof-of-concept. We have obtained a bid for the same from Applied Chemical Technology Company located in Alabama. This firm has over 25 years of experience in developing new processes for the chemical and related industries for commercial use. The quote includes: ***Design, engineering, fabrication, assembly, start-up, operation, and data collection for scale-up of a bench scale pilot plant system for nylon recycling.*** Total cost for pilot: $600,000;(52 weeks).

Stage II: 13-24 months: Contract with a design and engineering firm to design a 1 million pounds/year plant using the information from the pilot. Applied Chemical Technology Company does design and build full-size plants too. Begin selling and taking orders for 3 plants. Our analysis shows that a nylon recycling plant (1 million lbs/yr nylon capacity) can be manufactured and sold for about $1,000,000 each (Appendix C). Goal: get orders for 3 plants from for delivery next year to the Customers of MCRI.

Stage III: 25-36 months: Commission a supplier/manufacturer to make and deliver 3 plants this year to investor/customers. Take 10 more orders for delivery next year to investors/customers. MCRI will be in black when it sells three plants (Appendix C).

6.5 How the Launchpad Award will be used

The award will be used to cover part of the cost of designing, building and testing the pilot plant described above. To abide by the rules of the contest, the Award funds may be released to MCRI when created to exploit the said AU technology.

6.6 Due Diligence

The team researched the recycling practices of forty-one US metropolitan locations with populations over 500,000. The team has a database of contacts and practices related to carpet waste and potential interest in our patented process. More in-depth contacts were made with ten cities, two including Washington D.C. expressed interest in the technology and what it could do for their recycling efforts.

Additionally, in metropolitan areas, names of businesses related to recycling, waste transport, and carpet removal were compiled. Three companies that collect, clean, separate and sell used carpets have shown interest in our technology. Their interest is clearly in purchasing the modular plants which they could locate in Boston, Dallas, Houston, Austin, and other places. Interest in recycled carpets can be found in the web pages for “Carpet Reclamation Partners,” Carpet and Rug Institute,” “Carpet America Recovery Effort (CARE),” and “Carpet reclamation centers from CARE.”

See: Appendix A (Sales flyer) page 9; Appendix B (financials for MCRI) page 10; Appendix C (financials for customers of MCRI) page 11