Incentives and Impediments to the Adoption of Green Building Technologies: Why Straw Materials have not Penetrated Mainstream Construction

Proposer: Jay Ruskey
Oryzatech Inc.
Jay@oryzatech.com
(805)685-4189

Faculty Sponsor: Christopher Costello
Assistant Professor of Environmental & Resource Economics
Donald Bren School of Environmental Science & Management, UCSB

Problem Statement This project concerns the impediments to the adoption of "green" construction technologies. "Green" construction is the practice of increasing a building's energy, water, and materials efficiency in order to reduce impacts on human health and the environment[1]. In addition to the positive environmental and health attributes, there is emerging evidence that green buildings may offer a financial advantage over their traditional counterparts. For example, a recent report compiled results of over 40 government agencies and found that minimal increases of upfront costs of about 2% to support green building design would result in a lifecycle savings of about 20% of the total construction costs[2].

Despite the environmental, health, and financial benefits, green building technologies have been slow to penetrate the mainstream. Of the 1.3 million new US residential homes built per year about 85% use wood light-frame construction and 10% are built out of masonry construction[3]; fewer than 1% will employ natural ("green") technologies such as adobe, rammed earth and straw bale[4]. Surprisingly, even these miniscule numbers represent a modest increase from historical values.

In short, despite the benefits of green building, the notion and availability of green building technologies have not successfully penetrated the mainstream construction industry. This project will rigorously examine why these seemingly beneficial technologies have not been widely adopted.

Objectives & Approach In particular, we propose to explore the factors responsible for supply and demand of green building technology adoption, with an emphasis on identifying the primary impediments to adoption of this seemingly beneficial technology. Rather than focusing on the industry as a whole, we propose limiting the scope of this group project to an in-depth analysis of a single technology that holds significant promise in both residential and commercial applications. The technology is the straw bale, which exploits what has historically been a waste product of agricultural production.

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1 Office of the Federal Environmental Executive, 2003. The Federal Commitment to Green Building: Experiences and Expectations. 18 September.

2 Capital E, Department of Health Services, and Lawrence Berkeley Laboratory, 2003. The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force. October.

3 United States Department of Commerce, U.S. Industry Trade Outlook. 2004.

4 Development Center of Technology. 2004.

Possible drivers of the slow adoption of straw as a mainstream construction material include both supply-side, demand-side, and regulatory factors:

Supply-side factors	Demand-side factors	Regulatory factors
• Requires learning new building techniques • Cost • Uncertainty over durability, response to adverse events, future demand • Cost of substitutes or complementary technologies • Burdensome regulations • Poorly developed distribution channels	• Lack of information on environmental, health, and financial attributes • Difficulty in trading off higher fixed costs, lower variable costs • Burdensome regulations • Seasonal distribution and availability	• Building codes for straw construction often poorly developed or non-existent. • Government incentives • Seismic requirements • Rice-burning requirements

As proposed, the primary objective of this project is to determine the most significant impediments to the adoption of straw as a mainstream construction material. And while defining the most efficient approach for answering that question will be left to the group, a number of suggested research questions are listed below:

- [Background and Market Research] What is the overall size of the green building materials market? What are the trends (geographically, by product, compared to conventional technologies) in the industry?
- [Market Research] Given present and near future supply, demand, and governmental factors, can straw bale building technology exist as a viable small to medium sized private enterprise.
- [Demand-side] What is the consumer response to straw-based building materials compared with traditional building materials? Are perceptions correct? What would be required to correct perceptions?
- [Demand-side] What is the consumer demand for straw-based building materials? What is the relative importance of environmental vs. health vs. financial attributes?
- [Supply-side/Regulatory] What are the supply-side and regulatory impediments to adoption, and how can they be remedied (e.g. by incentives, product testing, or standardizing)?

Straw as a Construction Material Throughout history people have used straw as a reliable and easily obtained building material. In the US the first straw homes were built at the turn-of-the-century in the plains states. Some of these century-old homes are still occupied. Although nobody knows the exact number, thousands of straw homes have been built in the US to date, most of which are found in the southwest, where large temperature fluctuations and low precipitation create an ideal climate for this technology.

The Client – Oryzatech, Inc. The Yolo, CA based company Oryzatech, Inc. has developed a proprietary technology to process rice straw into environmentally sustainable building materials which they call “culm-pressed blocks” (CP Blocks®). These blocks would be the first certified and standardized commercially available straw block that is made of all rice straw. The straw from which CP Blocks are made is entirely a residual of rice production in Northern California. Until

now, this straw had to be burned or harvested and disposed of at a waste facility; both methods have serious environmental consequences. In 2004 there were approximately 450,000 acres of rice grown resulting in 900,000 tons residual straw, enough straw to build 50,000 average single family homes. In four years, Oryzatech has plans to use 20% of the California straw to construct CP blocks. CP Blocks would recycle the straw into a resource-efficient, structurally-insulated building block with dimensions adaptable to the building industry. While the material has historically been made into boards, panels and composite wood substitutes on a very small scale, Oryzatech hopes to penetrate the mainstream construction market, where CP Blocks could substitute for:

- Cinder blocks (e.g. for sound walls on freeways)
- Traditional stick frame construction (e.g. in residential housing)
- Industrial cold storage and sound insulated structures

The products of this group project will assist in that objective.

Besides the obvious interest of the client, Oryzatech Inc., the stakeholders for this project include:

- California Department of Food and Agriculture
- United States Department Agriculture
- Ecological Building Network
- US Rice Farmers
- California Rice Commission
- California Straw Builders Association
- Builder Associations
- Homeowners

Data Availability and Sources Most of the data for this project will be collected from building associations (US Green Building Council, National Association of Home Builders Research Center, Ecological Building Network) and government agencies (USDA, Department of Commerce). If appropriate, students will also collect primary data with surveys eliciting both demand and supply-side information.

Student Support Oryzatech Inc., will make available two summer internships for a total of $4,000 plus up to $1,000 to cover materials and student travel for work directly related to this project, for a grand total of $5,000.