

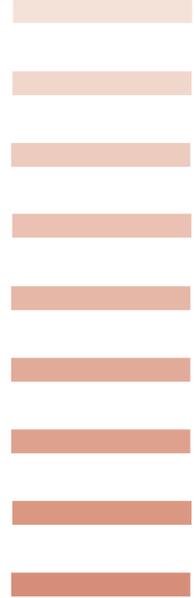
# technology *scanning*



**PD&R**

U.S. Department of  
Housing and Urban Development  
Office of Policy Development  
and Research

**PATH**  
PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING

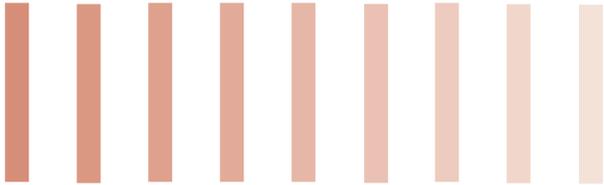


*Finding  
New  
Ideas For  
Housing*

*Cover photographs courtesy of: Conita  
Technologies, Symbol Technologies, and  
Lawrence Berkeley National Laboratory.*



**Issue 1**  
**November 2001**



## *Finding New Ideas For Housing*

***Prepared for:***

U.S. Department of Housing and Urban Development  
Office of Policy Development and Research  
Washington, D.C.

***Prepared by:***

NAHB Research Center, Inc.  
Upper Marlboro, MD

***Contract No.:***

C-OPC-21289

One of PATH's major research support services is PATH Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning*—published by the U.S. Department of Housing and Urban Development/PATH and prepared by the NAHB Research Center, Inc.—is updated as technology developments dictate. The Research Center works to unite technology developers from outside of residential construction with manufacturers in the residential housing sector.

These issues of *Technology Scanning* are one in a series. Each issue in the series falls into one of the following categories:

- *Design and Internet Tools*
- *Safety*
- *Surfaces and Interior Finishes*
- *Building Envelope Technologies*
- *Electrical*
- *Plumbing*
- *Heating, Ventilating and Air Conditioning*
- *Energy/Power Systems Generation*
- *Basic Materials*
- *Information Technology*
- *Sustainable Design Strategies*
- *Materials Recycling and Reuse*
- *Thermal and Moisture Protection*
- *Indoor Environmental Quality*

Call the ToolBase Hotline at 800-898-2842 for information about other available *Technology Scanning* issues. Or, log onto pathnet.org and www.toolbase.org.

## PATH Technology Scans

### Description

The Partnership for Advancing Technology in Housing (PATH) advances technology in the home building industry to improve the affordability and value of new and existing homes. Through public and private efforts, PATH adds value to seven of the nation's key housing attributes: affordability, energy efficiency, environmental impact, quality, durability and maintenance, hazard mitigation, and labor safety. PATH recognizes the importance of planning research and setting priorities for technology development that will enable the home building industry to work towards the PATH mission.

One major research support service that PATH provides is called PATH Technology Scanning. Technology Scanning tells us about technology developments in entirely different industries, from other nations, and from other building sectors that may have application in residential construction.

### History

To date, PATH has accomplished its first exploration for the "Other Industries" Technology Scan. This ongoing effort involved mining reports and publications on

new and existing technologies from private industry, research universities, and government laboratories. Through this effort, it is PATH's hope that manufacturers and builders will begin making contacts with other industries for new R&D efforts, and that those industries will begin to develop building-specific applications and technology transfer opportunities. In the long term, we hope that there will be a sustained investment and interest by the housing industry into technological developments in other areas.

### Update

The Technology Scanning project continues to develop as new and emerging technologies in areas from energy use to materials to information technology are uncovered. We suggest that all building product manufacturers review these lists for great new ideas, just like we hope that non-building innovators realize the great opportunities and markets available in housing. Get new report updates by visiting [www.pathnet.org](http://www.pathnet.org) or [www.toolbase.org](http://www.toolbase.org).

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Phone: 202-708-4370  
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### Notice

The work that provided the basis for this publication was supported by funding under contract number C-OPC-21289 from the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author is solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the government.

While the information in this document is believed to be accurate, neither the authors, nor reviewers, nor the U.S. Department of Housing and Urban Development, nor the NAHB Research Center, Inc., nor any of their employees or representatives makes any warranty, guarantee, or representation, expressed or implied, with respect to the accuracy, effectiveness, or usefulness of any information, method, or material in this document, nor assumes any liability for the use of any information, methods, or materials disclosed herein, or for damages arising from such use.

### About the NAHB Research Center, Inc.

The NAHB Research Center is a not-for-profit subsidiary of the National Association of Home Builders (NAHB). The NAHB has 200,000 members, including 50,000 builders who build more than 80 percent of new American homes. The NAHB Research Center conducts research, analysis, and demonstration programs in all areas relating to home building and carries out extensive programs of information dissemination and interchange among members of the industry and between the industry and the public.

# technology *scanning*

## Safety

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### PATH

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Email: [pathtsc@pathnet.org](mailto:pathtsc@pathnet.org)

### Safer Digging Near Utilities

Soft trencher, a new technology in excavating equipment, uses supersonic air to break soil. Loosened dirt can then be vacuumed away. It is harmless to buried utilities and safer for the operator. It clears a one foot wide trench (wider with multiple passes) up to a depth of 10 feet @ 15cfm/min.

**Contact:**  
Steve Okonek  
Electric Power Research Institute  
3412 Hillview  
Palo Alto, CA 94304-1395  
Phone: 850-855-1068

### Safer Inspection

Climber Robot is a mobile robot that propels itself vertically for inspection to perform remote sensing of man-made structures. Applications today include shipbuilding, aircraft inspection, bridge inspection, and building inspection. It could be used in inspecting roofs, second story applications, foundation or trenches, where the person inspecting may be at risk for fall or injury.

**Contact:**  
Vanderbilt University  
Office of Technology Transfer  
Nashville, TN  
Phone: 615-343-2430

### Safety Equipment from Logging Industry

This firm from the logging industry provides some of the best safety devices for the logging industry and is now entering the construction industry. One of its construction safety products is a new state-of-the-art Ultra-Jack Scaffold system. Other products include fall-arresters, roof brackets, and wind anchors.

**Contact:**  
Qual Craft Industries, Inc.  
Stoughton, MI  
Phone: 781-344-1000  
[www.qualcraft.com](http://www.qualcraft.com)

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**Contact:**  
Leonhard Bernhold  
Associate Professor of Civil Engineering  
North Carolina State University  
Phone: 919-515-3677

### Research to Reduce Construction Back Injuries

North Carolina State Industrial Engineering Department, Ergonomics Lab, is doing motion analysis on jobsites. From that research they hope to develop prototype tools using lumbar motion monitors, as well as develop comparative tool and equipment testing and analysis.

**Contact:**  
Dr. Steven Lorenz  
Association Director  
Center for Construction Technology and Integration  
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Raleigh, NC 27695-7908  
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Issue 1  
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## Foreword

As a result of rising levels of homeownership in recent years, the homebuilding industry has expanded to meet the new demand for homes for America's families. Unfortunately, most homes being produced do not fully utilize available technologies that can result in greater affordability, durability and energy efficiency. Too often, the home building industry has lagged others in the pace of technological innovation and adoption. Several causes have been identified to account for this slow pace of technology adoption. They include high development costs, code acceptance, and the need for extensive experience with a product before builders will adopt it.

Because new technologies can play an increasingly critical role in the affordability, durability and energy efficiency of American homes, we must identify ways to speed their integration into the housing industry. While many promising technologies are currently in use, other industries have developed products or processes that can be used in housing. These technologies have demonstrated performance that can be evaluated.

Looking to other industries will reduce the time and costs associated with the introduction of new products in the housing industry. By selecting proven technologies, homebuilders will be able to provide more affordable, durable and energy efficient housing to America's families. In addition, many of the technologies will provide homes which are safer for both the residents and builders.

This process of ***Technology Scanning*** was sponsored by the Partnership for Advancing Technology in Housing (PATH), a public-private partnership administered by the U.S. Department of Housing and Urban Development. ***Technology Scanning*** examined technology developments in other industries, from other nations, from federal laboratories, and from other building sectors for potential breakthroughs that could be transferred and applied to the residential construction industry. This cross-industry information sharing has never been performed in such a comprehensive manner. ***Technology Scanning*** efforts will also include highlighting housing opportunities to industries that traditionally have not marketed to the housing industry.

This report presents the results of PATH's initial ***Technology Scanning*** efforts. Many of those technologies have the potential to make housing more affordable, durable and energy efficient. Future reports on PATH's ***Technology Scanning*** activities will be prepared as technology developments are identified.

A handwritten signature in black ink, reading "Lawrence L. Thompson". The signature is fluid and cursive, with a long horizontal stroke at the end.

Lawrence L. Thompson  
General Deputy Assistant Secretary for Policy Development and Research

## Design and Internet Tools

*This category highlights some of the new applications in design, engineering software, and associated tools, as well as internet collaboration design and engineering sites.*

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### New Tool for Designers, Idea People

Sketch-up is a new sketching software that combines the elegance and spontaneity of pencil sketching with the speed and flexibility of digital media. It allows users to more quickly explore "what-if" scenarios.

#### Contact:

Last Software  
Boulder, CO  
Phone: 303-245-0086  
www.sketchup.com

### Pocket CAD

Now you can download CAD drawings to a PDA or pocket PC instead of running and carrying sets of blueprints. You can electronically send prints to a customer's printer or site. Or, you can do a wireless transfer to another PC. Prints can be projected to a presentation screen or large monitor for electronic presentation. This system is powered by AutoDesk technology. Pocket CAD Pro costs \$199. A downloaded demo is available at www.pocketcad.com.

### From Manufacturer to Architect

Now 3D images of a company's product can be instantly inserted into a design or project. You can determine the visual and cost impacts of that product on the building or home. Product!Center, run by Briscnet, is a database with more than 30,000 manufacturers and over 70,000 products. All in Visual Basic Applications (VBA), they are ready for downloading and 3D insertion into a set of plans. The database also applies the specifications to the plan in a copy and paste format. A spreadsheet connected to the plans can be opened and the cost impact determined. Similar products can be compared visually and cost competitively for trade-off analysis.

#### Contact:

Brisnet  
Phone: 603-436-6868  
www.brisnet.com

### Collaborative Design/Engineering Online

A host of websites offer collaborative design and engineering services. Included are some of the following:

- **AEC Cafe.com**—free online resource for architects, engineers, CAD techs, project managers;
- **BuildFind.com**—Buildfind includes [AECjobbank.com](http://AECjobbank.com), [Building.com](http://Building.com), [Remodelonline.com](http://Remodelonline.com), [Contractorlocate.com](http://Contractorlocate.com), and [Builderscentral.com](http://Builderscentral.com);
- **Buzzsaw.com**—online collaboration and procurement;
- **Engineering.com**—resource tool built by engineers for engineers to share, search, and source;
- **Ideal.com**—transform, acquire, view, collaborate, store, edit, and transfer large CAD files;
- **Projectvillage.com**—Enterprise community model, web-based collaboration, customizable workflow, and e-commerce;
- **ProjectEdge.com**—project communication/management systems, workflow and collaborative capabilities, full off-line functionality;
- **ProjectGuides.com**—online professional service consultants automate business development and consultant selection;
- **BuildZone.net**—leading building industry portal with special focus on Indian construction industry;
- **Construction.com**—access to the construction marketplace through Dodge, Sweets, ENR, ARCHITECTURAL RECORD, and various state construction sites; and
- **Projecttalk.com**—an internet based community where you use project management tools without updating or maintaining them or worrying about security. Employees or users get unique access codes.

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Association Director  
Center for Construction Technology  
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North Carolina State University  
Campus Box 7908  
Raleigh, NC 27695-7908  
Phone: 919-515-3677

## Surfaces and Interior Finishes

*Outlined here are several finish and surfaces technologies that could be applied in housing for various benefits stated.*

### Lower Cost Solid Surfaces

Granicoat is an economical, durable, and sprayable solid surface application. It has the same properties as

solid surface sheet material and can be applied with spray equipment. It is more forgiving than solid surface sheet goods, with a seamless look. This new breakthrough makes wall surfaces and other interiors easier and more economical to finish with solid surface material. Granicoat, when applied properly, gives a ten-year warranty.

**Contact:**  
Safas Corp  
Clinton, NJ  
Phone: 973-772-5252  
www.safascorp.com

### Decorative Surface Material Wears Like Armor

Vydex can be shaped into rounds, curves, etc., and is thermally formed to create seamless, long-lasting surfaces for walls and retail fixtures displays. The material is relatively low cost and combines durable PVC film and high impact resistant rigid PVC into a surface product that stands up in high wear areas.

For housing it could be used in wall panel interior applications or traditional surface areas like counters for low cost, high wear applications.

**Contact:**  
TC Millwork  
Bensalem, PA  
Phone: 215-245-4210  
www.tcmillwork.com

### Eco Floors

Made from recycled rubber, this durable flooring is used in retail and commercial environments. It makes use of old tires. It is manufactured in tile form. Tiles are odor-free, flexible in design, and could be used in places where ceramic tile is found today for a softer, environmentally attractive floor surface.

**Contact:**  
Phone: 1-877-ECO-SURF  
Email: srzgerberltd.com  
www.regupol.com

### Pre-Finished Wood Wall Covering

ColorWall, using over 300 colors, patterns, and species of dyed wood veneers, provides an environmentally friendly, naturally beautiful wall surface. It is less expensive than paneling, provides more natural beauty, with no

finishing or staining required. It adapts to many different surfaces with its flexible fabric backing.

ColorWall uses natural or reconstituted dyed veneers with a tough, sealed coating, formulated specifically to veneers, for superior protection from UV and everyday wear. Standard sheet sizes used in retail interior applications are 24"x96".

**Contact:**  
VenTec  
Chicago, IL  
Phone: 312-733-7383  
www.ventecveneer.com

### Innvironments Organic Wall Coverings

Innovations has produced a revolutionary new line of organic wall coverings which create a new direction in the surfaces industry. The line of wall coverings is created entirely from natural resources or environmentally attractive products. The organics, including coffee, adzuki bean, green tea, charcoal and mugwort, are transformed into particle form and applied to cellulose backing.

Its other line is PaperWeaves, developed from cellulose paper and washed with pearlized translucent color. It uses powder from mineral mica. Both lines are amazingly creative, fresh, and environmentally attractive wall coverings or surface solutions.

**Contact:**  
Innovations  
Phone: 1-800-227-8053  
www.innovationsusa.com/  
innvironments.html

### Textra Paintable Wall Coverings

Johns Manville introduced Textra Glass Textile, a wall finish system. It is affordable, durable, and easy-to-install. Made from woven glass yarns, which are strong and flame resistant, its open-weave structures permit natural moisture vapor diffusion. Textra can be applied directly to concrete, OSB, and plywood surfaces. Textra is competitive versus alternative finishes on both initial cost and life-cycle cost, with lower installation time and cost.

**Contact:**  
Johns Manville  
Denver, CO  
Phone: 303-654-3103  
www.jm.com/textra

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## Building Envelope Technologies

*This category includes technologies which relate to the structure, assembly of, the protection of, or the thermal efficiency of the exterior building envelope. Technologies outlined here relate to wall panels, roof and floor systems, and insulation applications. Some technologies outlined here are creative thinking about the exterior building shell and its function of protecting the occupants.*

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### International Space Station

NASA's Environmentally Closed Life Support Systems (ECLSS) group developed vehicle/habitat systems that incorporate lightweight, re-configurable materials, spaces, or modules. Included are fasteners that are quick, strong, and easy to use and assemble.

NASA has also developed new, inflatable living quarters made from a 24-layer composite of textiles. It is stronger than metal, and its indestructible outer layers protect inner bladders that hold air. An outer shell provides insulating properties from 250°F to -200°F. Using Nextel 3M material from the auto industry, Kevlar from DuPont, Combitherm from the food packaging industry, and Nomax from the protective clothing industry, NASA engineers have developed an innovative, thick, inflatable shell able to withstand extreme temperatures, meteorite debris, and other flying space debris. Many of these ideas can be transferred on an earthly scale to housing. Down-scaled, more earth-like applications of this material/textile composite could be used in walls and roofs of homes.

### Contact:

Laura Nelson  
NASA Johnson Space Center  
Email: lnelson@ems.jsc.nasa.gov

### Integrated Window and Wall System (IWS)

LBL National Laboratory, Environmental Energy Tech Division, has developed an integrated window/wall system. A pre-engineered panel extends full width and height and thickness of a wall section. It includes an operable or fixed sash, recessed night insulation panel, integral solar shading panel, and a moveable interior control device. It is designed to be a factory-built wall section shipped to the site and incorporated with the rest of the wall structure. It uses wall framing to anchor window sashes and does away with window frames and typical window header framing. With its night insulation deployed, its thermal



**A sample of a GFP baffle, removed from its barrier bag. Inert gas fills the sealed interior of the panel.**

resistance is R-12. Full-scale prototypes have been fabricated and are in test and structural analysis mode.

### Contact:

Darius Arasteh, LBL National Laboratory  
Phone: 510-486-6844  
Email: D\_Arasteh@lbl.gov  
[http://windows.lbl.gov/adv\\_Sys/integrated/default.htm](http://windows.lbl.gov/adv_Sys/integrated/default.htm)

### Gas-Filled Wall Panels (GFPs)

Lawrence Berkeley National Laboratory, Building Technologies Program has been working since the late 1980s on gas-filled wall panels. Using the same principles that are now common in gas-filling air space in windows, they have developed wall panels filled with an inert gas in a controlled space. They are able to achieve an R-19 wall in the space normally consumed by a 2x4 wall cavity, and R-30 in the space of a 2x6 wall cavity. Some effort has been focused on residential wall panels, as well as insulation for appliances, namely refrigerator panels filled with gas.

**Gas-Filled  
Wall Panels (GFPs).**  
continued

A cellular structure inside the panel, with low diffusion gas barrier films in a hermetic seal, retains the panel gas fill of argon or krypton. Cost per square feet = \$0.69 for 2x4, 16" o.c. wall, and \$0.94 for 2x6, 16" o.c. wall. The weight is comparable or less than the weight of traditional wall construction. Technical issues being addressed include thermal aging characteristics and search for low-flame spread materials.

**Contact:**

Dariusz Arasteh, LBL National Laboratory  
Phone: 510-486-6844  
Email: D\_Arasteh@lbl.gov  
<http://gfp.lbl.gov/>

**Composite Building**

Funded by the Office of Naval Research and developed at the U.S. Navy's Manufacturing Technology Center of Excellence for Composites Manufacturing (CECMT), this technology employs composites for the entire house. The building/shelter technology is easy to assemble. It was assembled in the Dominican Republic in less than 24 hours by 10 people without specialized tools or heavy equipment. The outside finish and roofing materials were applied within an additional 36 hours. It has very good thermal values, with R-42 roofs and R-24 walls. It is also fire resistant, corrosion resistant, and termite resistant. The DOD labs are going to work with CECMT to incorporate composites into "contingency" structures and field test them.

**Contact:**

Loretta DeSio  
Phone: 703-696-5032  
Email: desiol@onr.navy.mil

**Composolite FRP Panels**

This is a new lightweight, high strength, glass fiber reinforced polymer modular construction system. It has been used extensively in Europe for over 10 years, and is now being produced by Strongwell in the U.S. Applications for housing include wall panels, floor decking, and roof decking.

**Contact:**

Phone: 540-645-8000  
Email: dfayler@strongwell.com  
[www.strongwell.com](http://www.strongwell.com)

**Composite Housing System  
Uses Waste Glass**

The ACE awards, recognizing the composite industry's best new applications, went to the Ambiente Housing System made completely of composite materials in September 2000. It is billed as hazard-resistant housing, designed to resist hurricanes and withstand earthquake forces. It is also fire and flame resistant. With no timber or steel in the home, it's made entirely from recycled glass core material, generating no production waste in the manufacturing process. This housing system has superior thermal and sound characteristics, is low maintenance, durable, and long lasting.

Raw waste glass is processed into honeycomb-like material, then cast into a composite of resin and fiber. This technology uses non-degradable waste. It uses 13 tons of waste glass that would have gone to landfill for each house.

This system is affordable and durable (20-year warranty). It reduces damage from natural hazards and is environmentally responsible and friendly. Ambiente has turn-key manufacturing plants developed. This technology has direct potential application for advanced wall panel systems and whole house systems.

**Contact:**

Malcolm Parish, Director  
Ambersham Technology Group  
Ambiente Housing  
Luquillo, Puerto Rico  
Phone: 787-889-1362  
Email: ambiente@prtc.net  
[www.ambientehomes.com](http://www.ambientehomes.com)

**Emergency Housing Ships Flat,  
Folds Out**

A Milan, Italy company, Top Glass S.p.A, has developed a portable, lightweight house that ships in folded form. It is stacked three high for shipping and folds out to 92 inches high when deployed. It was developed for the Universita del Progetto, Italy, as emergency housing or command centers in natural disaster areas. The units meet international modular shipping standards. When stacked three high, they occupy similar space to truck cargo containers. The units are insulated composite panels around a metal frame that is hinged for folding. The units can be folded and unfolded many times, so they are re-locatable as well.

The units consist of composite structural panels for the sides, end walls, and roofs. The units have been structurally certified independently in Italy and Japan for design, wind, and snow loads. The units, once folded out to an 88 inch wide x 260 inch long x 92 inch high (33 inch high when folded for shipping) rectangular cube, provide 151 square feet while weighing around 3,500 lbs. Many of these principles and ideas could be applied in whole or part to the U.S. housing industry.

**Contact:**

Top Glass S.p.A.  
Milan, Italy  
[www.topglass.it](http://www.topglass.it) or  
[www.compositestech.com](http://www.compositestech.com)  
(March/April 2001 issue of Composites Technology)

**Tilt-up Foam Core Panels**

Energy Panel Structures, Inc, displayed its latest technology for pre-engineered buildings at the World Dairy Expo, which allows for one of the most flexible, low-cost building options for agricultural buildings. The tilt-up foam core panels are water resistant and have 50 percent better R-values with pre-finished interiors.

**Contact:**

Energy Panel Structures, Inc.  
Graettinger, IA  
Phone: 1-800-967-2130  
[www.epsbuildings.com](http://www.epsbuildings.com)

**Keep Water Away from Foundation**

ElectroOsmotic Pulse (EOP) is a technology developed for the U.S. Army. It repels water molecules electronically, controlling groundwater intrusion into structures. Keeping groundwater away prevents structural and corrosion damage, while improving indoor air quality.

**Contact:**

Vincent Hock  
Army Corps of Engineers  
Construction Engineering Research Laboratory (CERL)  
Phone: 217-373-6753  
Email: v-hock@cecer.army.mil

## Electrical

Listed in this section are the technology findings that directly or in part could be applied to the mechanical infrastructure (electrical) of housing.

### Technology Scanning

One of PATH's major research support services is PATH Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning*—published by the U.S. Department of Housing and Urban Development/PATH and prepared by the NAHB Research Center, Inc.—are updated as technology developments dictate. The Research Center works to unite technology developers from outside of residential construction with manufacturers in the residential housing sector.

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- Thermal and Moisture Protection
- Indoor Environmental Quality

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### New Efficient Lights

Incandescent bulbs offer warm but inefficient light. Fluorescent lights save energy and last longer but cast a green glow. Researchers have developed a new light combining the best of both types. It's a tiny, solid-state laser that delivers a longer lasting white light with minimal electricity. The device emits an ultraviolet light, which strikes a phosphor coating. The coating glows with an eye-pleasing white light. Light bulbs made with these chips would last 10 times longer than fluorescent bulbs and 50 times longer than incandescent bulbs. The chip, only 20 micrometers square, will be ready within two years as a prototype and pilot, with commercial models in 5-10 years. This technology has application for industrial, commercial, and residential lighting.

#### Contact:

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Sandia National Laboratories  
Albuquerque, NM  
Phone: 925-294-2951  
Email: jonhan@sandia.gov  
[http://www.sandia.gov/LabNews/LN10-06-00/uv\\_story.html](http://www.sandia.gov/LabNews/LN10-06-00/uv_story.html)

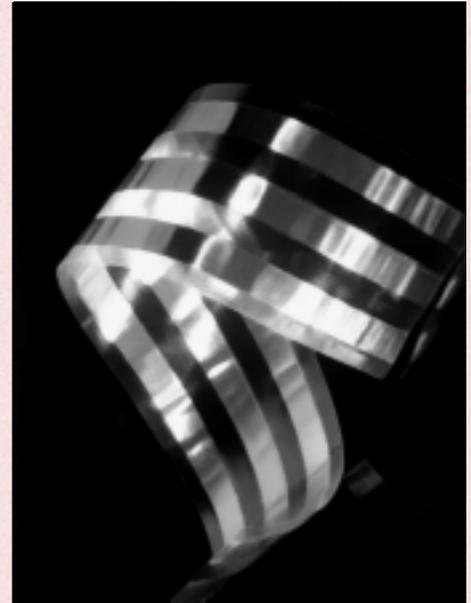
### Ultra Thin Electrical Wire

FlatWire is a technology consisting of three flat conductors insulated on either side with a film. It's thinner than a business card. Today it carries 12volt audio or 120v line current. It applies flat to a wall similar to drywall tape, and can be covered with drywall compound or paint. The manufacturer is seeking UL approval. They are also working with the National Electrical Code on an internal wiring system for new construction, especially those houses built with foam-core panels or insulated concrete form technology.

#### Contact:

DeCorp America  
Nashville, TN  
[www.decorp.com](http://www.decorp.com)

**DeCorp America's FlatWire consists of three flat conductors insulated on either side with a film.**



Courtesy: DeCorp America

### Fast-Cooking Technology

Developed for space station living, this will find its way into the home over the next several years. This technology cooks foods faster with focused, less wasted energy. The technology, called Eneyst, uses jets of hot air on the top and bottom of the oven focused on the food. This eliminates warm-up times and the energy to heat the whole oven cavity. Eneyst air impingement technology is being tried in restaurants (Domino's, Pizza Hut, Lincoln Food Services), and vending machines where hot, fast, oven-fresh food is desired and now possible.

Thermador has been working with Eneyst to develop a line of residential energy saving, fast cooking ovens for the consumer.

#### Contact:

Malcolm Webster  
Technology Liaison  
National Technology Transfer Center  
316 Washington Avenue  
Wheeling, WV 26003  
Phone: 304-243-2543  
Email: mwebster@nttc.edu  
[www.nttc.edu](http://www.nttc.edu)

## Plumbing

**Listed in this section are the technology findings that directly or in part could be applied to the mechanical infrastructure (plumbing) of housing.**

### Hot Water Recovery and Heat Capture

Oak Ridge National Laboratory, Buildings Technology Center, is researching emerging technology to

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capture heat from residential drainwater. Gravity Film HX (GFX) is the process being tested at two sites in Duluth, MN, and Madison, WI, to capture and reuse the heat from shower and dishwasher hot water for pre-heating of additional hot water (63 percent of the hot water use in a house). This technology could save a portion of the energy use in hot water heaters today.

A second project by this group is an integrated water-heating refrigerator. This uses the excess capacity and heat produced by refrigerator condensers for other uses in the house.

- Mode 1 - takes heat from the refrigerator's condenser and applies it to pre-heat water and air; and
- Mode 2 - when no refrigeration is needed, condenser heat is applied to water and a second evaporator is used to cool air space.

Benefits include reduced energy to produce hot water, extra space heat, and a reduced cooling load in summer. A prototype has been built and testing is underway. It is a joint effort between ORNL, North Carolina State University, and Davis Energy Group.

#### Contact:

John Tomlinson or Robert Wendt  
Oak Ridge National Lab  
Oak Ridge, TN  
Phone: 423-547-0260  
Email: jtomlinson@ornl.gov

### Plumbers Training Program— Low Cost Solar Water Heating

Solar water heating solutions have been around since the 1960s. Oftentimes the builders' reluctance to adopt them has prevented more widespread use of this technology. A UK company has developed "SHINE 21," a major new project aimed at low-cost training of plumbers in the design and installation of solar water heating systems. This program is being put into use in the UK for skilled craftspeople. The company that developed the program also sells and markets low cost solar water heating systems, which cost around 1500 British pounds or about \$2,100 U.S.

#### Contact:

Filsol, Ltd  
John Blower  
Phone: +01269 860229  
Email: info@filsol.co.uk

### Versiloc Tubing

This technology is a proprietary combination of silicone elastomers in a high strength pressure tubing. Smooth, inner surfaces are intended to reduce particulate build-up. It is temperature resistant to -112°F and 320°F. It is taste and odor free. This technology could have application in residential plumbing and movement of water.

#### Contact:

Saint-Gobain Performance Plastics  
Phone: 973-696-4056  
www.tygon.com

### Hot Water and Heating Comfort

MonoSolar is a sleek, well-designed system for hot water. A European design, it is compact and small. It can be connected to the company's Multisolar unit and other Daalderop heating units for central heating or extra heating. The Monosolar unit has 100-litre capacity, is easy to install, has an integrated drainback system, has frost and overheating safeguards, requires no antifreeze in cold climates, requires no maintenance, and has a long life span.

#### Contact:

Daalderop BV  
The Netherlands  
Phone: +31 344 636 500  
www.daalderop.nl

### Join Copper Pipe Faster

Pro Press system, a joint development by Ridgid Tools and Viega, forms a permanent, watertight seal in just seconds for common copper pipe sizes. There is no soldering and no sweating of joints, which is better for the environment. Additionally, it has faster installation time per run, per house. Each fitting, over 200 available, has a seal built in each end. There is also a special elector-hydraulic crimping tool developed by Ridgid that crimps the fitting and seals it to the pipe permanently.

#### Contact:

Ridgid Tools  
Phone: 1-888-743-4333  
www.ridgid.com

## Heating, Ventilating and Air Conditioning

Listed in this section are the technology findings that directly or in part could be applied to the mechanical infrastructure (heating, ventilating and air conditioning) of housing.

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### Next Generation Pulse Combustion Technology

Next generation pulse combustion technology reduces fuel consumption by 50 percent and reduces greenhouse gases by 30 percent through cleaner emissions. New breakthroughs in the design of heat chambers result in higher heat transfer coefficients with thermal efficiencies of 97 percent. This technology is under research for commercial and manufacturing uses, but with further research and development could be applied to residential heating systems.

#### Contact:

Dr. Dilip Manuel, Business Development Manager  
David Proctor, Primary Researcher  
CSIRO Thermal & Fluids Engineering  
Melbourne, Australia  
Phone: +61 3 9 252 6000  
Email: information@dbce.csiro.au

### Micro-Capillary Heat Exchange/Cooling System

Similar to radiant heat in floors, this technology uses liquid in tiny tubes in the ceiling to cool a space. Water moves through tiny tubes (twice the diameter of pencil lead) and is chilled to 59°F for cooling or warmed to 86°F for heating. The large surface area promotes faster heat exchange with substantial energy savings. Tubes are connected in parallel and placed in panel form, which can have plaster or other finishes applied over the top. Dehumidification is still required in humid climates.

#### Contact:

KaRo  
Archhamps, France  
www.karo.cc

### Hydronic Radiant Cooling

Lawrence Berkeley National Laboratory is working on a project to develop Hydronic Radiant Cooling (HRC), which separates the tasks of ventilation and thermal space conditioning as it shifts the peak cooling load to later in the day. The technology relies on radiation from a cooled surface to provide sensible cooling, and it uses air distribution to fulfill ventilation and indoor humidity requirements. Demonstrations are currently operating in office buildings in Switzerland, Austria (2), and Oakland, CA, as well as at a retail store in Utah. (Refer to Project LBNL-13)

#### Contact:

Helmut Feustel, LBL National Lab  
Phone: 510-486-4021  
Email: HEFeustel@lbl.gov  
<http://epb.lbl.gov/thermal/hydronic.html>

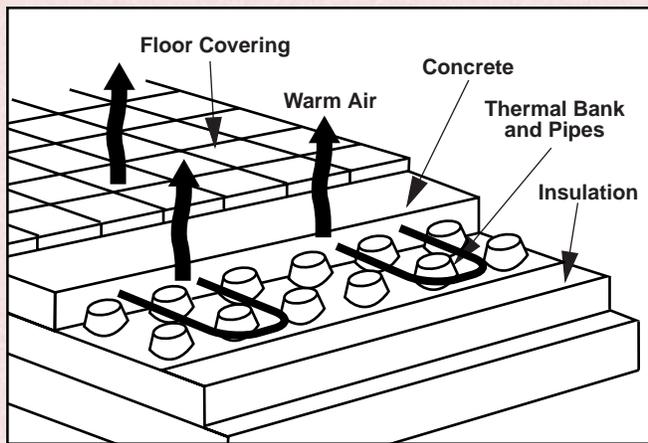
### Solar Pre-Heat of Fresh Air Cuts Heating Cost

This is a technology from the agriculture industry's crop drying process. It uses solar energy to preheat air used in ventilation systems. The Department of Energy and the National Renewable Energy Laboratory are developing this technology for use in commercial and residential structures. The system heats air by as much as 54°F, reducing the annual heating cost by \$1 to \$3 per square foot. Solarwall uses perforated metal sheeting as a solar absorber, which costs half as much as traditional glazed solar panels.

#### Contact:

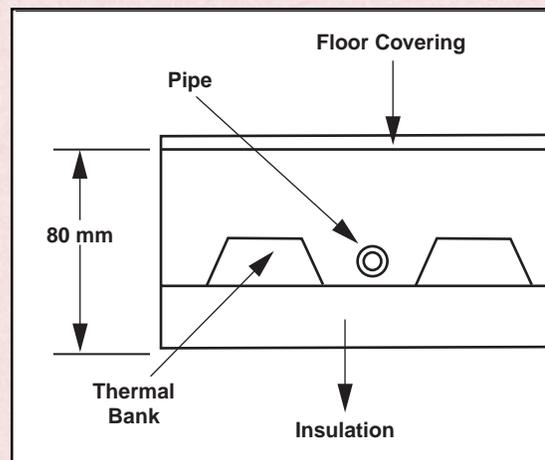
NREL Technology Transfer Office  
Phone: 303-275-3008

**The system installs simply over concrete slabs.**



Courtesy: Luwa BV, Netherlands, an agent of TEAP in Europe

**Energy is absorbed by the system during excess heat production times, then released during need in off-peak times.**



### **State-of-the Art in Building Automation**

Progress in communication standards has led to new forms of building automation. BACnet is one set of operability protocols that allow field devices in HVAC to talk to each other and centralized command centers. The other is LonMark and LonWorks operability protocols. The LonMark catalog now contains over 220 products that inter-operate over a LonWorks Network. The IT industry has spawned a whole new set of scripting languages with the intent of integration and blending of protocols and soft technologies. Common language has allowed many devices to link together and be controlled collectively versus individually.

**Contact:**  
Ken Sinclair  
Email: [sinclair@automatedbuildines.com](mailto:sinclair@automatedbuildines.com)

### **Heat Storage System Under-floor**

Luwa Sustainable Energy demonstrated its latest in heat storage systems for storing heat produced by solar PV systems, at Sustain 2001. Their TEAP29 product makes use of latent heat to achieve higher thermal density. Energy is absorbed by the system during excess heat production times, then released by programmable controls during need in off-peak times. The system installs simply over concrete slabs and comes in easy-to-use capsule sections that are embedded with under floor heating tubes or electrical heating cables. A screen is then applied over the top to provide a finished, walkable surface.

**Contact:**  
Luwa BV  
Netherlands  
Phone: +31 0-35-541-55-51  
Email : [infosustain.mrg@luwa.nl](mailto:infosustain.mrg@luwa.nl)  
[www.teappcm.com](http://www.teappcm.com)

### **Airflow Modeling Software**

Flovent provides software and consulting services to evaluate and simulate airflow/movement in a structure during the design phase to optimize the design and performance of HVAC systems for better indoor air quality, and healthier and more comfortable homes at lower costs. By studying and modeling airflow, more accurate equipment can be sized. Floor plans and wall plans can be adjusted to take problem areas away and create more efficient air flows, thereby reducing the energy needed to run the systems. They refer to it as interior aerodynamics.

**Contact:**  
Flowmerics  
Phone: 508-357-2012  
[www.flovent.com](http://www.flovent.com)

### **Duct Audits for Peak Efficiency**

Brookhaven National Laboratory is doing field research using duct audits on forced air duct system performance. They measure inefficiencies in duct design and layout and installation and assembly, which directly result in energy loss and indirectly contribute to poor indoor air quality.

(Project reference BNL-2)

**Contact:**  
Richard Krajawski  
Brookhaven National Laboratory  
Phone: 514-344-3804  
Email: [krajawski@bnl.gov](mailto:krajawski@bnl.gov)

### **Alternative to Metal Ductwork**

FabricAir, Inc. in Louisville, KY, has brought over a European series of fabric ductwork to the U.S. UL-approved and NFPA-certified, it has been used for over 30 years in Europe. It provides an alternative to metal ducts that is energy efficient, quieter, lightweight, and has a potentially lower installation cost. The fabric ducts are available in sizes from 8 to 80 inch diameter round ducts. The fabric is treated to resist mold, with zipper connections for ease of assembly.

**Contact:**  
[www.fabricair.com](http://www.fabricair.com)  
**Other Fabric Duct Manufacturers:**  
Pal Int'l Soft Air  
DuctSox, Dubuque, IA  
Phone: 319-589-2777  
Email: [pal@koolduct.com](mailto:pal@koolduct.com)

## Energy/Power Systems Generation

*The technology findings here relate to alternative means of power creation, conservation or conversion against traditional gas, coal-produced electric, or nuclear-based power. This area of sustainable energy technology is at the forefront of a number of industries including housing.*

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## Fuel Cell Technology

Fuel cell technology combines hydrogen and oxygen to generate electricity and pure water. This technology is virtually silent and produces no pollution. Fuel cells can be used to power vehicles, homes, factories, and offices. They are modular in design, making them versatile in configuration.

### Fuel Cells Engineering Framework and Road Map

Pacific Northwest National Laboratory, Material Resources Group, is establishing a systems engineering framework for the development of fuel cells. They are defining barriers and mapping a plan for advanced fuel cell development.

#### Contact:

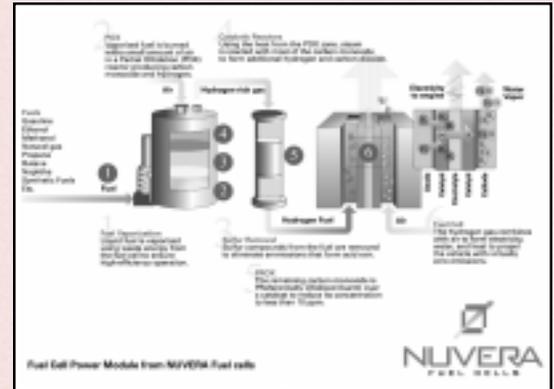
Bernie Saffell  
Pacific Northwest National Laboratory  
Richland, WA  
Phone: 509-372-4565  
Email: bf\_saffell@pnl.gov  
www.pnl.gov/fuelcells

### Nuvera Introduces Line of Residential Fuel Cell Modules

In response to a growing need for alternative on-site energy solutions, Nuvera is developing small-scale fuel cell power modules designed to provide a range of deployable power anywhere, anytime. The modules are flexible fuel cell technology that provide the user freedom of fuel choice from hydrogen, natural gas, or propane.

The units are intended for remote power use away from a power grid or as residential backup to traditional power sources. Three lines of compact, stacked fuel cells in aesthetically pleasing housing are under development:

- ▶ Premium Fuel Cell Module 1kW - Propane
- ▶ Premium Fuel Cell Module 1kW - Hydrogen
- ▶ Premium Fuel Cell Module 5kW - Natural Gas



Courtesy: Nuvera Fuel Cells

Nuvera intends to work with leading organizations around the world to demonstrate and test the commercial viability of small-scale power modules. The demonstrations will be designed to increase overall awareness and perception of fuel cells among consumers as viable clean energy alternatives. Nuvera was formed in April 2000 in a merger of De Nora Fuel Cells, Milan, Italy, and Epyx Corp, a fuel processing division of the American consulting firm of Arthur D. Little.

#### Contact:

Nuvera Fuel Cells  
Deborah Cullen  
Cambridge, MA  
Phone: 617-498-5398  
Email: cullen.d@nuvera.com  
www.nuvera.com

### **World's Largest Fuel Cell Installation**

Middletown, Connecticut, USA Juvenile Training Center, has ordered a 1.2 MW fuel cell system for an estimated \$18 million. It is to be installed by Select Energy. This will be the largest single installation to date. When fully debugged and operational, it will provide a major portion of the facility's power.

### **Iceland to Demonstrate First Real Hydrogen Based Economy**

Iceland announced plans to start a fleet of hydrogen powered fuel cell buses and hydrogen filling stations to provide the world's first real demonstration of a hydrogen-based economy. A consortium of companies including Shell Hydrogen, Daimler-Chrysler, and Norsk Hydro, will spend about \$6.5 million U.S. dollars to start up the project. The four-year project will demonstrate the viability and implementation issues for a hydrogen-based economy. Three buses powered by fuel cells and a refilling station at an existing Shell retail site will be at the heart of the demonstration.

### **Fuel Cell Vacuum Cleaner**

Electrolux LLC has designed, and is ready to release with the assistance of Manhattan Scientifics, Inc., the first fuel cell powered vacuum. Using technology from NovArs GmbH, located near Passau, Germany, the stacked fuel cell is a composite material held together with sealants instead of bolts. The cells are lightweight and generate power of 1,000 watts. Electrolux will sell the backpack vacuum cleaner next year.

Passau, the fuel cell provider, feels it will help users get comfortable with fuel cells in and around the home and encourage greater use of fuel cell adoption for homes, cars, appliances, and outdoor power equipment. The VP of Marketing for NovArs GmbH said, "If people get comfortable with this technology on a small scale, they are more likely to have confidence with it on a larger scale."

MIT is currently performing tests on the new application.

#### **Contact:**

Manhattan Scientifics, Inc.  
Marvin Maslow  
New York, NY  
Phone: 212-752-0505  
Email: maslow@ix.netcom.com  
www.mhtx.com/media-center/  
pressrelease30.htm

### ***Photovoltaic/Solar Technology***

Solar technologies have been around for a long time. However, our knowledge of solar technology has improved greatly over the past few decades. There are now better, more practical applications to harness the sun's power. Photovoltaic conversion occurs within solar cells made from silicon. Multiple cells are connected together and sealed to form solar power modules which collect the sun's energy and convert it into electricity.

### **Solar Dynamic Energy Conversion**

This conversion technology generates electricity/power with a small surface area. It is lightweight, and has a higher power-weight ratio than conventional photovoltaics. It can be applied to housing with a relatively small surface area and power generation units.

#### **Contact:**

Great Lakes Industrial Technology Center  
John Glenn Research Center  
Cleveland, OH  
Phone: 216-433-4000

### **Solar Cell Technology and Systems for Houses**

Sanyo, a Japanese maker of electronics, has developed a new structure cell, called HIT, with 17 percent mass production line cell efficiency. This new hybrid structure of a cell reduces energy loss and is the world's highest efficiency for a prototype cell at 20 percent. Sanyo's goal for the new process is a low-cost, large-volume production solar cell for housing. To date these cells have been applied in houses as shingles in Japan's test houses. The key technology breakthrough has been in the application of a thin film technology of Amorphous Silicon (a-Si:H cell) on a crystalline Silicon base. Pilot manufacturing lines have demonstrated mass production capability and potential efficiency.

#### **Contact:**

Solec International, Inc.  
Jawid Shahryar  
Carson, CA  
Phone: 310-834-5800 (x207)  
Email: solec@solecintl.com  
www.sanyo.com/aboutsanyona/  
company\_profiles/solec.html



**Hpower's RCU 1-10 kW AC residential unit.**

Courtesy: Hpower



**The Georgetown University Fuel Cell Bus.**

Courtesy: Fuel Cells 2000

**SunSlates Roofing and Façade Systems**

Atlantis Solar Systems' strategy has been to incorporate photovoltaic technology into building products. In its first demonstration project installed in Switzerland one year ago, they used SunSlates photovoltaic, a thin-film solar cell roofing and façade product. Since then, it has been used successfully in Burgdorf Switzerland's Regional Hospital, along with 70 other applications across Germany and Switzerland. Solar Building Systems LTD, Exmore, VA, have installed some systems in the U.S.

**Contact:**

Atlantis Solar Systems  
Jorn Jurgens  
Bern, Switzerland  
Phone: +41 31 300 3200  
Email: info@atlantisenergy.ch  
www.atlantisenergy.com/as1.htm

**Photovoltaic Cladding**

Located just outside London, the University of Southampton is the first building to have mono-crystalline vertically mounted PV arrays generating electricity. It is the most monitored, most watched installation of PVs. The goal is not only to collect performance data, but also reliability, durability, and economic data. A total of 96 modules are configured in sub-arrays divided across four levels of the building.

**Contact:**

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Southampton SO17 1BJ, UK  
Phone: + 44 23 80 592051  
Email: A.S.Bahaj@soton.ac.uk  
www.soton.ac.uk/~serg/solar/solar.htm

**Photovoltaics Integrated into Windows**

The National Renewable Energy Laboratory has integrated a PV electrochromatic device into smart windows. Termed PV-EC Smart Window, this technology could derive better functional use of the window and reduce heating and cooling needs of the building by 25 percent, lighting demand by 50 percent, and peak power demand by 30 percent. A dye-sensitized solar cell electrode is the heart of the technology and can be used in conjunction with today's known window technologies of Low e coatings, gas fills, and space evacuation techniques. Making the cells thin enough to be semi-transparent to the human eye is one of the technical challenges being worked on. Another method of building the cells into the

window frame is being pursued as well. Reliability and durability will be key attributes to prove.

**Contact:**

National Center for Photovoltaics  
National Renewable Energy Laboratory  
Golden, CO  
Email: jack\_stone@nrel.gov  
www.nrel.gov/ncpv.NCPVHotline

**Solar-Shell Renewables**

Technology to turn the sun's rays into power on earth has been around for some time, but recent focused efforts around photovoltaics are forging new inroads. The energy conversion takes place within a solar cell manufactured from silicon. Multiple cells are connected together and sealed into solar power modules. Shell has recently opened a state-of-the-art solar cell plant in Germany. It is the world's most integrated plant and Europe's largest single solar cell line. With their size and technical know-how, Shell has produced cooperative efforts in Amersfoort, Holland, with 70 architects to bring about the largest solar residential development in Europe. Through a joint venture with a South African utility company, Eskom, Shell is bringing sun-derived power to 50,000 homes in remote areas not connected to public power grids. They



Credit: Jim Yost

**Mid-sized photoelectrochromic window turning dark under a voltage applied by two small PV cells attached to the side of the window.**



**The hybrid solar/wind project at Parker Ranch, Waimea, Hawaii, leverages daytime sunlight and warm Hawaiian winds.**

**Amorphous Solar Cells**

Amorphous silicon solar cells hold a number of advantages over typical crystal silicon cells. They can be manufactured using less energy and raw materials, which promises to be a lower cost and more environmentally friendly means to produce cells in mass production quantities. Also, their thin film design allows for physical flexibility and the ability to be fabricated into large-area cells, or wide varieties of shapes and sizes. Embedding them into other substrates is also easier due to their thin configuration. Manufacturers see great potential for integration of function and design.

**Contact:**

Baekaert ECD Solar Systems LLC  
 Auburn Hills, MI  
 Phone: 248-475-0100  
 Email: info@uni-solar.com  
 www.ovonic.com/unisolar.html

**DunaSolar-Amorphous Solar Cells**

Amorphous silicon solar cells provide 8-15 percent more energy than crystalline ones when illumination is low (scattered cloudiness). Dunsolar is one of the leading producers of these cells. They currently have U.S. test sites with UL-approved panels in Davis and Sacramento, CA, in industrial and public buildings. Their Sacramento sites will be the focus of a tour at the 6<sup>th</sup> annual UPVG Photovoltaic Conference in October 2001.

A company representative said DunaSolar has great interest in working with the U.S. building industry on solar photovoltaics and would be interested in further test installations or pilot applications. They also would like to work with some roofing manufacturers on integration.

**Contact:**

DunaSolar Inc,  
 Budapest, Hungary  
 Phone: +361 431 9620 ask for the Market Applications manager  
 www.dunasolar.com

**Quick Connectors for Easier Installation Solar Cells**

Solel of Israel introduced a simple, innovative technology at Sustain 2001, which allows flexible, quick connection of solar cells to create large banks of cells. Efficiently connecting larger banks of cells results in lower costs, reduced thermal loss, and higher efficiency. Their system avoids harmful emissions and is maintenance-free once installed.

**Contact:**

Solel Solar Systems LTD  
 Israel  
 Phone: 972-2-9996620  
 www.solel.com

**Photovoltaics and Wind Power Hybrid System Installed in Waimea, Hawaii**

One of the world's largest hybrid solar/wind energy power projects is up and running in Waimea, Hawaii, at Parker Ranch on the Big Island. The 175 kW's of PV panels are a ground-mounted tracker system that rotates to follow the sun east to west, capturing the maximum

**Solar-Shell Renewables,**  
 continued

have supplied Shell Oil's offshore drilling rigs with solar power in harsh conditions with special adaptations. They are supplying Sun Stations (combinations of solar and biomass) for village electrical needs in the Philippines. Solar power generation is expected to grow by 22 percent per year to a capacity of 1.5-2 Gigawatts by 2010.

**Contact:**

Shell Solar BV  
 Amsterdam Netherlands  
 Phone: +31 20 630 3000  
 www.shell-renewables.com

**The hybrid solar/wind project at Parker Ranch features 175 kW of solar and 50 kW of wind turbines.**



amount of the sun's power, supplemented by 50 kW's of energy produced by five wind turbines. The combined system leverages clean renewable energy 24 hours a day providing power for the ranch's water pumping operations. The cost of the hybrid system is more than covered by the amount of reduced utility bills. The entire system was designed and installed by PowerLight Corporation of California.

**Contact:**

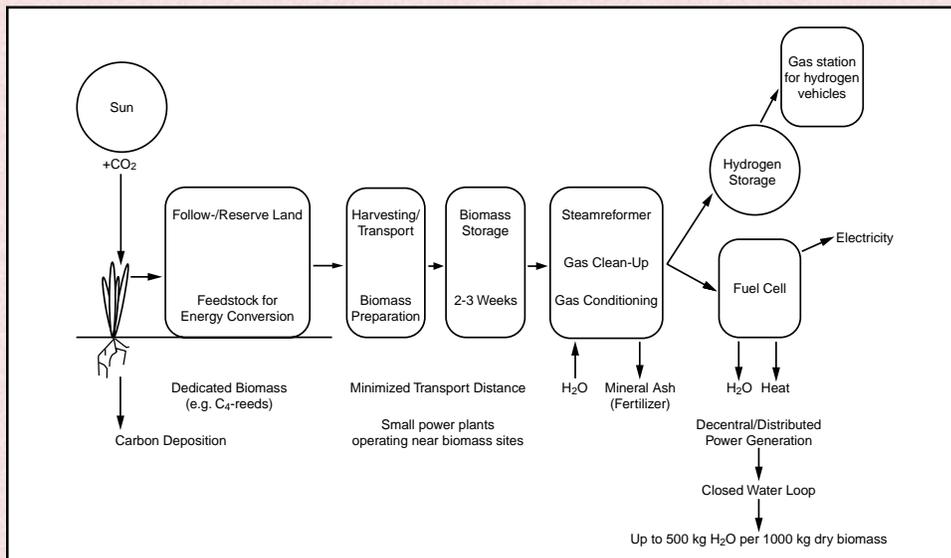
PowerLight Corporation  
 Berkeley, CA  
 Phone: 510-540-0550  
 www.PowerLight.com

**Italian Government Speeds Adoption Process for PV**

The Italian government allocated L60 billion (approx \$28 million U.S.) for a program to provide incentives for the early adoption of PV technology. Approximately \$9 million goes toward public, government, and municipal buildings' installation of PV, while about \$19 million will be used for private sector and households that wish to use PV to supply a significant portion of their power needs. Up to 75 percent of the cost of the system will be covered in the form of grants from this program. This is a good example of government providing funds to get technology adopted and in use in both the public and private sector.

**Contact:**

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 Phone: +39 06 442 49241-47  
 Email: info@isesitalia.it  
 www.isesitalia.it



**The Electro-Farming™ Concept**

Courtesy: Dr. Wolf G. Johnssen

**BioMass Technology**

Biomass technology converts waste stream material or rapidly renewable plant material into useful heat and/or electricity. Some current applications in Europe take waste from wood processing industries or the agricultural sector and produce briquettes and pellets. These are then burned cleanly in specially designed units which can heat factories, offices, and even homes.

**BioMass = Chemically Stored Solar Energy**

Biomass Co-generation and Electro-Farming is a process to use and harness nature's power. BioMass for energetic conversion results from many sources:

- ▶ Waste material from forestry recultivation;
- ▶ Recycling from landscape conservation measures;
- ▶ Recycling from the wood processing industry;
- ▶ By-products from the agricultural sector;
- ▶ By-products from the food processing industry (olives, lemon peels);
- ▶ Specific cultivation of biogenic

energy carriers (perennial plants, rapidly growing trees, annual plants and grasses); and

- ▶ Natural building and packaging materials.

The patented Electro-Farming process enhances the role of biomass in future power supply via a new process for the thermo-chemical transformation of biomass. The biomass is broken down into its chemical components, and then cooked with high temperature steam. The water is cracked into its components, hydrogen and oxygen. This process results in a high conversion rate of energy/unit of weight. This process opens the door for the commercially viable production of hydrogen from biomass for fuel cells. Small or mini-plants can produce small batches for local consumption, even to the extent of a home producing and processing its own biomass into hydrogen for fuel cell use, thereby greatly reducing infrastructure and transportation energy envisioned for delivering biomass or hydrogen to individual customers. Electro-Farming has the capability to develop the smallest possible power plants with the highest possible efficiency levels and low operating costs.

**Contact:**

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### **Biomass -Shell Renewables**

Shell Oil might change its name one day to eliminate the word "oil." The name of one of its fastest growing divisions, Shell Renewables, could be a leading contender. Biomass is in the commercially viable stage. The idea of its use is proven but the logistics and commercial selling of it is yet to be tried in large scale. Shell Renewables' goal is to develop a dedicated wood fueled biomass business on a worldwide scale with a 10 percent global share for Biomass by 2010, with several hundred megawatts of capacity in place by 2005. Already demonstration trials are underway in Chile and Uruguay, showing a scaled infrastructure producing (in conjunction with Shell Forestry) and using biomass to generate clean power with total regard for the environment. Larger scale capacity is being developed in Northern and Central Europe.

In Norway, biomass is in action providing energy to industrial and residential customers using bark residues from a nearby wood processing plant. Whitewood briquettes are being marketed to customers for heating alternatives to fuel oils, using specially designed units for residential homes. These commercial pilots are beginning to show competitive potential against gas, oil, and coal even in these early stages.

**Contact:**

Shell Renewables  
Shell Centre  
London UK  
Phone: +44 171 934 3628/ 3646  
[www.shell-renewables.com](http://www.shell-renewables.com)

### **International Awards for Residential Biomass Heating Unit**

OkoFen, a German company, has won several international awards for its innovative residential heating unit that runs off biomass pellets. Its powerful design and function were awarded the Energy Globe 2001 and the Innovation 2000 award by the world sustainable energy community. It provides heat for hot water systems and radiant heating systems. It is self-cleaning and automatically compresses the ashes produced. It delivers fully automated heating needs fueled by biomass pellets that burn clean. OkoFen is a pioneer in pellet burning systems and today's market leader. They were one of the most popular exhibits for residential energy systems at the Sustain 2001: Sustainable Energy Exposition. The unit is very well designed, compact and installation ready.

**Contact:**

OkoFen Pellet Heating  
Phone: 0043 0 7286/7450  
[www.pelletsheizung.at](http://www.pelletsheizung.at)

## **Basic Materials**

***The Basic Materials category outlines technology in coatings, chemicals, or ingredients that improve durability and longevity; composite materials; advanced multipurpose materials; and structural or strength materials. These technologies, many of which originated at basic research levels in universities or national labs, hold promise for a variety of construction applications.***

### **Technology Scanning**

One of PATH's major research support services is PATH Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning*—published by the U.S. Department of Housing and Urban Development/PATH and prepared by the NAHB Research Center, Inc.—are updated as technology developments dictate. The Research Center works to unite technology developers from outside of residential construction with manufacturers in the residential housing sector.

This issue of *Technology Scanning* is one in a series. Each issue in the series falls into one of the following categories:

- Design and Internet Tools
- Safety
- Surfaces and Interior Finishes
- Building Envelope Technologies
- Electrical
- Plumbing
- Heating, Ventilating and Air Conditioning
- Energy/Power Systems Generation
- Basic Materials
- Information Technology
- Sustainable Design Strategies
- Materials Recycling and Reuse
- Thermal and Moisture Protection
- Indoor Environmental Quality

Call the ToolBase Hotline at 800-898-2842 for information about other available *Technology Scanning* issues. Or, log onto pathnet.org and www.toolbase.org.

**PATH**

451 7th Street, SW  
Washington, DC 20410  
Email: pathnet@pathnet.org

## **Coatings, Chemicals, and Ingredient Materials**

These material technologies have been developed by large global materials research companies to be sold into a number of applications such as coatings, chemical additives, and ingredients. They have specific engineered properties that when combined with other materials, provide a desired engineered outcome.

### **DuPont Tefzel**

This ingredient material is engineered to have durable, wear-resistant characteristics. It is used today as a protective coating for Uni-Solar shingles and standing-seam metal roofing. The roofing products are wear-resistant, durable, and weatherable. This ingredient material has other potential applications in construction products, where the desired outcome is durability and wear resistance (siding, decking, flooring, and other surface products).

#### **Contact:**

DuPont  
Technology Transfer Office  
Phone: 877-881-9787  
[www.dupont.com/teflon/films/next-gen.html](http://www.dupont.com/teflon/films/next-gen.html)

### **DuPont ImRon Coating**

This DuPont coating comes from a history of coating innovation. It is touted to out-weather other industrial paints. It has superior abrasion resistance. Currently, it's used in heavy equipment manufacturing for equipment that sees harsh conditions on a daily basis. It has significantly reduced maintenance costs for those users of heavy equipment. Applications in housing could include paints and stains, along with coatings on a variety of exterior components.

#### **Contact:**

DuPont  
Technology Transfer Office  
Phone: 877-881-9787  
[www.dupont.com/finishes/na/000401.html](http://www.dupont.com/finishes/na/000401.html)

### **Self-Placing Concrete (MelFlow)**

This formulation of ingredients for concrete reduces the amount of water used, optimizes water/cement ratio, increases strength and durability, and reduces mixing time by 30 to 40 percent. It is self-compatible and self-consolidating. It requires no tamping or vibrating, and it provides density without segregation. It is being developed for the Korean and Asian building industries.

#### **Contact:**

Meca Engineering Ltd  
3rd Kumho Bldg 123-25  
Karrak-Dong Songpa- Ku  
Seoul, Korea  
Phone: +82-2-443-3497  
[www.new-technologies.org/ECT/Civil/flowconc.htm](http://www.new-technologies.org/ECT/Civil/flowconc.htm)

### **Highly Durable, Environmentally Friendly Paint**

The Army Research Lab (ARL) has patented coating technology available for transfer that is highly weatherable and durable. It is flexible at ambient and subzero temperatures, mar-resistant, and corrosion chemical agent resistant. This water-dispersible coating can be applied with standard spray equipment and low VOCs. The technology may have paint and finish applications in the housing industry.

#### **Contact:**

John Escarsega  
Coatings Technology Team  
Michael Ruasa Technology Transfer  
Phone: 410-278-5028  
Email: jescarse@arl.army.mil

### **Durable, Tough, No-Slip Coating**

From the after-market and OEM truck industry, bed liner material, which is applied by spray or roller, can be looked at for a weatherable, durable, and slip-resistant surface for almost any substrate. TUFF STUFF, one brand of coating, can be applied to almost any metal, wood, or concrete surface. One can create various textures and colors with additives. It has been proven for 15 years in the truck bed liner market. This coating could have application in roofing for homes or other coatings needing weatherable, durable properties. If applied in roofing, it could speed up the time to finish a roof and be a safer means to finish the roof for the worker.

**Contact:**

Rhino Linings  
San Diego, CA  
Phone: 619-450-0041  
www.rhino linings.com

### **Concrete Corrosion Solutions**

This technology uses electrical treatment combined with a chemical process to fight destruction of concrete structures from salt air, moisture, and baking sun. It was developed by NASA's Kennedy Space Center research scientists for the protection of all of NASA's concrete structures, buildings, and miles of runways and launch pads in Florida, the Texas Gulf, and Alabama. The process, called electromigration, sends corrosion-inhibiting ions to the rebar or steel within a slab or structure. Surtreat's proprietary chemical protection is applied to the surface and seeps into the concrete to the rebar to prevent further corrosion. It corrects the chemical imbalance that can cause the rebar to corrode.

Concrete loses its pH or acidity level over time. New poured concrete has values of 11, 12, or 13, and these high values help to inhibit corrosion. As concrete naturally ages and is exposed to more UV, the pH values drop. When it reach levels in the 8-9 range, concrete becomes susceptible to quicker deterioration. That's why bridges, buildings, roadways, driveways, patios, and sidewalks deteriorate more rapidly after they reach a certain age. NASA anticipates saving significant time and money over traditional repair methods that are shorter lived.

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Email: mwebster@nttc.edu  
www.nttc.edu  
www.new-technologies.org/ECT/Civil/  
surtreat.htm

### **Composites and Coatings Consortium**

This group has developed Advanced Coating deposition technology that can efficiently deposit thin films or sputter coats of durable coatings on a variety of materials. This consortium has also developed affordable, high-wear, high heat-resistant ceramic composites.

**Contact:**

Great Lakes Industrial Technology Center  
John Glenn Research Center  
Cleveland, OH  
Phone: 216-898-6426

### **Moisture-Resistant Coatings**

This NASA-developed coating for ceramics makes the coatings 1,000 times more durable. The moisture-resistant coating made from specially treated boron nitride extends the shelf life of composite materials. It can also be applied by chemical vapor deposition to many substrates where durability and protection from heat, moisture, and other elements are desirable. The process and coating, developed for NASA by Advanced Ceramics Corp, Cleveland, OH, opens up new opportunities for more durable materials and composites in all industries.

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316 Washington Avenue  
Wheeling, WV 26003  
Phone: 304-243-2543  
Email: mwebster@nttc.edu  
www.nttc.edu

### **New Acrylic Roof Coating**

Vanberg Coatings, introduced to the dairy industry, is a new acrylic roof coating that is a monolithic membrane providing a durable, water-tight surface over concrete, wood, or metal roofs. It withstands UV light, temperature extremes, mildew, etc.

**Contact:**

Vanberg Coatings  
Lenexa, KS  
Phone: 800-874-0631  
Email: vscoat@qni.com  
www.vanbergcoatings.com

### **Durable New Metal Coating**

Cleary Building Corp, Verona, WI, introduced a breakthrough in painted metal panels to the dairy industry for metal outbuildings. Alurite 2000Plus coating system is a durable enhancement which allows for a 35-year warranty on painted metal panels for roofs, sidewalls, etc.—an industry first. This coating could be looked at for other building component durability enhancements in residential building products.

**Contact:**

Cleary Building Corporation  
Verona, WI  
Phone: 608-845-9700  
www.Clearybuilding.com

### **Biocide Coating Additives**

This coating additive controls mold or mildew cost effectively for interior or exterior coatings. Mergal S90 is formulated for roofing products, sealants, and architectural coatings. Troy biocides are environmentally sound, durable, and long lasting.

**Contact:**

Troy Corp.,  
Florham Park, NJ  
Phone: 973-443-4200  
www.troycorp.com

### **Duration High-Performance Exterior Coating**

Sherwin-Williams, in addition to showing its low odor paints launched last year, exhibited another new coating at the International Coatings 2001 Expo, called Duration high performance exterior coating. The company offers a lifetime warranty for a single coat properly applied on exterior walls. This coating is based on modified acrylic that adheres well, is flexible, and protects against cracks and chips.

Another brand new development launched this year makes coatings that dry on substrates as cool as 35 degrees Fahrenheit, which extends the painting season well into the fall and winter months in many parts of the country.

**Contact:**

Sherwin-Williams  
www.sherwin-williams.com/dig/  
newsolutions/duration.asp

## ***Composite/Fiber Structural Materials and Applications***

Composite material and process technologies are among the fastest growing new material applications. Composites are combinations of materials and resins that orient fibers, mats, or matrix structures in the desired area and direction to take advantage of their individual properties. Composites are usually stronger and lighter in weight than the materials they replace. Currently the automotive industry is the biggest user of new applications. The construction industry is emerging as the next big target for the composites industry. As applications expand, processes improve for volume applications, and the volume of composites increase. The raw materials and finished part costs will continue their downward trend. New configurations and materials are also emerging, namely ceramics and carbon fiber technology.

### **Affordable Fiber-Reinforced Ceramic Composites**

This consortium has developed affordable, high-wear, high heat-resistant ceramic composites. Developed for the defense and aerospace industries, these technologies are finding their way into many civilian applications through the federal government's Technology Transfer Centers.

#### **Contact:**

Great Lakes Industrial Technology Center  
John Glenn Research Center  
Cleveland, OH  
Phone: 216-433-4000

### **Owens Corning Composite Systems**

At the Composites 2001 Show, Owens Corning displayed its latest venture with a tier-one automotive supplier—a complete composite truck bed assembly for Ford. It incorporates a composite bed, fenders, and sidewalls in one component ready to assemble to a truck frame. It eliminated multiple metal and steel components; it increased durability; it reduced weight; and it improved fuel efficiency. This is a good example of systems integration. Owens Corning, a current building industry supplier, could explore this approach for components in houses (i.e., walls, floors, roof panels), taking more of a component/systems approach vs. parts and pieces.

#### **Contact:**

Owens Corning World Headquarters  
Phone: 800-438-7465  
[www.owenscorning.com/composites](http://www.owenscorning.com/composites)



Courtesy: Owens Corning

**Owens Corning complete composite truck bed incorporates a composite bed, fenders, and sidewalls in one component ready to assemble to a truck frame.**

### **Plastic Silica Composite Tougher than FRP**

Ohio State University scientists have patented a method of mixing plastic with silica to create a heat-resistant material five times more impact resistant than fiber reinforced plastic (FRP). The patented manufacturing process forces melted plastic into the pores of silica, thereby creating a stronger bond. It can be used as a lightweight substitute for iron, steel, or aluminum. The process was first developed for making tough plastic dental fillings for the medical industry.

#### **Contact:**

John Lanutti  
Ohio State University  
Phone: 614-292-3926  
Email: [lanutti.1@osu.edu](mailto:lanutti.1@osu.edu)  
[www.acs.ohio-state.edu/units/research/archive/tufplast.htm](http://www.acs.ohio-state.edu/units/research/archive/tufplast.htm)

### **ParaBeam 3D Glass Fabrics**

At the Composites 2001 Show, a Dutch firm demonstrated cutting-edge technology to make impregnated, lightweight sandwich panels and skins from glass fabrics. Panels or skins are an ideal basis for easy finishing with other laminates or foils. Foam cores can be integrated for thermal purposes. Properties include lightweight, excellent strength and stiffness, full service adhesive properties, easy reparability, and corrosion and water-resistance. Applications in Europe include storage tank walls, high-speed watercraft skins, truck and cargo floors, train and bus exteriors, building cladding, and interior partitions. Ideal applications in the housing industry could include building panels and skins, and floor and roof panels.

#### **Contact:**

ParaBeam, the Netherlands  
Phone: +31 (0) 492-570625  
Fax: +31 (0) 492-570733  
Email: [derek.bolianatz@parabeam.com](mailto:derek.bolianatz@parabeam.com)  
[www.composite.about.com/library/PR/2001/blparabeam1.htm](http://www.composite.about.com/library/PR/2001/blparabeam1.htm)

### **Reinforced Cores at Lower Costs**

Webcore Technologies of Dayton, Ohio, claim their Tycor fiber-reinforced foam cores are a low-cost solution for composite sandwich. The process uses glass or carbon fibers to build a 3D web and lattice structure within low-density foam. Both skin faces are mechanically stitched together through the core. The fiber structure allows for quick resin flow and uniform wet-out. Cores and panels are being developed for commercial industries (aviation, marine, truck, and civil engineering). Applications in construction could include building panels, and structural components that combine thermal, structural, and surface properties in one composite sandwich instead of individual parts.

#### **Contact:**

Lynn Stanley  
Webcore Technologies  
Dayton, OH  
Phone: 937-879-3212  
[www.compositecenter.org/press4\\_content.stm](http://www.compositecenter.org/press4_content.stm)

### **Composolite FRP Panels**

This is a new lightweight, high strength, glass fiber reinforced polymer modular construction system. Used extensively in Europe for over 10 years, it is produced by Strongwell in the U.S. Applications for housing include wall panels, floor decking, and roof decking.

**Contact:**

Phone: 540-645-8000  
Email: dfayler@strongwell.com  
www.strongwell.com/PULT/  
pultusion.htm

### **Tougher Fiber/Cement Composites**

This is a process technology to increase bond strength and interface toughness of synthetic fibers. It is used in reinforcing cement-based composites. Application allows tailoring interface properties of a given system to produce cost effective, high performance, fiber-reinforced, cement-based composites (Patent issued) (File #1193). The material, called Torex, optimizes geometry of fiber reinforcement in cement, ceramics, and polymeric composites for lower cost (Patent issued) (File #1063).

**Contact:**

Mitch Goodkin  
University of Michigan  
TechTransfer Office  
Ann Arbor, MI  
Phone: 734-764-4290  
Email: mgoodkin@umich.edu  
www.umich.edu (search on "Torex")

### **Low Weight Composite Sandwich Promises High Strength**

Moldite Technologies has developed a pultrudable reinforced plastic that can rival steel and aluminum in strength and stiffness at a tenth of the weight. Other benefits include impact resistance, mildew resistance, and fire resistance. Dave Peash, Chief Executive, sees potential applications in the automotive, marine, aerospace, and construction industries. Currently, they are testing the material formulation in plastic reusable pallets.

**Contact:**

Dave Peash or Dave Demerst  
Moldite Technologies  
Novi, MI  
Phone: 1-810-296-8851  
www.link2semiconductor.com/articles/  
is032313.jsp

### **Composite Panel Structural Material**

From the civil engineering industry comes a technology called Composite Fiber Reinforced Polymer (FRP) bridge deck. The deck sections are lightweight, highly durable, strong, and rigid. Test bridge installations can be found in Ohio, Virginia, West Virginia, and Pennsylvania. This technology could be applied in wall panels, roof decks, floor, and deck panel systems.

**Contact:**

Robert Sweet, Jr.  
Creative Pultrusions, Inc  
214 Industrial Lane  
PO Box 6  
Alum Bank, PA 15521-0006  
Phone: 814-839-4186  
www.creativepultrusions.com

### **Space Age Materials on Earth**

Transfer of high tech composites technologies from aerospace has always been relatively cost prohibitive. With simpler and more accessible production processes, composites could reach broader markets faster and less expensively.

Quickstep Technologies of Australia has developed an advanced mass production process for high quality composites. They are able to produce fiber reinforced plastics that are cheaper, with higher strength, improved appearance, and reduced cure times. The solution involves an innovative system employing lightweight rigid molds suspended in heat transfer liquids (water or oil). The liquid circulates in a low-pressure environment with a flexible membrane maintaining constant pressure and heat on the mold. The pressure and heat compact the laminate and cure the component, while vibration forces out trapped air and gases. Quickstep has set up a pilot plant to test a mass production scalable effect.

**Contact:**

Quickstep Technologies  
Phone: +61-8-9364-8270  
www.quickstep.com.au

### **Lower Cost Structural Substitute**

Structural fiber reinforced plastics is a new material technology that could be a substitute for traditional structural materials like steel, concrete, masonry, and wood. It is low weight, high strength, with lower installed costs and lower maintenance costs than traditional structural materials. The technology is being tested in Japan as concrete mesh reinforcement; in highway bridges in Calgary, Canada; in a prototype composite bridge in Russell, Kansas; and in

pedestrian bridges in western U.S. National Parks. Upon verification of the benefits and properties, other broader complex applications can be developed and tested.

**Contact:**

Antonio Nanni  
University of Missouri-Rolla  
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Rolla, MO  
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www.rb2c.umn.edu

### **Carbon Fiber Mat**

This technology creates more opportunity for application of carbon fiber as a structural material in composites. Several companies have now perfected carbon fiber in mat or sheet form as reinforcement in composites, making it much easier to develop products with superior strength, and lighter weight than traditional wood or steel products. Previous carbon fiber forms of strands or fiber length were application specific and limited in what applications could be developed.

This advancement greatly expands the opportunity to use carbon fiber in structural composites and plastics. Here are several of the new materials:

- Fortafil Fibers- Uniweb continuous fibers sheet and IsoWeb random chopped fiber mat;
- OBS, Inc- Produces lightweight carbon fiber yarn fabric for extremely thin, lightweight application;
- Schappe Techniques- 100 percent carbon fiber yarn and multi-axial fabric; and
- Saint-Gobain Technical Fabrics- Bay Mills Carbon Fabrics.

Currently applications have been in leisure and recreational products, industrial products, and aerospace applications. Carbon fiber fabrics and mats could be developed into composite wall systems, roof panels, floor panels to produce high-strength, lightweight, easy-to-handle building panels. Carbon fibers have been added to Glulam beams to increase the load bearing capacity by up to 100 percent.

**Contact:**

www.fortafil.com  
www.sgbt.com (Saint Gobain)  
Dedicated search engines at  
www.wvcomposites.com

### **Snap Joint Technology for Assembling Composite Structures**

Developed for aerospace applications and utility transmission towers, this technology allows composites to be used in many applications with the benefits of less weight, faster assembly, less labor, and less equipment. It is in use on DOT projects and transmission towers in California. It is proposed for assembly of all composite rocket towers at Vandenberg Air Force Base. This technology has won industry awards and has made the job of connecting composite applications simpler.

#### **Contact:**

Dr. Clem Hiel  
W. Brandt Goldsworthy & Associates  
Torrance, CA  
Phone: 310-375-4565  
Email: clemhiel@aol.com  
www.blackzendedesign.com/contractwork/goldwebsite/product/mainprod.htm

### **Structural Ceramics**

University of Pennsylvania, Department of Materials Science and Engineering, is doing work in deformation and fracture of structural materials, chemistry and physics of ceramics, polymeric materials, and electronic materials.

Surfaces and interfaces research includes: metal-ceramic interfaces, polymer-ceramic interfaces, carbon based materials, and inter-metallic alloys. Synthesis and materials processing research provides the discipline that looks at materials (new or modified) to solve a standing industry problem or enable applications of new materials into an industry. Some of the specific projects with potential for construction industry use and application include:

- ▶ Structural Ceramics—Professor I-Wei Chen developed two novel ceramic applications, including a ceramic wood combination;
- ▶ Molecular Control of Adhesion—Professor Russell Composto; and
- ▶ Interface of Structural Materials—Professor David Luzz.

#### **Contact:**

Takeshi Egami Cahir, Department of Materials Science and Engineering  
University of Pennsylvania  
Philadelphia, PA  
University of Penn Technology  
Transfer Center  
Phone: 215-573-4500  
www.seas.upenn.edu/mse

### **Innovative Structural Modeling and Simulation**

CSIR Boutek, a national agency and research arm in South Africa, aligns R&D with current and future needs in South Africa, bringing the latest technology to bear on applied solutions. Among the materials research is an assessment of new innovative structural applications (modeling and simulation, physical testing), and ceramics use and application in building products.

#### **Contact:**

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Neo Moikango, Div. Director  
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Email: nmokang@csir.co.za

### **Glass Reinforced Plastic Won't Shatter**

Glass reinforced plastic flat sheet developed in the UK claims to be able to withstand the most violent of storms.

Called Meshlite Starlite, the glass panels can withstand a 50 kg weight dropped from a height of 4m. It is designed to be tougher than glass and lower in price. Its main uses include doors, windows, and skylights. It is currently being tested in nuclear power plant applications where shatter resistance is critical.

#### **Contact:**

Meshlite, Ltd  
Phone: +44-1691-652545  
www.meshlite.com

### **Flexible Glass**

The Material Resources Group at the Pacific NW National Laboratory is developing flexible glass for the flat panel display industry. It has the flexibility of plastic and barrier protection approaching that of glass. Roll-up computer screens and other flexible wall displays are possible. The process involves depositing multiple layers of organic and inorganic materials in stacks. The



**Scintillating glass optical fibers are the first viable medium for large-area, solid-state, thermal neutron sensors that have applications in national security, medicine, and materials research. Here, ultraviolet-induced fluorescence mimics scintillation.**

**Flexible Glass,**  
continued

stacking architecture allows each layer to help protect against defects in adjacent layers (10 microns thick).

The results are glass-like clarity, impermeable, and durable, but flexible and a lot like glass. Flexible glass could have application in doors and windows in the future or incorporate the functions of windows and displays into one product. Windows could be simpler, lighter weight, and with fewer parts.

**Contact:**

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Materials Resource Group  
Pacific NW National Laboratory  
Richland, WA  
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**New Composite Material to Replace Concrete**

Ductal® is a new composite building material being developed jointly by several European companies and LaFarge Corp of the U.S. LaFarge Corporation is one of North America's largest suppliers of construction materials like cement, gypsum, roofing, aggregates, and concrete. The new material announced at the World of Concrete 2001 is impermeable, non-corrosive, cementitious-like, containing chopped wollastinite and bronze fibers along with mineral fillers.

Carbon fiber can be added and the material adjusted for the different properties required. Ductal® can take any surface texture and can be pigmented for a high quality surface finish. Ductal® is expected to be lighter weight, less labor and machine intensive, and a replacement for conventional concrete structural parts. With strength similar to steel and toughness equal to ceramics, it can outperform steel and concrete. The purported cost savings come from faster construction time generating labor and material savings. Ductal® is pre-mixed and with the addition of water can run through existing concrete batching equipment.

**Contact:**

Andy Radler  
VP & GM in charge of development  
LaFarge Corp  
Herndon, VA  
Phone: 703-480-3600  
www.lafargecorp.com

**Advanced "Smart" Materials**

A new generation of materials is in the research phase at several national labs and universities. These materials perform multiple functions, can be engineered to change function, and can be embedded with other chip and coating technology to make materials do what we want and when we want on demand to set criteria.

**A Plastic that Heals Itself**

The Washington Post reports on a self-healing plastic that uses high tech materials and a low-tech concept inspired by the human body. It has been developed for use in repair of car bodies, surfboards, Defense Department applications, pole-vaulting, and cell phones. Work is also being done on embedded sensors in the materials that show weak or wear spots by changing their color, so that the user knows fatigue of the material before it fails and causes harm or injury. Healing is site specific to the area fractured or cracked and is accomplished when new resin is self generated and formed around the fissures or cracks.

**Contact:**

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Department of Aeronautical and  
Astronautical Engineering  
University of Illinois at Urbana-  
Champaign  
Phone: 217-333-1017  
Email: swhite@uiuc.edu  
www.ssm7.aae.uiuc.edu/self-healing

**New "Active" Materials**

Funded by the Army Research Office, with development at MIT, this technology utilizes electric voltage to direct material change into a desired mechanical response (active fiber composites). Materials with multiple, changeable functions can be engineered to replace many materials with one application. In the building industry, changeable glass is already being tested. Other applications include interior / exterior surfaces that adjust to conditions or can be adjusted to fit pre-desired conditions.

**Contact:**

Professor Yet-Ming Chiang  
Material Sciences at MIT  
Phone: 617-253-6471  
Email: ychiang@mit.edu  
www.mit.edu/ceramics/research.html

**Material Can Change Functions**

Graphite flakes and film, highly reflective and silvery-black, are electrically conductive and can be used wherever appearance and conductive coatings are important (high luster paints, surface coatings, conductive flooring, shielding material) (Tech #129ML).

**Contact:**

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Email: goncalves@mail.templ.edu  
www.patents.temple.edu/  
complete\_list.html

## Information Technology

***This category includes a lot of the latest IT wireless, Personal Digital Assistant, and mobile computing technology. The technologies here streamline the paper documentation process and other construction related tasks.***

***For more information on this topic, see [Design and Internet Tools](#).***

### Technology Scanning

One of PATH's major research support services is PATH Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning*—published by the U.S. Department of Housing and Urban Development/PATH and prepared by the NAHB Research Center, Inc.—are updated as technology developments dictate. The Research Center works to unite technology developers from outside of residential construction with manufacturers in the residential housing sector.

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- *Electrical*
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451 7th Street, SW  
Washington, DC 20410  
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## *Streamlining the Inspection Function*

### Mobile Inspection Assistance

This technology, developed by Carnegie Mellon students, employs wearable inspection computers with image capture, voice recognition, pen and voice interface. It is aimed currently at bridge inspectors and surveyors, but once perfected can be configured for almost any construction inspection process to achieve greater speed and accuracy with less manual or subjective intervening.

#### **Contact:**

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Pittsburgh, PA 15213  
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Email: garrett@cmu.edu  
www.ce.cmm.edu/ngarrett/home/  
research-activity.html

### Virtual Inspections

At Purdue University they are developing technology using embedded sensors, which leads to smart structures that can be evaluated and inspected remotely. Along with this capability, researchers are developing hybrid, computerized decision support systems for virtual inspections. The system uses digital cameras and optical scanners to acquire data and images to be machine processed. The technology applied to inspections leaves out interpretive judgment, while bringing objective, quantitative, and reliable results.

#### **Contact:**

Luh Maan Chang, School of Civil Engineering  
Purdue University, Construction Engineering Management Division  
West Lafayette, IN  
Phone: 765-494-2240  
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### Visual Remote Control of Devices

With this technology one could signal and control remote mechanisms with visual information stream — allowing for user-friendly control inputs and simpler, inexpensive means to control remote devices. This method creates icons on the visual scene through which

control information is sent and interpreted at the remote site. (Patent issued) (File #095 1) This technology could be applied in a remote inspection process, or for automation of hazardous construction tasks.

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University of Michigan  
TechTransfer Office  
Ann Arbor, MI  
Phone: 734-764-4290  
Email: robinlr@umich.edu  
www.techtransfer.umich.edu  
(Search: 0951)

### Human-Computer Intelligent Interaction

Cutting-edge research is being done using artificial intelligence, robotics, computer vision, and cognitive science to attempt to duplicate human perception and interpretation. If research continues to be successful, the merger of computing and human skills could open up many applications.

#### **Contact:**

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Beckman Institute for Advanced Science and Technology  
University of Illinois  
Urbana, IL  
Phone: 217-333-1837  
Email: info@beckman.uiuc.edu  
www.vision.ai.uiuc.edu

### Adaptive Computing System Capable of Learning and Discovery

This technology bridges the realm of artificial intelligence and computer simulation of natural learning and discovery. It is well suited for repeatable, predictable tasks. (Patent issued) (File #0059)

#### **Contact:**

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(Search: 0059)

## ***Logistics Streamlining***

### **Next Generation Bar Coding for Logistics**

Tracking and Integration Software from the MIT Research works with the latest in bar code technology to take complex logistics and simplify and streamline them. Born out of research for the defense industry, this latest technology is now being applied to civilian industries. It is available for transfer and is adaptable to almost any logistics process.

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MIT  
Boston, MA  
Phone: 617-253-5589  
Email: siu@sunny.mit.edu  
www.mit.edu/newsoffice/  
newbarcode.html

### **Wireless Tracking Technology**

Wave ID will license technology developed at the Pacific NW National Laboratory for the DOD that can track the movement of goods and people. The systems include wireless radio frequency tags ranging in size from a grain of rice to a credit card. The tags are used to identify, locate, and monitor items as they move through a system or complex distribution.

#### **Contact:**

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Richland, WA  
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Email: staci.maloof@pnl.gov  
www.pnl.gov/news/2000/waveid.htm

### **Efficiently Moving People, Equipment, Materials, Job Tasks**

Logistics technology is an enhanced capability to plan, analyze, deploy, and sustain material and personnel flow to multiple points. Components include real time data updates, data reconciliation, data visualization, machine learning, multi-level access and security, integrated applications, simulations, and training and communication. The military is very

**Conita's PVA enables mobile workers to call from any phone and access crucial information and people through a single, intuitive, voice-driven interface.**



Courtesy: Conita Technologies

good at logistics, a definitive factor in the recent Gulf War. The technology they use can be applied or transferred to other industries.

This technology uses a radio frequency identification tag, which is a silicon chip less than 3 millimeters square, embedded in a label, the packaging, or the product itself. It allows readers and computers to track a product as it moves through a factory, through warehouses and distribution centers, into retail establishments, even as its product life is up as it goes to a recycle center. It uses a magnetic field emitted by the reader to power the chip.

In order to communicate, the chip has conductive carbon ink which, when the chip is powered, the antenna coil transmits data from the chip back to the reader. The ultimate goal is to put a radio tag on virtually every manufactured item, each tracked by networks of readers in factories, warehouses, and homes, transforming huge supply chains into intelligent, self-managed entities.

Today bar codes only identify classes of products. This, however, identifies individual products. Bar codes have to be deliberately scanned at specific orientations; radio tags need only be within range of a reader.

The Department of Defense picked up this technology after the huge logistics tasks involved in the Gulf War of moving supplies and equipment to different destinations. The cost of the radio tag was \$100 for military applications in extreme conditions. Since then, manufacturers and researchers have modified the tags to satisfy more commercial requirements and the cost is now down around \$0.50-\$1.00 per tag for short-range chips. The goal of researchers and manufacturers of the tags is to get a penny per tag cost.

Savi Technology, developer of this technology, originally tried marketing this technology to parents to keep track of toddlers in the supermarket. When parents rejected the idea, he found a military application and contracted with DOD after the Gulf War to end wasteful "just in-case" logistics. From that success, they were able to employ technology commercially in specialty industries that ship time sensitive goods. Companies using the system say it has paid for itself

many times over: 8 percent gains in productivity, 80 percent drop in incorrect items shipped, 50 percent drop in product shortages, and increases in inventory accuracy to 99.5 percent.

#### **Contact:**

Savi Technology  
Mountain View, CA  
Phone: 1-650-934-8000  
www.savi.com

### **Other Companies Manufacturing Radio Tags or EFIDs:**

Texas Instruments, Dallas, TX  
Motorola, Rolling Meadows, IL  
Intermec, Everett, WA  
Phillips Semi-conductors, Eindhoven, Netherlands  
SCS, San Diego, CA

#### **Military Contact:**

CECOM (Army Communication Electronic Command)  
Research and Development Engineering  
Fort Monmouth, NJ  
Phone: 908-532-0353

### **Mobile Logistics Devices for Common PDAs**

Dynasys has developed the latest in data collection attachments for Palm Pilot and Symbol PDAs. They are in use by many warehousing, manufacturing, and logistics companies. These devices allow for mobile collection of data for logistics and tracking purposes. They attach and interface with common Palm and Symbol PDAs and software.

Three areas potentially relating to the construction industry are:

- The Mag Card Swipe attaches to a Palm Pilot and takes data from the magnetic stripe on credit cards, health insurance cards, and information cards. Talking to the technical representative about use for the construction industry, he said it could be to take data onsite from subs and trade workers for time and attendance or hours worked by issuing them pass cards with appropriate information embedded in the magnetic stripe.

- Scan barcodes with portable attachments to Palm Pilots or Symbol PDAs could be used for inventory control, or for tracking of materials into or out of

Courtesy: Savi Technology



**Savi's 412 tag is used to track ammunition in the military.**

the site. Product barcodes, which many have now as a result of mass merchants' requests to manufacturers, would be needed on the construction materials.

► Scan 2D symbolgies, PDF, DataMatrix, or Maxicodes could be used in inspection tasks to automate, simplify, and link to electronic plans and documents about the house.

**Contact:**

Dynasys  
Clearwater, FL  
Phone: 1-800-867-5968  
www.dyna-sys.com

### ***Documentation Streamlining & Task Productivity***

#### **Personal Virtual Assistant (PVA)**

Conita develops voice-driven, mobile productivity solutions—connecting workers who are on the go with their most critical data and communications—anytime, anywhere. The PVA enables mobile workers to call from any phone and access crucial information and people through a single, intuitive, voice-driven interface. Conita solutions enable mobile workers to stay in-the-know,

increase their responsiveness, and recapture time lost in transit and while remote.

**Contact:**

Conita Technologies  
Columbia, SC  
Phone: 888-515-6200  
Email: info@conita.com  
www.conita.com

#### **Rugged, Waterproof, Durable, Field-Ready PDAs and Computers**

At the Mobile and Field Automation Expo, several companies introduced field-ready rugged devices for computing that withstand the rigors of tough conditions and harsh environments like a construction jobsite. The following are a few examples:

► SideArm All-Terrain Handheld PC—Designed for the Real World— readable display even in bright sunlight, built-in microphone, durable display window and rugged Santoprene case, wireless access to the internet, automated tracking and dispatch systems, and peer-peer communications. It has a 16-hour battery life on a single charge, and has a water-sealed design.

**Contact:**

Melard Technologies  
Armonk, NY  
Phone: 914-273-4488  
www.melard.com

► TouchLite Handheld PC- tough, rugged design with a large carry handle, touch screen commands, and Windows CE platform. It has an easy, no keypad use with a large display screen.

**Contact:**

Two Technologies, Inc.  
Horsham, PA  
Phone: 215-441-5305  
www.2T.com

► GETAC Notebook PC- has water- and dust- tight magnesium cases, Intel PII or III chips, and touch screen and sunlight options. They are shock proof, vibration proof, wireless, and built to survive.

► GETAC Tablet PCs — have launched three new models: CA35, CA25, and PC700/702 series. All of these have rugged, durable, magnesium outer shells and screens, and are tested to 3 foot drop heights. They are either pen activated or touch screens.

**Contact:**

GETAC, Inc.  
Irvine, CA  
Phone: 949-699-2888  
www.getacusa.com

► Symbol Technologies and ViryaNet Mobile Software- tough, rugged, mobile PDAs can be configured to fit a company's internal network so that the field force has the same connection to the company as the desktop users in the company. Some models are available as PDA and phone. These are used heavily for field service functions in locating and dispatching field service people, ensuring they arrive on time, and with the right parts to meet the service obligation. Information can be transmitted back to the company on call completion, parts used, detailed expenses and notes—all in real time at the close of the service call. This system could be applied in construction not only in service calls but also in up-front construction with subs and trade groups who come on the jobsite to perform tasks or to bring parts.

**Contact:**

ViryaNet  
Southboro, MA  
Phone: 1-800-661-7096  
www.viryanet.com  
or  
Symbol Technologies  
Holtzville, NY  
Phone: 631-738-2400  
www.symbol.com



Courtesy: Symbol Technologies' SPT 1700

**Ruggedized, mobile-wireless devices use ViryaNet to connect field engineers and on site managers to remote services and corporate data.**

### **E-phone Does it All**

The PC-ePhone (CYBird) is a wireless personal digital assistant with full internet, PC, cell phone, and organization capabilities. This mobile phone and PDA/PC runs on Microsoft's CE operating system. The bluetooth wireless technology features a handset that is adaptable up to 30 feet away from the main unit. The cost is estimated between \$1500-\$1700. This device dispenses the notion of three separate devices: PDA, cell phone, and computer. They are waiting for FCC approval for release of the product.

**Contact:**

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South Korea  
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www.cb.co.kr/e/index.asp

### **E-paper**

Electronic paper, developed by 3M and Xerox, is thin and flexible. It is made with a thin layer of tiny round beads sandwiched inside the paper to display images. The beads are black on one side and white on the other. Specialized electronic devices signal the paper to flip certain beads to form the desired image. E-paper is portable and updateable. Single sheets can be used for many images. Potential applications in housing include blueprints or construction documents, especially where lots of changes are occurring.

**Contact:**

Xerox Palo Alto Research Center  
Palo Alto, CA  
Phone: 650-812-4000  
Email: webmaster@parc.xerox.com  
www.parc.xerox.com/dhl/projects/gyricon  
www.sciam.com/2001/1101issue/  
1101ditlea.html

Courtesy: Deanna Horvath, Xerox PARC photographer



**SmartPaper MaestroSigns, prototypes of the ones Macy's installed for a pilot at their Bridgewater, New Jersey store.**

### **Procurement & Labor Streamlining**

A host of website companies offering procurement services continues to expand and decline as some come in and others exit. They include some of the following:

- ▶ BuildFind.com—the building industry hub, Buildfind includes AECjobbank.com, Building.com, Remodelonline.com, Contractorlocate.com, Builderscentral.com;
- ▶ Buzzsaw.com—online collaboration and procurement;
- ▶ One Build.com—leading e-market enabler and supply chain provider for construction materials;
- ▶ ProcureZone.com—specification library and tools for automating procurement of engineered equipment and materials;
- ▶ BuildZone.net—building industry portal with special focus on Indian construction industry;
- ▶ RealLabor.com—labor management software to track and manage daily labor;

- ▶ EngineerSupply.com—online purchasing of architectural, engineering, and construction supplies;
- ▶ Construction.com—access to the construction marketplace through Dodge, Sweets, ENR, ARCHITECTURAL RECORD, and various state construction sites; and
- ▶ Projecttalk.com—an internet based community where you use project management tools without updating or maintaining them or worrying about security. Employees or users get unique access codes.



Courtesy: Xerox

**SmartPaper being unrolled.**

## Sustainable Design Strategies

*This category highlights a variety of technologies and land use orientation ideas which contribute to improved design efficiency, particularly as related to energy efficiency and sustainability.*

### Technology Scanning

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### Design/Layout

The Design/Layout category lists ideas and technologies that involve design and orientation. Low energy architecture and community design cover ideas that change the dynamics of heat gain in groupings of homes or communities. Software and information technology are also included in this category, which contributes to more efficient design capability.

### Urban Micro-Climate/Urban Geometry

Urban Micro-Climate (the effect of a cluster of homes on each individual home) is often neglected in many urban designs. For example, in hot, dry climates, the compact cluster of homes generate a large, thermal mass attenuating the ambient conditions around each home, making each home's air conditioner work harder and longer.

Proper street orientation and layout of homes can have considerable effect on the shading, which affects the urban micro-climate and environmental performance of the homes. Building heights, proximity, and street width influence the heat generation characteristics of the street surfaces and surrounding grounds in the local urban micro-climate.

- ▶ North/South street orientation can result in street shading between 40 percent and 80 percent (dependent on latitude);
- ▶ Street orientation of NW/SE can only manage shading between 30 percent and 50 percent of the street area throughout the year; and

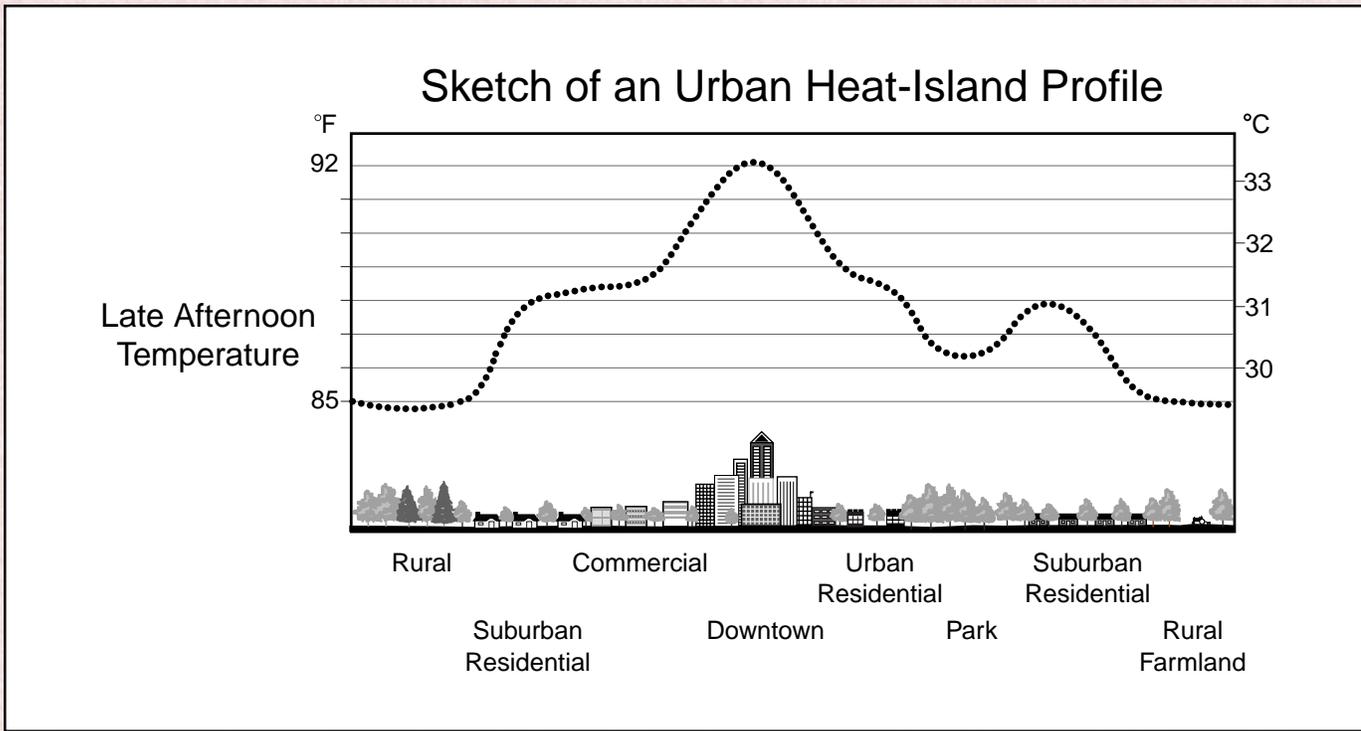
▶ East/West Street orientation can only achieve 30 percent street shading.

In addition to street orientation, urban layout affects energy use. The following are some good and poor examples of layout and its impact on energy use:

- ▶ Inner tier suburb streets with very mature trees provide added shading and reduced energy costs to each home in the area;
- ▶ New developments, often built in farm fields or large tracts of open land, are some of the worst "heat sinks" and continue to be for 10 to 20 years, assuming trees are planted;
- ▶ Concrete streets reflect more heat back into the atmosphere; asphalt streets absorb and store more heat. However, because of first cost, more asphalt streets and driveways are put in than concrete;
- ▶ Wide streets that are poorly shaded generate added heat for the homes around them versus narrower streets, oriented and properly shaded;
- ▶ Parkways (separated by grass or landscaped islands) are also more effective than wide streets at giving off less heat;
- ▶ Water near and adjacent to street surfaces also reduces the amount of heat given off to surrounding homes;
- ▶ The position of the home in proximity to the street also can influence heat gain. Homes close to the street in tightly packed neighborhoods leave little room for wind to dissipate heat, leaving heat to be absorbed by surrounding homes; and
- ▶ Cul-de-sacs also have large asphalt surface areas and can have tight housing configurations, which absorb heat from the street surface.

### Contact:

Department of Architecture and Urban Design  
University of Constantine  
Algeria  
[www.univ-constantine.d3](http://www.univ-constantine.d3) (French)  
MIT Department of Architecture  
[www.destech.mit.edu/forum/research.html](http://www.destech.mit.edu/forum/research.html)



**Lawrence Berkeley National Laboratory's Environmental Energy Division is working on a project which uses light (cooler) surfaces and specific trees strategically placed to reduce the effects of urban heat islands on cooling loads.**

**Reducing Urban Heat Islands through Design**

Lawrence Berkeley National Laboratory's Environmental Energy Division is working on a project which uses light (cooler) surfaces and specific trees strategically placed to reduce the effects of urban heat islands on cooling loads. Urban heat islands increase the cooling loads on surrounding areas and accelerate formation of urban smog. The research examines solar reflectivity of building materials and paving materials, and uses computer modeling of climate and air quality to see the effects of large-scale changes in solar reflectivity.

Several demonstration buildings and landscapes are located in San Jose, Sacramento, Gilroy, and Downy, California. The next stage of the project will use the information learned to date to work with roofing manufacturers to develop cooler materials, paving companies to look at next generation paving materials, and with municipalities to offer incentives to use the new materials and landscape strategies. They also have begun to draft roof reflectivity standards and codes. (Project ref LBNL-7)

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 LBL National Laboratory  
 Environmental Energy Division  
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**City of Tomorrow, Malmo, Sweden**

The City of Tomorrow in Malmo, Sweden, is being built to include a Sustainable Housing Expo and permanent living. It will be the largest of its kind. The city of Tomorrow (Bo01) aims to stimulate debate on architecture, technology, construction, and living that will contribute to international R&D in the housing sector, and that will spread knowledge on future homes to many people.

Malmo is taking the first coordinated step towards development of a sustainable city. This will be a long-term initiative, with a number of future additional elements that make it the expected world leader in dense, urban, sustainable development and a model for other projects around the globe.

Over 800 living units (apartments) and homes of the future will be on display during and after construction in 2001, in the largest housing exhibition of the modern era. Bo01, with around 50 homes, is specifically designed to demonstrate new thinking and new technologies around sustainable practices. The housing area exhibit will include different types of sustainable buildings with regard to energy, building materials, waste treatment, IT solutions, and green issues.

The European Village (formally open in August '01) will be a demonstration of houses that reflect national characteristics of 16 countries adapted to Sweden's climate and building conditions. These houses will be built using environmentally sustainable methods. As of May, eight countries had begun construction. Among the countries showcasing their best will be Sweden, Germany, Denmark, Hungary, Czech Republic, Greece, Slovenia, Latvia, and Lithuania. During construction, those from building related fields are invited to view the construction practices and technology only visible during construction. Once construction is finished, the Village will be open to the general public (August '01).

Examples of specific countries' housing applications:

► **Norway:** 3 levels or longitudinal zones (services, living, and solar) built on a strict planning module to avoid waste; construction is easily dismantled for future recycling; designed and built for 25 percent energy reduction over the norm in Norway; uses a rainwater collection system and solar collection and regulation practices.

► **Sweden:** ecologically adapted for a long lifespan; low maintenance; recyclable materials; energy management with high direct sunlight; limited number

of and low emitting materials; prepped for future deconstruction and recycling; IT for effective operation.

► **Lithuania:** heating and hot water via connection to local heating grid; rainwater usage and air recuperation systems; natural building materials like clay and wood; PV incorporated into the design.

Beyond housing, the City of Tomorrow will showcase public transportation, electric hybrid vehicles, urban planning methods and practices, IT for the environment, biodiversity, and 100 percent locally renewable energy. Sun, wind, and water will be the forms of energy production, together with energy from refuse and sewage generated in the district. Electricity will be generated by wind power and photovoltaic cells.

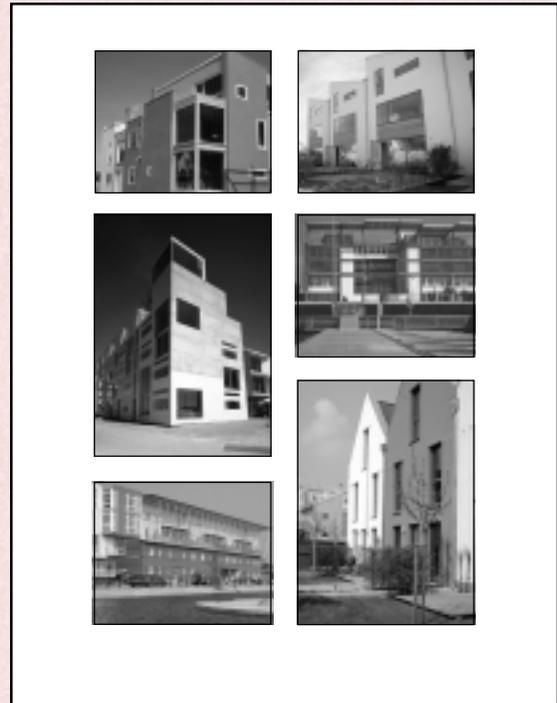
**Contact:**

City of Malmo's Project Office for Bo01  
 Phone: +46 40 35 95 50  
 Email: per-arne.nilsson@malmo.se,  
 www.bo01.com

**Low Energy, Sustainable Architecture & Community Design**

Low energy architecture looks at concepts and new thinking in regards to landscaping, street and site layout, with

respect to the sun and surrounding buildings. Also outlined in this section are materials or surfaces, which reduce the effects of architecture and infrastructure on heat gain.



**Shown above are six of the buildings being constructed as part of the City of Tomorrow.**

**The City of Tomorrow (Bo01) aims to stimulate debate on architecture, technology, construction, and living that will contribute to international R&D in the housing sector.**



### **Sustainable Urban Housing In China**

Demonstration projects were highlighted at the Sustain2001 Conference. These are being planned in Beijing, Shanghai, and Shenzhen, China as part of a joint effort by MIT and Tsinghua University. Three years of pre-planning and criteria development have gone into the effort to date, with construction starting in year 4 (late 2001). This demonstration will showcase the exploration of design, technology, and implementation of environmentally responsive urban housing.

Areas of special focus are site orientations and design integration with natural cooling properties, mechanical systems advancements, envelope/enclosure thermal comfort, and visual comfort. Promising technologies and systems will be incorporated into the project.

The collaborative includes the following:

- ▶ MIT Department of Architecture, U.S.;
- ▶ University of Tokyo Industrial Sciences, Japan;
- ▶ Tsinghua University and Tongji University, China; and
- ▶ Institute of Solar Energy Resource, Air & Climate Group, Switzerland.

Sponsors and funding include:

- ▶ Kann-Rasmussen Foundation (Velux –founder); and
- ▶ Alliance for Global Sustainability.

#### **Contact:**

MIT Leon Glicksman  
Email : glicks@mit.edu or  
Qingyan Chen  
Email: qchen@mit.edu  
Website on the demonstration:  
//chinahousing.mit.edu

Courtesy: B001



*Over 800 housing units will be on display in 2001.*

**The City of Tomorrow takes a big step forward towards the development of a sustainable city.**

### **Technologies for Sustainable Buildings**

Sustainability in this instance means “meeting the needs of the present without compromising the ability of future generations to meet their needs.” Sustainable buildings are characterized over their period of use by:

- ▶ Consuming minimal energy and water use;
- ▶ Efficiently using environmentally benign material and energy;
- ▶ Minimizing direct and indirect waste;
- ▶ Integration with surrounding environment;

- ▶ Sustainable urban transportation system;
- ▶ Safety for workers and occupants; and
- ▶ Healthy to live in for users.

#### **Contact:**

Centre for Sustainable Technologies  
University of Ulster, Northern Ireland  
[www.engi.ulst.ac.uk/CSTNEW](http://www.engi.ulst.ac.uk/CSTNEW)  
[www.arch.VUW.ac.nz/cbpr/index.html](http://www.arch.VUW.ac.nz/cbpr/index.html)  
Centre for Building Performance  
Research  
Victoria University  
Wellington, New Zealand

## Materials Recycling and Reuse

*This category has technologies that are made from environmentally attractive materials (salvaged products, post-consumer or post-industrial recycled content, rapidly renewable products, minimally processed materials). It also can include products that are green because of what isn't there (products that use less material, products that are alternatives to ozone-depleting substances, and other hazardous components).*

### Technology Scanning

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- Indoor Environmental Quality

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Washington, DC 20410  
Email: pathnet@pathnet.org

### Alternative Use

These specific technologies could provide more environmentally attractive alternatives to common building ingredients. They involve rapidly regenerating resources.

#### Soy Bean Composite Products

These products are made from environmentally attractive, agricultural, rapidly renewable resources that farmers can grow in many regions of the U.S. Many are lower cost alternatives as well. Three products that are ready for use are as follows:

- *Environ* is a bio-composite that resembles wood, but is made from recycled paper products, soy flour, and soy-based resin. It is designed for use in countertops and cabinetry. Tests have shown it to be three times harder than oak.
- *SoyOyl* is a soy-based foam with uses in appliances, carpets, and other construction products.
- *Soy-Based Wood Adhesives* are under development as replacements for formaldehyde adhesives used today in OSB and plywood. These would reduce VOC emissions at major processing plants making building products and sheet materials consumed in home building.

#### **Contact:**

United Soybean Board  
St Louis, MO  
Phone: 888-235-4332  
www.unitedsoybean.org

#### Innvironments Organic Wall Coverings

*Innovations* has produced a revolutionary new line of organic wall coverings that create a new direction in the surfaces industry. The line of wall coverings is created entirely from natural resources or environmentally attractive products.

The organics, including coffee, adzuki bean, green tea, charcoal, and mugwort are transformed into particle form and applied to cellulose backing. Its other line is Paper-Weaves, developed from cellulose paper, washed with

pearlized translucent color using powder from mineral mica. Both lines are amazingly creative, fresh, and environmentally friendly wall coverings or surface solutions.

#### **Contact:**

Innovations  
New York, NY  
Phone: 1-800-227-8053  
Email: samples@innovationsusa.com  
www.innovationsusa.com/  
innvironments.html

### Waste Stream Reuse

These technologies take advantage and put to use waste stream material that otherwise is thrown away. They have been reused in part or in whole in applications that solve problems for another industry.

#### Extensive South African Study on Waste for Usable Construction Products

CSIR Boutek, a national agency in South Africa, aligns R&D with current and future needs in South Africa, bringing the latest technology to bear on applied solutions. Among the materials research is an extensive study of waste materials turned into construction products.

#### **Contact:**

Theuns Knoetze, Programmer  
Phone: +27-12-841-4985  
Email: tknoetze@csir.co.za  
Neo Moikangoa, Div. Director  
Phone: +27-12-841-3763  
Email: nmoikang@csir.co.za  
www.csir.co.za

#### Solid Waste Used as Synthetic Aggregate

The University of Calgary developed Terra-Bond, a process which encapsulates any form of solid waste (contaminated soil, sand, mine tailings, ash, slag, mineral, and refinery wastes) and binds their contaminants to produce an inert aggregate. This inert aggregate (a patent is pending in the U.S. and Canada) is then available for use in most any masonry, landscaping, or concrete mix application. This waste stream reuse

**Solid Waste Used as Synthetic Aggregate,**  
continued

technology also reduces the impact of mining natural aggregate from gravel pits, river bottoms, and other open excavation processes.

**Contact:**

Hugh Jones, VP of UTI  
University of Calgary - University  
Technologies International  
Calgary, Alberta  
Phone: 403-270-7027  
Email: jonesh@uti.com  
www.uti.ca

**Coating from Shellfish  
Protects Materials**

This unique solution was derived watching and wondering how the delicate body of a shellfish stays protected in harsh conditions. The technology is an environmentally attractive, water-based coating made from extracted components of crushed shellfish. This coating protects metals and other common substrates from corrosion and moisture damage. It is harmless to the environment and puts to use a by-product of the seafood processing industry, which is thrown out today.

**Contact:**

Peter Genzer  
Brookhaven National Laboratory  
Phone: 631-344-3174  
Email: genzer@bnl.gov  
www.bnl.gov/bnlweb/pubaf/pr/  
bnlpr082399.html

**Eco Floors**

Made from recycled rubber, this durable flooring is used in retail and commercial environments. It makes use of old tires. It is manufactured in tiles that are odor-free, and flexible in design. It could be used in places where ceramic tile is found today for a softer, environmentally friendly floor surface.

**Contact:**

Phone: 1-877-ECO-SURF  
Email: EcoSurfaces@Dodge-Regupol, Inc  
www.regupol.com/comm/ECOSurf.htm

**Composite Housing System Uses  
Thirteen Tons of Waste Glass**

The ACE awards, one of the composites industry's best new applications, went to the Ambiente Housing System made completely of composite

materials. It is billed as hazard-resistant housing, designed to resist hurricanes and withstand earthquake forces. It also claims to be fire and flame resistant. With no timber or steel in the home, it's made entirely from recycled glass core material, generating no production waste in the manufacturing process. This housing system has superior thermal and sound characteristics, is low maintenance, durable, and long lasting.

Raw waste glass is processed into honeycomb-like material, then cast into a composite of resin and fiber. This technology uses non-degradable waste. It uses 13 tons of waste glass per house, that is waste that would have gone to landfill.

This system is affordable, durable (20-year warranty), reduces damage from natural hazards, and is environmentally responsible and friendly. Ambiente has turn-key manufacturing plants developed. This technology has direct potential application for advanced wall panel systems and whole house systems.

**Contact:**

Malcolm Parish, Director  
Ambersham Technology Group  
Ambiente Housing  
Luquillo, Puerto Rico  
Phone: 787-889-1362  
Email: ambiente@prtc.net  
www.ambientehomes.com

**Edible Packaging Can be Consumed**

Edible packaging material technology that is being developed for the food packaging industry could rapidly be applied across other industries. This consumable packaging, under development at the U.S. Department of Agriculture, Agricultural Research Center in Albany, CA, could eliminate much of the packaging going to landfill. Developer Tara McHugh created the packaging from pureed fruits and vegetables, dried and formed to a thin sheet.

Current work is looking at consumable modifiers that adapt the packaging to various property needs in different packaging applications. The packaging can be consumed by people or more likely by animals instead of being thrown away. If applied to other industries, it brings new meaning to "eating on the job." You could open up a whole new animal-based clean-up crew for jobsites.

**Contact:**

Tara McHugh  
U.S. Dept. of Agriculture  
Agricultural Research Center  
Albany, CA  
Phone: 550-559-6060  
www.pw.usda.gov



Courtesy: Pacific Northwest National Laboratory

**By studying shells, bones, and teeth, Pacific Northwest National Laboratory researchers developed a process that "grows" bone-like material on implants, such as the hip implant shown here, making them stronger and last longer.**

## Thermal and Moisture Protection

*This category outlines technologies that could be applied to thermal or moisture protection products to keep people more comfortable and protected from the elements. The technologies are from various industries and include NASA technology, which keeps people comfortable and protected in space.*

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## Thermal Technologies

### NASA Aerogels, Super Cryogenic Insulation

Aerogel, an aerosol-based super thin insulation technology, provides very high thermal properties with a very thin application. Aerogels can be applied in several forms. This technology holds potential in almost any building envelope application.

#### Contact:

Lew Parish, STAC Tech Counselor  
Southern Technology Applications Center (STAC)  
University of Florida  
Gainesville, FL  
Phone: 407-867-6373  
www.myflorida.com/stac

### NASA Heat Shield Protective Coatings and Insulation

Ames Research Center has developed protective coatings for ceramic materials which lower the surface temperature of a thermal coating. They reduce the heat transfer through the surface preventing the degradation of the underlying substrate. They also have very good impact resistance. The estimated cost is \$5 /square foot. This technology, developed for heat shields, can be applied to many other materials besides ceramics to convey heat away from a substrate.

These are lightweight, flexible, easily formulated, and environmentally safe (water based, no solvents). Potential applications include roofing for homes, especially in high fire danger areas. They could also be used for fireproof insulation, or as a siding product or paint coating to reduce summer heat gain.

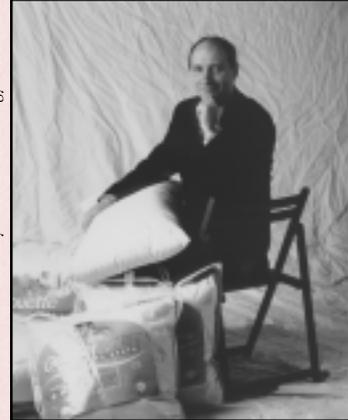
These technologies are also used to keep space travel comfortable and are transferable to solve insulation or thermal problems:

- Toughened uniPC fibrous insulation (TUFI)
- Composite flexible blanket insulation (CFBI)

#### Contact:

Phil Herlth  
NASA Ames Research Center  
Phone: 650-604-0625  
Email: pherlth@mail.arc.nasa.gov  
www.ctoserver.arc.nasa.gov:80/TechOpps/pccm.html

Courtesy: French Technology Press Office



Some examples of antibacterial, anti-dust mite and stain-resistant textiles for healthcare, such as covers and fillings for bedding (mattresses, duvets, pillows) from the French company Abeil.

### Super Therm Ceramic Paint Insulation

Developed in conjunction with a division of NASA, this technology contains several ceramic components. When applied as a coating to walls, roofs, etc., it will provide a non-toxic, non-flammable, durable coating that keeps heat out and conserves energy. The coating is water based and environmentally friendly. It is applied in spray or roller form. NASA is currently testing it on shuttle launch pads and external tanks.

#### Contact:

Jerry Pope  
Superior Products International  
6459 Universal Ave.  
Kansas City, MO 64120  
www.new-technologies.org/ECT/Civil/supertherm.htm

### NASA High-Tech, Low Temp Insulation

New lightweight metal alloy and ceramic insulation used for protection of the space craft during re-entry has been applied to mittens and gloves and emergency rescue blankets. A low density, honeycomb-like material was fabricated, capable of inhibiting convective and radiative heat transfer. This cloth-like honeycomb material can be fabricated to match the temperature range of the application it will face, so if you don't need it to withstand 2200°, like NASA, it can be fabricated to match more normal earthly temperature extremes.

**NASA High-Tech,  
Low Temp  
Insulation,**  
continued

Using the same honeycomb concept, NASA scientists and a private company, Thermolon, developed a lightweight, lower cost version of plastic insulation for blankets and clothing that has better properties than wool or polyester fleece. It is four times warmer; it dries faster; and the honeycomb structure doesn't trap moisture. The honeycomb insulation structure has even been made from recycled plastic or milk containers to demonstrate its environmental sense. Whirlpool Corporation is looking to use this moisture-tolerant alternative to replace CFC blown foam insulation that would make refrigerators even more energy efficient and environmentally responsible.

**Contact:**

Malcolm Webster  
Technology Liaison  
National Technology Transfer Center  
316 Washington Avenue  
Wheeling, WV 26003  
Phone: 304-243-2543  
Email: mwebster@nttc.edu  
www.nttc.edu

**3M Thermal Barrier Nextel**

This application of technology in auto racing reduces heat transfer from the engine, exhaust, and track surface. Nextel delivers a flexible insulating barrier against high temperature. It can be made into tiles, textiles, or wraps. It is also used in the burners of high efficiency hot water tanks reducing nitrogen oxide emissions by as much as 85 percent.

**3M Metal Matrix Composites**

3M has developed a high performance, high strength, metal matrix composite material used to reinforce aluminum and its alloys. This non-magnetic, low-density material has the

strength of steel at a fraction of the weight and has excellent performance at high temperature.

**3M Thermal Insulation**

This application absorbs sound in high-noise areas and provides excellent thermal properties. The 3M Acoustic Composite Sheet Material (ACM) – a ceramic composite that is lightweight and can be cut, fabricated, shaped, or molded to nearly any configuration. It is also fire resistant and retains its physical properties up to 400 degrees F.

It comes in sheets 4'x4' and thickness from 1 inch to 3 inches.

**Contact:**

Bronwen Kleissler  
Phone: 651-736-6930  
brkleissler@mmm.com  
www.3m.com

**Performance Technologies  
from the Textile Industry**

**High-Tech Fabrics for Clothes**

Developed by French technologists, several fabric technologies bring more function to clothes. One textile technology allows jackets to become warmer as temperatures drop. Another technology makes T-shirts with ceramic fibers to repel ultra-violet rays. A third technology impregnates clothing with a chemical that wards off insects. Any of these have application potential for protecting occupants of homes.

**Contact:**

French Technology Press Office  
Chicago, IL  
Phone: 312-222-1235  
www.consulfrance-chicago.org/french/english/sciencetechnology.htm

**Intelligent Textiles**

► Cambrelle Extreme is an exceptionally warm textile which keeps radiant heat in, while it wicks away moisture harmlessly. This superior thermal and moisture management system is found in footwear and other outerwear;

► Thermolite Extreme is unsurpassed in warmth per unit of weight, and it's extremely durable. It is applied most often in high performance outdoor gear;

► CoolMax and ThermoStat performance fibers are worn by Olympians and race car drivers to control moisture and regulate temperature; and  
► NoMax Fibers are flame resistant fibers for race suits. They provide superior flame resistance in various locations.

These DuPont textile technologies hold potential for many building envelope products, components, and systems.

**Contact:**

DuPont Technology Transfer Office  
Phone: 877-881-9787  
www.dupont.com/insulations/product/thermoextreme.html

**Breathable Coating Technology**

Several companies, including W.L. Gore, employ the latest in breathable fibers and textiles. These textiles permit moisture to pass through one way and keep heat in. Gore Tex, well known in the outdoor business, could be applied to housing to solve similar moisture management problems that it did in outdoorwear.

**Contact:**

W.L. Gore & Associates  
Elkton, MD  
Phone: 800-455-2791  
www.gore.com

A European Company with a textile called Breathe performs the same function— keeping heat in, keeping rain out, while allowing moisture to pass through from the inside.

**Contact:**

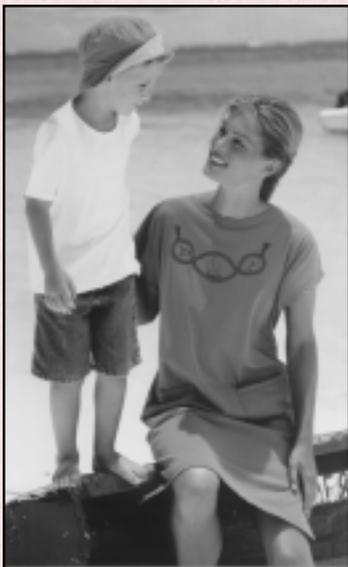
UCB Sectar Chimique  
Belgique, UK  
Phone: +32-2-334-5111  
www.search.ucb-group.com/default.cfm?UCBC

A third company, StedFast, makes StedAir, a moisture barrier used by firefighters to keep them comfortable, letting moisture out, keeping heat away, and keeping them dry inside.

**Contact:**

StedFast Moisture Management Systems  
Phone: 888-673-8441  
www.stedfast.com

**Damart's  
anti-UV, heat-  
reflective tee  
shirts for men,  
women, and  
children.**



**A blanket  
made of  
Rhovyl AS+  
fiber with  
antibacterial  
and anti-dust  
mite  
properties  
(from Rhovyl).**

## Indoor Environmental Quality

**Indoor environmental quality includes technologies that hold potential for improving the various aspects of indoor living quality: indoor air quality, water quality, health, and comfort quality.**

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## Water Quality

### Water Purification - BioClear

BioClear is an inexpensive, chemical-free process for purifying water. It was originally developed for the defense industry and NASA. It is technology that is migrating to the recreation industry and holds potential for clean water systems development in the housing industry.

#### Contact:

Natural Water Technologies  
Atlanta, GA  
Phone: 401-303-0068  
[www.nctn.hq.nasa.gov/innovation/Innovation56/water.htm](http://www.nctn.hq.nasa.gov/innovation/Innovation56/water.htm)

## Comfort Quality

### Intelligent Rooms

This technology allows a room to respond to verbal commands for information or give users related information the user didn't think to ask for but might need or find useful. It begins to automate the comfort aspects of indoor living and gives users of the room easier command of their environment to meet their specific criteria.

#### Contact:

Howard Shrobe, Director of Artificial Intelligence Lab  
MIT  
Phone: 617-253-7877  
Email: [hes@w.ai.mit.edu](mailto:hes@w.ai.mit.edu)  
[www.ai.mit.edu](http://www.ai.mit.edu)

### Embedded Technologies in Houses

As a connected technology to the project above, this technology makes a house responsive and reactive to environmental influences, much like the human body does. As the body automatically adjusts itself to the surrounding conditions, so, too, would the house. Embedding thinking chips, sensors, and other control devices will allow homes to anticipate, adjust, and react to changes around it.

#### Contact:

Chris Luebke  
Assistant Professor  
MIT  
Email: [chrisl@mit.edu](mailto:chrisl@mit.edu)  
[www.web.mit.edu/newsoffice/mr/1998/house.html](http://www.web.mit.edu/newsoffice/mr/1998/house.html)

## International Joint Venture Indoor Comfort

Canada and Japan collaborated to provide improved ventilation in houses. The joint venture focused on the development of international standards for non-forced air systems. Japan's Building Research Institute (BRI) has built a test house using alternative systems. Testing, data collection, and experiments are done jointly, with exchange of ideas and information to find better alternatives for indoor home comfort.

The collaborative effort is investigating thermal comfort and noise reduction for mechanical ventilation systems. The agencies will bring findings to manufacturers, designers, and regulatory agencies in an effort to create better ventilation and indoor air quality strategies than are currently used.

#### Contact:

National Research Council of Canada  
Institute for Research in Construction  
Dr. James Reardon  
Phone: 613-993-9700  
Email: [james.reardon@nrc.ca](mailto:james.reardon@nrc.ca)  
[www.nrc.ca/corporate/english/index.html](http://www.nrc.ca/corporate/english/index.html)

## Building Control Systems and Micro HVAC Systems

Pacific NW National Laboratory, Material Resources Group, is researching advanced controls, low-cost, highly reliable long-life sensors, automated diagnostics, and advanced micro-scale HVAC technology. The micro-scale HVAC technology consists of compact heat pumps, miniature heat actuated compressors, and a micro-channel heat exchanger. This technology could make automation control available on a miniaturized scale.

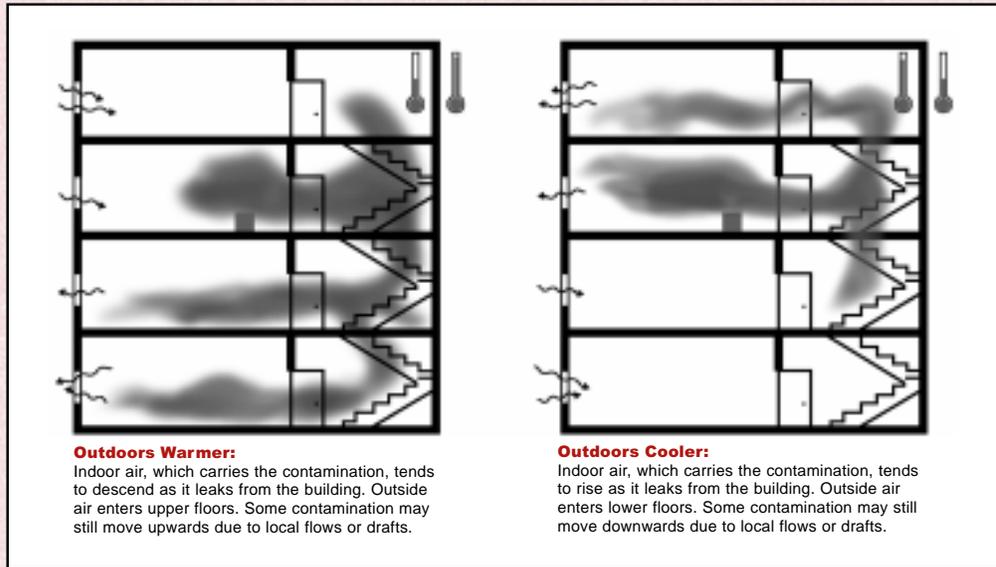
#### Contact:

Bernie Saffell  
Pacific NW National Laboratory  
Richland, WA  
Phone: 509-372-4565  
Email: [bf\\_saffell@pnl.gov](mailto:bf_saffell@pnl.gov)  
[www.pnl.gov/microcats](http://www.pnl.gov/microcats)

**Information for  
FIRST RESPONDERS TO AN  
INDOOR CHEMICAL  
RELEASE**

**Ventilation System OFF**

Flows depend strongly on wind and on the indoor-outdoor temperature difference, especially when windows are open.



Courtesy: Lawrence Berkeley National Laboratory

## *Air Quality*

### Indoor Pollutant Sources Study

LBNL has a large research program on the indoor environment, including air distribution and ventilation in commercial and residential buildings, chemistry and physics of indoor air pollution, air flows and pollutant transport within buildings, and exposures to airborne pollutants and resulting health risks.

Although this research program is not funded to answer questions about the above topics from home builders, building owners and the general public, the researchers maintain a useful website where the visitor can identify existing publications in journals, in conference papers, and as LBNL reports. It is then possible to request copies of specific publications from LBNL.

The website of the Indoor Environment Department is:  
<http://eetd.lbl.gov/ied.html>

**Contact:**

Lawrence Berkeley National Lab  
Email: RCDiamond@LBL.GOV

### Intelligent Air Quality Monitoring

The Idaho National Engineering and Environmental Lab has a project, which integrates embedded sensors and micro-systems to detect, measure, and analyze indoor air quality. They then use the information to make necessary adjustments in the HVAC system to meet pre-determined parameters for indoor air quality. (Project reference INEEL-4)

**Contact:**

Idaho National Engineering and Environmental Laboratory  
Idaho Falls, ID  
Phone: 800-708-2680  
Email: info@inel.gov

### “Displacement Ventilation” Indoor Air Quality

Sponsored by ASHRAE, this is an approach to ventilation that improves indoor air quality while saving energy. “Displacement ventilation” provides cleaner air with greater comfort while reducing the amount of air needing heating or cooling. It is an alternative method to move hot or cold air in a structure.

**Contact:**

Professor Quingyen Chen or Leon Glickman  
MIT  
[www.architecture.mit.edu/research/bt/iaq\\_fdv.html](http://www.architecture.mit.edu/research/bt/iaq_fdv.html)

### Materials Produce No Out-gassing

Materials that produce no out-gassing in closed system environments (like the space station) can significantly improve indoor air quality. In outer space, it's critical to survival. Applied to homes on earth, it creates healthier living spaces. Any gasses given off materials can dramatically affect the air quality of the space station. Materials NASA is researching in various applications include glass textiles, non-porous composites, non-toxic adhesives, and material surfaces that do not promote bacterial growth. They are also researching materials which will assist in low noise propagation.

**Contact:**

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