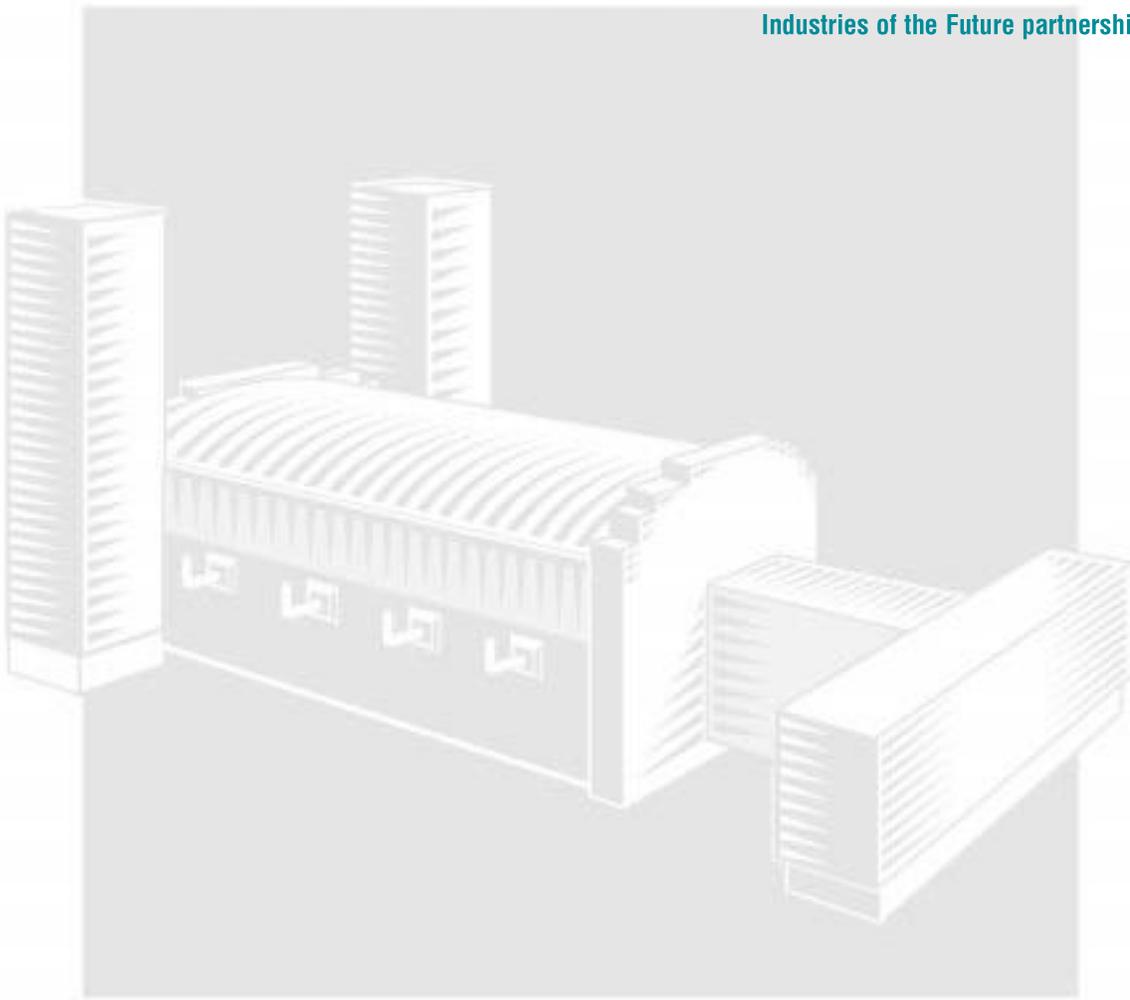


glass

Glass — Industry of the Future



The glass industry is developing, demonstrating, and deploying advanced technology as a result of active participation in the Industries of the Future partnership.



Office of Industrial Technologies



Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

partnership

Why work together?

By adopting the Industries of the Future strategy and remaining actively engaged in all aspects of the Office of Industrial Technologies' partnership, the glass industry today enjoys:

- A powerful common voice through the Glass Manufacturing Industry Council (www.gmic.org)
- Clearly defined technology priorities and goals
- Expanded resources for R&D
- Increased collaboration among researchers, including national laboratories and universities
- Cleaner, more energy-efficient technologies and processes to boost glass-making productivity now and revolutionary process development for the future

Unified industry launches collaborative partnership

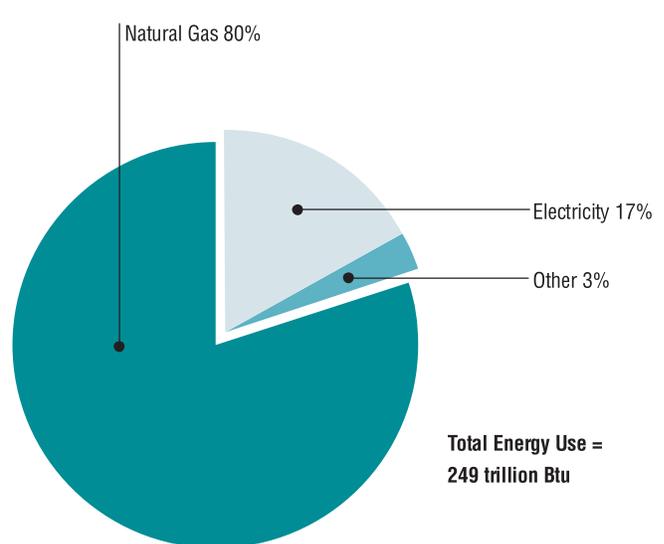
The U.S. glass industry is a world leader in the production of flat, fiber, container, and specialty glass products. With annual shipments of slightly more than 20 million tons, valued at \$27 billion, the industry employs 150,000 people and has significant operations in numerous states. The high temperatures required to melt sand and other materials make the glass industry one of the most energy-intensive industries in the manufacturing sector.

In 1996, leaders in the glass industry joined in a unique partnership with the U.S. Department of Energy's Office of Industrial Technologies (OIT) to foster the development and use of advanced technologies and processes. The partnership was unique since at the time there was no single organization that represented the entire glass industry. The Industries of the Future partnership has helped effectively position the U.S. glass industry for continuing prosperity while advancing national energy efficiency and environmental goals.

"The American glass industry can continue to lead the international community in the sustainable development and production of glass products in an ecologically responsible manner."

Glass: A Clear Vision for a Bright Future

Energy Sources for Glass



The glass industry relies predominantly on natural gas to meet its energy needs.

Source: EIA, MECS, 1994



Industry drives the process

The U.S. glass industry is actively implementing the Industries of the Future strategy through the leadership of the Glass Manufacturing Industry Council (GMIC)—which was formed in 1998 as a result of the partnership activities and which represents all sectors of the glass industry. By reaching consensus on common goals and

priorities, the industry has created a powerful force for attracting and guiding public and private investment in new technology development. As successes occur, the partnership is taking an active role to ensure advances are made available to the industry—while continuing to pursue other promising technologies.

Vision

Glass: A Clear Vision for a Bright Future

The 1996 document established long-term goals and broad research priorities based on key business, market, and environmental trends.

Roadmap

Industry-led subcommittees working through the GMIC interact regularly to refine research priorities, issue proposal requests, rank recommended proposals for funding, and review ongoing projects.

Implementation

To date, OIT has provided cost-shared support for around 25 R&D projects proposed by collaborative partnerships to address industry-defined priorities and meet national goals for energy and the environment.

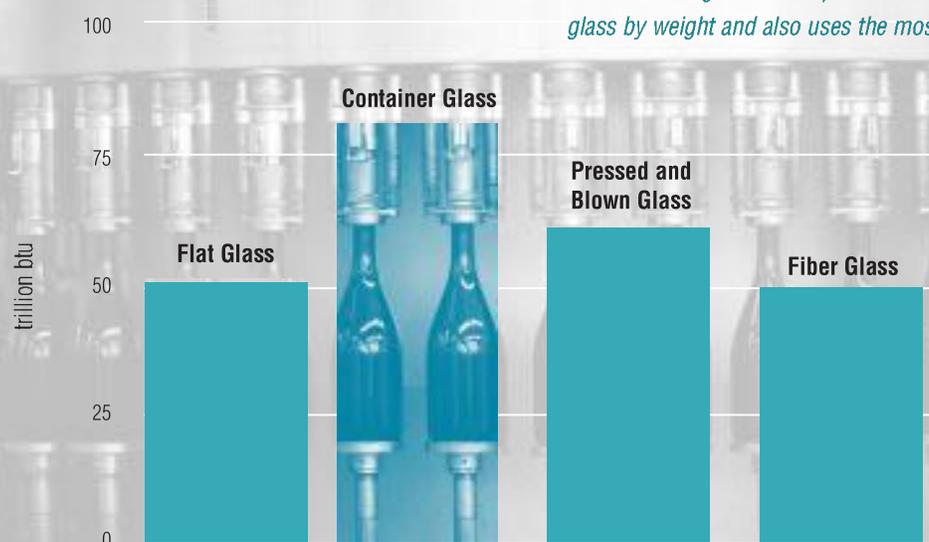
Renewed Commitment

The industry reaffirmed its commitment to the partnership by signing a second compact with DOE in 1999, which emphasized the role that the GMIC would have in implementing the partnership.

Benefits to local communities and the nation:

- A cleaner environment
- Improved national energy security
- Reduced emissions of gases implicated in global climate change

Glass Industry – Energy Use by Sector



The container glass sector produces the most glass by weight and also uses the most energy.

Source: EIA, MECS, 1994



Improving industry performance

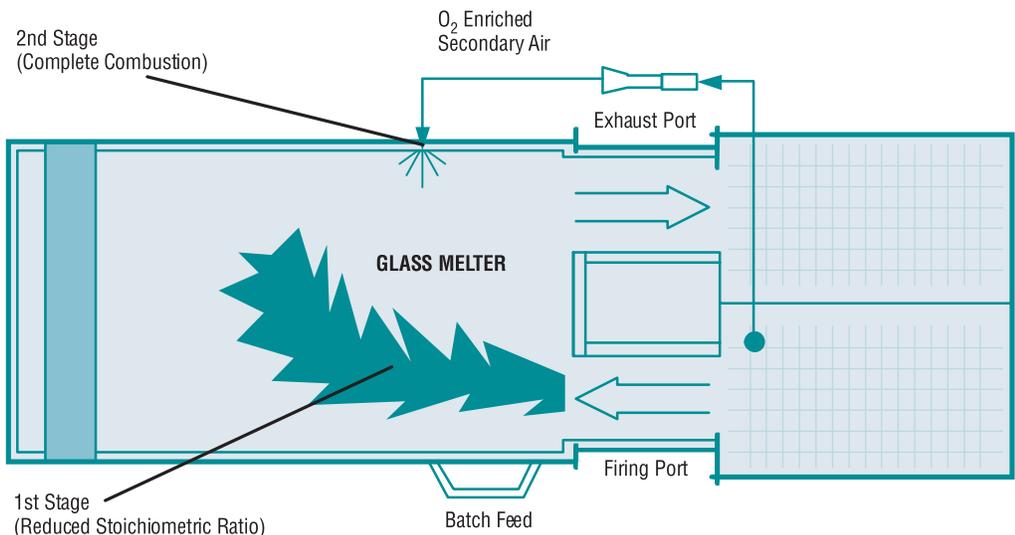
OIT awards cost-shared support to projects that will improve the glass industry's energy efficiency and global competitiveness, based on industry-defined priorities and recommendations. Collaborative teams from industry, national laboratories, suppliers, universities, and other organizations share the costs and risks of R&D.

To date, OIT's Glass Team has supported approximately 25 projects, worth a total of \$22 million in OIT funding. The industry cost-share has been about \$10 million. A majority of the projects relate to the glass furnace—which easily accounts for the largest share of energy use in glass processing and is used in all sectors of the glass industry.

Demonstrating success

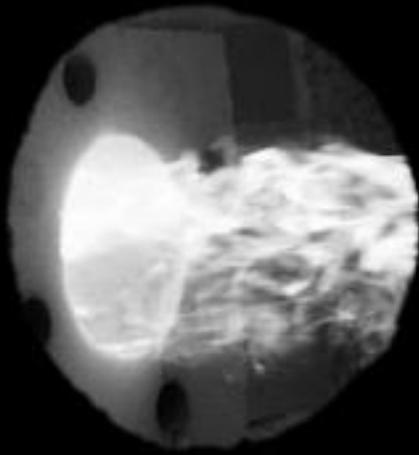
Of the technologies supported by the partnership to date, two have already become commercial successes, and three others are currently in the demonstration phase, attaining promising results. Among commercial successes, Oxygen-Enriched Air Staging is currently in use at several container glass plants and has a measured reduction in NO_x emissions while maintaining consistent quality and increasing productivity. Another commercial success, an Advanced Combustion Space Model, has been licensed for distribution and is currently in use in three glass sectors to analyze potential impacts of combustion system adjustments and evaluate furnace designs.

Oxygen-Enriched Air Staging Concept for Endport Furnaces



To date, OIT's Glass Team has cofunded about 25 projects addressing a broad spectrum of industry priorities. A representative listing is shown on facing page.

Oxygen-Enriched Air Staging uses a two-stage process to reduce NO_x formation. The amount of air entering the furnace is reduced, which not only reduces NO_x formation but also yields incomplete combustion. Therefore, oxygen or oxygen-enriched air is injected into the furnace near the exhaust port to complete combustion and heat release.



High-Luminosity, Low-NOx Burner

Partners have developed a novel burner that increases luminosity and radiant heat transfer. It will increase thermal efficiency and reduce energy use. The burner has reached the commercial demonstration stage. Partners in the project are Gas Technology Institute, New York State Energy Research and Development Agency, Combustion Tec, and Owens Corning.

Pursuing industry priorities

Through the Glass Team, industry plays a central role in focusing near-term and long-term research investments. Industry-led subcommittees for four technical focus areas—Production Efficiency, Energy Efficiency, Environment, and Innovative Uses—work with DOE to conduct solicitations, merit reviews of all incoming proposals, and technical reviews of all ongoing RD&D projects. OIT makes the final selection for new R&D awards based on ranked lists from these subcommittees.

In addition, the partnership has created an innovative program—known as GPLUS—for glass manufacturers belonging to the GMIC. Through this program, individual companies work directly with the national laboratories on industry-defined projects that tap the unique capabilities offered in the national laboratory system.

Research and Development Projects

Percentage of Total Energy Use by Glass Industry

7%

54%

25%

14%

Batch Preparation and Charging

Integrated Batch and Cullet System Measurement and Control of Glass Feedstocks
In-House Recovery and Recycling of Glass from Glass Manufacturing Waste

Melting and Refining

Molybdenum Disilicide Composites for Glass Processing Sensors
Redox State Sensor Technology in Glass Melts
Diagnostics and Modeling of Corrosion of Superstructure Refractories in Oxy-Fuel Glass Furnaces
Glass Furnace Combustion and Melting Test Facility
Development and Validation of a Coupled Combustion Space/Glass Bath Furnace Simulation
Improved Refractories for Glass
Development of Advanced Combustion Space Models
High-Luminosity, Low-NOx Burner
Modeling of Glassmaking Processes
Monitoring and Control Technologies in Glass Melting Furnaces

Forming

Auto Glass Process Control
Advanced Process Control for Glass Fabrication

Finishing

Enhanced Cutting and Finishing of Handglass
Online Sensor System for Monitoring the Cure of Coatings on Glass Optical Fibers and Assemblies
Development of Process Optimization Strategies, Models and Chemical Databases for On-Line Coatings of Float Glass
Integrated Ion Exchange Systems for High-Strength Glass Products

Visit www.oit.doe.gov/glass to learn more about the projects in OIT's Glass portfolio.

resources

Coordinated assistance for today and tomorrow

OIT awards approximately \$4 million annually to new and ongoing cost-shared projects that benefit the glass industry. Awards are based on a competitive solicitation process open to collaborative industry teams and the national laboratories as prime contractors. Universities and other organizations can participate on the collaborative teams.

OIT's Glass Team supplements its own R&D budget by coordinating activities with other OIT programs that can help advanced glass industry goals. OIT's program in Sensors and Controls, for example, has funded the development of a process control system using sensor fusion. OIT's Steel Team also funds R&D in high-temperature processing, some of which is adaptable to the glass industry. Emerging technologies gain credibility through demonstrations funded under OIT's NICE³ (National Industrial Competitiveness through Energy, Environment, and Economics) program.

OIT programs of value to the glass industry include research and development of **Enabling Technologies**, **BestPractices** initiatives, and **Financial Assistance**.



Enabling Technologies

OIT works with industry, the national laboratories, academia, and others to research, develop, and commercialize enabling materials that can benefit a wide range of industries, including glass. In **Industrial Materials**, the focus is on new and improved materials and coatings. The MPLUS program assists industrial users in accessing national laboratory resources in materials. Efforts in **Combustion** target clean, cost-effective technologies that will improve energy efficiency, reduce emissions, and enhance fuel flexibility while increasing productivity. Research in **Sensors and Controls** addresses such challenges as improving sensor reach and accuracy in harsh environments and providing integrated, on-line measurement systems for operator-independent control of glass-making operations in real time.



Plant-wide assessment at Anchor Glass Container Corporation

Anchor Glass Container Corporation was recently selected for a cost-shared, plant-wide assessment as a result of a competitive OIT solicitation. Anchor Glass plans to assess major end uses of steam, motors, cogeneration, and heat recovery at two plants—one in Jacksonville, Florida, and the other in Warner Robbins, Georgia.



BestPractices

Through the BestPractices program, OIT helps glass manufacturers apply existing technologies to save money, cut emissions, and reduce wastes. OIT alerts companies to opportunities for funding, tools, expertise, and potentially applicable technologies in OIT's extensive portfolio of crosscutting products and services.

BestPractices also offers **plant-wide assessments**, helping manufacturers develop a comprehensive strategy to increase efficiency, reduce emissions, and boost productivity. Up to \$100,000 in matching funds is awarded for each assessment through a competitive solicitation process. Participants agree to a case study follow-up of results. Small to mid-sized manufacturers can take advantage of the **Industrial Assessment Centers** program, which provides no-charge assessments through a network of engineering universities.

Financial Assistance

Two Financial Assistance programs are offered by OIT to accelerate technology development and application. The **Inventions and Innovation** program awards grants of up to \$200,000 to inventors of energy-efficient technologies. Grants are used to establish technical performance, conduct early development, and initiate commercialization activities. The second program, **NICE**³, provides cost-shared grants of up to \$500,000 to industry-state partnerships for demonstrations of clean and energy-efficient technologies.

State-Level Industries of the Future

In addition, State-Level Industries of the Future programs are starting up in a number of states to bring the energy, environmental, and economic benefits of industrial partnerships to the local level.

For more information on these and other resources, please contact the OIT Clearinghouse at (800) 862-2086.

How to get involved

Through Industries of the Future partnerships, U.S. glass companies benefit from the competitive advantages of more productive and efficient technologies and contribute to our nation's energy efficiency and environmental quality.

To participate:

- *Monitor the OIT Glass Team's Web site for news and announcements of R&D solicitations, meetings and conferences, and research projects (www.oit.doe.gov/glass)*
- *Team with other organizations and respond to solicitations for cost-shared research*
- *Begin saving energy, reducing costs, and cutting pollution today by participating in any of the BestPractices programs.*
- *Take advantage of OIT's extensive information resources, including fact sheets and case studies, training, software decision tools, searchable CDs, newsletters, and publications catalog.*
- *Attend the biennial Industrial Energy Efficiency Symposium and Expo.*

www.oit.doe.gov/glass



For more information on the Glass Industry of the Future,
contact the OIT Clearinghouse at (800) 862-2086
or visit www.oit.doe.gov/glass

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov



Office of Industrial Technologies
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy



Printed with a renewable-source ink on paper containing at
least 50% wastepaper, including 20% postconsumer waste.

February 2001
DOE/GO-102001-1155