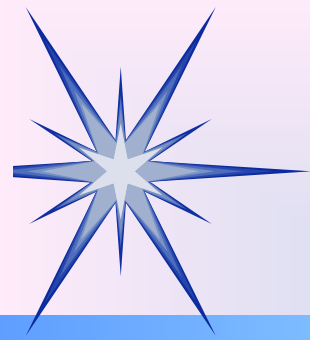


Innovations of Glass Melting Methods in USA

Glassman Europe
13 May 2009

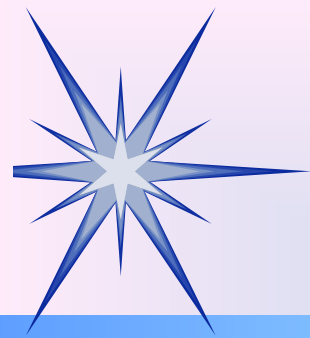


Michael Greenman
Executive Director



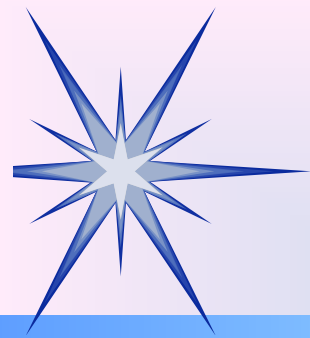
Outline

- Structure of GMIC
- Melting Technologies
- Additional Direction
 - Waste Heat Recover
 - Alternative Energy Sources



GMIC Membership

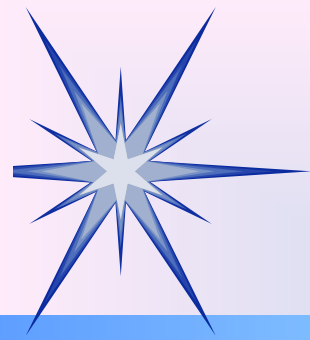
- Four Glass Categories (20) (2007 – International)
 - Container
 - Flat Glass
 - Fiberglass (Insulation and Textile)
 - Specialty
- Associate Members (22)
- University (11)
- Affiliate (13)
 - Individuals, Consultants, Small Research Groups



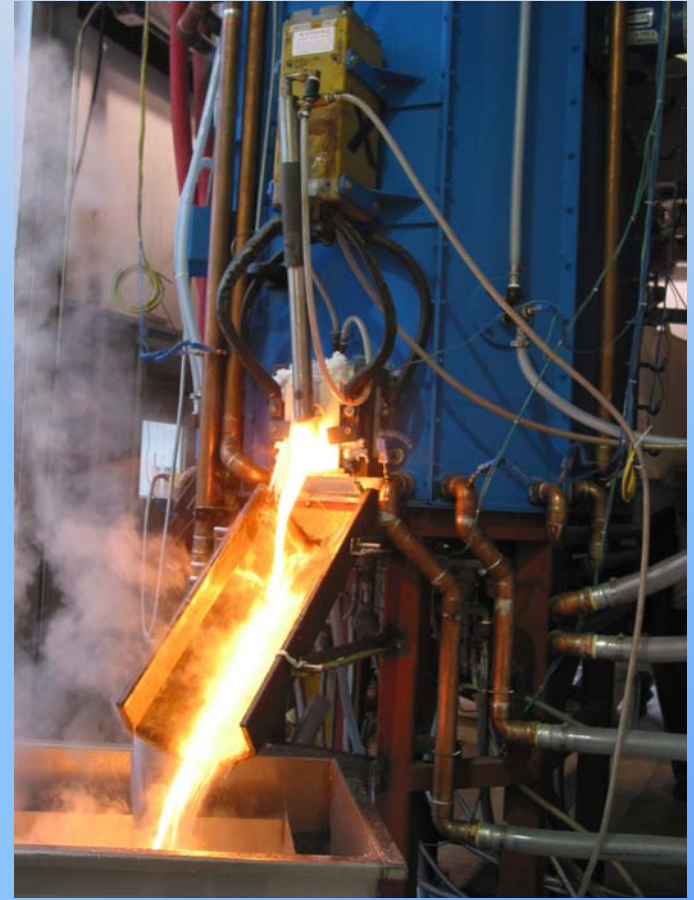
Submerged Combustion Melter

➤ Primary Features

- Metal Box – Watercooled Walls
 - Oxy-Fuel Burners
 - Low Capital Cost
 - (-60%)
 - Low Footprint
 - (6-8 X Pull Rate for equivalent area)
 - High Efficiency, Low Emissions
 - (20% more efficient)
 - High Flexibility
 - 4 hours hot to cold or cold to hot
 - New products, markets, business models
 - IMM – first commercial Application
 - Water Glass
- ## ➤ Work on Refining project

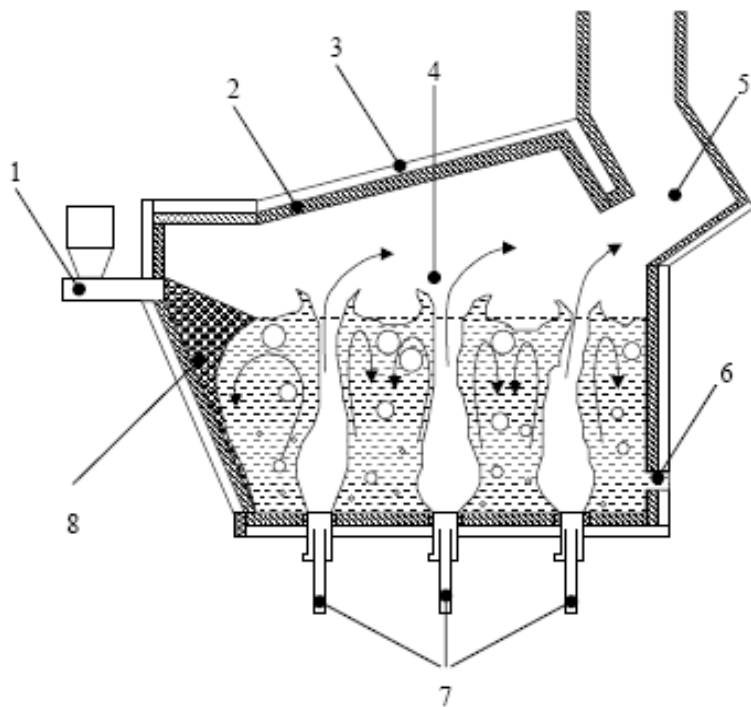


SCM – Pilot Melter

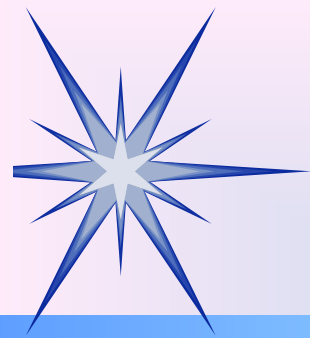


Submerged Combustion Melter

SCM Process

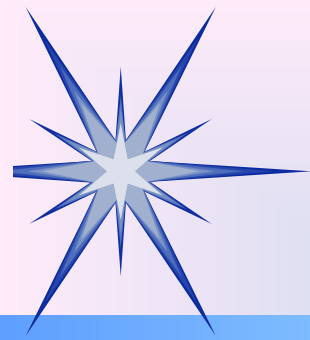


- 1- Batch charger;
- 2- Refractory lining;
- 3- Water cooled panels;
- 4- Melting zone;
- 5- Exhaust;
- 6- Melt outlet;
- 7- Submerged oxygas burners;
- 8- Batch material (sloped pocket of batch)



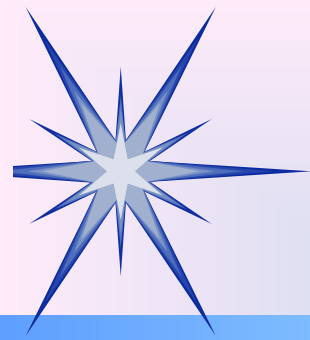
Cross-Cutting Applications

- Steel Industry – Electric Arc Furnace Dust
- Aluminum – Spent Aluminum Potliner
- Forest Products – Black Liquor Gasification
- Cement – Blended and Specialty Cements
- Chemicals – Sodium Silicate
- Waste Vitrification – Portable – Move to location
- Mineral Wool – Original Application
- Nuclear Waste Stabilization – Increase Cost-Effectiveness



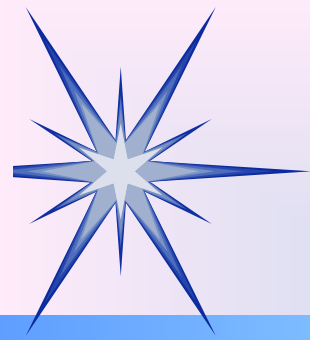
Indiana Melting and Manufacturing, LaPorte, IN





Melter Sidewall

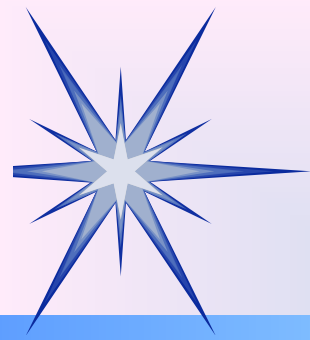




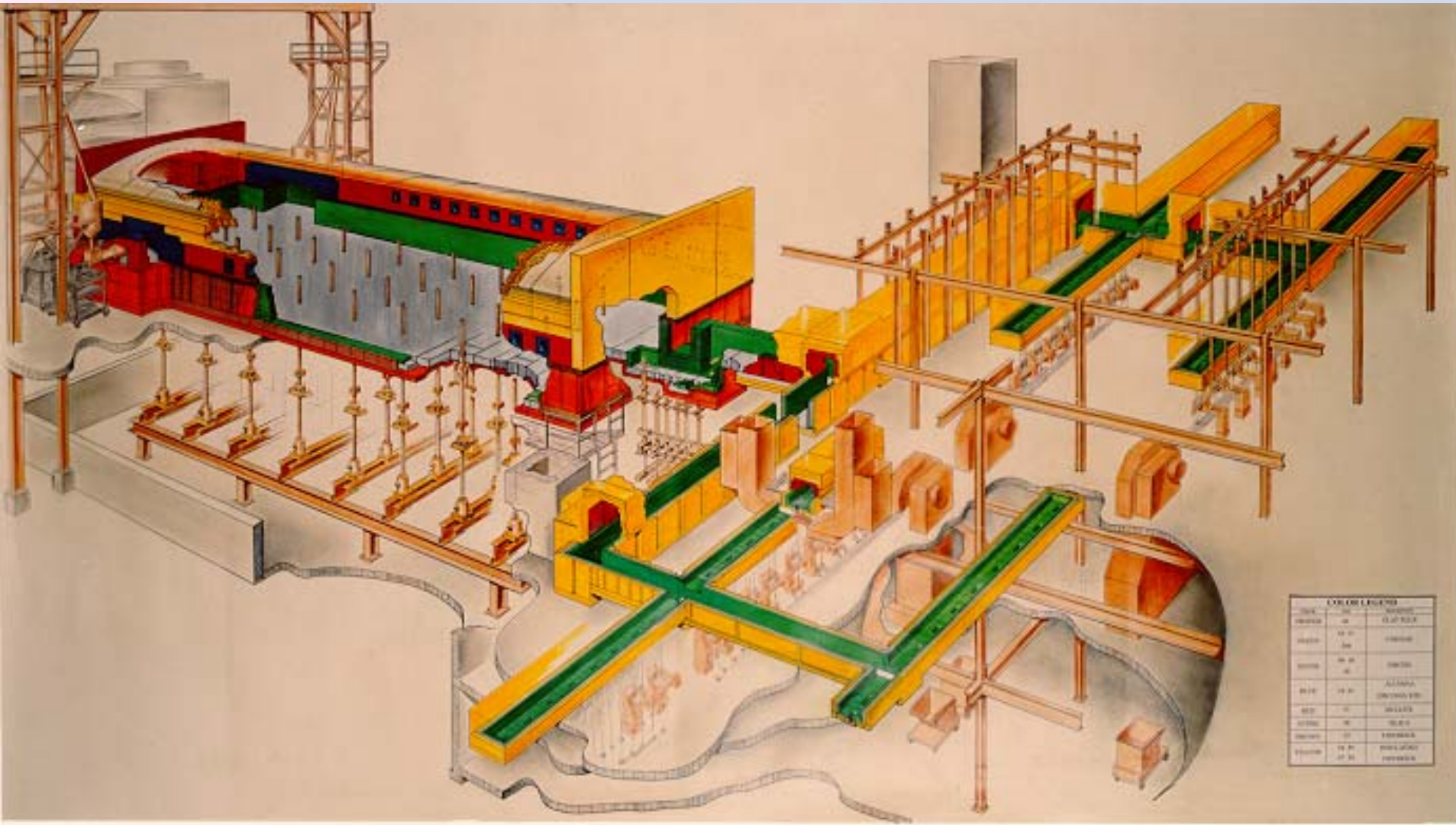
Additional Innovative Research Projects

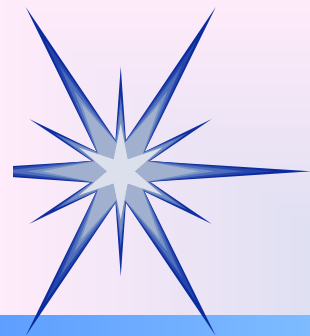
➤ Oxy-Fuel Front End





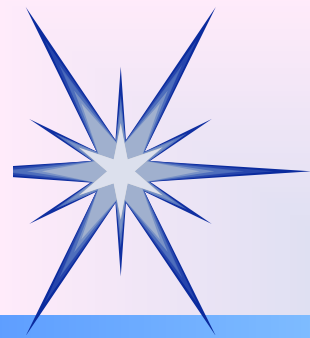
Development/Demonstration of Advanced Oxy-Fuel Front End





Additional Innovative Research Projects

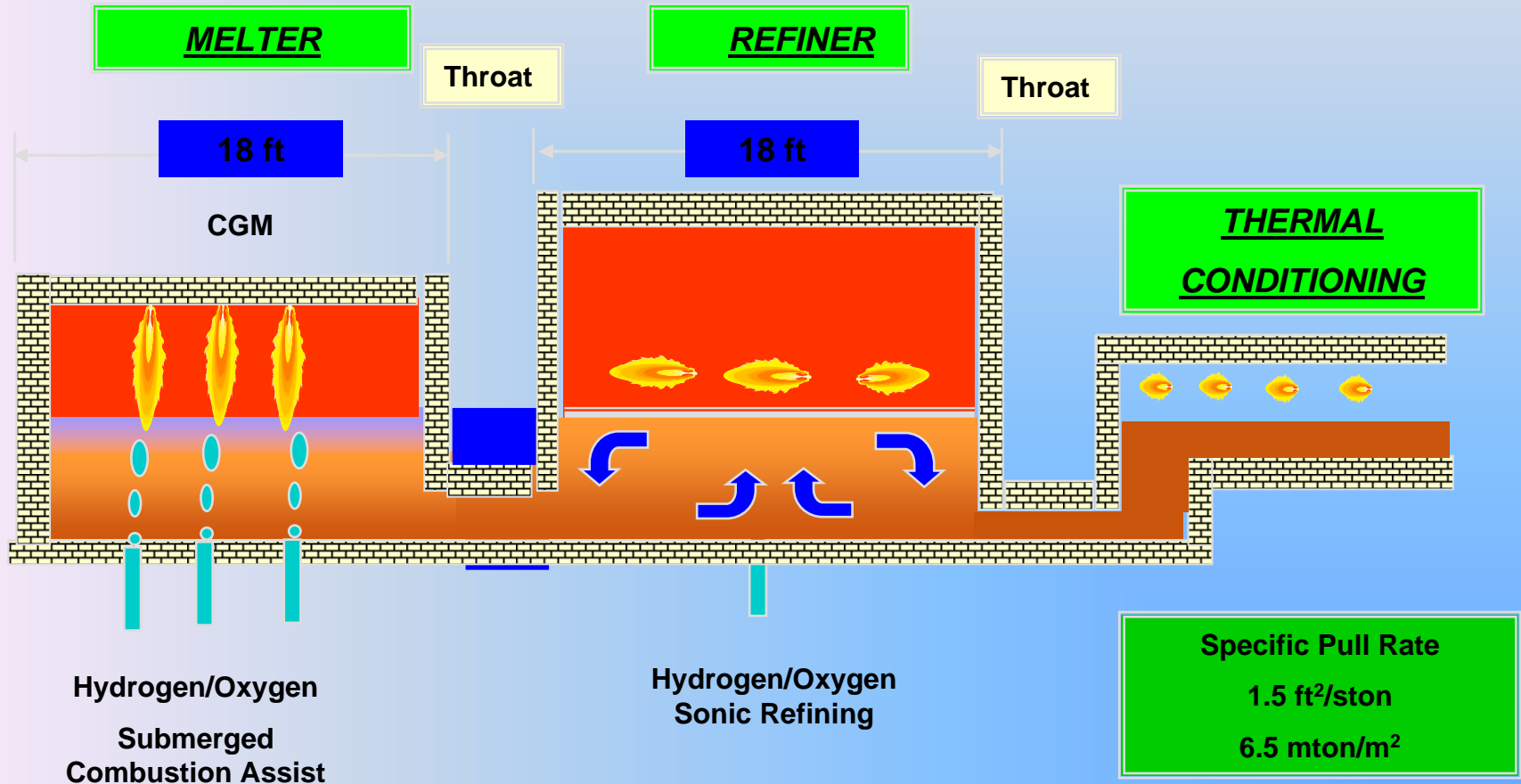
- Oxy-Fuel Front End
 - Fewer Burners
 - 61% Reduction in Total Energy Usage
 - 64% Reduction in CO₂ Emissions
 - No Adverse Impact on Productivity



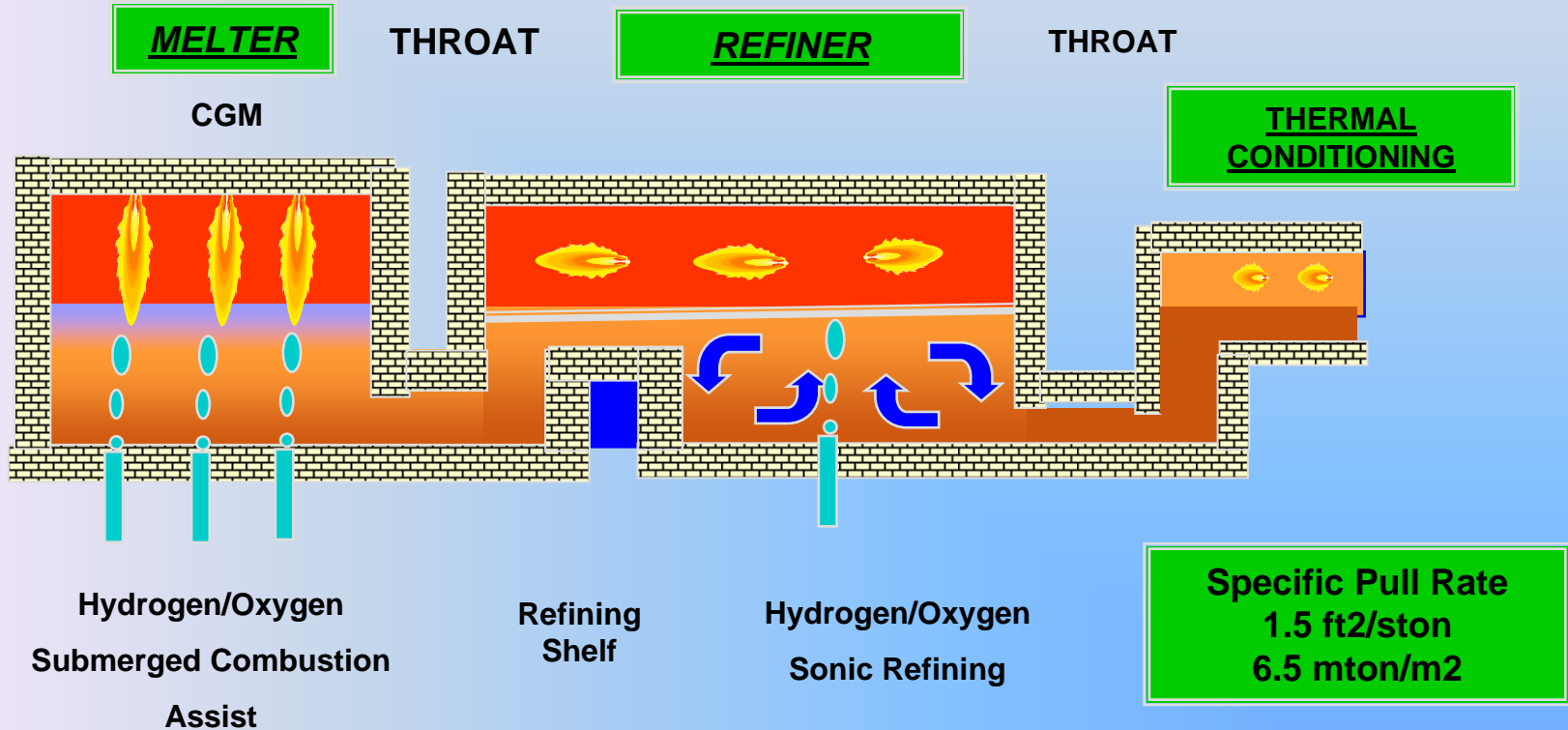
Proposed CGM Project

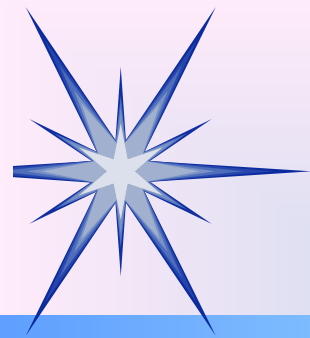
- Linde proposal – seeking partners
- Benefits of CGM combined with SCM
- Segmented design.■
 - Melter
 - Refiner
 - Thermal Conditioning
- Objective: increase pull of furnace by 100% for a given size.

High Performance Modular Design - 1



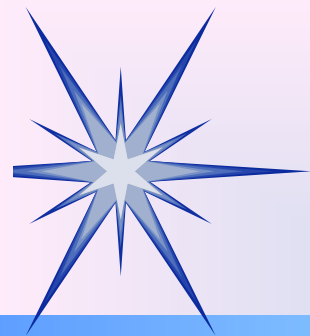
High Performance Modular Design - 2





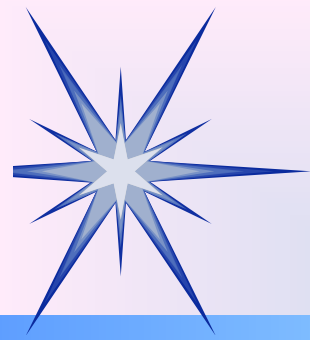
Expected Benefits

- Similar design as existing furnaces
- Convert with same footprint
- Energy reduction at lower capital cost
 - 10% energy reduction
 - 25% reduction in capital costs
- Double throughput



Strength of Glass

<u>Condition of Glass</u>	<u>lb/Square Inch</u>
➤ Surfaces ground and sandblasted	< 4,000
➤ Pressed Articles	3,000 – 8,000
➤ Blown Ware:	
➤ Hot Iron Molds	4,000 – 9,000
➤ Paste Molds	5,000 – 1,500 10,000
➤ Inner Surfaces	15,000 – 40,000
➤ Drawn tubing or rod	6,000 – 15,000
➤ Window Glass	8,000 – 20,000
➤ <i>LCD (0.65 mm)</i>	<i>~45,000</i>
➤ Annealed fibers	
➤ Annealed	10,000 – 40,000
➤ Freshly drawn	30,000 – 400,000
➤ Gorilla Glass (Apple iPhone)	100,000-200,000
➤ <i>Telecommunications Fiber</i>	<i>>100,000</i>



Glass Strength Contest

4,000 feet above the Colorado River, you'll find

Strength in *G* LASS

1st Prize: \$20,000
2nd Prize: \$10,000
3rd Prize: \$5,000

**So, What would
you do with
stronger glass?**

All glass Skywalk at the Grand Canyon allows visitors to look straight down at the Colorado River 4,000 feet below.

**Details and updates at
www.materialadvantage.org**

Please respond to: materialadvantage@materialadvantage.org

Submit your most innovative ideas for the desirable physical properties and economic qualities of glass. We'll select the top 100 entries.

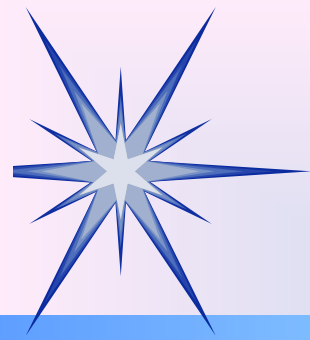
- What new applications can you imagine for this stronger glass?
- What impact will this stronger glass have on the environment?
- What about energy savings?
- What about environmental impact?
- How might such a discovery change our lives?

The Glass Manufacturing Industry Council, the Glass & Ceramics Materials Division of The American Ceramic Society, the Center for Glass Research, and the NSF International Materials Institute are sponsoring this contest with a total prize pool of \$30,000 for the best ideas submitted by students for new, innovative applications for glass based on a 50% improvement in the strength of manufactured glass. We are NOT asking for a description of HOW you would achieve the 50% strength enhancement. We rather what new products, engineering capabilities or cost savings would emerge if a stronger glass were available.

What's in it for me?

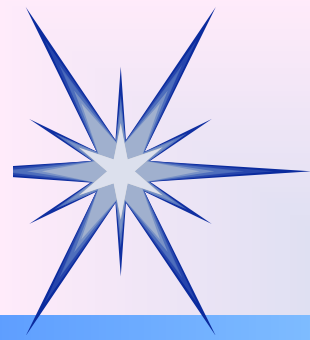
We share your innovative, creative... ideas with... others. In addition to the prize, your problem-solving, teamwork, leadership skills may also all be awarded.

Deadline for Entries: May 6, 2010

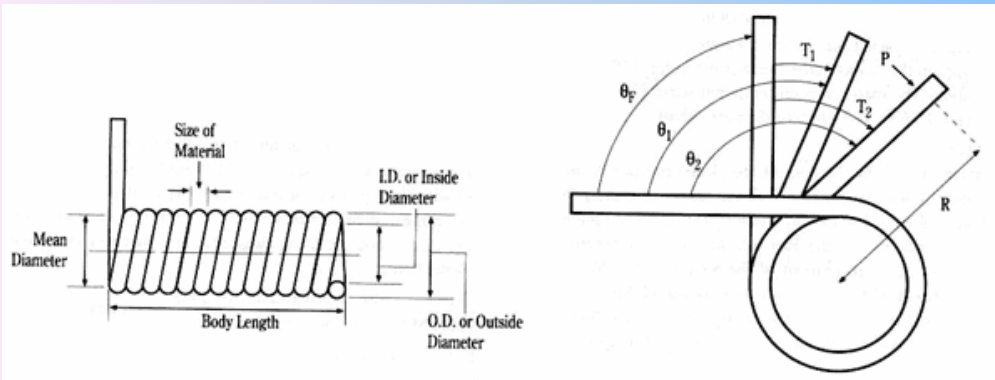
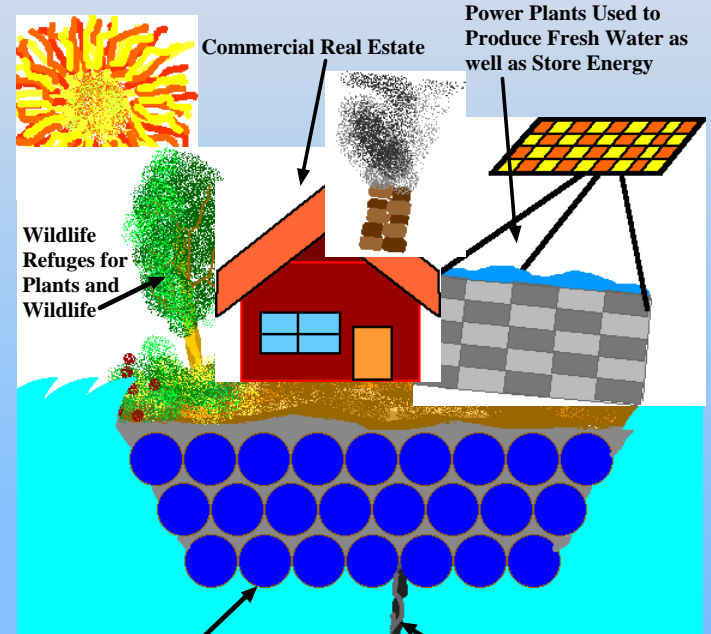


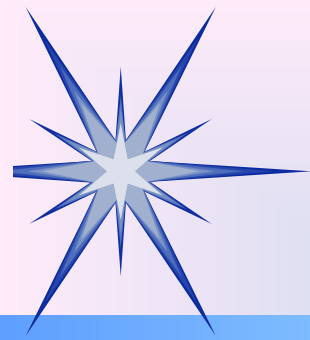
Possible New Markets for Ultra-Strong Glass

- Ultra-Thin film Solar Cells
- Energy Storage
- Glass Balloon Satellites
- Liquid Mirror Telescopes
- Structural Supports



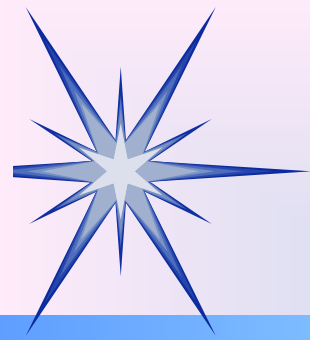
Ultra-Strong Glass





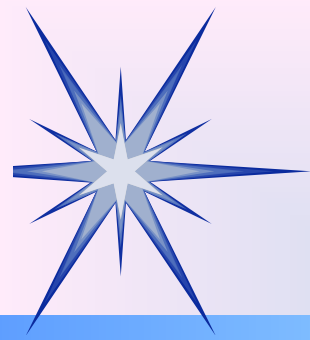
Glass Strength – Next Steps

- Bi-Annual Contest
- Meetings/Conferences
 - “Towards Ultrastrong Glass (Germany) – September 2008
 -
 - “Roadmap Brainstorming” conference (Europe) – Spring 2009
 - Global Conference – at PacRim/GOMD/ICG (Vancouver) – June 2009
- Brain Trust
 - Identify experts around the world with interest/knowledge in glass strength.
 - <http://glass-fracture.org>



Additional Developments

- Waste Heat Recovery
 - Pre-Heat Batch/Cullet
 - Distributed Generation
 - Glass Plant as Power Plant
- Solar Energy
- Alternative Fuels
 - Coal Gasification, Landfill Gas

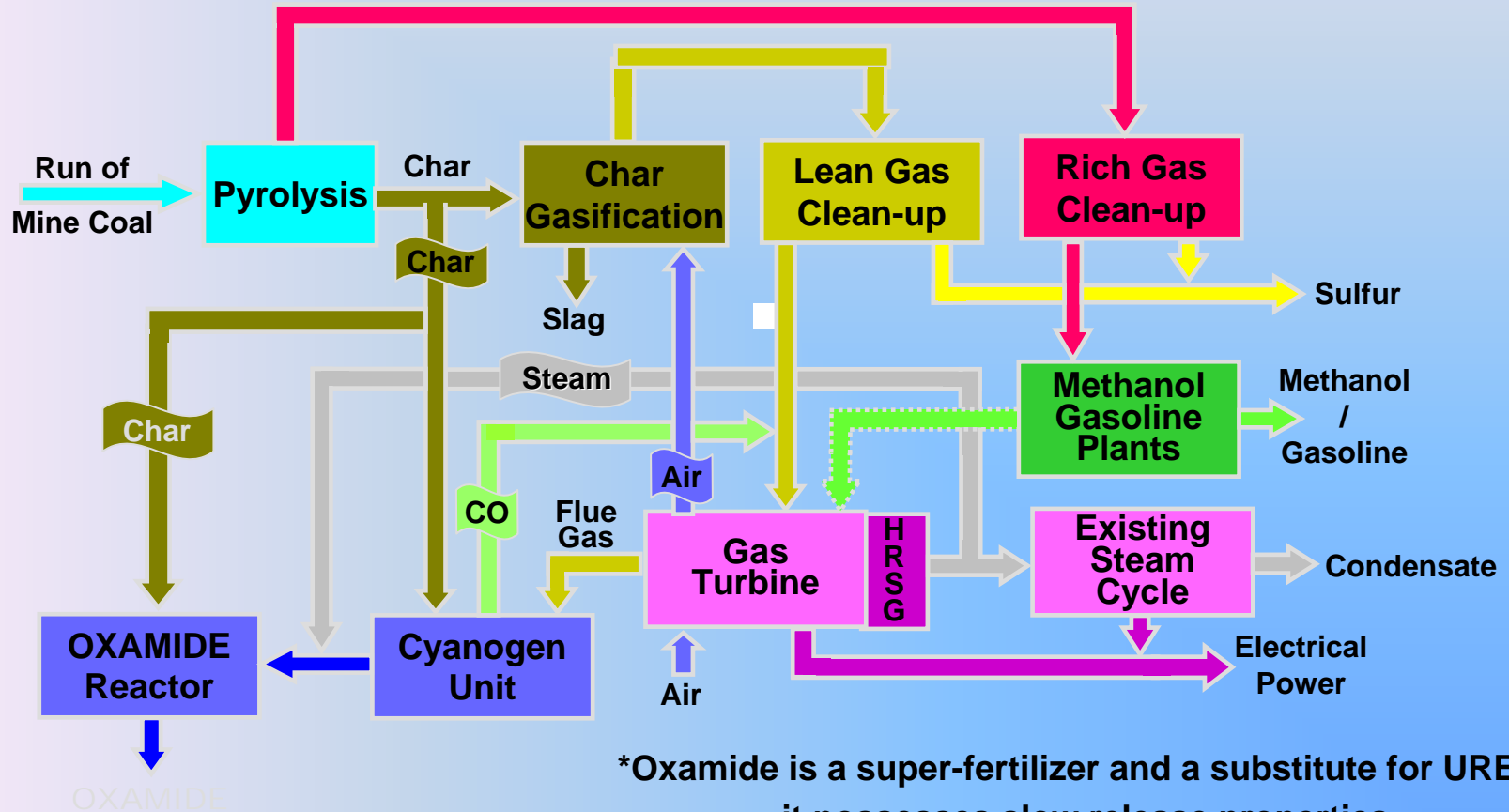


Calderon – Pilot Gasifier

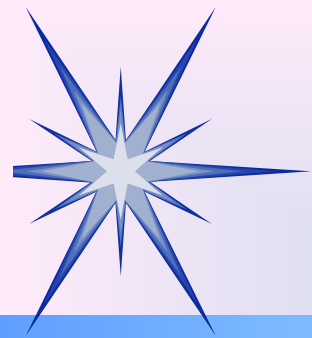


Repowering Existing Coal Burning Power Stations

Calderon Clean Coal Technology for the Co-Production Of Liquid Transport Fuel, Electric Power and Oxamide*



***Oxamide is a super-fertilizer and a substitute for UREA;
it possesses slow release properties**



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