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

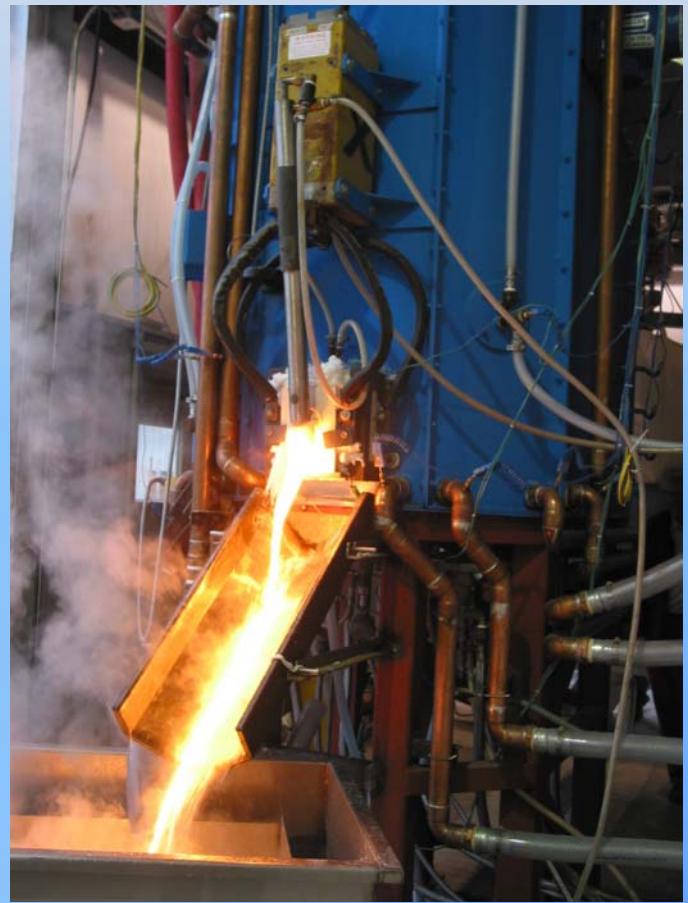
GMIC Membership

- 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

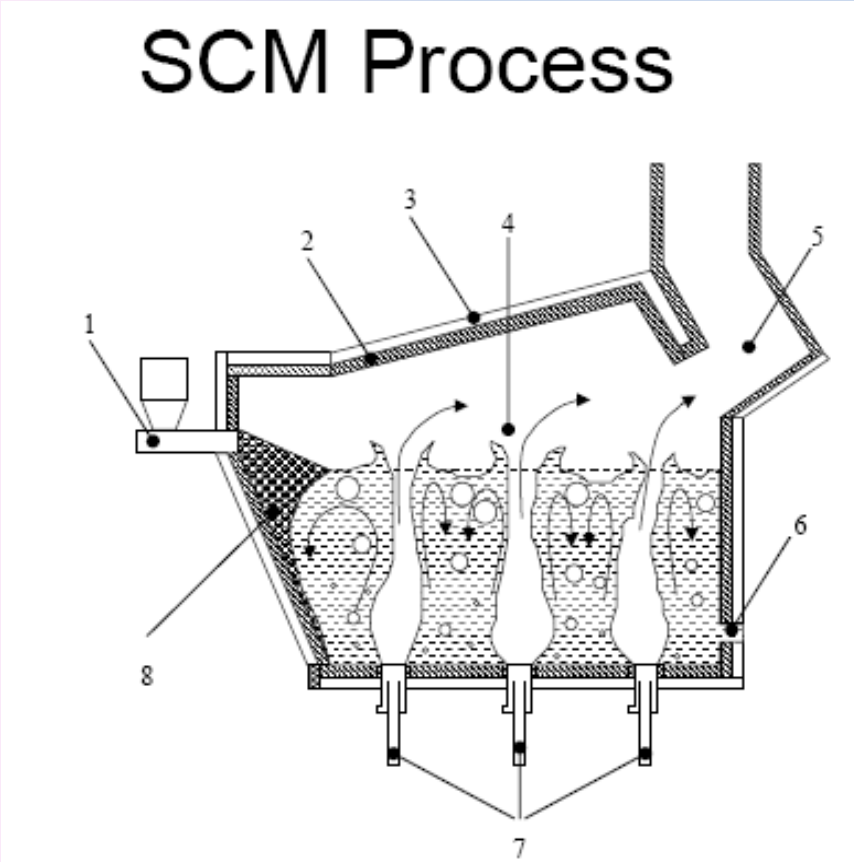
Submerged Combustion Melter

- 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



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

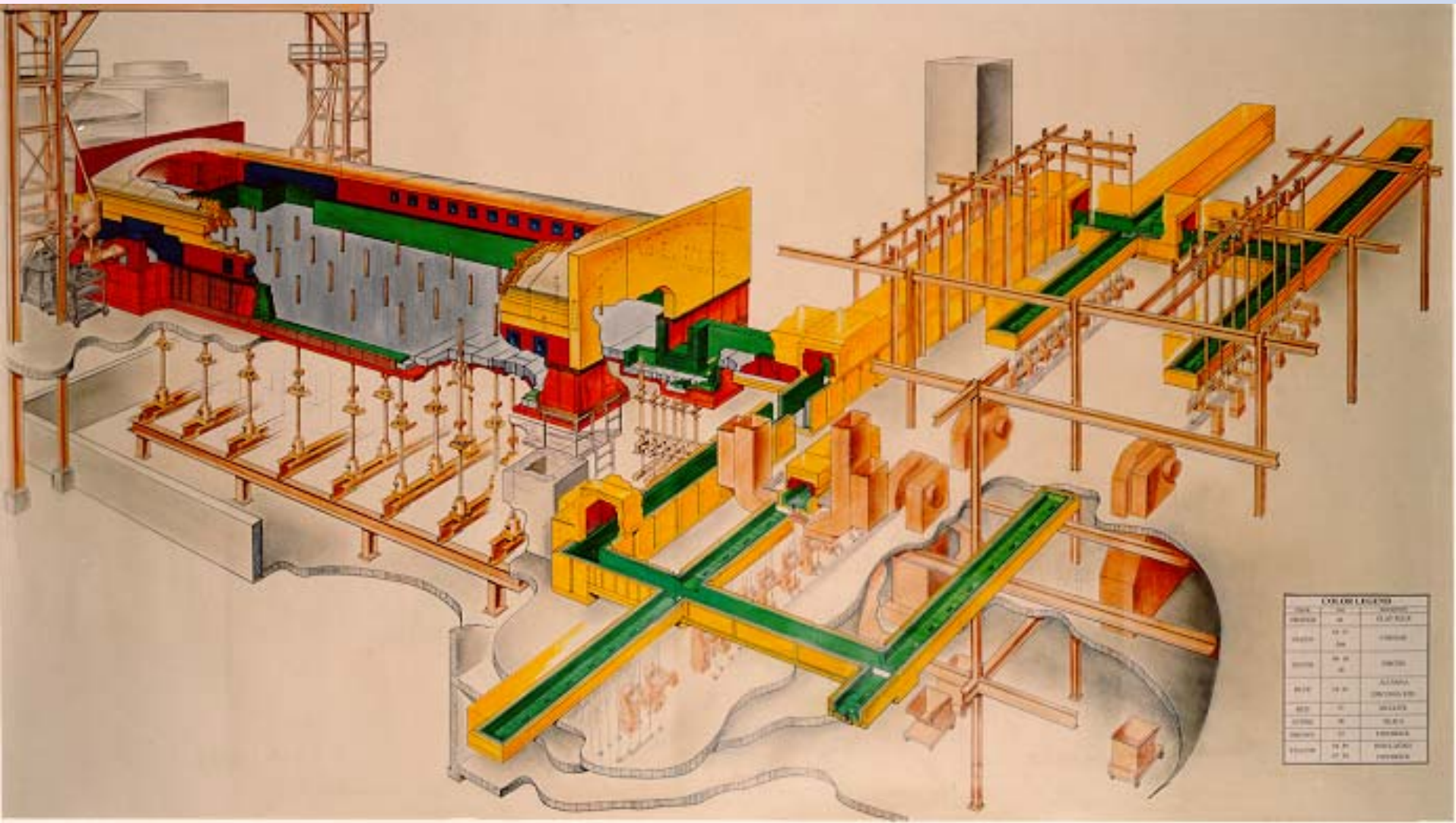
Indiana Melting and Manufacturing, LaPorte, IN

Melter Sidewall

Additional Innovative Research Projects

- Oxy-Fuel Front End

Development/Demonstration of Advanced Oxy-Fuel Front End



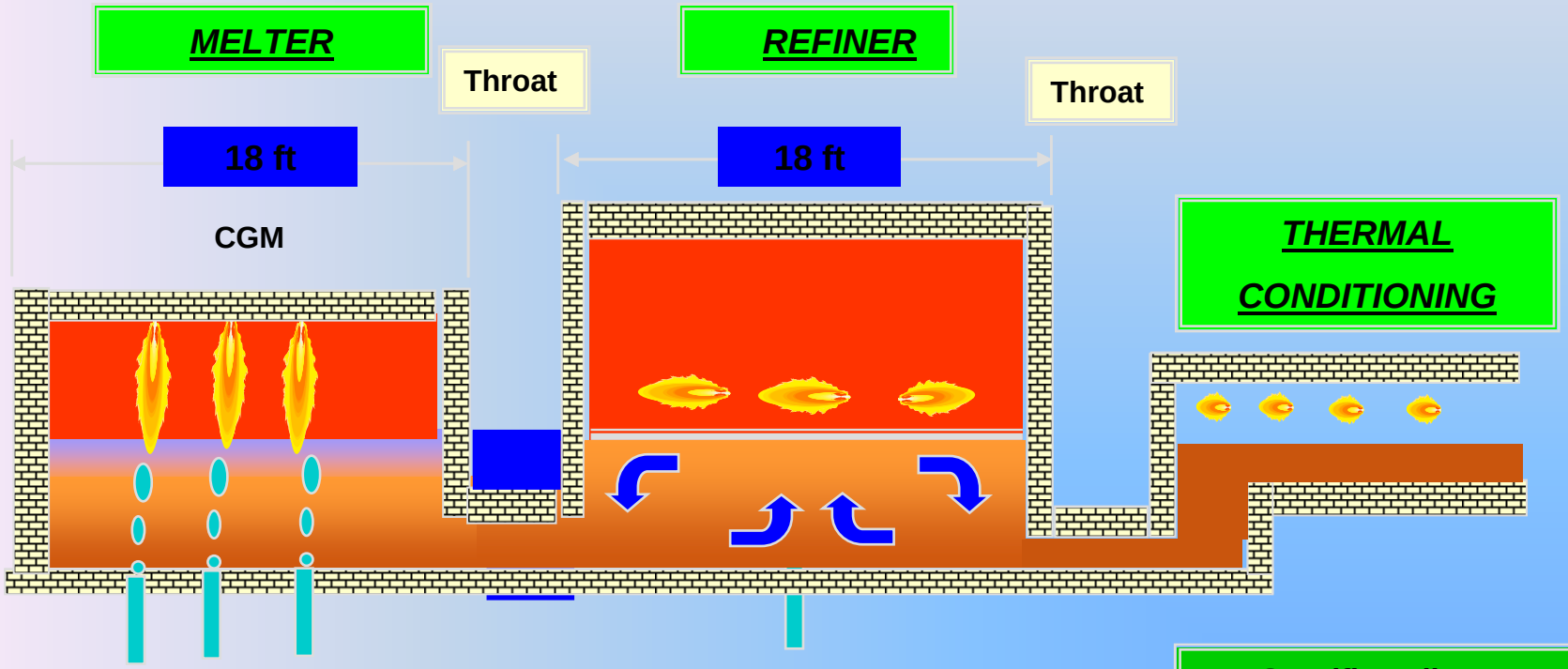
Additional Innovative Research Projects

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

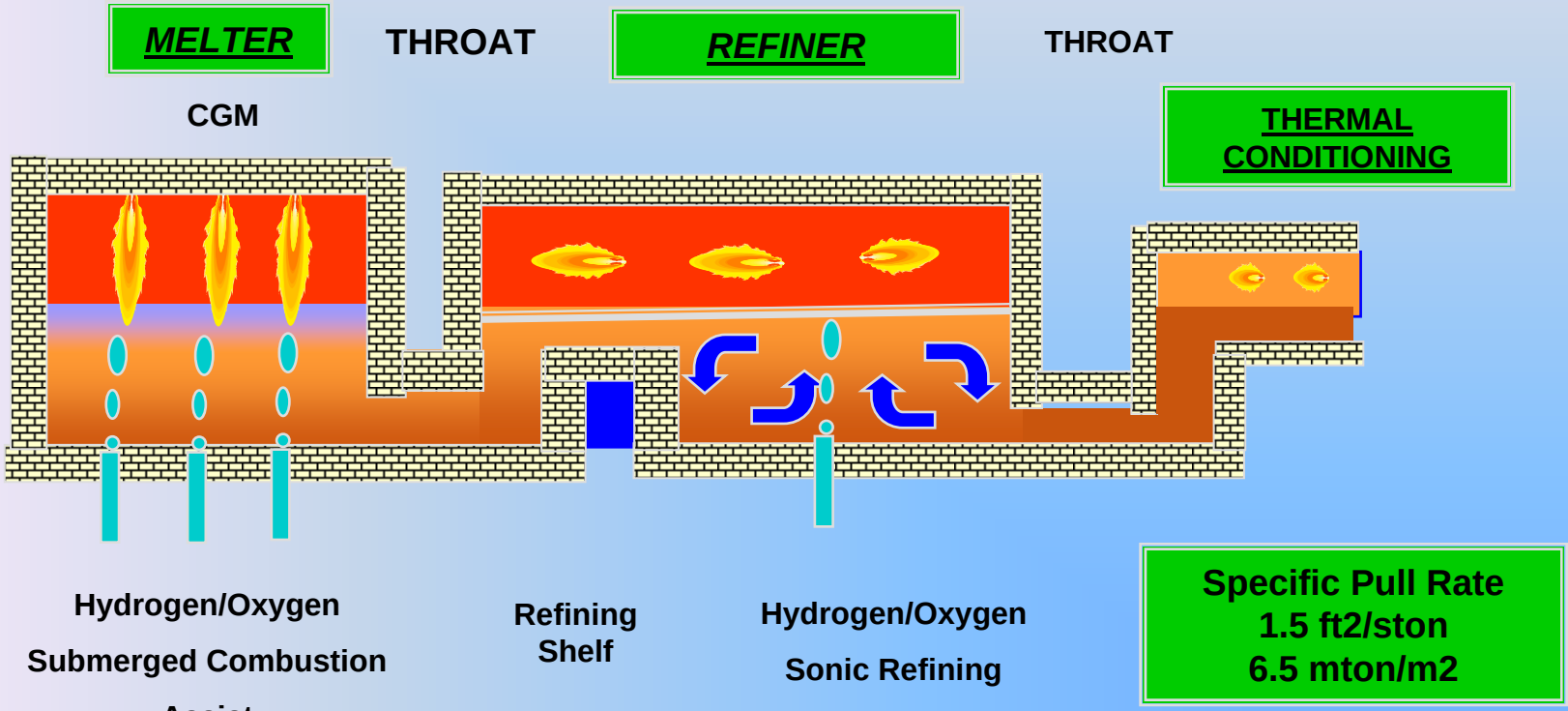
Proposed CGM Project

- 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

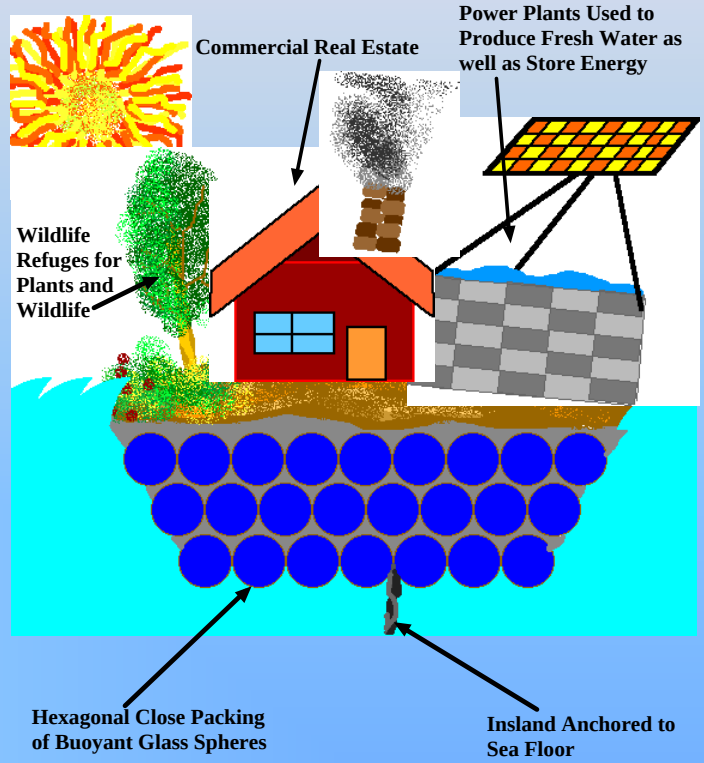
Condition of Glass	lb/Square Inch
Surfaces ground and sandblasted	< 4,000
Pressed Articles	3,000 – 8,000
Blown Ware:	
Hot Iron Molds	4,000 – 9,000
Paste Molds	5,000 – 1,500 10,000
Inner Surfaces	15,000 – 40,000
Drawn tubing or rod	6,000 – 15,000
Window Glass	8,000 – 20,000
LCD (0.65 mm)	*~45,000*
Annealed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

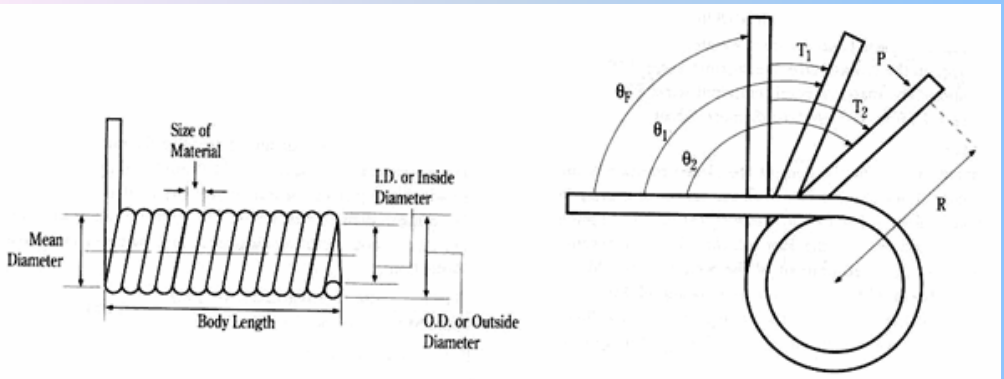
Glass Strength Contest

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

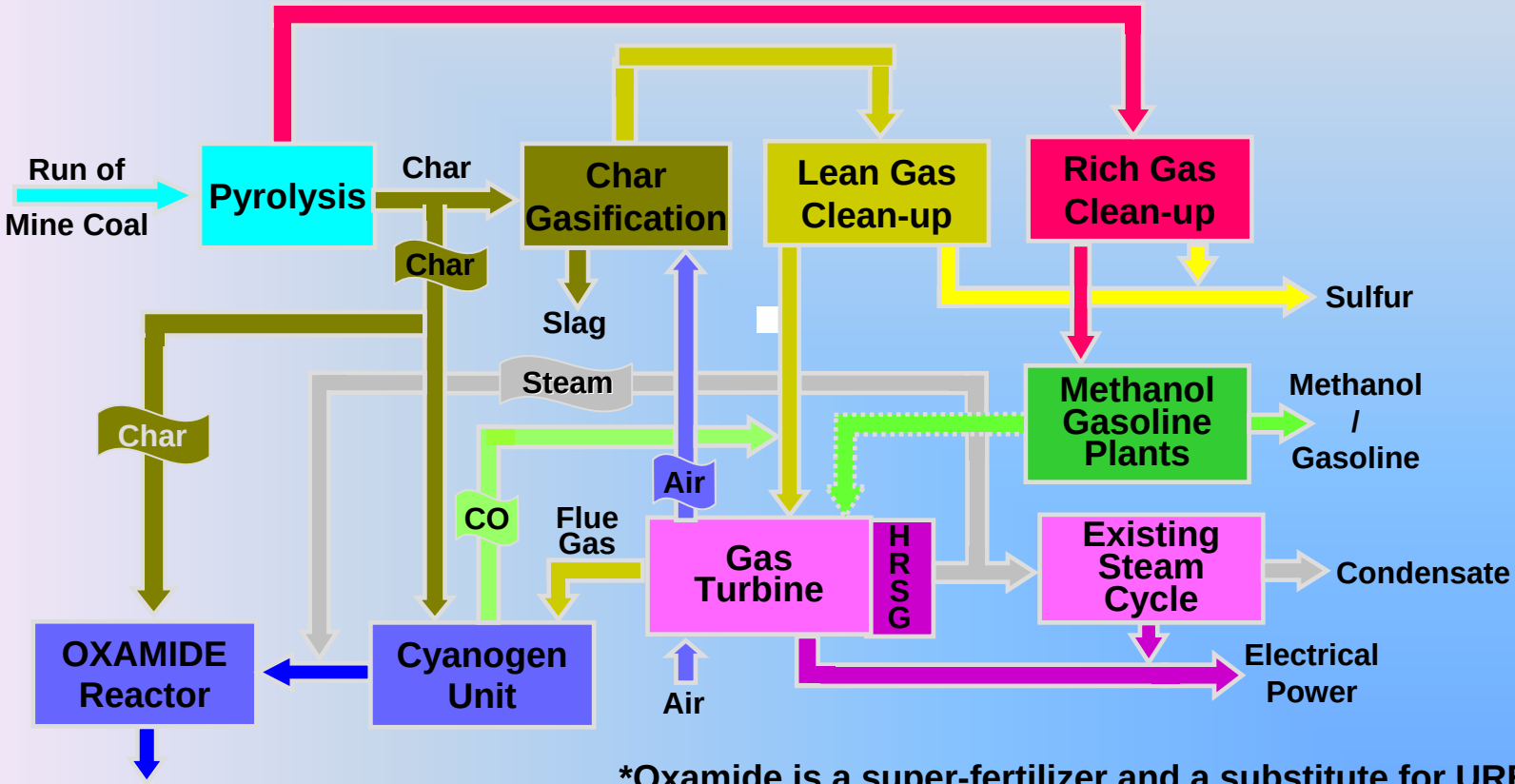
Additional Developments

- 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

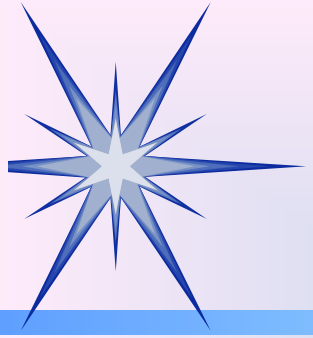
Repowering Existing
Coal Burning Power Stations

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**

Patents Issued; Other Pending



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+1-614-818-9423