

FGD Gypsum Use Progress & Opportunities

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Presentation for

McIlvaine Hot Topic Hour

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Innogyps Inc.

- Innogyps Inc. 1997- present
 - Promoting innovation and growth in the global gypsum industry
 - Internally develop new products/processes
 - Provide information relating to gypsum business development and technology trends
 - Provide consulting services
 - 150 clients over 15 years , many patents granted
 - International reputation in gypsum industry
 - Increasing involvement in gypsum from FGD in USA

Presentation today is primarily related to FGD Gypsum use

What is the problem?

- FGD scrubbers at coal fired power plants produce large quantities of coal combustion products (CCP), including **FGD gypsum**.
- Although utilization rates have grown, in most regions CCP supply exceeds demand creating **financial and environmental burdens for the power plants**.

What is gypsum?

Calcium sulfate dihydrate -
 $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

- Natural gypsum
 - selenite, alabaster, massive, gypsite
- Byproduct or Synthetic gypsum
 - Flue gas desulfurization (SO₂ + air + Lime)
 - Phosphogypsum, Titanogypsum, Fluorogypsum,
 - any neutralized sulfuric acid



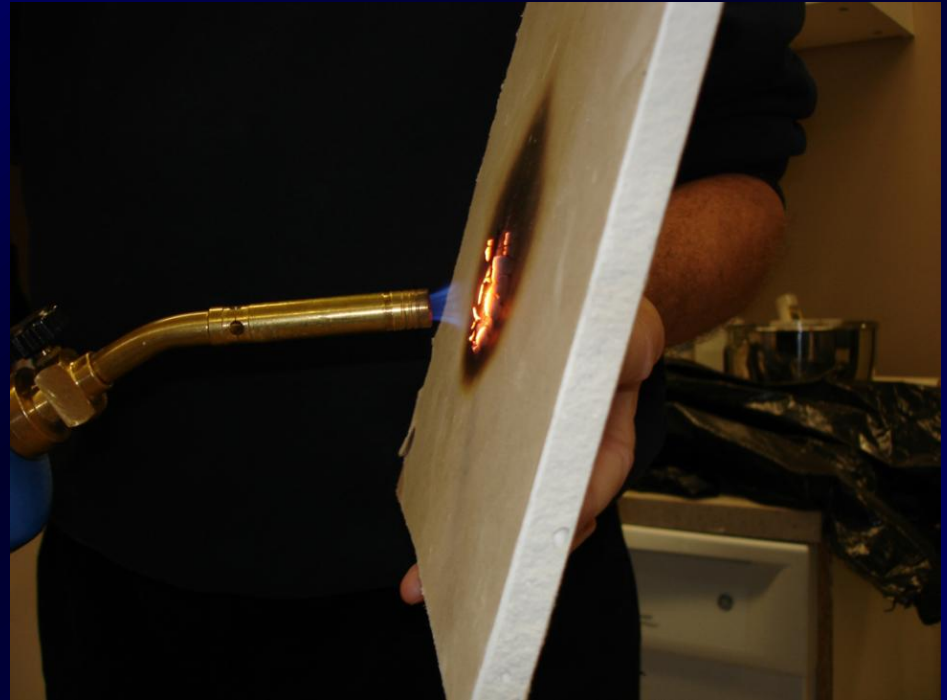
Gypsum – Why is it used?

1. It sets



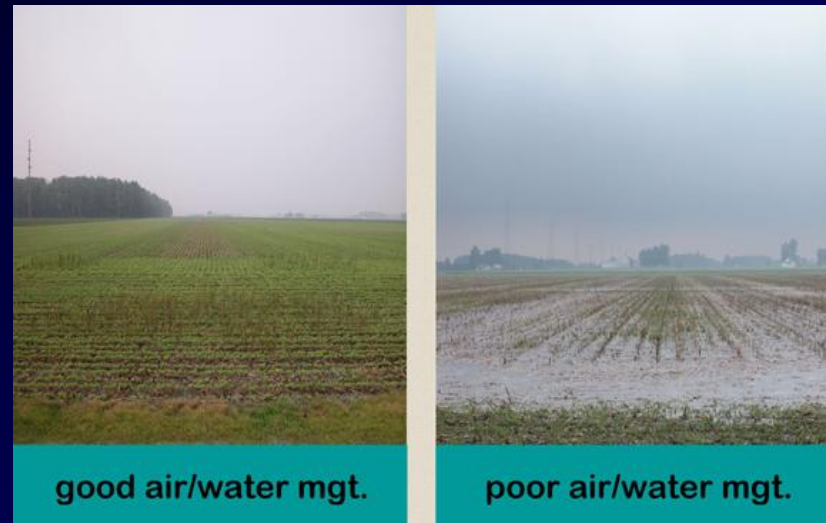
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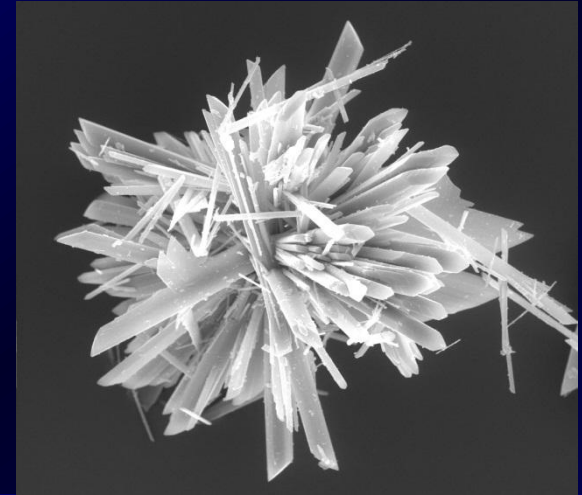
Gypsum – Why is it used?

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3. Ca^{2+} , S, $\text{SO}_4^{=}$ content –
Cement, agriculture
4. Non-toxic fine particles
5. Low cost



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Beer, bread

Pharmaceuticals

Chemical carriers (pesticides, etc.)

Adsorbents, Cat litter

Medical, dental (plaster casts)

Toothpaste, Classroom chalk

Landfill cover

What is the market for gypsum?

North America

- Total used

2007 - 33 million tons

2011 – 23 million tons

Gypsum board > 90%

Cement and agricultural ~ 5%

Special uses - remainder

Global

- Total produced

2007 - 127 million tons

2011 - 148 million tons

– China, Iran, Spain, USA, Thailand, most countries

– Large volumes used for plasters and cement in some regions

– Gypsum board use growing in developing countries

What is the competition to FGD Gypsum?

Source	Availability	Advantages	Disadvantages
FGD Gypsum	Regional, Growing	Price, purity, consistent	Wet, transport
Mined Rock	Widespread	Price, dry	Naturally variable
Recycled board	Growing	“Green”	Logistics cost
Phosphogypsum	Regional	Price	Impurities
Titanogypsum	Few locations	Color?	Handling
Any neutralized sulfuric acid			Impurities, small volumes



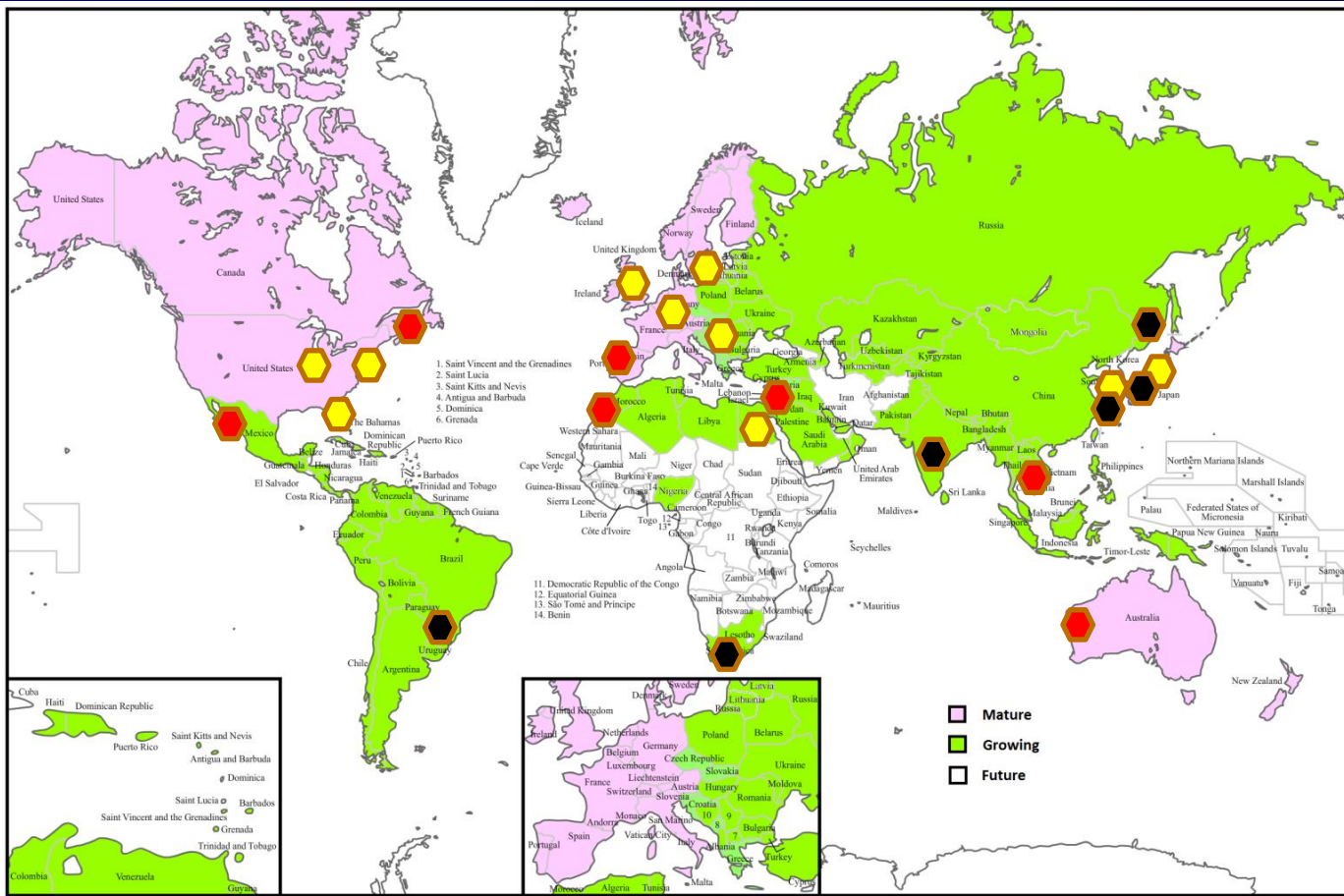
Gypsum Supply Options - Global

Map shows overall gypsum growth potential – **Mature**, **Growing**, Future

Major gypsum mines with export potential – 

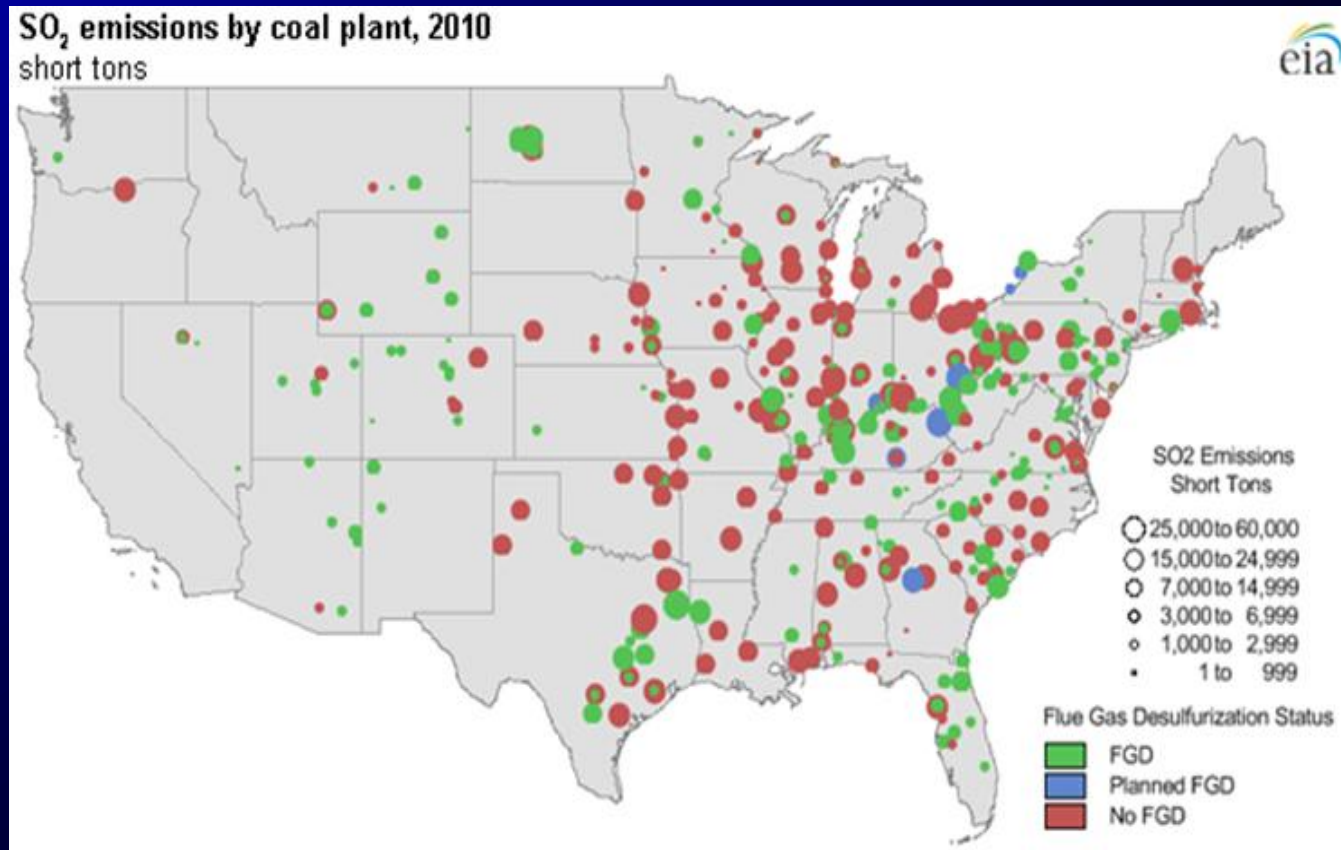
Significant FGD gypsum production – 

Phosphogypsum use - 



Where is FGD Gypsum made in USA?

USA FGD Scrubbers – SO2 Emissions

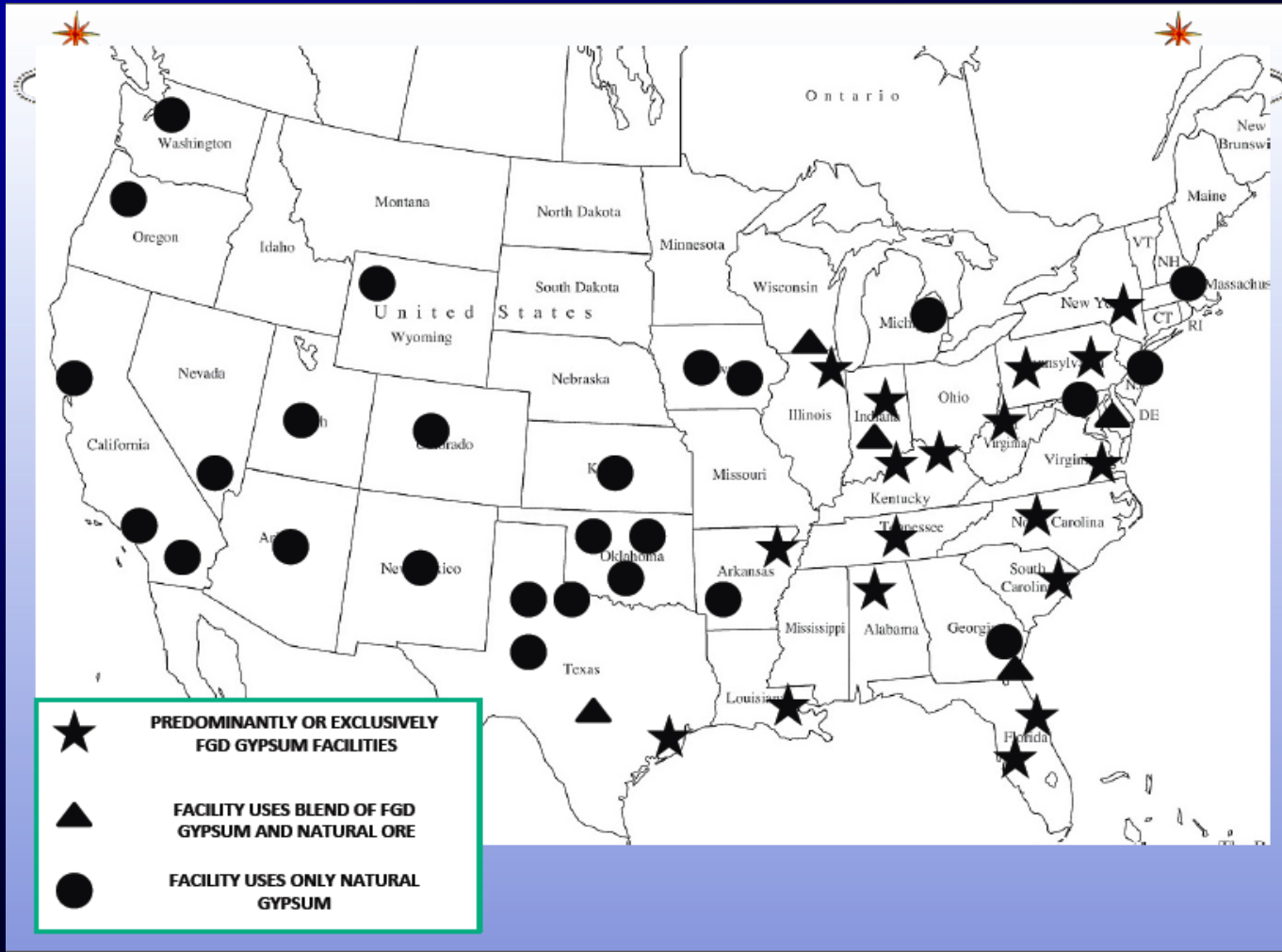


Each ton of SO₂ scrubbed will
make 2.7 tons of FGD gypsum

Source: U.S. Energy Information Administration, 2011 Forecast

Source: U.S. Energy Information Administration, based on Form EIA-860

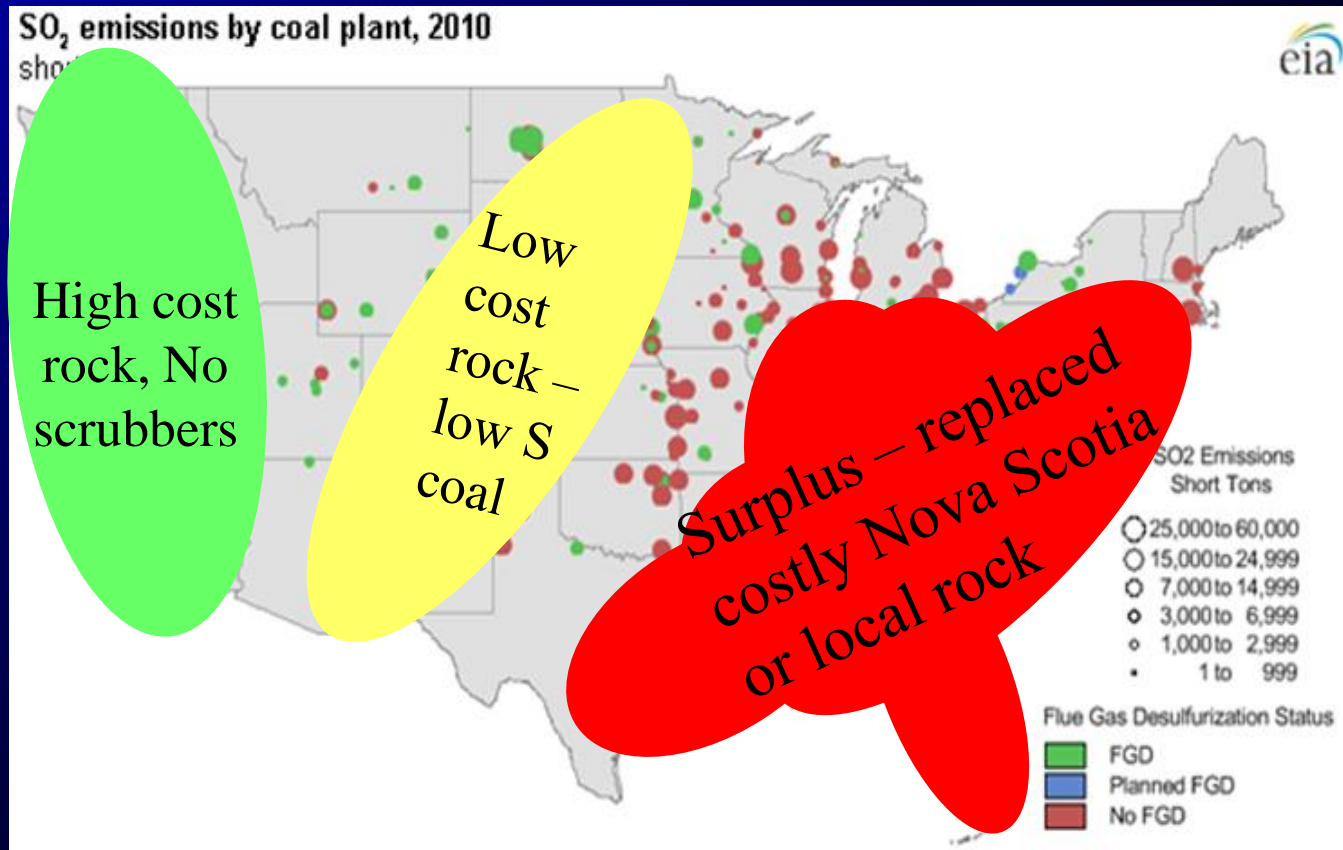
USA Board Plants Using FGD Gypsum



Gardner - Situational Update on USEPA Proposal to Regulate Coal Combustion Residuals – Global Gypsum 2011

General FGD Gypsum Supply/Demand

USA FGD Scrubbers – SO2 Emissions

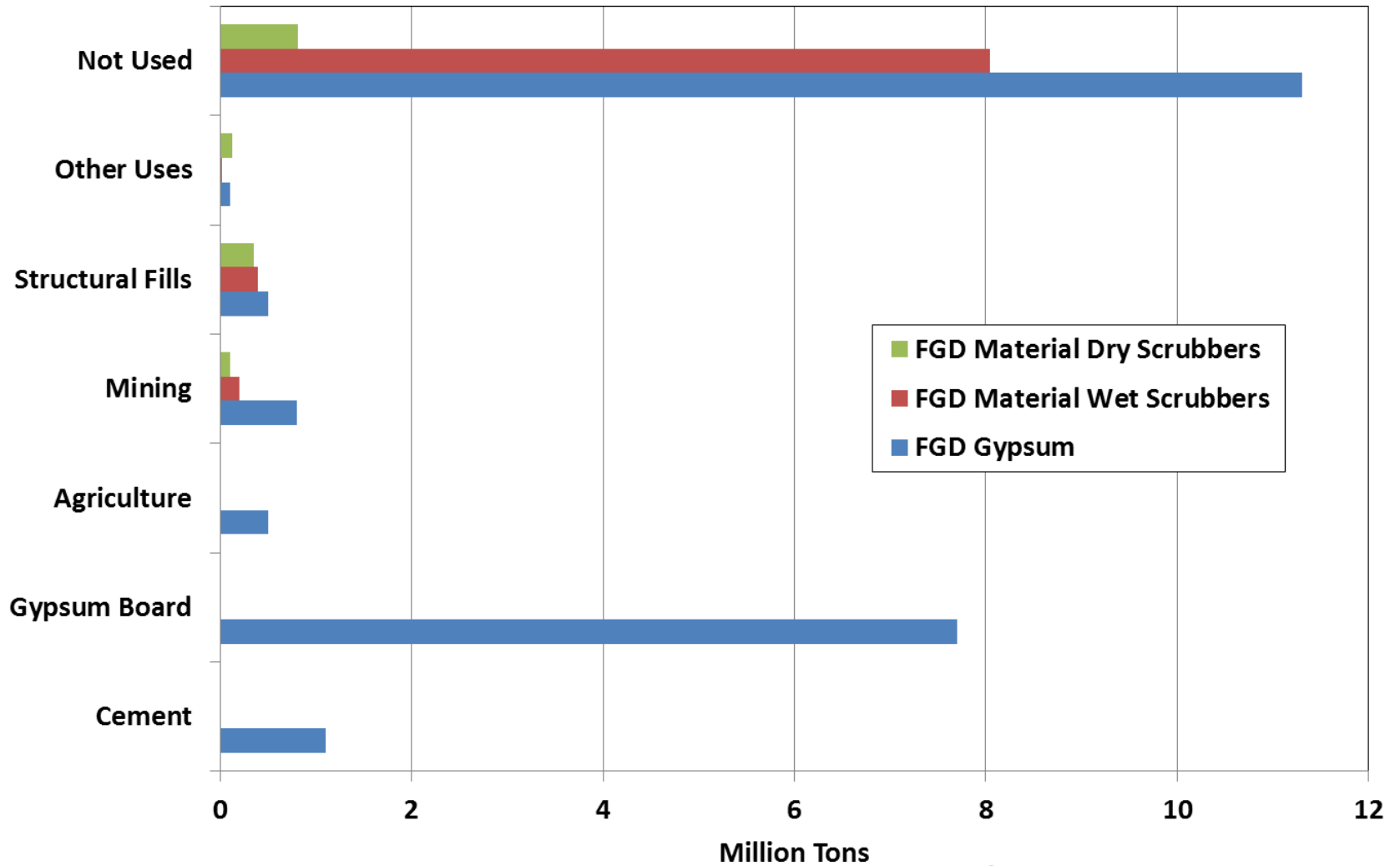


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USA 2010 - FGD Materials Utilization



Data from ACAA 2010 Report on CCP Usage

How does FGD Gypsum quality compare?

	Gypsum Rock	FGD Gypsum
Purity	80-95%	Consistently 95%
Salt	Low, some surprises	Controlled by washing
Handling	Conventional	Control particle shape and moisture content
Moisture content	Low but variable	Controlled by process
Consistency	Naturally variable	Process consistent

Quality requirements depend on end use application.

Economics of FGD Gypsum Use

SO₂

Sulfite

Gypsum

Plaster

Special
Plaster



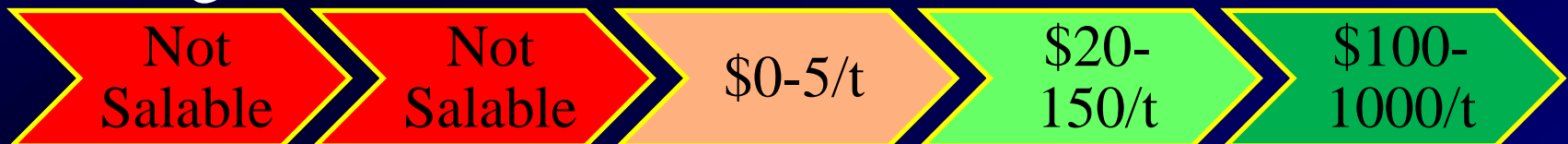
Economics of FGD Gypsum Use



Processing Cost



Selling Price



What are the barriers to using more?

- Some existing markets are saturated (board)
- Competition from existing mines and manufacturing plants – likely needed in future
- New uses require process/market knowledge which is generally only available to gypsum companies
- Regulatory restrictions on use – US EPA

What are the opportunities for the future?

- Remove regulatory uncertainty (EPA)
 - Make FGD Gypsum Fully Exempt under RCRA 40 C.F.R. § 261.4(a)
- FGD Gypsum
 - Global growth in gypsum board – export?
 - USA housing recovery will help
 - Learn to process gypsum to plasters that are useful
- FGD Materials Wet Scrubbers
 - Oxidize and process as above
- FGD Materials Dry Scrubbers
 - Grow stabilization, fill and mining applications

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