

Comparing the Foundry Industry in the United States to Europe

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What drives innovation?

And, in which direction?



Key Drivers

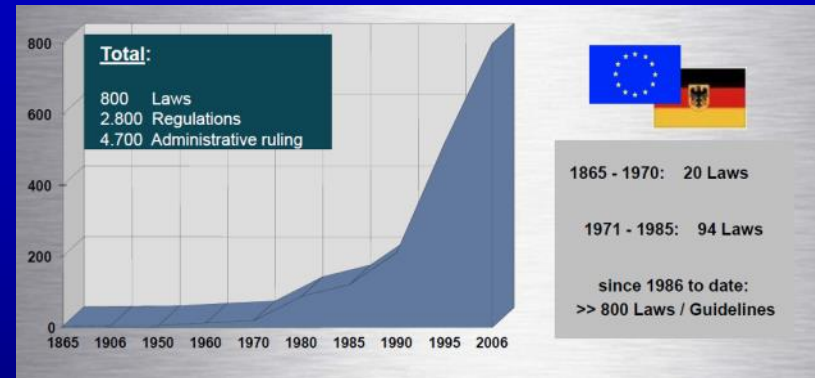
- **Innovation**
 - *People*
 - *Processes*
 - *Productivity*
 - *Profit*
 - *Planet*
- **Sustainability is the key driver**



D.R. Cooper, "Sustainability is the Key Driver of Innovation", 71st World Foundry Congress, Bilbao, Spain, May 2014

Sustainable Development

- Constraints imposed by regulations moving us to reserve resources and save energy for future generations



Emissions standards as a new design constraint for innovation

D.R. Cooper, Ibid.

Content

- **General Comparisons**
- **Molding & Core Making Methods**
- **Molding & Core Making Materials**
 - *Binder, Coating, G/S Trends*
 - *Environmental & Regulatory Impacts*
 - *Emissions Trading*

Global Casting Production

- **Worldwide increase in foundry capacity over the last ten years**
- **On track to reach at least 110 million tons by 2015**

Global Production (000 metric tons)					
	2004	2008	2010	2012	2015e
Total	79,745	93,449	91,673	98,269	110,000

Al Spada, "Global Metalcasting", 71st World Foundry Congress, Bilbao, Spain, May 2014

General Comparisons

- **Shift of the capacity center from West to East**
 - *China, India & South Korea lead*
 - *>60% capacity*
- **China equals combined total of the next seven countries!**
- **Top ten producers stays consistent**

2012

Country	Million metric tons	# plants
China	42.5	30,000
U.S.	10.93	2,010
India	10.57	4,500
Japan	5.34	2,113
Germany	5.21	605
Russia	4.3	1,240
Brazil	2.86	1,277
Korea	2.44	897
Italy	1.96	1,111
Ukraine	1.53	805

*Don Huizenga, past President of AFS and WFO, Personal Communication, June 2014
Al Spada, Ibid.*

Should we be concerned?

- **The West has lost significant capacity over the last 20 years**
 - *US from 20% to about 10%*
 - *China from 15% to over 40%*
 - *Closing of thousands of plants during this capacity migration*



*Don Huizenga, past President of AFS and WFO, Personal Communication, June 2014
Al Spada, Ibid.*

Should we be concerned?

EU Metalcasting

- 15.2 MM tons
- 4,958 plants
- EU as a whole exceeds the US
- Germany & Italy in top 10

US Metalcasting

- 10.93 MM tons
- 2,001 plants in 2013
- 2nd overall producer – individual country
- 80% employing <100 people

H. Lickfett, CAEF The European Foundry Assoc., IFF 2013, Venice, Al Spada, Ibid.



3 year comparison

Year	Country	Total Ferrous Production	Total Nonferrous Production	Production Total	Facilities Total	Production per Facilities
2010	Germany	3,864,271	929,908	4,794,179	614	7,808
2011	Germany	4,491,933	974,763	5,466,696	612	8,933
2012	Germany	4,283,058	931,056	5,214,114	605	8,618
						+10.4%
2010	China	34,800,000	4,800,000	39,600,000	26,000	1,523
2011	China	35,865,000	5,395,000	41,260,000	30,000	1,375
2012	China	37,000,000	5,500,000	42,500,000	30,000	1,417
						-7.0%
2010	U.S.	6,369,435	1,868,798	8,238,233	2,060	3,999
2011	U.S.	7,882,000	2,126,000	10,008,000	2,010	4,979
2012	U.S.	10,293,910	2,531,050	12,824,960	2,010	6,381
						+59.5%

Al Spada, Unpublished Data, Personal Correspondence, 9/14



Should we be concerned?

EU Metalcasting

- **Forecast is cautiously optimistic**
 - *High energy costs*
 - +42% '07-'11
- **Germany strongest casting producer in EU**
 - *5th overall*
 - *Very high productivity*
 - *In need of more labor*
 - *At capacity*

US Metalcasting

- **Grown 10% per year since 2009**
 - *Forecast is strong*
 - *Low energy costs*
 - *Low labor content and high productivity*

CAEF The European Foundry, 7th Intl Foundry Forum, 2012 & Al Spada, Ibid.

Germany Metalcasting Industry

- Foundry methods observations:
 - Advanced use of technology and automation
 - Modern, better capitalized, well maintained & managed
 - Management with engineering backgrounds
 - *vs. production & financial backgrounds*



HegerFerrit – specialized foundry for hand-molded iron castings produced in series. The novel logistical concept ensures high productivity and maximum process control; capacity is 30,000 tons of castings per year.

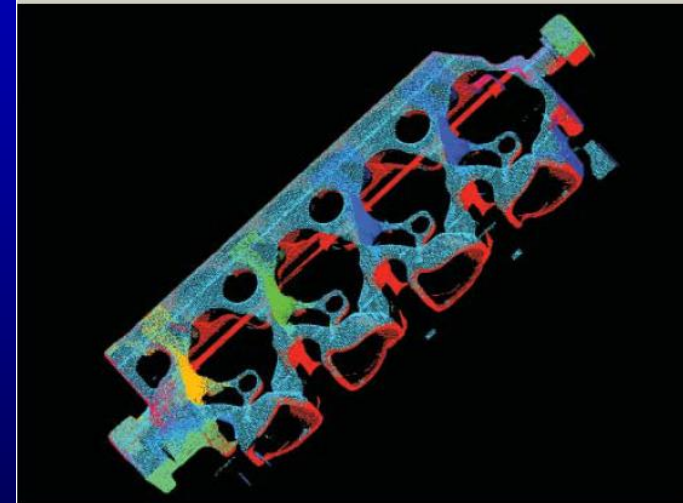
Ray Monroe, Don Huizenga, Joe Muniza, Personal Communications, June 2014

Germany Metalcasting Industry

- Foundry methods observations:
 - Focus on process control during manufacturing
 - *Metallurgical control*
 - *vs. quality control after manufacturing*

“LASER SCANNING IS AN IMPORTANT ASSET IN MAINTAINING HIGH-QUALITY MANUFACTURING OF SAND CORE AND ALUMINUM PARTS.”

- Frank Jeltsch, Metrology Technician at Volkswagen in Hannover



A view on a scanned image of an engine water jacket sand core in Metris Focus Scan software.

Ray Monroe, Ibid. & Hugh Kind

Differences

- **Differences between EU and U.S. foundries from a product technology perspective**
- **Differences between product development strategies of major suppliers**

Differences

- Differences between EU and U.S. foundries from environmental regulations
- EU leads in many areas but lags in a few others
 - *Until recently, formaldehyde in binders not as significant a concern as in the USA*
 - *EU has adopted inorganic binders earlier than USA*

Numerous Sources



Material Differences

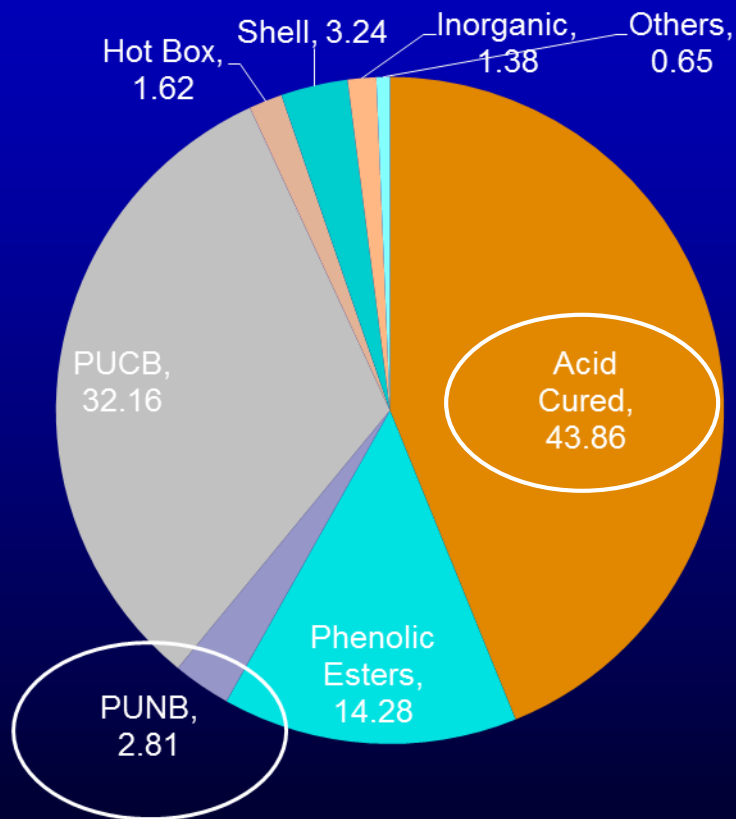
- **Material choices tend to be regional vs. a single global market driver**
 - *Use of FNB as system of choice in EU steel foundries vs. UNB in US*



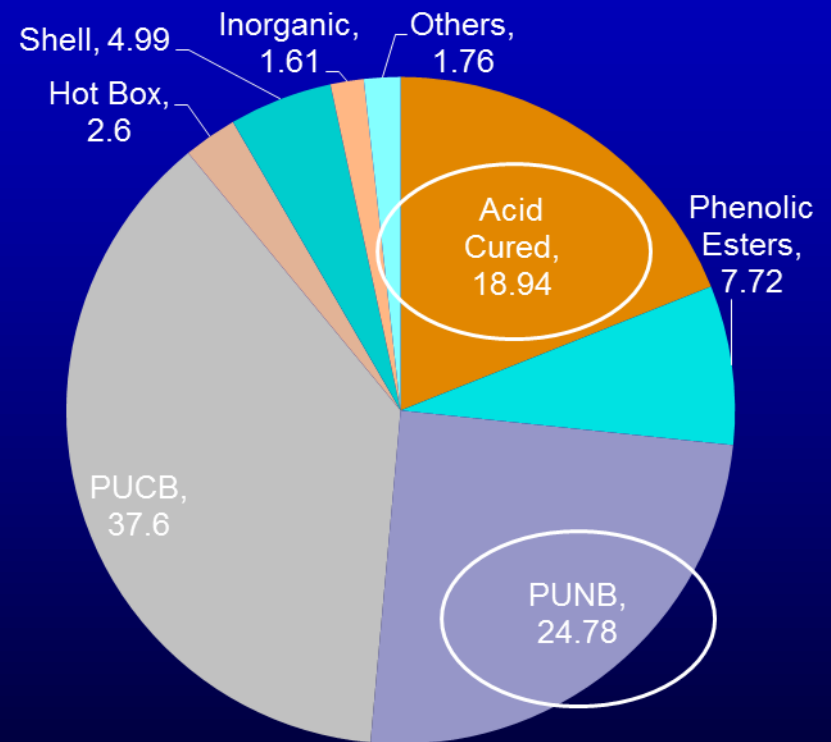
Ray Monroe, Personal Communication, September 2014

Binder Market Comparison

EU



USA

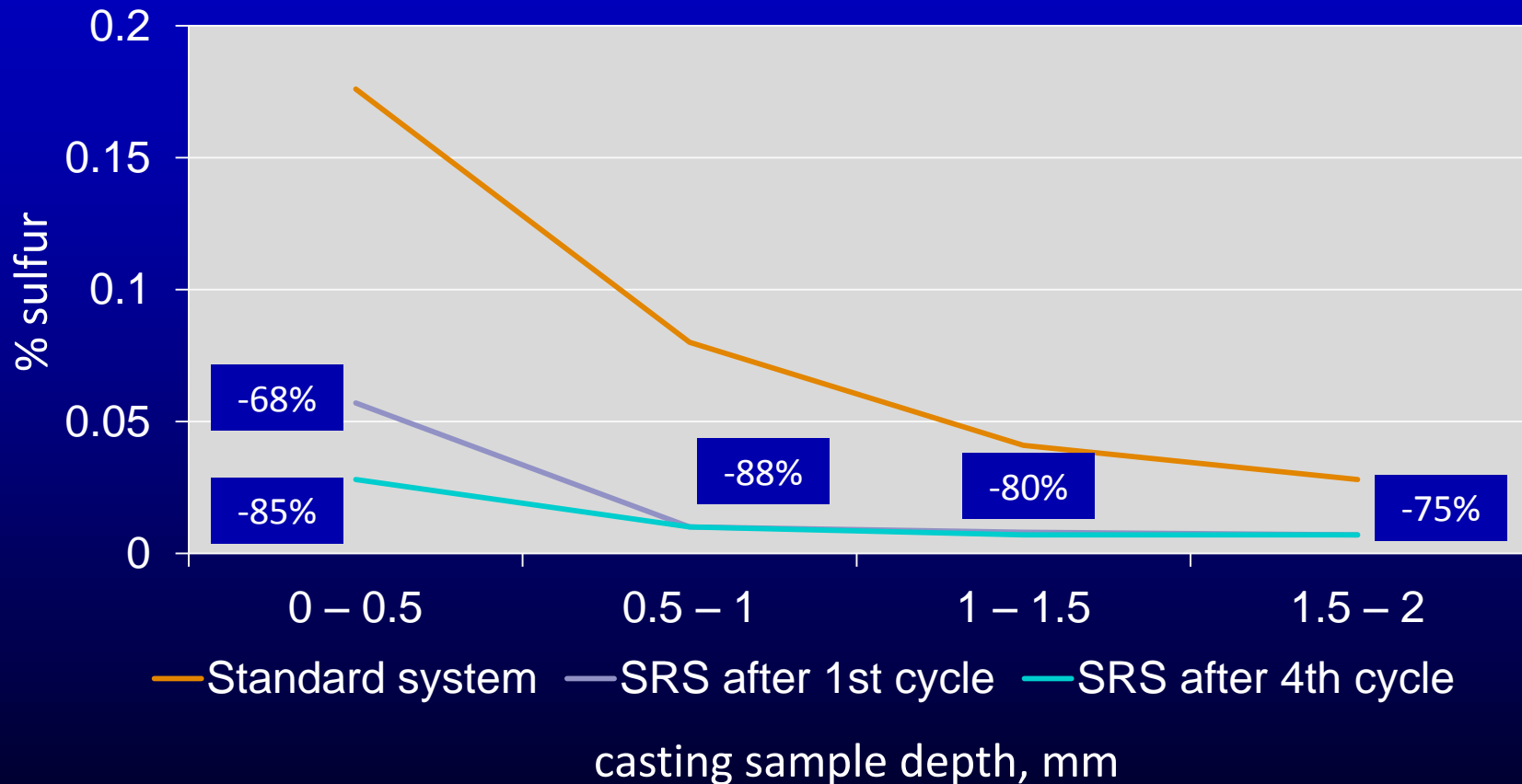


Wind Energy Segment

- **Wind Energy Segment**
 - *> 10,000 MW annually installed*
 - *Nearly double 2004*
- **Drives product innovation**
 - *Ductile iron: sulfur reduced FNB's*
 - *Reduce graphite reversion*



Sulfur content [%] in different depth areas of the casting



Formaldehyde

EU

- **Formaldehyde to be classified as 1B carcinogen**
 - *Effective April 2015*
 - *Forces resins to non-reportable formaldehyde levels (< 0.1%)*
 - *No exposure limit established (under development)*

USA

- **Formaldehyde is classified as 1A carcinogen**
 - *Resins already formulated to < 0.1% in most binder segments*
 - *US PEL 0.75 ppm, Action Level 0.5 ppm*
 - *EU reviewed same data and came to a different classification.*

Dr. Michael Deißler, & Jeff Krause, Personal Communications, September 2014

Material Trends

- **Product solutions tend to be more company specific than regional**
 - *One company's solution to meet regulations not the same as the next*

EU Cold-Box Resin Development

COLD-BOX: A TECHNOLOGY OF THE FUTURE!

As an innovative foundry supplier, Hüttenes-Albertus soon started to develop cold box binder systems with improved properties. In 1999, the first generation of cold box systems with solvents containing silicate was used in foundries. Compared to the aliphatic and aromatic solvents used until then in the cold box process, the use of tetraethyl orthosilicate was the first step towards a cold box system of an inorganic nature.

The tried and tested systems based on REM or TES, or with reduced monomers, are still the productive standard today appreciated by many foundries.



TEOS to reduce emissions, smoke & odor in UCB systems

EU Cold-Box Resin Development

ECOCURE™ HE

The high efficiency™ cold box binder system sets the benchmark in ecology and economy! Increasing the added value is a major goal for the further development of the cold box process. This involves making it possible to add the smallest possible amount of binders. This can have a positive impact on multiple factors, such as catalyst consumption, odor, emissions, core box cleanliness or the formation of gas. This offers advantages for quality, productivity and the environment and ensures a high savings potential.

This is precisely what the new “high efficiency” cold box binder system from ASK Chemicals offers.

- Binder consumption is 25% lower on average thanks to high efficiency cold box systems from ASK Chemicals that offer the following:
- BTX emissions are up to 42% lower (cost savings and protection of the environment and your staff).
- Amine consumption is up to 25% lower (cost savings and reduction of emissions and odor).
- A number of shots that is up to 16% higher (cost savings and increased productivity).
- Formation of gas and condensate is up to 25% lower (higher tool availability, therefore time saving in terms of cleaning and increased productivity).
- Precisely tailored amine catalysts for hardening the ISOCURE™ and ECOCURE™ binder systems are available with the 700 catalyst series.

Higher strength resin to reduce binder usage and lower emissions

From ASK Chemicals Website

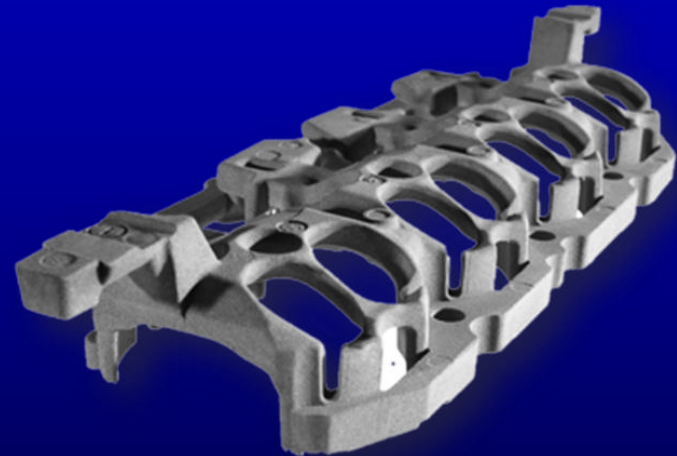
“Inorganic Binders – breakthrough or everlasting hope?”

- **EU: Keen interest in inorganic binders**
- **Sharp focus after VDG Conference in 2002**
- **Laempe introduces “Beach Box” process at 2003 GIFA**



Inorganic Binders

- German foundries have **“Gone Green”!**
- OEM and Tier 1 automotive foundries are using inorganic binders in high volume aluminum casting applications
 - *VW, Daimler, BMW, Nemak, others*
- Reclamation works!



Inorganic Binders

- **But not in the U.S.**
- **Some Asian transplants are interested in evaluating advanced inorganics**
 - *But, only slowly*
- **Focus more on improving productivity of organic systems**
- *Why?*

Inorganic Binders

- **Why?**
 - **Significant organizational commitment to get inorganics running**
 - *Daimler, VW, BMW*
 - **Multiple year commitment to get inorganic running**
 - **Significant equipment investment**
 - **Significant process change**

Huettenes-Albertus & Joe Muniza, Personal Communication, September 2014



Inorganic Binders

- **Some conversions involve a large change**
- **Goal is to maintain:**
 - *Productivity*
 - *Sand reuse levels*
 - *Casting quality*
 - *Costs*
- **For smaller facilities – *Investment cost vs. benefit is huge***

Refractory Coatings

- In EU more use of flow coating
- Use of automated process control equipment
 - *Control specific gravity or density*
 - Foseco CCP
 - OAS SCCD



Hugh Kind, Personal Communication, September 2014, & WFC Presentations

G/S Binder & Additives

EU & Germany

- Europe uses soda ash activated calcium bentonite
- Bentonite level is similar

USA

- North America uses Wyoming and Alabama bentonites
 - *Western Bentonite (Na)*
 - *Southern Bentonite (Ca)*

- *Clay types are very different*
- *No processing or casting quality differences regardless of source*

Vic LaFay, Personal Communication, June 2014

G/S Binder & Additives

EU & Germany

- Seacoal as the predominate source of organics
- Addition of lustrous carbon formers into pre-blend formulations
 - *Increases emissions in green sand*
 - *Interest growing in this technology in Europe*

USA

- Seacoal as the predominate source of organics
- Use of causticized lignite into pre-blend formulations
 - *Causticized lignite not a lustrous carbon former*
 - *Clay modifier and emission reduction additive*

Vic LaFay, Ibid.

Emissions Trading

- **Market-based approach to control pollution.**
 - *"Cap and Trade"*
 - *Economic incentives for reducing emissions*



Various Sources

Emissions Trading

- Record 36 billion tons of CO₂ from all sources
- 2.5% increase in 2014
 - exceed 40 billion tons
- Growth since 2009 slower than prior period of 2000-08

Country	% of global total	Per capita average
China	29	7.2
USA	15	16.5
EU	10	6.8

Global Carbon Project, September 2014

EU Emissions Trading

- **EU largest carbon trading market in the world**
 - *Purpose is to avoid dangerous climate change*
- **For large European foundries, carbon emissions trading is real**



From theguardian.com, July 2011, Photograph: Martin Meissner/AP

Dr. Michael Deißler, & Jeff Krause, Personal Communications, September 2014

EU Emissions Trading

- **EU ETS now in its third phase**
 - *Running from 2013 to 2020*
 - *Single EU-wide cap on emissions vs. national caps*
 - *More sectors covered, including foundries*
 - *Further 20% reduction by 2020 to 1990 levels*

European Commission, September 2014



EU Emissions Trading

- **Despite problems – some success**
 - *2-4% annual CO₂ emissions reduction probably attributable to trading*

Dr. Michael Deißler, & Jeff Krause, Ibid.

Emissions Trading

- **California launched its cap-and-trade program**
 - *Second in size only to the EU's*
 - *Ninth largest economy in the world*
 - *Reduce CO₂ emissions by more than 16 percent between 2013 and 2020 to 1990 levels*
 - *Trading credits for 2 years*

Stephanie Salmon & James Simonelli, Personal Communication, September 2014



Emissions Trading

- **Example of how cap-and-trade system can function in the US**
 - **Cost: \$12/ton (~9.45 €)**

Stephanie Salmon & James Simonelli, Personal Communication, September 2014

CA Emissions Trading

- Metalcasting industry in “General Combustion Sources” category
- Threshold 25,000 ton/year (CO₂)
- Only CO₂ emissions are counted towards the total
 - *None of metalcasting process emissions count towards total*
 - *Only count direct energy usage*

James Simonelli, Personal Communication, September, 2014



CA Emissions Trading

- Magnesium casters – elimination of SF₆ as cover gas
- Magnesium facilities were included in early action measures (2007)
- SF₆ most potent greenhouse gas known
 - 23,900 x's > CO₂
- Temporary exemption granted through January 1, 2015

James Simonelli, Ibid.



AFS Concerns

- The Obama administration is using EPA to propose regulations for existing U.S. power plants
- EPA's "*Clean Power Plant Rule*" would allow "*operators to trade emissions credits...to meet the target.*"
- Imposes cap-and-trade systems and other anti-fossil fuel policies on U.S. states and foundries.

Stephanie Salmon, Personal Communication, September 2014



AFS Concerns

- **Substantially increase electricity and natural gas costs**
- **Puts foundries and the manufacturing sector at competitive disadvantage**
- **May force companies offshore along with good paying jobs – *all for a relatively small climate impact***

Stephanie Salmon, Ibid.



AFS Concerns

- **For foundries, small increases in the cost of energy can have large impacts on competitiveness**
- **AFS supports responsible cost-effective action to address climate change**

Stephanie Salmon, Ibid.



Summary

- **Differences between the EU and US exist**
 - **Some in Molding Methods**
 - *Engineering & Process Control Methodology*
 - **More in Materials**
 - *Driven by environment regulations*
 - *More from EU to USA*
- **Opportunity for sustainable development to drive Innovation**

Thanks to my contributors

- **Dr. Michael Deißler, Head of Product Safety and EHS, Huettenes-Albertus**
- **Don Huizenga, Past AFS/WFO President**
- **Thomas Iven, Product Management, Chemex**
- **Hugh Kind, Marketing & Technology Director, Europe, Foseco**
- **Jeff Krause, Director EH&S, HA International**
- **Dr. Carsten Kuhlitz, President & CEO, Huettenes-Albertus**
- **Vic LaFay, R&D Foundry USA Manager, S&B Industrial Minerals N.A, Inc.**

Thanks to my contributors

- **Dr. Ray Monroe, Executive VP, SFSA**
- **Joe Muniza, Sr. Vice President Global Cold Box Binders, ASK Chemicals LP**
- **Stephanie Salmon, Vice President Government Affairs, AFS**
- **Amine Serghini, VP Global Sales, Huettenes-Albertus**
- **James Simonelli, Executive Director, California Metals Coalition**
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