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Public Policy Rationale for Tier 3 Implementation On January 1, 2017

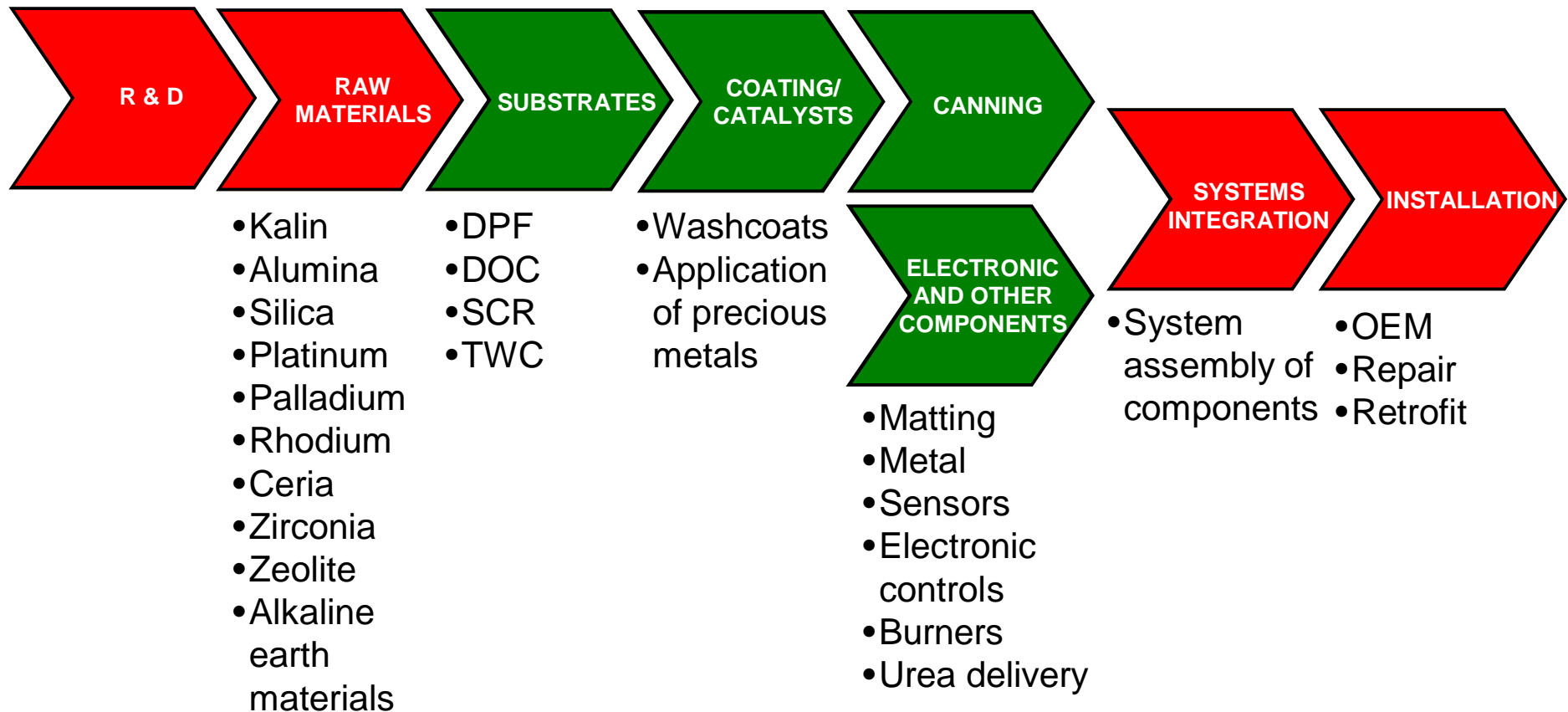
Friday, February 21, 2014

- Paul Bugala:** Senior Sustainability Analyst, Extractive Industries, Calvert Investment Management, Inc.
- David Bushnell:** Managing Dir., JMD Associates, Inc., Representing BASF Corp's Catalysts Division
- Roy Houseman:** Legislative Representative, United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union (USW)
- Dr. Timothy Johnson:** Dir., Emerging Technologies & Regulations, Corning Incorporated
- Dr. Sanath Kumar:** Global Marketing Director, Mobile Emissions Catalysts, BASF
- Emile Peters:** Director, Emission Control Operations, Unifrax, I LLC
- Timothy Regan:** Senior Vice President, Corning Incorporated

Agenda

- Key messages
 - To be successful, both the tailpipe and LSF standards must be implemented on January 1, 2017
 - Delay in the LSF mandate will have negative policy and emission systems consequences
 - Strong evidence shows that three year implementation of the LSF standard is reasonable given flexibility in the rule
- Agenda
 - Industry structure
 - Public policy rationale
 - Need for MY17 implementation
 - Need for low-sulfur fuel
 - Reasonableness of three-year implementation of 10ppm standard
 - Rebuttals of oil industry criticisms

Mobile Source Emission Control Industry Value Chain



Mobile Source Emission Control Industry's Contribution to Clean Air



- Mobile emissions control products have prevented

4 billion tons of hydrocarbons

4 billion tons of nitrogen oxides

40 billion tons of carbon monoxide

...from entering the air we breathe

25 years, 50:1 50 Tier 3 cars emit the same pollution as 1 car from 1989

Tier 3 is in the Public Interest

- Saves Lives: By the 2030, Tier 3 will annually prevent 820 to 2,400 premature deaths, 3,200 hospital admissions and asthma related emergency room visits, 22,000 asthma exacerbations, 23,000 respiratory symptoms in children, and 1.8 million lost school and days
- Cleans the Air: Tier 3 reducing emissions of ozone precursors from each vehicle by 80 percent and PM by 70 percent providing relief for 158 million Americans who currently breathe unhealthy due to auto pollution
- Generates Economic Growth: Navigant study concludes that Tier 3 will generate \$2.6 billion in economic value added for three years, \$1.5 billion in increased employment compensation, and \$0.6 billion in tax revenue
- Strong Investor Support: Investors representing \$11 trillion in assets under management support submitted a comment to the EPA indicating how Tier 3 would be benefit to their portfolios

Tier 3 is in the Public Interest *(cont'd)*

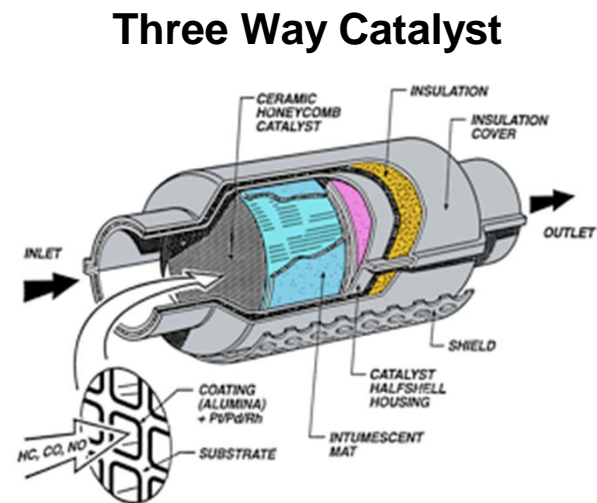
- *Creates Jobs*: Navigant Economics estimates that Tier 3 will create of 24,500 jobs over three years to construct the new desulfurization facilities and another 5,300 permanent jobs to operate and maintain these facilities
- *Doesn't Increase Gas Prices*: Navigant study shows that historically there has been no correlation between the price of gasoline and emission control regulations under Tier 2
- *Reduces Compliance Costs for the States*: Tier 3 is the most efficient means for states to achieving ozone standards (i.e., reducing a ton of NOx under Tier 3 costs \$3,300 per ton versus \$39,700 to \$79,700 for power plants)
- *Addresses Global, State Standards' Inefficiencies*: Requires reduction in the sulfur content consistent with fuel standard in Europe, Japan, Korea, and soon China, Brazil, and later India. Harmonizes with California tailpipe standard

MY17 Implementation (on January 17, 2017) is Needed

- Human Health: Delay exposes 158 million Americans to unhealthy air for one or two years more, resulting in premature death, acute bronchitis, aggravated asthma, especially in children and in the elderly
- Exports: Delay impedes the adoption of tighter standards overseas (e.g., China) that present an export opportunity for the U.S. emissions control industry. It sends the message “Tier 3 goes too far
- States: Delay makes it more difficult/expensive for states to comply to ozone standards
- Jobs: Delay denies job creation and economic growth that is sorely needed
- Inefficiencies: Delay imposes inefficiencies on the auto and supplier industries as they design/build different systems for California and the rest of the country
- Industry ROI: Delay denies the auto and supplier industries a return on investment in R&D and capital needed to meet the LEV III/Tier 3 standards

10ppm Fuel is Needed (see Tab A)

- Tier 3 emission system is very complex as it must control from multiple variables
 - Thermal dynamics of substrate material
 - Cell density in substrate
 - Mat characteristics
 - Active materials and coating used as catalysts
 - Exhaust temperature
 - Concentration of sulfur dioxides in exhaust gases
 - Air to fuel ratio
 - Back pressure
 - Engine management controls
- Sulfur is a well known catalyst poison that reduces emissions system performance by
 - Contaminating platinum group metals through chemisorption
 - Inhibits catalytic reactions through SO_2/SO_3 oxidization and formation of aluminae sulfates



10ppm Fuel is Needed *(see Tab A) (cont'd)*

- Studies show that fuel greater than 10ppm results in lower emissions reduction
 - EPA MSAT study showed lower emissions NO_x (33%), THC (11%), CO (17%), NH₃ (33%) with 5ppm vs. 28 ppm fuel
 - Confidential auto testimony showed failure to comply with SULEV/Bin 2 with >10ppm fuel
 - Toyota demonstrated substantial increase in NO_x and HC on LEV vehicles with increase in sulfur from 8ppm to 30ppm
 - Umicore showed “NO_x creep” with switch from 3ppm to 30ppm fuel
 - Ford demonstrated a 44% emissions reduction for both NO_x and CO when sulfur was reduced from 30ppm to 5ppm
- Reversing sulfur contamination is problematic
 - Needed high operating temperature permanently reduces systems emissions reduction performance through thermal degradation of catalyst and sintering of active materials
 - Results in higher PM, NMOG, CO emissions

10ppm Fuel is Needed *(see Tab A) (cont'd)*

- Needed high operating temperature difficult to maintain
- Increases fuel consumption to operate at high load/temperature
- Reduces durability, making system vulnerable to failing 150,000 mile requirement
- Lean burn strategies are in development for the U.S. (Mercedes Benz)
 - Required NOx catalysts can be permanently impacted by sulfur through enhanced grain growth of the sulfate

EPA's 3-Year Fuel Implementation is Reasonable (see Tab B)

- Refineries: Small number of refineries significantly affected
 - 29 refineries (26%) can comply now
 - 66 refineries (60%) can make operational changes and revamp existing facilities to comply in two years or less
 - Only 16 refineries (14%) must invest in new grassroots FCC postheaters, but only moderate to light desulfurization will be required
- Studies: Many refineries have completed their scoping studies
- Tier 2: Lead time proved adequate for Tier 2 which required more investment (\$6.1B for Tier 2 vs. \$2.1B for Tier 3) and was more complex to implement (300 to 30ppm for Tier 2 vs. 30 to 10ppm for Tier 3)
- Credits: Lots of credit for early compliance (supply to exceed demand by 4-6 times) will be available for refiners that need more time to comply
- Special Accommodations: Small refineries (<75,000 barrels per day) can delay compliance until 2020
- Hardship: Refineries can apply for hardship relief to deal with unforeseen circumstances

Rebuttals of Oil Industry Criticism *(see Tab C)*

- Emissions Reduction: API/AFPM mischaracterizes ENVIRON as evidence that EPA's estimates are exaggerated when ENVIRON's estimates, in fact, are consistent with EPA (NOx fully implemented in 2030)

Percent Reduction in Emissions
From Tier 2 to Tier 3 Standards

	EPA Estimates		ENVIRON Estimates
	2022	2030	2022
SO2	51%	51%	50%
PM 2.5	2.6%	10.4%	3%
CO	9.1%	30.4%	7%
VOC	6.8%	23.1%	6%
NOx	13.8%	27.8%	5%

Rebuttals of Oil Industry Criticism *(see Tab C) (cont'd)*

- Monetized Benefits: EPA's estimate is \$7.5B - \$23B by 2030 is affirmed by ALA (\$8.5B to \$22B) and Navigant (estimated PM reduction \$10.1B-\$10.8B), while API/AFPM estimate (\$0.8B - \$2.3B) fails to take into consideration a large percentage of the affected population
- Compliance Cost: EPA's estimate of the average cost of 0.89 cents per gallon is affirmed by MathPro and Navigant (about 1 cent per gallon), while API/AFPM sponsored Baker and O'Brien estimated 1.9 cents per gallon because it fails to take into consideration ABT and assumes excessive capital costs
- Timing: EPA's three year implementation is based on a refinery by refinery linear program analysis, while API/AFPM's proposed five year implementation is unsupported by analysis

Conclusions

- To be successful, both the tailpipe and LSF standards must be implemented on January 1, 2017
- Delay in the LSF mandate will have negative policy and emission systems consequences
- Strong evidence shows that three year implementation for LSF standard is reasonable given flexibility