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Research Triangle Park, North Carolina, 27711

Attention: EPA–HQ–OAR–2021–0382; FRL–7547–01–OAR

Re: Potential Future Regulation Addressing Pyrolysis and Gasification Units

1.0 INTRODUCTION

The American Fuel & Petrochemical Manufacturers (“AFPM”) respectfully submits these comments on the Environmental Protection Agency’s (“EPA” or “the Agency”) *Federal Register* notice titled “Potential Future Regulation Addressing Pyrolysis and Gasification Units” (“the advanced notice of proposed rule” or “the ANPRM”).¹ Specifically, EPA is soliciting information to assist in the potential development of regulations under the Clean Air Act (“CAA”) for pyrolysis and gasification units that are used to convert solid or semi-solid feedstocks, including plastics, to value-added products such as energy, fuels and manufacturing building blocks.

1.1 AFPM’s Interest in the Proceeding

AFPM is the leading trade association representing the makers of the fuels that keep us moving, the petrochemicals that are the essential building blocks for modern life, and the midstream companies that get our feedstocks and products where they need to go. Petrochemicals are the building blocks for plastic products that improve the health, safety, and living conditions of humankind and make modern life possible. AFPM members are committed to sustainably and efficiently manufacturing the petrochemicals and derivatives for plastics that growing global populations and economies need to thrive, improving and innovating recycling and reuse rates and technologies, and developing policies to address plastic waste in the environment.

AFPM members are committed to collaborating with policymakers and other stakeholders to develop sound, risk- and science-based policies to address environmental issues including the complex plastic waste challenge. AFPM supports policies designed to protect the environment, decrease emissions, incentivize recycling, and promote research and development in recycling technologies through pilot phases and full commercialization. To this end, AFPM supports the innovation and development of plastic waste repurposing technologies that have the potential to recover plastic waste by transforming it into value-added materials.

¹ See 86 *Fed. Reg.* 50296, “Potential Future Regulation Addressing Pyrolysis and Gasification Units”, EPA–HQ–OAR–2021–0382; FRL–7547–01–OAR, published September 8, 2021, at <https://www.govinfo.gov/content/pkg/FR-2021-09-08/pdf/2021-19390.pdf>

Pyrolysis and gasification are essential manufacturing technologies that advanced recycling facilities and petrochemical manufacturers use to convert post-use plastic into feedstocks that can be transformed into polymers and manufactured into high-quality plastics with the same or similar physical properties as virgin materials.² One-size-fits-all policies will hinder innovation rather than increase recycling rates and content.

AFPM members comply with numerous chemical and environmental regulations administered by EPA. Effective environmental regulation of advanced recycling and associated manufacturing technologies must recognize how plastics improve the lives of people while addressing environmental issues, including plastic pollution and emissions associated with advanced recycling. AFPM supports the regulation of advanced recycling as a manufacturing process because advanced recycling facilities receive plastics feedstock as a raw material and manufacture it into a higher-value commodity in processes that do not involve incineration. Advanced recycling processes should be treated as manufacturing processes, not as waste or incineration processes

1.2 Benefits of Advanced Recycling

Most recycling currently taking place in the US is considered “mechanical recycling.” This type of recycling takes certain types of plastic, shreds, washes and then melts them into plastic pellets, which can then be used to make new products. Mechanical recycling has its limitations, however, including limitation in sortation, challenges with contamination, and limits on the types of materials recycled plastics can be used in and the number of times the plastics can be recycled before degrading (similar to what is seen in recycling paper).

Advanced recycling addresses some of the limitations of mechanical recycling. Specifically, advanced recycling can be used to recycle more types of plastics into a wider range of new plastics and products. Further, advanced recycling is used to manufacture virgin polymers that are made from recycled plastic as feedstock. This process can be repeated almost an infinite number of times, whereas mechanical recycling may be repeated two or three times. In addition, an independently reviewed life cycle analysis study concludes that recycling via pyrolysis of mixed plastic waste emits 50% less CO₂ than incineration of mixed plastic waste.³ Advanced recycling is needed to complement mechanical recycling that can help EPA meet its goals of creating a more circular economy for plastics and increasing overall recycling rates.

Petrochemical producers recognize the potential of advanced recycling to complement mechanical recycling and better address plastic waste in the environment. Petrochemical manufacturers are driving real breakthroughs in advanced recycling using pyrolysis and gasification. In the last four years, 64 recycling projects have been announced in the United States; new investment valued at \$5.3 billion with the potential to divert 3.6 million tons of waste

² Pyrolysis is the process of thermal conversion of organic matter using a catalyst in the absence of oxygen. Gasification is a thermo-chemical process that converts biomass into a combustible gas called producer gas (syngas).

³ See “Life cycle assessment (LCA) for ChemCycling” <https://www.basf.com/global/en/who-we-are/sustainability/we-drive-sustainable-solutions/circular-economy/mass-balance-approach/chemcycling/lca-for-chemcycling.html> [accessed November 8, 2021]

from landfills.⁴ AFPM and its members are exploring policies to spur investment and scaling of these technologies as a key element to address plastic waste in the environment.

Regulating advanced recycling as solid waste incineration would be inconsistent with the legal definitions and the precedent 14 states have set when they enacted laws appropriately defining advanced recycling as a manufacturing process, as opposed to solid waste disposal or incineration. Treating pyrolysis and gasification units used in advanced recycling as an incineration action as opposed to a manufacturing process would defy scientific convention – advanced recycling processes do not involve combustion – and may trigger inappropriate permitting requirements that could hamper the US’s ability to modernize and expand plastics recycling, improve sustainability, and reduce emissions.

2.0 AFPM’S COMMENT ON THE POTENTIAL REGULATION OF PYROLYSIS AND GASIFICATION UNITS UNDER CLEAN AIR ACT SECTION 129

2.1 The Clean Air Act Section 129 is not Appropriate for Regulating Advanced Recycling Processes Including Pyrolysis and Gasification Units

While EPA does not expressly request comment in the ANPRM on whether pyrolysis or gasification units should be regulated under CAA §129, the Agency notes ongoing confusion as to the applicability of the existing CAA §129 standards and explains that the information gathered through the ANPRM will inform the “growing interest in the general need to determine whether these conversion technologies should be regulated under CAA section 129 as part of a category (or subcategory) of solid waste incineration unit, or as a specific source category under other provisions of the CAA, including under CAA sections 111 or 112.”⁵

EPA further explains that the ANPRM is motivated in part by comments received on its 2020 proposal to determine that the CAA §129 standard for Other Solid Waste Incineration Units (“OSWI”) does not apply to pyrolysis units.⁶ In that proposed rule, EPA explained that it “believe[s] the reference to pyrolysis/combustion units as MWC Municipal Waste Combustor should not apply to OSWI units because such units are used to combust uncontained gases and do not involve the combustion of solid waste as defined in the OSWI rule.”⁷ More specifically:

In a closely coupled pyrolysis/combustion chamber, the gaseous material comes out of the pyrolysis chamber and immediately is incinerated in the combustion chamber. The pyrolysis gas is not placed into a container and then combusted. Therefore, the pyrolysis

⁴ See “The Roadmap to Reuse – Plastics Solutions for American 2020” published by American Chemistry Council page 19, accessed October 13, 2021

<https://www.plasticmakers.org/files/Oad2b4b877997c3b91878b785b6e51f821857c2d.pdf>

⁵ See 86 Fed. Reg. 50303, “Potential Future Regulation Addressing Pyrolysis and Gasification Units”, EPA-HQ-OAR-2021-0382; FRL-7547-01-OAR, published September 8, 2021, at <https://www.govinfo.gov/content/pkg/FR-2021-09-08/pdf/2021-19390.pdf>

⁶ *Id.* at 50298

⁷ See 85 Fed. Reg. 54178, “Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Other Solid Waste Incineration Units Review” EPA-HQ-OAR-2003-0156 FRL-10013-19-OAR, published Aug. 31, 2020 <https://www.federalregister.gov/documents/2020/08/31/2020-17730/standards-of-performance-for-new-stationary-sources-and-emission-guidelines-for-existing-sources>

gas in the closely coupled pyrolysis/combustion chamber is not “contained gaseous material,” as referenced in the definition of solid waste.

EPA noted that this conclusion was consistent with its determination in the OSWI rule that “thermal oxidizers, catalytic oxidizers, and flameless thermal oxidizers are not considered to be subject to the OSWI rule if these units are used to combust uncontained gas from an industrial process (70 FR 74877).”⁸

Lastly, EPA observed that “the pyrolysis process, by itself, is not combustion” because “unlike combustion, the pyrolysis process is endothermic and does not require the addition of oxygen (*i.e.*, the partial pressure of oxygen during a pyrolysis process is maintained close to zero).”⁹ In fact, a pyrolysis process by definition must EXCLUDE oxygen to produce the desired product.

AFPM agrees with this analysis and urges EPA to finalize these conclusions in relevant upcoming rules and extend them to gasification units. The key to the Agency’s analysis is to recognize that pyrolysis is a discrete process that does not entail “combustion.” In some applications, certain products of a pyrolysis unit may be routed to a combustion device. But the subsequent combustion of pyrolysis gas byproducts does not cause the pyrolysis unit itself to be a combustion unit that is susceptible to regulation under CAA §129.

Interestingly, while CAA §129 applies broadly to “solid waste combustion,” the term “combustion” is not defined in §129 or elsewhere in the CAA. That likely is because the term “combustion” has such a well-established common meaning that defining the term was deemed unnecessary by the drafters. It is indisputable that combustion is synonymous with burning.¹⁰ Moreover, it is commonly understood that the goal of combustion or burning is to promote the reaction of the fuel or raw material with oxygen, usually with the goal of maximizing the conversion of the fuel or raw material to carbon dioxide, water, and other trace products of combustion. Indeed, the whole purpose of CAA §129 is to require waste combustors to operate as cleanly and efficiently as possible. Among other things, that means complete combustion of the solid waste feedstock.

In contrast, pyrolysis plainly does not entail combustion because the process is designed to minimize or virtually eliminate the presence of oxygen in order to produce hydrocarbon liquids, avoiding production of carbon dioxide, water, and other trace products of combustion. In other words, pyrolysis units are carefully designed and operated to prevent the “combustion” or “burning” of the feedstock. Consistent with these principles, EPA correctly explains in the ANPRM that “[p]yrolysis is a process where materials are thermally decomposed or rearranged under process conditions where extremely little to no oxygen is present.”¹¹ Also, as noted above, EPA explains in the ANPR that pyrolysis reactions are endothermic, which means that energy must be added to the reaction to obtain the desired reaction products. Combustion is commonly understood to be an exothermic reaction – *i.e.*, one that produces rather than consumes energy.

⁸ *Id.* 85 Fed. Reg. 54188

⁹ *Id.*

¹⁰ See, e.g., www.merriam-webster.com/dictionary/combustion (“combustion” means “an act or instance of burning”).

¹¹ See 86 Fed. Reg. at 50299.

Similarly, the object of a gasification unit is not to burn the feedstock. Instead, gasification units are designed to produce a value-added gaseous product (“syngas”) that is subsequently used for conversion to value added hydrocarbons, alcohols, or other products. In gasification units, the amount of oxygen is carefully controlled to produce syngas and avoid production of carbon dioxide, water, and other trace products of combustion. In other words, as with pyrolysis units, the entire purpose of a gasification unit is to prevent burning of the feedstock. As EPA explains in the ANPRM, “[o]xygen (as air, concentrated oxygen, or steam) is added in small amounts to maintain a reducing (*i.e.*, oxidation or combustion-preventing) atmosphere, where the quantity of oxygen available is less than the stoichiometric ratio (*i.e.*, amount needed for complete combustion of the feed material).”¹²

In sum, neither pyrolysis nor gasification entails combustion and, thus, neither process is subject to regulation under CAA §129. We note that this conclusion holds true even when the feedstock to a pyrolysis or combustion unit is solid waste. The key here is that these units are not combustion units, which remains the case whether or not the feedstock is solid waste.

In the OSWI proposal, EPA continues its analysis by asserting that combustion of the output of a pyrolysis unit in a downstream combustion unit does not constitute combustion of a solid waste – even when the feedstock to the pyrolysis unit is solid waste – because the gaseous products of a pyrolysis unit constitute “uncontained gas.” EPA’s solid waste definition encompasses “contained gas” (*i.e.*, gases that are in a container when that container is combusted”), but “pyrolysis gas is not placed into a container and then combusted” in a pyrolysis/combustion unit. Therefore, the output of the pyrolysis unit is not a solid waste.¹³

AFPM concurs with this analysis and recommends that EPA extend its conclusion to include gasification units. As in pyrolysis units, the output of the gasification unit is a valuable chemical building block, namely syngas. Syngas is not a solid waste and therefore any downstream combustion unit is not a solid waste incinerator. In addition, syngas, which is the primary product of gasification (carbon monoxide and hydrogen) and carbon dioxide can be used as a fuel or a chemical feedstock to produce other materials.

2.2 Adverse Comments on the 2020 OSWI Proposal Were Unconvincing and Wrong.

EPA notes in the ANPRM that it received “adverse comment” on its proposal that pyrolysis should be considered solid waste combustion and that pyrolysis/gasification units should be regulated under the OSWI rule and not regulated under CAA §129.¹⁴ Those comments are not persuasive and provide no credible grounds for changing EPA’s proposed determination. The key adverse comments on EPA’s proposed approach to pyrolysis/gasification units presented four main arguments.¹⁵ First, the commenters argued that “the pyrolysis process is

¹² *Id.* at 50300.

¹³ *See* 85 Fed. Reg. at 54187.

¹⁴ *See* 86 Fed. Reg. at 50301

¹⁵ *See* Comments of Earthjustice on Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Other Solid Waste Incineration Units; Review, 85 Fed. Reg. 54,178 (August 31, 2020), Docket No. HQ-OAR-2003-0156-0185 <https://www.regulations.gov/comment/EPA-HQ-OAR-2003-0156-0185>.

combustion” because “there is oxygen in the primary combustion chamber, and that oxygen is combined with carbon in a combustion process.” The commenters assert that “this reaction is not actually endothermic ... but exothermic” and “[b]ecause it is an oxidation reaction that produces heat, pyrolysis is combustion.”¹⁶

That argument makes no sense because pyrolysis by definition is conversion of hydrocarbons in the *absence* of oxygen. The commentor is confusing combustion and pyrolysis, two totally different processes. Pyrolysis processes inherently have multiple chemical reactions because they involve free-radical reactions at elevated temperatures. Pyrolysis units are designed to minimize or virtually eliminate the presence of oxygen. It is illogical to define a pyrolysis unit as a combustion unit when the design is intended to minimize or eliminate oxygen and oxidation reactions.

The second argument presented by adverse commenters is that “the gases in pyrolysis units are “contained” within the meaning of the solid waste definition in RCRA” because “[t]he gases are, at all times, in one combustion chamber or the other [*i.e.*, in the pyrolysis component of the unit or in the actual combustion chamber].”¹⁷ This argument is wholly without merit because “contained gases” are defined as gases that are in a container (e.g., a cylinder) when combusted. There is simply no reasonable way to interpret the definition of solid waste such that a combustion unit itself is a “container” and that any gas processed in the unit is “contained gas.” A combustion unit is a processing apparatus. A sphere or cylinder is a container.

Third, the adverse commenters argued that “[e]ven if the gases in the secondary combustion chamber are not “contained” they are derived from solid waste and are, therefore, solid waste themselves.”¹⁸ This is plainly wrong because there is no “derived from” rule applicable to the definition of solid waste. That concept applies only to hazardous waste.

Fourth, and lastly, the adverse commenters assert that “the pyrolysis process does not produce just gases but, in reality, a combination of gases, liquids and solids.” Because “solids and liquids” are sent to the combustion unit, “at least some materials [combusted in that unit] satisfy the definition of solid waste – even if the gases they burn are not “contained.”¹⁹ In a pyrolysis process, solids and liquids are NOT sent to a combustion unit; they are isolated as products. As an initial matter, the commenters failed to provide any documentation or citations to support their assertions that solids result in gas streams sent to a combustion unit from pyrolysis or gasification. Their bare, unsupported factual assertions cannot be given weight. More importantly, even if the commenters are factually correct, it is reasonable for EPA to conclude that the gas streams from of a pyrolysis unit should be treated as a gas, even if there are minor amounts of solids and liquids. The law does not demand perfection. Regulating the gaseous streams from a pyrolysis unit as a gas because it mostly (but not completely) is gaseous is a reasonable exercise of EPA’s authority.

¹⁶ *Id.* at 5.

¹⁷ *Id.* at 6.

¹⁸ *Id.*

¹⁹ *Id.*

2.3 Pyrolysis and Gasification are Widely Used Processes. EPA Must be Careful to Avoid Regulatory Overlap and Unintended Consequences.

It is clear that the Agency understands that pyrolysis and gasification processes have long been used in a wide variety of applications. EPA observes that “[p]yrolysis units have been used for decades in the production of olefins such as ethylene and propylene, and similarly, gasification units have been used for many years in the production of fuel gas from coal.”²⁰ On the other hand, EPA states in the ANPRM that “the United States is in the early stages in development of pyrolysis and gasification technologies” and expressly is seeking “real-world cost, design, process, and environmental information about these technologies, especially for those that have advanced beyond laboratory-scale or bench-scale research and development stages to operational pilot-scale plants or facilities that are already in commercial operation.”²¹

So the focus of the ANPRM is not all pyrolysis and gasification operations, but rather a much smaller subset of pyrolysis or gasification operations that are being developed for processing “solid or semi-solid feedstocks, including solid waste [], biomass, plastics, tires, and organic contaminants in soils and oily sludges to useful products such as energy, fuels and chemical commodities.”²² The list of potentially relevant facilities included in the ANPRM seems to confirm the Agency’s much narrower scope of inquiry.

This highlights the importance of precisely defining the scope of potentially affected facilities to make sure that any future regulatory activity is appropriately targeted. EPA admits in the ANPRM that it is unsure how to characterize the facilities on which it is focusing and explains that a major goal of the current effort is to better define the types of pyrolysis and gasification operations that might warrant regulation under the CAA. So, it is not possible at this time to recommend definitions that would appropriately target the relevant facilities.

But it already is possible to identify groups of pyrolysis and gasification operations that should not be included. Most importantly, facilities already subject to regulation under CAA §§111 or 112 should be excluded from this effort – for example, ethylene plants (ethane or naphtha crackers), which already are covered by §112 National Emission Standards for Hazardous Air Pollutants (NESHAP), and clean-up projects covered by the site remediation NESHAP. Avoiding regulatory overlap must be a high priority as EPA continues this effort.

2.4 If EPA Considers Regulating new Types of Pyrolysis or Gasification Processes Under CAA sections 111 or 112, the Agency may Establish Regulations Only if the Statutory Threshold Criteria are met.

While the ANPRM seems motivated in part by a concern that certain pyrolysis and gasification operations may not currently be covered by CAA emissions standards under §§111, 112, or 129, such an outcome may be appropriate, such as where there are no harmful emissions to the environment. For example, air pollutants emitted from a given source category may be regulated under CAA §111 only if the Administrator finds that the emissions cause or contribute

²⁰ See 86 Fed. Reg. at 50299.

²¹ *Id.* at 50301-2

²² *Id.* at 50296.

significantly to air pollution which may reasonably be anticipated to endanger public health or welfare.²³ Under CAA §112, EPA must regulate every major source category and may regulate area source categories if specified findings are made by the Administrator.²⁴

Because the scope of affected facilities remains uncertain, it currently is not possible to determine how the affected facilities might be logically grouped into one or more source categories. It is further not possible, for now, to determine whether any new source category might satisfy the criteria authorizing regulation under CAA §§111, 112, or 129. But EPA should not prejudge the outcome and should wait until more is known to determine whether additional regulations are necessary or authorized under the CAA.

Note that a determination that additional federal emissions standards are not needed would not mean that affected facilities would not be appropriately regulated under the CAA. Such facilities still would be subject to Title I minor and major new source permitting programs, which would assure that emissions do not cause or contribute to nonattainment with national ambient air quality standards (“NAAQS”). Many such facilities also would need Title V permits. Moreover, state implementation plans may prescribe category-specific standards, such as RACT requirements, as needed to attain the NAAQS. And it is common for states to have additional requirements in their preconstruction permitting programs, such as some sort of “best available technology” requirement for new and modified sources. All of this means that emissions from affected facilities will be appropriately regulated even in the absence of federal emissions standards.

2.5 Advanced Recycling Processes Should be Treated as Manufacturing Processes, not as Waste or Incineration Processes

The most predominant process used for advanced recycling, especially molecular recycling, is pyrolysis. Like many manufacturing processes, pyrolysis is not explicitly defined in the Clean Air Act or its amendments. As pointed out earlier in these comments, pyrolysis does not involve oxygen nor is it a combustion process. Pyrolysis is a process by which larger hydrocarbon molecules are manufactured into smaller or more specialized hydrocarbon molecules than can be made into a wide variety of other manufacturing inputs; therefore, it is reasonable to categorize pyrolysis processes as being near the top of the supply chain for myriad manufacturing processes.

Manufactured petrochemical products, most of which are derived from pyrolysis products, are part of supply chains ranging from pharmaceuticals to electronics, all the way through to automotive and aerospace manufacturing. Manufactured pyrolysis products and their derivatives can also be found in goods, such as personal protective equipment, identified by multiple federal agencies as critical to the security of the United States. It is unreasonable to isolate pyrolysis processes related to advanced recycling and categorize them differently than other pyrolysis processes. Categorization of processes should be based on physics and chemistry.

²³ See CAA §111(b)(1)(A).

²⁴ See CAA §§112(c)(1) and (c)(3).

Manufacturing processes are already regulated under the Clean Air Act, including petroleum refining and petrochemical manufacturing. Many of the refining and petrochemical processes employ pyrolysis units to manufacture specific products that are used as building blocks for many different manufacturing supply chains. AFPM strongly urges EPA to consider pyrolysis processes, irrespective of their feedstocks, as being near the top of the manufacturing supply chain and to regulate those processes as it would similar manufacturing processes.

To further illustrate that advanced recycling and gasification processes should not be considered a waste or incineration process but rather a manufacturing process, EPA should look to the Fourteen States that have provided a roadmap on how to define Pyrolysis and Gasification Units and processes involved in advanced recycling. Since 2017, these states have enacted laws appropriately defining advanced recycling as a manufacturing process, as opposed to solid waste disposal or incineration. While laws passed have varied between states, each of these states have recognized that pyrolysis and gasification units involved in advanced recycling should be considered as manufacturing processes because advanced recycling facilities receive plastics feedstock as a raw material and manufacture it into a higher-value commodity in processes that do not involve combustion or incineration.

In early filed comments, some stakeholders expressed the viewpoint that converting plastics to fuel should not be considered recycling and EPA should clearly state this as part of this rulemaking. This ANPRM does not, and should not, be focused on definitions of recycling as its focus is on what processes should be regulated under the CAA. Definitions of recycling are immaterial to the statutory authority of the CAA. AFPM urges EPA to maintain its focus on whether pyrolysis and gasification are combustion processes and thus regulated under CAA. As stated clearly in these comments, these processes (pyrolysis and gasification) do not include combustion and should not be regulated under CAA section 129.

3.0 AFPM COMMENTS ON DATA COLLECTION

The information EPA is requesting likely includes sensitive business information. Much of the information that EPA is requesting in the ANPRM is proprietary and typically protected from disclosure through contractual agreements, nondisclosure agreements, licensing agreements, and other such legal tools. The advanced recycling technologies employed at American manufacturing sites are considered cutting-edge and give American manufacturers a distinct competitive advantage over competitors using conventional means to recycle used plastics into value-added materials.

EPA should not attempt to conduct an information collection through regulatory means, which would result in enormous resources being spent to collect and protect Confidential Business Information. AFPM strongly recommends EPA to conduct one-on-one outreach to technology owners to educate the Agency on advanced recycling processes.

4.0 CONCLUSION

AFPM appreciates the opportunity to comment on this important issue. AFPM members are committed to addressing environmental issues including reducing emissions and preventing the

leakage of plastic waste into the environment. Petrochemical producers recognize the potential that advanced recycling has to complement mechanical recycling and increase overall recycling rates thus reducing the leakage of plastic waste in the environment. Petrochemical manufacturers are driving real breakthroughs in advanced recycling using pyrolysis and gasification. As our comments state, AFPM has concerns with EPA regulating pyrolysis and gasification units as combustion or incineration processes under the CAA. We respectfully ask EPA to consider our comments and avoid regulations that will hinder the development of advanced recycling.

Sincerely,

A handwritten signature in blue ink, appearing to read "Rob Benedict".

Rob Benedict
Vice President, Petrochemicals & Midstream
American Fuel & Petrochemical Manufacturers