SCREENING-LEVEL HAZARD CHARACTERIZATION

Petroleum Hydrocarbon Gases Category

SUBCATEGORY I: HYDROCARBON GASES, C1–C4

SPONSORED CHEMICALS
(See Appendix)

SUPPORTING CHEMICALS

1-Butene	**CASRN 106-98-9**
2-Butene	**CASRN 107-01-7**
Ethylene	**CASRN 74-85-1**
1-Propene, 2-methyl-	**CASRN 115-11-7**

SUBCATEGORY II: HYDROCARBON GASES, C1–C4 WITH 1,3-BUTADIENE

SPONSORED CHEMICALS
(See Appendix)

SUPPORTING CHEMICALS
Subcategory I supporting chemicals (see above)

1,3-Butadiene	**CASRN 106-99-0**

SUBCATEGORY III: HYDROCARBON GASES, C1–C6

SPONSORED CHEMICALS
(See Appendix)

SUPPORTING CHEMICALS
Subcategory I supporting chemicals (see above)

Light catalytic cracked naphtha	**CASRN 64741-55-5**
Sweetened naphtha	**CASRN 64741-87-3**
Gasoline	**CASRN 86290-81-5**

SUBCATEGORY IV: HYDROCARBON GASES, C1–C6 WITH 1,3-BUTADIENE

SPONSORED CHEMICALS
(See Appendix)

SUPPORTING CHEMICALS
Subcategory III supporting chemicals (see above)
1,3-Butadiene CASRN 106-99-0

SUBCATEGORY V: HYDROCARBON GASES, C1–C6 WITH BENZENE

SPONSORED CHEMICALS
(See Appendix)

SUPPORTING CHEMICALS
Subcategory III supporting chemicals (see above)
Benzene CASRN 71-43-2

SUBCATEGORY VI: HYDROCARBON GASES, C1–C6 WITH 1,3-BUTADIENE AND BENZENE

SPONSORED CHEMICALS
Petroleum gases, liquefied CASRN 68476-85-7
Petroleum gases, liquefied, sweetened CASRN 68476-86-8
Gases (petroleum), C3 – 4, isobutane-rich CASRN 68477-33-8
Tail gas (petroleum), saturate gas plant mixed stream, C4-rich CASRN 68478-32-0

SUPPORTING CHEMICALS
Subcategory V supporting chemicals (see above)
1,3-Butadiene CASRN 106-99-0

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The High Production Volume (HPV) Challenge Program[1] was conceived as a voluntary initiative aimed at developing and making publicly available screening-level health and environmental effects information on chemicals manufactured in or imported into the United States in quantities greater than one million pounds per year. In the Challenge Program, producers and importers of HPV chemicals voluntarily sponsored chemicals; sponsorship entailed the identification and initial assessment of the adequacy of existing toxicity data/information, conducting new testing if adequate data did not exist, and making both new and existing data and information available to the public. Each complete data submission contains data on 18 internationally agreed to "SIDS" (Screening Information Data Set[1,2]) endpoints that are screening-level indicators of potential hazards (toxicity) for humans or the environment.

The Environmental Protection Agency's Office of Pollution Prevention and Toxics (OPPT) is evaluating the data submitted in the HPV Challenge Program on approximately 1400 sponsored chemicals by developing hazard characterizations (HCs). These HCs consist of an evaluation of the quality and completeness of the data set provided in the Challenge Program submissions. They are not intended to be definitive statements regarding the possibility of unreasonable risk of injury to health or the environment.

The evaluation is performed according to established EPA guidance[2,3] and is based primarily on hazard data provided by sponsors; however, in preparing the hazard characterization, EPA considered its own comments and public comments on the original submission as well as the sponsor's responses to comments and revisions made to the submission. In order to determine whether any new hazard information was developed since the time of the HPV submission, a search of the following databases was made from one year prior to the date of the HPV Challenge submission to the present: (ChemID to locate available data sources including Medline/PubMed, Toxline, HSDB, IRIS, NTP, ATSDR, IARC, EXTOXNET, EPA SRS, etc.), STN/CAS online databases (Registry file for locators, ChemAbs for toxicology data, RTECS, Merck, etc.) and Science Direct. OPPT's focus on these specific sources is based on their being of high quality, highly relevant to hazard characterization, and publicly available.

OPPT does not develop HCs for those HPV chemicals which have already been assessed internationally through the HPV program of the Organization for Economic Cooperation and Development (OECD) and for which Screening Initial Data Set (SIDS) Initial Assessment Reports (SIAR) and SIDS Initial Assessment Profiles (SIAP) are available. These documents are presented in an international forum that involves review and endorsement by governmental authorities around the world. OPPT is an active participant in these meetings and accepts these documents as reliable screening-level hazard assessments.

These hazard characterizations are technical documents intended to inform subsequent decisions and actions by OPPT. Accordingly, the documents are not written with the goal of informing the general public. However, they do provide a vehicle for public access to a concise assessment of the raw technical data on HPV chemicals and provide information previously not readily available to the public.

[1] U.S. EPA. High Production Volume (HPV) Challenge Program; http://www.epa.gov/chemrtk/index.htm.
[2] U.S. EPA. HPV Challenge Program – Information Sources; http://www.epa.gov/chemrtk/pubs/general/guidocs.htm.
[3] U.S. EPA. Risk Assessment Guidelines; http://cfpub.epa.gov/ncea/raf/rafguid.cfm.

Chemical Abstract Service Registry Number (CASRN)	**Sponsored Chemicals** **See Appendix** **Supporting Chemicals** **See Appendix**
Chemical Abstract Index Name	
Structural Formula	

Summary

The petroleum hydrocarbon gases category consists of 99 gaseous substances or highly volatile liquids that arise from natural gas processing and petroleum refining operations. Of these substances, 10 compounds are individual chemicals and 89 are complex mixtures. The components of this category are gases or volatile liquids that possess high vapor pressure and moderate to high water solubility. They are expected to possess moderate to high mobility in soil. Volatilization is expected to be high based on their Henry's Law constants. The rate of hydrolysis is expected to be negligible. The rate of atmospheric photooxidation is expected to be negligible to rapid for the members of this category. The members of the petroleum hydrocarbon gases category are expected to possess low persistence (P1) and low bioaccumulation potential (B1).

Human Health Hazard

Subcategory I: Hydrocarbon gases, C1 – C4

The acute inhalation toxicity of CASRN 115-07-1 and the supporting chemical, CASRN 107-01-7 in rats is low. Rats repeatedly exposed via inhalation to CASRN 115-07-1 for up to 14-weeks showed no adverse treatment-related effects; the NOAEC for systemic toxicity is 10,000 ppm/day (highest concentration tested). In combined inhalation repeated-dose/reproductive/developmental toxicity screening tests in rats, CASRNs 74-84-0, 75-28-5, 106-97-8 and 106-98-9 (supporting chemical) showed no adverse treatment-related effects; the NOAECs for systemic toxicity are 15,502 ppm/day, 9148 ppm/day, 9157 ppm/day and 8000 ppm/day, respectively (highest concentrations tested). In a combined inhalation repeated-dose/reproductive/developmental toxicity screening test in rats, CASRN 74-98-6 showed decreased body weight gain in males, and hematological effects in females at 12,168 ppm/day; the NOAEC for systemic toxicity is 3990 ppm/day. The supporting chemicals, CASRNs 74-85-1, 107-01-7 and 115-11-7 showed no treatment-related effects with repeated inhalation exposure in rats; the NOAECs for systemic toxicity range from 5009 ppm/day (CASRN 107-01-7) to 10,000 ppm/day (CASRN 74-85-1, highest concentrations tested). The supporting chemical, CASRN 115-11-7, showed no treatment-related effects after 14 weeks of repeated inhalation exposure in mice; the NOAEC for systemic toxicity is 7980 ppm/day (highest concentration tested). In the combined repeated-dose/reproductive/developmental screening tests previously mentioned, CASRNs 74-84-0, 106-97-8 and the supporting chemicals CASRNs 107-01-7 and CASRN 106-98-9 showed no treatment-related effects on reproduction; the NOAECs for reproductive/maternal/developmental toxicity in rats are15,502 ppm/day, 9157 ppm/day, 5009 ppm/day and 8000 ppm/day, respectively (highest concentrations tested). Repeated inhalation exposure with CASRN 75-28-5 in rats showed decreased fertility and increased post-

implantation loss at 9148 ppm; the NOAEC for reproductive toxicity is 3122 ppm/day and the NOAEC for maternal/developmental toxicity is 9148 ppm/day (highest concentration tested). The combined repeated-dose/reproductive/developmental screening test with CASRN 74-98-6 in rats, showed a decrease in the number of live pups and an increase in the number of stillborn pups after inhalation exposure at 3990 ppm/day; the NOAEC for reproductive/developmental toxicity is 1230 ppm/day. Based on the systemic effects observed at 12,168 ppm/day (decreased body weight gain and hematological effects), the NOAEC for maternal toxicity is 3990 ppm/day. No specific reproductive toxicity studies are available for CASRN 115-11-7 (supporting chemical); however, in the 14-week inhalation repeated-dose toxicity study described above, there was a decrease in sperm motility at 7970 ppm/day. However, no adverse developmental effects were observed in the prenatal developmental toxicity study in rats; for CASRN 115-11-7 the NOAEC for maternal/developmental toxicity is 18.4 mg/L/day (highest concentration tested). In a combined inhalation reproductive/developmental toxicity screening test in rats, the supporting chemical, CASRN 74-85-1 showed no adverse effects; the NOAEC for reproductive/maternal/developmental toxicity is 10,000 ppm/day (highest concentration tested). In an inhalation prenatal developmental toxicity study in rats, CASRN 115-07-1 showed no treatment-related effects; the NOAEC for maternal/developmental toxicity is 10,000 ppm/day (highest concentration tested). CASRN 115-07-1 induced gene mutations in bacteria, but was equivocal for mutagenicity in mouse lymphoma cells *in vitro*. CASRNs 74-82-8 and 106-97-8, as well as the supporting chemicals, CASRNs 74-85-1, 115-11-7, 106-98-9 and 107-01-7 did not induce gene mutations in bacteria or mouse lymphoma cells *in vitro*. CASRNs 74-85-1 and 107-01-7 (supporting chemicals) did not induce chromosomal aberrations in rat lymphocytes or Chinese hamster ovary (CHO) cells *in vitro* and CASRN 115-07-1 and the supporting chemicals CASRNs 74-85-1, 115-11-7 and 106-98-9 did not induce micronuclei in rats and/or mice *in vivo*. CASRN 115-07-1 was not carcinogenic in rats or mice when administered via the inhalation route of exposure. CASRN 115-11-7 increased the incidence of tumors in male rats but not female rats, or mice of both sexes.

No data gaps were identified under the HPV Challenge Program.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene

No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data in subcategory I can also be used to address the human health endpoints for subcategory II. Please see the human health summary for subcategory I above.

The acute inhalation toxicity of CASRN 106-99-0 is low in rats. Repeated-dose studies show the mouse to be more sensitive to CASRN 106-99-0 exposure than the rat. Several studies of inhalation exposure for up to two-years showed minimal effects in rats; the NOAEC for systemic toxicity is 7886 ppm/day. In a 14-week inhalation repeated-dose toxicity study in mice, CASRN 106-99-0 showed mortality at 1250 ppm/day; the NOAEC for systemic toxicity is 625 ppm/day. The most sensitive reproductive endpoint observed in subchronic studies with CASRN 106-99-0 was fetal deaths in dominant lethal studies in mice exposed by inhalation for 28-days at 65 ppm/day; the NOAEC for dominant lethal effects is 12.5 ppm/day. In two-year bioassays, the most sensitive reproductive effects were ovarian atrophy in female mice at 6.25 ppm/day and testicular atrophy in male mice at 625 ppm/day. The NOAEC for reproductive toxicity in female mice is not established and in male mice is 200 ppm/day. In a combined

reproductive/developmental toxicity screening test, rats exposed to CASRN 106-99-0 by vapor inhalation showed no effects on reproduction; the NOAEC for reproductive/developmental toxicity is 13.3 mg/L/day (highest concentration tested). Maternal toxicity, as evidenced by decreased body weight, was observed in dams treated at 3.3 mg/L; the NOAEC for maternal toxicity is 0.66 mg/L/day. Prenatal developmental toxicity studies in rats and mice showed decreased body weight gains in treated dams following inhalation exposure to CASRN 106-99-0 at 200 and 1000 ppm/day, in mice and rats, respectively. No effects on developmental parameters were observed in rats; the NOAECs for maternal and developmental toxicity are 200 ppm/day and 1000 ppm/day (highest concentration tested), respectively. Reduced fetal body weight was observed in male mice at 40 ppm/day; the NOAECs for maternal and developmental toxicity are not established. CASRN 106-99-0 was mutagenic in bacteria *in vitro* and induced chromosomal aberrations *in vivo*. CASRN 106-99-0 increased incidences of various tumors at multiple sites in rats and mice and there is "sufficient evidence" from epidemiologic studies of exposed workers to consider CASRN 106-99-0 carcinogenic to humans.

No data gaps were identified under the HPV Challenge Program.

Subcategory III: Hydrocarbon gases, C1-C6

The sponsored and supporting chemical data from subcategory I can also be used to address the human health endpoints for subcategory III. Please see human health summary for subcategory I above.

The acute oral, inhalation and dermal toxicity of subcategory III in rats is low. In 90-day vapor inhalation repeated-dose studies in rats, CASRNs 109-66-0 and 287-92-3 showed no adverse treatment-related effects; the NOAECs for systemic toxicity are 20 mg/L/day and 30 mg/L/day (highest concentrations tested), respectively. Rats exposed to the supporting chemical, CASRN 86290-81-5 by inhalation for 13 weeks, showed no adverse treatement-related effects; the NOAEC for systemic toxicity is 20.3 mg/L/day (highest concentration tested). In an inhalation combined repeated-dose/reproductive/developmental toxicity screening test in rats, CASRN 513-35-9 showed heart leasions in males and longer clotting times in females at 2026 ppm/day; the NOAEC for systemic toxicity is 584 ppm/day. No effects on reproduction were observed; the NOAEC for reproductive/developmental toxicity is 7097 ppm/day (highest concentration tested). Based on the systemic effects described above, the NOAEC for maternal toxicity is 584 ppm/day. No specific reproductive toxicity studies are available for CASRN 109-66-0; however no effects were observed on the reproductive organs in rats following 90-day inhalation exposure. In an oral prenatal developmental toxicity study in rats, CASRN 109-66-0 showed no maternal or developmental effects; the NOAEC for maternal/developmental toxicity is 1000 mg/kg/day (highest dose tested). CASRNs 78-78-4, 109-66-0, 287-92-3 and 513-35-9 did not induce gene mutations in mouse lymphoma cells and bacteria *in vitro*. CASRN 109-66-0 was equivocal for chromosomal aberrations *in vitro* and negative in a rat micronuleus assay *in vivo*. CASRN 287-92-3 was positive in the absence, and negative in the presence of metabolic activation, for chromosomal aberrations *in vitro*, and negative in a mouse micronucleus assay *in vivo*. CASRN 513-35-9 did not induce chromosomal aberrations *in vitro* but induced micronuclei in rats and mice *in vivo*; whereas a micronuclei test of the same chemical was equivocal in hamsters. CASRN 86290-81-5 induced sister chromatid exchange in rats, but not in micronuclei *in vivo*. CASRN 78-78-4 is not irritating to the respiratory tract in mice and is not a skin sensitizer in guinea pigs. CASRN 109-66-0 is irritating to rabbit eyes, not irritating to

rabbit skin or the respiratory tract of mice and not a skin sensitizer in guinea pigs. CASRN 287-92-3 is moderately irritating to rabbit eyes and not irritating to rabbit skin. CASRN 513-35-9 is irritating to rabbit skin, but not to rabbit eyes. CASRN 287-92-3 is not irritating to rabbit skin, but is irritating to rabbit eyes. CASRN 513-35-9 is not a skin sensitizer in guinea pigs.

No data gaps were identified under the HPV Challenge Program.

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data from subcategories I, II and III can also be used to address the human health endpoints for subcategory IV. Please see these human health summaries.

No data gaps were identified under the HPV Challenge Program.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data from subcategories I and III can also be used to address the human health endpoints for subcategory V. Please see human health summaries for subcategories I and III above.

The acute oral and inhalation toxicity of CASRN 71-43-2 in rats is low and moderate, respectively. Repeated-dose studies with CASRN 71-43-2 show that the hematopoietic system is the most sensitive indicator of toxicity. Mice exposed repeatedly via vapor inhalation to CASRN 71-43-2 showed hematological effects [e.g. decreases in blood cell counts (RBC and WBC), platelets, hemoglobin, hematocrit], thymic atrophy and testicular effects at 0.96 mg/L/day; the NOAEC for systemic toxicity is0.1 mg/L/day. In a similar study in mice, designed to assess specific effects on hematology, increases in spleen weight, total nucleated cells per spleen and nucleated RBCs were seen at 0.03 mg/L; the NOAEC is not established. Repeated inhalation exposure of rats to CASRN 71-43-2 showed a decrease in WBC counts and percentage of lymphocytes at 0.96 mg/L/day; the NOAEC for hematological effects on peripheral blood circulation is 0.096 mg/L/day. Guideline reproductive toxicity studies are not available; however, in the 13-week inhalation exposures with CASRN 71-43-2 in mice, adverse effects were observed on the male and female reproductive organs. In a modified prenatal developmental toxicity study, female rats exposed to CASRN 71-43-2 via vapor inhalation pre- and post- mating and through lactation, had female pups with reduced body and liver weights at 0.96 mg/L/day; the NOAECs for maternal and developmental toxicity are 0.96 mg/L/day (highest concentration tested) and 0.096 mg/L/day, respectively. In an inhalation prenatal developmental toxicity study in mice, CASRN 71-43-2 showed effects on the hematopoietic system in offspring at 0.064 mg/L/day; the NOAECs for maternal and developmental toxicity are 0.064 mg/L/day (highest concentration tested) and 0.032 mg/L/day, respectively. CASRN 71-43-2 induced gene mutations in bacteria *in vitro*, sister chromatid exchange in human lymphocytes *in vitro* and in rat and mouse lymphocytes *in vivo*. CASRN 71-43-2 induced micronuclei in rats and mice *in vivo*.

No data gaps were identified under the HPV Challenge Program.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
The sponsored and supporting chemical data from subcategories I, II, III, IV and V can also be used to address the human health endpoints for subcategory IV. Please see these summaries.

In a 13-week repeated-dose inhalation toxicity study in rats, CASRN 68476-85-7 did not show consistent treatment-related effects; the NOAEC for systemic toxicity is 10,000 ppm/day (highest concentration tested). No specific reproductive toxicity studies are available for CASRN 68476-85-7; however, in the 13-week inhalation study, there was an increased incidence in the percent of abnormal sperm observed at 9996 ppm. No effects were observed on sperm count and motility. In an inhalation prenatal developmental toxicity study in rats, CASRN 68476-85-7 showed no maternal and developmental toxicity; the NOAEC for maternal/developmental toxicity is 19 mg/L/day (highest concentration tested). CASRN 68476-85-7 did not induce micronuclei in rats *in vivo*.

No data gaps were identified under the HPV Challenge Program.

Hazard to the Environment
The 96-h LC_{50} value for acute toxicity to fish for CASRN 109-66-0 is 4.26 mg/L: values for CASRNs 513-35-9 and 71-43-2 (supporting chemical) are within this range. The 48-h EC_{50} values for acute toxicity to aquatic invertebrates range from 2.7 mg/L (CASRN 109-66-0) to 10.5 mg/L (CASRN 287-92-3): values for CASRNs 513-35-9 and 74-85-1 (supporting chemical) are within this range. The 72-h EC_{50} values for aquatic plants range from 7.5 (CASRN 109-66-0) to 28 mg/L (CASRN 71-43-2, supporting chemical) for biomass and 10.7 (CASRN 109-66-0) to 72 mg/L (CASRN 74-85-1, supporting chemical) for growth rate. The 32-d NOEC chronic toxicity to fish for the supporting chemical, CASRN 71-43-2 is 0.8 mg/L.

No data gaps were identified under the HPV Challenge Program.

The sponsor, the American Petroleum Institute Petroleum HPV Testing Group, submitted a Test Plan and Robust Summaries to EPA for the Petroleum Hydrocarbon Gases Category on August 15, 2000. EPA posted the submission on the ChemRTK HPV Challenge website on September 11, 2000 (http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm). EPA comments on the original submission were posted to the website on January 9, 2001. Public comments were also received and posted to the website. The sponsor submitted updated/revised documents on October 12, 2001, which were posted to the ChemRTK website on October 12, 2001. The sponsor submitted a final test plan and robust summaries on November 18, 2009, which were posted to the ChemRTK website on April 12, 2010. The substances of the petroleum hydrocarbon gases category are listed in the Appendix.

Category Justification

The petroleum hydrocarbon gases category consists of 99 gaseous substances (gases or highly volatile liquids) that are mainly produced in petroleum refineries as the light end fractions of numerous distillation and cracking processes, or in gas plants that separate natural gas and natural gas liquids. Of these, 10 substances are individual chemicals and 89 are mixtures. The mixtures are composed primarily of paraffinic and olefinic hydrocarbons, mostly containing one to six carbon atoms (C1 – C6). Some of the mixtures may contain varying amounts of other components, including benzene, C7 – C8 hydrocarbons, hydrogen, nitrogen and carbon dioxide. The sponsor provided compositional ranges for the sponsored chemicals, based on limited historical (1992 – 2002) data from several U.S. petrochemical and petroleum company refineries in the Gulf Coast and mid-continent areas. A complete list of hydrocarbons was not provided for each mixture; instead, most hydrocarbon constituents were placed into two broad classes: C1 – C4 and C5 – C6 hydrocarbons. The remaining constituents were 1,3-butadiene, benzene, hydrogen, nitrogen and carbon dioxide. The chemical compositions of category members, as provided by the sponsor, are presented in the Appendix in Table 8. Using these chemical compositions, for the human health endpoints, the petroleum gases category has been divided into several subcategories, which are defined by a range of hydrocarbon chain lengths with or without components known to have potentially high toxicity, i.e., 1,3-butadiene and benzene. The inorganic gases (hydrogen, nitrogen and carbon dioxide) have not been considered in the subcategory definitions due to their natural abundance. The chemical subcategories are defined in Table 1.

For ecotoxicity endpoints, the designations for Sub-Categories I-VI have been modified. Petroleum gases composed primarily of paraffinic and olefinic hydrocarbons with C1 – C8 carbon atoms will generally exert the same if not similar toxicity in an aquatic environment based on similar physical chemical properties. Therefore, the sub-categories have been eliminated and instead, all category members will be assessed as one category and will have the same supporting chemicals (see Table 2).

Table 1. Petroleum Hydrocarbon Gases Subcategories for Human Health Endpoints		
I	Hydrocarbon gases, C1 – C4	Paraffinic and olefinic hydrocarbons in the range of C1 – C4 (not including 1,3-butadiene)
II	Hydrocarbon gases, C1 – C4 with 1,3-Butadiene	Paraffinic and olefinic hydrocarbons in the range of C1 – C4, including 1,3-butadiene
III	Hydrocarbon gases, C1 – C6	Paraffinic and olefinic hydrocarbons in the range of C1 – C7, primarily C1 – C6 (not including 1,3-butadiene)
IV	Hydrocarbon gases, C1 – C6 with 1,3-Butadiene	Paraffinic and olefinic hydrocarbons in the range of C1 – C6, including 1,3-butadiene
V	Hydrocarbon gases, C1 – C6 with Benzene	Paraffinic and olefinic hydrocarbons in the range of C1 – C8, primarily C1 – C6 (not including 1,3-butadiene), and also containing benzene
VI	Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene	Paraffinic and olefinic hydrocarbons in the range of C1 – C8, primarily C1 – C6, including 1,3-butadiene, and also containing benzene

Table 2. Petroleum Hydrocarbon Gases Category for Ecotoxicity Endpoints		
Category	**Components**	**Organic components**
Category C Petroleum Gases	Hydrocarbon gases, C1 – C4, Hydrocarbon gases, C1 – C6, Hydrocarbon gases, C1 – C8	Paraffinic and olefinic hydrocarbons in the range of C1 – C4, Paraffinic and olefinic hydrocarbons in the range of C1 – C7, primarily C1 – C6, Paraffinic and olefinic hydrocarbons in the range of C1 – C6, all with or without 1,3-Butadiene, Paraffinic and olefinic hydrocarbons in the range of C1 – C8, primarily C1 – C6 with our without Benzene and/ or 1,3 Butadiene.
Supporting Chemicals	Ethylene	C2 olefin
	Benzene	C6 aromatic ring

Justification for Supporting Chemicals

The sponsor proposed the use of several supporting chemicals: 1-butene (CASRN 106-98-9), 2-butene (CASRN 107-01-7), 1,3-butadiene (CASRN 106-99-0), benzene (CASRN 71-43-2), carbon dioxide (CASRN 124-38-9), hydrogen (CASRN 1333-74-0), nitrogen (CASRN 7727-37-9), light catalytic cracked naphtha (CASRN 64741-55-5), sweetened naphtha (CASRN 64741-87-3), light alkylate naphtha (CASRN 64741-66-8), catalytically reformed naphtha (CASRN 68955-35-1) and gasoline (CASRN 86290-81-5). 1-Butene and 2-butene were accepted as supporting chemicals for all of the subcategories on the basis that these C4 hydrocarbons are some of "the most abundant components in petroleum gas streams," as stated in the sponsor's test plan dated October 12, 2001 (page 7). 1,3-Butadiene has been accepted as a supporting chemical for subcategories II, IV and VI because it is a

component of these subcategories. Benzene has been accepted as a supporting chemical for subcategories V and VI, as it is a component of these subcategories. Carbon dioxide, hydrogen or nitrogen are gases whose toxicity and environmental impact have been addressed elsewhere (see below).

The sponsor proposed the use of data from members of the gasoline blending stream category to describe the toxicity of C5 – C6 hydrocarbons. EPA will be preparing a hazard characterization document on the substances described in this category in the future. The gasoline blending streams are volatile liquid petroleum substances consisting of paraffinic, olefinic, naphthenic and aromatic hydrocarbons, with carbon numbers approximately in the range of C4 – C12 (as defined in the API Petroleum HPV Testing Group's test plan, dated 8/21/08). API 83-20, a sample of light catalytic cracked naphtha (CASRN 64741-55-5) , was accepted as a supporting chemical for subcategories that contain C5 – C6 hydrocarbons (III, IV, V and VI); API 83-20 contains 31% paraffins, 10% naphthenes, 46% olefins and 13% aromatics, with hydrocarbon chain lengths that are ~ 2% C4, ~ 45% C5 – C6 and ~ 53% > C6.[1] API 81-08, a sample of sweetened naphtha, was accepted as a supporting chemical for subcategories that contain C5 – C6 hydrocarbons (III, IV, V and VI); API 81-08 contains 72% paraffins, 21% naphthenes and 7% aromatics, with hydrocarbon chain lengths that are ~ 90% C5 – C6. API 83-19, a sample of light alkylate naphtha, was not accepted as an appropriate supporting chemical to describe the toxicity of C5 – C6 hydrocarbons because it contains only ~14% C5 – C6 hydrocarbons and ~82% > C6. API 83-05, a sample of catalytically reformed naphtha, was not accepted as an appropriate supporting chemical for petroleum hydrocarbon gases because it contains a high percentage (63%) of aromatic hydrocarbons, whereas petroleum hydrocarbons gases contain primarily alkanes and alkenes. API 99-01, a sample of unleaded gasoline vapor condensate, which was used as a supporting chemical for the gasoline blending stream category, was accepted as an appropriate supporting chemical for subcategories that contain C5 – C6 hydrocarbons (III, IV, V and VI); it contains ~ 86% paraffins, ~ 2% naphthenes, ~ 4% olefins and ~ 7% aromatics, with hydrocarbon chain lengths that are ~ 14% C4, ~ 72% C5 – C6 and ~ 12% > C6.[2] Additional samples of gasoline (composition not specified) were also accepted as supporting chemicals for the C5 – C6 petroleum hydrocarbon gases.

In addition to the supporting chemicals proposed by the sponsor, two additional supporting chemicals were included in this hazard characterization: ethylene (CASRN 74-85-1) and 1-propene, 2-methyl- (CASRN 115-11-7). The sponsor identified these substances as some of "the most abundant components in petroleum gas streams" in its test plan dated October 12, 2001 (page 7), and therefore, data from these substances were included to provide a more complete characterization of the potential hazards of petroleum hydrocarbon gases. Ethylene (C2) and 1-propene, 2-methyl- (C4) were used as supporting chemicals for all subcategories.

Further, for the human health endpoints, chemicals in Subcategory I may be used as supporting chemicals for all of the other subcategories because all subcategories may include hydrocarbons in the range of C1 – C4.

In cases where no data were submitted on the toxicity of sponsored substances, the toxicity is read across from other members of the subcategory or from supporting chemicals from that subcategory.

[1] The compositions of API 83-20, API 81-08, API 83-19 and API 83-05 were obtained from a document included in the final HPV submission for the gasoline blending streams category, submitted by the American Petroleum Institute (API) on behalf of the Petroleum HPV Testing Group. This information can be viewed at: http://www.epa.gov/chemrtk/pubs/summaries/gasnecat/c13409tc.htm.

[2] The composition of API 99-01 was provided by the sponsor in the robust summaries.

The sponsored substances and supporting chemicals are listed in Table 7 in the Appendix. For ecotoxicity purposes, EPA has determined ethylene (CASRN 74-85-1) and benzene (CASRN 71-43-2) are appropriate supporting chemicals based on similar physical-chemical properties, environmental fate and mechanism of toxic action.

The sponsored substances 1-propene (CASRN 115-07-1: SIAM 16; http://webnet.oecd.org/hpv/ui/Search.aspx), butane, 2-methyl- (CASRN 78-78-4: SIAM 26, C5 aliphatic hydrocarbon solvents category; http://webnet.oecd.org/hpv/ui/Search.aspx), *n*-pentane (CASRN 109-66-0: SIAM 13 and SIAM 26, C5 aliphatic hydrocarbon solvents category; http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=ed4e1315-0f28-4a6f-9563-9a88b20a66bf&idx=0), cyclopentane (CASRN 287-92-3: SIAM 26, C5 aliphatic hydrocarbon solvents category; http://webnet.oecd.org/hpv/ui/Search.aspx) and 2-butene, 2-methyl- (CASRN 513-35-9: SIAM 19; http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf) have been assessed in the OECD HPV program. The data can be viewed at the links provided in parentheses.

The toxicity of 1-butene (CASRN 106-98-9: SIAM 19, butenes category: http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012), 2-butene (CASRN 107-01-7: SIAM 19, butenes category; http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012), 1,3-butadiene (CASRN 106-99-0: SIAM 4; http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf), 1-propene, 2-methyl- (isobutylene, CASRN 115-11-7: SIAM 17 and SIAM 19, butenes category; http://www.chem.unep.ch/irptc/sids/OECDSIDS/115117.pdf and http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012, respectively) and benzene (CASRN 71-43-2: SIAM 21; http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf) have been assessed in the OECD HPV program. The data can be viewed at the links provided in parentheses. Ethylene (CASRN 74-85-1) was assessed in the OECD HPV program at SIAM 5: http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).

EPA IRIS assessments are also available for benzene (CASRN 71-43-2: http://www.epa.gov/ncea/iris/subst/0276.htm) and 1,3-butadiene (CASRN 106-99-0: http://www.epa.gov/ncea/iris/subst/0139.htm)

Some data for this hazard characterization were submitted in the HPV submissions for the low 1,3-butadiene C4 category, crude butadiene C4 category and propylene streams category and can also be viewed at http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm, http://www.epa.gov/chemrtk/pubs/summaries/olefins/c12064tc.htm and http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm, respectively. A hazard characterization for these categories is being prepared and will be available for viewing at http://iaspub.epa.gov/oppthpv/hpv_hc_characterization.get_report?doctype=2.

Methane (CASRN 74-82-8; sponsored substance) and carbon dioxide (CASRN 124-38-9; trace constituent of some sponsored substances) are greenhouse gases whose hazard to the environment is

described on the EPA website: http://www.epa.gov/climatechange/emissions/index.html. Hydrogen (trace) and nitrogen (~78%) are naturally occurring atmospheric gases.

1. Chemical Identity

The components of this category are gases or volatile liquids that possess high vapor pressure and moderate to high water solubility.

1.1 Identification and Purity

The Appendix contains both a table listing the predominant constituents for each stream and a figure showing how the streams are made and used.

1.2 Physical-Chemical Properties

The physical-chemical properties of the sponsored substances contained in the Petroleum Hydrocarbon Gases and its supporting chemicals are summarized in Table 3. A description of the complex mixtures used for this category or the chemical structures of the specific compounds is provided in the Appendix.

Note on representative structures: The structures chosen for each category member were largely based on the CAS definition included in the CAS registry name. This was supplemented with any information that could be gleaned from the refinery processes included in the CAS registry names and from the limited compositional data provided by the sponsor in the Test Plan. It should be understood that each category member consists of many hydrocarbon substances, well beyond the three or four substances shown in the Appendix for most members. The representative structures are meant to show the range of carbon numbers present in each complex mixture.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory I: Hydrocarbon gases, C1 – C4									
Property	**SPONSORED CHEMICAL Methane**	**SPONSORED CHEMICAL Ethane**	**SPONSORED CHEMICAL Propane**	**SPONSORED CHEMICAL 1-Propene**	**SPONSORED CHEMICAL Propane, 2-methyl-**	**SPONSORED CHEMICAL Butane**	**SPONSORED CHEMICAL Natural gas[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer[2]**	**SPONSORED CHEMICAL Natural gas, dried[2]**
CASRN	74-82-8	74-84-0	74-98-6	115-07-1	75-28-5	106-97-8	8006-14-2	68308-11-2	68410-63-9
Molecular Weight	16.04	30.07	44.10	42.08	58.12	58.12	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas								
Melting Point	-182.4°C (measured)[3]	-182.8°C (measured)[3]	-187.6°C (measured)[3]	-185°C (measured)[3]	-138.3°C (measured)[3]	-138.2°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-182.8 to -182.4°C (measured)[3]
Boiling Point	-161.5°C (measured)[3]	-88.6°C (measured)[3]	-42.1°C (measured)[3]	-48°C (measured)[3]	-11.7°C (measured)[3]	-0.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to -88.6°C (measured)[3]
Vapor Pressure	4.66×10^5 mm Hg at 25°C (measured)[3]	3.15×10^4 mm Hg at 25°C (measured)[3]	7,150 mm Hg at 25°C (measured)[3]	8,690 mm Hg at 25°C (measured)[3]	2,610 mm Hg at 25°C (measured)[3]	1,820 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]	3.15×10^4 to 4.66×10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.66 atm-m^3/mol (measured)[3]	0.500 atm-m^3/mol (measured)[3]	0.707 atm-m^3/mol (measured)[3]	0.196 atm-m^3/mol (measured)[3]	1.19 atm-m^3/mol (measured)[3]	0.95 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.500 to 0.66 atm-m^3/mol (measured)[3]
Water Solubility	22 mg/L at 25°C (measured)[3]	60.2 mg/L at 25°C (measured)[3]	62.4 mg/L at 25°C (measured)[3]	200 mg/L at 25°C (measured)[3]	48.8 mg/L at 25°C (measured)[3]	61.2 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 60.2 mg/L at 25°C (measured)[3]
Log K_{ow}	1.09 (measured)[3]	1.81 (measured)[3]	2.36 (measured)[3]	1.77 (measured)[3]	2.76 (measured)[3]	2.89 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.40 (measured)[3]	1.09–1.81 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.

[2] Raw natural gas contains roughly 70–90% methane (CASRN 74-82-8) and 0–20% ethane (CASRN 74-84-0), propane (CASRN 74-98-6), and butane (CASRN 106-97-8), as well as O_2, N_2, and H_2S. Data range is based upon the representative structures; see Appendix for detailed information on the structures.

[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases [1]									
Subcategory I: Hydrocarbon gases, C1 – C4 (*continued*)									
Property	**SPONSORED CHEMICAL Alkanes, C1 – 2[2]**	**SPONSORED CHEMICAL Alkanes, C2 – 3[2]**	**SPONSORED CHEMICAL Alkanes, C3 – 4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C2 – 4, C3-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), C2 – 3[2]**	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 3[2]**
CASRN	68475-57-0	68475-58-1	68475-59-2	68476-49-3	68477-70-3	68477-86-1	68477-88-3	68477-90-7	68527-16-2
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas								
Melting Point	-182.8 to -182.4°C (measured)[3]	-187.6 to -182.8°C (measured)[3]	-187.6 to -135.2°C (measured)[3]	-187.6 to -185°C (measured)[3]	-187.6 to -169°C (measured)[3]	-182.8 to -169°C (measured)[3]	-187.6°C (measured)[3]	-187.6 to -182.5°C (measured)[3]	-187.6 to -182.4°C (measured)[3]
Boiling Point	-161.5 to -88.6°C (measured)[3]	-88.6 to -42.1°C (measured[3]	-42.1 to -0.5°C (measured)[3]	-48 to -42.1°C (measured)[3]	-103.7 to -42.1°C (measured)[3]	-103.7 to -88.6°C (measured)[3]	-42.1°C (measured)[3]	-88.6 to -42.1°C (measured)[3]	-161.5 to -42.1°C (measured)[3]
Vapor Pressure	3.15×10^4 to 4.66×10^5 mm Hg at 25°C (measured[3]	7,150 to 3.15×10^4 mm Hg at 25°C (measured)[3]	1,820 to 7,150 mm Hg at 25°C (measured)[3]	7,150 to 8,690 mm Hg at 25°C (measured)[3]	7,150 to 5.21×10^4 mm Hg at 25°C (measured)[3]	3.15×10^4 to 5.21×10^4 mm Hg at 25°C (measured)[3]	7,150 mm Hg at 25°C (measured)[3]	7,150 to 3.15×10^4 mm Hg at 25°C (measured)[3]	7,150 to 4.66×10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.500 to 0.66 atm-m^3/mol (measured)[3]	0.500 to 0.707 atm-m^3/mol (measured)[3]	0.707 to 0.95 atm-m^3/mol (measured)[3]	0.196 to 0.707 atm-m^3/mol (measured)[3]	0.196 to 0.707 atm-m^3/mol (measured)[3]	0.228 to 0.500 atm-m^3/mol (measured)[3]	0.707 atm-m^3/mol (measured)[3]	0.196 to 0.707 atm-m^3/mol (measured)[3]	0.500 to 0.707 atm-m^3/mol (measured)[3]
Water Solubility	22 to 60.2 mg/L at 25°C (measured)[3]	60.2 to 62.4 mg/L at 25°C (measured)[3]	61.2 to 62.4 mg/L at 25°C (measured)[3]	62.4 to 200 mg/L at 25°C (measured)[3]	60.2 to 200 mg/L at 25°C (measured)[3]	60.2 to 131 mg/L at 25°C (measured)[3]	62.4 mg/L at 25°C (measured)[3]	60.2 to 200 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases [1]

Subcategory I: Hydrocarbon gases, C1 – C4 (*continued*)

Property	SPONSORED CHEMICAL **Alkanes, C1 – 2**[2]	SPONSORED CHEMICAL **Alkanes, C2 – 3**[2]	SPONSORED CHEMICAL **Alkanes, C3 – 4**[2]	SPONSORED CHEMICAL **Hydrocarbons, C2 – 4, C3-rich**[2]	SPONSORED CHEMICAL **Gases (petroleum), C2 – 3**[2]	SPONSORED CHEMICAL **Gases (petroleum), deethanizer overheads**[2]	SPONSORED CHEMICAL **Gases (petroleum), deethanizer overheads, C3-rich**[2]	SPONSORED CHEMICAL **Gases (petroleum), depropanizer dry, propene-rich**[2]	SPONSORED CHEMICAL **Hydrocarbons, C1 – 3**[2]
Log K_{ow}	1.09–1.81 (measured)[3]	1.81–2.36 (measured)[3]	2.36–2.89 (measured)[3]	1.77–2.36 (measured)[3]	1.13–2.36 (measured)[3]	1.13–1.81 (measured)[3]	2.36 (measured)[3]	1.77–2.36 (measured)[3]	1.09–2.36 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]				
Subcategory I: Hydrocarbon gases, C1 – C4 (*continued*)				
Property	**SPONSORED CHEMICAL Hydrocarbons, C3[2]**	**SPONSORED CHEMICAL Fuel gases, refinery, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead[2]**
CASRN	68606-26-8	68918-98-9	68919-20-0	68955-34-0
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas			
Melting Point	-187.6 to -185°C (measured)[4]	-187.6 to -182.4°C (measured)[4]	-187.6 to -185°C (measured)[4]	-182.8°C (measured)[4]
Boiling Point	-48 to -42.1°C (measured)[4]	-161.5 to -42.1°C (measured)[4]	-48 to -42.1°C (measured)[4]	-88.6°C (measured)[4]
Vapor Pressure	7,150 to 8,690 mm Hg at 25°C (measured)[4]	7,150 to 4.66 × 10^5 mm Hg at 25°C (measured)[4]	7,150 to 8,690 mm Hg at 25°C (measured)[4]	3.15 ×10^4 mm Hg at 25°C (measured)[4]
Dissociation Constant (pK_a)	Not applicable			
Henry's Law Constant	0.196 to 0.707 atm-m^3/mol (measured)[4]	0.500 to 0.707 atm-m^3/mol (measured)[4]	0.196 to 0.707 atm-m^3/mol (measured)[4]	0.500 atm-m^3/mol (measured)[4]
Water Solubility	62.4 to 200 mg/L at 25°C (measured)[4]	22 to 62.4 mg/L at 25°C (measured)[4]	62.4 to 200 mg/L at 25°C (measured)[4]	60.2 mg/L at 25°C (measured)[4]
Log K_{ow}	1.77–2.36 (measured)[4]	1.09–2.36 (measured)[4]	1.77–2.36 (measured)[4]	1.81 (measured)[4]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] Data range is for both isomers: 2-Butene, (2Z)- (CASRN 590-18-1) and 2-Butene, (2E)- (CASRN 624-64-6).
[4] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]						
Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene						
Property	**SPONSORED CHEMICAL Gases (petroleum), C3 – 4[2]**	**SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 4, sweetened[2]**	**SPONSORED CHEMICAL Hydrocarbons, C2 – 4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C4-unsatd.[2]**
CASRN	68131-75-9	68477-94-1	68514-31-8	68514-36-3	68606-25-7	68956-54-7
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas					
Melting Point	-187.6 to -185°C (measured)[3]	-187.6°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-187.6 to -182.8°C (measured)[3]	-185.3 to -108.9°C (measured)[3]
Boiling Point	-48 to -42.1°C (measured)[3]	-42.1°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-88.6 to -6.2°C (measured)[3]	-6.2 to -4.4°C (measured)[3]
Vapor Pressure	7,150 to 8,690 mm Hg at 25°C (measured)[3]	7,150 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 3.15 ×10^4 mm Hg at 25°C (measured)[3]	2,110 to 2,250 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable					
Henry's Law Constant	0.196 to 0.707 atm-m^3/mol (measured)[3]	0.707 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.500 to 0.707 atm-m^3/mol (measured)[3]	0.0736 to 0.233 atm-m^3/mol (measured)[3]
Water Solubility	62.4 to 200 mg/L at 25°C (measured)[3]	62.4 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	60.2 to 221 mg/L at 25°C (measured)[3]	221 to 735 mg/L at 25°C (measured)[3]
Log K_{ow}	1.77–2.36 (measured)[3]	2.36 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.40 (measured)[3]	1.81–2.4 (measured)[3]	1.99–2.40 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory III: Hydrocarbon gases, C1 – C6									
Property	**SPONSORED CHEMICAL Butane, 2-methyl-**	**SPONSORED CHEMICAL Pentane**	**SPONSORED CHEMICAL Cyclopentane**	**SPONSORED CHEMICAL 2-Butene, 2-methyl-**	**SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer[2]**
CASRN	78-78-4	109-66-0	287-92-3	513-35-9	68308-02-1	68308-03-2	68308-04-3	68308-06-5	68308-08-7
Molecular Weight	72.15	72.15	70.14	70.14	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Volatile liquid or gas	Volatile liquid	Volatile liquid	Volatile liquid	Gas	Gas/liquid	Gas/liquid	Gas/liquid	Gas
Melting Point	-159.9°C (measured)[3]	-129.7°C (measured)[3]	-93.8°C (measured)[3]	-133.7°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185 to -133.7°C (measured)[3]	-187.6 to -182.4°C (measured)[3]
Boiling Point	27.8°C (measured)[3]	36°C (measured)[3]	49.3°C (measured)[3]	38.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]
Vapor Pressure	689 mm Hg at 25°C (measured)[3]	514 mm Hg at 25°C (measured)[3]	318 mm Hg at 25°C (measured)[3]	468 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	1.4 atm-m^3/mol (measured)[3]	1.25 atm-m^3/mol (measured)[3]	0.152 atm-m^3/mol (measured)[3]	0.224 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]
Water solubility	48 mg/L at 25°C (measured)[3]	39 mg/L at 25°C (measured)[3]	156 mg/L at 25°C (measured)[3]	193 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]

Subcategory III: Hydrocarbon gases, C1 – C6

Property	SPONSORED CHEMICAL Butane, 2-methyl-	SPONSORED CHEMICAL Pentane	SPONSORED CHEMICAL Cyclopentane	SPONSORED CHEMICAL 2-Butene, 2-methyl-	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant[2]	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer[2]
Log K_{ow}	2.72 (estimated)[4]	3.39 (measured)[3]	3.0 (measured)[3]	2.67 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.40 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory III: Hydrocarbon gases, C1 – C6 (*continued*)									
Property	**SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free[2]**	**SPONSORED CHEMICAL Alkanes, C4 – 5[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C4 – 5[2]**	**SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich[2]**	**SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. Splitter[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich[2]**
CASRN	68308-09-8	68308-10-1	68475-60-5	68476-40-4	68476-42-6	68477-69-0	68477-76-9	68478-19-3	68478-33-1
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas/liquid	Gas	Gas/liquid	Gas	Gas/liquid	Gas	Gas	Gas	Gas
Melting Point	-185 to -133.7°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-159.9 to -138.2°C (measured)[3]	-187.6 to -185.3°C (measured)[3]	-138.2 to -133.7°C (measured)[3]	-187.6 to -135.2°C (measured)[3]	-187.6 to -182.8°C (measured)[3]	-187.6 to -135.2°C (measured)[3]	-182.8 to -182.4°C (measured)[3]
Boiling Point	-161.5 to 38.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-0.5 to 27.8°C (measured)[3]	-42.1 to -6.2°C (measured)[3]	-0.5 to 38.5°C (measured)[3]	-42.1 to -0.5°C (measured)[3]	-88.6 to -0.5°C (measured)[3]	-42.1 to -0.5°C (measured)[3]	-161.5 to -88.6°C (measured)[3]
Vapor Pressure	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]	689 to 1,820 mm Hg at 25°C (measured)[3]	2,250 to 7,150 mm Hg at 25°C (measured)[3]	468 to 1,820 mm Hg at 25°C (measured)[3]	1,820 to 7,150 mm Hg at 25°C (measured)[3]	1,820 to 3.15×10^4 mm Hg at 25°C (measured)[3]	1,820 to 7,150 mm Hg at 25°C (measured)[3]	3.15×10^4 to 4.66×10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.95 to 1.4 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.224 to 0.95 atm-m^3/mol (measured)[3]	0.707 to 0.95 atm-m^3/mol (measured)[3]	0.500 to 0.95 atm-m^3/mol (measured)[3]	0.707 to 0.95 atm-m^3/mol (measured)[3]	0.500 to 0.66 atm-m^3/mol (measured)[3]
Water solubility	22 to 193 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	48 to 61.2 mg/L at 25°C (measured)[3]	62.4 to 221 mg/L at 25°C (measured)[3]	61.2 to 193 mg/L at 25°C (measured)[3]	61.2 to 62.4 mg/L at 25°C (measured)[3]	60.2 to 62.4 mg/L at 25°C (measured)[3]	61.2 to 62.4 mg/L at 25°C (measured)[3]	22 to 60.2 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]

Subcategory III: Hydrocarbon gases, C1 – C6 (*continued*)

Property	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free[2]	SPONSORED CHEMICAL Alkanes, C4 – 5[2]	SPONSORED CHEMICAL Hydrocarbons, C3 – 4[2]	SPONSORED CHEMICAL Hydrocarbons, C4 – 5[2]	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich[2]	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. Splitter[2]	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich[2]
Log K_{ow}	1.09–2.76 (measured)[3]	1.09–2.40 (measured)[3]	2.72–2.89 (estimated)[4]	2.36–2.40 (measured)[3]	2.67–2.89 (measured)[3]	2.36–2.89 (measured)[3]	1.81–2.89 (measured)[3]	2.36–2.89 (measured)[3]	1.09–1.81 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]								
Subcategory III: Hydrocarbon gases, C1 – C6 (*continued*)								
Property	**SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off[2]**	**SPONSORED CHEMICAL Gas (petroleum), dehexanizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off[2]**	**SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter residues[2]**
CASRN	68513-12-2	68513-17-7	68918-99-0	68919-00-6	68919-05-1	68919-06-2	68919-10-8	68919-19-7
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas	Gas/liquid	Gas/liquid	Gas/liquid	Gas/liquid	Gas	Gas	Gas
Melting Point	-187.6 to -138.3°C (measured)[3]	-187.6 to -153.7°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -185.3°C (measured)[3]
Boiling Point	-161.5 to -0.5°C (measured)[3]	-88.6 to 60.2°C (measured)[3]	-161.5 to 27.8°C (measured)[3]	-161.5 to 27.8°C (measured)[3]	-161.5 to 27.8°C (measured)[3]	-161.5 to -0.5°C (measured)[3]	-161.5 to -0.5°C (measured)[3]	-42.1 to -6.2°C (measured)[3]
Vapor Pressure	1,820 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	211 to 3.15 × 10^4 mm Hg at 25°C (measured)[3]	689 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	689 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	689 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	1,820 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	1,820 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 7,150 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable							
Henry's Law Constant	0.500 to 0.95 atm-m^3/mol (measured)[3]	0.500 to 1.71 atm-m^3/mol (measured)[3]	0.66 to 1.4 atm-m^3/mol (measured)[3]	0.66 to 1.4 atm-m^3/mol (measured)[3]	0.66 to 1.4 atm-m^3/mol (measured)[3]	0.500 to 0.95 atm-m^3/mol (measured)[3]	0.500 to 0.95 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]
Water Solubility	22 to 62.4 mg/L at 25°C (measured)[3]	14 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	62.4 to 221 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]

Subcategory III: Hydrocarbon gases, C1 – C6 (*continued*)

Property	SPONSORED CHEMICAL **Fuel gases, saturate gas unit fractionater-absorber overheads[2]**	SPONSORED CHEMICAL **Gases (petroleum), light straight-run naphtha stabilizer off[2]**	SPONSORED CHEMICAL **Gases (petroleum), crude oil fractionation off[2]**	SPONSORED CHEMICAL **Gas (petroleum), dehexanizer off[2]**	SPONSORED CHEMICAL **Gases (petroleum), light straight run gasoline fractionation stabilizer off[2]**	SPONSORED CHEMICAL **Gases (petroleum), naphtha unifiner desulfurization stripper off[2]**	SPONSORED CHEMICAL **Gases (petroleum), straight-run stabilizer off[2]**	SPONSORED CHEMICAL **Gases (petroleum), fluidized catalytic cracker splitter residues[2]**
Log K_{ow}	1.09–2.89 (measured)[3]	1.81–3.21 (estimated)[4]	1.09–2.76 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.89 (measured)[3]	1.09–2.89 (measured)[3]	2.36–2.40 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene									
Property	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed[2]**	**SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free[2]**
CASRN	68307-98-2	68307-99-3	68308-05-4	68409-99-4	68476-54-0	68477-42-9	68477-71-4	68477-72-5	68477-73-6
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas	Gas	Gas	Gas/liquid	Gas/liquid	Gas	Gas	Gas/liquid	Gas
Melting Point	-187.6 to -182.4°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-185 to -133.7°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-183.5 to -140.4°C (measured)[3]	-138.2 to -185.3°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -185°C (measured)[3]
Boiling Point	-161.5 to -6.2°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-48 to 38.5°C (measured)[3]	-42.1 to 27.8°C (measured)[3]	-6.9 to -6.2°C (measured)[3]	-6.2 to -0.5°C (measured)[3]	-42.1 to 27.8°C (measured)[3]	-48 to -42.1°C (measured)[3]
Vapor Pressure	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	468 to 8,690 mm Hg at 25°C (measured)[3]	689 to 7,150 mm Hg at 25°C (measured)[3]	2,250 to 2,310 mm Hg at 25°C (measured)[3]	1,820 to 2,250 mm Hg at 25°C (measured)[3]	689 to 7,150 mm Hg at 25°C (measured)[3]	7,150 to 8,690 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.196 to 1.19 atm-m^3/mol (measured)[3]	0.707 to 1.4 atm-m^3/mol (measured)[3]	0.217 to 0.233 atm-m^3/mol (measured)[3]	0.233 to 0.95 atm-m^3/mol (measured)[3]	0.707 to 1.4 atm-m^3/mol (measured)[3]	0.196 to 0.707 atm-m^3/mol (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene

Property	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber[2]	SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads[2]	SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed[2]	SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free[2]
Water solubility	22 to 221 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	48.8 to 200 mg/L at 25°C (measured)[3]	48 to 62.4 mg/L at 25°C (measured)[3]	221 to 263 mg/L at 25°C (measured)[3]	61.2 to 221 mg/L at 25°C (measured)[3]	48 to 62.4 mg/L at 25°C (measured)[3]	62.4 to 200 mg/L at 25°C (measured)[3]
Log K_{ow}	1.09–2.40 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.40 (measured)[3]	1.77–2.67 (measured)[3]	2.36–2.76 (measured)[3]	2.34–2.40 (measured)[3]	2.4–2.89 (measured)[3]	2.36–2.76 (measured)[3]	1.77–2.36 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (*continued*)									
Property	**SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed[2]**	**SPONSORED CHEMICAL Gases (petroleum), C4-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate[2]**	**SPONSORED CHEMICAL Butane, branched and linear[2]**
CASRN	68477-83-8	68477-85-0	68477-87-2	68477-91-8	68478-24-0	68478-26-2	68478-34-2	68512-91-4	68513-65-5
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas/liquid	Gas	Gas	Gas	Gas/liquid	Gas	Gas/liquid	Gas	Gas
Melting Point	-185 to -133.7°C (measured)[3]	-138.2 to -138.3°C (measured)[3]	-187.6 to -135.2°C (measured)[3]	-187.6 to -182.8°C (measured)[3]	-185 to -133.7°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-185 to -133.7°C (measured)[3]	-187.6 to -185.3°C (measured)[3]	-138.2 to -138.3°C (measured)[3]
Boiling Point	-48 to 38.5°C (measured)[3]	-11.7 to -0.5°C (measured)[3]	-42.1 to -0.5°C (measured)[3]	-88.6 to -0.5°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-42.1 to -6.2°C (measured)[3]	-11.7 to -0.5°C (measured)[3]
Vapor Pressure	468 to 8,690 mm Hg at 25°C (measured)[3]	1,820 to 2,610 mm Hg at 25°C (measured)[3]	1,820 to 7,150 mm Hg at 25°C (measured)[3]	1,820 to 3.15×10^4 mm Hg at 25°C (measured)[3]	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66×10^5 mm Hg at 25°C (measured)[3]	468 to 4.66×10^5 mm Hg at 25°C (measured)[3]	2,250 to 7,150 mm Hg at 25°C (measured)[3]	1,820 to 2,610 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.196 to 1.19 atm-m^3/mol (measured)[3]	0.95 to 1.19 atm-m^3/mol (measured)[3]	0.707 to 0.95 atm-m^3/mol (measured)[3]	0.500 to 0.95 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.95 to 1.19 atm-m^3/mol (measured)[3]
Water solubility	48.8 to 200 mg/L at 25°C (measured)[3]	48.8 to 61.2 mg/L at 25°C (measured)[3]	61.2 to 62.4 mg/L at 25°C (measured)[3]	60.2 to 62.4 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	62.4 to 221 mg/L at 25°C (measured)[3]	48.8 to 61.2 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (*continued*)									
Property	**SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed[2]**	**SPONSORED CHEMICAL Gases (petroleum), C4-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate[2]**	**SPONSORED CHEMICAL Butane, branched and linear[2]**
Log K_{ow}	1.77–2.67 (measured)[3]	2.76–2.89 (measured)[3]	2.36–2.89 (measured)[3]	1.81–2.89 (measured)[3]	1.09–2.76 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.76 (measured)[3]	2.36–2.40 (measured)[3]	2.76–2.89 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (*continued*)									
Property	**SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction[2]**	**SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet**	**SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product[2]**	**SPONSORED CHEMICAL Gases (petroleum), alkylation feed[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation off[2]**	**SPONSORED CHEMICAL Fuel gases, refinery, sweetened[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracking[2]**	**SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened[2]**
CASRN	68513-66-6	68527-19-5	68602-83-5	68606-24-6	68606-27-9	68606-34-8	68783-61-9	68783-64-2	68783-65-3
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas	Gas	Gas/liquid	Gas/liquid	Gas	Gas	Gas/liquid	Gas/liquid	Gas
Melting Point	-138.2°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185.3 to -108.9°C (measured)[3]	-138.3 to -108.9°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185 to -133.7°C (measured)[3]	-187.6 to -182.8°C (measured)[3]
Boiling Point	-0.5°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-161.5 to 38.5°C (measured)[3]	-48 to 38.5°C (measured)[3]	-48 to -4.4°C (measured)[3]	-11.7 to -0.5°C (measured)[3]	-161.5 to 60.2°C (measured)[3]	-48 to 38.5°C (measured)[3]	-88.6 to -6.2°C (measured)[3]
Vapor Pressure	1,820 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	468 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	468 to 8,690 mm Hg at 25°C (measured)[3]	2,110 to 8,690 mm Hg at 25°C (measured)[3]	1,820 to 2,610 mm Hg at 25°C (measured)[3]	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	468 to 8,690 mm Hg at 25°C (measured)[3]	2,250 to 3.15 ×10^4 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.95 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]	0.196 to 1.19 atm-m^3/mol (measured)[3]	0.0736 to 0.233 atm-m^3/mol (measured)[3]	0.0736 to 1.19 atm-m^3/mol (measured)[3]	0.224 to 1.71 atm-m^3/mol (measured)[3]	0.196 to 1.19 atm-m^3/mol (measured)[3]	0.500 to 0.707 atm-m^3/mol (measured)[3]
Water solubility	61.2 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]	48.8 to 200 mg/L at 25°C (measured)[3]	200 to 735 mg/L at 25°C (measured)[3]	48.8 to 735 mg/L at 25°C (measured)[3]	14 to 193 mg/L at 25°C (measured)[3]	48.8 to 200 mg/L at 25°C (measured)[3]	60.2 to 221 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (*continued*)									
Property	**SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction[2]**	**SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet**	**SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product[2]**	**SPONSORED CHEMICAL Gases (petroleum), alkylation feed[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation off[2]**	**SPONSORED CHEMICAL Fuel gases, refinery, sweetened[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracking[2]**	**SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened[2]**
Log K_{ow}	2.89 (measured)[3]	1.09–2.40 (measured)[3]	1.09–2.76 (measured)[3]	1.77–2.67 (measured)[3]	1.09–2.40 (measured)[3]	1.99–2.89 (measured)[3,]	1.09–3.21 (estimated)[4]	1.77–2.67 (measured)[3]	1.81–2.4 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data provided are based upon the typical representative structure; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]				
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (*continued*)				
Property	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha debutanizer[2]**	**SPONSORED CHEMICAL Gases (petroleum), light steam-cracked, butadiene conc.[2]**	**SPONSORED CHEMICAL Residues (petroleum), catalytic cracking depropanizer, C4-rich[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber[2]**
CASRN	68952-76-1	68955-28-2	71329-37-8	71808-30-5
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas	Gas	Gas	Gas/liquid
Melting Point	-187.6 to -182.4°C (measured)[3]	-185.3 to -108.9°C (measured)[3]	-138.2 to -185.3°C (measured)[3]	-185 to -133.7°C (measured)[3]
Boiling Point	-161.5 to -6.2°C (measured)[3]	-6.2 to -4.4°C (measured)[3]	-6.2 to -0.5°C (measured)[3]	-161.5 to 38.5°C (measured)[3]
Vapor Pressure	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,110 to 2,250 mm Hg at 25°C (measured)[3]	1,820 to 2,250 mm Hg at 25°C (measured)[3]	468 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable			
Henry's Law Constant	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.0736 to 0.233 atm-m^3/mol (measured)[3]	0.233 to 0.95 atm-m^3/mol (measured)[3]	0.224 to 1.19 atm-m^3/mol (measured)[3]
Water solubility	22 to 221 mg/L at 25°C (measured)[3]	221 to 735 mg/L at 25°C (measured)[3]	61.2 to 221 mg/L at 25°C (measured)[3]	22 to 193 mg/L at 25°C (measured)[3]
Log K_{ow}	1.09–2.40 (measured)[3]	1.99–2.40 (measured)[3]	2.4–2.89 (measured)[3]	1.09–2.76 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene									
Property	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Hydrocarbons, C>3[2]**	**SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber[2]**
CASRN	68308-12-3	68476-44-8	68477-25-8	68477-74-7	68477-75-8	68477-79-2	68513-15-5	68919-16-4	68952-81-8
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas/liquid	Gas/liquid	Gas/liquid	Gas/liquid	Gas/liquid	Gas	Gas/liquid	Gas/liquid	Gas/liquid
Melting Point	-185 to -133.7°C (measured)[3]	-153.7 to -133.7°C (measured)[3]	-187.6 to -153.7°C (measured)[3]	-187.6 to -153.7°C (measured)[3]	-187.6 to -138.3°C (measured)[3]	-187.6 to -182.4°C (measured)[3]	-185 to -133.7°C (measured)[3]	-185 to 5.5°C (measured)[3]	-185 to -133.7°C (measured)[3]
Boiling Point	-161.5 to 60.2°C (measured)[3]	-0.5 to 60.2°C (measured)[3]	-161.5 to 60.2°C (measured)[3]	-161.5 to 60.2°C (measured)[3]	-161.5 to 27.8°C (measured)[3]	-161.5 to -6.2°C (measured)[3]	-88.6 to 60.2°C (measured)[3]	-48 to 80°C (measured)[3]	-161.5 to 60.2°C (measured)[3]
Vapor Pressure	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	211 to 1,820 mm Hg at 25°C (measured)[3]	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	689 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	2,250 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]	211 to 3.15 × 10^4 mm Hg at 25°C (measured)[3]	94.8 to 8,690 mm Hg at 25°C (measured)[3]	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.224 to 1.71 atm-m^3/mol (measured)[3]	0.224 to 1.71 atm-m^3/mol (measured)[3]	0.66 to 1.71 atm-m^3/mol (measured)[3]	0.66 to 1.71 atm-m^3/mol (measured)[3]	0.66 to 1.4 atm-m^3/mol (measured)[3]	0.233 to 0.707 atm-m^3/mol (measured)[3]	0.196 to 1.71 atm-m^3/mol (measured)[3]	0.00555 to 1.19 atm-m^3/mol (measured)[3]	0.224 to 1.71 atm-m^3/mol (measured)[3]
Water solubility	14 to 193 mg/L at 25°C (measured)[3]	14 to 193 mg/L at 25°C (measured)[3]	14 to 62.4 mg/L at 25°C (measured)[3]	14 to 62.4 mg/L at 25°C (measured)[3]	22 to 62.4 mg/L at 25°C (measured)[3]	22 to 221 mg/L at 25°C (measured)[3]	14 to 200 mg/L at 25°C (measured)[3]	48.8 to 1,790 mg/L at 25°C (measured)[3]	14 to 193 mg/L at 25°C (measured)[3]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene									
Property	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Hydrocarbons, C>3[2]**	**SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber[2]**
Log K_{ow}	1.09–3.21 (estimated)[4]	2.67–2.89 (measured)[3]	1.09–3.21 (estimated)[4]	1.09–3.21 (estimated)[4]	1.09–2.76 (measured)[3]	1.09–2.40 (measured)[3]	1.77–3.21 (estimated)[4]	1.77–3.13 (estimated)[4]	1.09–3.21 (estimated)[4]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.

[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.

[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.

[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]	
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene (*continued*)	
Property	**SPONSORED CHEMICAL** **Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking[2]**
CASRN	68952-82-9
Molecular Weight	Complex mixture
Physical state	Gas/liquid
Melting Point	-185 to -133.7°C (measured)[4]
Boiling Point	-161.5 to 60.2°C (measured)[4]
Vapor Pressure	211 to 4.66 × 10^5 mm Hg at 25°C (measured)[4]
Dissociation Constant (pK_a)	Not applicable
Henry's Law Constant	0.224 to 1.71 atm-m^3/mol (measured)[4]
Water solubility	14 to 193 mg/L at 25°C (measured)[4]
Log K_{ow}	1.09–3.21 (estimated)[5]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] Data range is for both isomers: 2-Butene, (2Z)- (CASRN 590-18-1) and 2-Butene, (2E)- (CASRN 624-64-6).
[4] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[5] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]				
Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene				
Property	**SPONSORED CHEMICAL Petroleum gases, liquefied[2]**	**SPONSORED CHEMICAL Petroleum gases, liquefied, sweetened[2]**	**SPONSORED CHEMICAL Gases (petroleum), C3-4, isobutane-rich[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), saturate gas plant mixed stream, C4-rich[2]**
CASRN	68476-85-7	68476-86-8	68477-33-8	68478-32-0
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	Complex mixture
Physical State	Gas/liquid	Gas/liquid	Gas	Gas
Melting Point	-187.6 to -90.6°C (measured)[3]	-187.6 to -90.6°C (measured)[3]	-138.2 to -138.3°C (measured)[3]	-138.2 to -138.3°C (measured)[3]
Boiling Point	-42.1 to 98.5°C (measured)[3]	-42.1 to 98.5°C (measured)[3]	-11.7 to -0.5°C (measured)[3]	-11.7 to -0.5°C (measured)[3]
Vapor Pressure	46 to 7,150 mm Hg at 25°C (measured)[3]	46 to 7,150 mm Hg at 25°C (measured)[3]	1,820 to 2,610 mm Hg at 25°C (measured)[3]	1,820 to 2,610 mm Hg at 25°C (measured)[3]
Dissociation Constant (pK_a)	Not applicable			
Henry's Law Constant	0.220 to 2 atm-m^3/mol (measured)[3]	0.220 to 2 atm-m^3/mol (measured)[3]	0.95 to 1.19 atm-m^3/mol (measured)[3]	0.95 to 1.19 atm-m^3/mol (measured)[3]
Water solubility	3.4 to 193 mg/L at 25°C (measured)[3]	3.4 to 193 mg/L at 25°C (measured)[3]	48.8 to 61.2 mg/L at 25°C (measured)[3]	48.8 to 61.2 mg/L at 25°C (measured)[3]
Log K_{ow}	2.36–4.66 (measured)[3]	2.36–4.66 (measured)[3]	2.76–2.89 (measured)[3]	2.76–2.89 (measured)[3]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[4] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]									
Property	**SUPPORTING CHEMICAL[2] Naphtha (petroleum), light catalytic cracked**	**SUPPORTING CHEMICAL[2] Naphtha (petroleum), sweetened**	**SUPPORTING CHEMICAL[2] Baseline Gasoline Vapor Condensate [BGVC]**	**SUPPORTING CHEMICAL 1-Butene**	**SUPPORTING CHEMICAL[3] 2-Butene**	**SUPPORTING CHEMICAL Ethene**	**SUPPORTING CHEMICAL 1-Propene, 2-methyl-**	**SUPPORTING CHEMICAL 1,3-Butadiene**	**SUPPORTING CHEMICAL Benzene (C6)**
CASRN	64741-55-5	64741-87-3	86290-81-5	106-98-9	107-01-7	74-85-1	115-11-7	106-99-0	71-43-2
Molecular Weight	Complex mixture	Complex mixture	Complex mixture	56.11	56.11	28.05	56.11	54.09	70.14
Physical state	Volatile liquid	Volatile liquid	Volatile liquid	Gas	Gas	Gas	Gas	Gas	Liquid
Melting Point	-168.5 to -157.3°C (measured)[4]	-162.9 to -128.8 °C (measured)[4]	-159.9 to -138.2 °C (measured)[4]	-185.3°C (measured)[4]	-105.5 to -138.9°C (measured)[4]	-169°C (measured)[4]	-140.4°C (measured)[4]	-108.9°C (measured)[4]	5.5°C (measured)[4]
Boiling Point	20.1 to 55.6 °C (measured)[4]	31.2 to 60.2 °C (measured)[4]	-0.5 to 27.8 °C (measured)[4]	-6.2°C (measured)[4]	0.8 to 3.7°C (measured)[4]	-103.7°C (measured)[4]	-6.9°C (measured)[4]	-4.4°C (measured)[4]	80°C (measured)[4]
Vapor Pressure	252 to 903 mm Hg at 25 °C (measured)[4]	190 to 610 mm Hg at 25 °C (measured)[4]	689 to 1,820 mm Hg at 25 °C (measured)[4]	2,250 mm Hg at 25°C (measured)[4]	1,600 to 1,760 mm Hg at 25°C (measured)[4]	5.21×10^4 mm Hg at 25°C (measured)[4]	2,310 mm Hg at 25°C (measured)[4]	2,110 mm Hg at 25°C (measured)[4]	94.8 mm Hg at 25°C (measured)[4]
Dissociation Constant (pK_a)	Not applicable								
Henry's Law Constant	0.42 to 0.54 atm-m^3/mol (measured)[4]	0.43 to 1.71 atm-m^3/mol (measured)[4]	0.95 to 1.4 atm-m^3/mol (measured)[4]	0.233 atm-m^3/mol (measured)[4]	0.231 to 0.234 atm-m^3/mol (measured)[4]	0.228 atm-m^3/mol (measured)[4]	0.218 atm-m^3/mol (measured)[4]	0.074 atm-m^3/mol (measured)[4]	0.0055 atm-m^3/mol (measured)[4]
Water solubility	80.1 to 130 mg/L at 25 °C (measured)[4]	14 to 130 mg/L at 25 °C (measured)[4]	48 to 61.2 mg/L at25°C (measured)[4]	221 mg/L at 25°C (measured)[4]	511 to 659 mg/L at 25°C (measured)[4]	131 mg/L at 25°C (measured)[4]	263 mg/L at 25°C (measured)[4]	735 mg/L at 25°C (measured)[4]	1,790 mg/L at 25°C (measured)[4]

Table 3. Physical-Chemical Properties of Petroleum Hydrocarbon Gases[1]

Property	SUPPORTING CHEMICAL[2] Naphtha (petroleum), light catalytic cracked	SUPPORTING CHEMICAL[2] Naphtha (petroleum), sweetened	SUPPORTING CHEMICAL[2] Baseline Gasoline Vapor Condensate [BGVC]	SUPPORTING CHEMICAL 1-Butene	SUPPORTING CHEMICAL[3] 2-Butene	SUPPORTING CHEMICAL Ethene	SUPPORTING CHEMICAL 1-Propene, 2-methyl-	SUPPORTING CHEMICAL 1,3-Butadiene	SUPPORTING CHEMICAL Benzene (C6)
Log K_{ow}	2.59 to 3.13 (estimated)[5]	2.7 to 3.42 (measured)[4]	2.72 to 2.89 (measured)[4]	2.40 (measured)[4]	2.31–2.33 (measured)[4]	1.13 (measured)[4]	2.34 (measured)[4]	1.99 (measured)[4]	2.13 (measured)[4]

[1] The Petroleum HPV Testing Group. 2009. Revised Test Plan and Robust Summary for Petroleum Gas. Available online at http://www.epa.gov/hpv/pubs/summaries/ptrlgas/c13224tc.htm as of September 7, 2010.
[2] Data range is based upon the representative structures; see Appendix for detailed information on the structures.
[3] Data range is for both isomers: 2-Butene, (2Z)- (CASRN 590-18-1) and 2-Butene, (2E)- (CASRN 624-64-6).
[4] SRC. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at http://www.syrres.com/esc/physprop.htm as of August 18, 2010.
[5] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of August 18, 2010.

2. General Information on Exposure

2.1 Production Volume and Use Pattern

The petroleum hydrocarbon gases category chemicals had an aggregated production and/or import volume in the United States greater than 54 billion 901 million pounds in calendar year 2005.

- CASRN 74-82-8: 1 billion pounds and greater;
- CASRN 74-84-0: 1 billion pounds and greater;
- CASRN 74-98-6: 1 billion pounds and greater;
- CASRN 115-07-1: 1 billion pounds and greater;
- CASRN 75-28-5: 1 billion pounds and greater;
- CASRN 106-97-8: 1 billion pounds and greater;
- CASRN 8006-14-2: 100 to < 500 million pounds
- CASRN 68308-11-2: 50 to < 100 million pounds
- CASRN 68410-63-9: 1 billion pounds and greater;
- CASRN 68475-57-0: 1 billion pounds and greater;
- CASRN 68475-58-1: 1 billion pounds and greater;
- CASRN 68475-59-2: 100 to < 500 million pounds
- CASRN 68476-49-3: 1 billion pounds and greater;
- CASRN 68477-86-1: 1 billion pounds and greater;
- CASRN 68477-88-3: 50 to <100 million pounds
- CASRN 68477-90-7: 1 billion pounds and greater;
- CASRN 68606-26-8: 1 billion pounds and greater;
- CASRN 68919-20-0: 500 million to < 1 billion pounds
- CASRN 68955-34-0: 500 million to < 1 billion pounds
- CASRN 68131-75-9: 1 billion pounds and greater;
- CASRN 68477-94-1: 1 billion pounds and greater;
- CASRN 68514-31-8: 1 billion pounds and greater;
- CASRN 68606-25-7: 1 billion pounds and greater;
- CASRN 68956-54-7: 1 billion pounds and greater;
- CASRN 78-78-4: 1 billion pounds and greater;
- CASRN 109-66-0: 1 billion pounds and greater;
- CASRN 287-92-3: 1 to < 10 million pounds
- CASRN 513-35-9: 10 to < 50 million pounds
- CASRN 68308-04-3: 100 to < 500 million pounds
- CASRN 68308-06-5: 10 to < 50 million pounds
- CASRN 68308-08-7: 50 to < 100 million pounds
- CASRN 68308-09-8: 100 to < 500 million pounds
- CASRN 68475-60-5: 1 billion pounds and greater;
- CASRN 68476-40-4: 1 billion pounds and greater;
- CASRN 68476-42-6: 1 billion pounds and greater;
- CASRN 68477-69-0: 1 billion pounds and greater;
- CASRN 68477-76-9: 500 million to < 1 billion pounds

- CASRN 68513-12-2: 100 to < 500 million pounds
- CASRN 68513-17-7: 100 to < 500 million pounds
- CASRN 68918-99-0: 1 billion pounds and greater;
- CASRN 68919-00-6: 500 million to < 1 billion pounds
- CASRN 68919-05-1: 500 million to < 1 billion pounds
- CASRN 68919-06-2: 10 to < 50 million pounds
- CASRN 68919-10-8: 1 billion pounds and greater;
- CASRN 68919-19-7: 1 billion pounds and greater;
- CASRN 68307-99-3: 100 to < 500 million pounds
- CASRN 68308-05-4: 1 billion pounds and greater;
- CASRN 68409-99-4: 500 million to < 1 billion pounds
- CASRN 68476-54-0: 1 billion pounds and greater;
- CASRN 68477-42-9: 1 billion pounds and greater;
- CASRN 68477-71-4: 100 to < 500 million pounds
- CASRN 68477-72-5: 100 to < 500 million pounds
- CASRN 68477-73-6: 100 to < 500 million pounds
- CASRN 68477-83-8: 1 billion pounds and greater;
- CASRN 68477-85-0: 1 billion pounds and greater;
- CASRN 68477-87-2: 1 billion pounds and greater;
- CASRN 68477-91-8: 1 billion pounds and greater;
- CASRN 68478-26-2: 100 to < 500 million pounds
- CASRN 68478-34-2: 500 million to < 1 billion pounds
- CASRN 68512-91-4: 500 million to < 1 billion pounds
- CASRN 68513-65-5: 1 billion pounds and greater;
- CASRN 68513-66-6: 1 billion pounds and greater;62
- CASRN 68527-19-5: 1 billion pounds and greater;
- CASRN 68602-83-5: 1 billion pounds and greater;
- CASRN 68606-24-6: 100 to < 500 million pounds
- CASRN 68606-27-9: 1 billion pounds and greater;
- CASRN 68606-34-8: 1 billion pounds and greater;
- CASRN 68783-61-9: 1 billion pounds and greater;
- CASRN 68783-64-2: 1 billion pounds and greater;
- CASRN 68783-65-3: 500 million to < 1 billion pounds
- CASRN 68955-28-2: 1 billion pounds and greater;
- CASRN 71808-30-5: 100 to < 500 million pounds
- CASRN 68308-12-3: 100 to < 500 million pounds
- CASRN 68476-44-8: 50 to < 100 million pounds
- CASRN 68477-25-8: 100 to < 500 million pounds
- CASRN 68477-74-7: 1 billion pounds and greater;
- CASRN 68477-79-2: 100 to < 500 million pounds
- CASRN 68513-15-5: 10 to < 50 million pounds
- CASRN 68919-16-4: 10 to < 50 million pounds
- CASRN 68952-81-8: 50 to < 100 million pounds
- CASRN 68952-82-9: 500 million to < 1 billion pounds

- CASRN 68476-85-7: 1 billion pounds and greater;
- CASRN 68476-86-8: 1 billion pounds and greater;
- CASRN 68477-33-8: 1 billion pounds and greater;
- CASRN 68478-32-0: 1 billion pounds and greater;

CASRNs 68918-98-9, 68514-36-3, 68308-02-1, 68308-03-2, 68308-10-1, 68478-19-3, 68478-33-1, 68307-98-2, 68478-24-0, 68952-76-1, 71329-37-8, and CASRN 68477-75-8 were not reported in the 2006 IUR.

CASRNs 68308-11-2, 68475-57-0, 68475-58-1, 68475-59-2, 68476-49-3, 68477-86-1, 68477-88-3, 68477-90-7, 68919-20-0, 68955-34-0, 68514-31-8, 68606-25-7, 68956-54-7, 68308-04-3, 68308-06-5, 68308-08-7, 68308-09-8, 68475-60-5, 68476-40-4, 68476-42-6, 68477-69-0, 68477-76-9, 68513-12-2, 68513-17-7, 68919-00-6, 68919-05-1, 68919-06-2, 68919-10-8, 68919-19-7, 68307-99-3, 68308-05-4, 68409-99-4, 68476-54-0, 68477-71-4, 68477-72-5, 68477-73-6, 68477-83-8, 68477-85-0, 68477-87-2, 68477-91-8, 68478-26-2, 68478-34-2, 68512-91-4, 68513-66-6, 68527-19-5, 68602-83-5, 68606-24-6, 68606-27-9, 68606-34-8, 68783-61-9, 68783-64-2, 68783-65-3, 68955-28-2, 71808-30-5, 68308-12-3, 68476-44-8, 68477-25-8, 68477-74-7, 68477-79-2, 68513-15-5, 68952-81-8, 68952-82-9 and CASRN 68478-32-0:
No industrial processing and uses, and commercial and consumer uses were reported for these chemicals.

CASRN 74-82-8:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petrochemical manufacturing as intermediates; oil and gas extraction as agricultural chemicals (nonpesticidal); commodity contracts brokerage, other basic organic chemical manufacturing and petroleum refineries as fuels. Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives; “other”; and not otherwise obtainable (NRO).

CASRN 74-84-0:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include other basic organic chemical manufacturing, petrochemical manufacturing, resin and synthetic rubber manufacturing, and oil and gas extraction as intermediates; petrochemical manufacturing and oil and gas extraction as not otherwise obtainable (NRO); oil and gas extraction and petroleum refineries as fuels; pipeline transportation of refined petroleum products as “other.” Non-confidential commercial and consumer uses of this chemical include rubber and plastic products.

CASRN 74-98-6:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum bulk stations and terminals as aerosol propellants; all other chemical product and preparation manufacturing, fuel dealers, industrial gas manufacturing, natural gas distribution, not readily obtainable (NRO), oil and gas extraction, other basic organic chemical manufacturing, petroleum and petroleum products merchant wholesalers (except bulk stations and terminals), petroleum bulk stations and terminals, petroleum refineries, pipeline transportation of refined petroleum products, pulp mills, and resin and synthetic rubber manufacturing as fuels; oil and gas extraction, other basic organic chemical manufacturing,

petroleum refineries, and petrochemical manufacturing as intermediates; oil and gas extraction, petrochemical manufacturing, petroleum refineries as not readily obtainable (NRO); not readily obtainable (NRO), oil and gas extraction, other basic organic chemical manufacturing, petroleum refineries, and pipeline transportation of refined petroleum products as "other"; other basic organic chemical manufacturing and petroleum refineries as processing aid, not otherwise listed; petroleum refineries as solvents (which become part of product formulation or mixture). Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives; rubber and plastic products; transportation products; "other"; and not readily obtainable (NRO).

CASRN 115-07-1:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include fuel dealers, industrial gas manufacturing, other petroleum and coal products manufacturing, petroleum refineries as fuels; oil and gas extraction, other basic organic chemical manufacturing, other plastics product manufacturing, petrochemical manufacturing, petroleum refineries, resin and synthetic rubber manufacturing as intermediates; petrochemical manufacturing and petroleum refineries as not otherwise obtainable (NRO); other basic organic chemical manufacturing, other chemical and allied products merchant wholesalers, petroleum refineries, and resin and synthetic rubber manufacturing as "other"; petroleum refineries as solvents (which become part of product formulation or mixture). Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives; rubber and plastic products; "other"; and not otherwise obtainable (NRO).

CASRN 75-28-5:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include gasoline stations with convenience stores, natural gas distribution, not otherwise obtainable (NRO), oil and gas extraction, petroleum bulk stations and terminals, and petroleum refineries as fuels; oil and gas extraction, other basic organic chemical manufacturing, and petroleum refineries as intermediates; oil and gas extraction, petrochemical manufacturing, and petroleum refineries as not otherwise obtainable (NRO); oil and gas extraction, other basic organic chemical manufacturing, petrochemical manufacturing, petroleum refineries, and pipeline transportation of refined petroleum products as "other"; petroleum refineries as processing aid, not otherwise listed. Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives; transportation products; "other"; and not otherwise obtainable (NRO).

CASRN 106-97-8:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include fuel dealers, gasoline stations with convenience stores, natural gas distribution, not otherwise obtainable (NRO), oil and gas extraction, petrochemical manufacturing, petroleum bulk stations and terminals, petroleum refineries, and pipeline transportation of refined petroleum products as fuels; oil and gas extraction, petrochemical manufacturing, and petroleum refineries as intermediates; oil and gas extraction, petrochemical manufacturing, petroleum refineries, and pipeline transportation of refined petroleum products as not otherwise obtainable (NRO); oil and gas extraction, other basic organic chemical manufacturing, petroleum refineries, and pipeline transportation of refined petroleum products as "other"; petroleum refineries as processing aid, not otherwise listed. Non-confidential commercial and consumer uses of this chemical include not otherwise obtainable (NRO); lubricants, greases and fuel additives; "other"; rubber and plastic products; transportation products.

CASRN 8006-14-2:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include natural gas distribution and petroleum refineries as fuels. Non-confidential commercial and consumer uses of this chemical include transportation products and "other."

CASRN 68410-63-9:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include natural gas distribution, oil and gas extraction and natural gas distribution as fuels. Non-confidential commercial and consumer uses of this chemical include "other."

CASRN 68606-26-8:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include pipeline transportation of refined petroleum products as other. Non-confidential commercial and consumer uses of this chemical include not otherwise obtainable (NRO).

CASRN 68131-75-9:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum refineries as fuels. Non-confidential commercial and consumer uses of this chemical include "other."

CASRN 68477-94-1 and 513-35-9:
Industrial processing and uses, and commercial and consumer uses are claimed confidential

CASRN 78-78-4:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum bulk stations and terminals and petroleum refineries as fuel; petroleum refineries as intermediates; petrochemical manufacturing as not otherwise obtainable (NRO); oil and gas extraction, other basic organic chemical manufacturing, petroleum bulk stations and terminals, and polystyrene foam product manufacturing as "other"; petrochemical manufacturing as solvents (for chemical manufacture and processing and are not part of product at greater than 1% by weight). Non-confidential commercial and consumer uses of this chemical include rubber and plastic products; "other"; not otherwise obtainable (NRO); transportation products.

CASRN 109-66-0:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum bulk stations and terminals and petroleum refineries as fuels; oil and gas extraction, other basic organic chemical manufacturing, and polystyrene foam product manufacturing as "other"; petrochemical manufacturing as solvents (for chemical manufacture and processing and are not part of product at greater than 1% by weight). Non-confidential commercial and consumer uses of this chemical include rubber and plastic products; "other"; not otherwise obtainable (NRO); transportation products.

CASRN 287-92-3:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petrochemical manufacturing as not readily obtainable (NRO); urethane and other foam product (except polystyrene) manufacturing as functional fluids. Non-confidential commercial and consumer uses of this chemical include "other."

CASRN 68918-99-0 and 68477-42-9:
Industrial processing and uses are claimed confidential. No commercial and consumer uses are reported for this chemical.

CASRN 68513-65-5:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include local general freight trucking, pipeline transportation of refined petroleum products, and rail transportation as "other." Non-confidential commercial and consumer uses of this chemical include not readily obtainable (NRO).

CASRN 68919-16-4:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum refineries as fuels. No commercial and consumer uses are reported for this chemical.

CASRN 68476-85-7:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include oil and gas extraction as agricultural chemicals (nonpesticidal); and natural gas distribution as fuels. Non-confidential commercial and consumer uses of this chemical include "other."

CASRN 68476-86-8:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include petroleum refineries as fuels. Non-confidential commercial and consumer uses of this chemical include "other."

CASRN 68477-33-8:
Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include pipeline transportation of refined petroleum products as "other." Non-confidential commercial and consumer uses of this chemical include not readily obtainable (NRO).

2.2 Environmental Exposure and Fate

The environmental fate properties are provided in Table 4.

The members of the petroleum hydrocarbon gases category are expected to have moderate to high mobility in soil. Experimental biodegradation data is available for a majority of the individual chemicals; these data are extrapolated to the other individual chemicals as well as to the category members which are complex mixtures. n-Pentane and benzene were found to be readily biodegradable by use of the OECD Guideline 301C (MITI (I) test), showing 96% biodegradation after 28 days, and 40% degradation after 14 days, respectively, by BOD. Pentane, 2-methyl- and n-heptane, both used as representative chemicals for the complex mixtures, showed 93% and 100% degradation over 28 days by BOD, respectively, according to the OECD Guideline 301C (MITI (I) test). In the OECD Guideline 301D (closed bottle test), 1-propene; 1-butene; 1,3-butadiene; and 2-butene, 2-methyl- demonstrated 1, 3, 0–4, and 7% degradation by BOD, respectively, over 28 days. Although there is no headspace in the closed bottle test, volatile substances like these often still pose technical difficulties, especially if the dosing of test bottles is not performed with sensitivity to the substances' volatility. For example, it is

often necessary in such cases to dose the bottles by direct injection through a rubber septum using a syringe. The usual method of premixing test substance in test medium and then dispensing this solution into the bottles often does not work, even if it is carried out quickly. Therefore, it is possible that low or no biodeg was observed in the closed bottle tests because there was little or no test substance there to be degraded. However, alkane- and alkene-utilizing bacteria present in soil would most likely be able to metabolize these hydrocarbons. In an unspecified OECD guideline ready test, butane, 2-methyl- was found to be readily biodegradable. When tested in a non-standard aerobic ready test, propane, 2-methyl- and n-propane showed 49 and 57% degradation over 30 days, respectively, by CO_2 evolution. In an unspecified OECD guideline inherent test, cyclopentane was found to be inherently biodegradable. In non-standard inherent tests, methane and ethane demonstrated 66 and 73% degradation over 35 days, respectively, suggesting that these two low molecular weight hydrocarbons will be inherently biodegradable when test conditions are modified to take into account the gaseous nature of these two chemicals. Volatilization is expected to be high for all category members based on their Henry's Law constants; thus, this is expected to be an important fate process. The rate of hydrolysis for all members is expected to be negligible since none of the substances in this category possess functional groups that are susceptible to hydrolysis under environmental conditions. The rate of atmospheric photooxidation is considered slow to moderate for nearly all individual chemicals. The exceptions are methane and ethane, which have negligible rates of photooxidation, and 1,3-butadiene and 2-butene, 2-methyl-, which have rapid rates. For the category members that are complex mixtures, the effective rates of photooxidation will depend on the particular compositions of individual hydrocarbons present in each member. The overall weight of experimental evidence and read across from structurally similar compounds from these studies suggest that all members of the category will have low persistence (P1). The members of the petroleum hydrocarbon gases category are expected to possess low bioaccumulation potential (B1).

Conclusion: The petroleum hydrocarbon gases category consists of 99 gaseous substances or highly volatile liquids that arise from natural gas processing and petroleum refining operations. Of these substances, 10 compounds are individual chemicals and 89 are complex mixtures. The components of this category are gases or volatile liquids that possess high vapor pressure and moderate to high water solubility. They are expected to possess moderate to high mobility in soil. Volatilization is expected to be high based on their Henry’s Law constants. The rate of hydrolysis is expected to be negligible. The rate of atmospheric photooxidation is expected to be negligible to rapid for the members of this category. The members of the Petroleum Hydrocarbon Gases Category are expected to possess low persistence (P1) and low bioaccumulation potential (B1).

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases[1]									
Subcategory I: Hydrocarbon gases, C1 – C4									
Property	**SPONSORED CHEMICAL Methane**	**SPONSORED CHEMICAL Ethane**	**SPONSORED CHEMICAL Propane**	**SPONSORED CHEMICAL 1-Propene**	**SPONSORED CHEMICAL Propane, 2-methyl-**	**SPONSORED CHEMICAL Butane**	**SPONSORED CHEMICAL Natural gas[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer[2]**	**SPONSORED CHEMICAL Natural gas, dried[2]**
CASRN	74-82-8	74-84-0	74-98-6	115-07-1	75-28-5	106-97-8	8006-14-2	68308-11-2	68410-63-9
Photodegradation Half-life	4.3 years (estimated)[3]	39 days estimated)[3]	8.4 days (estimated)[3]	4.9 hours (estimated)[3]	4.4 days (estimated)[3]	4.1 days (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	39 days to 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	60% in 35 days (inherently bio-degradable)[4]	73% in 35 days (inherently bio-degradable)[4]	57% in 30 days (not readily biodegradable)[5]	1% in 28 days (not readily biodegradable)[6,7]	49% in 30 days (not readily biodegradable)[5]	No data	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; 1-Butene: 1% in 28 days (not readily biodegradable)[6,7]	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; 1-Butene: 1% in 28 days (not readily biodegradable)[6,7]	Methane: 66% in 35 days (inherently bio-degradable)[4]; Ethane: 73% in 35 days (inherently bio-degradable)[4]
Bioaccumulation Factor	BAF = 1.9 estimated)[3]	BAF = 6.9 (estimated)[3]	BAF = 21 (estimated)[3]	BAF = 6.4 (estimated)[3]	BAF = 47 (estimated)[3]	BAF = 61 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 1.9–6.9 (estimated)[3]
Log K_{oc}	0.60 (estimated)[3]	1.12 (estimated)[3]	1.34 (estimated)[3]	1.34 (estimated)[3]	1.50 (estimated)[3]	1.60 (estimated)[3]	0.60–1.60 (estimated)[3]	0.60–1.60 (estimated)[3]	0.60–1.12 (estimated)[3]

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases[1]

Subcategory I: Hydrocarbon gases, C1 – C4

Property	SPONSORED CHEMICAL Methane	SPONSORED CHEMICAL Ethane	SPONSORED CHEMICAL Propane	SPONSORED CHEMICAL 1-Propene	SPONSORED CHEMICAL Propane, 2-methyl-	SPONSORED CHEMICAL Butane	SPONSORED CHEMICAL Natural gas[2]	SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer[2]	SPONSORED CHEMICAL Natural gas, dried[2]
Fugacity (Level III Model)[3]									
Air (%)	57	55	50	11	44	48	11–57	11–57	55–57
Water (%)	42	44	49	87	55	51	42–87	42–87	42–44
Soil (%)	0.50	0.56	0.61	1.4	0.66	0.80	0.5–1.9	0.5–1.9	0.50–0.56
Sediment (%)	<0.1	0.11	0.14	0.24	0.17	0.16	<0.1–0.24	<0.1–0.24	<0.1–0.11
Persistence[8]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[8]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5]Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[6] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[7] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[8] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]									
Subcategory I: Hydrocarbon gases, C1 – C4 (continued)									
Property	**SPONSORED CHEMICAL Alkanes, C1-2[2]**	**SPONSORED CHEMICAL Alkanes, C2-3[2]**	**SPONSORED CHEMICAL Alkanes, C3-4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C2-4, C3-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), C2-3[2]**	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1-3[2]**
CASRN	68475-57-0	68475-58-1	68475-59-2	68476-49-3	68477-70-3	68477-86-1	68477-88-3	68477-90-7	68527-16-2
Photodegradation Half-life	39 days to 4.3 years (estimated)[3]	8.4–39 days (estimated)[3]	4.1–8.4 days (estimated)[3]	4.9 hours to 39 days (estimated)[3]	4.9 hours to 39 days (estimated)[3]	15 hours to 39 days (estimated)[3]	8.4 days (estimated)[3]	4.9 hours to 39 days (estimated)[3]	8.4 days to 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	Methane: 66% in 35 days (inherently bio-degradable)[4]; Ethane: 73% in 35 days (inherently bio-degradable)[4]	Ethane: 73% in 35 days (inherently bio-degradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]	Propane: 57% in 30 days (not readily bio-degradable)[5]; Butane: no data	Propane: 57% in 30 days (not readily bio-degradable)[5]; Propene: 1% in 28 days (not readily bio-degradable)[6,7]	Ethane: 73% in 35 days (inherently bio-degradable)[4]; Ethene: no data; Propane: 57% in 30 days (not readily bio-degradable)[5]; Propene: 1% in 28 days (not readily bio-degradable)[6,7]	Ethane: 73% in 35 days (inherently bio-degradable)[4]; Ethene: no data	Propane: 57% in 30 days (not readily bio-degradable)[5]	Ethane: 73% in 35 days (inherently bio-degradable)[4]; Propane: 57% in 30 days (not readily bio-degradable)[5]; Propene: 1% in 28 days (not readily bio-degradable)[6,7]	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]
Bioaccumulation Factor	BAF = 1.9–6.9 (estimated)[3]	BAF = 6.9–21 (estimated)[3]	BAF = 21–61 (estimated)[3]	BAF = 6.4–21 (estimated)[3]	BAF = 2.1–21 (estimated)[3]	BAF = 2.1–6.9 (estimated)[3]	BAF = 21 (estimated)[3]	BAF = 6.4–21 (estimated)[3]	BAF = 1.9–21 (estimated)[3]
Log K_{oc}	0.60–1.12 (estimated)[3]	1.12–1.34 (estimated)[3]	1.34–1.60 (estimated)[3]	1.34 (estimated)[3]	1.12–1.34 (estimated)[3]	1.12 (estimated)[3]	1.34 (estimated)[3]	1.12–1.34 (estimated)[3]	1.9–1.34 (estimated)[3]

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory I: Hydrocarbon gases, C1 – C4 (continued)

Property	SPONSORED CHEMICAL Alkanes, C1-2[2]	SPONSORED CHEMICAL Alkanes, C2-3[2]	SPONSORED CHEMICAL Alkanes, C3-4[2]	SPONSORED CHEMICAL Hydrocarbons, C2-4, C3-rich[2]	SPONSORED CHEMICAL Gases (petroleum), C2-3[2]	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads[2]	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich[2]	SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich[2]	SPONSORED CHEMICAL Hydrocarbons, C1-3[2]
Fugacity (Level III Model)[3]									
Air (%)	55–57	50–55	48–50	11–50	11–55	26–55	50	11–55	50–57
Water (%)	42–44	44–49	49–51	49–87	44–87	44–73	49	44–87	42–49
Soil (%)	0.50–0.56	0.56–0.61	0.61–0.80	0.61–1.4	0.56–1.4	0.56–1.05	0.61	0.56–1.4	0.50–0.61
Sediment (%)	<0.1–0.11	0.11–0.14	0.14–0.16	0.14–0.24	0.11–0.24	0.11–0.17	0.14	0.11–0.24	<0.1–0.14
Persistence[8]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[8]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5]Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[6] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[7] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[8] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]				
Subcategory I: Hydrocarbon gases, C1 – C4 (continued)				
Property	**SPONSORED CHEMICAL Hydrocarbons, C3[2]**	**SPONSORED CHEMICAL Fuel gases, refinery, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead[2]**
CASRN	68606-26-8	68918-98-9	68919-20-0	68955-34-0
Photodegradation Half-life	4.9 hours to 39 days (estimated)[3]	8.4 days to 4.3 years (estimated)[3]	4.9 hours to 39 days (estimated)[3]	39 days (estimated)[3]
Hydrolysis Half-life	Stable			
Biodegradation	Propane: 57% in 30 days (not readily biodegradable)[4]; Propene: 1% in 28 days (not readily biodegradable)[5,6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[4]	Propane: 57% in 30 days (not readily biodegradable)[4]; Propene: 1% in 28 days (not readily biodegradable)[5,6]	73% in 35 days (inherently biodegradable)[7]
Bioaccumulation Factor	BAF = 6.4–21 (estimated)[3]	BAF = 1.9–21 (estimated)[3]	BAF = 6.4–21 (estimated)[3]	BAF = 6.9 (estimated)[3]
Log K_{oc}	1.34 (estimated)[3]	1.9–1.34 (estimated)[3]	1.34 (estimated3	1.12 (estimated)[3]
Fugacity (Level III Model)[3]				
Air (%)	11–50	50–57	11–50	55
Water (%)	49–87	42–49	49–87	44
Soil (%)	0.61–1.4	0.50–0.61	0.61–1.4	0.56
Sediment (%)	0.14–0.24	<0.1–0.14	0.14–0.24	0.11
Persistence[8]	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[8]	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[5] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[7]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[8] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]						
Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene						
Property	**SPONSORED CHEMICAL Gases (petroleum), C3-4[2]**	**SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1-4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1-4, sweetened[2]**	**SPONSORED CHEMICAL Hydrocarbons, C2-4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C4-unsatd.[2]**
CASRN	68131-75-9	68477-94-1	68514-31-8	68514-36-3	68606-25-7	68956-54-7
Photodegradation Half-life	4.9 hours to 39 days (estimated)[3]	8.4 days (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	4.6 hours to 39 days (estimated)[3]	1.9–4.7 hours (estimated)[3]
Hydrolysis Half-life	Stable					
Biodegradation	Propane: 57% in 30 days (not readily biodegradable)[4]; Propene: 1% in 28 days (not readily biodegradable)[5,6]	Propane: 57% in 30 days (not readily biodegradable)[4]	Methane: 66% in 35 days (inherently biodegradable)[7]; Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[4]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[4]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,6]	Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[4]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,6]	1,3-Butadiene: 0–4% in 28 days (not readily biodegradable)[5,6]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,6]
Bioaccumulation Factor	BAF = 6.4–21 (estimated)[3]	BAF = 21 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 6.9–61 (estimated)[3]	BAF = 10–24 (estimated)[3]
Log K_{oc}	1.34 (estimated)[3]	1.34 (estimated)[3]	0.60–1.60 (estimated)[3]	0.60–1.60 (estimated)[3]	1.12-1.60 (estimated)[3]	1.6 (estimated)[3]
Fugacity (Level III)[3]						
Air (%)	11–50	50	11–57	11–57	11–55	5.7–11
Water (%)	49–87	49	42–87	42–87	44–86	86–91
Soil (%)	0.61–1.4	0.61	0.5–1.9	0.5–1.9	0.56–2.0	2.0–3.0
Sediment (%)	0.14–0.24	0.14	<0.1–0.24	<0.1–0.24	0.11–0.27	0.27–0.32
Persistence[8]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]						
Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene						
Property	**SPONSORED CHEMICAL Gases (petroleum), C3-4[2]**	**SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1-4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C1-4, sweetened[2]**	**SPONSORED CHEMICAL Hydrocarbons, C2-4[2]**	**SPONSORED CHEMICAL Hydrocarbons, C4-unsatd.[2]**
Bioaccumulation[8]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1] The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.
[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.
[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.
[4] Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.
[5] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.
[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.
[7] European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.
[8] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]									
Subcategory III: Hydrocarbon gases, C1 – C6									
Property	**SPONSORED CHEMICAL Butane, 2-methyl-**	**SPONSORED CHEMICAL Pentane**	**SPONSORED CHEMICAL Cyclopentane**	**SPONSORED CHEMICAL 2-Butene, 2-methyl-**	**SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer[2]**
CASRN	78-78-4	109-66-0	287-92-3	513-35-9	68308-02-1	68308-03-2	68308-04-3	68308-06-5	68308-08-7
Photo-degradation Half-life	32 hours (estimated)[3]	32 hours (estimated)[3]	28 hours (estimated)[3]	1.5 hours (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	1.5 hours to 4.3 years (estimated)[3]	1.5 hours to 4.3 years (estimated)[3]	1.5 hours to 4.3 years (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	Readily bio-degradable[4]	96% in 28 days (readily bio-degradable)[5]	Inherently bio-degradable[4]	7% in 28 days (not readily bio-degradable)[6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[8]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,9]	Methane: 66% in 35 days (inherently biodegradable)[7]; Propene: 1% in 28 days (not readily biodegradable)[5,9]; Isobutane: 49% in 30 days (not readily biodegradable)[8]; 2-Methyl-2-butene: 7% in 28 days (not readily biodegradable)[6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Propene: 1% in 28 days (not readily biodegradable)[5,9]; Isobutane: 49% in 30 days (not readily biodegradable)[8]; 2-Methyl-2-butene: 7% in 28 days (not readily biodegradable)[6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Propene: 1% in 28 days (not readily bio-degradable)[5,9]; Isobutane: 49% in 30 days (not readily bio-degradable)[8]; 2-Methyl-2-butene: 7% in 28 days (not readily biodegradable)[6]	Methane: 66% in 35 days (inherently biodegradable)[7]; Ethane: 73% in 35 days (inherently biodegradable)[7]; Propane: 57% in 30 days (not readily biodegradable)[8]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,9]
Bioaccumulation Factor	BAF = 44 (estimated)[3]	BAF = 150 (estimated)[3]	BAF = 132 (estimated)[3]	BAF = 44 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–61 (estimated)[3]

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory III: Hydrocarbon gases, C1 – C6

Property	SPONSORED CHEMICAL Butane, 2-methyl-	SPONSORED CHEMICAL Pentane	SPONSORED CHEMICAL Cyclopentane	SPONSORED CHEMICAL 2-Butene, 2-methyl-	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant[2]	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer[2]
Log K_{oc}	1.78 (estimated)[3]	1.86 (estimated)[3]	1.90 (estimated)[3]	1.78 (estimated)[3]	0.60–1.60 (estimated)[3]	0.60–1.90 (estimated)[3]	0.60–1.90 (estimated)[3]	0.60–1.90 (estimated)[3]	0.60–1.60 (estimated)[3]
Fugacity (Level III Model)[3]									
Air (%)	39	43	35	0.98	11–57	0.98–57	0.98–57	0.98–57	11–57
Water (%)	60	56	64	96	42–87	42–96	42–96	42–96	42–87
Soil (%)	0.75	0.91	0.84	2.0	0.5–1.9	0.5–2.0	0.5–2.0	0.5–2.0	0.5–1.9
Sediment (%)	0.25	0.23	0.32	0.42	<0.1–0.24	<0.1–0.42	<0.1–0.42	<0.1–0.42	<0.1–0.24
Persistence[10]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bio-accumulation[10]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1] The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4] OECD. 2008. SIDS Initial Assessment Profile for C5 Aliphatic Hydrocarbon Solvents Category. SIAM 26, 16 April. Organisation for Economic Co-operation and Development. Available online at http://webnet.oecd.org/hpv/ui/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d as of September 15, 2010. [SIDS dataset not available online]

[5] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[6] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available online at http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of September 15, 2010.

[7] European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of September 15, 2010.

[8] Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[9] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[10] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Property	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydro-desulfurizer, H_2S free[2]	SPONSORED CHEMICAL Alkanes, C4 – 5[2]	SPONSORED CHEMICAL Hydro-carbons, C3 – 4[2]	SPONSORED CHEMICAL Hydro-carbons, C4 – 5[2]	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich[2]	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. Splitter[2]	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich[2]
CASRN	68308-09-8	68308-10-1	68475-60-5	68476-40-4	68476-42-6	68477-69-0	68477-76-9	68478-19-3	68478-33-1
Photodegradation Half-life	1.5 hours to 4.3 years (estimated)[3]	4.6 hours to 4.3 years (estimated)[3]	2.6– 4.0 days (estimated)[3]	4.6 hours to 8.4 days (estimated)[3]	1.5 hours to 4.1 days (estimated)[3]	4.1–8.4 days (estimated)[3]	4.1–39 days (estimated)[3]	4.1–8.4 days (estimated)[3]	39 days to 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	Methane: 66% in 35 days (inherently biodegradable)[4]; Propene: 1% in 28 days (not readily biodegradable)[5,6]; Isobutane: 49% in 30 days (not readily biodegradable)[7]; 2-Methyl-2-butene: 7% in 28 days (not readily biodegradable)[8]	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[7]; 1-Butene: 1% in 28 days (not readily biodegradable)[5,6]	Butane: no data; 2-Methyl-butane: Readily bio-degradable[9]	Propane: 57% in 30 days (not readily bio-degradable)[7]; 1-Butene: 1% in 28 days (not readily bio-degradable)[5,6]	Butane: no data; 2-Methyl-2-butene: 7% in 28 days (not readily bio-degradable)[8]	Propane: 57% in 30 days (not readily bio-degradable)[7]; Butane: no data	Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[7]; Butane: no data	Propane: 57% in 30 days (not readily biodegradable)[7]; Butane: no data	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]
Bioaccumulation Factor	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 43–61 (estimated)[3]	BAF = 21–23 (estimated)[3]	BAF = 43–61 (estimated)[3]	BAF = 21–61 (estimated)[3]	BAF = 6.9–21 (estimated)[3]	BAF = 21–61 (estimated)[3]	BAF = 1.9–6.9 (estimated)[3]

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Property	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free[2]	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydro-desulfurizer, H_2S free[2]	SPONSORED CHEMICAL Alkanes, C4 – 5[2]	SPONSORED CHEMICAL Hydro-carbons, C3 – 4[2]	SPONSORED CHEMICAL Hydro-carbons, C4 – 5[2]	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich[2]	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. Splitter[2]	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich[2]
Log K_{oc}	0.60–1.90 (estimated)[3]	0.60–1.60 (estimated)[3]	1.60–1.78 (estimated)[3]	1.34–1.60 (estimated)[3]	1.60–1.78 (estimated)[3]	1.34–1.60 (estimated)[3]	1.12–1.34 (estimated)[3]	1.34–1.60 (estimated)[3]	0.60–1.12 (estimated)[3]
Fugacity (Level III Model)[3]									
Air (%)	0.98–57	11–57	39–48	11–50	1.0–48	48–50	50–55	48–50	55–57
Water (%)	42–96	42–87	50–60	49–86	50–96	49–51	44–49	49–51	42–44
Soil (%)	0.5–2.0	0.5–1.9	0.75–0.80	0.61–1.9	0.80–2.1	0.61–0.80	0.55–0.61	0.61–0.80	0.50–0.56
Sediment (%)	<0.1–0.42	<0.1–0.24	0.16–0.26	0.13–0.27	0.16–0.42	0.13–0.16	0.11–0.13	0.13–0.16	<0.1–0.11
Persistence[10]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bio-accumulation[10]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1] The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of September 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of September 15, 2010.

[4] European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of September 15, 2010.

[5] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[7] Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[8] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available online at http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of September 15, 2010.

[9] OECD. 2008. SIDS Initial Assessment Profile for C5 Aliphatic Hydrocarbon Solvents Category. SIAM 26, 16 April. Organisation for Economic Co-operation and Development. Available online at http://webnet.oecd.org/hpv/ui/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d as of September 15, 2010. [SIDS dataset not available online]

[10] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]								
Subcategory III: Hydrocarbon gases, C1 – C6 (continued)								
Property	**SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads[2]**	**SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off[2]**	**SPONSORED CHEMICAL Gas (petroleum), dehexanizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off[2]**	**SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off[2]**	**SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter residues[2]**
CASRN	68513-12-2	68513-17-7	68918-99-0	68919-00-6	68919-05-1	68919-06-2	68919-10-8	68919-19-7
Photodegradation Half-life	4.1 days to 4.3 years (estimated)[3]	23 hours to 39 days (estimated)[3]	32 hours to 4.3 years (estimated)[3]	32 hours to 4.3 years (estimated)[3]	32 hours to 4.3 years (estimated)[3]	4.1 days to 4.3 years (estimated)[3]	4.1 days to 4.3 years (estimated)[3]	4.6 hours to 8.4 days (estimated)[3]
Hydrolysis Half-life	Stable							
Biodegradation	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Butane: no data	Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; 2-Methylbutane: readily biodegradable[6]; 2-Methylpentane: 93% in 28 days (readily biodegradable)[7]	Methane: 66% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Isobutane: 49% in 30 days (not readily biodegradable)[5]; 2-Methylbutane: readily biodegradable[6]	Methane: 66% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Isobutane: 49% in 30 days (not readily biodegradable)[5]; 2-Methylbutane: readily biodegradable[6]	Methane: 66% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Isobutane: 49% in 30 days (not readily biodegradable)[5]; 2-Methylbutane: readily biodegradable[6]	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Butane: no data	Methane: 66% in 35 days (inherently biodegradable)[4]; Ethane: 73% in 35 days (inherently biodegradable)[4]; Propane: 57% in 30 days (not readily biodegradable)[5]; Butane: no data	Propane: 57% in 30 days (not readily biodegradable)[5]; 1-Butene: 1% in 28 days (not readily biodegradable)[7,8]
Bioaccumulation Factor	BAF = 1.9–61 (estimated)[3]	BAF = 6.9–106 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–47 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 1.9–61 (estimated)[3]	BAF = 21–23 (estimated)[3]
Log K_{oc}	0.60–1.60 (estimated)[3]	1.12–2.04 (estimated)[3]	0.60–1.78 (estimated)[3]	0.60–1.78 (estimated)[3]	0.60–1.78 (estimated)[3]	0.60–1.60 (estimated)[3]	0.60–1.60 (estimated)[3]	1.34–1.6 (estimated)[3]

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Property	SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads[2]	SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off[2]	SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off[2]	SPONSORED CHEMICAL Gas (petroleum), dehexanizer off[2]	SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off[2]	SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off[2]	SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off[2]	SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter residues[2]
Fugacity (Level III Model)[3]								
Air (%)	48–57	34–55	39–57	39–57	39–57	48–57	48–57	11–50
Water (%)	42–51	44–65	42–60	42–60	42–60	42–51	42–51	49–86
Soil (%)	0.50–0.80	0.56–0.85	0.50–0.75	0.50–0.75	0.50–0.75	0.50–0.80	0.50–0.80	0.61–1.9
Sediment (%)	<0.1–0.16	0.11–0.40	<0.1–0.26	<0.1–0.26	<0.1–0.26	<0.1–0.16	<0.1–0.16	0.13–0.27
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online at http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of September 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of September 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online at http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of September 15, 2010.

[5] Solano-Serena, F; Marchal, R; Huet, T; et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl Microbiol Biotech 54(1):121–125.

[6] OECD. 2008. SIDS Initial Assessment Profile for C5 Aliphatic Hydrocarbon Solvents Category. SIAM 26, 16 April. Organisation for Economic Co-operation and Development. Available from http://webnet.oecd.org/hpv/ui/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d as if September 15, 2010. [SIDS dataset not available online]

[7] National Institute of Technology and Evaluation. 2002. Biodegradation and bioaccumulation of the existing chemical substances under the Chemical Substances Control Law. Available online at http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html as of September 27, 2010.

[8] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See: Van Ginkel, CG; Welten, HG; de Bont, JA. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl Env Microbiol 53(12):2903–2907.

[9] Federal Register. 1999. Category for persistent, bioaccumulative, and toxic new chemical substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene[1]

Property	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber[2]	SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer[2]	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads[2]	SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed[2]	SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free[2]
CASRN	68307-98-2	68307-99-3	68308-05-4	68409-99-4	68476-54-0	68477-42-9	68477-71-4	68477-72-5	68477-73-6
Photodegradation Half-life	4.7 hours – 4.3 years (estimated)[3]	4.7 hours – 4.3 years (estimated)[3]	4.7 hours – 4.3 years (estimated)[3]	1.5 hours – 4.4 days (estimated)[3]	32 hours – 8.4 days (estimated)[3]	2.5 – 4.7 hours (estimated)[3]	4.7 hours-4.1 days (estimated)[3]	32 hours – 8.4 days (estimated)[3]	4.9 hours-8.4 days (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	methane: 66% in 35 days (inher. biodeg)[4]; ethane: 73% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[5]; 1-butene: 1% in 28 days (not readily biodeg)[6,7]	methane: 66% in 35 days (inher. biodeg)[4]; ethane: 73% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[5]; 1-butene: 1% in 28 days (not readily biodeg)[6,7]	methane: 66% in 35 days (inher. biodeg)[4]; ethane: 73% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[5]; 1-butene: 1% in 28 days (not readily biodeg)[6,7]	propene:1% in 28 days (not readily biodegrad)[6,7]; isobutane: 49% in 30 days (not readily biodeg)[5]; 2-methyl-2-pentene: No data	propane: 57% in 30 days (not readily biodeg)[5]; isobutane: 49% in 30 days (not readily biodeg)[5]; Readily biodegradable[8]	2-methylpropene: no date; 1-butene: 1% in 28 days (not readily biodeg)[6,7]	butane: no data; 1-butene: 1% in 28 days (not readily biodeg)[6,7]	propane: 57% in 30 days (not readily biodeg)[5]; isobutane: 49% in 30 days (not readily biodeg)[5]; Readily biodegradable[8]	propane: 57% in 30 days (not readily biodeg)[5]; propene:1% in 28 days (not readily biodegrad)[6,7]
Bioaccumulation Factor	BAF = 1.9 – 24 (estimated)[3]	BAF = 1.9 – 24 (estimated)[3]	BAF = 1.9 – 24 (estimated)[3]	BAF = 6.4 – 47 (estimated)[3]	BAF = 21 – 47 (estimated)[3]	BAF = 21 – 24 (estimated)[3]	BAF = 24 – 61 (estimated)[3]	BAF = 21 – 47 (estimated)[3]	BAF = 6.4 – 21 (estimated)[3]
Log K_{oc}	0.6 – 1.6 (estimated)[3]	0.6 – 1.6 (estimated)[3]	0.6 – 1.6 (estimated)[3]	1.34-1.78 (estimated)[3]	1.34 – 1.78 (estimated)[3]	1.5-1.6 (estimated)[3]	1.60 (estimated)[3]	1.34 – 1.78 (estimated)[3]	1.34 (estimated)[3]
Fugacity(Level III) Air (%) Water (%) Soil (%) Sediment (%)	11-57 42-86 0.5-2.0 <0.1-0.27	11-57 42-86 0.5-2.0 <0.1-0.27	11-57 42-86 0.5-2.0 <0.1-0.27	0.98-44 55-96 0.66-2.0 0.17-0.42	39-50 49-60 0.61-0.75 0.14-0.25	11-7.0 86-91 1.6-2.0 0.27-0.29	11-48 51-86 0.8-2.0 0.16-0.27	39-50 49-60 0.61-0.75 0.14-0.25	11-50 49-87 0.61-1.4 0.14-0.24
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.
[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.
[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.
[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.
[6] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.
[7] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.
[8] OECD. 2008. SIDS Initial Assessment Profile for C5 Aliphatic Hydrocarbon Solvents Category. SIAM 26, 16 April. Organisation for Economic Co-operation and Development. Available from http://webnet.oecd.org/hpv/ui/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d
[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene[1]

Property	SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed[2]	SPONSORED CHEMICAL Gases (petroleum), C4-rich[2]	SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads[2]	SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads[2]	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined[2]	SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer[2]	SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker[2]	SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate[2]	SPONSORED CHEMICAL Butane, branched and linear[2]
CASRN	68477-83-8	68477-85-0	68477-87-2	68477-91-8	68478-24-0	68478-26-2	68478-34-2	68512-91-4	68513-65-5
Photodegradation Half-life	1.5 hours – 4.4 days (estimated)[3]	4.1 – 4.4 days (estimated)[3]	4.1 – 8.4 days (estimated)[3]	4.1 – 39 days (estimated)[3]	1.5 hours – 4.3 years (estimated)[3]	4.7 hours – 4.3 years (estimated)[3]	1.5 hours – 4.3 years (estimated)[3]	4.7 hours – 8.4 days (estimated)[3]	4.1 – 4.4 days (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	propene:1% in 28 days (not readily biodegrad)[4,5]; isobutane: 49% in 30 days (not readily biodeg)[6]; 2-methyl-2-pentene: No data	isobutane: 49% in 30 days (not readily biodegr)[6]; butane: no data	propane: 57% in 30 days (not readily biodegradable)[6]; butane: no data	ethane: 73% in 35 days (inherently biodegradable)[7]; propane: 57% in 30 days (not readily biodegradable)[6]; butane: no data	methane: 66% in 35 days (inherently biodegradable)[7]; propene:1% in 28 days (not readily biodegradable)[4,5]; isobutane: 49% in 30 days (not readily biodegr)[6]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[8]	methane: 66% in 35 days (inherently biodegradable)[7]; ethane: 73% in 35 days (inherently biodegradable)[7]; propane: 57% in 30 days (not readily biodeg)[6]; 1-butene: 1% in 28 days (not readily biodegradable)[4,5]	methane: 66% in 35 days (inherently biodegradable)[7]; propene:1% in 28 days (not readily biodegradable)[4,5]; isobutane: 49% in 30 days (not readily biodegr)[6]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[8]	propane: 57% in 30 days (not readily biodegradable)[6]; 1-butene: 1% in 28 days (not readily biodegradable)[4,5]	isobutane: 49% in 30 days (not readily biodegr)[6]; butane: no data
Bioaccumulation Factor	BAF = 6.4 – 47 (estimated)[3]	BAF = 47 – 61 (estimated)[3]	BAF = 21 – 61 (estimated)[3]	BAF = 6.9 – 61 (estimated)[3]	BAF = 1.9 – 47 (estimated)[3]	BAF = 1.9 – 24 (estimated)[3]	BAF = 1.9 – 47 (estimated)[3]	BAF =21-24 (estimated)[3]	BAF = 47 – 61 (estimated)[3]
Log K_{oc}	1.34 – 1.78 (estimated)[3]	1.50 – 1.60(estimated)[3]	1.34 – 1.6 (estimated)[3]	1.12 – 1.6 (estimated)[3]	0.6 – 1.78 (estimated)[3]	0.6 – 1.6 (estimated)[3]	0.6 – 1.78 (estimated)[3]	1.34 – 1.6 (estimated)[3]	1.50 – 1.60 (estimated)[3]
Fugacity(Level III)[3]									
Air (%)	0.98-44	44-48	48-50	48-55	0.98-57	11-57	0.98-57	11-50	44-48
Water (%)	55-96	51-55	49-51	44-51	42-96	42-86	42-96	49-86	51-55
Soil (%)	0.66-2.0	0.66-0.80	0.61-0.8	0.56-0.8	0.50-2.0	0.5-2.0	0.50-2.0	0.61-2.0	0.66-0.80
Sediment (%)	0.17-0.42	0.16-0.17	0.14-0.16	0.11-0.16	<0.1-0.42	<0.1-0.27	<0.1-0.42	0.14-0.27	0.16-0.17
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.
[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.
[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.
[4] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.
[5] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test

period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.

[6]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.

[7]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[8] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.

[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Property	SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich[2]	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction[2]	SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet[2]	SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product[2]	SPONSORED CHEMICAL Gases (petroleum), alkylation feed[2]	SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation[2]	SPONSORED CHEMICAL Fuel gases, refinery, sweetened[2]	SPONSORED CHEMICAL Gases (petroleum), catalytic cracking[2]	SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened[2]
CASRN	68513-66-6	68527-19-5	68602-83-5	68606-24-6	68606-27-9	68606-34-8	68783-61-9	68783-64-2	68783-65-3
Photodegradation Half-life	4.1 days (estimated)[3]	4.7 hours – 4.3 years (estimated)[3]	1.5 hours – 4.3 years (estimated)[3]	1.5 hours– 4.4 days(estimated)[3]	1.9 – 4.9 hours (estimated)[3]	1.9 hours – 4.4 days (estimated)[3]	1.5 hours – 4.3 years(estimated)[3]	1.5 hours – 4.4 days (estimated)[3]	4.7 hours – 39 days (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	No data	methane: 66% in 35 days (inherently biodegradable)[4]; ethane: 73% in 35 days (inherently biodegradable)[4]; propane: 57% in 30 days (not readily biodeg)[5]; 1-butene: 1% in 28 days (not readily biodegradable)[6,7]	methane: 66% in 35 days (inherently biodegradable)[4]; propene:1% in 28 days (not readily biodegradable)[6,7]; isobutane: 49% in 30 days (not readily biodegr)[5]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[8]	propene:1% in 28 days (not readily biodegrad)[6,7]; isobutane: 49% in 30 days (not readily biodeg)[5]; 2-methyl-2-pentene: No data	propene:1% in 28 days (not readily biodegradable)[6,7]; 1-butene: 1% in 28 days (not readily biodegrad)[6,7]; butadiene: 4% in 28 days(not readily biodeg)[6,7]	butane; no data; isobutane: 49% in 30 days (not readily biodegr)[5]; butadiene: 4% in 28 days(not readily biodeg)[6,7]	methane: 66% in 35 days (inherently biodegradable)[4]; propene:1% in 28 days (not readily biodegrad)[6,7]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[8]; 2-methylpentane: 93% in 28 days (readily biodegradable)[6]	propene:1% in 28 days (not readily biodegrad)[6,7]; isobutane: 49% in 30 days (not readily biodeg)[5]; 2-methyl-2-pentene: No data	ethane: 73% in 35 days (inherently biodegradable)[4]; propane: 57% in 30 days (not readily biodegradable)[5]; 1-butene: 1% in 28 days (not readily biodegradable)[6,7]
Bioaccumulation Factor	BAF = 61 (estimated)[3]	BAF = 1.9 – 24 (estimated)[3]	BAF = 1.9 – 47 (estimated)[3]	BAF = 6.4 – 47 (estimated)[3]	BAF = 6.4 – 24 (estimated)[3]	BAF = 10 – 61 (estimated)[3]	BAF = 1.9 – 106 (estimated)[3]	BAF = 6.4 – 47 (estimated)[3]	BAF = 6.9 – 24 (estimated)[3]
Log K_{oc}	1.60 (estimated)[3]	0.6 – 1.6 (estimated)[3]	0.6 – 1.78 (estimated)[3]	1.34–1.78 (estimated)[3]	1.34–1.60 (estimated)[3]	1.50–1.60 (estimated)[3]	0.6–2.79 (estimated)[3]	1.34–1.78 (estimated)[3]	1.12–1.60 (estimated)[3]
Fugacity (Level III)[3]									
Air (%)	48	11-57	0.98-57	0.98-44	5.7-11	5.7-48	0.98-33.4	0.98-44	11-55
Water (%)	51	42-86	42-96	55-96	86-91	51-91	42-96	55-96	44-86
Soil (%)	0.80	0.5-2.0	0.50-2.0	0.66-2.0	1.4-3.0	0.66-3.0	0.5-1.4	0.66-2.0	0.56-2.0
Sediment (%)	0.16	<0.1-0.27	<0.1-0.42	0.17-0.42	0.24-0.32	0.16-0.32	<0.1-0.42	0.17-0.42	0.11-0.27
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.\

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.

[6] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.

[7] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.

[8] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.

[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]				
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)				
Property	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha debutanizer[2]**	**SPONSORED CHEMICAL Gases (petroleum), light steam-cracked, butadiene conc[2]**	**SPONSORED CHEMICAL Residues (petroleum), catalytic cracking depropanizer, C4-rich[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber[2]**
CASRN	68952-76-1	68955-28-2	71329-37-8	71808-30-5
Photodegradation Half-life	4.7 hours – 4.3 years (estimated)[3]	1.9 – 4.7 hours (estimated)[3]	4.7 hours – 4.1 days (estimated)[3]	1.5 hours – 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable			
Biodegradation	methane: 66% in 35 days (inherently biodegradable)[4]; ethane: 73% in 35 days (inherently biodegradable)[4]; propane: 57% in 30 days (not readily biodeg)[5]; 1-butene: 1% in 28 days (not readily biodegradable)[6,7]	butadiene: 4% in 28 days(not readily biodeg)[6,7]; 1-butene: 1% in 28 days (not readily biodegradable)[6,7]	butane: no data; 1-butene: 1% in 28 days (not readily biodegradable)[6,7]	methane: 66% in 35 days (inherently biodegradable)[4]; propene:1% in 28 days (not readily biodegradable)[6,7]; isobutane: 49% in 30 days (not readily biodegr)[5]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[8]
Bioaccumulation Factor	BAF = 1.9 – 24 (estimated)[3]	BAF = 10 – 24 (estimated)[3]	BAF = 24 – 61 (estimated)[3]	BAF = 1.9 – 47 (estimated)[3]
Log K_{oc}	0.6 – 1.6 (estimated)[3]	1.60 (estimated)[3]	1.60 (estimated)[3]	0.6 – 1.78 (estimated)[3]
Fugacity (Level III Model)[3]				
Air (%)	11-57	5.7-11	11-48	0.98-57
Water (%)	42-86	86-91	51-86	42-96
Soil (%)	0.5-2.0	2.0-3.0	0.8-2.0	0.50-2.0
Sediment (%)	<0.1-0.27	0.27-0.32	0.16-0.27	<0.1-0.42
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.

[6] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.

[7] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.

[8] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.

[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]									
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene									
Property	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free[2]**	**SPONSORED CHEMICAL Hydrocarbons, C>3[2]**	**SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich[2]**	**SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off[2]**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber[2]**
CASRN	68308-12-3	68476-44-8	68477-25-8	68477-74-7	68477-75-8	68477-79-2	68513-15-5	68919-16-4	68952-81-8
Photodegradation Half-life	1.5 hours – 4.3 years (estimated)[3]	1.5 hours – 4.1 days (estimated)[3]	22.1 hours – 4.3 years (estimated)[3]	22.1 hours-4.3 years (estimated)[3]	32 hours – 4.3 years (estimated)[3]	4.7 hours – 4.3 years (estimated)[3]	1.5 hours – 39 days (estimated)[3]	1.5 hours-5.1 days (estimated)[3]	1.5 hours – 4.3 years(estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	methane: 66% in 35 days (inher. biodeg)[4]; propene:1% in 28 days (not readily biodeg)[5,6] 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]	butane: no data; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]	methane: 66% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[8]; 2-methylbutane: readily biodegradable[9]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]	methane: 66% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[8]; 2-methylbutane: readily biodegradable[9]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]	methane: 66% in 35 days (inherently biodegradable)[4]; propane: 57% in 30 days (not readily biodegradable)[8]; isobutane: 49% in 30 days (not readily biodegradable) [8]; 2-methylbutane: readily biodeg[9]	methane: 66% in 35 days (inher. biodeg)[4]; ethane: 73% in 35 days (inher. biodeg)[4]; propane: 57% in 30 days (not readily biodeg)[8]; 1-butene: 1% in 28 days (not readily biodeg)[5,6]	ethane: 73% in 35 days (inher. biodeg)[4]; propene:1% in 28 days (not readily biodeg)[5,6] 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]	propene:1% in 28 days (not readily biodeg)[5,6] 2-methylpentene: no data; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; benzene: 40% in 14 days (readily biodegradable)[5]	methane: 66% in 35 days (inher. biodeg)[4]; propene:1% in 28 days (not readily biodeg)[5,6] 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]
Bioaccumulation Factor	BAF = 1.9 – 106 (estimated)[3]	BAF = 44 – 106 (estimated)[3]	BAF = 1.9 –106 (estimated)[3]	BAF = 1.9 –106 (estimated)[3]	BAF = 1.9 – 47 (estimated)[3]	BAF = 1.9 – 24 (estimated)[3]	BAF = 6.4 – 106 (estimated)[3]	BAF = 6.4 – 15 (estimated)[3]	BAF = 1.9-106 (estimated)[3]
Log K_{oc}	0.6-2.79 (estimated)[3]	1.60-2.79 (estimated)[3]	1.60-2.79 (estimated)[3]	1.60-2.79 (estimated)[3]	0.6-1.78 (estimated)[3]	0.6-1.6 (estimated)[3]	1.12-2.79 (estimated)[3]	1.34-2.16 (estimated)[3]	0.6-2.79 (estimated)[3]
Fugacity(Level III)									
Air (%)	0.98-33.4	0.98-48	33.4-57	33.4-57	39-57	11-57	0.98-55	0.98-44	0.98-33.4
Water (%)	42-96	51-96	42-65.4	42-65.4	42-60	42-86	44-96	41.3-96	42-96
Soil (%)	0.5-1.4	0.80-2.0	0.50-0.862	0.50-0.862	0.5-0.75	0.5-2.0	0.56-2.0	0.66-26.8	0.5-1.4
Sediment (%)	<0.1-0.42	0.16-0.42	<0.1-0.41	<0.1-0.41	<0.1-0.25	<0.1-0.27	0.11-0.42	0.17-0.372	<0.1-0.42
Persistence[10]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[10]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from:

http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.

[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.

[7] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.

[8]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.

[9] OECD. 2008. SIDS Initial Assessment Profile for C5 Aliphatic Hydrocarbon Solvents Category. SIAM 26, 16 April. Organisation for Economic Co-operation and Development. Available from http://webnet.oecd.org/hpv/ui/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d as if Sept. 15, 2010. [SIDS dataset not available online].

[10]Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]	
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene (continued)	
Property	**SPONSORED CHEMICAL** **Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking**[2]
CASRN	68952-82-9
Photodegradation Half-life	1.5 hours – 4.3 years (estimated)[3]
Hydrolysis Half-life	Stable
Biodegradation	methane: 66% in 35 days (inher. biodeg)[4]; propene:1% in 28 days (not readily biodeg)[5,6] 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[7]; 2-methylpentane: 93% in 28 days (readily biodeg)[5]
Bioaccumulation Factor	BAF = 1.9 – 106 (estimated)[3]
Log K_{oc}	0.6 – 2.79 (estimated)[3]
Fugacity (Level III Model)[3]	
Air (%)	0.98-33.4
Water (%)	42-96
Soil (%)	0.5-1.4
Sediment (%)	<0.1-0.42
Persistence[8]	P1 (low)
Bioaccumulation[8]	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.
[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.
[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.
[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.
[5] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.
[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.
[7] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.
[8] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]				
Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene				
Property	**SPONSORED CHEMICAL Petroleum gases, liquefied[2]**	**SPONSORED CHEMICAL Petroleum gases, liquefied, sweetened[2]**	**SPONSORED CHEMICAL Gases (petroleum), C3-4, isobutane-rich[2]**	**SPONSORED CHEMICAL Tail gas (petroleum), saturate gas plant mixed stream, C4-rich[2]**
CASRN	68476-85-7	68476-86-8	68477-33-8	68478-32-0
Photodegradation Half-life	1.5 hours – 8.4 days (estimated)[3]	1.5 hours – 8.4 days (estimated)[3]	4.1 – 4.4 days (estimated)[3]	4.1 – 4.4 days (estimated)[3]
Hydrolysis Half-life	Stable			
Biodegradation	propane: 57% in 30 days (not readily biodeg)[4]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[5]; heptane: 100% in 28 days (readily biodegradable)[6]	propane: 57% in 30 days (not readily biodeg)[4]; 2-methyl-2-butene: 7% in 28 days (not readily biodeg)[5]; heptane: 100% in 28 days (readily biodegradable)[6]	isobutane: 49% in 30 days (not readily biodegr)[4]; butane: no data	isobutane: 49% in 30 days (not readily biodegr)[4]; butane: no data
Bioaccumulation Factor	BAF = 21 – 688 (estimated)[3]	BAF = 21 – 688 (estimated)[3]	BAF = 47 – 61 (estimated)[3]	BAF = 47 – 61 (estimated)[3]
Log K_{oc}	1.34 – 2.38 (estimated)[3]	1.34 – 2.38 (estimated)[3]	1.50 – 1.60(estimated)[3]	1.50 – 1.60(estimated)[3]
Fugacity (Level III Model)[3] Air (%) Water (%) Soil (%) Sediment (%)	 0.98-50 49-96 0.61-2.0 0.14-0.561	 0.98-50 49-96 0.61-2.0 0.14-0.561	 44-48 51-55 0.66-0.80 0.16-0.17	 44-48 51-55 0.66-0.80 0.16-0.17
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.
[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.
[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.
[4]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.
[5] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.
[6] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.
[7]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.
[8] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.
[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

Table 4. Environmental Fate Characteristics of Petroleum Hydrocarbon Gases (continued)[1]

Property	SUPPORTING CHEMICAL[2] Naphtha (petroleum), light catalytic cracked	SUPPORTING CHEMICAL[2] Naphtha (petroleum), sweetened	SUPPORTING CHEMICAL[2] Baseline Gasoline Vapor Condensate [BGVC]	SUPPORTING CHEMICAL 1-Butene	SUPPORTING CHEMICAL 2-Butene	SUPPORTING CHEMICAL Ethene	SUPPORTING CHEMICAL 1-Propene, 2-methyl-	SUPPORTING CHEMICAL 1,3-Butadiene	SUPPORTING CHEMICAL Benzene
CASRN	64741-55-5	64741-87-3	86290-81-5	106-98-9	107-01-7	74-85-1	115-11-7	106-99-0	71-43-2
Photodegradation Half-life	2.4 to 4.5 hours (estimated)[3]	2.4 to 23.6 hours (estimated)[3]	32-48.8 hours (estimated)[3]	4.7 hours (estimated)[3]	2.1 hours (estimated)[3]	15 hours (estimated)[3]	2.5 hours (estimated)[3]	1.9 hours (estimated)[3]	5.14 days (estimated)[3]
Hydrolysis Half-life	Stable								
Biodegradation	Biodegradable	Biodegradable	Biodegradable	1% in 28 days (not readily biodegradable)[5,6]	No data	No data	No data	0-4% in 28 days (not readily biodegradable)[5,6]	40% in 14 days (readily biodegradable)[5]
Bioaccumulation Factor	BAF = 33.7 to 104 (estimated)[3]	BAF = 46.1-195.9 (estimated)[3]	BAF = 44-61 (estimated)[3]	BAF = 24 (estimated)[3]	BAF = 21 (estimated)[3]	BAF = 2.1 (estimated)[3]	BAF = 21 (estimated)[3]	BAF = 10 (estimated)[3]	BAF = 15 (estimated)[3]
Log K_{oc}	1.8 to 2.0 (estimated)[3]	1.8-2.1 (estimated)[3]	1.6-1.8 (estimated)[3]	1.60 (estimated)[3]	1.60 (estimated)[3]	1.12 (estimated)[3]	1.50 (estimated)[3]	1.60 (estimated)[3]	2.16 (estimated)[3]
Fugacity (Level III Model)[3]									
Air (%)	6.6-9.8	6.0-34.2	39-48	11	3.0	26	7.0	5.7	31.4
Water (%)	88.4-91.2	64.5-92.1	51-60	86	94	72	91	91	41.3
Soil (%)	1.3-1.7	0.8-1.5	0.7-0.8	2.0	2.1	1.0	1.6	3.0	26.8
Sediment (%)	0.4-0.5	0.3-0.4	0.2	0.27	0.30	0.17	0.29	0.32	0.372
Persistence[9]	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)	P1 (low)
Bioaccumulation[9]	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)	B1 (low)

[1]The Petroleum HPV Testing Group. October 21, 2009. Revised Robust Summary and Test Plan for Petroleum Hydrocarbon Gases Category. Available online from: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224tc.htm as of Sept 15, 2010.

[2] Data provided are based on the typical representative structures; see Appendix for detailed information on the structures chosen for each complex mixture.

[3] U.S. EPA. 2010. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.00. U.S. Environmental Protection Agency, Washington, DC, USA. Available online from: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm as of Sept 15, 2010.

[4]European Commission – European Chemicals Bureau. 2000. IUCLID Dataset on n-Butane. Available online from: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/106978.pdf as of Sept. 15, 2010.

[5] National Institute of Technology and Evaluation. 2002. Biodegradation and Bioaccumulation of the Existing Chemical Substances under the Chemical Substances Control Law. http://www.safe.nite.go.jp/english/kizon/KIZON_start_hazkizon.html.

[6] Low biodegradability may be a result of the test substance residing in the vessel headspace, rather than in the aqueous medium. Hence, the substance will be less bioavailable for degradation by microbes during the test period. However, alkane- and alkene-utilizing bacteria found in soil are likely to transform these hydrocarbons through various oxidation processes. See Van Ginkel et al. 1987. Oxidation of gaseous and volatile hydrocarbons by selected alkene-utilizing bacteria. Appl. Env. Microbiol. 53: 2903-2907.

[7] OECD. 2004. SIDS Initial Assessment Report on 2-Methyl-2-butene. SIAM 19, 19-22 October. Organisation for Economic Co-operation and Development. Available from http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf as of Sept. 15, 2010.

[8]Solano-Serena F. et al. 2000. Biodegradability of volatile hydrocarbons of gasoline. Appl. Microbiol. Biotech. 54: 121-125.

[9] Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

3. Human Health Hazard

A summary of health effects data submitted for SIDS endpoints is provided in Table 5. The table also indicates where data for tested category members are read-across (RA) to untested members of the category.

Acute Oral Toxicity

Subcategory III: Hydrocarbon gases, C1 – C6
Cyclopentane (CASRN 287-92-3)
(1) Sprague-Dawley rats (5/sex/dose) were administered cyclopentane via gavage at 5000 mg/kg and observed for 14 days following dosing. No mortality was observed. TSCATS (OTS0556745)
LD_{50} > 5000 mg/kg

(2) See human health data at http://webnet.oecd.org/hpv/ui/Search.aspx

2-Butene, 2-methyl- (CASRN 513-35-9)
See human health data at http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
1059 mg/kg-bw < Rat LD_{50} < 1655 mg/kg

Subcategory V: Hydrocarbon gases, C1 – C6 with benzene
Benzene (CASRN 71-43-2, supporting chemical)
See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
Rat **LD_{50} > 810-10,000 mg/kg**

Acute Inhalation Toxicity

Subcategory I: Hydrocarbon gases, C1 – C4
Propane (CASRN 74-98-6)
Rats of unspecified strain (six males or females) were exposed whole-body to propane at 800,000 ppm for 15 minutes. They were observed for CNS effects over a 10 minute exposure period. Mortality was observed during exposure only: recovery from non-lethal exposure was rapid and the rats appeared normal within 10 minutes of exposure.
EC_{50} (CNS depression; 10 min) = 280,000 ppm
LC_{50} (15 min) > 800,000 ppm

1-Propene (CASRN 115-07-1)
Sprague-Dawley rats exposed to 65,000 ppm 1-propene via inhalation for four hours. No mortalities were observed. See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx
Rat LC_{50} > 65,000 ppm (highest concentration tested)

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
See human health data at: http://www.chem.unep.ch/irptc/sids/oecdsids/115117.pdf.
LC_{50} (mouse) = 180,000 ppm
LC_{50} (rat) = 270,000 ppm

2-Butene (CASRN 107-01-7, supporting chemical)
(1) Wistar Crl:WI(WU)BR rats (5/sex/test concentration) were exposed whole-body to 2-butene (42.4% cis, 55.3% trans) as a vapor at a mean measured concentration of 23.1 mg/L for 4 hours and observed for 14 days following dosing. No mortality was observed.
LC_{50} > 23.1 mg/L

(2) See human health data at http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
2-Butene (CASRN 107-01-7, supporting chemical)
(1) Wistar Crl:WI(WU)BR rats (5/sex/test concentration) were exposed whole-body to 2-butene (42.4% cis, 55.3% trans) as a vapor at a mean measured concentration of 23.1 mg/L for 4 hours and observed for 14 days following dosing. No mortality was observed.
LC_{50} > 23.1 mg/L

(2) See human health data at http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) In the rat, 4-hour LC_{50} value was reported to be 285 mg/L (129,000 ppm). Information is not available on the strain, age, number and sex, number of exposure concentrations or post observation period.
LC_{50} = 285 mg/L

(2) See human health data at http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf.

Subcategory III: Hydrocarbon gases, C1 – C6
Butane, 2-methyl- (CASRN 78-78-4)
See human health data for C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx
Rat LC_{50} > 12.1 mg/L

Pentane (CASRN 109-66-0)
See human health data for CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.
Rat LC_{50} > 18.0 mg/L

Cyclopentane (CASRN 287-92-3)
In two studies, Sprague-Dawley rats (5/sex/test concentration) were exposed whole-body to cyclopentane as a vapor at mean measured concentrations of 0, 25.3 or 72 mg/L for 4 hours and observed for 14 days following dosing. One male died at 72 mg/L on day 14 post-exposure. TSCATS (OTS0556746 and OTS0558772).
LC_{50} > 72 mg/L

2-Butene, 2-methyl- (CASRN 513-35-9)
See human health data at http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
Rat LC_{50} > 175 mg/L

Light catalytic cracked naphtha (CASRN 64741-55-5, supporting chemical)
Sprague-Dawley rats (5/sex/test concentration) were exposed whole-body to light catalytic cracked naphtha (API 83-20) via inhalation at a nominal concentration of 5 mg/L for 4 hours and observed for 14 days following dosing. The mean measured concentration was 5.28 mg/L. No mortality was observed.
LC_{50} > 5.28 mg/L

Sweetened naphtha (CASRN 64741-87-3, supporting chemical)
Sprague-Dawley rats (5/sex/test concentration) were exposed whole-body to sweetened naphtha (API 81-08) via inhalation at a nominal concentration of 5 mg/L for 4 hours and observed for 14 days following dosing. The mean measured concentration was 5.2 mg/L. No mortality was observed.
LC_{50} > 5.2 mg/L

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) Rats (strain, sex and number per dose not specified) were exposed to 1,3-butadiene via inhalation at unspecified concentrations for 4 hours. Mortality was not specified.
LC_{50} = 285 mg/L

(2) See human health data at http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf.

Light catalytic cracked naphtha (CASRN 64741-55-5, supporting chemical)
Sprague-Dawley rats (5/sex/test concentration) were exposed whole-body to light catalytic cracked naphtha (API 83-20) via inhalation at a nominal concentration of 5 mg/L for 4 hours and observed for 14 days following dosing. The mean measured concentration was 5.28 mg/L. No mortality was observed.
LC_{50} > 5.28 mg/L

Sweetened naphtha (CASRN 64741-87-3, supporting chemical)
Sprague-Dawley rats (5/sex/dose) were exposed whole-body to sweetened naphtha (API 81-08) via inhalation at a nominal concentration of 5 mg/L for 4 hours and observed for 14 days following dosing. The mean measured concentration was 5.2 mg/L. No mortality was observed.
LC_{50} > 5.2 mg/L

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
Benzene (CASRN 71-43-2, supporting chemical)
(1) Sprague-Dawley rats (10 females/test concentration) were exposed to benzene via inhalation at unspecified concentrations for 4 hours and observed for 14 days following dosing. Mortality was not specified.
LC_{50} = 43.7 mg/L

(2) See human health data at http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) Rats (strain, sex and number per dose not specified) were exposed to 1,3-butadiene via inhalation at unspecified concentrations for 4 hours. Mortality was not specified.
LC_{50} = 285 mg/L

(2) See human health data at http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf.

Benzene (CASRN 71-43-2, supporting chemical)
(1) Sprague-Dawley rats (10 females/test concentration) were exposed to benzene via inhalation at unspecified concentrations for 4 hours and observed for 14 days following dosing. Mortality was not specified.
LC_{50} = 43.7 mg/L

(2) See human health data at http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf

Acute Dermal Toxicity

Subcategory III: Hydrocarbon gases, C1 – C6
2-Butene, 2-methyl- (CASRN 513-35-9)
See human health data at http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
Rat LD_{50} > 2000 mg/kg

Repeated-Dose Toxicity

Subcategory I: Hydrocarbon gases, C1 – C4
Ethane (CASRN 74-84-0)
In a combined repeated-dose/reproductive/developmental toxicity screening test, Sprague-Dawley CD rats (12 males and 24 females/test concentration) were exposed whole-body to ethane as a gas at nominal concentrations of 0, 1600, 5000 or 16,000 ppm, 6 hours/day, 7 days/week for at least 4 weeks. One half of the females were evaluated for subchronic effects after 28 days of exposure. The other half was allowed to mate to assess effects of ethane on reproduction and development. Subchronic effect endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology and clinical

chemistry. The mean measured concentrations were 0, 1703, 4762 or 15,502 ppm. No treatment-related effects on survival or evaluated endpoints were observed.
NOAEC = 15,502 ppm/day (highest concentration tested)

Propane (CASRN 74-98-6)
In a combined repeated-dose/reproductive/developmental toxicity screening test, Sprague-Dawley CD rats (12 males and 24 females/test concentration) were exposed whole-body to propane as a gas at nominal concentrations of 0, 1200, 4000 or 12,000 ppm, 6 hours/day, 7 days/week for at least 4 weeks. One half of the females were evaluated for subchronic effects after 28 days of exposure. The other half was allowed to mate to assess effects of propane on reproduction and development. Subchronic effect endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology and clinical chemistry. The mean measured concentrations were 0, 1230, 3990 or 12,168 ppm. There were no treatment-related effects on survival. Male rats exposed to 12,168 ppm exhibited a decrease in weight gain. Small, but significant increases were observed in hemoglobin concentration, hematocrit, erythrocytes and absolute eosinophils in females exposed to 12,168 ppm. Decreases in absolute and relative kidney weights were observed in males exposed to 1230 and 12,168 ppm. Decreases in absolute liver weights were observed in males at 12,168 ppm and decreases in relative liver weights were observed in females exposed to 3990 and 12,168 ppm. In the absence of kidney or liver pathological findings, the changes in organ weights were not considered to be treatment-related.
LOAEC = 12,168 ppm/day (based on decreased weight gain in males and increases in hemoglobin concentration, hematocrit, erythrocytes and absolute eosinophils in females)
NOAEC = 3990 ppm/day

1-Propene (CASRN 115-01-1)
In a 14-week inhalation study, rats were exposed up to 10,000 ppm 1-propene via the inhalation route of exposure. See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx
Rat NOAEC = 10,000 ppm/day (highest concentration tested)

Propane, 2-methyl- (CASRN 75-28-5)
In a combined repeated-dose/reproductive/developmental toxicity screening test, Sprague-Dawley CD rats (12 males and 24 females/test concentration) were exposed whole-body to propane, 2-methyl- gas at nominal concentrations of 0, 900, 3000 or 9000 ppm, 6 hours/day, 7 days/week. Subchronic effect endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology and clinical chemistry. The mean measured concentrations were 0, 930, 3122 and 9148 ppm. No mortality was observed. Hematological changes included significant increases in hemoglobin and mean corpuscular hemoglobin in males at 9148 ppm, decreases in platelets in males at 3122 and 9148 ppm, and decreases in monocytes in females at 3122 and 9148 ppm. No other effects on hematological parameters were observed suggesting that the toxicological significance of this observation is unclear. A significant increase in sodium concentration was observed in males at 9148 ppm. Decreases in phosphorus concentration were observed in all exposed females. An increase in spleen weight (relative and absolute) was observed in males at 930 and 3122 ppm, but not at 9148 ppm, and therefore, was not considered to be an effect of exposure.
NOAEC = 9148 ppm/day (highest concentration tested)

Butane (CASRN 106-97-8)
In a combined repeated-dose/reproductive/developmental toxicity screening test, Sprague-Dawley CD rats (12 males and 24 females/test concentration) were exposed whole-body to butane gas at nominal concentrations of 0, 900, 3000 or 9000 ppm, 6 hours/day, 7 days/week for at least 4 weeks. One half of the females were evaluated for subchronic effects after 28 days of exposure. The other half was allowed to mate to assess effects of butane on reproduction and development. Subchronic effect endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology and clinical chemistry. The mean measured concentrations were 0, 931, 3022 and 9157 ppm. There was a low incidence of chromodacryorrhea or transient red nasal discharge among males exposed to 9157 ppm. A small, significant decrease in male forelimb grip strength was observed in males at 9157 ppm, but an increase in forelimb grip strength was observed in females at the same dose level. A decrease in total bilirubin concentration was observed in males at 3022 and 9157 ppm.
NOAEC = 9157 ppm/day (highest concentration tested)

1-Butene (CASRN 106-98-9, supporting chemical)
(1) In a combined repeated-exposure/reproductive/developmental toxicity study, Sprague-Dawley Crl:CD IGS BR rats (12/sex/dose) were exposed to 1-butene as a gas at 0, 500, 2000 or 8000 ppm, 6 hours/day. The mean measured concentrations were 0, 524, 2062 or 8271 ppm. There were no treatment-related effects on body weight, body weight change, food consumption, motor activity, functional observational battery, hematology, clinical chemistry, organ weights or histopathology. (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm)
NOAEC = 8271 ppm/day (highest concentration tested)

(2) See human health data at: http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
NOAEC = 8000 ppm/day (highest concentration tested)

2-Butene (CASRN 107-01-7, supporting chemical)
(1) In a combined repeated-dose/reproductive/developmental toxicity screening study, Wistar (Hsd/Cpd:WU) rats (12/sex/concentration) were exposed whole-body to 2-butene (cis/trans mixture) gas at nominal concentrations of 0, 2500 or 5000 ppm, 6 hours/day for 7 days/week. Males were exposed for 39 – 46 days and females were exposed for 2 weeks (pre-mating), during mating (up to 1 week) and through gestation day 19. Mean measured concentrations were 0, 2476 and 5009 ppm. Endpoints included clinical signs, body weight, food consumption, hematology, clinical chemistry, organ weights and histopathology. A significant reduction in mean body weight changes was observed in males at 2476 ppm during the first and fourth weeks of exposure and at 5009 ppm during the first week of exposure. Significant decreases in mean body weight were observed in females at 2476 on day 14 and at 5009 on days 7, 14 and lactation day 1; however, body weight changes in dams were comparable to controls throughout the study. Total white blood cell (WBC) count and number of lymphocytes were elevated in males at ≥ 2476 ppm, but the effects were not dose-dependent and values were within historical control ranges. Plasma calcium concentrations were slightly decreased in males at 5009 ppm, but the change was not considered to be toxicologically significant.
NOAEC = 5009 ppm/day (highest concentration tested)

(2) See human health data at: http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
NOAEC = 5000 ppm/day (highest concentration tested)

Ethylene (CASRN 74-85-1, supporting chemical)
(1) In a 13-week study, rats (15/sex/dose, strain not specified) were exposed to ethylene as a gas at 300, 1000, 3000 or 10,000 ppm, 6 hours/day, 5 days/week. There were no effects observed on body weight, body weight change, food consumption, hematology, clinical chemistry, gross pathology or histopathology. Red deposits were observed around the eyes or nose of rats in several dose groups, including the control group. Liver weights were reduced in several dose groups, but the response was not dose-related (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
NOAEC = 10,000 ppm/day (highest concentration tested)

(2) In a 24-month study, Fischer 344 rats (120/sex/test concentration) were exposed to ethylene as a gas at 0, 300, 1000 or 3000 ppm, 6 hours/day, 5 days/week. There were no treatment-related effects on survival, body weight, body weight change, hematology, blood chemistry or histology (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
NOAEC = 3000 ppm/day (highest concentration tested)

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
(1) In a 28-day study, Sprague-Dawley CD(SR)BR rats (5/sex/dose) were administered 1-propene, 2-methyl- in corn oil via gavage at 0, 1.49, 14.86 or 148.55 mg/kg/day. Endpoints included clinical signs, body weights, hematology, clinical chemistry and histopathology. The total WBC count (predominantly leucocytes and monocytes) was significantly reduced by 11 and 44% in males and females, respectively, at 148.55 mg/kg/day; however, these values were within the historical background range of the laboratory. No other significant effects were observed. (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm and http://www.chem.unep.ch/irptc/sids/OECDSIDS/115117.pdf)
NOAEL = 148.6 mg/kg/day (highest dose tested)

(2) In a 13-week study, Sprague-Dawley Crl:CD(SR)BR rats (10/sex/dose) were exposed whole-body to 1-propene, 2-methyl- as a gas at 0, 250, 1000 or 8000 ppm, 6 hours/day, 5 days/week. The 8000 ppm concentration level was the highest chamber concentration that could be tested below the explosive limit. Endpoints included body weight, body weight gain, food consumption, hematology, clinical chemistry, organ weights, urinalysis and histopathology. No biologically significant treatment-related effects were observed. (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm)
NOAEC = 8000 ppm/day (highest concentration tested)

(3) In a 14-week National Toxicology Program (NTP) study, Fischer 344 rats (10/sex/test concentration) were exposed whole-body to 1-propene, 2-methyl gas at nominal concentrations of 0, 500, 1000, 2000, 4000 or 8000 ppm, 6 hours/day, 5 days/week. Mean measured concentrations were 0, 495, 1010, 1990, 4010 or 7970 ppm. Endpoints included clinical signs, body weights, organ weights, hematology, clinical chemistry, histopathology, sperm count and motility, estrus cycle length and relative frequency of estrus stages. No mortality was observed. Relative right kidney weights were elevated in all exposed males. Absolute kidney weights in males were increased at ≥ 4000 ppm. Increases were observed in the relative liver weight of females at ≥ 500 ppm and in the absolute liver weight of females at ≥ 1000 ppm,

but the increases did not occur in a concentration-dependent manner. In the absence of kidney or liver pathological findings, the changes in organ weights were not considered to be treatment-related. Minimal hypertrophy of goblet cells lining the nasopharyngeal duct in the most caudal section of the nasal cavity was observed in all groups of exposed males and females. A significant decrease in sperm motility was observed at 8000 ppm (NTP Technical Report No. 487).
NOAEC = 7970 ppm/day (highest concentration tested)

(4) In a 14-week NTP study, B6C3F1 mice (10/sex/test concentration) were exposed whole-body to 1-propene, 2-methyl gas at nominal concentrations of 0, 500, 1000, 2000, 4000 or 8000 ppm, 6 hours/day, 5 days/week. Mean measured concentrations were 0, 495, 1010, 1990, 4010 or 7980. Endpoints included clinical signs, body weights, organ weights, hematology, clinical chemistry, histopathology, sperm count and motility, estrus cycle length and relative frequency of estrus stages. No mortality was observed. Relative and absolute right kidney weights were elevated in all exposed females and in males exposed to 7980 ppm. In the absence of kidney pathological findings, the changes in organ weights were not considered to be treatment-related. In females exposed to 1990 or 4010 ppm, time spent in diestrus was increased with a concurrent decrease in the time spent in estrus, although the length of the average estrus cycle was not altered; these effects did not occur in a dose-related manner (NTP Technical Report No. 487).
NOAEC = 7980 ppm/day (highest concentration tested)

(5) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/115117.pdf and http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) In a 52-week study, Sprague-Dawley rats (10/sex/test concentration) were exposed whole-body to 1,3-butadiene as a gas at nominal concentrations of 0, 1000 or 8000 ppm, 6 hours/day, 5 days/week. Mean measured concentrations were 0.7, 999 and 7886 ppm. Endpoints included clinical signs, body weight, hematology, clinical chemistry, urinalysis, neuromuscular function, organ weights and histopathology. Clinical signs at 7886 ppm included wet and ruffled fur and slight limb weakness or incoordination from the second to the fifth month of exposure. An increase in liver weight was observed at doses ≥ 999 ppm, but there was no associated liver pathology. There were no other treatment-related effects observed at the end of exposure. (Additional details were obtained from Owen and Glaister, 1990, Environmental Health Perspectives 86:19-25)
NOAEC = 7886 ppm/day (highest concentration tested)

(2) In a 14-week NTP study, B6C3F1 mice (10/sex/test concentration) were exposed to 1,3-butadiene (rubber grade, containing 0.02% t-butyl catechol)as a gas at 0, 625, 1250, 2500, 5000 or 8000, 6 hours/day, 5 days/week (64 exposures). Because four male mice in the high-exposure group died by day 4, another two groups of 10 male mice each were restarted (control and 8000 ppm). At the end of the 95- or 93-day (restart) studies, surviving mice were sacrificed. Endpoints included clinical signs, body weights and histopathology. Mortalities and/or morbidities occurred at 1250 ppm and above. Body weight gains were reduced at concentrations ≥ 2500 ppm in males and ≥ 5000 ppm in females. There were no histopathological effects observed (NTP Technical Report No. 288).

LOAEC = 1250 ppm/day (based on mortalities)
NOAEC = 625 ppm/day

(3) In a 13-week study, Sprague-Dawley rats (40/sex/dose) were exposed to 1,3-butadiene as a gas at 0, 1000, 2000, 4000 or 8000 ppm, 6 hours/day, 5 days/week. Endpoints included clinical signs, body weight, food consumption, urinalysis, hematology, clinical chemistry, brain cholinesterase activity, organ weights, histopathology and neuromuscular function. No significant treatment-related adverse effects were observed (crude butadiene C4 category; http://www.epa.gov/chemrtk/pubs/summaries/olefins/c12064tc.htm).
NOAEL =8000 ppm/day (highest concentration tested)

(4) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Pentane (CASRN 109-66-0)
(1) In a 90-day study, rats were exposed to pentane via inhalation at concentrations ranging from 5 to 20 mg/L. No adverse effects were observed (C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
NOAEC = 20 mg/L/day (highest concentration tested)

(2) See human health data for CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.

Cyclopentane (CASRN 287-92-3)
(1) In a 28-day inhalation study in rats, hematological changes (decreased erythrocyte count, decreased mean corpuscular hemoglobin and increased mean corpuscular volume) were observed in male rats at 5.3 mg/L (C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
LOAEC (males) =5.3 mg/L/day (based on hematological changes)
NOAEC (males) =1.12 mg/L/day
NOAEC (females) =5.3 mg/L/day (highest concentration tested)

(2) In a 90-day inhalation study in rats, no adverse effects were observed up to the highest concentration tested (C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
NOAEC = 30 mg/L/day (highest concentration tested)

(3) See human health data at C5 aliphatic hydrocarbon solvents category: http://webnet.oecd.org/hpv/ui/Search.aspx

2-Butene, 2-methyl- (CASRN 513-35-9)
(1) In a combined repeated-dose/reproductive/developmental toxicity screening test, Sprague-Dawley Crl:CD rats (12 males and 24 females/test concentration) were exposed to 2-butene, 2-methyl- gas at 0, 580, 2000 or 7000 ppm, 6 hours/day, 7 days/week for at least 28 days. One half of the females were allowed to mate to assess effects of 2-butene, 2-methyl- on reproduction and development. The other

half was evaluated for subchronic effects. Endpoints (for both sexes) included body weight, feed consumption, motor activity, hematology, clinical chemistry, organ weights and macroscopic and microscopic pathology. The mean measured concentrations were 0, 584, 2026 and 7097 ppm. Effects observed at 7097 ppm included decreased body weight gain, longer clotting time, increased cholesterol in females, increased liver weight, mild centrilobular hepatocyte hypertrophy in females, decreased extramedullary hematopoiesis of the spleen and increased goblet cell hyperplasia in the nasal passages of males. At ≥ 2026 ppm, effects included increased myocardial inflammatory heart lesions and cortical/medullary tubular basophilia in the kidneys of males and longer clotting time in females. [This study was reported in the TSCA 8(e)/FYI Initial Screen Database (FYI-0105-1485A)]
LOAEC = 2026 ppm/day (based on increased myocardial inflammatory heart lesions and cortical/medullary tubular basophilia in the kidneys of males and longer clotting time in females)
NOAEC = 584 ppm/day

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf

Gasoline (CASRN 86290-81-5, supporting chemical)
In a 13-week study, Sprague-Dawley Crl:CD IGS BR rats (10/sex/test concentration) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day, 5 days/week. Mean measured concentrations were 0, 2.1, 10.1 and 20.3 mg/L. Endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology, clinical chemistry, ophthalmoscopy and neuropathology. An increase in red nasal discharge was observed in animals exposed to 20.3 mg/L, which correlated with eosinophilic material within the nasolacrimal duct lumen at terminal sacrifice in treated animals. Renal histopathological changes observed in males at concentrations ≥ 2.1 mg/L consisted of hyaline droplet nephropathy attributable to the accumulation of alpha-2-microglobulin within renal tubular epithelial cells.[1]
NOAEL = 20.3 mg/L/day (based on no adverse effects observed at the highest dose tested)

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See also data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) In a 10-week study, CD-1 mice (11 – 12 males/test concentration) were exposed to benzene via inhalation at 0 or 9.6 ppm (0 or 0.03 mg/L), 6 hours/day, 5 days/week. Hematological parameters were evaluated at the end of exposure. No mortality was observed. Increases were observed in spleen weight, total nucleated cells per spleen and nucleated red blood cells (RBCs) at 0.03 mg/L.
LOAEC ~ 0.03 mg/L/day (based on increases in spleen weight, total nucleated cells per spleen and nucleated RBCs)
NOAEC = Not established

[1] Nephropathy seen in male rats may be occurring by an alpha 2μ-globulin-mediated mechanism (which is male rat-specific and not considered relevant to humans). EPA's Risk Assessment Forum has outlined key events and data that are necessary to demonstrate this mode of action (Alpha 2μ-Globulin: Association with Chemically Induced Renal Toxicity and Neoplasia in the Rat, EPA/625/3-91/019F).

(2) In a 13-week study, CD-1 mice (40/sex/test concentration) were exposed whole-body to benzene as a vapor at 0, 1, 10, 30 or 300 ppm (approximately 0, 0.003, 0.03, 0.10 or 0.96 mg/L), 6 hours/day, 5 days/week. Endpoints included behavior, body weights, organ weights, clinical pathology, gross pathology, histopathology, hematology and clinical chemistry. At ~0.96 mg/L, hematological effects included decreases in RBC counts, WBC counts, platelets, hemoglobin, myeloid/erythroid ratios and hematocrit. Other effects at ~0.96 mg/L included femoral myeloid hypoplasia, extramedullary hemotopoiesis in the spleen, thymic atrophy, decreases in absolute and relative testis weights, minimal to moderately severe bilateral atrophy/degeneration of testes, moderate to moderately severe decreases in spermatozoa and a minimal to moderate increase in abnormal sperm morphology. Bilateral ovarian cysts were observed in four females at 0.96 mg/L. Histopathological changes were also observed in mesenteric and mandibular lymph nodes, as well as in the liver at ~0.96 mg/L.
LOAEC ~ 0.96 mg/L/day (based on decreases in RBC counts, WBC counts, platelets, hemoglobin, myeloid/erythroid ratios and hematocrit, femoral myeloid hypoplasia, extramedullary hemotopoiesis in the spleen, thymic atrophy, decreases in absolute and relative testis weights, minimal to moderately severe bilateral atrophy/degeneration of testes, moderate to moderately severe decreases in spermatozoa, a minimal to moderate increase in abnormal sperm morphology, bilateral ovarian cysts and unspecified histopathological changes in the liver and mesenteric and mandibular lymph nodes)
NOAEC ~ 0.10 mg/L/day

(3) Several studies are described in the OECD SIDS documents at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See also data for Subcategories I-V above.

Petroleum Gases, liquefied (CASRN 68476-85-7)
In a 13-week study, Sprague-Dawley rats (15/sex/test concentration) were exposed to petroleum gases, liquefied via inhalation at nominal concentrations of 0, 1000, 5000 or 10,000 ppm, 6 hours/day, 5 days/week. The mean measured concentrations were 0, 1019, 5009 and 9996 ppm. Endpoints included body weight, feed consumption, functional observational battery, motor activity, clinical observations, organ weights, histopathology, macroscopic observations, hematology, clinical chemistry, ophthalmoscopy, estrus cyclicity and neuropathology. Decreases in WBC, lymphocyte and monocyte numbers were noted in some or all of the exposed females but there was no exposure-related pattern or similar observations in males. Similarly, significant differences were observed in glucose, sodium, potassium and total protein levels in some or all exposed animals that were not observed in both sexes. Decreased kidney and thymus weights were observed at 5009 ppm, but were not observed in a dose-related pattern and/or absolute differences were minimal. An increased incidence (4/10 males) of abnormal sperm was observed at 9996 ppm, as evidenced by an increase in the incidence of "mid-tail blob" (cytoplasmic droplet) in sperm. Sperm count and motility were not affected.
NOAEC = 10,000 ppm/day (highest concentration tested)

Reproductive Toxicity

Subcategory I: Hydrocarbon gases, C1 – C4
Ethane (CASRN 74-84-0)

In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/test concentration) were exposed to up to 15,502 ppm ethane as a gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. Males were exposed during mating and post-mating periods for at least 28 days. The dams were allowed to deliver their litters, which were retained until lactation day 4. Reproductive endpoints included mating success, time to mating, number of females pregnant, male fertility, gestation duration, numbers of corpora lutea and implantation sites, number of stillborn pups, number of pups delivered and pup sex ratio. No effects were observed on reproductive organs or any reproductive parameter.
NOAEC (reproductive toxicity) = 15,502 ppm/day (highest concentration tested)

Propane (CASRN 74-98-6)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/dose) were exposed to 12,168 ppm propane gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. Males were exposed during mating and post-mating periods for at least 28 days. The dams were allowed to deliver their litters, which were retained until lactation day 4. Reproductive endpoints included mating success, time to mating, number of females pregnant, male fertility, gestation duration, numbers of corpora lutea and implantation sites, number of stillborn pups, number of pups delivered and pup sex ratio. A statistically significant decrease in the number of live born pups, in combination with an increase in the number of stillborn pups, was observed at concentrations ≥ 3990 ppm. These effects were attributable to the loss of a single total litter at each of the two highest doses (3990 and 12,168 ppm); the losses were preceded by severely reduced body weight gain in the last week of gestation for two particular dams.
LOAEC (reproductive toxicity) = 3990 ppm/day (based on a decrease in the number of live pups and increase in the number of stillborn pups)
NOAEC (reproductive toxicity) = 1230 ppm/day

Propane, 2-methyl- (CASRN 75-28-5)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/concentration) were exposed to up to 9148 ppm propane, 2-methyl- gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. Males were exposed during mating and post-mating periods for at least 28 days. The dams were allowed to deliver their litters, which were retained until lactation day 4. Reproductive endpoints included mating success, time to mating, number of females pregnant, gestation duration, number of stillborn pups, pre- and post-implantation loss, number of pups delivered and pup sex ratio. At 9148 ppm, the fertility index (percent of mated females that became pregnant) was reduced by 25% compared to the control. An increase in post-implantation loss was also observed at 9148 ppm.
LOAEC (reproductive toxicity) = 9148 ppm/day (based on a reduction in fertility index and an increase in post-implantation loss)
NOAEC (reproductive toxicity) = 3122 ppm/day

Butane (CASRN 106-97-8)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/concentration) were exposed to up to 9157 ppm butane gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. Males were exposed during mating and post-mating periods for at least 28 days. The dams were allowed to deliver their litters, which were retained until lactation day 4. Reproductive endpoints included mating success, time to mating, number of females pregnant, male fertility, gestation duration, numbers of corpora lutea and implantation sites,

number of stillborn pups, number of pups delivered and pup sex ratio. No treatment-related effects were observed on reproductive organs or any reproductive parameter.
NOAEC (reproductive toxicity) = 9157 ppm/day (highest concentration tested)

1-Butene (CASRN 106-98-9, supporting chemical)
In the combined inhalation repeated-exposure/reproductive/developmental toxicity study in rats, described previously, no mortality or treatment related changes in body weights or feed consumption were observed. No treatment-related effects were observed on any of the reproductive parameters that were evaluated, including mating, conception and fertility, time to mating, gestation length, and litter size, as well as offspring gestation and postnatal survival, postnatal survival, pre- and post-implantation loss, pup body weight and pup sex ratio (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
NOAEC (reproductive toxicity) = 8000 ppm/day (highest concentration tested)

2-Butene (CASRN 107-01-7, supporting chemical)
(1) In the combined repeated-dose/reproductive/developmental inhalation toxicity screening study in Wistar rats described previously, reproductive endpoints included mating success, time to mate, fecundity index, gestation duration, litter size, number of pups per sex, number of stillbirths, pup malformations, pup body weight, number of implantation sites and corpora lutea and reproductive organ weights and histopathology. No treatment-related reproductive effects were observed up to 5009 ppm.
NOAEC (reproductive toxicity) = 5009 ppm/day (highest concentration tested)

(2) See human health data at: http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
NOAEC (reproductive toxicity) = 5000 ppm/day (highest concentration tested)

Ethylene (CASRN 74-85-1, supporting chemical)
(1) In a combined reproductive/developmental toxicity screening test [OECD TG 421], rats (10/sex/dose, strain not specified) were exposed head-only to ethylene via inhalation at 0, 200, 1000 or 5000 ppm for 6 hours/day. Males received ethylene for 2 weeks prior to mating and during the mating period for at least 28 days. Exposure of females continued until day 20 of gestation; the females were allowed to litter and rear their offspring until day 4 post-partum. Parental endpoints included mortality, clinical condition, body weight, food intake and histopathology of ovaries, testes and epididymides. Reproductive endpoints included litter size, pup sex ratio, pup weight and clinical condition. No adverse effects were observed (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
NOAEC (reproductive toxicity) = 5000 ppm/day (highest concentration tested)

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
(1) No specific reproductive toxicity study is available. However, in the 14-week inhalation repeated-dose NTP study described previously, male Fischer 344 rats exposed to 1-propene, 2-methyl at 8000 ppm exhibited a decrease in sperm motility (NTP Technical Report No. 487).

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/115117.pdf and http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) A recent (2002) Integrated Risk Information System (IRIS) review by EPA on 1,3-butadiene is available at http://www.epa.gov/ncea/iris/subst/0139.htm.

The most sensitive reproductive endpoint observed in subchronic studies with CASRN 106-99-0 was fetal deaths in dominant lethal studies in mice exposed for 28-days at 65 ppm (see *Other* section for details); the NOAEC was 12.5 ppm. In two-year bioassays, the most sensitive reproductive effects were ovarian atrophy in female mice at 6.25 ppm and testicular atrophy in male mice at 625 ppm. The NOAEC for reproductive toxicity in female mice was not established and in male mice was 200 ppm (see *Carcinogenicity* section for details).

(2) In a combined reproductive/developmental toxicity screening test (OECD TG 421), Sprague-Dawley rats (12/sex/concentration) were exposed whole-body to 1,3-butadiene as a vapor at 0, 300, 1500 or 6000 ppm (approximately 0, 0.66, 3.3 or 13.3 mg/L) for 6 hours/day. Animals of both sexes were exposed for 2 weeks prior to mating and 2 weeks during mating. Males continued to be exposed after mating for a total of 70 days. Females were exposed on gestation days 0 – 19 and postnatal days 5 – 18. After weaning on postnatal day 21, one male and one female from each litter were exposed for 7 days to the same concentration of 1,3-butadiene as its dam. Beginning on postnatal day 28, previously unexposed weanlings (1/sex/litter) were exposed for 7 days to the same concentration of 1,3-butadiene as their dams. Reproductive endpoints included assessments of gonadal function, mating behavior, conception, gestation and parturition (details not specified). Reductions in body weight parameters (details not specified) were observed in the parental generation and offspring at concentrations ≥ 3.3 mg/L. Transient reductions in food consumption were observed in the parental generation during the first week of exposure. Clinical signs at 13.3 mg/L included chromodacryorrhea, chromorhinorrhea and salivation in the parental generation and infrequent occurrences of dried red material in the perioral and perinasal regions of four exposed pups. No reproductive effects were observed.
NOAEC (reproductive toxicity) ~ 13.3 mg/L/day (highest concentration tested)

(3) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Pentane (CASRN 109-66-0)
No specific reproductive toxicity study is available. However, in the 90-day inhalation repeated-dose inhalation study with rats described previously, no effects on the reproductive organs were observed (CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).

Cyclopentane (CASRN 287-92-3)
In the OECD HPV program, the reproductive toxicity endpoint for cyclopentane was addressed using data from a 2-generation reproductive toxicity study in rats with cyclohexane (CASRN 110-82-7:

http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=8e1c6169-bdfd-49e5-872c-f721963cb2d8&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx). No effects on reproductive parameters were observed up to the highest concentration tested.
NOAEC (reproductive toxicity) ~ 24.1 mg/L/day (highest concentration tested).

2-Butene, 2-methyl- (CASRN 513-35-9)
(1) In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley Crl:CD female rats (12/concentration) were exposed to up to 7097 ppm 2-butene, 2-methyl- gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. The dams were allowed to deliver their litters, which were retained until lactation day 4. Males were exposed simultaneously. Reproductive endpoints included estrus cycles, mating performance, fertility indices, gestation length, organ weights, macroscopic pathology, number of live and dead offspring, pup weight and sex ratio. There were no effects observed on any of the reproductive parameters. [This study was reported in the TSCA 8(e)/FYI Initial Screen Database (FYI-0105-1485A)].
NOAEC (reproductive toxicity) = 7097 ppm/day (highest concentration tested)

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf

Gasoline (CASRN 86290-81-5, supporting chemical)
In a 2-generation reproductive toxicity study, Sprague-Dawley Crl:CD IGS BR rats (26/sex/test concentration) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day, 7 days/week. Each of the two generations was exposed for 10 weeks prior to mating, 2 weeks during mating, 3 weeks during gestation and 4 weeks during lactation, with the exception of the time between gestation day 19 and lactation day 5 for females. Mean measured concentrations were 0, 20.1, 10.1 and 20.0 mg/L. Endpoints included physical observations, body weights, feed consumption, organ weights, histopathology and neuropathology. Reproductive organs evaluated included ovaries, uterus, testes, seminal vesicles, prostate and epididymides. Sperm evaluations included motility, sperm count and morphology. Ovary histopathology included evaluation of the primordial follicle population, number of growing follicles and corpora lutea. Reproductive endpoints included number of live and dead pups per litter, sex ratio, pup weight, abnormalities, viability (4-day survival), survival through lactation (day 28) and organ weights of pups. Decreases in body weight gain were observed at 20.0 mg/L in the first parental generation (P0) females during the last 3 weeks of the pre-mating period and in the first filial generation (F1) males during the initial 8 weeks of the pre-mating period. Significant increases in kidney weights (absolute and relative) were observed at concentrations ≥ 10.1 mg/L in P0 and F1 males and at 20.0 mg/L in P0 females. Hyaline droplet nephropathy was observed only in males at 20.0 mg/L. No evidence of neuropathology was observed. No adverse effects were observed on any reproductive parameter.
LOAEC (parental toxicity) = 20.0 mg/L/day (based on decreases in body weight gain in both sexes)
NOAEC (parental toxicity) = 10.1 mg/L/day
NOAEC (reproductive toxicity) = 20.0 mg/L/day (highest concentration tested)

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) In the 13-week inhalation study in CD-1 mice described previously, effects on male reproductive organs at 0.96 mg/L included decreases in absolute and relative testes weights, minimal to moderately severe bilateral atrophy/degeneration of testes, moderate to moderately severe decreases in spermatozoa and a minimal to moderate increase in abnormal sperm morphology. In addition, bilateral ovarian cysts were observed in four females at 0.96 mg/L.

(2) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See also data for Subcategories I-V above.

Petroleum gases, liquefied (CASRN 68476-85-7)
In the 13-week inhalation study in Sprague-Dawley rats described previously, there was an increased incidence (4/10 males) in the percent of abnormal sperm observed at 9996 ppm, as evidenced by the presence of "mid-tail blob" (cytoplasmic droplet) in sperm. No effects were observed on sperm count and motility [TSCA 8(e)/FYI Initial Screen Database (8EHQ-0306-16426)].

Developmental Toxicity

Subcategory I: Hydrocarbon gases, C1 – C4
Ethane (CASRN 74-84-0)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/test concentration) were exposed to up to 15,502 ppm ethane gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. The dams were allowed to deliver their litters, which were retained until lactation day 4. Developmental endpoints included number of stillborn pups, number of live pups per litter, pre- and post-implantation loss, pup sex ratio, pup body weight and weight gain, macroscopic postmortem evaluations of pups and pup viability (4-day survival after birth). No effects were observed on any developmental parameter.
NOAEC (maternal/developmental toxicity) = 15,502 ppm/day (highest concentration tested)

Propane (CASRN 74-98-6)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, Sprague-Dawley CD female rats (12/test concentration) were exposed to up to 12,168 ppm propane gas for 2 weeks prior to mating, during mating and on gestation days 0 – 19. The dams were allowed to deliver their litters, which were retained until lactation day 4. Developmental endpoints included number of stillborn pups, number of live pups per litter, pre- and post-implantation loss, pup sex ratio, pup body weight and weight gain, macroscopic postmortem evaluations of pups and pup viability (4-day survival after birth). A statistically significant decrease in the number of live born pups, in combination with an increase in the number of stillborn pups, was observed at concentrations ≥ 3990 ppm. These effects were attributable to the loss of a single total litter at each of the two highest doses (3990 and 12,168 ppm); the losses were preceded by severely reduced body weight gain in the last week of gestation for two particular dams.
LOAEC (maternal toxicity) = 12,168 ppm/day (based on increases in hemoglobin concentration, hematocrit, erythrocytes and absolute eosinophils)

NOAEC (maternal toxicity) = 3990 ppm/day
LOAEC (developmental toxicity) = 3990 ppm/day (based on a decrease in the number of live pups and increase in the number of stillborn pups)
NOAEC (developmental toxicity) = 1230 ppm/day

1-Propene (CASRN 115-07-1)
(1) In a prenatal developmental toxicity study, pregnant Wistar rats (25/test concentration) were exposed whole-body to 1-propene as a gas at 0, 200, 1000 or 10,000 ppm for 6 hours/day on gestation days 6 – 19. Measured endpoints included clinical signs, food and water consumption, body weight, numbers of corpora lutea, implantation sites, resorptions and live and dead fetuses, fetus sex and weight and visceral and skeletal abnormalities. No systemic or developmental effects were observed (Propylene streams category: http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm).
NOAEC (maternal/developmental toxicity) = 10,000 ppm/day (highest concentration tested)

(2) See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx

Propane, 2-methyl- (CASRN 75-28-5)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, developmental endpoints included number of stillborn pups, number of live pups per litter, pre- and post-implantation loss, pup sex ratio, pup body weight, macroscopic postmortem evaluations of pups and pup viability (4-day survival after birth). At 9148 ppm, an increase in post-implantation loss was observed.
NOAEC (maternal toxicity/developmental toxicity) = 9148 ppm/day (highest concentration tested)

Butane (CASRN 106-97-8)
In the combined repeated-dose/reproductive/developmental toxicity screening test described previously, developmental endpoints included number of stillborn pups, number of live pups per litter, pre- and post-implantation loss, pup sex ratio, pup body weight and weight gain, macroscopic postmortem evaluations of pups and pup viability (4-day survival after birth). No treatment-related effects were observed on any developmental parameter.
NOAEC (maternal/developmental toxicity) = 9157 ppm/day (highest concentration tested)

1-Butene (CASRN 106-98-9, supporting chemical)
In the combined inhalation repeated-exposure/reproductive/developmental toxicity study in rats, described previously, no mortality or treatment related changes in body weights or feed consumption were observed. There were no treatment-related effects on any of the developmental parameters evaluated, including pup body weights or weight gains in pups or macroscopic postmortem evaluations of pups. No quantitative information on findings was submitted.
NOAEC (maternal/developmental toxicity) = 8000 ppm/day (highest concentration tested)

2-Butene (CASRN 107-01-7, supporting chemical)
(1) In the combined repeated-dose/reproductive/developmental inhalation toxicity screening study in rats described previously, developmental endpoints included litter size, number of pups per sex, number of stillbirths, pup malformations, pup body weight and pup body weight gain and survival until lactation day 4. No treatment-related developmental effects were observed.
NOAEC (maternal/developmental toxicity) = 5009 ppm/day (highest concentration tested)

(2) See human health data at: http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.
NOAEC (maternal/developmental toxicity) = 5000 ppm/day (highest concentration tested)

Ethylene (CASRN 74-85-1, supporting chemical)
(1) In the combined reproductive/developmental inhalation toxicity screening test in rats described previously, developmental endpoints included litter size, sex ratio, pup weight, growth and survival. No adverse effects were observed (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
NOAEC (maternal/developmental toxicity) = 10,000 ppm/day (highest concentration tested)

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
(1) Pregnant Wistar rats (24/test concentration) were exposed whole-body to 1-propene, 2-methyl- as a vapor at 0, 500, 2000 or 8000 ppm (approximately 0, 1.1, 4.6 or 18.4 mg/L) for 6 hours/day on gestation days 5 – 21. Endpoints included clinical signs, maternal body weight, food and water consumption, numbers of corpora lutea and implantation sites, sex and weight of fetuses and visceral and skeletal abnormalities. There were no treatment-related effects observed. (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm)
NOAEC (maternal/developmental toxicity) ~ 18.4 mg/L/day (highest concentration tested)

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/115117.pdf and http://webnet.oecd.org/hpv/UI/handler.axd?id=db117c7c-460a-4361-8a85-507f4da63012.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supportingchemical)
(1) In the combined inhalation reproductive/developmental toxicity screening test in Sprague-Dawley rats described previously, developmental endpoints included assessments of conception, parturition, lactation and development of offspring (details not specified). No developmental effects were observed.
LOAEC (maternal toxicity) = 3.3 mg/L/day (based on reductions in body weight parameters)
NOAEC (maternal toxicity) = 0.66 mg/L/day
NOAEC (developmental toxicity) = 13.3 mg/L/day (highest concentration tested)

(2) In a prenatal developmental toxicity study, pregnant Sprague-Dawley rats (24 – 28/dose) were exposed to 1,3-butadiene gas at 0, 40, 200 or 1000 ppm, 6 hours/day on gestation days 6 – 15. Dams were examined for mortality, morbidity, signs of toxicity, body weight, gross tissue abnormalities and uterus and placental weights. Developmental endpoints included numbers of implantations sites, resorptions, live and dead fetuses, fetal weight and external, visceral and skeletal abnormalities. A decrease in body weight gain was observed in dams at 1000 ppm. No developmental effects were observed.
LOAEC (maternal toxicity) = 1000 ppm/day (based on a decrease in body weight gain)
NOAEC (maternal toxicity) = 200 ppm/day
NOAEC (developmental toxicity) = 1000 ppm/day (highest concentration tested)

(3) In a prenatal developmental toxicity study, pregnant Swiss (CD-1) mice (18 – 22/dose) were exposed to 1,3-butadiene gas at 0, 40, 200 or 1000 ppm, 6 hours/day on gestation days 6 – 15. Dams were examined for mortality, morbidity, signs of toxicity, body weight, gross tissue abnormalities and uterus and placental weights. Developmental endpoints included numbers of implantations sites, resorptions, live and dead fetuses, fetal weight and external, visceral and skeletal abnormalities. A decrease in maternal body weight was observed at 2.2 mg/L. Reduced maternal body weight gain was observed at concentrations ≥ 0.44 mg/L. Placental weights were reduced for male fetuses at ≥ 0.44 mg/L and for females at 2.2 mg/L. Fetal body weights were significantly reduced in males at ≥ 0.088 mg/L and in females at ≥ 0.44 mg/L. There was no treatment-related increase in malformations, but there was an increase in fetal variations (supernumary ribs and reduced ossification of sternebrae) at concentrations ≥ 0.44 mg/L. (Crude butadiene C4 category; http://www.epa.gov/chemrtk/pubs/summaries/olefins/c12064tc.htm. Additional details were obtained from Morrissey et al., 1990, Environmental Health Perspectives 86:79-84).
LOAEC (maternal toxicity) = 200 ppm/day (based on a decrease in body weight gain)
NOAEC (maternal toxicity) = 40 ppm/day
LOAEC (developmental toxicity) = 40 ppm/day (based on reduced male fetal body weights)
NOAEC (developmental toxicity) = Not established

(4) In a prenatal developmental toxicity study, pregnant Sprague-Dawley CD rats (24/dose) were exposed whole-body to 1,3-butadiene gas at 0, 200, 1000 or 8000 ppm, 6 hours/day on gestation days 6 – 15; dams were sacrificed on gestation day 20. Endpoints included clinical signs, maternal body weight and body weight gain, numbers of implantations and pre- and post-implantation losses, gravid uterine weight, fetal weight, crown/rump length, sex ratio and abnormalities. A significant decrease in maternal body weight gain during the exposure period was observed at concentrations ≥ 200 pppm. Mean fetal weight and crown/rump length were reduced at 8000 ppm. A significantly higher incidence of bipartite thoracic centra was observed at concentrations ≥ 200 ppm. Significantly higher incidences of incomplete and irregular ossification, as well as lens opacity, were observed at 8000 ppm. A significant increase in the incidence of major skeletal defects was observed at concentrations ≥ 1000 ppm; skeletal defects included wavy ribs and abnormalities of the skull, spine, sternum and long bones (TSCATS (OTS0505459).
LOAEC (maternal toxicity) = 200 ppm/day (based on reduced body weight gain)
NOAEC (maternal toxicity) = Not established
LOAEC (developmental toxicity) = 200 ppm/day (based on a higher incidence of bipartite thoracic centra)
NOAEC (developmental toxicity) = Not established

(5) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Pentane (CASRN 109-66-0)
In a prenatal oral developmental toxicity study, pregnant Crl:CDBR rats were treated with 100, 500 or 1000 mg/kg/day *n*-pentane on days 6-15 of gestation. There was no mortality or statistically significant differences in mean body weight, body weight change, uterine weight, corrected body weight, or uterine implantation data between treated and control dams at any dose. There was no evidence of growth

retardation or increased fetal death at any dose. There were no statistically significant differences in total or individual variations or malformations. (CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
NOAEL (maternal toxicity) = 1000 mg/kg/day (highest dose tested)
NOAEL (developmental toxicity) = 1000 mg/kg/day (highest dose tested)

Cyclopentane (CASRN 287-92-3)
(1) In the OECD HPV program, the devlopmental toxicity endpoint for cyclopentane was addressed using data from a 2-generation reproductive toxicity study in rats with cyclohexane (CASRN 110-82-7: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=8e1c6169-bdfd-49e5-872c-f721963cb2d8&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx). A slight decrease (significance not stated) in pup body weight was observed at 24.1 mg/L/day and maternal toxicity (narcotic effects) was observed at 6.88 mg/L/day.
LOAEC (maternal toxicity) = 6.88 mg/L/day (based on narcotic effects)
NOAEC (maternal toxicity) = 1.72 mg/L/day
LOAEC (developmental toxicity) = 24.1 mg/L/day (based on decreased pup weights)
NOAEC (developmental toxicity) = 6.88 mg/L/day

(2) See human health data for cyclohexane at: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=8e1c6169-bdfd-49e5-872c-f721963cb2d8&idx=0

2-Butene, 2-methyl- (CASRN 513-35-9)
(1) In the combined inhalation repeated-dose/reproductive/developmental toxicity screening test in Sprague-Dawley rats described previously, developmental endpoints included number of live and dead offspring, pup weight, sex ratio and pup growth and survival. There were no effects observed on any of the developmental parameters. [This study was reported in the TSCA 8(e)/FYI Initial Screen Database (FYI-0105-1485A)].
LOAEC (maternal toxicity) = 2026 ppm/day (based on increased myocardial inflammatory heart lesions and cortical/medullary tubular basophilia in the kidneys of males and longer clotting time in females)
NOAEC (maternal toxicity) = 584 ppm/day
NOAEC (developmental toxicity) = 7097 ppm/day (highest concentration tested)

(2) See human health data at: http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf

Gasoline (CASRN 86290-81-5, supporting chemical)
(1) Pregnant Crl:CD-1(ICR)BR mice (25/dose) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day on gestation days 5 – 17. Mean measured concentrations were 0, 2.9, 10.6 and 20.9 mg/L. Endpoints included clinical signs, maternal body weight, food consumption, uterine weights, numbers of live, dead and resorbed fetuses, number of corpora lutea, fetal weights and sex ratio and visceral and skeletal abnormalities. Significant decreases in body weight and body weight change were observed in dams at 20.9 mg/L. A significant reduction in fetal body weight was observed at 10.6 and 20.9 mg/L. A significant decrease in the number of live

fetuses was observed at 20.9 mg/L, in combination with an increase in the ratio of resorptions to implantation sites.
LOAEC (maternal toxicity) = 20.9 mg/L/day (based on decreases in body weight and body weight change)
NOAEC (maternal toxicity) = 10.6 mg/L/day
LOAEC (developmental toxicity) = 10.6 mg/L/day (based on reduced fetal body weight)
NOAEC (developmental toxicity) = 2.9 mg/L/day

(2) Sprague-Dawley Crl:CD(SD)IGSBR rats (25/dose) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day on gestation days 5 – 20. Mean measured concentrations were 0, 2.0, 10.7 and 20.6 mg/L. Endpoints included clinical signs, maternal body weight, food consumption, uterine weights, numbers of live, dead and resorbed fetuses, number of corpora lutea, fetal weights and sex ratio and visceral and skeletal abnormalities. No treatment-related effects were observed.
NOAEC (maternal/developmental toxicity) = 20.6 mg/L (highest concentration tested)

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) Pregnant Swiss-Webster Crl:CFW(SW)Br mice (15/dose) were exposed to benzene as a vapor at 0, 5, 10 or 20 ppm (approximately 0, 0.016, 0.032 or 0.064 mg/L), 6 hours/day on gestation days 6 – 15. Mice (5/dose) were sacrificed on gestation day 16. Endpoints included the numbers of live, dead and resorbed fetuses, fetal weights and external gross morphological malformations, RBC and WBC counts and hemoglobin analysis of fetal blood and numbers of cells in the hematopoietic differentiating proliferating pool (DPP) of fetal livers. Additional mice (5/dose) were allowed to proceed through normal parturition and on day 2 postpartum, pups were subjected to hematological examination, as above. The remaining mice (5/dose) were allowed to proceed through normal parturition and after 6 weeks postpartum, peripheral blood samples were removed from offspring for RBC and WBC counts; additionally, cells of the DPP were enumerated in the spleen and femoral bone marrow. No mortality, morbidity or weight loss of dams was observed during the exposure. No effects of exposure were observed on litter sizes, sex ratios, pup weights and numbers of dead, resorbed or malformed fetuses. Reduced counts of erythroid precursor cells (early nucleated cells) were observed in the peripheral blood of 2-day old pups exposed to benzene (concentrations not specified). Depressed numbers of late nucleated red cells and elevated numbers of granulocytic precursor cells (non-dividing granulocytes) were observed in the peripheral blood of 2-day old pups exposed to 0.064 mg/L. Lower numbers of early and late nucleated RBCs were observed in the livers of 2-day old pups at 0.064 mg/L. Elevated numbers of blasts, dividing/non-dividing granulocytes and lymphocytes were observed in the livers of 2-day old pups and spleens and femurs of 6-week old offspring of dams exposed to 0.064 mg/L.
NOAEC (maternal toxicity) ~ 0.064 mg/L/day (highest concentration tested)
LOAEC (developmental toxicity) ~ 0.064 mg/L/day (based on effects on the hematopoietic system)
NOAEC (developmental toxicity) ~ 0.032 mg/L/day

(2) In a modified prenatal developmental toxicity study, female Sprague-Dawley rats (26 /dose) were exposed to benzene as a vapor at 0, 1, 30 or 300 ppm (approximately 0, 0.0032, 0.096 or 0.96 mg/L), 6 hours/day, 5 days/week for a 10-week pre-mating and mating period and daily on gestation days 0 – 20 and lactation days 5 – 20. Endpoints included maternal body weight, pregnancy rate, length of gestation, numbers of live and dead pups, sex ratio, pup survival, pup body weight change and pup organ weights. Reduced body and liver weights were observed in female pups at 0.96 mg/L. [EPA's Toxicological Review of Benzene, 2002 (EPA/635/R-02/001F)].
NOAEC (maternal toxicity) ~ 0.96 mg/L/day (highest concentration tested)
LOAEC (developmental toxicity) ~ 0.96 mg/L/day (based on reduced body and liver weights in female pups)
NOAEC (developmental toxicity) ~ 0.096 mg/L/day

(3) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See also data for Subcategories I-V above.

Petroleum gases, liquefied (CASRN 68476-85-7)
Pregnant Sprague-Dawley rats (24/dose) were exposed to petroleum gases, liquefied as a vapor at 0, 1000, 5000 or 10,000 ppm, 6 hours/day, 7 days/week on gestation days 6 – 19. Mean measured concentrations were 0, 1013, 5079 and 10,426 ppm (approximately 0, 1.8, 9.3 and 19 mg/L).[1] Dams were observed for clinical signs, body weight and feed consumption; maternal organs were examined at necropsy. Developmental endpoints included numbers of live and dead fetuses, number of corpora lutea, pre- and post-implantation losses, fetal body weight, sex ratio and visceral and skeletal abnormalities. There were no treatment-related maternal or developmental effects.
NOAEC (maternal/developmental toxicity) ~ 19 mg/L/day (highest concentration tested)

Genetic Toxicity – Gene Mutation

In vitro

Subcategory I: Hydrocarbon gases, C1 – C4
Methane (CASRN 74-82-8)
In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to methane gas at 0, 0.001, 0.002, 0.007, 0.013 or 0.027 µg/plate in a gas chamber with and without metabolic activation. No cytotoxicity was observed. Positive and negative controls were used and responded appropriately. No increase in mutation frequency was observed.
(NTP study 297396: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
Methane was not mutagenic in this assay.

Propane (CASRN 74-98-6)
Salmonella typhimurium strains TA98, TA100, TA1535, TA1537 and TA1538 were exposed to propane

[1] Concentrations were converted from ppm to mg/L using an estimated molecular weight of 44.6 g/mole. The molecular weight of petroleum gases, liquefied was estimated based on a composition of 85% propane, 10% propene and 5% butane (the major components of petroleum gases, liquefied, according to the sponsor's test plan dated 10/21/2009).

at concentrations ranging from 10,000 to 500,000 ppm/plate (~ 17.21 – 860.5 mg/L) with and without metabolic activation for 6 hours. Positive and negative controls were included and responded appropriately (Propylene streams category: http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm).
CASRN 74-98-6 was not mutagenic in this assay

1-Propene (CASRN 115-07-1)
(1) In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to 1-propene gas at concentrations of 0.001 – 0.027 µg/plate with and without metabolic activation. Positive and negative controls were tested concurrently and responded appropriately. No cytotoxicity was reported. In the presence of activation, mutagenicity was observed in strains TA1535 and TA100. Without activation, mutagenicity was noted in strain TA1535 only. (NTP study 779144: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
1-Propene was mutagenic in this assay.

(2) *Salmonella typhimurium* strains TA98, TA100, TA1535 and TA1537 and *Escherichia coli* strain WP2uvrA (pKM101) were exposed to 1-propene gas at concentrations of 0, 0.031, 0.063, 0.125, 0.25, 0.5 and 1% with and without metabolic activation. Negative controls responded appropriately. Positive controls were tested concurrently, but the responses were not specified. Mutagenic activity was observed only in TA1535 with activation (Propylene streams category: http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm).
1-Propene was mutagenic in this assay.

(3) L5178Y mouse lymphoma cells were exposed to 1-propene gas at concentrations of 20 – 50% for 4 hours with and without metabolic activation. The use and response of controls were not specified. 1-Propene did not induce mutations without activation, but results were equivocal with activation (http://ecb.jrc.ec.europa.eu/esis/).
1-Propene was equivocal for mutagenicity in this assay.

(4) Mouse lymphoma cells were exposed to 1-propene at concentrations of 0, 2.5, 5, 10, 20 or 30 µg/mL with and without metabolic activation. An increase in mutation frequency was observed with activation; however, this result was not reproducible. Positive and negative controls were tested concurrently and responded appropriately. No cytotoxicity was observed. (NTP study 537921: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
1-Propene was not mutagenic in this assay.

(5) See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx

Butane (CASRN 106-97-8)
In an NTP assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to butane as a gas at concentrations of 0, 0.001, 0.002, 0.007, 0.013 and 0.027 µg/plate, with and without metabolic activation. Positive and negative controls were used and responded appropriately. No cytotoxicity was observed. Butane did not induce an increase in mutation frequency. (NTP study 295295: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
Butane was not mutagenic in this assay.

1-Butene (CASRN 106-98-9, supporting chemical)
Salmonella typhimurium strains TA98, TA100, TA1535 and TA1537 and *Escherichia coli* strain WP2 uvrA were exposed to 1-butene as a gas at concentrations up to 50% with and without metabolic activation. The use of positive and negative controls was not specified. 1-Butene did not increase the mutation frequency (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
1-Butene was not mutagenic in this assay.

2-Butene (CASRN 107-01-7, supporting chemical)
(1) *Salmonella typhimurium* strains TA98, TA100, TA1535 and TA1537 and *Escherichia coli* strain WP2 uvrA were exposed to 2-butene as a gas at concentrations up to 50% with and without metabolic activation. The use and responses of controls were not specified. 2-Butene did not increase the mutation frequency (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
2-Butene was not mutagenic in this assay.

(2) *Salmonella typhimurium* strains TA98, TA100, TA1535 and TA1537 were exposed to 2-butene (42.4% *cis*, 55.3% *trans*) as a gas at 0, 10, 20, 40, 60 or 80% with and without metabolic activation. Positive and negative controls were used and responded appropriately. Cytotoxicity was observed at concentrations ≥ 60%. 2-Butene did not increase the mutation frequency.
2-Butene was not mutagenic in this assay.

Ethylene (CASRN 74-85-1, supporting chemical)
In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to ethylene in an unspecified solvent as a vapor from a liquid at levels up to 4.7 mL/chamber. Positive and negative controls were used and responded appropriately. No cytotoxicity was reported. Ethylene did not increase the mutation frequency.
Ethylene was not mutagenic in this assay.

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
(1) *Salmonella typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 and *Escherichia coli* strain WP2 uvrA (pKM101) were exposed to 1-propene, 2-methyl- as a gas at concentrations up to 100% with and without metabolic activation. Positive and negative controls were tested concurrently and responded appropriately. 1-Propene, 2-methyl- did not increase the mutation frequency in any strain. Cytotoxicity was observed at concentrations ≥ 80% (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
1-Propene, 2-methyl- was not mutagenic in this assay.

(2) In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to 1-propene, 2-methyl- as a gas at concentrations up to 0.027 moles/dessicator with and without metabolic activation. Positive and negative controls responded appropriately. Exposure to 1-propene, 2-methyl- did not increase the mutation frequency in any strain (NTP Technical Report No. 272).
1-Propene, 2-methyl- was not mutagenic in this assay.

(3) L5178Y TK^+/TK^- mouse lymphoma cells were exposed to 1-propene, 2-methyl- as a gas at concentrations of 0, 6.25, 12.5, 25, 50 or 100% with or without metabolic activation. Positive and

negative controls responded appropriately. Cytotoxicity was observed at concentrations ≥ 12.5%. 1-Propene, 2-methyl- did not increase the mutation frequency (Low 1,3-butadiene category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
1-Propene, 2-methyl- was not mutagenic in this assay.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to 1,3-butadiene as a gas at concentrations of 0, 30, 40, 50 or 60% with and without metabolic activation. The use of a positive control was not specified. An increase in mutation frequency was observed only in TA1535 in the presence of rat or mouse activation, but not human activation.
1,3-Butadiene was mutagenic in this assay.

(2) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Butane, 2-methyl- (CASRN 78-78-4)
In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to vapor from liquid butane, 2-methyl- at concentrations of 0, 0.05, 0.1, 0.5, 1, 2, 2.5 and 5 mL/chamber with and without metabolic activation. Positive and negative controls were used and responded appropriately. No cytotoxicity was observed. No increase in mutation frequency was observed (NTP study 211868: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
Butane, 2-methyl- was not mutagenic in this assay.

Pentane (CASRN 109-66-0)
(1) In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to pentane in dimethylsulfoxide (DMSO) at concentrations up to 6667 µg/plate with and without metabolic activation. Positive and negative controls were tested concurrently and responded appropriately. Cytotoxicity was observed at concentrations ≥ 100 µg/plate for all strains with and without activation. Pentane did not cause an increase in mutation frequency in any strain with or without activation (NTP study 502864: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
Pentane was not mutagenic in this assay.

(2) See human health data for CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.

Cyclopentane (CASRN 287-92-3)
In a reverse-mutation assay, *Salmonella typhimurium* strains TA97, TA98, TA100 and TA1535 were exposed to cyclopentane in DMSO at concentrations of 0, 100, 333, 1000, 3333 or 10,000 µg/plate with

and without metabolic activation. Positive and negative controls were tested concurrently and responded appropriately. Cytotoxicity was observed in all strains at concentrations ≥ 10,000 µg/plate with and without activation. Cyclopentane did not increase the mutation frequency in any strain (NTP study A90637: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome).
Cyclopentane was not mutagenic in this assay.

2-Butene, 2-methyl- (CASRN 513-35-9)
(1) *Salmonella typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 and *Escherichia coli* strains WP2 and WP7 uvrA were exposed to 2-butene, 2-methyl- in ethanol at concentrations of 0, 0.2, 2, 20, 500 or 2000 µg/plate with and without metabolic activation. Positive and negative controls were used but the results were not specified. 2-Butene, 2-methyl- did not increase the mutation frequency in any strain (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl- was not mutagenic in this assay.

(2) In a gene conversion assay, *Saccharomyces cerevisiae* were exposed to 2-butene, 2-methyl- in ethanol at concentrations of 0.01, 0.1, 0.5, 1 or 5 mg/mL with and without metabolic activation. No treatment-related increase in mitotic gene conversion was observed (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl- was not mutagenic in this assay.

Gasoline (CASRN 86290-81-5, supporting chemical)
(1) Mouse lymphoma L5178Y TK+/- cells were exposed to unleaded gasoline (wholly vaporized) in acetone at 0, 0.065, 0.13, 0.26, 0.52 or 1.04 µg/mL with and without metabolic activation. Positive controls were used and responded appropriately. Little cytotoxicity was observed. No increase in the mutation frequency was observed.
Gasoline was not mutagenic in this assay.

(2) *Salmonella typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 and *Saccharomyces cerevisiae* strain D4 were exposed to unleaded gasoline (wholly vaporized) in DMSO at concentrations of 0, 0.375, 0.75, 1.5 and 3% for bacteria and 0, 0.625, 1.25, 2.5 and 5% for yeast with and without metabolic activation. Positive and negative controls responded appropriately. No dose-dependent, reproducible increases in mutation frequency were observed.
Gasoline was not mutagenic in this assay.

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) *Salmonella typhimurium* strains TA98, TA100, TA104 and TA1535 were exposed to benzene as a vapor at concentrations of 0, 3, 6, 15, 30, 100, 300 or 1000 ppm with and without metabolic activation. A positive control was not used. Exposure to benzene increased the mutation frequency in TA100, TA104 and TA1535 with activation. Cytotoxicity was not specified.

Benzene was mutagenic in this assay.

(2) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See data for Subcategories I-V above.

In vivo

Subcategory I: Hydrocarbon gases, C1 – C4
1-Propene (CASRN 115-07-1)
Fischer 344 rats (8 males/dose) were exposed to 1-propene via inhalation at 0, 200, 2000 or 10,000 ppm for 6 hours/day for a total of 20 exposures. After sacrifice, spleens were removed and cultured to select for Hprt mutant T-lymphocytes. Exposure to 1-propene did not increase the mutation frequency at the Hprt locus (Propylene streams category: http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm).
1-Propene was not mutagenic in this assay.

Genetic Toxicity – Chromosomal Aberrations

In vitro

Subcategory I: Hydrocarbon gases, C1 – C4
2-Butene (CASRN 107-01-7, supporting chemical)
Sprague-Dawley rat lymphocytes were exposed to 2-butene (42.4% cis, 55.3% trans) as a gas at 0, 10, 20, 40, 50, 60, 80 or 100% with and without metabolic activation. Positive and negative controls were used and responded appropriately. Cytotoxicity was observed at concentrations ≥ 50%. 2-Butene did not induce significant dose-related increases in frequency of structural chromosome aberrations or polyploid cells.
2-Butene did not induce chromosomal aberrations in this assay.

Ethylene (CASRN 74-85-1, supporting chemical)
CHO cells were exposed to ethylene at concentrations up to ~25% in a nitrogen atmosphere in 3-hour pulse treatments for 20 hours with and without metabolic activation. Positive and negative controls responded appropriately. The frequency of chromosomal aberrations was not significantly affected by exposure to ethylene (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
Ethylene did not induce chromosomal aberrations in this assay.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) CHO cells were exposed to 1,3-butadiene in ethanol at 0, 24, 30 or 200 µM with or without metabolic activation. A positive control was used but results were not specified. 1,3-Butadiene was weakly positive for the induction of sister chromatid exchange in the presence of activation.
1,3-Butadiene induced sister chromatid exchange in this assay.

(2) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/butadienereport019.pdf

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Pentane (CASRN 109-66-0)
Chinese hamster ovary cells were treated with pentane with and without metabolic activation. The results obtained were inconclusive (See human health data for CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
Pentane was equivocal for chromosomal aberrations in this assay.

Cyclopentane (CASRN 287-92-3)
Human lymphocytes were treated with cyclopentane with and without metabolic activation. Negative results were obtained with activation and positive results were obtained without activation. (See human health data from C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
Cyclopentane was induced chromosomal aberrations without activation and did not induce chromosomal aberrations with activation in this assay.

2- Butene, 2-methyl- (CASRN 513-35-9)
In a cytogenetics assay, rat hepatocytes were exposed to 2-butene, 2-methyl- at 12.5, 25 or 50 mL/mL. Exposure to 2-butene did not increase the frequency of chromatid gaps, breaks or aberrations (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl- did not induce chromosomal aberrations in this assay.

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) Human lymphocytes were exposed to benzene at concentrations of 16, 78 or 391 mg/L with or without metabolic activation. Increases in the frequency of sister chromatid exchange and cytotoxicity were observed with activation. No positive control was used.
Benzene induced sister chromatid exchange in this assay.

(2) See human health data at: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See data for Subcategories I-V above.

In vivo

Subcategory I: Hydrocarbon gases, C1 – C4
1-Propene (CASRN 115-07-1)
In a micronucleus assay, male Fischer 344 rats (8/dose) were exposed to 1-propene via inhalation at 0, 200, 2000 or 10,000 ppm, 6 hours/day, 5 days/week for 4 weeks. Positive and negative controls were tested and responded appropriately. No treatment-related increase in micronuclei was observed (Propylene streams category: http://www.epa.gov/chemrtk/pubs/summaries/prplstrm/c13281tc.htm).
1-Propene did not induce micronuclei in this assay.

1-Butene (CASRN 106-98-9, supporting chemical)
In a micronucleus assay, Crl:CDR(ICR)Br Swiss mice (10 – 15/sex/dose) were exposed to 1-butene whole-body via inhalation at 0, 1000, 9000 or 22,000 ppm, 2 hours/day for 1 – 2 days. A positive control was used, but the response was not specified. Exposure to 1-butene did not increase the frequency of micronuclei formation in polychromatic erythrocytes (PCEs) or mature erythrocytes.
1-Butene did not induce micronuclei in this assay.

Ethylene (CASRN 74-85-1, supporting chemical)
In two micronucleus assays, rats and mice (10/dose, strain and sex not specified) were exposed to ethylene via inhalation at concentrations of 0, 40, 1000 or 3000 ppm, 6 hours/day, 5 days/week for 4 weeks. The positive control responded appropriately. Exposure to ethylene did not result in an increase in the frequency of micronuclei in either species (http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf).
Ethylene did not induce micronuclei in this assay.

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
(1) In a micronucleus assay, B6C3F1 mice (10 males/dose) were exposed to 1-propene, 2-methyl- whole-body via inhalation at 0, 1000, 3260 or 10,000 ppm, 6 hours/day for 2 days. Positive and negative controls responded appropriately. Exposure to 1-propene, 2-methyl- did not increase the number of micronuclei in PCEs (Low 1,3-butadiene C4 category HPV submission: http://www.epa.gov/chemrtk/pubs/summaries/lowbutd/c13122tc.htm).
1-Propene, 2-methyl- did not induce micronuclei in this assay.

(2) In a micronucleus assay conducted by the NTP, mice (5/sex/dose) were exposed to 1-propene, 2-methyl- via inhalation at 0, 500, 1000, 2000, 4000 or 8000 ppm for 14 weeks. Negative controls responded appropriately. There was not a significant increase in the frequency of micronuclei (NTP Technical Report No. 272).
1-Propene, 2-methyl- did not induce micronuclei in this assay.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
See also data for Subcategory I above.

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) In a micronucleus assay, male Wistar rats (10/dose) were exposed to 1,3-butadiene as a gas at 0, 50, 200 or 500 ppm, 6 hours/day for 5 days. The use of a positive control was not specified. No increase in the frequency of micronuclei was observed. A slight toxic effect was observed in rat bone marrow cells at 500 ppm.
1,3-Butadiene did not induce micronuclei in this assay.

(2) In a micronucleus assay, female CB6F1 mice (20/dose) were exposed to 1,3-butadiene as a gas at 0, 50, 200, 500 or 1300 ppm, 6 hours/day for 5 days. The use of a positive control was not specified. A dose-dependent increase in micronuclei frequency was observed in both blood and bone marrow cells at all exposure levels.
1,3-Butadiene induced micronuclei in this assay.

Subcategory III: Hydrocarbon gases, C1 – C6
See also data for Subcategory I above.

Pentane (CASRN 109-66-0)
In a micronecleus assay, rats were treated with pentane via inhalation and bone marrow micronuclei examined (See human health data for CASRN 109-66-0: http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0 and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
Pentane did not induce micronuclei in this assay.

Cyclopentane (CASRN 287-92-3)
In two micronucleus assays, different strains of mice were treated with cyclopentane via inhalation and erythrocyte micronuclei examined. (See human health data from C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx).
Cyclopentane did not induce micronuclei in this assay.

2-Butene, 2-methyl- (CASRN 513-35-9)
(1) In a micronucleus assay, male and female NMRI mice were exposed to 2-butene, 2-methyl- via inhalation at 1000, 3000 or 10,000 ppm for two 6-hour exposures. Male and female B6C3F1 mice were similarly exposed at 10,000 ppm only. Animals were sacrificed 24 hours following the second exposure period. A dose-related biologically relevant increase in PCEs containing micronuclei was observed at ≥ 1000 ppm in male NMRI mice and at ≥ 3000 ppm in female NMRI mice. Increased numbers of micronuclei were also observed in B6C3F1 mice at 10,000 ppm [This study was reported in the TSCA 8(e)/FYI Initial Screen Database (8EHQ-0409-17500A)].
2-Butene, 2-methyl induced micronuclei in this assay.

(2) In a micronucleus assay, male Crl:CD BR rats (10/group) were exposed whole-body to 2-butene, 2-methyl- as a vapor at target concentrations of 0, 1000, 3260 and 10,000 ppm in air, 6 hours/day for 2 consecutive days. Actual mean exposure concentrations were 0, 1005, 3207 and 9956 ppm, respectively. Bone marrow samples were collected and prepared for evaluation of micronucleus formation approximately 24 hours after dosing. A small but statistically significant increase in

micronucleus formation was observed at 3260 and 10,000 ppm. In addition, a dose-related increase was noted for the mean number of micronucleated PCEs. A statistically significant decrease in the mean percent of PCEs was observed at ≥ 1000 ppm (TSCATS (OTS0524006-2 and OTS0524006-3).
2-Butene, 2-methyl- induced micronuclei in this assay.

(3) In a micronucleus assay, Syrian hamsters were exposed to 2-butene, 2-methyl- via inhalation at 1000 ppm, 6 hours/day for 2 days. A marginal increase in bone marrow micronuclei was observed (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl was equivocal for the induction of micronuclei in this assay.

(4) In a micronucleus assay, B6C3F1 mice were exposed to 2-butene, 2-methyl- via inhalation at 1000, 3260 or 10,000 ppm, 6 hours/day for 2 days. A dose-related increase in the number of micronuclei was observed at ≥ 3260 ppm (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf)
2-Butene, 2-methyl induced micronuclei in this assay.

Gasoline (CASRN 86290-81-5, supporting chemical)
(1) In a sister chromatid exchange assay, Sprague-Dawley Crl:CD IGS BR rats (5/sex/dose) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day, 5 days/week for 4 weeks. Mean measured concentrations were 0, 2.1, 10.1 and 20.3 mg/L. A positive control was used and responded appropriately. Increases in sister chromatid exchange were observed in females at all exposure levels and in males at doses ≥ 10 mg/L.
Gasoline induced sister chromatid exchange in this assay.

(2) In a micronucleus assay, Sprague-Dawley Crl:CD IGS BR rats (5/sex/dose) were exposed whole-body to gasoline (API 99-01) as a vapor at nominal concentrations of 0, 2, 10 or 20 mg/L, 6 hours/day, 5 days/week for 4 weeks. Mean measured concentrations were 0, 2.1, 10.1 and 20.3 mg/L. A positive control was used and responded appropriately. No increase in the frequency of micronuclei or cytotoxicity was observed in exposed mice.
Gasoline did not induce micronuclei in this assay.

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
See data for Subcategories I, II and III above.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) In a sister chromatid exchange assay, male Sprague-Dawley rats (5/dose) were exposed to benzene as a vapor at 0, 0.1, 0.3, 1, 3, 10 or 30 ppm for 6 hours. Upon sacrifice, lymphocytes were assayed for sister chromatid exchange. The use of a positive control was not specified. At doses ≥ 3 ppm, a dose-dependent increase in the frequency of sister chromatid exchange was observed.
Benzene induced sister chromatid exchange in this assay.

(2) In a micronucleus assay, male Sprague-Dawley rats (5/dose) were exposed to benzene as a vapor at 0, 0.1, 0.3, 1, 3, 10 or 30 ppm for 6 hours. The use of a positive control was not specified. Significant increases in the frequency of micronuclei were observed at doses ≥ 1 ppm.
Benzene induced micronuclei in this assay.

(3) In a sister chromatid exchange assay, male DBA/2 mice (5/dose) were exposed to benzene as a vapor at 0, 10, 100 or 1000 ppm for 6 hours; upon sacrifice, lymphocytes were assayed for sister chromatid exchange. The use of a positive control was not specified. Increases in the frequency of sister chromatid exchange were observed at all doses.
Benzene induced sister chromatid exchange in this assay.

(4) In a micronucleus assay, male DBA/2 mice (5/dose) were exposed to benzene as a vapor at 0, 10, 100 or 1000 ppm for 6 hours. The use of a positive control was not specified. Significant increases in the frequency of micronuclei were observed at all doses.
Benzene induced micronuclei in this assay.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See data for Subcategories I-V above.

Petroleum Gases, liquefied (CASRN 68476-85-7)
In a micronucleus assay, Sprague-Dawley rats (5/sex/dose) were exposed to petroleum gases, liquefied via inhalation at nominal concentrations of 0, 1000, 5000 or 10,000 ppm, 6 hours/day, 5 days/week for 13 weeks. The mean measured concentrations were 0, 1019, 5009 and 9996 ppm. A positive control was used and responded appropriately. Exposure did not increase the frequency of micronuclei.
Petroleum Gases, liquefied did not induce micronuclei in this assay.

Additional Information

Skin Irritation

Subcategory III: Hydrocarbon gases, C1 – C6
Pentane (CASRN 109-66-0)
See human health data for CASRN 109-66-0:
http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0
and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.
Pentane was not a skin irritant in rabbits in this study.

Cyclopentane (CASRN 287-92-3)
New Zealand White rabbits (3/sex) were administered 0.5 mL of cyclopentane via the dermal route to both intact and abraded skin under occlusive conditions for 24 hours and were observed for up to 72 hours following exposure. No erythema, edema or other dermal effects were noted at 24 hours post-exposure; therefore, the primary irritation score was 0 [TSCATS (OTS0556742)].
Cyclopentane was not irritating to rabbit skin in this study.

2-Butene, 2-methyl- (CASRN 513-35-9)
New Zealand White rabbits (3/sex) were administered 0.5 mL of 2-butene, 2-methyl- via the dermal route to both intact and abraded skin under occlusive conditions for 24 hours and were observed for 7 days following exposure. Mild irritation was observed, including erythema and edema. The primary irritation index was 1.79 (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl was slightly irritating to rabbit skin in this study.

Eye Irritation

Subcategory III: Hydrocarbon gases, C1 – C6
Pentane (CASRN 109-66-0)
See human health data for CASRN 109-66-0:
http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0
and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.
Pentane was minimally irritating to rabbit eyes in this study.

Cyclopentane (CASRN 287-92-3)
In two studies, New Zealand White rabbits (6/sex) were administered 0.1 mL of cyclopentane in the left eye. Treated eyes were either left unwashed or washed with tap water (40 mL) 4 seconds after treatment. Untreated eyes served as controls. Animals were observed for 7 days following administration. Excessive blinking and rubbing were observed upon instillation. In washed eyes, conjunctival redness was noted in all six rabbits at the 1-hour observation and was characterized by inflamed, more diffuse and deeper crimson red blood vessels, with individual vessels not easily discernible. Redness persisted in two rabbits up to 24 hours and in another rabbit up to 48 hours. No corneal opacity, iritis, conjunctival chemosis or discharge was noted in any of the washed eyes. In unwashed eyes, iritis and chemosis were noted in one rabbit, and conjunctival redness was noted in all six rabbits. No corneal opacity or conjunctival discharge was noted in any of the unwashed eyes. All ocular lesions had cleared by day 4 [TSCATS (OTS0556743 and OTS0556744)].
Cyclopentane was moderately irritating to rabbit eyes in these studies.

2-Butene, 2-methyl- (CASRN 513-35-9)
New Zealand White rabbits (6/dose) were administered 0.2 mL of 2-butene, 2-methyl- in one eye and were observed for 7 days following exposure. A moderate initial pain response was observed (scored as a 4 on a scale of 1 – 6). No significant irritation was observed (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl was not irritating to rabbit eyes in this study.

Respiratory Tract Irritation

Subcategory III: Hydrocarbon gases, C1 – C6
Butane, 2-methyl- (CASRN 78-78-4)
See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx
Butane, 2-methyl- was not a respiratory tract irritant in mice in this study.

Pentane (CASRN 109-66-0)
See human health data for CASRN 109-66-0:
http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0
and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.
Pentane was not a respiratory tract irritant in mice in this study.

Skin Sensitization

Subcategory III: Hydrocarbon gases, C1 – C6
Butane, 2-methyl- (CASRN 78-78-4)
See human health data at: http://webnet.oecd.org/hpv/ui/Search.aspx
Butane, 2-methyl- was not sensitizing to guinea pig skin in this study.

Pentane (CASRN 109-66-0)
See human health data for CASRN 109-66-0:
http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=0af02fa3-f3ef-4df9-b050-43116efd8ef1&idx=0
and C5 aliphatic hydrocarbon solvents category - http://webnet.oecd.org/hpv/ui/Search.aspx.
Pentane was not sensitizing to guinea pig skin in this study.

2-Butene, 2-methyl- (CASRN 513-35-9)
Guinea pigs (20/dose) were administered 2-butene, 2-methyl- as a 0.1% solution in corn oil intradermally and then as a 50% solution in corn oil topically in the induction phase. The topical challenge consisted of a 25% solution in corn oil. No positive reactions were observed after the challenge phase (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf).
2-Butene, 2-methyl- was not sensitizing to guinea pig skin in this study.

Carcinogenicity

Subcategory I: Hydrocarbon gases, C1 – C4
1-Propene (CASRN 115-07-1)
(1) In multiple studies, Sprague-Dawley rats (≥ 100/sex/dose) were exposed to 1-propene via inhalation at 0, 200, 1000 or 5000 ppm, 7 hours/day, 5 days/week for 24 months. No treatment-related effects on survival, body weight or tumor incidence were observed {http://ecb.jrc.ec.europa.eu/esis/ and TSCATS (OTS0000116-0)}.
1-Propene did not increase the incidence of tumors in rats in this study.

(2) In a National Toxicology Program study, F344 rats (50/sex/group) were exposed whole-body to 1-propene as a gas at 0, 5000 or 10,000 ppm, 6 hours/day, 5 days/week for 103 weeks. No significant effects on survival were observed. No changes in body weight were noted and no clinical signs of toxicity were observed. An increased incidence of squamous metaplasia of the respiratory epithelium was noted in exposed rats at ≥ 5000 ppm. Epithelial hyperplasia of the nasal cavity occurred at an increased incidence in females at 10,000 ppm (9/50) and at a slightly increased incidence in males at 10,000 ppm (5/50). Inflammation of the nasal cavity was found in both males and females, at ≥ 5000 and 10,000 ppm, respectively. Inflammation was characterized by an influx of lymphocytes, macrophages and granulocytes into the submucosa and an influx of granulocytes into the lumen. An elevated incidence of hyperplasia of parafollicular (C-cell) cells in the thyroid was found in exposed

male and female rats. C-cell adenomas and C-cell adenomas or carcinomas (combined) occurred in females with a significant negative trend. The incidence of C-cell adenomas at 10,000 ppm was significantly lower than that in the controls. The incidences of C-cell adenomas or carcinomas (combined) in males were not significantly different in exposed groups [NTP Technical Report No. 272].
1-Propene did not increase the incidence of tumors in rats in this study.

(3) In multiple studies, Swiss mice (≥ 100/sex/dose) were exposed to 1-propene via inhalation at 0, 200, 1000 or 5000 ppm, 7 hours/day, 5 days/week for 18 months. No treatment-related changes in survival, body weight or tumor incidence were observed {http://ecb.jrc.ec.europa.eu/esis/ and TSCATS (OTS0000116-0)}.
1-Propene did not increase the incidence of tumors in mice in this study.

(4) In an NTP study, B6C3F1 mice (49 – 50/sex/group) were exposed whole-body to 1-propene as a gas at 0, 5000 or 10,000 ppm, 6 hours/day, 5 days/week for 103 weeks. After week 59, mean body weights of males at 10,000 ppm were ~ 5% lower than those of the controls. No compound-related effects were observed on clinical signs or survival. Chronic focal inflammation of the kidneys occurred at increased incidence in exposed mice of both sexes. The incidence of alveolar/bronchiolar carcinomas in males at 5000 ppm was significantly lower than in the controls. There was a dose-dependent decrease in alveolar/bronchiolar adenomas or carcinomas (combined) in male mice. The incidence of endometrial stromal polyps in female mice increased in a dose-dependent manner, but the incidences in the exposed groups were not significantly higher than that of the controls [NTP Technical Report No. 272].
1-Propene did not increase the incidence of tumors in mice in this study.

1-Propene, 2-methyl- (CASRN 115-11-7, supporting chemical)
F344/N rats (50/sex/group) and B63F1 mice (50/sex/group) were exposed to 0, 500, 2000, or 8000 ppm CASRN 115-11-7 gas by whole body exposure for 6 hours/day, 5 days/week for two years. Survival of controls and exposed groups were comparable, as were body weights, with the exception of the female mice exposed to 2000 and 8000 ppm isobutylene. Nonneoplastic effects included increased incidences and/or severities of nasal lesions, including hyaline degeneration of olfactory epithelium, in male and female rats and mice, and hyaline degeneration of the respiratory epithelium in male and female mice. There was some evidence of carcinogenic activity in male F344/N rats exposed to 8000 ppm CASRN 115-11-7 gas, based on an increased incidence of follicular cell carcinoma of the thyroid gland. There was no evidence of carcinogenic activity in female rats or mice of both sexes up to the highest concentration tested. National Toxicology Program, NTP TR 487, December 1998: http://ntp.niehs.nih.gov/ntp/htdocs/LT_rpts/tr487.pdf
CASRN 115-11-7 increased the incidence of tumors in male rats in this study.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene
1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) In an NTP study, B6C3F1 mice (50/sex/concentration) were exposed to 1,3-butadiene gas via inhalation at 0, 625 or 1250 ppm, 6 hours/day, 5 days/week. The study was scheduled to last 2 years but, was terminated at 60 (males) and 61 weeks (females) because of high mortality in both exposure groups. Survival was markedly reduced in exposed animals due primarily to malignant tumors. Increased incidences and early induction of hemangiosarcomas of the heart, malignant lymphomas, alveolar/bronchiolar adenomas and carcinomas, and pappilomas of the stomach in males and females were seen. In addition, in females, acinar cell carcinomas of the mammary gland, granulose

cell tumors of the ovary, hepatocellular adenomas and adenomas or carcinomas (combined) were seen. 1,3-Butadiene was associated with nonneoplastic lesions in the respiratory epithelium, liver necrosis, and testicular or ovarian atrophy.
(http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome)
1,3-Butadiene increased incidences of various tumors at multiple sites in this assay.

(2) Sprague-Dawley rats (100/sex/dose) were exposed whole-body to 1,3-butadiene as a gas at nominal concentrations of 0, 1000 or 8000 ppm, 6 hours/day, 5 days/week for 105 weeks for females or 111 weeks for males. Mean measured concentrations were 0.7, 999 and 7886 ppm (0.001, 2.2 and 17.4 mg/L). At concentrations ≥ 999 ppm, significant increases were observed in uterine sarcomas, total mammary gland tumors (adenomas and carcinomas combined) and thyroid follicular cell adenomas in females, as well as Leydig cell tumors in males. At 7886 ppm, significant increases were observed in the incidences of pancreatic exocrine adenomas in males and Zymbal gland carcinomas in females. [Additional details were obtained from Owen and Glaister, 1990, Environmental Health Perspectives 86:19-25.]
1.3-Butadiene was carcinogenic to rats in this study.

(3) In two NTP studies, B6C3F1 mice (50 – 70/sex/dose) were exposed to 1,3-butadiene as a gas at concentrations of 6.25 – 1250 ppm for 6 hours/day, 5 days/week for up to 2 years. Treatment-related effects included increased incidences and early induction of hemangiosarcomas of the heart, malignant lymphomas, alveolar/bronchiolar carcinomas, squamous cell carcinomas of the stomach, acinar cell carcinomas of the mammary gland, malignant granulosa cell tumors of the ovary, hepatocellular adenomas and carcinomas (combined), histiocytic sarcomas and adenoacanthomas. [Details were obtained from NTP studies C50602A and C50602C. See NTP TR-434].
1.3-Butadiene was carcinogenic to mice in these studies.

(4) There is "sufficient evidence" from epidemiologic studies of exposed workers to consider 1,3-butadiene carcinogenic to humans (http://www.epa.gov/iris/subst/0139.htm).

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
See data for Subcategories I and III above.

Benzene (CASRN 71-43-2, supporting chemical)
(1) In a NTP study, haploinsufficient $p16^{Ink4a}$/$p19^{Arf}$ mice (15/sex/dose) were administered benzene in corn oil via gavage at 0, 25, 50, 100 or 200 mg/kg-bw, 5 days/week for 27 weeks. The incidence of malignant lymphoma was significantly increased in males at 200 mg/kg-bw. [Details were obtained from NTP study C99034: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome].
Benzene was carcinogenic to mice in this study.

(2) In an NTP study, F344/N rats (50/sex/dose) were administered benzene in corn oil via gavage at 0, 25, 50 or 100 mg/kg-bw, 5 days/week for 103 weeks. Treatment-related increases were observed in the incidences of Zymbal gland carcinomas, squamous cell papillomas and carcinomas of the oral cavity and squamous cell papillomas and carcinomas of the skin (males only). [Details were obtained from NTP study C55276: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome].
Benzene was carcinogenic to rats in this study.

(3) In an NTP study, B6C3F1 mice (50/sex/dose) were administered benzene in corn oil via gavage at 0, 25 (females only), 50, 100 or 200 (males only) mg/kg-bw, 5 days/week for 103 weeks. Exposure to benzene increased the incidences of Zymbal gland squamous cell carcinomas, malignant lymphomas, alveolar/bronchiolar carcinomas, squamous cell carcinomas of the preputial gland, ovarian granulosa cell tumors and carcinomas and carcinosarcomas of the mammary gland. [Details were obtained from NTP study C55276: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchhome].
Benzene was carcinogenic to mice in this study.

(4) Benzene is characterized as a known human carcinogen for all routes of exposure based upon convincing human evidence as well as supporting evidence from animal studies (http://www.epa.gov/ncea/iris/subst/0276.htm).

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
See data for Subcategories I-V above.

Other

1,3-Butadiene (CASRN 106-99-0, supporting chemical)
(1) Male B6C3F1 mice (20 mice/concentration) were exposed to 1,3-butadiene gas at 0, 200, 1000 or 5000 ppm, 6 hours/day for 5 days and sacrificed 5 weeks after the end of exposure. Mice were examined for lesions of the reproductive tract and other gross abnormalities. Sperm from the cauda of the right epididymis were examined for morphological abnormalities. A significant, dose-related increase in the frequency of abnormal sperm heads was observed at ≥ 1000 ppm. This study was designed to assess the effects of 1,3-butadiene on sperm head morphology and did not include all of the endpoints necessary to assess the reproductive toxicity of a substance (Crude butadiene C4 category; http://www.epa.gov/chemrtk/pubs/summaries/olefins/c12064tc.htm).

(2) In a dominant lethal mutation assay, male CD-1 mice (50/dose) were exposed to 1,3-butadiene gas at 0, 12.5, 65 or 130 ppm (0, 0.028, 0.14 or 0.29 mg/L), 6 hours/day, 5 days/week for 4 weeks, and then mated with unexposed females. Females were sacrificed on gestation day 17 and uterine contents were examined. An increase in early embryonic deaths was observed at concentrations ≥ 0.14 mg/L. An increased frequency of runts (fetuses with weight reduced by 75%) was observed at 0.29 mg/L; runts exhibited an increased frequency of skeletal abnormalities, including macroscopic changes in the sternum, vertebrae, pelvic girdle and forelimbs [TSCATS (OTS0559090)].
1,3-Butadiene induced dominant lethal mutations in this assay.

Conclusion:

Hydrocarbon gases containing C1 – C4 Hydrocarbons
Subcategory I: Hydrocarbon gases, C1 – C4
The acute inhalation toxicity of CASRN 115-07-1 and the supporting chemical, CASRN 107-01-7 in rats is low. Rats repeatedly exposed via inhalation to CASRN 115-07-1 for up to 14-weeks showed no adverse treatment-related effects; the NOAEC for systemic toxicity is 10,000 ppm/day (highest concentration tested). In combined inhalation repeated-dose/reproductive/developmental toxicity screening tests in rats, CASRNs 74-84-0, 75-28-5, 106-97-8 and 106-98-9 (supporting chemical) showed no adverse treatment-related effects; the NOAECs for systemic toxicity are 15,502 ppm/day, 9148 ppm/day, 9157 ppm/day and 8000 ppm/day, respectively (highest concentrations tested).

In a combined inhalation repeated-dose/reproductive/developmental toxicity screening test in rats, CASRN 74-98-6 showed decreased body weight gain in males, and hematological effects in females at 12,168 ppm/day; the NOAEC for systemic toxicity is 3990 ppm/day. The supporting chemicals, CASRNs 74-85-1, 107-01-7 and 115-11-7 showed no treatment-related effects with repeated inhalation exposure in rats; the NOAECs for systemic toxicity range from 5009 ppm/day (CASRN 107-01-7) to 10,000 ppm/day (CASRN 74-85-1, highest concentrations tested). The supporting chemical, CASRN 115-11-7, showed no treatment-related effects after 14 weeks of repeated inhalation exposure in mice; the NOAEC for systemic toxicity is 7980 ppm/day (highest concentration tested). In the combined repeated-dose/reproductive/developmental screening tests previously mentioned, CASRNs 74-84-0, 106-97-8 and the supporting chemicals CASRNs 107-01-7 and CASRN 106-98-9 showed no treatment-related effects on reproduction; the NOAECs for reproductive/maternal/developmental toxicity in rats are15,502 ppm/day, 9157 ppm/day, 5009 ppm/day and 8000 ppm/day, respectively (highest concentrations tested). Repeated inhalation exposure with CASRN 75-28-5 in rats showed decreased fertility and increased post-implantation loss at 9148 ppm; the NOAEC for reproductive toxicity is 3122 ppm/day and the NOAEC for maternal/developmental toxicity is 9148 ppm/day (highest concentration tested). The combined repeated-dose/reproductive/developmental screening test with CASRN 74-98-6 in rats, showed a decrease in the number of live pups and an increase in the number of stillborn pups after inhalation exposure at 3990 ppm/day; the NOAEC for reproductive/developmental toxicity is 1230 ppm/day. Based on the systemic effects observed at 12,168 ppm/day (decreased body weight gain and hematological effects), the NOAEC for maternal toxicity is 3990 ppm/day. No specific reproductive toxicity studies are available for CASRN 115-11-7 (supporting chemical); however, in the 14-week inhalation repeated-dose toxicity study described above, there was a decrease in sperm motility at 7970 ppm/day. However, no adverse developmental effects were observed in the prenatal developmental toxicity study in rats; for CASRN 115-11-7 the NOAEC for maternal/developmental toxicity is 18.4 mg/L/day (highest concentration tested). In a combined inhalation reproductive/developmental toxicity screening test in rats, the supporting chemical, CASRN 74-85-1 showed no adverse effects; the NOAEC for reproductive/maternal/developmental toxicity is 10,000 ppm/day (highest concentration tested). In an inhalation prenatal developmental toxicity study in rats, CASRN 115-07-1 showed no treatment-related effects; the NOAEC for maternal/developmental toxicity is 10,000 ppm/day (highest concentration tested). CASRN 115-07-1 induced gene mutations in bacteria, but was equivocal for mutagenicity in mouse lymphoma cells *in vitro*. CASRNs 74-82-8 and 106-97-8, as well as the supporting chemicals, CASRNs 74-85-1, 115-11-7, 106-98-9 and 107-01-7 did not induce gene mutations in bacteria or mouse lymphoma cells *in vitro*. CASRNs 74-85-1 and 107-01-7 (supporting chemicals) did not induce chromosomal aberrations in rat lymphocytes or Chinese hamster ovary (CHO) cells *in vitro* and CASRN 115-07-1 and the supporting chemicals CASRNs 74-85-1, 115-11-7 and 106-98-9 did not induce micronuclei in rats and/or mice *in vivo*. CASRN 115-07-1 was not carcinogenic in rats or mice when administered via the inhalation route of exposure. CASRN 115-11-7 increased the incidence of tumors in male rats but not female rats, or mice of both sexes.

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene

No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data in subcategory I can also be used to address the human health endpoints for subcategory II. Please see the human health summary for subcategory I above.

The acute inhalation toxicity of CASRN 106-99-0 is low in rats. Repeated-dose studies show the mouse to be more sensitive to CASRN 106-99-0 exposure than the rat. Several studies of inhalation exposure for up to two-years showed minimal effects in rats; the NOAEC for systemic toxicity is 7886 ppm/day.

In a 14-week inhalation repeated-dose toxicity study in mice, CASRN 106-99-0 showed mortality at 1250 ppm/day; the NOAEC for systemic toxicity is 625 ppm/day. The most sensitive reproductive endpoint observed in subchronic studies with CASRN 106-99-0 was fetal deaths in dominant lethal studies in mice exposed by inhalation for 28-days at 65 ppm/day; the NOAEC for dominant lethal effects is 12.5 ppm/day. In two-year bioassays, the most sensitive reproductive effects were ovarian atrophy in female mice at 6.25 ppm/day and testicular atrophy in male mice at 625 ppm/day. The NOAEC for reproductive toxicity in female mice is not established and in male mice is 200 ppm/day. In a combined reproductive/developmental toxicity screening test, rats exposed to CASRN 106-99-0 by vapor inhalation showed no effects on reproduction; the NOAEC for reproductive/developmental toxicity is 13.3 mg/L/day (highest concentration tested). Maternal toxicity, as evidenced by decreased body weight, was observed in dams treated at 3.3 mg/L; the NOAEC for maternal toxicity is 0.66 mg/L/day. Prenatal developmental toxicity studies in rats and mice showed decreased body weight gains in treated dams following inhalation exposure to CASRN 106-99-0 at 200 and 1000 ppm/day, in mice and rats, respectively. No effects on developmental parameters were observed in rats; the NOAECs for maternal and developmental toxicity are 200 ppm/day and 1000 ppm/day (highest concentration tested), respectively. Reduced fetal body weight was observed in male mice at 40 ppm/day; the NOAECs for maternal and developmental toxicity are not established. CASRN 106-99-0 was mutagenic in bacteria *in vitro* and induced chromosomal aberrations *in vivo*. CASRN 106-99-0 increased incidences of various tumors at multiple sites in rats and mice and there is "sufficient evidence" from epidemiologic studies of exposed workers to consider CASRN 106-99-0 carcinogenic to humans.

Subcategory III: Hydrocarbon gases, C1-C6

The sponsored and supporting chemical data from Subcategory I can also be used to address the human health endpoints for subcategory III. Please see human health summary for subcategory I above.

The acute oral, inhalation and dermal toxicity of subcategory III in rats is low. In 90-day vapor inhalation repeated-dose studies in rats, CASRNs 109-66-0 and 287-92-3 showed no adverse treatment-related effects; the NOAECs for systemic toxicity are 20 mg/L/day and 30 mg/L/day (highest concentrations tested), respectively. Rats exposed to the supporting chemical, CASRN 86290-81-5 by inhalation for 13 weeks, showed no adverse treatement-related effects; the NOAEC for systemic toxicity is 20.3 mg/L/day (highest concentration tested). In an inhalation combined repeated-dose/reproductive/developmental toxicity screening test in rats, CASRN 513-35-9 showed heart leasions in males and longer clotting times in females at 2026 ppm/day; the NOAEC for systemic toxicity is 584 ppm/day. No effects on reproduction were observed; the NOAEC for reproductive/developmental toxicity is 7097 ppm/day (highest concentration tested). Based on the systemic effects described above, the NOAEC for maternal toxicity is 584 ppm/day. No specific reproductive toxicity studies are available for CASRN 109-66-0; however no effects were observed on the reproductive organs in rats following 90-day inhalation exposure. In an oral prenatal developmental toxicity study in rats, CASRN 109-66-0 showed no maternal or developmental effects; the NOAEC for maternal/developmental toxicity is 1000 mg/kg/day (highest dose tested). CASRNs 78-78-4, 109-66-0, 287-92-3 and 513-35-9 did not induce gene mutations in mouse lymphoma cells and bacteria *in vitro*. CASRN 109-66-0 was equivocal for chromosomal aberrations *in vitro* and negative in a rat micronuleus assay *in vivo*. CASRN 287-92-3 was positive in the absence, and negative in the presence of metabolic activation, for chromosomal aberrations *in vitro*, and negative in a mouse micronucleus assay *in vivo*. CASRN 513-35-9 did not induce chromosomal aberrations *in vitro* but induced micronuclei in rats and mice *in vivo*; whereas a micronuclei test of the same chemical was equivocal in hamsters. CASRN 86290-81-5

induced sister chromatid exchange in rats, but not in micronuclei *in vivo*. CASRN 78-78-4 is not irritating to the respiratory tract in mice and is not a skin sensitizer in guinea pigs. CASRN 109-66-0 is irritating to rabbit eyes, not irritating to rabbit skin or the respiratory tract of mice and not a skin sensitizer in guinea pigs. CASRN 287-92-3 is moderately irritating to rabbit eyes and not irritating to rabbit skin. CASRN 513-35-9 is irritating to rabbit skin, but not to rabbit eyes. CASRN 287-92-3 is not irritating to rabbit skin, but is irritating to rabbit eyes. CASRN 513-35-9 is not a skin sensitizer in guinea pigs.

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene
No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data from Subcategories I, II and III can also be used to address the human health endpoints for subcategory IV. Please see these human health summaries.

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene
No data are available for the sponsored substances for the human health endpoints. The sponsored and supporting chemical data from Subcategories I and III can also be used to address the human health endpoints for subcategory V. Please see human health summaries for subcategories I and III above.

The acute oral and inhalation toxicity of CASRN 71-43-2 in rats is low and moderate, respectively. Repeated-dose studies with CASRN 71-43-2 show that the hematopoietic system is the most sensitive indicator of toxicity. Mice exposed repeatedly via vapor inhalation to CASRN 71-43-2 showed hematological effects [e.g. decreases in blood cell counts (RBC and WBC), platelets, hemoglobin, hematocrit], thymic atrophy and testicular effects at 0.96 mg/L/day; the NOAEC for systemic toxicity is0.1 mg/L/day. In a similar study in mice, designed to assess specific effects on hematology, increases in spleen weight, total nucleated cells per spleen and nucleated RBCs were seen at 0.03 mg/L; the NOAEC is not established. Repeated inhalation exposure of rats to CASRN 71-43-2 showed a decrease in WBC counts and percentage of lymphocytes at 0.96 mg/L/day; the NOAEC for hematological effects on peripheral blood circulation is 0.096 mg/L/day. Guideline reproductive toxicity studies are not available; however, in the 13-week inhalation exposures with CASRN 71-43-2 in mice, adverse effects were observed on the male and female reproductive organs. In a modified prenatal developmental toxicity study, female rats exposed to CASRN 71-43-2 via vapor inhalation pre- and post- mating and through lactation, had female pups with reduced body and liver weights at 0.96 mg/L/day; the NOAECs for maternal and developmental toxicity are 0.96 mg/L/day (highest concentration tested) and 0.096 mg/L/day, respectively. In an inhalation prenatal developmental toxicity study in mice, CASRN 71-43-2 showed effects on the hematopoietic system in offspring at 0.064 mg/L/day; the NOAECs for maternal and developmental toxicity are 0.064 mg/L/day (highest concentration tested) and 0.032 mg/L/day, respectively. CASRN 71-43-2 induced gene mutations in bacteria *in vitro*, sister chromatid exchange in human lymphocytes *in vitro* and in rat and mouse lymphocytes *in vivo*. CASRN 71-43-2 induced micronuclei in rats and mice *in vivo*.

Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene
The sponsored and supporting chemical data from Subcategories I, II, III, IV and V can also be used to address the human health endpoints for subcategory IV. Please see these summaries.

In a 13-week repeated-dose inhalation toxicity study in rats, CASRN 68476-85-7 did not show consistent treatment-related effects; the NOAEC for systemic toxicity is 10,000 ppm/day (highest concentration tested). No specific reproductive toxicity studies are available for CASRN 68476-85-7;

however, in the 13-week inhalation study, there was an increased incidence in the percent of abnormal sperm observed at 9996 ppm. No effects were observed on sperm count and motility. In an inhalation prenatal developmental toxicity study in rats, CASRN 68476-85-7 showed no maternal and developmental toxicity; the NOAEC for maternal/developmental toxicity is 19 mg/L/day (highest concentration tested). CASRN 68476-85-7 did not induce micronuclei in rats *in vivo*.

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4

Endpoints	SPONSORED CHEMICAL Methane (C1) (74-82-8)	SPONSORED CHEMICAL Ethane (C2) (74-84-0)	SPONSORED CHEMICAL Propane (C3) (74-98-6)	SPONSORED CHEMICAL 1-Propene (C3) (115-07-1)	SPONSORED CHEMICAL Propane, 2-methyl- (C4) (75-28-5)	SPONSORED CHEMICAL Butane (C4) (106-97-8)	SPONSORED CHEMICAL Natural gas (C1 – C4) (8006-14-2)	SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer (C1 – C4) (68308-11-2)	SPONSORED CHEMICAL Natural gas, dried (C1 – C4) (68410-63-9)
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data 23.1 (RA)		**>800,000 ppm (15 min)**	**>65,000 ppm**			No Data > 23.1 (RA)		
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 3990 LOAEC = 12,168 (RA)	**NOAEC = 15,502 (highest concentration tested)**	**NOAEC= 3990 LOAEC= 12,168**	**NOAEC = 10,000 (highest concentration tested)**	**NOAEC = 9148 (highest concentration tested)**	**NOAEC = 9157 (highest concentration tested)**	No Data NOAEC = 3990 LOAEC = 12,168 (RA)	No Data NOAEC = 3990 LOAEC = 12,168 (RA)	No Data NOAEC = 3990 LOAEC = 12,168 (RA)
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day)									
Reproductive Toxicity	No Data NOAEC = 1230 LOAEC = 3990 (RA)	**NOAEC = 15,502 (highest concentration tested)**	**NOAEC = 1230 LOAEC = 3990**	No Data NOAEC = 1230 LOAEC = 3990 (RA)	**NOAEC = 3122 LOAEC = 9148**	**NOAEC = 9157 (highest concentration tested)**	No Data NOAEC = 1230 LOAEC = 3990 (RA)	No Data NOAEC = 1230 LOAEC = 3990 (RA)	No Data NOAEC = 1230 LOAEC = 3990 (RA)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)									
Maternal Toxicity	No Data NOAEC = 3990 LOAEC=12,168	**NOAEC = 15,502 (highest concentration tested)**	**NOAEC = 3990 LOAEC=12,168**	**NOAEC = 10,000 (highest concentration tested)**	**NOAEC = 9148 (highest concentration tested)**	**NOAEC = 9157 (highest concentration tested)**	No Data NOAEC = 3990 LOAEC=12,168	No Data NOAEC = 3990 LOAEC=12,168	No Data NOAEC = 3990 LOAEC=12,168
Developmental Toxicity	NOAEC = 1230 LOAEC=3990 (RA)	**NOAEC = 15,502 (highest concentration tested)**	**NOAEC = 1230 LOAEC=3990**	**NOAEC = 10,000 (highest concentration tested)**	**NOAEC = 9148 (highest concentration tested)**	**NOAEC = 9157 (highest concentration tested)**	NOAEC = 1230 LOAEC=3990 (RA)	NOAEC = 1230 LOAEC=3990 (RA)	NOAEC = 1230 LOAEC=3990 (RA)

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4									
Endpoints	**SPONSORED CHEMICAL Methane (C1) (74-82-8)**	**SPONSORED CHEMICAL Ethane (C2) (74-84-0)**	**SPONSORED CHEMICAL Propane (C3) (74-98-6)**	**SPONSORED CHEMICAL 1-Propene (C3) (115-07-1)**	**SPONSORED CHEMICAL Propane, 2-methyl- (C4) (75-28-5)**	**SPONSORED CHEMICAL Butane (C4) (106-97-8)**	**SPONSORED CHEMICAL Natural gas (C1 – C4) (8006-14-2)**	**SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer (C1 – C4) (68308-11-2)**	**SPONSORED CHEMICAL Natural gas, dried (C1 – C4) (68410-63-9)**
Genetic Toxicity – Gene Mutation *In vitro*	**Negative**	No Data Negative (RA)	**Negative**	**Positive**	No Data Negative (RA)	**Negative**	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	**Negative**	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)
Genetic Toxicity – Chromosomal Aberrations *In vitro*					No Data Negative (RA)				
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	**Negative**	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)	No Data Negative (RA)
Additional Information Carcinogenicity	–	–	–	**Negative**	–	–	–	–	–

Measured data in bold text; (RA) = Read Across; **–** indicates that endpoint was not addressed for this chemical

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4 (continued)

Endpoints	SPONSORED CHEMICAL Alkanes, C1 – 2 (68475-57-0)	SPONSORED CHEMICAL Alkanes, C2 – 3 (68475-58-1)	SPONSORED CHEMICAL Alkanes, C3 – 4 (68475-59-2)	SPONSORED CHEMICAL Hydrocarbons, C2 – 4, C3-rich (68476-49-3)	SPONSORED CHEMICAL Gases (petroleum), C2 – 3 (68477-70-3)	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads (C1 – C4) (68477-86-1)	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich (C1 – C4) (68477-88-3)	SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich (C1 – C4) (68477-90-7)	SPONSORED CHEMICAL Hydrocarbons, C1 – 3 (68527-16-2)
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 23.1 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 3990 LOAEC = 12,168 (RA)								
Reproductive Toxicity NOAEL/LOAEL Inhalation (ppm/day)	No Data NOAEC = 1230 LOAEC = 3990 (RA)								
Reproductive Toxicity									
Developmental Toxicity NOAEL/LOAEL Inhalation (mg/L/day)	No Data NOAEC = 3990 LOAEC=12,168								
Maternal Toxicity	NOAEC = 1230 LOAEC=3990 (RA)								
Developmental Toxicity									

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4 (continued)

Endpoints	SPONSORED CHEMICAL Alkanes, C1 – 2 (68475-57-0)	SPONSORED CHEMICAL Alkanes, C2 – 3 (68475-58-1)	SPONSORED CHEMICAL Alkanes, C3 – 4 (68475-59-2)	SPONSORED CHEMICAL Hydrocarbons, C2 – 4, C3-rich (68476-49-3)	SPONSORED CHEMICAL Gases (petroleum), C2 – 3 (68477-70-3)	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads (C1 – C4) (68477-86-1)	SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich (C1 – C4) (68477-88-3)	SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich (C1 – C4) (68477-90-7)	SPONSORED CHEMICAL Hydrocarbons, C1 – 3 (68527-16-2)
Genetic Toxicity – Gene Mutation ***In vitro***	No Data Negative (RA)								
Genetic Toxicity – Gene Mutation ***In vivo***	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Negative (RA)								

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4 (continued)

Endpoints	SPONSORED CHEMICAL Hydrocarbons, C3 (68606-26-8)	SPONSORED CHEMICAL Fuel gases, refinery, hydrogen sulfide-free (C1 – C4) (68918-98-9)	SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter overheads (C1 – C4) (68919-20-0)	SPONSORED CHEMICAL Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead (C1 – C4) (68955-34-0)
Acute Inhalation Toxicity LC_{50} (ppm)	No Data > 23.1 (RA)			
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)			
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 3990 LOAEC = 12,168 (RA)			
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No Data NOAEC = 1230 LOAEC = 3990 (RA)			
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEC = 3990 LOAEC=12,168 NOAEC = 1230 LOAEC=3990 (RA)			

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory I: Hydrocarbon gases, C1 – C4 (continued)

Endpoints	SPONSORED CHEMICAL Hydrocarbons, C3 (68606-26-8)	SPONSORED CHEMICAL Fuel gases, refinery, hydrogen sulfide-free (C1 – C4) (68918-98-9)	SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter overheads (C1 – C4) (68919-20-0)	SPONSORED CHEMICAL Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead (C1 – C4) (68955-34-0)
Genetic Toxicity – Gene Mutation ***In vitro***	No Data Negative (RA)			
Genetic Toxicity – Gene Mutation ***In vivo***	No Data Negative (RA)			
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Negative (RA)			
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Negative (RA)			

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene

Endpoints	SPONSORED CHEMICAL Gases (petroleum), C3 – 4 (68131-75-9)	SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads (C1 – C4) (68477-94-1)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4 (68514-31-8)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, sweetened (68514-36-3)	SPONSORED CHEMICAL Hydrocarbons, C2 – 4 (68606-25-7)	SPONSORED CHEMICAL Hydrocarbons, C4-unsatd. (68956-54-7)
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 23.1 (RA)					
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)					
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)					
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No Data (rat) NOAEC = 1230 LOAEC = 3990 (mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (RA)					

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene

Endpoints	SPONSORED CHEMICAL Gases (petroleum), C3 – 4 (68131-75-9)	SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads (C1 – C4) (68477-94-1)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4 (68514-31-8)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, sweetened (68514-36-3)	SPONSORED CHEMICAL Hydrocarbons, C2 – 4 (68606-25-7)	SPONSORED CHEMICAL Hydrocarbons, C4-unsatd. (68956-54-7)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = Not Established LOAEC = 200					
Maternal Toxicity						
Developmental Toxicity	NOAEC = Not established LOAEC = 40 (RA)					
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)					
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)					
Genetic Toxicity – Chromosomal Aberrations *In vitro*	No Data Positive (RA)					
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Positive (RA)					

(RA) = Read Across; (m) = male; (f) = female

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6

Endpoints	SPONSORED CHEMICAL Butane, 2-methyl (C5) (78-78-4)	SPONSORED CHEMICAL Pentane (C5) (109-66-0)	SPONSORED CHEMICAL Cyclopentane (C5) (287-92-3)	SPONSORED CHEMICAL 2-Butene, 2-methyl- (C5) (513-35-9)	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free (C1 – C6) (68308-02-1)	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber (C1 – C6) (68308-03-2)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant (C1 – C6) (68308-04-3)	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free (C1 – C6) (68308-06-5)	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer (C1 – C6) (68308-08-7)
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)		**> 5000**	**$1059 < LD_{50} < 1655$**	No Data $1059 < LD_{50} < 1655$ (RA)				
Acute Inhalation Toxicity LC_{50} (mg/L)	**>12.1**	**>18.0**	**> 72**	**> 175**	No Data > 175 (RA)				
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)			**> 2000**	No Data > 2000 (RA)				
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (mg/L/day)	No Data NOAEC = 20 (RA)	**(rat) NOAEC=20 (highest concentration tested)**	**(rat) NOAEC=30 (highest concentration tested)**	**(rat; ppm) NOAEC = 625 LOAEC = 1250**	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)				

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6

Endpoints	SPONSORED CHEMICAL Butane, 2-methyl (C5) (78-78-4)	SPONSORED CHEMICAL Pentane (C5) (109-66-0)	SPONSORED CHEMICAL Cyclopentane (C5) (287-92-3)	SPONSORED CHEMICAL 2-Butene, 2-methyl- (C5) (513-35-9)	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free (C1 – C6) (68308-02-1)	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber (C1 – C6) (68308-03-2)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant (C1 – C6) (68308-04-3)	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free (C1 – C6) (68308-06-5)	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer (C1 – C6) (68308-08-7)
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data		No Data* (rat – CASRN 110-82-7) 24.1 mg/L	**(rat) NOAEC = 7097 (highest concentration tested)**	No Data NOAEC = 7097 (RA)				
Reproductive Toxicity	No effects on reproductive organs in rats in 90-day repeated-dose study (RA)	No effects on reproductive organs in rats in 90-day repeated-dose study							
Developmental Toxicity NOAEL/LOAEL Oral (mg/kg/day)			–	–	–	–	–	–	–
Maternal Toxicity	No Data NOAEL = 1000	**(rat) NOAEL = 1000 (highest dose tested)**	–	–	–	–	–	–	–
Developmental Toxicity	NOAEL = 1000 (RA)	**NOAEL = 1000 (highest dose tested)**							

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6

Endpoints	SPONSORED CHEMICAL Butane, 2-methyl (C5) (78-78-4)	SPONSORED CHEMICAL Pentane (C5) (109-66-0)	SPONSORED CHEMICAL Cyclopentane (C5) (287-92-3)	SPONSORED CHEMICAL 2-Butene, 2-methyl- (C5) (513-35-9)	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free (C1 – C6) (68308-02-1)	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber (C1 – C6) (68308-03-2)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant (C1 – C6) (68308-04-3)	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free (C1 – C6) (68308-06-5)	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer (C1 – C6) (68308-08-7)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)			No Data* (rat – CASRN 110-82-7)	**(rat) NOAEC = 584 LOAEC = 2026**					
Maternal Toxicity	No Data NOAEC = 584 LOAEC = 2026	No Data NOAEC = 584 LOAEC = 2026	NOAEC = 1.72 mg/L/day LOAEC = 6.88 mg/L/day	**NOAEC = 7097 (highest concentration tested)**	No Data NOAEC = 584 LOAEC = 2026	No Data NOAEC = 584 LOAEC = 2026	No Data NOAEC = 584 LOAEC = 2026	No Data NOAEC = 584 LOAEC = 2026	No Data NOAEC = 584 LOAEC = 2026
Developmental Toxicity	NOAEC = 7097 (RA)	NOAEC = 7097 (RA)	NOAEC = 6.88 mg/L/day LOAEC = 24.1 mg/L/day		NOAEC = 7097 (RA)	NOAEC = 7097 (RA)	NOAEC = 7097 (RA)	NOAEC = 7097 (RA)	NOAEC = 7097 (RA)

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6

Endpoints	SPONSORED CHEMICAL Butane, 2-methyl (C5) (78-78-4)	SPONSORED CHEMICAL Pentane (C5) (109-66-0)	SPONSORED CHEMICAL Cyclopentane (C5) (287-92-3)	SPONSORED CHEMICAL 2-Butene, 2-methyl- (C5) (513-35-9)	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free (C1 – C6) (68308-02-1)	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber (C1 – C6) (68308-03-2)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant (C1 – C6) (68308-04-3)	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free (C1 – C6) (68308-06-5)	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer (C1 – C6) (68308-08-7)
Genetic Toxicity – Gene Mutation ***In vitro***	**Negative**	**Negative**	**Negative**	**Negative**			No Data Negative (RA)		
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Equivocal (RA)	**Equivocal**	**Negative (with activation) Positive (without activation)**	**Negative**			No Data Negative (RA)		
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Negative (RA)	**Negative**	**Negative**	**Positive**			No Data Positive (RA)		
Additional Information									
Skin Irritation	**–**	**Not irritating**	**Not irritating**	**Slightly irritating**	–	–	–	–	–
Eye Irritation	**–**	**Minimally irritating**	**Moderately irritating**	**Not irritating**	–	–	–	–	–
Respiratory Tract Irritation	**Not irritating**	**Not irritating**	**–**	**–**	–	–	–	–	–
Skin Sensitization	**Negative**	**Negative**	**–**	**Negative**	–	–	–	–	–
Carcinogenicity	**–**	–	**–**	**–**	–	–	–	–	–

Measured data in bold text; (RA) = Read Across; **–** indicates that endpoint was not addressed for this chemical; * As read-across in the C5 aliphatic hydrocarbon solvents category in the OECD HPV program - http://webnet.oecd.org/hpv/ui/Search.aspx.

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free (C1 – C6) (68308-09-8)	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free (C1 – C6) (68308-10-1)	SPONSORED CHEMICAL Alkanes, C4 – 5 (68475-60-5)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4 (68476-40-4)	SPONSORED CHEMICAL Hydrocarbons, C4 – 5 (68476-42-6)	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads (C1 – C6) (68477-69-0)	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich (C1 – C6) (68477-76-9)	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. splitter (C1 – C6) (68478-19-3)	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich (C1 – C6) (68478-33-1)
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)								
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)								
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg/day)	No Data NOAEL = 14.9 LOAEL = 148.56 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)								
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day)									
Reproductive Toxicity	No Data NOAEC = 7097 (RA)	No Data NOAEC = 7097 (RA)	No Data NOAEC = 7097 (RA)	No Data NOAEC = 1230 LOAEC = 3990 (RA)	No Data NOAEC = 7097 (RA)	No Data NOAEC = 7097 (RA)	No Data NOAEC = 1230 LOAEC = 3990 (RA)	No Data NOAEC = 7097 (RA)	No Data NOAEC = 1230 LOAEC = 3990 (RA)

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free (C1 – C6) (68308-09-8)	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free (C1 – C6) (68308-10-1)	SPONSORED CHEMICAL Alkanes, C4 – 5 (68475-60-5)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4 (68476-40-4)	SPONSORED CHEMICAL Hydrocarbons, C4 – 5 (68476-42-6)	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads (C1 – C6) (68477-69-0)	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich (C1 – C6) (68477-76-9)	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. splitter (C1 – C6) (68478-19-3)	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich (C1 – C6) (68478-33-1)
Developmental Toxicity NOAEL/LOAEL Inhalation (mg/L/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)	No Data NOAEC = 584 LOAEC = 2026 NOAEC = 7097 (RA)
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)	No Data Positive (RA)	No Data Negative (RA)	No Data Negative (RA)	No Data Positive (RA)				
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations *In vitro*	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Positive (RA)								

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Endpoints	SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads (C1 – C6) (68513-12-2)	SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off (C1 – C7) (68513-17-7)	SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off (C1 – C6) (68918-99-0)	SPONSORED CHEMICAL Gas (petroleum), dehexanizer off (C1 – C6) (68919-00-6)	SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off (C1 – C6) (68919-05-1)	SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off (C1 – C6) (68919-06-2)	SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off (C1 – C6) (68919-10-8)	SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter residues (C1 – C6) (68919-19-7)
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)							
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)							
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)							
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)							
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 LOAEC =1250 (RA)							
Reproductive Toxicity NOAEC/LOAEC Inhalation (mg/L/day) **Reproductive Toxicity**	No Data NOAEC = 7097 (RA)							

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory III: Hydrocarbon gases, C1 – C6 (continued)

Endpoints	SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads (C1 – C6) (68513-12-2)	SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off (C1 – C7) (68513-17-7)	SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off (C1 – C6) (68918-99-0)	SPONSORED CHEMICAL Gas (petroleum), dehexanizer off (C1 – C6) (68919-00-6)	SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off (C1 – C6) (68919-05-1)	SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off (C1 – C6) (68919-06-2)	SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off (C1 – C6) (68919-10-8)	SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter residues (C1 – C6) (68919-19-7)
Developmental Toxicity NOAEL/LOAEL Inhalation (mg/L/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEL = 2.2 LOAEL = 5.7 NOAEL = 5.7 LOAEL = 7.2 (RA)							
Genetic Toxicity – Gene Mutation *In vitro*	No Data Negative (RA)							
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)							
Genetic Toxicity – Chromosomal Aberrations *In vitro*	No Data Negative (RA)							
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Positive (RA)							

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data									
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene									
Endpoints	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber (C1 – C6) (68307-98-2)**	**SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer (C1 – C6) (68307-99-3)**	**SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer (C1 – C6) (68308-05-4)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads (C1 – C6) (68409-99-4)**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed (C1 – C6) (68476-54-0)**	**SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich (C1 – C6) (68477-42-9)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free (C1 – C6) (68477-71-4)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich (C1 – C6) (68477-72-5)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free (C1 – C6) (68477-73-6)**
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)								
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)								
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Inhalation (mg/L/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)								

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber (C1 – C6) (68307-98-2)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer (C1 – C6) (68307-99-3)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer (C1 – C6) (68308-05-4)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads (C1 – C6) (68409-99-4)	SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed (C1 – C6) (68476-54-0)	SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich (C1 – C6) (68477-42-9)	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free (C1 – C6) (68477-71-4)	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich (C1 – C6) (68477-72-5)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free (C1 – C6) (68477-73-6)
Reproductive Toxicity NOAEL/LOAEL Inhalation (mg/L/day) **Reproductive Toxicity**	No Data (rat) NOAEC = 1230 LOAEC = 3990 (mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (RA)								
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEC = Not Established LOAEC = 200 NOAEC = Not established LOAEC = 40 (RA)								

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber (C1 – C6) (68307-98-2)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer (C1 – C6) (68307-99-3)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant deethanizer (C1 – C6) (68308-05-4)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked overheads (C1 – C6) (68409-99-4)	SPONSORED CHEMICAL Hydrocarbons, C3 – 5, polymn. unit feed (C1 – C6) (68476-54-0)	SPONSORED CHEMICAL Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich (C1 – C6) (68477-42-9)	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free (C1 – C6) (68477-71-4)	SPONSORED CHEMICAL Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich (C1 – C6) (68477-72-5)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free (C1 – C6) (68477-73-6)
Genetic Toxicity – Gene Mutation ***In vitro***	No Data Positive (RA)								
Genetic Toxicity – Gene Mutation ***In vivo***	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Positive (RA)								
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Positive (RA)								

(RA) = Read Across; (m)= male; (f) = female

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed (C1 – C6) (68477-83-8)	SPONSORED CHEMICAL Gases (petroleum), C4-rich (C1 – C6) (68477-85-0)	SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads (C1 – C6) (68477-87-2)	SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads (C1 – C6) (68477-91-8)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator (C1 – C6) (68478-24-0)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer (C1 – C6) (68478-26-2)	SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker (C1 – C6) (68478-34-2)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate (C1 – C6) (68512-91-4)	SPONSORED CHEMICAL Butane, branched and linear (C1 – C6) (68513-65-5)
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)								
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)								
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)								

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed (C1 – C6) (68477-83-8)	SPONSORED CHEMICAL Gases (petroleum), C4-rich (C1 – C6) (68477-85-0)	SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads (C1 – C6) (68477-87-2)	SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads (C1 – C6) (68477-91-8)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator (C1 – C6) (68478-24-0)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer (C1 – C6) (68478-26-2)	SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker (C1 – C6) (68478-34-2)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate (C1 – C6) (68512-91-4)	SPONSORED CHEMICAL Butane, branched and linear (C1 – C6) (68513-65-5)
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No Data NOAEC = 1230 LOAEC = 3990 (RA)								
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEC = Not Established LOAEC = 200 NOAEC = Not established LOAEC = 40 (RA)								
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)								
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)								

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed (C1 – C6) (68477-83-8)	SPONSORED CHEMICAL Gases (petroleum), C4-rich (C1 – C6) (68477-85-0)	SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads (C1 – C6) (68477-87-2)	SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads (C1 – C6) (68477-91-8)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator (C1 – C6) (68478-24-0)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer (C1 – C6) (68478-26-2)	SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker (C1 – C6) (68478-34-2)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate (C1 – C6) (68512-91-4)	SPONSORED CHEMICAL Butane, branched and linear (C1 – C6) (68513-65-5)
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Positive (RA)								
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Positive (RA)								

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich (C1 – C6) (68513-66-6)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction (C1 – C6) (68527-19-5)	SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet (C1 – C6) (68602-83-5)	SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product (C1 – C6) (68606-24-6)	SPONSORED CHEMICAL Gases (petroleum), alkylation feed (C1 – C6) (68606-27-9)	SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation off (C1 – C6) (68606-34-8)	SPONSORED CHEMICAL Fuel gases, refinery, sweetened (C1 – C6) (68783-61-9)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracking (C1 – C6) (68783-64-2)	SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened (C1 – C6) (68783-65-3)
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)								
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)								
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)								
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)								
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)								
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No Data NOAEC = 1230 LOAEC = 3990 (RA)								

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich (C1 – C6) (68513-66-6)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction (C1 – C6) (68527-19-5)	SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet (C1 – C6) (68602-83-5)	SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product (C1 – C6) (68606-24-6)	SPONSORED CHEMICAL Gases (petroleum), alkylation feed (C1 – C6) (68606-27-9)	SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation off (C1 – C6) (68606-34-8)	SPONSORED CHEMICAL Fuel gases, refinery, sweetened (C1 – C6) (68783-61-9)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracking (C1 – C6) (68783-64-2)	SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened (C1 – C6) (68783-65-3)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data								
Maternal Toxicity	NOAEC = Not Established LOAEC = 200								
Developmental Toxicity	NOAEC = Not established LOAEC = 40 (RA)								
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)								
Genetic Toxicity – Gene Mutation *In vivo*	No Data Negative (RA)								
Genetic Toxicity – Chromosomal Aberrations *In vitro*	No Data Positive (RA)								
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Positive (RA)								

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data				
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)				
Endpoints	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha debutanizer (C1 – C6) (68952-76-1)**	**SPONSORED CHEMICAL Gases (petroleum), light steam-cracked, butadiene conc. (C1 – C6) (68955-28-2)**	**SPONSORED CHEMICAL Residues (petroleum), catalytic cracking depropanizer, C4-rich (C1 – C6) (71329-37-8)**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber (C1 – C6) (71808-30-5)**
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)			
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data > 175 (RA)			
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)			
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)			
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 625 ppm LOAEC =1250 ppm (RA)			
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No Data NOAEC = 1230 LOAEC = 3990 (RA)			

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene (continued)

Endpoints	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha debutanizer (C1 – C6) (68952-76-1)	SPONSORED CHEMICAL Gases (petroleum), light steam-cracked, butadiene conc. (C1 – C6) (68955-28-2)	SPONSORED CHEMICAL Residues (petroleum), catalytic cracking depropanizer, C4-rich (C1 – C6) (71329-37-8)	SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber (C1 – C6) (71808-30-5)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Maternal Toxicity** **Developmental Toxicity**	No Data NOAEC = Not Established LOAEC = 200 NOAEC = Not established LOAEC = 40 (RA)			
Genetic Toxicity – Gene Mutation ***In vitro***	No Data Positive (RA)			
Genetic Toxicity – Gene Mutation ***In vivo***	No Data Negative (RA)			
Genetic Toxicity – Chromosomal Aberrations ***In vitro***	No Data Positive (RA)			
Genetic Toxicity – Chromosomal Aberrations ***In vivo***	No Data Positive (RA)			

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data					
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene					
Endpoints	**SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free (C1 – C7) (68308-12-3)**	**SPONSORED CHEMICAL Hydrocarbons, C4 and higher (C1 – C8) (68476-44-8)**	**SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6 (C1 – C7) (68477-25-8)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker (C1 – C7) (68477-74-7)**	**SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich (C1 – C6) (68477-75-8)**
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)				
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data 43.7 (RA)				
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)				
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)				
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (mg/L/day)	No Data NOAEC = 0.10 LOAEC = 0.96 (RA)				
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	No data NOAEC = 1230 LOAEC = 3990 (RA)				

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free (C1 – C7) (68308-12-3)	SPONSORED CHEMICAL Hydrocarbons, C4 and higher (C1 – C8) (68476-44-8)	SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6 (C1 – C7) (68477-25-8)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracker (C1 – C7) (68477-74-7)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich (C1 – C6) (68477-75-8)
Developmental Toxicity NOAEC/LOAEC Inhalation (mg/L/day)			No Data		
Maternal Toxicity			NOAEC = 0.064		
Developmental Toxicity			NOAEC = 0.032 LOAEC = 0.064 (RA)		
Genetic Toxicity – Gene Mutation ***In vitro***			No Data Positive (RA)		
Genetic Toxicity – Chromosomal Aberrations ***In vitro***			No Data Positive (RA)		
Genetic Toxicity – Chromosomal Aberrations ***In vivo***			No Data Positive (RA)		

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data					
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene (continued)					
Endpoints	**SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich (C1 – C6) (68477-79-2)**	**SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off (C1 – C7) (68513-15-5)**	**SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products (C1 – C7) (68919-16-4)**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber (C1 – C7) (68952-81-8)**	**SPONSORED CHEMICAL Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking (C1 – C7) (68952-82-9)**
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)				
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data 43.7 (RA)				
Acute Dermal Toxicity LD_{50} (mg/kg)	No Data > 2000 (RA)				
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)				
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data NOAEC = 0.10 LOAEC = 0.96 (RA)				
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) Reproductive Toxicity	No data NOAEC = 1230 LOAEC = 3990 (RA)				

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene (continued)

Endpoints	SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich (C1 – C6) (68477-79-2)	SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off (C1 – C7) (68513-15-5)	SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products (C1 – C7) (68919-16-4)	SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber (C1 – C7) (68952-81-8)	SPONSORED CHEMICAL Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking (C1 – C7) (68952-82-9)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)	No Data				
Maternal Toxicity	NOAEC = 0.064				
Developmental Toxicity	NOAEC = 0.032 LOAEC = 0.064 (RA)				
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)				
Genetic Toxicity – Chromosomal Aberrations *In vitro*	No Data Positive (RA)				
Genetic Toxicity – Chromosomal Aberrations *In vivo*	No Data Positive (RA)				

(RA) = Read Across

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data				
Subcategory VI: Hydrocarbon gases, C1-C6 with 1,3-Butadiene and Benzene				
Endpoints	**SPONSORED CHEMICAL Petroleum gases, liquefied (C1 – C8) (68476-85-7)**	**SPONSORED CHEMICAL Petroleum gases, liquefied, sweetened (C1 – C6) (68476-86-8)**	**SPONSORED CHEMICAL Gases (petroleum), C3-4, isobutane-rich (C1 – C6) (68477-33-8)**	**SPONSORED CHEMICAL Tail gas (petroleum), saturate gas plant mixed stream, C4-rich (C1 – C7) (68478-32-0)**
Acute Oral Toxicity LD_{50} (mg/kg)	No Data $1059 < LD_{50} < 1655$ (RA)			
Acute Inhalation Toxicity LC_{50} (mg/L)	No Data 43.7 (RA)			
Acute Dermal Toxicity LD_{50} (mg/kg-bw)	No Data > 2000 (RA)			
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	No Data NOAEL = 14.9 LOAEL = 148.6 (RA)			
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	**(rat) NOAEC = 10,000 (highest concentration tested)**	No Data NOAEC = 10,000 (RA)	No Data NOAEC = 9148 (RA)	No Data NOAEC = 10,000 (RA)

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data				
Subcategory VI: Hydrocarbon gases, C1-C6 with 1,3-Butadiene and Benzene				
Endpoints	**SPONSORED CHEMICAL Petroleum gases, liquefied (C1 – C8)** **(68476-85-7)**	**SPONSORED CHEMICAL Petroleum gases, liquefied, sweetened (C1 – C6)** **(68476-86-8)**	**SPONSORED CHEMICAL Gases (petroleum), C3-4, isobutane-rich (C1 – C6)** **(68477-33-8)**	**SPONSORED CHEMICAL Tail gas (petroleum), saturate gas plant mixed stream, C4-rich (C1 – C7)** **(68478-32-0)**
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) **Reproductive Toxicity**	In the 13-week inhalation study, an increased incidence in the percent of abnormal sperm was observed at 9996 ppm in rats.	No Data (rat) NOAEC = 1230 LOAEC = 3990 (mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (RA)	No Data (rat) NOAEC = 1230 LOAEC = 3990 (mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (RA)	No Data (rat) NOAEC = 1230 LOAEC = 3990 (mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (RA)
Developmental Toxicity NOAEC/LOAEC Inhalation (mg/L/day) **Maternal Toxicity** **Developmental Toxicity**	**(rat)** **NOAEC ~ 19 (highest concentration tested)** **NOAEC ~ 19 (highest concentration tested)**	No Data NOAEC ~ 19 (RA) No Data NOAEC ~ 19 (RA)	No Data NOAEC = Not Established LOAEC = 200 ppm NOAEC = Not established LOAEC = 40 ppm (RA)	No Data NOAEC ~ 19 (RA) No Data NOAEC ~ 19 (RA)
Genetic Toxicity – Gene Mutation *In vitro*	No Data Positive (RA)			
Genetic Toxicity – Chromosomal Aberrations *In vivo*	**Negative**	No Data Negative (RA)		

Measured data in bold text; (RA) = Read Across; (m) = male; (f) = female

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Endpoints	SUPPORTING CHEMICAL Ethylene (C2) (74-85-1)	SUPPORTING CHEMICAL 1-Butene (C4) (106-98-9)	SUPPORTING CHEMICAL 2-Butene (C4) (107-01-7)	SUPPORTING CHEMICAL 1-Propene, 2-methyl- (C4) (115-11-7)	SUPPORTING CHEMICAL Light catalytic cracked naphtha (C4 – C12) (64741-55-5)	SUPPORTING CHEMICAL Sweetened naphtha (C4 – C12) (64741-87-3)	SUPPORTING CHEMICAL Gasoline (C4 – C12) (86290-81-5)	SUPPORTING CHEMICAL 1,3-Butadiene (C4) (106-99-0)	SUPPORTING CHEMICAL Benzene (C6) (71-43-2)
Acute Oral Toxicity LD_{50} (mg/kg)	–	–	–	–	–	–	–	–	**(rat) 810-10,000**
Acute Inhalation Toxicity Rat LC_{50} (mg/L)	–	–	**> 23.1**	**180,000 ppm (mouse) 270,000 ppm (rat)**	**> 5.28**	**> 5.2**	–	**285**	**43.7**
Repeated-Dose Toxicity NOAEL/LOAEL Oral (mg/kg-bw/day)	–	–	–	**NOAEL = 14.86 LOAEL = 148.55**	–	–	–	**–**	–
Repeated-Dose Toxicity NOAEC/LOAEC Inhalation (ppm/day)	**(rat) NOAEC = 10,000 (highest concentration tested)**	**(rat) NOAEC = 8000 (highest concentration tested)**	**(rat) NOAEC = 5009 (highest concentration tested)**	**(rat) NOAEC = 7970 (highest concentration tested) (mouse) NOAEC = 7980 (highest concentration tested**	–	–	**(rat; mg/L) NOAEC = 20.3 (highest concentration tested)**	**(rat; ppm) NOAEC=7886 (highest concentration tested) (mouse) NOAEC=625 LOAEC=1250**	**(rat; mg/L) NOAEC = 0.10 LOAEC = 0.96**
Reproductive Toxicity NOAEC/LOAEC Inhalation (ppm/day) Reproductive Toxicity	**(rat) NOAEC = 5000 (highest concentration tested)**	**(rat) NOAEC = 8000 (highest concentration tested)**	**(rat) NOAEC = 5009 (highest concentration tested)**	A decrease in sperm motility was observed at 7970 ppm in a 14-wk inhalation repeated-dose toxicity study in rats.	–	–	**(rat; mg/L) NOAEL = 20.0 (highest concentration tested)**	**(mouse – 28-day) NOAEC = 12.5 LOAEC = 65 (mouse – 2-year) NOAEC(f) = Not Established LOAEC(f) = 6.25 NOAEC(m) = 200 LOAEC (m) = 625 (rat) NOAEC = 13.3 mg/L/day (highest concentration tested)**	Effects on male and female reproductive organs observed at 0.96 mg/L in 13-week inhalation repeated-dose toxicity study in mice.

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program – Human Health Data

Endpoints	SUPPORTING CHEMICAL Ethylene (C2) (74-85-1)	SUPPORTING CHEMICAL 1-Butene (C4) (106-98-9)	SUPPORTING CHEMICAL 2-Butene (C4) (107-01-7)	SUPPORTING CHEMICAL 1-Propene, 2-methyl- (C4) (115-11-7)	SUPPORTING CHEMICAL Light catalytic cracked naphtha (C4 – C12) (64741-55-5)	SUPPORTING CHEMICAL Sweetened naphtha (C4 – C12) (64741-87-3)	SUPPORTING CHEMICAL Gasoline (C4 – C12) (86290-81-5)	SUPPORTING CHEMICAL 1,3-Butadiene (C4) (106-99-0)	SUPPORTING CHEMICAL Benzene (C6) (71-43-2)
Developmental Toxicity NOAEC/LOAEC Inhalation (ppm/day)	**(rat) NOAEC = 5000 (highest concentration tested)**	**(rat) NOAEC = 8000 (highest concentration tested)**	**(rat) NOAEC = 5009 (highest concentration tested)**	**(rat) NOAEC = 18.4 mg/L/day (highest concentration tested)**	–	–	**(mouse) NOAEC = 10.6 LOAEC = 20.9**	**(rat) NOAEC = Not Established LOAEC = 200**	**(rat; mg/L) NOAEC = 0.96 (highest concentration tested)**
Maternal Toxicity					–	–	**NOAEC = 2.9 LOAEC = 10.6**	**NOAEC = Not Established LOAEC = 200**	**NOAEC = 0.096 LOAEC = 0.96**
Developmental Toxicity	**NOAEC = 5000 (highest concentration tested)**	**NOAEC = 8000 (highest concentration tested)**	**NOAEC = 5009 (highest concentration tested)**	**NOAEC = 18.4 mg/L/day (highest concentration tested)**				**(mouse) NOAEC = Not Established LOAEC = 200**	**(mouse; mg/L) NOAEC = 0.064 (highest concentration tested)**
Maternal Toxicity								**NOAEC = Not Established LOAEC = 40**	**NOAEC = 0.032 LOAEC = 0.064**
Developmental Toxicity									
Genetic Toxicity – Gene Mutation *In vitro*	**Negative**	**Negative**	**Negative**	**Negative**	–	–	**Negative**	**Positive**	**Positive**
Genetic Toxicity – Chromosomal Aberrations *In vitro*	**Negative**	–	**Negative**	–	–	–	**Positive**	**Positive**	**Positive**
Genetic Toxicity – Chromosomal Aberrations *In vivo*	**Negative**	**Negative**	–	**Negative**	–	–	–	**Positive**	**Positive**
Additional Information									
Skin Irritation	–	–	–	–	–	–	**Not irritating**	**Slightly Irritating**	–
Carcinogenicity	**Equivocal**	–	–	**Positive (male rats) Negative (female rats and mice of both sexes)**	–	–		–	**Positive**

Measured data in bold text; **–** indicates that endpoint was not addressed for this chemical

4. Hazard to the Environment

A summary of aquatic toxicity data submitted for SIDS endpoints is provided in Table 6. The table also indicates where data for tested category members are read-across (RA) to untested members of the category.

Sponsored Chemicals

The C1 - C4 hydrocarbons and the hydrocarbon gases, C1 – C6 with or without 1,3-butadiene are gaseous at environmentally relevant temperatures. If released into the environment they are expected to partition largely to air and aquatic toxicity is not expected. No aquatic toxicity testing was conducted for these chemicals.

Acute Toxicity to Fish

Pentane (CASRN 109-66-0)
(1) Rainbow trout (*Oncorhynchus mykiss)* were exposed to CASRN 109-66-0 for 96 hours. (http://ecb.jrc.it/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/n-pentanereport043.pdf)
96-h LC_{50} = 4.26 mg/L

(2) Coho salmon (*Oncorhynchus kisutch*) were exposed to CASRN 109-66-0 for 96 hours. pH = 8, temperature = 8 ° C, salinity = 30 ppt, and DO = 7 – 10.5 mg/L.
96-h LC_{50} = 100 mg/L (Morrow et al. 1975)

2-Butene, 2-methyl- (CASRN 513-35-9)
Rainbow trout (*Oncorhynchus mykiss*) were exposed to CASRN 513-35-9 at nominal concentrations of 0, 2.13, 4.7, 10.3, 22.7 or 50 mg/L under static renewal conditions for 96 hours. Mean measured concentrations were 0, 1.67, 2.93, 5.33, 8.51 and 25.9 mg/L. Mortality was observed at concentrations ≥ 5.33 mg/L. One hundred percent mortality was observed at ≥ 8.51 mg/L. (http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf)
96-h LC_{50} = 4.99 mg/L

Acute Toxicity to Aquatic Invertebrates

Pentane (CASRN 109-66-0)
Daphnia magna were exposed to CASRN 109-66-0 for 48 hours. (http://ecb.jrc.it/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/n-pentanereport043.pdf)
48-h EC_{50} = 2.7 mg/L

2-Butene, 2-methyl- (CASRN 513-35-9)
Daphnia magna were exposed to CASRN 513-35-9 at nominal concentrations of 2.13, 4.7, 10.3, 22.7 or 50 mg/L under static conditions for 48 hours. Mean measured concentrations were 0.691, 1.74, 2.95, 6.63 and 23.6 mg/L. Immobilization was observed at ≥ 2.95 mg/L. One hundred percent immobilization was observed at ≥ 6.63 mg/L.

(http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf)
48-h EC_{50} = 3.84 mg/L

Cyclopentane (CASRN 287-92-3)
Daphnia magna were exposed to CASRN 287-92-3 at unspecified concentrations under static conditions in sealed chambers for 48 hours.
(C5 aliphatic hydrocarbon solvents category; http://webnet.oecd.org/hpv/UI/handler.axd?id=b2243087-cb08-4f47-bd24-9df8ca840c7d)
48-h EC_{50} = 10.5 mg/L

Toxicity to Aquatic Plants

Pentane (CASRN 109-66-0)
Green algae (*Pseudokirchneriella subcapitata*) were exposed to CASRN 109-66-0 for 72 hours.
(http://ecb.jrc.it/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/n-pentanereport043.pdf)
72-h EC_{50} = 7.5 mg/L (biomass)
72-h EC_{50} = 10.7 mg/L (growth rate)

2-Butene, 2-methyl- (CASRN 513-35-9)
Green algae (*Pseudokirchneriella subcapitata*) were exposed to CASRN 513-35-9 for 96 hours.
(http://www.chem.unep.ch/irptc/sids/OECDSIDS/513359.pdf)
72-h EC_{50} = 10.5 mg/L (biomass)
72-h EC_{50} = 12.0 mg/L (growth rate)

Supporting Chemicals

Acute Toxicity to Fish

Ethylene (CASRN 74-85-1, supporting chemical)
No acute toxicity data to fish is available for CASRN 74-85-1. ECOSAR (v. 1.00a) was used to estimate toxicity.
96-h LC_{50} = 95.7 mg/L

Benzene (CASRN 71-43-2, supporting chemical)
(1) Rainbow trout (*Oncorhynchus mykiss*) were exposed to benzene at unspecified concentrations under flow-through conditions for 96 hours. (http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
96-h LC_{50} = 5.3 mg/L

(2) Bluegill sunfish (*Lepomis macrochirus*) were exposed to benzene at unspecified concentrations under static conditions for 96 hours.
(http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
96-h LC_{50} = 22.49 mg/L

(3) Coho salmon (*Oncorhynchus kisutch*) were exposed to benzene at unspecified concentrations under static conditions for 96 hours.
(http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
96-h LC_{50} = 12.4 mg/L

(4) Fathead minnow (*Pimephales promelas*) were exposed to benzene at unspecified concentrations under static conditions for 96 hours.
(http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
96-h LC_{50} = 12.6 mg/L

Acute Toxicity to Aquatic Invertebrates

Ethylene (CASRN 74-85-1, supporting chemical)
No acute toxicity data for aquatic invertebrates is available for CASRN 74-85-1. ECOSAR (v. 1.00a) was used to estimate toxicity.
48-h EC_{50} = 48.4 mg/L

Benzene (CASRN 71-43-2, supporting chemical)
Daphnia magna were exposed to CASRN 71-43-2 for 48 hours.
(http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
48-h EC_{50} = 10 mg/L

Toxicity to Aquatic Plants

Ethylene (CASRN 74-85-1, supporting chemical)
Green algae (*Pseudokirchneriella subcapitata*) were exposed to CASRN 74-85-1 at nominal concentrations of 8.2 – 131 mg/L for 72 hours. Mean measured concentrations were 3.3, 7.8, 13.9, 32 and 58 mg/L. Growth inhibition was observed at concentrations ≥ 32 mg/L. During the 72 hour exposure period there was a loss of ethylene in the range of 64-91 %; however, in calculation of results the mean measured ethylene concentration was used.
(http://www.chem.unep.ch/irptc/sids/OECDSIDS/74851.pdf)
72-h EC_{50} (biomass) = 40 mg/L
72-h EC_{50} (growth) = 72 mg/L

Benzene (CASRN 71-43-2)
Green algae *(Pseudokirchneriella subcapitata)* were exposed to CASRN 71-43-2 for 72 hours.
(http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba and http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/benzenereport063.pdf)
72h-EC_{50}= 28 mg/L (biomass)

Chronic Toxicity to Fish

Benzene (CASRN 71-43-2, supporting chemical)
Fathead minnow *(Pimephales promelas)* were exposed to CASRN 71-43-2. No other information was given: http://webnet.oecd.org/hpv/UI/handler.axd?id=b09084f6-37fd-4969-b474-cbe687e5f2ba
32d-NOEC = 0.8 mg/L

Conclusion: The 96-h LC_{50} value for acute toxicity to fish for CASRN 109-66-0 is 4.26 mg/L: values for CASRNs 513-35-9 and 71-43-2 (supporting chemical) are within this range. The 48-h EC_{50} values for acute toxicity to aquatic invertebrates range from 2.7 mg/L (CASRN 109-66-0) to 10.5 mg/L (CASRN 287-92-3): values for CASRNs 513-35-9 and 74-85-1 (supporting chemical) are within this range. The 72-h EC_{50} values for aquatic plants range from 7.5 (CASRN 109-66-0) to 28 mg/L (CASRN 71-43-2, supporting chemical) for biomass and 10.7 (CASRN 109-66-0) to 72 mg/L (CASRN 74-85-1, supporting chemical) for growth rate. The 32-d NOEC chronic toxicity to fish for the supporting chemical, CASRN 71-43-2 is 0.8 mg/L.

5. References

Morrow, J.E., Gritz, R.L., and Kirton, M.P. 1975. Effects of some components of Crude Oil on Young Coho Salmon. Copeia 2: 326 – 331.

Table 6. Summary Table of the Screening Information Data Set as submitted under the U.S. HPV Challenge Program – Aquatic Toxicity Data									
Endpoints	**SPONSORED CHEMICAL Natural gas (C1 – C4) (8006-14-2)**	**SPONSORED CHEMICAL Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer (C1 – C4) (68308-11-2)**	**SPONSORED CHEMICAL Natural gas, dried (C1 – C4 (68410-63-9)**	**SPONSORED CHEMICAL Alkanes, C1 – 2 (68475-57-0)**	**SPONSORED CHEMICAL Alkanes, C2 – 3 (68475-58-1)**	**SPONSORED CHEMICAL Alkanes, C3 – 4 (68475-59-2)**	**SPONSORED CHEMICAL Hydrocarbons, C2 – 4, C3-rich (68476-49-3)**	**SPONSORED CHEMICAL Gases (petroleum), C2 – 3 (68477-70-3)**	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads (C1 – C4) (68477-86-1)**
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								
Endpoints	**SPONSORED CHEMICAL Gases (petroleum), deethanizer overheads, C3-rich (C1 – C4) (68477-88-3)**	**SPONSORED CHEMICAL Gases (petroleum), depropanizer dry, propene-rich (C1 – C4) (68477-90-7)**	**SPONSORED CHEMICAL Hydrocarbons, C1 – 3 (68527-16-2)**	**SPONSORED CHEMICAL Hydrocarbons, C3 (68606-26-8)**	**SPONSORED CHEMICAL Fuel gases, refinery, hydrogen sulfide-free (C1 – C4) (68918-98-9)**	**SPONSORED CHEMICAL Gases (petroleum), fluidized catalytic cracker splitter overheads (C1 – C4) (68919-20-0)**	**SPONSORED CHEMICAL Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead (C1 – C4) (68955-34-0)**	**SPONSORED CHEMICAL Gases (petroleum), C3 – 4 (68131-75-9)**	**SPONSORED CHEMICAL Gases (petroleum), gas recovery plant depropanizer overheads (C1 – C4) (68477-94-1)**
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

(RA) = Read-Across

Table 6. Summary Table of the Screening Information Data Set as submitted under the U.S. HPV Challenge Program – Aquatic Toxicity Data (*continued*)

Endpoints	SPONSORED CHEMICAL Hydrocarbons, C1 – 4 (68514-31-8)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, sweetened (68514-36-3)	SPONSORED CHEMICAL Hydrocarbons, C2 – 4 (68606-25-7)	SPONSORED CHEMICAL Hydrocarbons, C4-unsatd. (68956-54-7)	SPONSORED CHEMICAL Tail gas (petroleum), distn., hydrogen sulfide-free (C1 – C6) (68308-02-1)	SPONSORED CHEMICAL Tail gas (petroleum), gas oil catalytic cracking absorber (C1 – C6) (68308-03-2)	SPONSORED CHEMICAL Tail gas (petroleum), gas recovery plant (C1 – C6) (68308-04-3)	SPONSORED CHEMICAL Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free (C1 – C6) (68308-06-5)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4 (68514-31-8)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), isomerized naphtha fractionation stabilizer (C1 – C6) (68308-08-7)	SPONSORED CHEMICAL Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free (C1 – C6) (68308-09-8)	SPONSORED CHEMICAL Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free (C1 – C6) (68308-10-1)	SPONSORED CHEMICAL Alkanes, C4 – 5 (68475-60-5)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4 (68476-40-4)	SPONSORED CHEMICAL Hydrocarbons, C4 – 5 (68476-42-6)	SPONSORED CHEMICAL Gases (petroleum), butane splitter overheads (C1 – C6) (68477-69-0)	SPONSORED CHEMICAL Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich (C1 – C6) (68477-76-9)	SPONSORED CHEMICAL Residual oils (petroleum), propene purifn. splitter (C1 – C6) (68478-19-3)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

(RA) = Read-Across

Table 6. Summary Table of the Screening Information Data Set as submitted under the U.S. HPV Challenge Program – Aquatic Toxicity Data (*continued*)

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich (C1 – C6) (68478-33-1)	SPONSORED CHEMICAL Fuel gases, saturate gas unit fractionater-absorber overheads (C1 – C6) (68513-12-2)	SPONSORED CHEMICAL Gases (petroleum), light straight-run naphtha stabilizer off (C1 – C7) (68513-17-7)	SPONSORED CHEMICAL Gases (petroleum), crude oil fractionation off (C1 – C6) (68918-99-0)	SPONSORED CHEMICAL Gas (petroleum), dehexanizer off (C1 – C6) (68919-00-6)	SPONSORED CHEMICAL Gases (petroleum), light straight run gasoline fractionation stabilizer off (C1 – C6) (68919-05-1)	SPONSORED CHEMICAL Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed (C1 – C6) (68477-83-8)	SPONSORED CHEMICAL Gases (petroleum), C4-rich (C1 – C6) (68477-85-0)	SPONSORED CHEMICAL Gases (petroleum), deisobutanizer tower overheads (C1 – C6) (68477-87-2)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

Endpoints	SPONSORED CHEMICAL Gases (petroleum), depropanizer overheads (C1 – C6) (68477-91-8)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator (C1 – C6) (68478-24-0)	SPONSORED CHEMICAL Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer (C1 – C6) (68478-26-2)	SPONSORED CHEMICAL Tail gas (petroleum), vacuum residues thermal cracker (C1 – C6) (68478-34-2)	SPONSORED CHEMICAL Hydrocarbons, C3 – 4-rich, petroleum distillate (C1 – C6) (68512-91-4)	SPONSORED CHEMICAL Butane, branched and linear (C1 – C6) (68513-65-5)	SPONSORED CHEMICAL Residues (petroleum), alkylation splitter, C4-rich (C1 – C6) (68513-66-6)	SPONSORED CHEMICAL Hydrocarbons, C1 – 4, debutanizer fraction (C1 – C6) (68527-19-5)	SPONSORED CHEMICAL Gases (petroleum), C1 – 5, wet (C1 – C6) (68602-83-5)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

(RA) = Read-Across

Table 6. Summary Table of the Screening Information Data Set as submitted under the U.S. HPV Challenge Program – Aquatic Toxicity Data (*continued*)

Endpoints	SPONSORED CHEMICAL Hydrocarbons, C4, butane concentrator by-product (C1 – C6) (68606-24-6)	SPONSORED CHEMICAL Gases (petroleum), alkylation feed (C1 – C6) (68606-27-9)	SPONSORED CHEMICAL Gases (petroleum), depropanizer bottoms fractionation off (C1 – C6) (68606-34-8)	SPONSORED CHEMICAL Fuel gases, refinery, sweetened (C1 – C6) (68783-61-9)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracking (C1 – C6) (68783-64-2)	SPONSORED CHEMICAL Gases (petroleum), C2 – 4, sweetened (C1 – C6) (68783-65-3)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracked naphtha debutanizer (C1 – C6) (68952-76-1)	SPONSORED CHEMICAL Gases (petroleum), light steam-cracked, butadiene conc. (C1 – C6) (68955-28-2)	SPONSORED CHEMICAL Residues (petroleum), catalytic cracking depropanizer, C4-rich (C1 – C6) (71329-37-8)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 10.7 7.5 (RA)								

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber (C1 – C6) (71808-30-5)	SPONSORED CHEMICAL Gases (petroleum), naphtha unifiner desulfurization stripper off (C1 – C6) (68919-06-2)	SPONSORED CHEMICAL Gases (petroleum), straight-run stabilizer off (C1 – C6) (68919-10-8)	SPONSORED CHEMICAL Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking (C1 – C7) (68952-82-9)	SPONSORED CHEMICAL Petroleum gases, liquefied (C1 – C8) (68476-85-7)	SPONSORED CHEMICAL Petroleum gases, liquefied, sweetened (C1 – C6) (68476-86-8)	SPONSORED CHEMICAL Gases (petroleum), C3-4, isobutane-rich (C1 – C6) (68477-33-8)	SPONSORED CHEMICAL Tail gas (petroleum), saturate gas plant mixed stream, C4-rich (C1 – C7) (68478-32-0)	SPONSORED CHEMICAL Tail gas (petroleum), thermal cracking absorber (C1 – C6) (71808-30-5)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

(RA) = Read-Across

Table 6. Summary Table of the Screening Information Data Set as submitted under the U.S. HPV Challenge Program – Aquatic Toxicity Data (*continued*)

Endpoints	SPONSORED CHEMICAL Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free (C1 – C7) (68308-12-3)	SPONSORED CHEMICAL Hydrocarbons, C4 and higher (C1 – C8) (68476-44-8)	SPONSORED CHEMICAL Waste gases, vent gas, C1 – 6 (C1 – C7) (68477-25-8)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracker (C1 – C7) (68477-74-7)	SPONSORED CHEMICAL Gases (petroleum), catalytic cracker, C1 – 5-rich (C1 – C6) (68477-75-8)	SPONSORED CHEMICAL Gases (petroleum), catalytic reformer, C1 – 4-rich (C1 – C6) (68477-79-2)	SPONSORED CHEMICAL Gases (petroleum), full-range straight-run naphtha dehexanizer off (C1 – C7) (68513-15-5)	SPONSORED CHEMICAL Hydrocarbons, C3 – 6, catalytic alkylation by-products (C1 – C7) (68919-16-4)	SPONSORED CHEMICAL Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber (C1 – C7) (68952-81-8)
Fish 96-h LC_{50} (mg/L)	No Data 4.26 (RA)								
Aquatic Invertebrates 48-h EC_{50} (mg/L)	No Data 2.7 (RA)								
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	No Data 7.5 10.7 (RA)								

Endpoints	SPONSORED CHEMICAL Pentane (C5) (109-66-0)	SPONSORED CHEMICAL Cyclopentane (C5) (287-92-3)	SPONSORED CHEMICAL 2-Butene, 2-methyl- (C5) (513-35-9)	SUPPORTING CHEMICAL Ethylene (C2) (74-85-1)	SUPPORTING CHEMICAL Benzene (C6) (71-43-2)
Fish 96-h LC_{50} (mg/L)	**4.26**	No Data 4.26 (RA)	**4.99**	**–**	**5.3 – 22.5**
Aquatic Invertebrates 48-h EC_{50} (mg/L)	**2.7**	**10.5**	**3.84**	–	**10**
Aquatic Plants 72-h EC_{50} (mg/L) biomass growth rate	**7.5** **10.7**	No Data 7.5 10.7 (RA)	**10.5** **12.0**	**40** **72**	**28** –

measured data in bold (i.e., derived from testing); (RA) = Read-Across; – indicates endpoint not addressed for this chemical

APPENDIX

The following pages show:

- Table 7 with a list of the sponsored substances and the supporting chemicals
- Table 8 with a list of the major constituents in the category streams
- Table 9 with a list of representative structures
- Explanation and figure(s) showing how the petroleum hydrocarbon gases category streams are made and used (taken from

"Petroleum Hydrocarbon Gases Category Analysis and Hazard Characterization" document: http://www.epa.gov/chemrtk/pubs/summaries/ptrlgas/c13224rt2.pdf)

Table 7. Petroleum Hydrocarbon Gases Category	
CASRN	**CA Index Name**
Subcategory I – Hydrocarbon gases, C1-C4 – Sponsored Chemicals	
74-82-8	Methane
74-84-0	Ethane
74-98-6	Propane
115-07-1	1-Propene
75-28-5	Propane, 2-methyl-
106-97-8	Butane
8006-14-2	Natural gas
68410-63-9	Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer
68308-11-2	Natural gas, dried
68475-57-0	Alkanes, C1 – 2 (non-HPV)
68475-58-1	Alkanes, C2 – 3
68475-59-2	Alkanes, C3 – 4
68476-49-3	Hydrocarbons, C2 – 4, C3-rich
68477-70-3	Gases (petroleum), C2 – 3
68477-86-1	Gases (petroleum), deethanizer overheads
68477-88-3	Gases (petroleum), deethanizer overheads, C3-rich
68477-90-7	Gases (petroleum), depropanizer dry, propene-rich
68527-16-2	Hydrocarbons, C1 – 3
68606-26-8	Hydrocarbons, C3
68918-98-9	Fuel gases, refinery, hydrogen sulfide-free
68919-20-0	Gases (petroleum), fluidized catalytic cracker splitter overheads
68955-34-0	Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead
Subcategory II – Hydrocarbon gases, C1-C4 with 1,3-butadiene – Sponsored Chemicals	
68131-75-9	Gases (petroleum), C3 – 4
68477-94-1	Gases (petroleum), gas recovery plant depropanizer overheads
68514-31-8	Hydrocarbons, C1 – 4
68514-36-3	Hydrocarbons, C1-4, sweetened
68606-25-7	Hydrocarbons, C2 – 4
68956-54-7	Hydrocarbons, C4-unsatd.
Subcategory III – Hydrocarbon gases, C1-C6 – Sponsored Chemicals	
78-78-4	Butane, 2-methyl-
109-66-0	Pentane
287-92-3	Cyclopentane

Table 7. Petroleum Hydrocarbon Gases Category	
CASRN	**CA Index Name**
513-35-9	2-Butene, 2-methyl-
68308-02-1	Tail gas (petroleum), distn., hydrogen sulfide-free (non-HPV)
68308-03-2	Tail gas (petroleum), gas oil catalytic cracking absorber
68308-04-3	Tail gas (petroleum), gas recovery plant
68308-06-5	Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free
68308-08-7	Tail gas (petroleum), isomerized naphtha fractionation stabilizer
68308-09-8	Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free (non-HPV)
68308-10-1	Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free
68475-60-5	Alkanes, C4 – 5
68476-40-4	Hydrocarbons, C3 – 4
68476-42-6	Hydrocarbons, C4 – 5
68477-69-0	Gases (petroleum), butane splitter overheads
68477-76-9	Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich (non-HPV)
68478-19-3	Residual oils (petroleum), propene purification splitter
68478-33-1	Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich
68513-12-2	Fuel gases, saturate gas unit fractionater-absorber overheads
68513-17-7	Gases (petroleum), light straight-run naphtha stabilizer off
68918-99-0	Gases (petroleum), crude oil fractionation off
68919-00-6	Gas (petroleum), dehexanizer off (non-HPV)
68919-05-1	Gases (petroleum), light straight run gasoline fractionation stabilizer off
68919-06-2	Gases (petroleum), naphtha unifiner desulfurization stripper off
68919-10-8	Gases (petroleum), straight-run stabilizer off
68919-19-7	Gases (petroleum), fluidized catalytic cracker splitter residues
Subcategory IV – Hydrocarbon gases, C1-C6 with 1,3-butadiene – Sponsored Chemicals	
68307-98-2	Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber
68307-99-3	Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer (non-HPV)
68308-05-4	Tail gas (petroleum), gas recovery plant deethanizer
68409-99-4	Gases (petroleum), catalytic cracked overheads
68476-54-0	Hydrocarbons, C3 – 5, polymn. unit feed
68477-42-9	Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich
68477-71-4	Gases (petroleum), catalytic-cracked gas oil depropanizerbottoms, C4-rich acid-

Table 7. Petroleum Hydrocarbon Gases Category	
CASRN	**CA Index Name**
	free
68477-72-5	Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich
68477-73-6	Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free
68477-83-8	Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed
68477-85-0	Gases (petroleum), C4-rich
68477-87-2	Gases (petroleum), deisobutanizer tower overheads
68477-91-8	Gases (petroleum), depropanizer overheads
68478-24-0	Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator
68478-26-2	Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer
68478-34-2	Tail gas (petroleum), vacuum residues thermal cracker
68512-91-4	Hydrocarbons, C3 – 4-rich, petroleum distillate
68513-65-5	Butane, branched and linear
68513-66-6	Residues (petroleum), alkylation splitter, C4-rich
68527-19-5	Hydrocarbons, C1 – 4, debutanizer fraction
68602-83-5	Gases (petroleum), C1 – 5, wet
68606-24-6	Hydrocarbons, C4, butane concentrator by-product
68606-27-9	Gases (petroleum), alkylation feed
68606-34-8	Gases (petroleum), depropanizer bottoms fractionation off
68783-61-9	Fuel gases, refinery, sweetened
68783-64-2	Gases (petroleum), catalytic cracking
68783-65-3	Gases (petroleum), C2 – 4, sweetened
68952-76-1	Gases (petroleum), catalytic cracked naphtha debutanizer
68955-28-2	Gases (petroleum), light steam-cracked, butadiene conc.
71329-37-8	Residues (petroleum), catalytic cracking depropanizer, C4-rich
71808-30-5	Tail gas (petroleum), thermal cracking absorber
Subcategory V – Hydrocarbon gases, C1-C6 with benzene – Sponsored Chemicals	
68308-12-3	Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free
68476-44-8	Hydrocarbons, C4 and higher
68477-25-8	Waste gases, vent gas, C1 – 6
68477-74-7	Gases (petroleum), catalytic cracker
68477-75-8	Gases (petroleum), catalytic cracker, C1 – 5-rich
68477-79-2	Gases (petroleum), catalytic reformer, C1 – 4-rich
68513-15-5	Gases (petroleum), full-range straight-run naphtha dehexanizer off

Table 7. Petroleum Hydrocarbon Gases Category	
CASRN	**CA Index Name**
68919-16-4	Hydrocarbons, C3 – 6, catalytic alkylation by-products
68952-81-8	Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber
68952-82-9	Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking
Subcategory VI – Hydrocarbon gases, C1-C6 with 1,3-butadiene and benzene – Sponsored Chemicals	
68476-85-7	Petroleum gases, liquefied
68476-86-8	Petroleum gases, liquefied, sweetened
68477-33-8	Gases (petroleum), C3 – 4, isobutane-rich
68478-32-0	Tail gas (petroleum), saturate gas plant mixed stream, C4-rich
Supporting Chemicals	
Subcategory I chemicals, where appropriate	
64741-55-5	Naphtha (petroleum), light catalytic cracked
64741-87-3	Naphtha (petroleum), sweetened
86290-81-5	Gasoline
106-98-9	1-Butene
107-01-7	2-Butene
74-85-1	Ethylene
115-11-7	1-Propene, 2-methyl-
71-43-2	Benzene
106-99-0	1,3-Butadiene

Table 8. CHEMICAL COMPOSITION OF SPONSORED SUBSTANCES IN THE PETROLEUM HYDROCARBON GASES CATEGORY[1]

Table 8. Component Compositional Ranges (Wt. %)										
Sponsored Substance	**CASRN**	**C1 – C4 Hydrocarbons**	**C5 – C6 Hydrocarbons**	**C7 Hydrocarbons**	**C8 Hydrocarbons**	**Benzene (71-43-2)**	**1,3-Butadiene (106-99-0)**	**Hydrogen (1333-74-0)**	**Nitrogen (7727-37-9)**	**Carbon dioxide (124-38-9)**
Subcategory I: Hydrocarbon gases, C1 – C4										
Methane	74-82-8	79 – 99	–	–	–	–	–	1 – 20	0 – 1	–
Ethane	74-84-0	100	–	–	–	–	–	–	–	–
Propane	74-98-6	100	–	–	–	–	–	–	–	–
1-Propene	115-07-1	100	–	–	–	–	–	–	–	–
Propane, 2-methyl-	75-28-5	100	–	–	–	–	–	–	–	–
Butane	106-97-8	100	–	–	–	–	–	–	–	–
Natural gas	8006-14-2	89.5 – 94.9	–	–	–	–	–	5 – 10	0.1 – 0.5	–
Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer	68308-11-2	100	–	–	–	–	–	–	–	–
Natural gas, dried	68410-63-9	89.5 – 94.9	–	–	–	–	–	5 – 10	0.1 – 0.5	–
Alkanes, C1 – 2	68475-57-0	98 – 100	–	–	–	–	–	0 – 2	–	–
Alkanes, C2 – 3	68475-58-1	100	–	–	–	–	–	–	–	–
Alkanes, C3 – 4	68475-59-2	100	–	–	–	–	–	–	–	–
Hydrocarbons, C2 – 4, C3-rich	68476-49-3	100	–	–	–	–	–	–	–	–
Gases (petroleum), C2 – 3	68477-70-3	100	–	–	–	–	–	–	–	–
Gases (petroleum), deethanizer overheads	68477-86-1	93 – 100	–	–	–	–	–	0 – 5	–	0 – 2
Gases (petroleum), deethanizer overheads, C3-rich	68477-88-3	95 – 100	–	–	–	–	–	0 – 5	–	–
Gases (petroleum), depropanizer dry, propene-rich	68477-90-7	93 – 100	–	–	–	–	–	0 – 5	–	0 – 2
Hydrocarbons, C1 – 3	68527-16-2	95 – 100	–	–	–	–	–	0 – 5	–	–
Hydrocarbons, C3	68606-26-8	100	–	–	–	–	–	–	–	–
Fuel gases, refinery, hydrogen sulfide-free	68918-98-9	85 – 99	–	–	–	–	–	1 – 15	–	–
Gases (petroleum), fluidized catalytic cracker splitter overheads	68919-20-0	100	–	–	–	–	–	–	–	–

[1] Chemical compositions are based on limited historical (1992 – 2002) data from several U.S. petrochemical and petroleum company refineries in the Gulf Coast and mid-continent areas.

Table 8. Component Compositional Ranges (Wt. %)										
Sponsored Substance	**CASRN**	**C1 – C4 Hydrocarbons**	**C5 – C6 Hydrocarbons**	**C7 Hydrocarbons**	**C8 Hydrocarbons**	**Benzene (71-43-2)**	**1,3-Butadiene (106-99-0)**	**Hydrogen (1333-74-0)**	**Nitrogen (7727-37-9)**	**Carbon dioxide (124-38-9)**
Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead	68955-34-0	100	–	–	–	–	–	–	–	–
Subcategory II: Hydrocarbon gases, C1 – C4 with 1,3-Butadiene										
Gases (petroleum), C3 – 4	68131-75-9	99.9 – 100	–	–	–	–	0 – 0.1	–	–	–
Gases (petroleum), gas recovery plant depropanizer overheads	68477-94-1	94.5 – 100	–	–	–	–	0 – 0.5	0 – 5	–	–
Hydrocarbons, C1 – 4	68514-31-8	92 – 99.8	–	–	–	–	0.1 – 3	0 – 3	–	0 – 1
Hydrocarbons, C1 – 4, sweetened	68514-36-3	97 – 99.9	–	–	–	–	0.1 – 3	–	–	–
Hydrocarbons, C2 – 4	68606-25-7	99 – 100	–	–	–	–	0 – 1	–	–	–
Hydrocarbons, C4-unsatd.	68956-54-7	70 – 90	–	–	–	–	10 – 30	–	–	–
Subcategory III: Hydrocarbon gases, C1 – C6										
Butane, 2-methyl-	78-78-4	–	100	–	–	–	–	–	–	–
Pentane	109-66-0	–	100	–	–	–	–	–	–	–
Cyclopentane	287-92-3	–	100	–	–	–	–	–	–	–
2-Butene, 2-methyl-	513-35-9	–	100	–	–	–	–	–	–	–
Tail gas (petroleum), distn., hydrogen sulfide-free	68308-02-1	64.5 – 83.5	1.5 – 5.5	–	–	–	–	15 – 30	–	–
Tail gas (petroleum), gas oil catalytic cracking absorber	68308-03-2	86 – 98.3	1.7 – 10.5	–	–	–	–	0 – 3	–	0 – 0.5
Tail gas (petroleum), gas recovery plant	68308-04-3	88.5 – 98.2	1.7 – 8	–	–	–	–	0.1 – 3	–	0 – 0.5
Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free	68308-06-5	82 – 98	2 – 18	–	–	–	–	–	–	–
Tail gas (petroleum), isomerized naphtha fractionation stabilizer	68308-08-7	99 – 100	0 – 1	–	–	–	–	–	–	–
Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free	68308-09-8	82 – 98	2 – 18	–	–	–	–	–	–	–
Tail gas (petroleum), straight run distillate hydrodesulfurizer, H_2S free	68308-10-1	98 – 100	0 – 2	–	–	–	–	–	–	–
Alkanes, C4 – 5	68475-60-5	35 – 65	35 – 65	–	–	–	–	–	–	–
Hydrocarbons, C3 – 4	68476-40-4	99 – 100	0 – 1	–	–	–	–	–	–	–

Table 8. Component Compositional Ranges (Wt. %)										
Sponsored Substance	**CASRN**	**C1 – C4 Hydrocarbons**	**C5 – C6 Hydrocarbons**	**C7 Hydrocarbons**	**C8 Hydrocarbons**	**Benzene (71-43-2)**	**1,3-Butadiene (106-99-0)**	**Hydrogen (1333-74-0)**	**Nitrogen (7727-37-9)**	**Carbon dioxide (124-38-9)**
Hydrocarbons, C4 – 5	68476-42-6	33 – 67	33 – 67	–	–	–	–	–	–	–
Gases (petroleum), butane splitter overheads	68477-69-0	98 – 100	0 – 2	–	–	–	–	–	–	–
Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2 – 4-rich	68477-76-9	73 – 95.3	4.7 – 27	–	–	–	–	–	–	–
Residual oils (petroleum), propene purifn. splitter	68478-19-3	95 – 99.5	0.5 – 5	–	–	–	–	–	–	–
Tail gas (petroleum), saturate gas recovery plant, C1 – 2-rich	68478-33-1	75.5 – 93.5	1.5 – 4.5	–	–	–	–	5 – 20	–	–
Fuel gases, saturate gas unit fractionater-absorber overheads	68513-12-2	67 – 89.9	0.1 – 3	–	–	–	–	10 – 30	–	–
Gases (petroleum), light straight-run naphtha stabilizer off	68513-17-7	34 – 82.4	16.6 – 66	0 – 1	–	–	–	–	–	–
Gases (petroleum), crude oil fractionation off	68918-99-0	54 – 92.3	6.7 – 36	–	–	–	–	1 – 10	–	–
Gas (petroleum), dehexanizer off	68919-00-6	58 – 93.3	6.7 – 42	–	–	–	–	–	–	–
Gases (petroleum), light straight run gasoline fractionation stabilizer off	68919-05-1	58 – 93.3	6.7 – 42	–	–	–	–	–	–	–
Gases (petroleum), naphtha unifiner desulfurization stripper off	68919-06-2	98 – 100	0 – 2	–	–	–	–	–	–	–
Gases (petroleum), straight-run stabilizer off	68919-10-8	88 – 99	0 – 2	–	–	–	–	1 – 10	–	–
Gases (petroleum), fluidized catalytic cracker splitter residues	68919-19-7	98 – 100	0 – 2	–	–	–	–	–	–	–
Subcategory IV: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene										
Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber	68307-98-2	96.5 – 99.9	0 – 1	–	–	–	0.1 – 2	0 – 2	–	0 – 0.5
Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer	68307-99-3	92 – 99.4	0 – 1	–	–	–	0.1 – 2	0.5 – 5	–	–
Tail gas (petroleum), gas recovery plant deethanizer	68308-05-4	97 – 99.9	0 – 1	–	–	–	0.1 – 2	–	–	–

Table 8. Component Compositional Ranges (Wt. %)

Sponsored Substance	CASRN	C1 – C4 Hydrocarbons	C5 – C6 Hydrocarbons	C7 Hydrocarbons	C8 Hydrocarbons	Benzene (71-43-2)	1,3-Butadiene (106-99-0)	Hydrogen (1333-74-0)	Nitrogen (7727-37-9)	Carbon dioxide (124-38-9)
Gases (petroleum), catalytic cracked overheads	68409-99-4	65 – 93	7 – 31	–	–	–	0.5 – 4	0 – 3	–	0 – 1
Hydrocarbons, C3 – 5, polymn. unit feed	68476-54-0	61 – 84.5	15.5 – 39	–	–	–	0 – 0.5	–	–	–
Gases (petroleum), extractive, C3 – 5, butane-isobutylene-rich	68477-42-9	82.5 – 97	3 – 16.5	–	–	–	0 – 0.1	–	–	–
Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free	68477-71-4	68 – 93	7 – 32	–	–	–	0.5 – 4	–	–	–
Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3 – 5-rich	68477-72-5	60 – 84.5	15.5 – 40	–	–	–	0 – 0.5	–	–	–
Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free	68477-73-6	99 – 100	0 – 1	–	–	–	0.1 – 2	–	–	–
Gases (petroleum), C3 – 5 olefinic paraffinic alkylation feed	68477-83-8	58.5 – 88.4	11.6 – 39.5	–	–	–	0 – 2	–	–	–
Gases (petroleum), C4-rich	68477-85-0	74 – 98.5	1.5 – 25.5	–	–	–	0 – 0.5	–	–	–
Gases (petroleum), deisobutanizer tower overheads	68477-87-2	94 – 100	0 – 5	–	–	–	0 – 1	–	–	–
Gases (petroleum), depropanizer overheads	68477-91-8	86 – 99	1 – 5	–	–	–	0 – 2	0 – 5	–	0 – 2
Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionator	68478-24-0	67.9 – 93.3	6.7 – 28	–	–	–	0 – 0.1	0 – 3	–	0 – 1
Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer	68478-26-2	91.9 – 99.5	0.5 – 5	–	–	–	0 – 0.1	0 – 3	–	–
Tail gas (petroleum), vacuum residues thermal cracker	68478-34-2	73 – 97	2.5 – 19	–	–	–	0.5 – 4	0 – 3	–	0 – 1
Hydrocarbons, C3 – 4-rich, petroleum distillate	68512-91-4	74 – 98.5	1.5 – 25.5	–	–	–	0 – 0.5	–	–	–
Butane, branched and linear	68513-65-5	97.5 – 100	0 – 2	–	–	–	0 – 0.5	–	–	–
Residues (petroleum), alkylation splitter, C4-rich	68513-66-6	68.5 – 89	11 – 31	–	–	–	0 – 0.5	–	–	–
Hydrocarbons, C1 – 4, debutanizer fraction	68527-19-5	95 – 99.9	0 – 2	–	–	–	0.1 – 3	–	–	–

Table 8. Component Compositional Ranges (Wt. %)										
Sponsored Substance	**CASRN**	**C1 – C4 Hydrocarbons**	**C5 – C6 Hydrocarbons**	**C7 Hydrocarbons**	**C8 Hydrocarbons**	**Benzene (71-43-2)**	**1,3-Butadiene (106-99-0)**	**Hydrogen (1333-74-0)**	**Nitrogen (7727-37-9)**	**Carbon dioxide (124-38-9)**
Gases (petroleum), C1 – 5, wet	68602-83-5	69.5 – 96.8	2.5 – 23	–	–	–	0.1 – 2	0.5 – 5	0.1 – 0.5	–
Hydrocarbons, C4, butane concentrator by-product	68606-24-6	56 – 91.4	8.5 – 40	–	–	–	0.1 – 4	–	–	–
Gases (petroleum), alkylation feed	68606-27-9	93 – 99.9	0 – 2	–	–	–	0.1 – 4	–	–	0 – 1
Gases (petroleum), depropanizer bottoms fractionation off	68606-34-8	68 – 85	0 – 2	–	–	–	15 – 30	–	–	–
Fuel gases, refinery, sweetened	68783-61-9	55 – 90.9	8.5 – 38	–	–	–	0 – 0.5	0.5 – 5	0.1 – 0.5	0 – 1
Gases (petroleum), catalytic cracking	68783-64-2	55 – 92.3	7.6 – 40	–	–	–	0.1 – 4	–	–	0 – 1
Gases (petroleum), C2 – 4, sweetened	68783-65-3	91 – 99.9	0 – 2	–	–	–	0.1 – 4	–	–	–
Gases (petroleum), catalytic cracked naphtha debutanizer	68952-76-1	94.9 – 100	0 – 2	–	–	–	0 – 0.1	0 – 3	–	–
Gases (petroleum), light steam-cracked, butadiene conc.	68955-28-2	38 – 60	0 – 2	–	–	–	40 – 60	–	–	–
Residues (petroleum), catalytic cracking depropanizer, C4-rich	71329-37-8	55 – 91.4	8.1 – 40	–	–	–	0.5 – 5	–	–	–
Tail gas (petroleum), thermal cracking absorber	71808-30-5	76 – 97	2.5 – 19	–	–	–	0.5 – 4	–	–	0 – 1
Subcategory V: Hydrocarbon gases, C1 – C6 with Benzene										
Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free	68308-12-3	26-84.9	15.1-73	0-1		0-1				
Hydrocarbons, C4 and higher	68476-44-8	16.2 – 51	33 – 82.2	1.6 – 15	0 – 1	0 – 1	–	–	–	–
Waste gases, vent gas, C1 – 6	68477-25-8	33 – 77.9	21.1 – 64	0 – 1	–	0 – 1	–	0 – 2	–	–
Gases (petroleum), catalytic cracker	68477-74-7	39.5 – 90.2	7.8 – 57	0.5 – 2	–	0 – 0.5	–	0 – 2	–	0 – 1
Gases (petroleum), catalytic cracker, C1 – 5-rich	68477-75-8	49.8 – 91.8	8.2 – 47	–	–	0 – 0.2	–	0 – 2	–	0 – 1
Gases (petroleum), catalytic reformer, C1 – 4-rich	68477-79-2	87.3 – 97.2	2.8 – 12.5	–	–	0 – 0.2	–	–	–	–
Gases (petroleum), full-range straight-run naphtha dehexanizer off	68513-15-5	36.5 – 82.4	16.6 – 63	0 – 1	–	0 – 0.5	–	–	–	–
Hydrocarbons, C3 – 6, catalytic alkylation by-products	68919-16-4	20.9 – 85.7	11.3 – 78.1	0 – 2	–	1 – 20	–	–	–	–

Table 8. Component Compositional Ranges (Wt. %)										
Sponsored Substance	**CASRN**	**C1 – C4 Hydrocarbons**	**C5 – C6 Hydrocarbons**	**C7 Hydrocarbons**	**C8 Hydrocarbons**	**Benzene (71-43-2)**	**1,3-Butadiene (106-99-0)**	**Hydrogen (1333-74-0)**	**Nitrogen (7727-37-9)**	**Carbon dioxide (124-38-9)**
Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber	68952-81-8	33.3 – 89.7	8.3 – 65	0.5 – 2	–	0 – 0.5	–	0 – 3	–	0 – 1
Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking	68952-82-9	34.5 – 89.7	8.3 – 65	0.5 – 2	–	0 – 0.5	–	–	–	–
Subcategory VI: Hydrocarbon gases, C1 – C6 with 1,3-Butadiene and Benzene										
Petroleum gases, liquefied	68476-85-7	17.2 – 61	18 – 80.1	2.6 – 17	0 – 2	0 – 1	0 – 0.1	–	–	–
Petroleum gases, liquefied, sweetened	68476-86-8	17.2 – 61	39 – 82.8	–	–	0 – 1	0 – 0.1	–	–	–
Gases (petroleum), C3 – 4, isobutane-rich	68477-33-8	76.5 – 96	4 – 22	–	–	0 – 0.5	0 – 1	–	–	–
Tail gas (petroleum), saturate gas plant mixed stream, C4-rich	68478-32-0	67.5 – 96.7	1.3 – 31	0 – 2	–	0 – 0.5	0 – 1	–	–	–

REPRESENTATIVE STRUCTURES OF THE PETROLEUM HYDROCARBON GASES CATEGORY

Note on representative structures: The structures chosen for each category member were largely based on the CAS definition included in the CAS registry name. This was supplemented with any information that could be gleaned from the refinery processes listed in the CAS registry name and from the limited compositional data provided by the sponsor. It should be understood that each category member consists of many hydrocarbon substances, well beyond the three or four substances shown in the Appendix for most members.

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

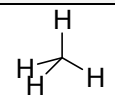
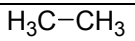
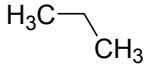
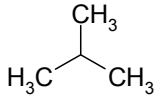
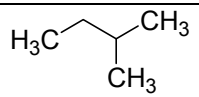
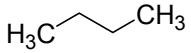
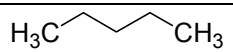
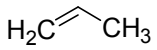
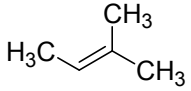
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Methane	74-82-8		C1-C4 = 79 to 99%; Hydrogen = 1 to 20%; Nitrogen = 0 to 1%
Ethane	74-84-0		C1-C4 = 100% tech.grade liquefied products are sold as 99% pure minimum
Propane	74-98-6		C1-C4 = 100% tech.grade liquefied products are sold as 99% pure minimum
Propane, 2-methyl-	75-28-5		C1-C4 = 100% % tech.grade liquefied products are sold as 99% pure minimum
Butane, 2-methyl-	78-78-4		C5-C6 = 100% % tech.grade liquefied products are sold as 99% pure minimum
Butane	106-97-8		C1-C4 = 100% % tech.grade liquefied products are sold as 99% pure minimum
Pentane	109-66-0		C5-C6 = 100% % tech.grade liquefied products are sold as 99% pure minimum
1-Propene	115-07-1		C1-C4 = 100% % tech.grade liquefied products are sold as 99% pure minimum
Cyclopentane	287-92-3		C5-C6 = 100%
2-Butene, 2-methyl-	513-35-9		C5-C6 = 100%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

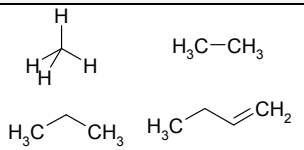
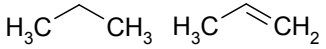
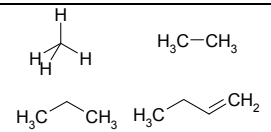
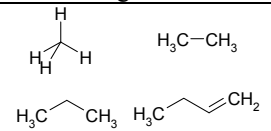
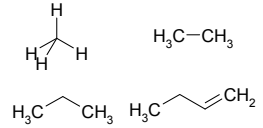
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Natural gas	8006-14-2	 Raw natural gas, as found in nature, or a gaseous combination of hydrocarbons having carbon numbers predominantly in the range of C1 through C4 separated from raw natural gas by the removal of natural gas condensate, natural gas liquid, and natural gas condensate/natural gas.	C1-C4 = 89.5 to 94.9%; Hydrogen = 5 to 10%; Nitrogen = 0.1 to 0.5%
Gases (petroleum), C3 – 4	68131-75-9	 A complex combination of hydrocarbons produced by distillation of products from the cracking of crude oil. It consists of hydrocarbons having carbon numbers in the range of C3 through C4, predominantly of propane and propylene, and boiling in the range of approximately -51°C to -1°C	C1-C4 = 99.9 to 100%; 1,3-Butadiene = 0 to 0.1%
Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber	68307-98-2	 The complex combination of hydrocarbons from the distillation of the products from catalytic cracked distillates and catalytic cracked naphtha. It consists predominantly of hydrocarbons having carbon numbers in the range of C1 through C4.	C1-C4 = 96.5 to 99.9%; C5-C6 = 0 to 1%; Hydrogen = 0 to 2%; Carbon dioxide = 0 to 0.5%; Butadiene = 0.1 to 2%
Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer	68307-99-3	 A complex combination of hydrocarbons from the fractionation stabilization products from polymerization of naphtha. It consists predominantly of hydrocarbons having carbon numbers in the range of C1 through C4.	C1-C4 = 92 to 99.4%. C5-C6 = 0 to 1%; Hydrogen = 0.5 to 5%; Butadiene = 0.1 to 2%
Tail gas (petroleum), distn., hydrogen sulfide-free	68308-02-1	 No description available	C1-C4 = 64.5 to 83.5%; C5-C6 = 1.5 to 5.5%; Hydrogen = 15% to 30%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

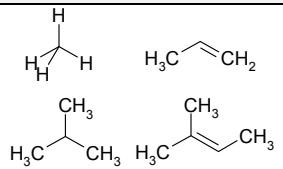
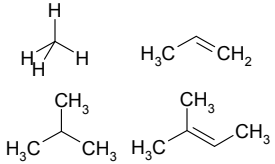
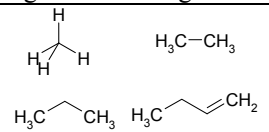
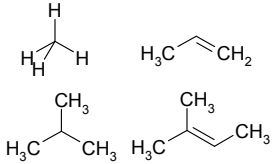
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Tail gas (petroleum), gas oil catalytic cracking absorber	68308-03-2	 A complex combination of hydrocarbons obtained from the distillation of products from the catalytic cracking of gas oil. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5	C1-C4 = 86 to 98.3%; C5-C6 = 1.7 to 10.5%; Hydrogen = 0% to 3%; Carbon dioxide = 0 to 0.5%
Tail gas (petroleum), gas recovery plant	68308-04-3	 A complex combination of hydrocarbons from the distillation of products from miscellaneous hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 88.5 to 98.2%; C5-C6 = 1.7 to 8%; Hydrogen = 0.1% to 3%; Carbon dioxide = 0 to 0.5%
Tail gas (petroleum), gas recovery plant deethanizer	68308-05-4	 A complex combination of hydrocarbons from the distillation of products from miscellaneous hydrocarbon streams. It consists of hydrocarbon having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 97 to 99.9%; C5-C6 = 0 to 1%; Butadiene = 0.1 to 2%
Tail gas (petroleum), hydrodesulfurized distillate and hydrodesulfurized naphtha fractionator, acid-free	68308-06-5	 A complex combination of hydrocarbons obtained from fractionation of hydrodesulfurized naphtha and distillate hydrocarbon streams and treated to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5	C1-C4 = 82 to 98%; C5-C6 = 2 to 18%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

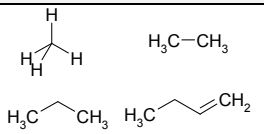
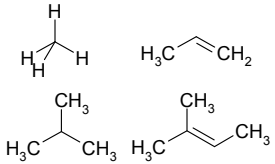
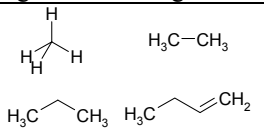
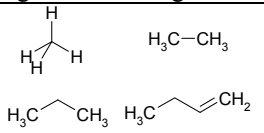
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Tail gas (petroleum), isomerized naphtha fractionation stabilizer	68308-08-7	 A complex combination of hydrocarbons obtained from the fractionation stabilization products from isomerized naphtha. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 99 to 100%; C5-C6 = 0 to 1%
Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free	68308-09-8	 A complex combination of hydrocarbons obtained from fractionation stabilization of light straight run naphtha and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 82 to 98%; C5-C6 = 2 to 18%
Tail gas (petroleum), straight run distillate hydrodesulfurizer, H2S free	68308-10-1	 A complex combination of hydrocarbons obtained from catalytic hydrodesulfurization of straight run distillates and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C4	C1-C4 = 98 to 100%; C5-C6 = 0 to 2%
Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer	68308-11-2	 A complex combination of hydrocarbons obtained from the distillation of the reaction products of propane with propylene. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C4	C1-C4 = 100%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

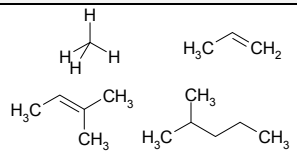
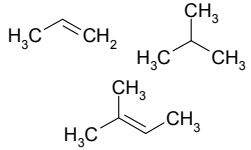
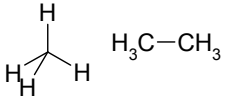
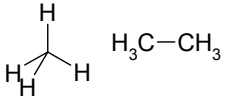
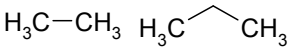
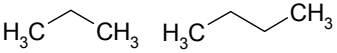
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free	68308-12-3	 A complex combination of hydrocarbons obtained from catalytic hydrodesulfurization of vacuum gas oil and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C6.	C1-C4 = 26 to 84.9%; C5-C6 = 15.1 to 73%; Benzene = 0 to 1% (C7 included in C5-C6; C7 = 0 to 1%)
Gases (petroleum), catalytic cracked overheads	68409-99-4	 A complex combination of hydrocarbons produced by the distillation of products from the catalytic cracking process. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C5 and boiling in the range of approximately 48°C to 32°C.	C1-C4 = 65 to 93%; C5-C6 = 7 to 31%; Hydrogen = 0 to 3%; Carbon dioxide = 0 to 1%; Butadiene = 0.5 to 4%
Natural gas, dried	68410-63-9	 A complex combination of hydrocarbons separated from natural gas. It consists of saturated aliphatic hydrocarbons having carbon numbers in the range of C1 through C4, predominantly methane and ethane.	C1-C4 = 89.5 to 94.9%; Hydrogen = 5 to 10%; Nitrogen = 0.1 to 0.5%
Alkanes, C1-2	68475-57-0	 No description available	C1-C4 = 98 to 100%; Hydrogen = 0 to 2%
Alkanes, C2-3	68475-58-1	 No description available	C1-C4 = 100%
Alkanes, C3-4	68475-59-2	 No description available	C1-C4 = 100%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

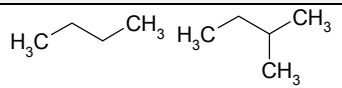
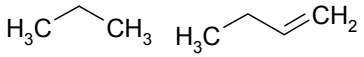
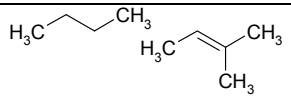
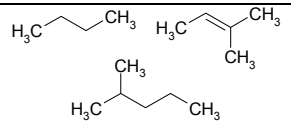
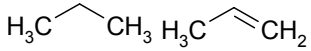
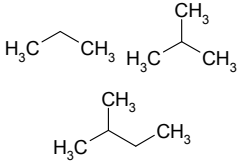
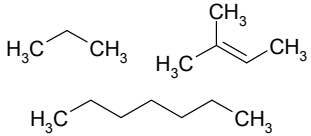
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Alkanes, C4-5	68475-60-5	 No description available	C1-C4 = 35 to 65%; C5-C6 = 35 to 65%
Hydrocarbons, C3-4	68476-40-4	 No description available	C1-C4 = 99 to 100%; C5-C6 = 0 to 1%
Hydrocarbons, C4-5	68476-42-6	 No description available	
Hydrocarbons, C>3	68476-44-8	 No description available	C1-C4 = 16.2 to 51%; C5-C6 = 49 to 83.8 %; Benzene = 0 to 1% (C7 and C8 included in C5-C6; C7 = 1.6 to 15%; C8 = 0 to 1%)
Hydrocarbons, C2-4, C3-rich	68476-49-3	 No description available	C1-C4 = 100%
Hydrocarbons, C3-5, polymn. unit feed	68476-54-0	 A complex combination of hydrocarbons collected from various processes. It consists predominantly of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 to C5 and boiling in the range of approximately –48 °C to 38 °C	C1-C4 = 61 to 84.5%; C5-C6 = 15.5 to 39%; Butadiene = 0 to 0.5%
Petroleum gases, liquefied	68476-85-7	 A complex combination of hydrocarbons produced by the distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C7 and boiling in the range of approximately -40°C to 80°C	C1-C4 = 17.2 to 61%; C5-C6 = 37 to 82.7%; Butadiene = 0 to 0.1%; Benzene = 0 to 1%; Mercaptans = 0.1 - 1% (C7 and C8 included in C5-C6; C7 = 2.6 to 17%; C8 = 0 to 2%)

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

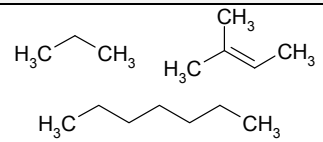
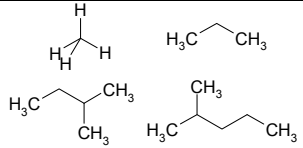
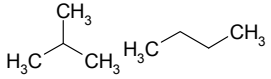
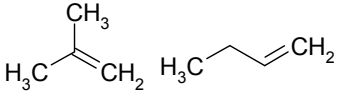
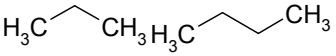
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Petroleum gases, liquefied, sweetened	68476-86-8	 A complex combination of hydrocarbons obtained by subjecting liquefied petroleum gas mix to a sweetening process to convert mercaptans or to remove acidic impurities. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C7 and boiling in the range of approximately -40°C to 80°C	C1-C4 = 17.2 to 61%; C5-C6 = 39 to 82.8%; Butadiene = 0 to 0.1%; Benzene = 0 to 1% (C7 and C8 included in C5-C6; C7 = 2.6 to 17%; C8 = 0 to 2%)
Waste gases, vent gas, C1-6	68477-25-8	 A complex combination of hydrocarbons produced by the distillation of products from the vacuum unit. It consists of saturated hydrocarbons having carbon numbers in the range of C1 through C6.	C1-C4 = 33 to 77.9%; C5-C6 = 22.1 to 64%; Hydrogen = 0 to 2%; Benzene = 0 to 1% (C7 included in C5-C6; C7 = 0 to 1%)
Gases (petroleum), C3-4, isobutane-rich	68477-33-8	 A complex combination of hydrocarbons from the distillation of saturated and unsaturated hydrocarbons usually ranging in carbon numbers from C3 through C6, predominantly butane and isobutane. It consists of saturated and unsaturated hydrocarbons having carbon numbers in the range of C3 through C4, predominantly isobutane.	C1-C4 = 76.5 to 96%; C5-C6 = 4 to 22%; Butadiene = 0 to 1%; Benzene = 0 to 0.5%
Gases (petroleum), extractive, C3-5, butene-isobutylene-rich	68477-42-9	 A complex combination of hydrocarbons obtained from extractive distillation of saturated and unsaturated aliphatic hydrocarbons usually ranging in carbon numbers from C3 through C5, predominantly C4. It consists of saturated and unsaturated hydrocarbons having carbon numbers predominantly in the range of C3 through C5, predominantly butenes and isobutylene.	C1-C4 = 82.5 to 97%; C5-C6 = 3 to 16.5%; Butadiene = 0 to 0.1%
Gases (petroleum), butane splitter overheads	68477-69-0	 A complex combination of hydrocarbons obtained from the distillation of the butane stream. It consists of aliphatic hydrocarbons	C1-C4 = 98 to 100%; C5-C6 = 0 to 2%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

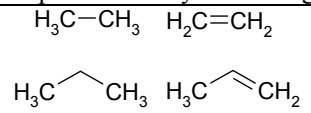
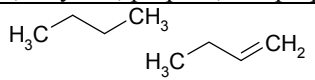
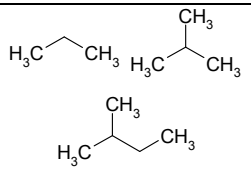
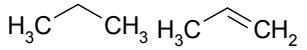
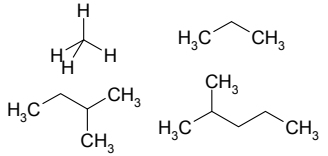
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		having carbon numbers predominantly in the range of C3 through C4.	
Gases (petroleum), C2-3	68477-70-3	 A complex combination of hydrocarbons produced by the distillation of products from a catalytic fractionation process. It contains predominantly ethane, ethylene, propane, and propylene.	C1-C4 = 100%
Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free	68477-71-4	 A complex combination of hydrocarbons obtained from fractionation of catalytic cracked gas oil hydrocarbon stream and treated to remove hydrogen sulfide and other acidic components. It consists of hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C4.	C1-C4 = 68 to 93%; C5-C6 = 7 to 32%; Butadiene = 0.5 to 4%
Gases (petroleum), catalytic-cracked naphtha debutanizer bottoms, C3-5-rich	68477-72-5	 A complex combination of hydrocarbons obtained from the stabilization of catalytic cracked naphtha. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C5	C1-C4 = 60 to 84.5%; C5-C6 = 15.5 to 40%; Butadiene = 0 to 0.5%
Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free	68477-73-6	 A complex combination of hydrocarbons obtained from fractionation of catalytic cracked hydrocarbons and treated to remove acidic impurities. It consists of hydrocarbons having carbon numbers in the range of C2 through C4, predominantly C3	C1-C4 = 99 to 100%; C5-C6 = 0 to 1%; Butadiene = 0.1 to 2%
Gases (petroleum), catalytic cracker	68477-74-7	 A complex combination of hydrocarbons produced by the distillation of the products from a catalytic cracking process. It consists predominantly of aliphatic hydrocarbons having carbon numbers	C1-C4 = 39.5 to 90.2%; C5-C6 = 9.8 to 57.5%; Hydrogen = 0 to 2%; Carbon dioxide = 0 to 1%; Benzene = 0 to 0.5% (C7 included in C5-C6; C7 = 0.5 to 2%)

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

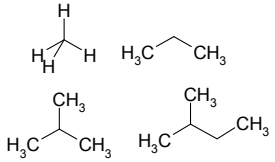
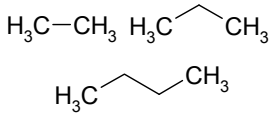
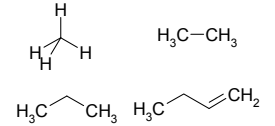
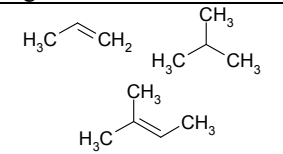
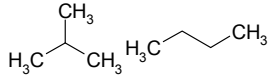
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		predominantly in the range of C1 through C6.	
Gases (petroleum), catalytic cracker, C1-5-rich	68477-75-8	 A complex combination of hydrocarbons produced by the distillation of products from a catalytic cracking process. It consists of aliphatic hydrocarbons having carbon numbers in the range of C1 through C6, predominantly C1 through C5.	C1-C4 = 49.8 to 91.8%; C5-C6 = 8.2 to 47%; Hydrogen = 0 to 2%; Carbon dioxide = 0 to 1%; Benzene = 0 to 0.2%
Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2-4-rich	68477-76-9	 A complex combination of hydrocarbons obtained from the fractionation stabilization of catalytic polymerized naphtha. It consists of aliphatic hydrocarbons having carbon numbers in the range of C2 through C6, predominantly C2 through C4.	C1-C4 = 73 to 95.3%; C5-C6 = 4.7 to 27%
Gases (petroleum), catalytic reformer, C1-4-rich	68477-79-2	 A complex combination of hydrocarbons produced by distillation of products from a catalytic reforming process. It consists of hydrocarbons having carbon numbers in the range of C1 through C6, predominantly C1 through C4.	C1-C4 = 87.3 to 97.2%; C5-C6 = 2.8 to 12.5%; Benzene = 0 to 0.2%
Gases (petroleum), C3-5 olefinic-paraffinic alkylation feed	68477-83-8	 A complex combination of olefinic and paraffinic hydrocarbons having carbon numbers in the range of C3 through C5 which are used as alkylation feed. Ambient temperatures normally exceed the critical temperature of these combinations	C1-C4 = 58.5 to 88.4%; C5-C6 = 11.6 to 39.5%; Butadiene = 0 to 2%
Gases (petroleum), C4-rich	68477-85-0		C1-C4 = 74 to 98.5%; C5-C6 = 1.5 to 25.5%; Butadiene = 0 - 0.5%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

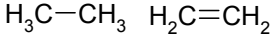
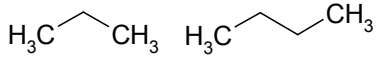
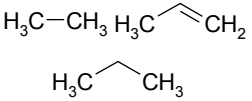
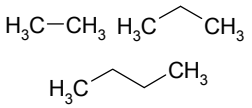
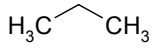
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		A complex combination of hydrocarbons produced by distillation of products from a catalytic fractionation process. It consists of aliphatic hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C4.	
Gases (petroleum), deethanizer overheads	68477-86-1	 A complex combination of hydrocarbons produced from distillation of the gas and gasoline fractions from the catalytic cracking process. It contains predominantly ethane and ethylene.	C1-C4 = 93 to 100%; Hydrogen = 0 to 5%; Carbon dioxide = 0 to 2%
Gases (petroleum), deisobutanizer tower overheads	68477-87-2	 complex combination of hydrocarbons produced by the atmospheric distillation of a butane-butylene stream. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C4.	C1-C4 = 94 to 100%, C5-C6 = 0 to 5%; Butadiene = 0 - 1%
Gases (petroleum), deethanizer overheads, C3-rich	68477-88-3	 A complex combination of hydrocarbons produced by distillation of products from the propylene purification unit. It consists of aliphatic hydrocarbons having carbon numbers in the range of C1 through C3, predominantly C3.	C1-C4 = 95 to 100%; Hydrogen = 0 to 5%
Gases (petroleum), depropanizer dry, propene-rich	68477-90-7	 A complex combination of hydrocarbons produced by the distillation of products from the gas and gasoline fractions of a catalytic cracking process. It consists predominantly of propylene with some ethane and propane.	C1-C4 = 93 to 100%; Hydrogen = 0 to 5%; Carbon dioxide = 0 to 2%
Gases (petroleum), depropanizer overheads	68477-91-8	 A complex combination of hydrocarbons produced by distillation of products from the gas and gasoline fractions of a catalytic cracking process. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C4.	C1-C4 = 86 to 99%; C5-C6 = 1 to 5%; Hydrogen = 0 - 5%; Carbon dioxide = 0 - 2%; Butadiene = 0 to 2%
Gases (petroleum), gas recovery plant depropanizer overheads	68477-94-1	 A complex combination of hydrocarbons obtained by fractionation of	C1-C4 = 94.5 to 100%; Hydrogen = 0 to 5%; Butadiene = 0 to 0.5%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

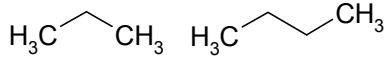
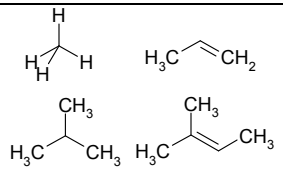
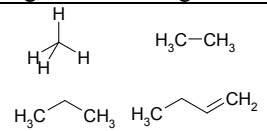
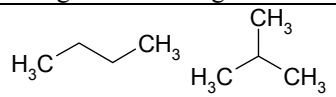
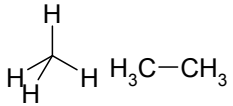
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		miscellaneous hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers in the range of C1 through C4, predominantly propane.	
Residual oils (petroleum), propene purifn. splitter	68478-19-3	 A complex residuum from the propene purification unit. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C4.	C1-C4 = 95 to 99.5%; C5-C6 = 0.5 to 5%
Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionater	68478-24-0	 A complex combination of hydrocarbons obtained from the fractionation of products from catalytic cracking, catalytic reforming and hydrodesulfurizing processes treated to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 67.9 to 93.3%; C5-C6 = 6.7 to 28%; Hydrogen = 0 to 3%; Carbon dioxide = 0 to 1%; Butadiene = 0 to 0.1%
Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer	68478-26-2	 A complex combination of hydrocarbons obtained from the fractionation stabilization of catalytic reformed naphtha. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 91.9 to 99.5%; C5-C6 = 0.5 to 5%; Hydrogen = 0 to 3%; Butadiene = 0 to 0.1
Tail gas (petroleum), saturate gas plant mixed stream, C4-rich	68478-32-0	 A complex combination of hydrocarbons obtained from the fractionation stabilization of straight-run naphtha, distillation tail gas and catalytic reformed naphtha stabilizer tail gas. It consists of hydrocarbons having carbon numbers in the range of C3 through C6, predominantly butane and isobutane.	C1-C4 = 67.5 to 96.7%; C5-C6 = 3.3 to 31%; Butadiene = 0 to 1%; Benzene = 0 to 0.5% (C7 included in C5-C6; C7 = 0 to 2%)
Tail gas (petroleum), saturate gas recovery plant, C1-2-rich	68478-33-1		C1-C4 = 75.5 to 93.5%; C5-C6 = 1.5 to 4.5%; Hydrogen = 5 to 20%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

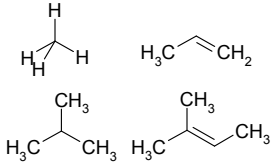
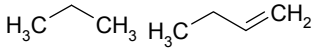
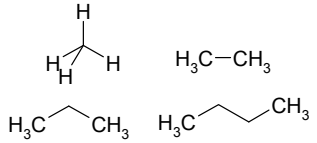
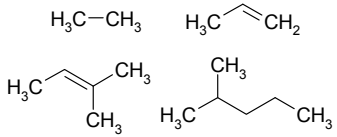
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		A complex combination of hydrocarbons obtained from fractionation of distillate tail gas, straight-run naphtha, catalytic reformed naphtha stabilizer tail gas. It consists predominantly of hydrocarbons having carbon numbers in the range of C1 through C5, predominantly methane and ethane.	
Tail gas (petroleum), vacuum residues thermal cracker	68478-34-2	 A complex combination of hydrocarbons obtained from the thermal cracking of vacuum residues. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 73 to 97%; C5-C6 = 2.5 to 19%; Hydrogen = 0 to 3%; Carbon dioxide = 0 to 1%; Butadiene = 0.5 to 4%
Hydrocarbons, C3-4-rich, petroleum distillate	68512-91-4	 A complex combination of hydrocarbons produced by distillation and condensation of crude oil. It consists of hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C3 through C4.	C1-C4 = 74 to 98.5%; C5-C6 = 1.5 to 25.5%; Butadiene = 0 - 0.5%
Fuel gases, saturate gas unit fractionater-absorber overheads	68513-12-2	 A complex combination produced by the fractionation and absorption of products of the saturate gas unit. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 67 to 89.9%; C5-C6 = 0.1 to 3%; Hydrogen = 10 to 30%
Gases (petroleum), full-range straight-run naphtha dehexanizer off	68513-15-5	 A complex combination of hydrocarbons obtained by the fractionation of the full-range straight-run naphtha. It consists of hydrocarbons having carbon numbers predominantly in the range of C2 through C6.	C1-C4 = 36.5 to 82.4%; C5-C6 = 17.6 to 63%; Benzene = 0 to 0.5 (C7 included in C5-C6; C7 = 0 to 1%)

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

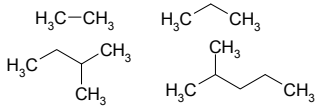
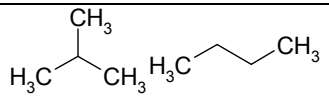
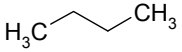
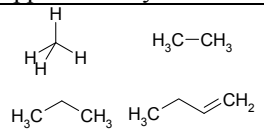
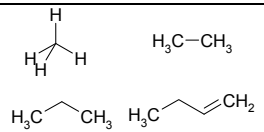
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Gases (petroleum), light straight-run naphtha stabilizer off	68513-17-7	 A complex combination of hydrocarbons obtained by the stabilization of light straight-run naphtha. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C6	C1-C4 = 34 to 82.4%; C5-C6 = 17.6 to 66% (C7 included in C5-C6; C7 = 0 to 1%)
Butane, branched and linear	68513-65-5	 No description available	C1-C4 = 97.5 to 100%; C5-C6 = 0 to 2%; Butadiene = 0 to 0.5%
Residues (petroleum), alkylation splitter, C4-rich	68513-66-6	 A complex residuum from the distillation of streams from various refinery operations. It consists of hydrocarbons having carbon numbers in the range of C4 through C5, predominantly butane and boiling in the range of approximately -11.7°C to 27.8°C.	C1-C4 = 68.5 to 89%; C5-C6 = 11 to 31%; Butadiene = 0 to 0.5
Hydrocarbons, C1-4	68514-31-8	 A complex combination of hydrocarbons produced by thermal cracking and absorber operations and by distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C4 and boiling in the range of approximately -164°C to - 5°C	C1-C4 = 92 to 99.8%; Hydrogen = 0 to 3%; Carbon dioxide = 0 to 1%; Mercaptans = 0.1 to 1%; Butadiene = 0.1 to 3%
Hydrocarbons, C1-4, sweetened	68514-36-3	 A complex combination of hydrocarbons obtained by subjecting hydrocarbon gases to a sweetening process to convert mercaptans or to remove acidic impurities. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C4 and boiling in the range of approximately -164°C to -0.5°C	C1-C4 = 97 to 99.9%; Butadiene = 0.1 to 3%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

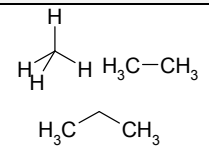
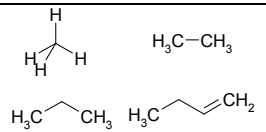
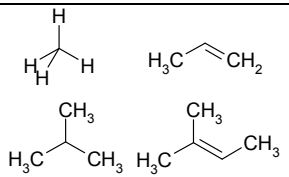
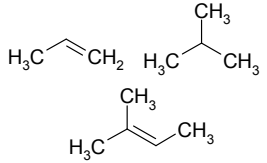
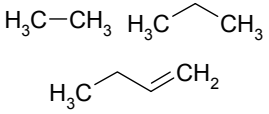
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Hydrocarbons, C1-3	68527-16-2	 A complex combination of hydrocarbons having carbon numbers predominantly in the range of C1 through C3 and boiling in the range of approximately -164°C to -42°C	C1-C4 = 95 to 100%; Hydrogen = 0 to 5%
Hydrocarbons, C1-4, debutanizer fraction	68527-19-5	 No description available	C1-C4 = 95 to 99.9%; C5-C6 = 0 to 2%; Butadiene = 0.1 to 3%
Gases (petroleum), C1-5, wet	68602-83-5	 A complex combination of hydrocarbons produced by the distillation of crude oil and/or the cracking of tower gas oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 69.5 to 96.8%; C5-C6 = 2.5 to 23%; Hydrogen = 0.5 to 5%; Nitrogen = 0.1 to 0.5%; Butadiene = 0.1 to 2%
Hydrocarbons, C4, butene concentrator by-product	68606-24-6	 A complex combination of hydrocarbons obtained in the production of butene concentrate. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C5.	C1-C4 = 56 to 91.4%; C5-C6 = 8.5 to 40%; Butadiene = 0.1 to 4%
Hydrocarbons, C2-4	68606-25-7	 No description available	C1-C4 = 99 to 100%; Butadiene = 0 to 1%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

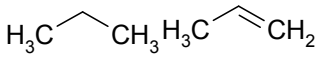
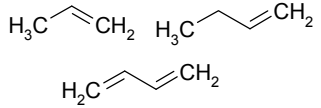
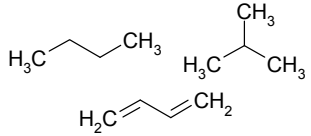
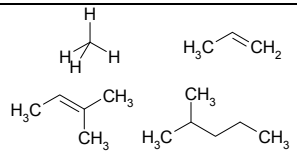
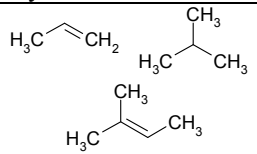
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Hydrocarbons, C3	68606-26-8	 No description available	C1-C4 = 100%
Gases (petroleum), alkylation feed	68606-27-9	 A complex combination of hydrocarbons produced by the catalytic cracking of gas oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C4.	C1-C4 = 93 to 99.9%; C5-C6 = 0 to 2%; Carbon dioxide = 0 to 1%; Butadiene = 0.1 to 4%
Gases (petroleum), depropanizer bottoms fractionation off	68606-34-8	 A complex combination of hydrocarbons obtained from the fractionation of depropanizer bottoms. It consists predominantly of butane, isobutane and butadiene.	C1-C4 = 68 to 85%; C5-C6 = 0 to 2%; Butadiene = 15 to 30%
Fuel gases, refinery, sweetened	68783-61-9	 A complex combination obtained by subjecting refinery fuel gases to a sweetening process to convert mercaptans or to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C5 and boiling in the range of approximately -73 °C to 50 °C.	C1-C4 = 55 to 90.9%; C5-C6 =8.5 to 38%; Hydrogen = 0.5 to 5%; Nitrogen = 0.1 to 0.5%; Carbon dioxide = 0 - 1%; Butadiene = 0 to 0.5%
Gases (petroleum), catalytic cracking	68783-64-2	 A complex combination of hydrocarbons produced by the distillation of the products from a catalytic cracking process. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C5.	C1-C4 = 55 to 92.3%; C5-C6 =7.6 to 40%; Carbon dioxide = 0 to 1%; Butadiene = 0.1 to 4%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

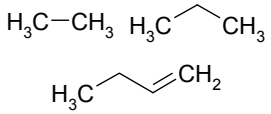
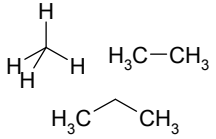
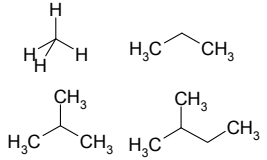
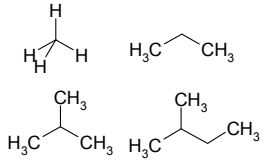
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Gases (petroleum), C2-4, sweetened	68783-65-3	 A complex combination of hydrocarbons obtained by subjecting a petroleum distillate to a sweetening process to convert mercaptans or to remove acidic impurities. It consists predominantly of saturated and unsaturated hydrocarbons having carbon numbers predominantly in the range of C2 through C4 and boiling in the range of approximately-51°C to -34°C.	C1-C4 = 94 to 99.9%; C5-C6 = 0 to 2%; Butadiene = 0.1 to 4%
Fuel gases, refinery, hydrogen sulfide-free	68918-98-9	 A complex combination of light gases consisting of hydrocarbons having carbon numbers predominantly in the range of C1 through C3. Produced from the fractionation and subsequent scrubbing of hydrotreating units.	C1-C4 = 85 to 99%; Hydrogen = 1 to 15%
Gases (petroleum), crude oil fractionation off	68918-99-0	 A complex combination of hydrocarbons produced by the fractionation of crude oil. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 54 to 92.3%; C5-C6 = 6.7 to 36%; Hydrogen = 1 to 10%
Gas (petroleum), dehexanizer off	68919-00-6	 A complex combination of hydrocarbons obtained by the fractionation of combined naphtha streams. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 58 to 93.3%; C5-C6 = 6.7 to 42%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

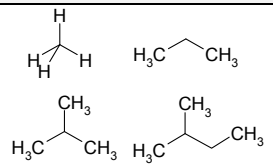
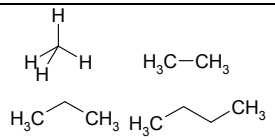
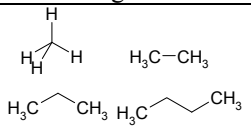
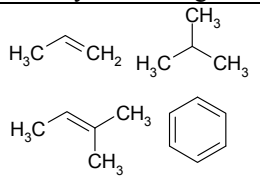
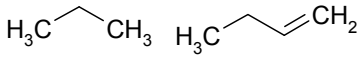
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
Gases (petroleum), light straight run gasoline fractionation stabilizer off	68919-05-1	 A complex combination of hydrocarbons obtained by the fractionation of light straight-run gasoline. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 58 to 93.3%; C5-C6 = 6.7 to 42%
Gases (petroleum), naphtha unifiner desulfurization stripper off	68919-06-2	 A complex combination of hydrocarbons produced by a naphtha unifiner desulfurization process and stripped from the naphtha product. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 98 to 100%; C5-C6 = 0 to 2%
Gases (petroleum), straight-run stabilizer off	68919-10-8	 A complex combination of hydrocarbons obtained from the fractionation of the liquid from the first tower used in the distillation of crude oil. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 88 to 99%; C5-C6 = 0 to 2%; Hydrogen = 1 to 10%
Hydrocarbons, C3-6, catalytic alkylation by-products	68919-16-4	 The complex combination of hydrocarbons obtained by the catalytic alkylation of benzene with propylene. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C6 and boiling in the range of approximately -40°C to 70°C (-40°F to 158°F). This stream may contain 1 to 20 vol. % of benzene.	C1-C4 = 20.9 to 85.7%; C5-C6 = 13.3 to 78.1%; Benzene = 1 to 20% (C7 included in C5-C6; C7 = 0 to 2%)
Gases (petroleum), fluidized catalytic cracker	68919-19-7		C1-C4 = 98 to 100%; C5-C6 =0 to 2%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

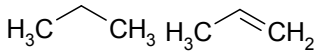
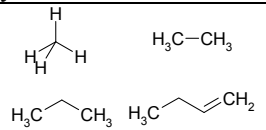
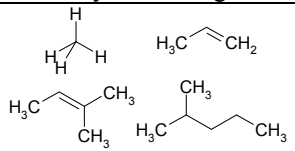
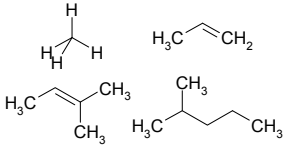
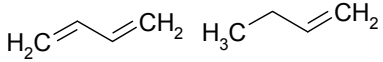
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
splitter residues		A complex combination of hydrocarbons produced by the fractionation of the charge to the C3-C4 splitter. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C4.	
Gases (petroleum), fluidized catalytic cracker splitter overheads	68919-20-0	 A complex combination of hydrocarbons produced by the fractionation of the charge to the C3-C4 splitter. It consists predominantly of C3 hydrocarbons.	C1-C4 = 100%
Gases (petroleum), catalytic cracked naphtha debutanizer	68952-76-1	 A complex combination of hydrocarbons obtained from fractionation of catalytic cracked naphtha. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C4.	C1-C4 = 94.9 to 100%; C5-C6 = 0 to 2%; Hydrogen = 0 to 3%; Butadiene = 0 to 0.1%
Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber	68952-81-8	 A complex combination of hydrocarbons obtained from the separation of thermal-cracked distillates, naphtha and gas oil. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C1 through C6.	C1-C4 = 33.3 to 89.7%; C5-C6 = 10.3 to 65.5%; Hydrogen = 0 to 3%; Carbon dioxide = 0 to 1%; Benzene = 0 to 0.5% (C7 included in C5-C6; C7 = 0.5 to 2%
Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking	68952-82-9	 A complex combination of hydrocarbons obtained from the fractionation stabilization of thermal cracked hydrocarbons from petroleum coking process. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C6.	C1-C4 = 34.5 o 89.7%; C5-C6 = 10.3 to 65.5%; Benzene = 0 to 0.5% (C7 included in C5-C6; C7 = 0.5 to 2%)
Gases (petroleum), light steam-cracked, butadiene conc.	68955-28-2	 A complex combination of hydrocarbons produced by the distillation of products from a thermal cracking process. It consists of	C1-C4 = 38 to 60%; C5-C6 = 0 to 2%; Butadiene = 40 to 60%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

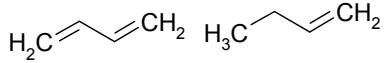
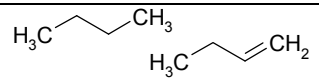
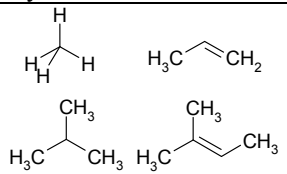
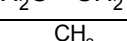
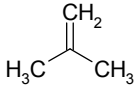
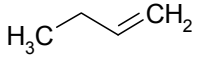
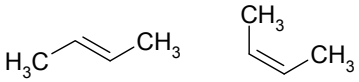
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
		hydrocarbons having a carbon number predominantly of C4.	
Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead	68955-34-0	 A complex combination of hydrocarbons obtained by the catalytic reforming of straight-run naphtha and the fractionation of the total effluent. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C2.	C1-C4 = 100%
Hydrocarbons, C4-unsatd.	68956-54-7	 No description available	C1-C4 = 70 to 90%; Butadiene = 10 to 30%
Residues (petroleum), catalytic cracking depropanizer, C4-rich	71329-37-8	 A complex residuum from the stabilization of catalytic cracked naphtha hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C5, primarily C4	C1-C4 = 55 to 91.4%; C5-C6 = 8.1 to 40%; Butadiene = 0.5 to 5%
Tail gas (petroleum), thermal cracking absorber	71808-30-5	 A complex combination of hydrocarbons obtained from the separation of thermal cracked naphtha, distillates and gas oil hydrocarbons. It consists of hydrocarbons having carbon numbers predominantly in the range of C1 through C5.	C1-C4 = 76 to 97%; C5-C6 =2.5 to 19%; Carbon dioxide = 0 to 1%; Butadiene = 0.5 to 4%
Supporting Chemicals			
Ethene	74-85-1		100%
1-Propene, 2-methyl-	115-11-7		100%
1-Butene	106-98-9		100%
2-Butene	107-01-7		100%

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases

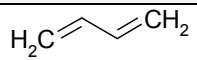
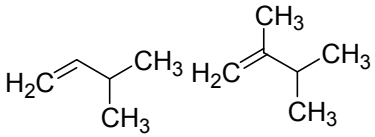
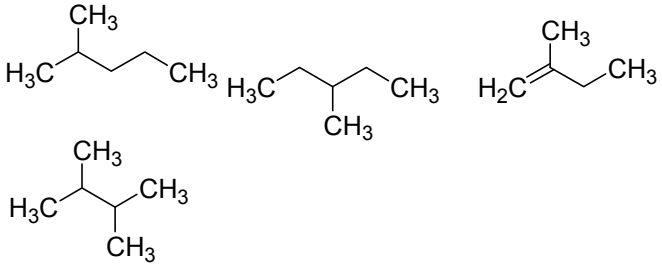
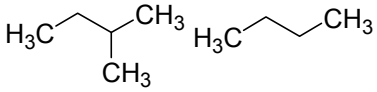
Name	CASRN	Chemical Structure TSCA Definition when avalable	Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)
1,3-Butadiene	106-99-0		100%
Benzene	71-43-2		100%
Naphtha (petroleum), light catalytic cracked	64741-55-5	 A complex combination of hydrocarbons produced by the distillation of products from a catalytic cracking process. It consists of hydrocarbons having carbon numbers predominantly in the range of C4 through C11 and boiling in the range of approximately -20 °C to 190 °C It contains a relatively large proportion of unsaturated hydrocarbons.	14% 3-methyl-1-butene; 7.3% 2,3-dimethyl-1-butene; 2.5% xylene; 3% methylcyclopentane + benzene; 3.4% 3-methylhexane; 4% cis-2-pentene 4.5% 4-methyl-2-pentene; And 61% other various hydrocarbons, up to approx. C12.
Naphtha (petroleum), sweetened	64741-87-3	 A complex combination of hydrocarbons obtained by subjecting a petroleum naphtha to a sweetening process to convert mercaptans or to remove acidic impurities. It consists of hydrocarbons having carbon numbers predominantly in the range of C4 through C12 and boiling in the range of approximately -10 °C to 230°C	11% 2-methylpentane and other methylpentane isomers; 19% 2-methyl-1-butene; 11.5% 2,3-dimethylbutane; 15.7% 3-methylpentane; 9% n-hexane; 5% benzene; 5% 3,3-dimethylpentane And 24% other hydrocarbons, up to approx C10.
Baseline Gasoline Vapor Condensate [BGVC]	86290-81-5		isopentane 36.5%; butane 12.78%; pentane 9.36%; 2-methylpentane 7.25%; Toluene 3.91%;

Table 9. Component Concentration Ranges for the Petroleum Hydrocarbon Gases			
Name	**CASRN**	**Chemical Structure TSCA Definition when avalable**	**Petroleum Hydrocarbon Gases Composition Ranges (wt/v%)**
		Baseline Gasoline Vapor Condensate [BGVC], a 20% light fraction of a whole unleaded gasoline sample was used in various inhalation studies. The main components were isopentane (36.5%) and butane (12.78%). All other components were below 10%.	3-methylpentane 4.27%; hexane 3.62%; trans 2-pentene 3.60%; benzene 2.75%

1. DESCRIPTION OF PETROLEUM HYDROCARBON GASES CATEGORY

Background
The original Petroleum Gases Category of 161 substances has been split into two separate categories; (1) the Petroleum Hydrocarbon Gases Category, and (2) the Refinery Gases Category. This Category Analysis Document provides the HPV hazard characterization for the Petroleum Hydrocarbon Gases Category. This division of petroleum gases into two categories is more consistent with petroleum gas categories developed by CONCAWE (Conservation of Clean Air, Water in Europe; the European petroleum industry technical organization) and used in European Union legislation.

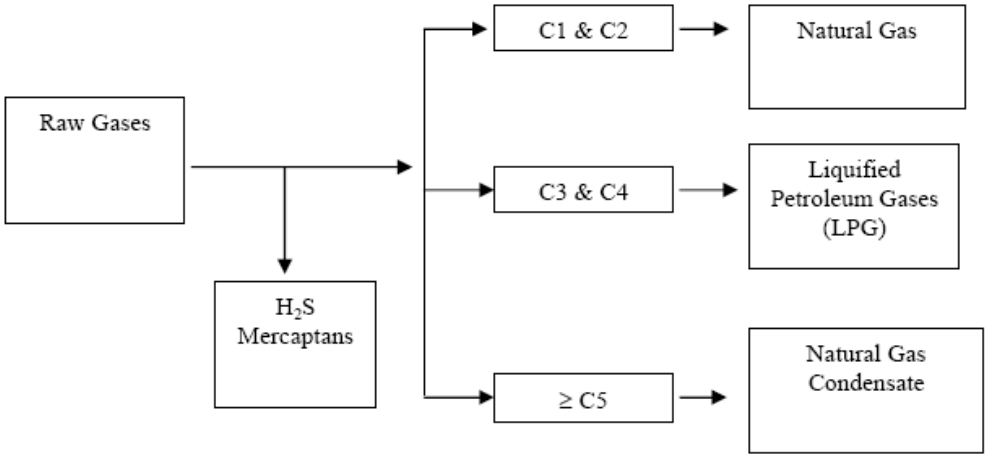
General Description of the Petroleum Hydrocarbon Gases Category
The Petroleum Hydrocarbon Gases Category contains 106 chemical substances. Of these 106 substances, 99 are petroleum hydrocarbon gases and 7 are individual supplemental chemicals:

- Ninety-two substances are petroleum petroleum hydrocarbon gases listed on the 1990 HPV substances list;
- Seven substances are petroleum hydrocarbon gases not listed on the 1990 HPV list; and
- Seven substances are included in the category as supplemental chemicals (four hydrocarbon and three asphyxiant gases)

The supplemental chemicals are included in this category to characterize the SIDS[1] endpoints for the petroleum hydrocarbon gases (as described below). These are included as single chemicals because they either exist in petroleum hydrocarbon gases at more than trace levels or are known to cause adverse effects in mammalian or aquatic organisms. A list of all category members by CASRN and their respective TSCA definition is provided in Appendix 1.

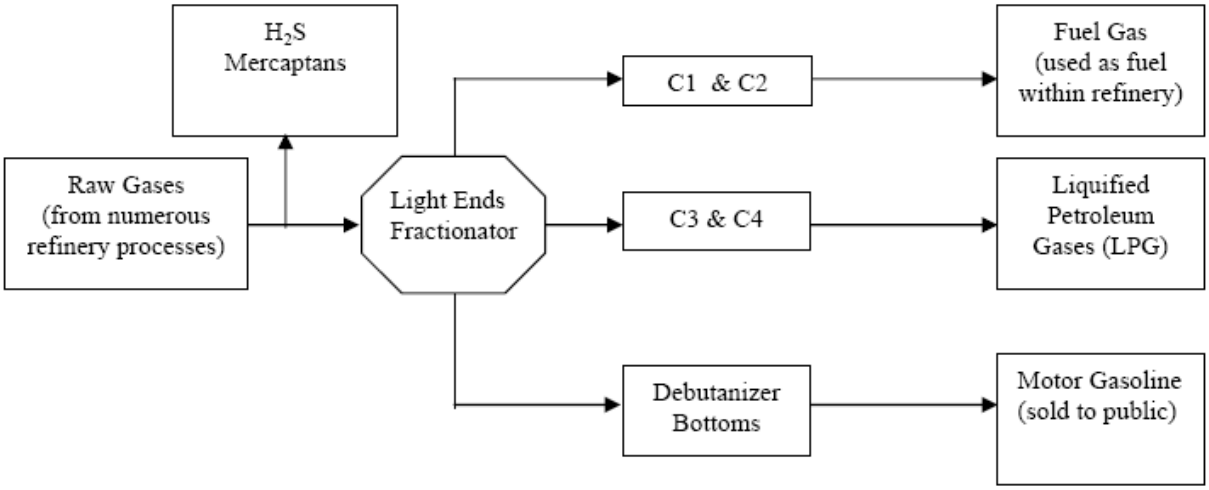
The 99 Petroleum Hydrocarbon Gas substances in this test plan are primarily produced in petroleum refineries as the light end fractions of numerous distillation and cracking processes, or in gas plants that separate natural gas and natural gas liquids. These gases exist as substances in closed systems in the refinery, with many of the gases being sold as finished products. All petroleum hydrocarbon gases in this category are comprised of predominantly one to four carbon atom hydrocarbons, and may contain asphyxiant gas components such as hydrogen, nitrogen, or carbon dioxide. Several petroleum hydrocarbon gases also contain benzene and/or butadiene. As with most of the substances handled within the petroleum industry, these gaseous substances are commonly referred to as "refinery streams." Simplified diagrams of how these substances are processed in Gas Plants and Refineries are given below:

Gas Plants



[1] SIDS = Screening Information Data Set

Refineries



A few of the gas streams contain only one component such as propane or butane, but most contain varying proportions of several components. Natural gas (methane) and liqified petroleum gas (LPG; predominantly propanes and butanes) are the two products from the Petroleum Gases category that are most commonly marketed to the general public. In addition to their use as fuels, some of the simple alkanes are used as propellants in spray cans. Most of these substances are identified on the Toxic Substances Control Act (TSCA) Chemical Inventory as Class II substances, "Chemical Substances of Unknown or Variable Composition, Complex Reaction Products and Biological Materials."