ENVIRONMENTAL PROTECTION AGENCY

40 CFR Chapter 1

[EPA–HQ–OAR–2009–0171; FRL–8895–5]

RIN 2060–ZA14

Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: Today the Administrator is proposing to find that greenhouse gases in the atmosphere endanger the public health and welfare of current and future generations. Concentrations of greenhouse gases are at unprecedented levels compared to the recent and distant past. These high atmospheric levels are the unambiguous result of human emissions, and are very likely the cause of the observed increase in average temperatures and other climatic changes. The effects of climate change observed to date and projected to occur in the future—including but not limited to the increased likelihood of more frequent and intense heat waves, more wildfires, degraded air quality, more heavy downpours and flooding, increased drought, greater sea level rise, more intense storms, harm to water resources, harm to agriculture, and harm to wildlife and ecosystems—are effects on public health and welfare within the meaning of the Clean Air Act. In light of the likelihood that greenhouse gases cause these effects, and the magnitude of the effects that are occurring and are very likely to occur in the future, the Administrator proposes to find that atmospheric concentrations of greenhouse gases endanger public health and welfare within the meaning of Section 202(a) of the Clean Air Act. She proposes to make this finding specifically with respect to six greenhouse gases that together constitute the root of the climate change problem: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The Administrator is also proposing to find that the combined emissions of carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons from new motor vehicles and new motor vehicle engines are contributing to this mix of greenhouse gases in the atmosphere. Thus, she proposes to find that the emissions of these substances from new motor vehicles and new motor vehicle engines are contributing to air pollution which is endangering public health and welfare under section 202(a) of the Clean Air Act.

DATES: Comments on this proposed action must be received on or before June 23, 2009. If you submitted comments on the issues raised by this proposal in dockets for other Agency efforts (e.g., the Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gases under the Clean Air Act), you must still submit your comments to the docket for this action (EPA–HQ–OAR–2009–0171) by the deadline if you want them to be considered.

There will be two public hearings. One hearing will be held on May 18, 2009 in Arlington, VA. The other hearing will be on May 21, 2009 in Seattle, WA. To obtain information about the public hearings or to register to speak at the hearings, *please see* the **SUPPLEMENTARY INFORMATION** section below or go to *http://www.epa.gov/climatechange/endangerment.html.*

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2009–0171, by one of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the online instructions for submitting comments.
- *E-mail: GHG–Endangerment-Docket@epa.gov.*
- *Fax:* (202) 566–1741.
- *Mail:* Environmental Protection Agency, EPA Docket Center (EPA/DC), Mailcode 6102T, Attention Docket ID No. EPA–HQ–OAR–2009–0171, 1200 Pennsylvania Avenue, NW., Washington, DC 20460.
- *Hand Delivery:* EPA Docket Center, Public Reading Room, EPA West Building, Room 3334, 1301 Constitution Avenue, NW., Washington, DC 20004. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA–HQ–OAR–2009–0171. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *http://www.regulations.gov,* including any personal information provided, unless the comment includes information claimed to be CBI or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *http://www.regulations.gov* or e-mail. The *http://www.regulations.gov* Web site is an ''anonymous access'' system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through *http://www.regulations.gov* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses.

Docket: All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at the Air Docket, EPA/DC, EPA West, Room B102, 1301 Constitution Ave., NW., Washington, DC. This Docket Facility is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Air Docket is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT: Jeremy Martinich, Climate Change Division, Office of Atmospheric Programs (MC–6207J), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460; *telephone number:* (202) 343–9927; *fax number:* (202) 343–2202; *e-mail address: ghgendangerment@epa.gov.* Please use this contact information for general questions only. Official comments must be submitted using the instructions above.

SUPPLEMENTARY INFORMATION:

Additional Information on Public Hearings: The two public hearings will be held on May 18 in Arlington, VA, and on May 21, 2009, in Seattle, WA. Both hearings will begin at 9 a.m. and end at 8 p.m., respective local times.

Addresses: The hearings will be held at the following locations:

1. *Arlington, VA:* One Potomac Yard, 2777 S. Crystal Drive, Arlington, VA 22202.

2. *Seattle, WA:* Bell Harbor International Conference Center, 2211 Alaskan Way, Pier 66, Seattle, WA 98121.

The public hearings will provide interested parties the opportunity to present data, views, or arguments concerning the proposed findings. The EPA may ask clarifying questions during the oral presentations, but will not respond to the presentations at that time. Written statements and supporting information submitted during the comment period will be considered with the same weight as any oral comments and supporting information presented at the public hearings. Written comments must be received by the last day of the comment period, as specified in the proposal.

To obtain additional information about the public hearings or to register to speak at the hearings, please go to: *http://www.epa.gov/climatechange/endangerment.html.* Alternatively, contact Jeremy Martinich at 202–343–9927. Verbatim transcripts of the hearings and written statements will be included in the rulemaking docket.

What Should I Consider as I Prepare My Comments for EPA?

1. Submitting CBI

Do not submit this information to EPA through *www.regulations.gov* or e-mail. Clearly mark the part or all of the information that you claim to be confidential business information (CBI). For CBI information in a disk or CD ROM that you mail to EPA, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

2. Tips for Preparing Your Comments

When submitting comments, remember to:

- Explain your views as clearly as possible.
- Describe any assumptions that you used.
- Provide any technical information and/or data you used that support your views.
- Provide specific examples to illustrate your concerns.
- Offer alternatives.
- Make sure to submit your comments by the comment period deadline identified.
- To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

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I. Introduction

A. Summary

Pursuant to section 202(a) of the Clean Air Act (CAA or Act), the Administrator proposes to find that the mix of six key greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and welfare. Specifically, the Administrator is proposing to define the ''air pollution'' referred to in section

202(a) of the CAA to be the mix of six key directly emitted and long-lived greenhouse gases: Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). It is the Administrator's judgment that the total body of scientific evidence compellingly supports a positive endangerment finding for both public health and welfare. The Administrator reached this judgment by considering both observed and projected future effects, and by considering the full range of risks and impacts to public health and welfare occurring within the U.S., which by itself warrants this judgment. In addition, the scientific evidence concerning risks and impacts occurring outside the U.S., including risks and impacts that can affect people in the U.S., provides further support for this finding.[1]

Under section 202(a) of the CAA, the Administrator is to determine whether emissions of any air pollutant from new motor vehicles and their engines cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. The Administrator further proposes to find that combined emissions from new motor vehicles and new motor vehicle engines of four of these greenhouse gases—carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons—contribute to this air pollution. The other greenhouse gases that are the subject of this proposal (perfluorocarbons and sulfur hexafluoride) are not emitted by motor vehicles.

The Administrator's proposed findings come in response to the Supreme Court's decision in *Massachusetts* v. *EPA,* 549 U.S. 497 (2007). That case involved a petition submitted by the International Center for Technology Assessment and 18 other environmental and renewable energy industry organizations requesting that EPA issue standards under section 202(a) of the Act for the emissions of carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons from new motor vehicles and engines. The proposed findings are in response to this petition and are for purposes of section 202(a). EPA is not proposing or taking action under any other provision of the Clean Air Act.

B. Background Information Helpful to Understanding This Proposal

1. Greenhouse Gases and Their Effects

Greenhouse gases are gases that effectively trap some of the Earth's heat that would otherwise escape to space. Greenhouse gases are both naturally occurring and anthropogenic. The primary greenhouse gases of concern directly emitted by human activities include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Of these six gases, four (carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons) are emitted by motor vehicles.

These six gases, once emitted, remain in the atmosphere for decades to centuries. Thus, they become well mixed globally in the atmosphere and their concentrations accumulate when emissions exceed the rate at which natural processes remove greenhouse gases from the atmosphere. The heating effect caused by the human-induced buildup of greenhouse gases in the atmosphere is very likely[2] the cause of most of the observed global warming over the last 50 years. A detailed explanation of climate change and its impact on health, society, and the environment is included in EPA's technical support document (docket #OAR–2009–0171) and discussed in the context of the Administrator's finding in Section III.

The U.S. transportation sector is a significant contributor to total U.S. and global anthropogenic emissions of greenhouse gases. Transportation sources subject to regulation under section 202(a) of the Act are the second largest greenhouse gas-emitting sector in the U.S., after electricity generation, and accounted for 24 percent of total U.S. greenhouse gas emissions in 2006 (see table 1 in section IV below) (these emissions are compared on carbon dioxide equivalent basis; see footnote 18 for an explanation). Detailed information on past, present, and projected greenhouse gas concentrations and emissions is provided in the Technical Support Document, and summarized in Sections III and IV, respectively.

2. Statutory Basis for This Proposal

Section 202(a)(1) of the CAA states that ''The Administrator shall by regulation prescribe (and from time to time revise) * * * standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in [her] judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.''

Before the Administrator may issue standards addressing emissions of greenhouse gases from new motor vehicles or engines under section 202(a), the Administrator must satisfy a two-step test. First, the Administrator must decide whether, in her judgment, the air pollution under consideration may reasonably be anticipated to endanger public health or welfare. Second, the Administrator must decide whether, in her judgment, emissions of an air pollutant from new motor vehicles or engines cause or contribute to this air pollution.[3] If the Administrator answers both questions in the affirmative, she must issue standards under section 202(a). *Massachusetts* v. *EPA,* 549 U.S. at 533.

Typically, the endangerment and cause or contribute findings have been proposed concurrently with proposed standards under various sections of the CAA, including section 202(a). Comment has been taken on these proposed findings as part of the notice and comment process for the emission standards. *See, e.g.,* Rulemaking for non-road compression-ignition engines under section 213(a)(4) of the CAA, Proposed Rule 58 FR 28809, 28813–14 (May 17, 1993), Final Rule 59 FR 31306, 31318 (June 17, 1994); Rulemaking for highway heavy duty diesel engines and diesel sulfur fuel under sections 202(a) and 211(c) of the CAA, Proposed Rule 65 FR 35430 (June 2, 2000), Final Rule 66 FR 5002 (Jan. 18, 2001). However, there is no requirement that the Administrator propose the endangerment and cause or contribute findings with proposed standards. The Administrator is moving forward with this proposed endangerment finding and a cause or contribute determination

[1] As discussed later, EPA does not need to determine, and is not determining, whether impacts occurring outside the U.S. would be sufficient by themselves to justify the proposed endangerment finding. Instead the impacts occurring outside the U.S. are considered as providing additional support for the proposed finding, in a situation where, as here, the impacts occurring within the U.S. are sufficient on their own to warrant the proposed finding. Thus, the Administrator does not now take a position on the legal question whether international effects, on their own, would be sufficient to support an endangerment finding under the Clean Air Act.

[2] According to Intergovernmental Panel on Climate Change (IPCC) terminology, ''very likely'' conveys a 90 to 99 percent probability of occurrence. ''Virtually certain'' conveys a greater than 99 percent probability, ''likely'' conveys a 66 to 90 percent probability, and ''about as likely as not'' conveys a 33 to 66 percent probability.

[3] To clarify the distinction between air pollution and air pollutant, the air pollution is the atmospheric concentrations and can be thought of as the total, cumulative stock problem of greenhouse gases in the atmosphere. The air pollutants, on the other hand, are the emissions of greenhouse gases and can be thought of as the flow that changes the size of the total stock.

while developing proposed standards under section 202(a).

The Administrator is applying the rulemaking provisions of CAA section 307(d) to this action.[4] Thus, these proposed findings will be subject to the same rulemaking requirements that would apply if the proposed findings were part of the standard-setting rulemaking. Any standard setting rulemaking under section 202(a) will also be subject to these notice and comment rulemaking procedures.

3. The Supreme Court's Decision in *Massachusetts* v. *EPA*

a. The Petition of the International Center for Technology Assessment

On October 20, 1999, the International Center for Technology Assessment and 18 other environmental and renewable energy industry organizations filed a ''Petition for Rulemaking and Collateral Relief Seeking the Regulation of Greenhouse Gas Emissions from New Motor Vehicles under Section 202(a) of the Clean Air Act.'' The thrust of the petition was that four greenhouse gases—carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons—are air pollutants as defined in CAA section 302(g), that emissions of these greenhouse gases contribute to air pollution which is reasonably anticipated to endanger public health or welfare, that these greenhouse gases are emitted by new motor vehicles, and therefore that EPA has a mandatory duty to issue regulations under CAA section 202(a) addressing these greenhouse gases.

After an opportunity for public comment, EPA denied the petition in a notice issued on August 8, 2003. The Agency concluded that it lacked authority under the CAA to regulate greenhouse gases for purposes of global climate change, and that even if it did have the authority to set greenhouse gas emission standards for new motor vehicles, it would be unwise to do so at that time. The federal appeals court in Washington, DC, upheld EPA's denial of the petition.

b. The Supreme Court's Decision

In *Massachusetts* v. *EPA,* the Supreme Court reversed the lower court's decision and held that EPA had improperly denied the petition. 549 U.S. 497 (2007). The Court held that greenhouse gases are air pollutants under the CAA, and that the alternative grounds EPA gave for denying the petition were ''divorced from the statutory text'' and hence improper.

Specifically, the Court held that carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons fit the CAA's ''sweeping definition of 'air pollutant' '' since they are ''without a doubt 'physical [and] chemical * * * substances which [are] emitted into * * * the ambient air.' The statute is unambiguous.'' *Id.* at 529. The Court also rejected the argument that post-enactment legislative developments even ''remotely suggest[ed] that Congress meant to curtail [EPA's] power to treat greenhouse gases as air pollutants.'' *Id.*

The Court further rejected the argument that EPA could not regulate motor vehicle emissions of the chief greenhouse gas, carbon dioxide, because doing so would essentially require control of vehicle fuel economy, and Congress delegated that authority to the Department of Transportation in the Energy Policy and Conservation Act. The Court held that the fact ''that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's 'health' and 'welfare,' 42 U.S.C. 7521(a)(1), a statutory obligation wholly independent of DOT's mandate to promote energy efficiency.'' *Id.* at 532 (citation omitted). The two obligations may overlap ''but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency.'' *Id.*

Turning to EPA's alternative grounds for denial, the Court held that EPA's decision on whether or not to grant the petition must relate to ''whether an air pollutant 'causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare.' '' *Id.* at 532–33. Thus, ''[u]nder the clear terms of the Clean Air Act, EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do.'' *Id.* at 533. The Court held that three of the four reasons EPA advanced as alternative grounds for denying the petition were unrelated to whether greenhouse gas emissions from new motor vehicles cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. Thus, EPA had failed to offer a reasoned explanation for its action. For example, the Court held that concerns related to foreign policy objectives had ''nothing to do with whether greenhouse gas emissions contribute to climate change'' and hence could not justify the denial. *Id.* The Court further held that EPA's generalized concerns about scientific uncertainty were likewise insufficient unless ''the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment as to whether greenhouse gases contribute to global warming,'' in which case EPA must so find. *Id.* at 534.

The Supreme Court was careful to note that it was not dictating EPA's action on remand, and was not deciding whether or not EPA must find that greenhouse gases endanger public health or welfare. Nor did the Court rule on ''whether policy concerns can inform EPA's actions in the event that it makes such a finding.'' *Id.* at 534–35. The Court also observed that under CAA section 202(a), ''EPA no doubt has significant latitude as to the manner, timing, content, and coordination of its regulations with those of other agencies.'' *Id.* at 533. Nonetheless, any EPA decisions concerning the endangerment and cause or contribute criteria must be grounded in the requirements of CAA section 202(a).

Since the Supreme Court's decision in April 2007, some stakeholders have taken the position, including in comments on the Advance Notice of Proposed Rulemaking discussed below, that the Supreme Court did not foreclose EPA's ability to deny the petition without addressing the endangerment question. For example, one industry group argued that EPA could deny the rulemaking petition based on statutory factors besides scientific uncertainty and those already rejected by the Court, but did not describe what those additional statutory factors may be or how they would support a denial of the ICTA petition.

EPA does not agree with these interpretations of the Supreme Court's decision. Moreover, commenters have not provided examples of additional statutory factors that they believe would justify denying the petition without addressing the endangerment and cause or contribute criteria. Today the Administrator is addressing these criteria, and is proposing to find that the mix of six key greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health

[4] Commenters on the Advanced Notice of Proposed Rulemaking on Regulating Greenhouse Gases under the Clean Air Act, 73 FR 44354 (2007), see Section I.B.4 below, argued that EPA is required to follow notice and comment requirements for the endangerment and cause or contribute findings. Without agreeing or disagreeing with the reasoning set forth in those comments, the Administrator is applying the rulemaking requirements of CAA section 307(d), including notice and comment, to today's action. *See, e.g.,* CAA sections 307(d)(1)(K) (applying 307(d) requirements to the promulgation or revisions of regulations under section 202), 307(d)(1)(V) (the provisions of section 307(d) apply to ''such other actions as the Administrator may determine.'').

and welfare due overwhelmingly to the effects of climate change. Furthermore, the Administrator is proposing to find that emissions of greenhouse gases by motor vehicles collectively contribute to the air pollution that endangers public health and welfare.

4. EPA's Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gases Under the Clean Air Act

On July 30, 2008, EPA published an Advance Notice of Proposed Rulemaking on ''Regulating Greenhouse Gas Emissions under the Clean Air Act'' (73 FR 44354) (ANPR). The ANPR presented information relevant to, and solicited public comment on, a wide variety of issues regarding the potential regulation of greenhouse gases under the CAA, including EPA's response to the Supreme Court's decision in *Massachusetts* v. *EPA.* Section V of the ANPR contained an earlier version of much of the material in this proposal, including the legal framework, a summary of the science of climate change, and an illustration of how the Administrator could analyze the cause or contribute element using information regarding the greenhouse gas emissions of the portion of the U.S. transportation sector covered by section 202(a). A July 2008 version of the Technical Support Document (TSD) for this proposal was also in the docket for the ANPR (EPA–HQ–OAR–2008–0318).

The ANPR also contained a summary of much of the work EPA had done in 2007 regarding draft greenhouse gas emission standards for light duty vehicles and trucks under section 202(a) of the Act. As noted earlier, EPA is currently developing proposed emissions standards related to today's proposal. EPA expects that these proposed standards will be ready to propose for public comment several months from now.

Finally, the ANPR also discussed pending petitions under various sections of the Act requesting that EPA regulate greenhouse gas emissions from other mobile sources, as well as stationary source rulemakings (recently completed, ongoing or remanded) in which commenters suggested EPA regulate greenhouse gas emissions. EPA is continuing to evaluate its response to those other pending petitions and rulemakings and will address them in later actions.

C. Solicitation of Comments

The Administrator requests comments on all aspects of this action. She requests comment on the data on which the proposed findings are based, the methodology used in obtaining and analyzing the data, and the major legal interpretations and policy considerations underlying the proposed findings.

II. Legal Framework for This Action

Two provisions of the CAA govern today's proposal. Section 202(a) sets forth a two-part predicate for regulatory action under that provision: endangerment and cause or contribute. Section 302 of the Act contains definitions of the terms air pollutant and welfare used in section 202(a). These statutory provisions are discussed below.

A. Section 202(a)—Endangerment and Cause or Contribute

As noted above, section 202(a) of the CAA calls for the Administrator to exercise her judgment and make two separate determinations: first, whether air pollution may reasonably be anticipated to endanger public health or welfare, and second whether emissions of any air pollutant from new motor vehicles or engines cause or contribute to this air pollution.

Based on the text of this provision and its legislative history, the Administrator interprets the two-part test as follows. First, the Administrator is required to protect public health and welfare. She is not asked to wait until harm has occurred but instead must be ready to take regulatory action to prevent harm before it occurs. The Administrator is thus to consider both current and future risks. Second, the Administrator is to exercise judgment by weighing risks, assessing potential harms, and making reasonable projections of future trends and possibilities. It follows that when exercising her judgment the Administrator balances the likelihood and severity of effects. This balance involves a sliding scale; on one end the severity of the effects may be significant, but the likelihood low, while on the other end the severity may be less significant, but the likelihood high. Under either scenario, the Administrator is permitted to find endangerment. If the harm would be catastrophic, the Administrator is permitted to find endangerment even if the likelihood is small. In the context of climate change, for example, the Administrator should take account of the most catastrophic scenarios and their probabilities. As explained below, however, it is not necessary to rely on low-probability outcomes in order to find endangerment here.[5]

Because scientific knowledge is constantly evolving, the Administrator may be called upon to make decisions while recognizing the uncertainties and limitations of the data or information available, as risks to public health or welfare may involve the frontiers of scientific or medical knowledge. At the same time, the Administrator must exercise reasoned decision making, and avoid speculative or crystal ball inquiries. Third, the Administrator is to consider the cumulative impact of sources of a pollutant in assessing the risks from air pollution, and is not to look only at the risks attributable to a single source or class of sources. Fourth, the Administrator is to consider the risks to all parts of our population, including those who are at greater risk for reasons such as increased susceptibility to adverse health effects. If vulnerable subpopulations are especially at risk, the Administrator is entitled to take that point into account in deciding the question of endangerment. Here too, both likelihood and severity of adverse effects are relevant, and here too, catastrophic scenarios and their probabilities should be considered. As explained below, vulnerable subpopulations face serious health risks as a result of climate change.

This framework recognizes that regulatory agencies such as EPA must be able to deal with the reality that ''[m]an's ability to alter his environment has developed far more rapidly than his ability to foresee with certainty the effects of his alterations.'' *See Ethyl Corp* v. *EPA,* 541 F.2d 1, 6 (D.C. Cir.), cert. denied 426 U.S. 941 (1976). Both ''the Clean Air Act 'and common sense * * * demand regulatory action to prevent harm, even if the regulator is less than certain that harm is otherwise inevitable.' '' *See Massachusetts* v. *EPA,* 549 U.S. at 506, n.7 (citing Ethyl Corp.). To be sure, the concept of ''expected value'' has its limitations in this context, but it is useful insofar as it suggests that when severe risks to the public health and welfare are involved, the Administrator need not wait as evidence continues to accumulate.

The Administrator recognizes that the context for this action is unique. There is a very large and comprehensive base of scientific information that has been

[5] Cf. *Massachusetts* v. *EPA,* 549 U.S. at 525 n.23, citing *Mountain States Legal Foundation* v. *Glickman,* 92 F.3d 1228, 1234 (D.C. Cir. 1996) (''The more drastic the injury that government action makes more likely, the lesser the increment in probability to establish standing''); *Village of Elk Grove Village* v. *Evans,* 997 F.2d 328, 329 (7th Cir. 1993) (''[E]ven a small probability of injury is sufficient to create a case or controversy—to take a suit out of the category of the hypothetical—provided of course that the relief sought would, if granted, reduce the probability.'').

developed over many years through a global consensus process involving numerous scientists from many countries and representing many disciplines. She also recognizes that there are varying degrees of uncertainty across many of these scientific issues. It is in this context that she is exercising her judgment and applying the statutory framework. Further discussion of the language in section 202(a) and its legislative history is provided below, to explain more fully the basis for this interpretation.

1. The Statutory Language

The interpretation described above flows from the statutory language itself. The phrase ''may reasonably be anticipated'' and the term ''endanger'' authorize, if not require, the Administrator to act to prevent harm and to act in conditions of uncertainty. They do not limit her to merely reacting to harm or to acting only when certainty has been achieved; indeed, the references to anticipation and to endangerment imply that to fail to look to the future or to less than certain risks would be to abjure the Administrator's statutory responsibilities. Moreover, by instructing the Administrator to consider whether emissions of an air pollutant cause or contribute to air pollution, the statute is clear that she need not find that emissions from any one sector or group of sources are the sole or even the major part of an air pollution problem. The use of the term contribute clearly indicates that a lower threshold than a finding that such emissions are the sole or major cause is a sufficient basis to make the required finding. Finally, the phrase ''in [her] judgment'' authorizes the Administrator to weigh risks and to consider projections of future possibilities, while also recognizing uncertainties and extrapolating from existing data. When exercising her judgment the Administrator balances the likelihood and severity of effects. Notably, the phrase ''in [her] judgment'' modifies both ''may reasonably be anticipated'' and ''cause or contribute.''

2. Origin of the Current Statutory Language

When Congress revised section 202(a) and other provisions of the CAA as part of the 1977 amendments to the CAA, it was responding to an opinion issued by the D.C. Circuit regarding the pre-1977 version of section 211(c) of the Act. The legislative history of those amendments, particularly the report by the House Committee on Interstate and Foreign Commerce, demonstrate that EPA's interpretation is fully consistent with Congress' intention in crafting this a provision *See* H.R. Rep. 95–294 (1977), as reprinted in 4 A Legislative History of the Clean Air Act Amendments of 1977 (1978) at 2465 (hereinafter ''LH'').

a. Ethyl Corp. v. EPA

In revising the statutory language, Congress relied heavily on the en banc decision in *Ethyl Corp.* v. *EPA,* which reversed a 3-judge panel opinion regarding an EPA rule restricting the content of lead in leaded gasoline.[6] After reviewing the relevant facts and law, the full court evaluated the statutory language at issue to see what level of ''certainty [was] required by the Clean Air Act before EPA may act.'' *Id.* at 7.

The petitioners argued that the statutory language ''will endanger'' required proof of actual harm, and that the actual harm had to come from emissions from the fuels in and of themselves. *Id.* at 12, 29. The en banc court rejected this approach, finding that the term ''endanger'' allowed the Administrator to act when harm is threatened, and did not require proof of actual harm. *Id.* at 13. ''A statute allowing for regulation in the face of danger is, necessarily, a precautionary statute.'' *Id.* Optimally, the court held, regulatory action would not only precede, but prevent, a perceived threat. *Id.*

The court also rejected petitioner's argument that any threatened harm must be ''probable'' before regulation was authorized. Specifically, the court recognized that danger ''is set not by a fixed probability of harm, but rather is composed of reciprocal elements of risk and harm, or probability and severity.'' *Id.* at 18. Next, the court held that EPA's evaluation of risk is necessarily an exercise of judgment, and that the statute did not require a factual finding. *Id.* at 24. Thus, ultimately, the Administrator must ''act, in part on 'factual issues,' but largely 'on choices of policy, on an assessment of risks, [and] on predictions dealing with matters on the frontiers of scientific knowledge * * *.'' *Id.* at 29 (citations omitted). Finally, the en banc court agreed with EPA that even without the language in section 202(a) regarding ''cause or contribute to,'' it was appropriate for EPA to consider the cumulative impact of lead from numerous sources, not just the fuels being regulated under section 211(c). *Id.* at 29–31.

b. The 1977 Clean Air Act Amendments

The dissent in the original *Ethyl Corp.* decision and the en banc opinion were of ''critical importance'' to the House Committee which proposed the revisions to the endangerment language in the 1977 amendments to the CAA. H.R. Rep. 95–294 at 48, 4 LH at 2515. In particular, the Committee believed the *Ethyl Corp.* decision posed several ''crucial policy questions'' regarding the protection of public health and welfare.'' *Id.*[7] The Committee addressed those questions with the language that now appears in section 202(a) and several other CAA provisions—''emission of any air pollutant * * *, which in [the Administrator's] judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.''

The legislative history clearly indicates that the Committee intended the language to serve several purposes consistent with the en banc decision in *Ethyl Corp.* In particular, the language (1) emphasizes the preventive or precautionary nature of the CAA[8]; (2) authorizes the Administrator to reasonably project into the future and weigh risks; (3) assures the consideration of the cumulative impact of all sources; (4) instructs that the health of susceptible individuals, as well as healthy adults, should be part of the analysis; and (5) indicates an awareness of the uncertainties and limitations in information available to the Administrator. H.R. Rep. 95–294 at 49–50, 4 LH at 2516–17.[9]

As noted above, the phrase ''in [her] judgment'' calls for the Administrator to make a comparative assessment of risks and projections of future possibilities, consider uncertainties, and extrapolate from limited data. Thus, the Administrator must balance the likelihood of effects with the severity of

[6] At the time of the 1973 rules requiring the reduction of lead in leaded gasoline, section 211(c)(1)(A) of the CAA stated that the Administrator may promulgate regulations that: ''control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle or motor vehicle engine (A) if any emissions product of such fuel or fuel additive will *endanger the public health or welfare* * * *.'' CAA 211(c)(1)(A) (1970) (emphasis added). The italicized language in the above quote is the relevant language revised by the 1977 amendments.

[7] The Supreme Court recognized that the current language in section 202(a)(1) is ''more-protective'' than the 1970 version that was similar to the section 211 language before the DC Circuit in *Ethyl Corp. Massachusetts* v. *EPA,* 549 U.S. at 506, fn 7.

[8] *See* H.R. Rep. 95–294 at 49, 4 LH at 2516 (''To emphasize the preventive or precautionary nature of the Act, i.e. to assure that regulatory action can effectively prevent harm before it occurs'').

[9] Congress also standardized this language across the various sections of the CAA which address emissions from both stationary and mobile sources. H.R. Rep. 95–294 at 50, 4 LH at 2517; Section 401 of CAA Amendments of 1977.

the effects in reaching her judgment. The Committee emphasized that ''judgment'' is different from a factual ''finding.''[10] The Administrator may make projections, assessments and estimates that are reasonable, as compared to a '' 'crystal ball' inquiry.'' Moreover, procedural safeguards apply to the exercise of judgment, and final decisions are subject to judicial review. Also, the phrase ''in [her] judgment'' modifies both the phrases ''cause and contribute'' and ''may reasonably be anticipated,'' as discussed below. H.R. Rep. 95–294 at 50–51, 4 LH at 2517–18.

As the Committee further explained, the phrase ''may reasonably be anticipated'' points the Administrator in the direction of assessing current and future risks rather than waiting for proof of actual harm. This phrase is also intended to instruct the Administrator to consider the limitations and difficulties inherent in information on public health and welfare. H.R. Rep. 95–294 at 51, 4 LH at 2518.[11]

Finally, the phrase ''cause or contribute'' ensures that all sources of the contaminant which contribute to air pollution are considered in the endangerment analysis (e.g., not a single source or category of sources). It is also intended to require the Administrator to consider all sources of exposure to a pollutant (for example, food, water, and air) when determining risk. *Id.*

3. Additional Considerations for the Cause or Contribute Analysis

By instructing the Administrator to consider whether emissions of an air pollutant cause or contribute to air pollution, the statute is clear that she need not find that emissions from any one sector or group of sources are the sole or even the major part of an air pollution problem. The use of the term contribute clearly indicates a lower threshold than the sole or major cause. Moreover, the statutory language in section 202(a) does not contain a modifier on its use of the term contribute. Unlike other CAA provisions, it does not require ''significant'' contribution. *See, e.g.,* CAA sections 111(b); 213(a)(2), (4). Congress made it clear that the Administrator is to exercise her judgment in determining contribution, and authorized regulatory controls to address air pollution even if the air pollution problem results from a wide variety of sources. While the endangerment test looks at the entire air pollution problem and the risks it poses, the cause or contribute test is designed to authorize EPA to identify and then address what may well be many different sectors or groups of sources that are each part of the problem.

The DC Circuit Court of Appeals has discussed the concept of contribution in the context of CAA section 213 and rules for nonroad vehicles. In *Bluewater Network* v. *EPA,* 370 F.3d 1 (DC Cir. 2004), industry argued that section 213(a)(3) requires a finding of a significant contribution before EPA can regulate, while EPA's view was that the CAA requires a finding only of contribution. *Id.* at 13. Section 213(a)(3), like section 202(a), is triggered by a finding that certain sources ''cause, or contribute to,'' air pollution, while an adjacent provision, section 213(a)(2), is triggered by a finding of a ''significant'' contribution. The court looked at the ''ordinary meaning of 'contribute' '' when upholding EPA's reading. After referencing dictionary definitions of contribute, the court also noted that ''[s]tanding alone, the term has no inherent connotation as to the magnitude or importance of the relevant 'share' in the effect; certainly it does not incorporate any 'significance' requirement.'' 370 F.3d at 13.[12] The court found that the bare ''contribute'' language invests the Administrator with discretion to exercise judgment regarding what constitutes a sufficient contribution for the purpose of making an endangerment finding. *Id.* at 14.[13]

Like section 213(a)(3), section 202(a) refers to contribution and does not specify that the contribution must be significant before an affirmative finding can be made. To be sure, any finding of a ''contribution'' requires some threshold to be met; a truly trivial or *de minimis* ''contribution'' might not count as such. The Administrator therefore has ample discretion in exercising her reasonable judgment and determining whether, under the circumstances presented, the cause or contribute criterion has been met.[14] In the past, the Administrator has evaluated the emissions of the source or sources in different ways, based on the particular circumstances involved. For instance, in some mobile source rulemakings, the Administrator has used the percent of emissions from the regulated mobile source category compared to the total mobile source inventory for that air pollutant as the best way to evaluate contribution. *See,* e.g., 66 FR 5001 (2001) (heavy duty engine and diesel sulfur rule). In other instances the Administrator has looked at the percent of emissions compared to the total nonattainment area inventory of the air pollution at issue. *See,* e.g., 67 FR 68,242 (2002) (snowmobile rule). EPA has found that air pollutant emissions that amount to 1.2 percent of the total inventory ''contribute.'' *Bluewater Network,* 370 F.3d at 15 (''For Fairbanks, this contribution was equivalent to 1.2 percent of the total daily CO inventory for 2001.'').

While these prior actions are instructive, they do not establish bright line emission levels above which a positive contribution determination must be made, or below which a contribution determination could not be made. The Administrator may determine that emissions at a certain level or percentage contribute to air pollution in one set of circumstances, while also judging that the same level or percentage of another air pollutant in a different circumstances and involving different air pollution does not contribute. When exercising her judgment, the Administrator not only considers the cumulative impact, but also looks at the totality of the circumstances (e.g., the air pollutant, the air pollution, the nature of the endangerment, the type of source category, the number of sources in the source category, and the number and type of other source categories that may emit the air pollutant) when determining whether the emissions ''justify regulation'' under the CAA. Further discussion of this issue can be found in Section IV.

[10] Throughout this Notice the judgments on endangerment and cause or contribute are described as a finding or findings. This is for ease of reference only, and is not intended to imply that the Administrator's exercise of judgment in applying the scientific information to the statutory criteria is solely a factual finding; while grounded squarely in the science of climate change, these judgments also embody policy considerations.

[11] Thus, contrary to the position set forth by at least one commenter on the Greenhouse Gas ANPR, the statutory language does not require that EPA prove the effects of climate change ''beyond a reasonable doubt.'' Indeed, such an approach is inconsistent with the concepts of reasonable anticipation and endangerment embedded in the statute.

[12] Specifically, the decision noted that '' 'contribute' means simply 'to have a share in any act or effect,' WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 496 (1993), or 'to have a part or share in producing,' 3 OXFORD ENGLISH DICTIONARY 849 (2d ed. 1989).'' Id. at 13.

[13] The court explained, ''[t]he repeated use of the term 'significant' to modify the contribution required for all nonroad vehicles, coupled with the omission of this modifier from the 'cause, or contribute to' finding required for individual categories of new nonroad vehicles, indicates that Congress did not intend to require a finding of 'significant contribution' for individual vehicle categories.'' Id. at 13.

[14] Section IV discusses the evidence in this case that supports the proposed finding of contribution. EPA need not determine at this time the circumstances in which emissions would be trivial or de minimis and would not warrant a finding of contribution.

4. Comments on Elements of the Endangerment and Cause or Contribute Tests Made During the ANPR Public Comment Period

Certain comments submitted on the ANPR [15] argued that when evaluating endangerment and cause or contribute, the Administrator is limited to considering only those impacts that can be traced to the amount of air pollution directly attributable to the greenhouse gases emitted by new motor vehicles and engines. Such an approach collapses the two prongs of the test by requiring that any climate change impacts upon which an endangerment determination is made result solely from the greenhouse gas emissions of motor vehicles. It essentially eliminates the ''contribute'' part of the ''cause or contribute'' portion of the test. This approach was clearly rejected by the en banc court in *Ethyl Corp.* 541 F.2d at 29 (rejecting the argument that the emissions of the fuel additive to be regulated must ''in and of itself, i.e. considered in isolation, endanger[s] public health.''). Moreover, it conflicts with an enumerated purpose of the 1977 CAA Amendments: ''To assure consideration of the cumulative impact of all sources of a pollutant in setting ambient and emission standards, not just the extent of the risk from the emissions from a single source or class of sources of the pollutant; * * *'' H.R. Rep. 95–294 at 49–50, 4 LH at 2516–17.

Nor does EPA agree with comments that argue the Administrator cannot make a positive endangerment or contribution determination unless the emissions reductions required by the resulting standards would ''effectively mitigate'' or ''fruitfully attack'' the impacts underlying the endangerment determination. Again, such an approach fails to appreciate the holistic approach that Congress adopted in 1977. Moreover, as the Supreme Court recognized, ''[a]gencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop.'' *Massachusetts* v. *EPA,* 549 U.S. at 524 (citations omitted).[16] The threshold endangerment and cause or contribute criteria are separate and distinct from the standard setting criteria that apply if the threshold findings are met, and they serve a different purpose. Indeed, the more serious the endangerment to public health and welfare, the more important it may be that action be taken to address the actual or potential harm even if no one action alone can solve the problem, and a series of actions is called for.

Importantly, these various narrow approaches to the endangerment and cause or contribute criteria would effectively preclude the Administrator from ever making a positive finding for a global phenomenon like climate change because the regulatory actions would always be limited to just part of the picture. Indeed, they would preclude the Administrator from making a positive finding for any complex pollution problem that cannot be solved by one regulatory action alone. This is contrary to Congress' direction that the Administrator consider the whole picture when exercising her judgment about the critical issues of cause or contribute and endangerment to public health and welfare.

B. Air Pollutant, Public Health and Welfare

The CAA defines both ''air pollutant'' and ''welfare.'' Air pollutant is defined as: ''Any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air. Such term includes any precursors to the formation of any air pollutant, to the extent the Administrator has identified such precursor or precursors for the particular purpose for which the term 'air pollutant' is used.'' CAA section 302(g). Greenhouse gases fit well within this capacious definition. See *Massachusetts* v. *EPA,* 549 U.S. at 532. They are ''without a doubt'' physical chemical substances emitted into the ambient air. *Id.* at 529. Section IV below contains further discussion on today's proposed definition of ''air pollutant'' for purposes of the contribution finding.

Regarding ''welfare'', the CAA states that ''[a]ll language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants.'' CAA section 302(h). This definition is quite broad. Importantly, it is not an exclusive list due to the use of the term ''includes, but is not limited to, * * *.'' Effects other than those listed here may also be considered effects on welfare.

Moreover, the terms contained within the definition are themselves expansive. For example, deterioration to property could include damage caused by extreme weather events. Effects on vegetation can include impacts from changes in temperature and precipitation as well as from the spreading of invasive species or insects. Prior welfare effects evaluated by EPA include impacts on vegetation generally, and changes in crop and forestry specifically, as well as reduced visibility, changes in nutrient balance and acidity of the environment, soiling of buildings and statues, and erosion of building materials. *See, e.g.,* Final National Ambient Air Quality Standard for Ozone, 73 FR 16436 (2007); Control of Emissions from Nonroad Large Spark Ignition Engines and Recreational Engines (Marine and Land-Based), 67 FR 68242 (2002); Final Heavy-Duty Engine and Vehicle Standards and Highway Diesel Sulfur Control Requirements, 66 FR 5002 (2001).

There is no definition of public health in the Clean Air Act. The Supreme Court has discussed the concept in the context of whether costs can be considered when setting National Ambient Air Quality Standards. *Whitman* v. *American Trucking Ass'n,* 531 U.S. 457 (2001). In *Whitman,* the Court imbued the term with its most natural meaning: ''the health of the public.'' *Id.* at 466.

When considering public health, EPA has looked at morbidity, such as

[15] Numerous comments on the ANPR discussed the endangerment and cause or contribute findings, and set forth how various stakeholders believe EPA is compelled to make those findings. EPA has reviewed the comments on the ANPR, and EPA appreciates the work that went into them. While we are not responding to every comment received in today's proposal, the Agency is taking this opportunity to respond to a few key comments related to the test that some stakeholders believe guides the Administrator when undertaking an endangerment analysis and cause or contribute evaluation. As noted above, commenters should submit to the docket for today's action any comments they want EPA to consider as it makes a decision on this proposed determination.

[16] EPA also rejects the comment that EPA has defined ''contribute'' as resulting in a ''humanly perceptible'' difference. See Regional Haze Regulations and Guidelines for Best Available Retrofit Technology [BART] Determinations, 70 FR 39104 (2005). In that rule, EPA noted that a 1.0 deciview change in visibility is humanly perceptible in virtually all situations. Based on this, EPA concluded that for a state making a contribution finding for an individual source under section 169A(b)(2)(A), it would be unreasonable to determine that a source emitting pollution that resulted in a 0.5 deciview change in visibility did not ''contribute'' to visibility impairment. Id. at 39120. In fact, EPA noted that ''[i]f 'causing' visibility impairment means causing a humanly perceptible change in visibility, * * * then 'contributing' to visibility impairment must mean having some lesser impact * * * that need not rise to the level of human perception.'' *Id.* at 39120, fn 32. The Agency did not establish a test that required human perception before contribution could be found.

impairment of lung function, aggravation of respiratory and cardiovascular disease, and other acute and chronic health effects, as well as mortality. *See,* e.g., Final National Ambient Air Quality Standard for Ozone, 73 FR 16436 (2007).

III. The Administrator's Proposed Endangerment Finding

This section describes the basis for the proposed endangerment finding, by laying out the scientific evidence and the Administrator's rationale for reaching this judgment. The first section describes the approach EPA has taken in gathering and synthesizing the best available scientific information to inform the Administrator's judgment, the next section describes the proposed definition of the air pollution, and the third section discusses the scientific evidence and the Administrator's reasons for judging that the air pollution is reasonably anticipated to endanger both public health and public welfare.

A. Approach in Utilizing the Best Available Scientific Information

EPA has developed a technical support document (TSD) which synthesizes major findings from the best available scientific assessments that have gone through rigorous and transparent peer review. The TSD therefore relies most heavily on the major assessment reports of both the Intergovernmental Panel on Climate Change (IPCC) and the U.S. Climate Change Science Program (CCSP). EPA took this approach rather than conducting a new assessment of the scientific literature. The IPCC and CCSP assessments base their findings on the large body of many individual, peer-reviewed studies in the literature, and then the IPCC and CCSP assessments themselves go through a transparent peer-review process. The TSD was in turn reviewed by a dozen federal government scientists, who have contributed significantly to the body of climate change literature, and indeed to our common understanding of this problem. The information in the TSD has therefore been developed and prepared in a manner that is consistent with EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility and Integrity of Information Disseminated by the Environmental Protection Agency.*[17] Furthermore, relying most heavily on the assessment reports that reflect the scientific literature more broadly guards against an overreliance on and narrow consideration of individual studies.

An earlier version of this TSD was publicly released on July 30, 2008, to accompany the ANPR. The July 2008 version of the TSD has been updated to reflect the findings of 11 additional CCSP reports that have since been published, and to incorporate more recent climate data from U.S. federal agencies. This addresses a number of concerns raised by commenters about the July 2008 version of the TSD, arguing that it relied too heavily on the IPCC Fourth Assessment Report (published 2007), which some argued was either not current enough or not specific enough to U.S. conditions. We note that the IPCC North American chapter (of the Working Group II volume) on impacts, adaptation and vulnerability covers the U.S. and Canada (not Mexico) and that the general findings in that chapter (drawn from many individual studies for the U.S.) are indeed applicable to U.S. conditions. Even with more recent information available, the IPCC Fourth Assessment Report remains a standard reference, essentially serving as the benchmark against which new findings over the next few years will be compared. Therefore it also serves as a robust and valuable reference for purposes of this proposal. The TSD has also been edited or updated in a number of places to reflect specific comments received on the July 2008 version, and to reflect comments from an additional round of review by the federal scientists following the incorporation of the more recent scientific findings.

Regarding the scope of the relevant scientific findings, EPA took the approach that the timeframe under consideration should be consistent with the timeframe over which greenhouse gases may influence the climate (i.e., observed effects and projected effects over the next several decades and indeed at least for the remainder of this century). Moreover, the analysis was not restricted to only those climate and public health or welfare effects which may be attributable solely to greenhouse gas emissions from section 202(a) sources under the Act. In addition, although the primary focus for evaluation of risks and impacts to public health or welfare was on the U.S., careful consideration was also given to the global context.

Finally, climate policy or societal responses to any known or perceived risks and impacts to public health or welfare, which may or may not be implemented in the future—whether through planned adaptation or greenhouse gas mitigation measures—were not explicitly assessed in the endangerment analysis. Some observed and projected effects or risks due to climate change reported in the TSD and summarized below do have embedded within them assumptions about autonomous behavioral or management changes to cope with climate change. We have noted these situations in the TSD. However, it is the Administrator's position that the purpose of the endangerment analysis is to assess the risks posed to public health and welfare, rather than to estimate how various adaptation and greenhouse gas mitigation policies may ameliorate or exacerbate any endangerment that exists. Indeed, the presumed need for adaptation and greenhouse gas mitigation to occur to avoid, lessen or delay the risks and impacts associated with human-induced climate change presupposes that there is endangerment to public health or welfare. The Administrator therefore disagrees with commenters on the ANPR who argue that when considering whether the atmospheric concentration of greenhouse gases may reasonably be anticipated to endanger public health or welfare, she must consider the impact from the regulation of greenhouse gases under the CAA following an endangerment finding. The Administrator also believes it is inappropriate, in considering whether greenhouse gases endanger public health or welfare, to consider potential private behavior aimed at alleviating some of the effects of climate change. Just as the Administrator would not consider, for example, the availability of asthma medication in determining whether criteria air pollutants endanger public health, so the Administrator will not consider private behavior in the endangerment determination at hand. On the contrary, ameliorative steps of that kind would attest to the fact of endangerment.

To be sure, private adaptation might be considered as a relevant factor in deciding on the proper regulatory approach, although the Administrator need not decide that here. Determining whether there are adverse public health and welfare impacts due to the existence of air pollution is a separate matter from considering the appropriate approaches for responding to any such impacts and the possible repercussions of those approaches. The proposed approach suggested by commenters essentially would insert extra-statutory considerations into the endangerment analysis.

[17] U.S. EPA (2002), EPA/260R–02–008 *http://www.epa.gov/quality/informationguidelines/documents/EPA_InfoQualityGuidelines.pdf.*

B. The Air Pollution

In applying the endangerment test to greenhouse gases under section 202(a), the Administrator must define the scope and nature of the relevant air pollution that must be evaluated. For this action, the Administrator is proposing that the air pollution be defined as the combined mix of six key directly-emitted and long-lived greenhouse gases which together constitute the root cause of human-induced climate change: carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The Administrator acknowledges that there are other anthropogenic climate forcers which play a role in climate change (discussed below), but that for today's action these other climate forcers are not the priority and may need to be evaluated further. What follows is a summary of key scientific findings from the TSD and the Administrator's rationale for the proposed definition of air pollution.

1. Common Features of the Six Key Greenhouse Gases

There are a number of scientific and policy reasons why the Administrator is proposing that the air pollution for this endangerment finding be defined as the combination of the six greenhouse gases. These six greenhouse gases are well studied by and have been the primary focus of climate change research, and are therefore the Administrator's first priority in addressing endangerment for greenhouse gases. These six greenhouse gases share common physical properties relevant to the climate change problem: all are long-lived [18] in the atmosphere; all become globally well mixed in the atmosphere regardless of where the emissions occur; all trap outgoing heat that would otherwise escape to space; and all are directly emitted as greenhouse gases rather than forming as a greenhouse gas in the atmosphere after emission of a precursor gas. Because of these properties, the climate effects of these greenhouse gases are generally better understood than the climate effects associated with most other climate-forcing agents (described in more detail in subsection 4 below).

As discussed above, carbon dioxide is the most important greenhouse gas directly emitted by human activities in terms of its total additional heating effect being exerted on the climate. However, the other greenhouse gases are stronger heat-trapping gases compared to carbon dioxide on a per mass basis, [19] and are responsible for a sizable fraction of the total anthropogenic climatic heating effect caused to date. Collectively, increased atmospheric concentrations of methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride have exerted an additional heating effect on the global climate since pre-industrial times that is about 40 percent as large as the additional carbon dioxide heating effect, according to the IPCC. Of these non-CO_2 greenhouse gases, methane is the most important in terms of its total additional heating effect. Under all future scenarios, carbon dioxide is projected to remain the dominant driver of climate change for the remainder of this century.

Because these six greenhouse gases share common properties and are the key driver of human-induced climate change, they have been the common focus of climate change science and policy to date. The United Nations Framework Convention on Climate Change (UNFCCC) addresses these six long-lived, well-mixed greenhouse gases not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer. The IPCC scientific assessments focus primarily on these six greenhouse gases and their effects on climate.

Treating the air pollution as the mix of the six greenhouse gases is consistent with other provisions of the Act and previous EPA practice under the Act, where separate air pollutants from different sources but with common properties may be treated as a class (e.g., Class I and Class II substances under Title VI). This approach addresses the cumulative effect that the elevated concentrations of the six greenhouse gases have on climate, and thus on different elements of health, society and the environment.[20]

The scientific literature that assesses the potential risks and end-point impacts of human-induced climate change does not typically assess these impacts on a gas-by-gas basis. It is true that estimates are available for how individual greenhouse gases and other climate-forcing agents are contributing to the anthropogenic heating (or cooling) effect being exerted on the global climate. However, as one moves farther down the causal chain towards end-point risks and impacts to human health, society and the environment, such impacts, whether observed or projected, are typically not attributed to the temperature increase or other climatic change due to the elevated atmospheric concentration of just one of the greenhouse gases.

2. Evidence That the Six Greenhouse Gases Are at Unprecedented Levels in the Atmosphere

Given the long atmospheric lifetime and global mixing of greenhouse gases, global average atmospheric concentrations are an important metric by which to measure changes in atmospheric composition. Current atmospheric greenhouse gas concentrations are now at elevated levels as a result of both historic and current anthropogenic emissions. The global atmospheric carbon dioxide concentration has increased about 38 percent from pre-industrial levels to 2009, and almost all of the increase is due to anthropogenic emissions. The current (year 2009) carbon dioxide concentration is 386 parts per million (ppm) and has recently been increasing by about 2.0 ppm per year. The global atmospheric concentration of methane has increased by 149 percent since pre-industrial levels (through 2007), and the nitrous oxide concentration has increased 23 percent (through 2007). The observed concentration increase in these gases can also be attributed primarily to anthropogenic emissions. The industrial fluorinated gases, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, are almost entirely anthropogenic in origin, and have relatively low atmospheric concentrations but are increasing rapidly; concentrations of many of these gases have increased by large factors

[18] We use ''long-lived'' here to mean that the gas has a lifetime in the atmosphere sufficient to become globally well mixed throughout the entire atmosphere, which requires a minimum atmospheric lifetime of about one year. IPCC also refers to these six greenhouse gases as long-lived. Methane has an atmospheric lifetime of roughly a decade. One of the most commonly used hydrofluorocarbons (HFC–134a) has a lifetime of 14 years. Nitrous oxide has a lifetime of 114 years; sulfur hexafluoride over 3,000 years; and some PFCs up to 10,000 to 50,000 years. Carbon dioxide is generally thought to have a lifetime of roughly 100 years, but for a given amount of carbon dioxide emitted some fraction is quickly absorbed by the oceans and terrestrial vegetation and the remainder will only slowly decay in the atmosphere after several years, and indeed some portion will remain in the atmosphere for many centuries.

[19] Global warming potentials (GWPs) for each greenhouse gas have been estimated by IPCC so that emissions of these gases can be compared to one another on a CO_2-equivalent basis. The GWP represents the cumulative heating effect of a gas over a specified timeframe in the atmosphere (100 years), relative the heating effect caused by carbon dioxide, the reference gas. Carbon dioxide is assigned a GWP of 1, whereas methane has a GWP of 21. The GWP of sulfur hexafluoride is 23,900.

[20] Due to the cumulative purpose of the statutory language, even if the Administrator were to look at the atmospheric concentration of each greenhouse gas individually, she would still consider the impact of the concentration of a single greenhouse gas in combination with that caused by the other greenhouse gases.

(between 4.3 and 1.3) between 1998 and 2005.

Historic data that go back many thousands of years show that current atmospheric concentrations of the two most important directly emitted, long-lived greenhouse gases (carbon dioxide and methane) are well above the natural range of atmospheric concentrations compared to the last 650,000 years. Atmospheric greenhouse gas concentrations have been increasing because human emissions have been outpacing the ability of the natural environment to remove greenhouse gases from the atmosphere over timescales of decades to centuries.

The Administrator recognizes these scientific findings that the current global atmospheric concentrations of the six greenhouse gases are now at unprecedented and record-high levels compared to both the recent and distant past. It is also unambiguous that the current elevated greenhouse gas concentrations are the primary result of human activities.

Total concentrations of these greenhouse gases are projected to continue climbing, and thus to continue pushing unprecedented levels upwards for the foreseeable future under different plausible assumptions of U.S. and global greenhouse gas-emitting activities. Given the long atmospheric lifetime of the six greenhouse gases, significant changes in total greenhouse gas global atmospheric concentrations do not come about quickly (i.e., within a few years). Future atmospheric greenhouse gas concentrations—not only for the remainder of the current century but indeed for decades and in some cases centuries well beyond 2100—will be influenced by our present and near-term greenhouse gas emissions. Consideration of future plausible scenarios, and how our current greenhouse gas emissions essentially commit present and future generations to cope with an altered atmosphere and climate, reinforces the Administrator's judgment that it is appropriate to define the combination of the six key greenhouse gases as the air pollution.

3. Evidence That Elevated Atmospheric Concentrations of the Six Greenhouse Gases Are the Root Cause of Observed Climate Change

The scientific evidence is compelling that elevated concentrations of heat-trapping greenhouse gases are the root cause of recently observed climate change. This is different from historic drivers of climate change, such as cyclical changes in the Earth's orbit, which have occurred over thousands of years.

The global average net effect of the increase in atmospheric greenhouse gas concentrations, plus other human activities (e.g., land use change and aerosol emissions), on the global energy balance since 1750 has been one of warming. This total net heating effect, referred to as forcing, is estimated to be 1.6 Watts per square meter (W/m^2), with much of the range surrounding this estimate due to uncertainties about the cooling and warming effects of aerosols. The combined radiative forcing due to the cumulative increase in atmospheric concentrations of carbon dioxide, methane, and nitrous oxide over the period 1750 to 2005 is 2.30 W/m^2. The positive radiative forcing due to carbon dioxide is the largest (1.66 W/m^2). Methane is the second largest source of positive radiative forcing (0.48 W/m^2). Nitrous oxide has a positive radiative forcing of 0.16 W/m^2. The rate of increase in forcing due to these three greenhouse gases during the industrial era is, according to IPCC, very likely [21] to have been unprecedented in more than 10,000 years.

Warming of the climate system is now unequivocal, as is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Global mean surface temperatures have risen by 0.74 °C (1.3 °F) over the last 100 years. Eight of the ten warmest years on record have occurred since 2001. Global mean surface temperature was higher during the last few decades of the 20th century than during any comparable period during the preceding four centuries.

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. Global observed temperatures over the last century can be reproduced only when model simulations include both natural and anthropogenic forcings, that is, simulations that remove anthropogenic forcings are unable to reproduce observed temperature changes. Thus, most of the warming cannot be explained by natural variability, such as variations in solar activity.

In addition to attributing recent global warming to anthropogenic greenhouse gas influence at the global scale, both the IPCC and CCSP reports attributed recent North American warming to elevated greenhouse gas concentrations. A 2008 CCSP report [22] found that for North America, ''more than half of this warming [for the period 1951–2006] is likely [23] the result of human-caused greenhouse gas forcing of climate change.''

Therefore, by defining air pollution as the six greenhouse gases, the Administrator is identifying the fundamental and underlying driver of human-induced climate change, which in turn, as described below, poses risks to human health, society, and the environment. The Administrator believes that the proposed definition of air pollution captures the root of the problem, and addresses the part of the problem that is best understood, scientifically speaking, and that is already the focus of scientists and policy analysts involved in studying climate change. Because the six greenhouse gases are collectively the primary driver of the climate change problem, all current and future risks due to human-induced climate change—whether these risks are associated with increases in temperature, changes in precipitation, a rise in sea levels, changes in the frequency and intensity of weather events, or more directly with the elevated greenhouse gas concentrations themselves—can be associated with this definition of ''air pollution.'' This does not imply that other anthropogenic climate forcers, discussed below, would pose no risks. EPA has considered whether other climate-forcing agents in addition to the six greenhouse gases should be included in this proposed definition of air pollution, and for the reasons discussed below is not proposing to include them in the definition of air pollution for purposes of this proposed endangerment finding.

4. Other Climate Forcers

There are other greenhouse gases and aerosols that have warming (and cooling) effects but are not being included in the proposed definition of air pollution. These include water vapor, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs),

[21] According to IPCC terminology, ''very likely'' conveys a 90 to 99 percent probability of occurrence. ''Virtually certain'' conveys a greater than 99 percent probability, and ''likely'' conveys a 66 to 90 percent probability.

[22] CCSP (2008) *Reanalysis of Historical Climate Data for Key Atmospheric Features: Implications for Attribution of Causes of Observed Change.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Randall Dole, Martin Hoerling, and Siegfried Schubert (eds.)]. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC, 156 pp.

[23] This CCSP report used likelihood terminology that is consistent with that used by IPCC where ''likely'' also conveys a 66 to 90 percent probability of occurrence.

halons, tropospheric ozone (O_3), black carbon, and other short-lived precursor gases. For each of these substances, there are different scientific and policy reasons why these substances are not being included in the proposed definition of air pollution for purposes of section 202(a).

a. Water Vapor

Water vapor is the most abundant naturally occurring greenhouse gas and therefore makes up a significant share of the natural, background greenhouse effect. However, direct water vapor emissions from human activities have only a negligible effect on atmospheric concentrations of water vapor, whereas direct emissions of the six greenhouse gases have significantly altered the global atmospheric concentrations of those gases, as detailed above. Significant changes to global atmospheric concentrations of water vapor can occur indirectly through human-induced global warming, which then increases the amount of water vapor in the atmosphere because a warmer atmosphere can hold more moisture. Therefore, changes in water vapor concentrations are not an initial driver of climate change, but rather an effect of climate change which then acts as a positive feedback that further enhances warming. For this reason, the IPCC does not list direct emissions of water vapor as an anthropogenic forcing agent of climate change, but does include this water vapor feedback mechanism in response to human-induced warming in all modeling scenarios of future climate change. Based on this recognition that anthropogenic emissions of water vapor are a negligible driver of anthropogenic climate change, EPA's annual *Inventory of U.S. Greenhouse Gas Emissions and Sinks* does not include water vapor, and greenhouse gas inventory reporting guidelines under the UNFCCC do not require data on water vapor emissions.

Water vapor may be an issue of concern when it is emitted by aircraft at high altitudes, where, under certain conditions, it can lead to the formation of condensation trails, referred to as contrails. Similar to high-altitude, thin clouds, contrails have a warming effect. Extensive cirrus clouds can also develop from aviation contrails, and increases in cirrus cloud cover would also have a warming effect. The IPCC Fourth Assessment Report estimated a very small positive heating effect for linear contrails, with a low degree of scientific understanding. Unlike the warming effects associated with the six long-lived, well-mixed greenhouse gases, the warming effects associated with contrails or contrail-induced cirrus cloud cover are more regional and temporal in nature. EPA has received a petition under the Act to consider the regulation of aircraft emissions (water vapor and NOx) that lead to formation of contrails (in addition to aircraft greenhouse gas emissions), and EPA plans to evaluate this issue further. At this time, the Administrator is not proposing to include aircraft-related contrails or emissions that are not greenhouse gases within the definition of air pollution for purposes of section 202(a).

b. The Ozone-Depleting Substances: CFCs, HCFCs and Halons

Chlorofluorocarbons (CFCs), hydro-chlorofluorocarbons (HCFCs) and halons are ozone-depleting substances that have been responsible for the depletion of stratospheric ozone, which prevents harmful forms of ultraviolet radiation from reaching the Earth's surface. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international agreement that controls these substances. In the U.S., these substances are being controlled and phased out under Title VI of the Act. Despite their ozone-depleting properties, which the six greenhouse gases in the definition of air pollution do not share, these substances share other common physical properties with the six greenhouse gases: They are also long-lived in the atmosphere; well mixed throughout the global atmosphere; are directly emitted by anthropogenic sources; and have been responsible for a share of the human-induced heating effect to date. However, these substances have not been a priority for the scientists and policy analysts involved in studying climate change, and they are not a priority for the Administrator for this action. The UNFCCC does not address these substances and instead defers their treatment to the Montreal Protocol. The Administrator is not proposing to include these substances in the definition of air pollution with this action, but will continue to consider these issues.

c. Tropospheric Ozone

Increased concentrations of tropospheric O_3 are estimated to be causing a significant anthropogenic warming effect. However, unlike the long-lived six greenhouse gases, tropospheric O_3 has a short atmospheric lifetime (hours to weeks) and therefore its concentrations are more variable over space and time. For these reasons, its global heating effect and contribution to climate change tend to entail greater uncertainty compared to the well-mixed, long-lived greenhouse gases. Tropospheric O_3 is also not a directly emitted greenhouse gas, but rather undergoes secondary formation in the atmosphere from the emission of precursor gases such as nitrogen oxides (NO_X) and volatile organic compounds (VOCs). For these reasons, the Administrator is not including tropospheric O_3 in the proposed definition of air pollution with this action.

d. Black Carbon

Black carbon is not a greenhouse gas but an aerosol particle that results from incomplete combustion of the carbon contained in fossil fuels, and remains in the atmosphere for only about a week. Black carbon is a component of particulate matter (PM), which is regulated as a criteria air pollutant under the Act. Scientific studies have found an association between exposure to PM and significant health problems.

Black carbon causes a warming effect by absorbing incoming sunlight (whereas greenhouse gases cause warming by trapping outgoing, infrared heat), and by darkening bright surfaces such as snow and ice, which reduces reflectivity. This latter effect in particular has been raising concerns about the role black carbon may be playing in observed warming and ice melt in the Arctic.

Black carbon is co-emitted with other pollutants, especially organic carbon, which all tend to have a direct cooling effect on climate because they reflect and scatter incoming sunlight. However, black carbon, per unit mass, is a more effective warming agent than organic carbon is a cooling agent. The IPCC Fourth Assessment Report estimated that co-emissions of organic carbon may be offsetting about 40 percent of black carbon's warming effect on a global average. The ratio of black carbon to organic carbon varies by fuel type and by combustion efficiency, such that different emission sources will have different net climate effects; likewise, different emission reduction measures will have different net climate effects. Furthermore, because black carbon is short lived in the atmosphere, the net climate effect of a black carbon emission source will also depend on location; for example, emissions that deposit on snow and ice, or get lofted above cloud surfaces, could have a stronger warming effect. Like other aerosols, black carbon can also affect the reflectivity and lifetime of clouds. How black carbon and other aerosols, such as sulfates, alter cloud properties is a key source of uncertainty in quantifying the total

human influence on the global climate. This total cloud indirect effect caused by all aerosols (e.g., sulfates, black carbon and organic carbon) is estimated to be causing a net cooling effect, with a large range of uncertainty. Given these reasons, there is considerably more uncertainty associated with black carbon's warming effect compared to the estimated warming effect of the six long-lived greenhouse gases.

Given the number of science issues for black carbon that are different than for the six greenhouse gases, the Administrator is not proposing to include black carbon in the definition of air pollution for purposes of section 202(a) with this action. However, EPA is already undertaking work to further evaluate the role of black carbon in climate change, in addition to its role as an element of the already-regulated $PM_{2.5}$. Indeed, a recent study [24] referenced in the TSD estimated that black carbon is having a much stronger direct warming effect (160 percent higher on a global average) compared to IPCC's estimate. EPA has also received petitions to specifically address black carbon emissions under the Act from marine and aviation sources, and EPA plans to respond to these petitions in a separate action.

e. Fluorinated Ethers and Recently Identified Greenhouse Gases

Fluorinated ethers are used in electronics, anesthetics, and as heat transfer fluids. Like the six greenhouse gases included in the proposed definition of air pollution, these fluorinated compounds have heat-trapping properties and can also be long-lived in the atmosphere. In many cases these fluorinated gases are used in expanding industries (e.g., electronics) or as substitutes for hydrofluorocarbons. Also, new compounds that have greenhouse gas attributes continue to be discovered, such as nitrogen trifluoride (NF_3). The IPCC has now assigned global warming potentials (GWPs) to both fluorinated ethers and NF_3. However, the total global radiative forcing contribution of these compounds is not yet available to compare with the anthropogenic heating effect caused by the six greenhouse gases. The Administrator is not proposing to include these gases in the definition of air pollution with this action.

[24] Ramanathan V. and G. Carmichael (2008) Global and regional climate changes due to black carbon. *Nature Geoscience,* 1: 221–227.

C. The Administrator's Proposed Finding That the Air Pollution Endangers Public Health and Welfare

The scientific evidence clearly indicates that atmospheric levels of the six greenhouse gases are at unprecedented elevated levels due to human activities, and that most of the observed global and continental warming can be attributed to this anthropogenic rise in greenhouse gases. The information presented here builds on these facts that support the proposed definition of air pollution.

Based on the total weight of evidence, which is briefly summarized here and set forth in more detail in the TSD, it is the Administrator's judgment that current and projected levels of the mix of the six greenhouse gases endanger the public health and welfare of current and future generations.

The Administrator's proposed endangerment finding is based on the entire range of observed risks and potential harms to public health and welfare. The Administrator is not basing her proposal on any one impact, but instead is weighing the evidence collectively and determining that as a whole it clearly indicates that the air pollution at issue endangers public health and welfare now and in the future.

Furthermore, the Administrator is taking into account a number of key considerations that provide guidance on how to weigh and interpret the collective body of scientific evidence for today's proposal, namely: The observed record of climate change and our ability to attribute these changes to the observed anthropogenic buildup of greenhouse gases in the atmosphere; plausible future changes in climate over the next several decades and beyond given both the accumulation of greenhouse gases in the atmosphere to date plus expected increases in concentrations under different scenarios of future greenhouse gas emission pathways; the level of certainty with which we can reasonably project both near- and long-term climate change; our ability to identify known risks to public health and welfare, both today and in the future in light of a continually changing climate; the vulnerability of particularly susceptible populations and regions; the likelihood that such risks to both public health and welfare are happening now and will happen in the future; the magnitude of such risks and impacts to public health and welfare; and finally a consideration of how key gaps in our knowledge of current, but especially future, effects factor into an endangerment decision.

The following discussion sets forth the Administrator's rationale for making this proposed endangerment finding, including a description of the supporting scientific findings showing evidence of the effects that elevated greenhouse gas concentrations are having currently and are projected to have in the future, and the implications of these effects for public health and welfare.

1. Evidence of Currently Observed Climatic and Related Effects

There is compelling evidence that a number of climate and physical changes are occurring now that can be attributed to the anthropogenic rise in atmospheric greenhouse gases, and other changes that are consistent with the direction of change expected from warming and human-induced climate change. These observed changes described below can adversely affect and pose risks to both public health and welfare.

The global indicators of change go beyond the well-established surface air temperature rise discussed above. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. Observations show that changes are occurring in the amount, intensity, frequency, and type of precipitation. There is strong evidence that global sea level gradually rose in the 20th century and is currently rising at an increased rate. Widespread changes in extreme temperatures have been observed in the last 50 years. Globally, cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent.

Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 ± 0.6 percent per decade, with larger decreases in summer of 7.4 ± 2.4 percent per decade. The latest data from NASA indicate Arctic sea ice set a record low in September 2007, 38 percent below the 1979–2007 average. In September 2008, Arctic sea ice reached its second lowest extent on record.

Like global mean temperatures, U.S. air temperatures have warmed during the 20th and into the 21st century. According to official data from NOAA's National Climatic Data Center:

- U.S. average annual temperatures are now approximately 1.25 °F (0.69 °C) warmer than at the start of the 20th century, with an increased rate of warming over the past 30 years. The rate of warming for the entire period of record (1895–2008) is 0.13 °F/decade while the rate of warming increased to

0.58 °F/decade (0.32 °C/decade) for the period from 1979–2008.

• 2005–2007 were exceptionally warm years (among the top 10 warmest on record), while 2008 was slightly warmer than average (the 39th warmest year on record), 0.2 °F (0.1 °C) above the 20th century (1901–2000) mean.

• The last ten 5-year periods (2004–2008, 2003–2007, 2002–2006, 2001–2005, 2000–2004, 1999–2003, 1998–2002, 1997–2001, 1996–2000, and 1995–1999), were the warmest 5-year periods in the 114 years of national records, demonstrating the anomalous warmth of the last 15 years.

Over the contiguous U.S., total annual precipitation increased at an average rate of 6.5 percent over the period 1901–2006. It is likely that there have been increases in the number of heavy precipitation events within many land regions, even in those where there has been a reduction in total precipitation amount, consistent with a warming climate.

Sea level has been rising along most of the U.S. Atlantic and Gulf coasts. In the mid-Atlantic region from New York to North Carolina, tide-gauge observations indicate that relative sea-level rise (the combination of global sea-level rise and land subsidence) rates were higher than the global mean and generally ranged between 2.4 and 4.4 millimeters per year, or about 0.3 meters (1 foot) over the twentieth century.

Climate changes are very likely already affecting U.S. water resources, agriculture, land resources, and biodiversity as a result of climate variability and change. A 2008 CCSP report [25] that examined these observed changes concluded, ''[t]he number and frequency of forest fires and insect outbreaks are increasing in the interior West, the Southwest, and Alaska. Precipitation, stream flow, and stream temperatures are increasing in most of the continental U.S. The western U.S. is experiencing reduced snowpack and earlier peaks in spring runoff. The growth of many crops and weeds is being stimulated. Migration of plant and animal species is changing the composition and structure of arid, polar, aquatic, coastal, and other ecosystems.''

Regarding observed changes in extreme events, another 2008 CCSP report [26] stated the following: ''Many extremes and their associated impacts are now changing. For example, in recent decades most of North America has been experiencing more unusually hot days and nights, fewer unusually cold days and nights, and fewer frost days. Heavy downpours have become more frequent and intense. Droughts are becoming more severe in some regions, though there are no clear trends for North America as a whole. The power and frequency of Atlantic hurricanes have increased substantially in recent decades, though North American mainland land-falling hurricanes do not appear to have increased over the past century. Outside the tropics, storm tracks are shifting northward and the strongest storms are becoming even stronger.''

2. Future Projected Climatic and Related Effects

Because atmospheric greenhouse gas concentrations are expected to climb for the foreseeable future, temperatures will continue to rise and the overall rate and magnitude of human-induced climate change will likely increase, such that risks to public health and welfare will likewise grow over time so that future generations will be especially vulnerable; their vulnerability will include potentially catastrophic harms. Projected effects here focus on the next several decades and the timeframe out to 2100.

The majority of future reference-case scenarios (assuming no explicit greenhouse gas mitigation actions beyond those already enacted) project an increase of global greenhouse gas emissions over the century, with climbing greenhouse gas concentrations. Long-lived gas concentrations increase even for those scenarios where annual emissions toward the end of the century are assumed to be lower than current annual emissions. Indeed, for a given amount of CO_2 released today, about half will be taken up by the oceans and terrestrial vegetation over the next 30 years, a further 30 percent will be removed over a few centuries, and the remaining 20 percent will only slowly decay over time such that it will take many thousands of years to remove from the atmosphere. Carbon dioxide is expected to remain the dominant anthropogenic driver of climate change over the course of the 21st century. The heating effect associated with the non-CO_2 greenhouse gases is still significant and growing over time.

Future warming over the course of the 21st century, even under scenarios of low emissions growth, is very likely to be greater than observed warming over the past century (Figure 1). Through about 2030, the global warming rate is affected little by the choice of different future emission scenarios, according to IPCC. By mid-century, the choice of scenario becomes more important for the magnitude of the projected warming; About a third of that warming is projected to be due to climate change that is already committed. By the end of the century, projected average global warming (compared to average temperature around 1990) varies significantly depending on emissions scenario and climate sensitivity assumptions, ranging from 1.8 to 4.0 °C (3.2 to 7.2 °F), with an uncertainty range of 1.1 to 6.4 °C (2.0 to 11.5 °F), according to the IPCC.

[25] Backlund, P., A. Janetos, D.S. Schimel, J. Hatfield, M.G. Ryan, S.R. Archer, and D. Lettenmaier (2008) Executive Summary. In: *The effects of climate change on agriculture, land resources, water resources, and biodiversity in the United States.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Washington, DC., USA, 362 pp.

[26] Karl, T.R., G.A. Meehl, T.C. Peterson, K.E. Kunkel, W.J. Gutowski, Jr., D.R. Easterling (2008) *Executive Summary* in Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

Figure 1. Observed and Projected Global Surface Warming
Source: IPCC Fourth Assessment Report (2007). Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The bottom line in the 2000-2100 period is for the experiment where concentrations were held constant at year 2000 values. The bars at right indicate the best estimate (solid line within each bar) and the likely range assessed for the six scenarios used by the IPCC.

Global mean precipitation is expected to increase with global warming. However, there are substantial spatial and seasonal variations. Increases in the amount of precipitation are very likely in high latitudes, while decreases are likely in the mid-latitudes and semi-arid low latitudes including much of the already water-stressed southwestern U.S., continuing observed patterns in recent trends. Drought is expected to increase in the western U.S., where water availability to meet demands for agricultural and municipal water needs is already limited. Another projected impact in the western U.S. is decreased water availability due to a range of inter-connected factors. These include: decreased snowpack, earlier snowmelt resulting in peak winter and decreased summer flows, which will disrupt and limit water storage capacity and will create additional challenges for water allocation among competing uses (agricultural, municipal, industrial, ecological). Rising sea levels could lead to salt water intrusion of coastal ground aquifers, which would further reduce freshwater availability for municipal and agricultural use among coastal communities that depend on these aquifers.

By the end of the century, sea level is projected by IPCC to rise between 0.18 and 0.59 meters relative to around 1990 in the absence of increased dynamic ice sheet loss. Recent rapid changes at the edges of the Greenland and West Antarctic ice sheets show acceleration of flow and thinning. While understanding of these ice sheet processes is incomplete, their inclusion in models would likely lead to increased sea-level projections for the end of the 21st century. Sea ice is projected to shrink in the Arctic under all IPCC emission scenarios.

All of the U.S. is very likely to warm during this century, and most areas of the U.S. are expected to warm by more than the global average. The largest warming through 2100 is projected to occur in winter over northern parts of Alaska. In western, central and eastern regions of North America, the projected warming has less seasonal variation and is not as large, especially near the coast, consistent with less warming over the oceans.

The U.S is projected to see an overall average increase in the intensity of precipitation events, which is likely to increase the risk of flood events, though projections for specific regions are very uncertain.

As the climate warms, glaciers will lose mass owing to dominance of summer melting over winter precipitation increases, contributing to sea level rise.

For North American coasts, sea level rise may be similar to the global mean, with slightly higher rates in western Alaska. The projected rate of sea level

rise off the low-lying U.S. South Atlantic and Gulf coasts is also higher than the global average.

Based on a range of models, it is likely that tropical cyclones (tropical storms and hurricanes) will become more intense, with stronger peak winds and more heavy precipitation associated with ongoing increases of tropical sea surface temperatures. Storm surge levels are likely to increase due to projected sea level rise. Frequency changes in hurricanes are currently too uncertain for confident projections.

3. Impacts on Public Health

Many of the observed and projected changes in climate and climate-sensitive systems discussed above pose serious risks to public health. The following discussion outlines specific public health concerns raised by observations and plausible future outcomes, recognizing the statutory requirement that the Administrator consider how sensitive or susceptible populations may be particularly at risk. As our discussion of increasing temperatures suggests, the adverse effects of greenhouse gas emissions are expected to mount over time. The findings of the IPCC, and of many others, indicate that risks to public health will be more severe in 20 years than in ten years, more severe in 30 years than in 20 years, more severe in 40 years than in 30 years, and so forth. There is disagreement about whether and when increases in adverse effects will be linear or nonlinear; on some projections, nonlinear increases in such effects can reasonably be expected at some future point. We believe that existing evidence supports a finding that there are current adverse effects. This evidence also supports a finding that these effects will become more serious over the next several decades, in some cases out to 2100.

To be clear, ambient concentrations of carbon dioxide and the other greenhouse gases, whether at current levels or at projected ambient levels under scenarios of high emissions growth over time, do not cause direct adverse health effects such as respiratory or toxic effects. All public health risks and impacts described here as a result of elevated atmospheric concentrations of greenhouse gases occur via climate change. The pathway or mechanism occurs through changes in climate, but the end result is an adverse effect on the health of the population. Thus these effects from climate change are appropriately denoted public health effects. It is important to acknowledge that effects on ''welfare'' do not always entail effects on ''public health,'' and the Administrator does not mean to interpret ''public health'' to include ''welfare'' effects as such. Today's interpretation does not collapse the two categories—many ''welfare'' effects do not and cannot involve public health. The Administrator simply means to recognize, with the scientific community, that concentrations of greenhouse gases endanger public health through a wide range of pathways.

As described above, there is evidence that unusually hot days and nights and heat waves have become more frequent in the U.S. Severe heat waves are projected to intensify in magnitude and duration over the portions of the U.S. where these events already occur, with likely increases in mortality and morbidity. The populations most sensitive to hot temperatures are older adults, the chronically sick, the very young, city-dwellers, those taking medications that disrupt thermoregulation, the mentally ill, those lacking access to air conditioning, those working or playing outdoors, and the socially isolated.

The Administrator also acknowledges that warming temperatures may bring about some health benefits. Both extremely cold days and extremely hot days are dangerous to human health. But at least in the short run, modest temperature increases may produce health benefits in the U.S. (and elsewhere). Although the IPCC projects reduced human mortality from cold exposure through 2100, it is currently difficult to ascertain the balance between increased heat-related mortality and decreased cold-related mortality. With respect to health, different regions will be affected in different ways. The Administrator does not believe that it is now possible to quantify the various effects. Because the risks from unusually hot days and nights, and from heat waves, are very serious, it is reasonable to find on balance that these risks support a finding that public health is endangered even if it is also possible that modest temperature increases will have some beneficial health effects.

Increases in regional ozone pollution in the U.S. relative to ozone levels without climate change are expected due to higher temperatures and a modification of meteorological factors. Increases in regional ozone pollution increase the risks of respiratory infection, aggravation of asthma, and premature death. EPA does have in place National Ambient Air Quality Standards (NAAQS) for ozone, which are premised on the harmfulness of ozone to public health and welfare. These standards and their accompanying regulatory regime have helped to reduce the dangers from ozone in the U.S. Substantial challenges remain with respect to achieving the air quality protection promised by the NAAQS for ozone. These challenges will be exacerbated by climate change.

There will likely be an increase in the spread of several food and water-borne pathogens (e.g., Salmonella, Vibrio) among susceptible populations depending on the pathogens' survival, persistence, habitat range and transmission under changing climate and environmental conditions. The primary climate-related factors that affect these pathogens include temperature, precipitation, extreme weather events, and shifts in their ecological regimes.

Climate change, including the direct changes in carbon dioxide concentrations themselves, could impact the production, distribution, dispersion and allergenicity of aeroallergens and the growth and distribution of weeds, grasses and trees that produce them. These changes in aeroallergens and subsequent human exposures could affect the prevalence and severity of allergy symptoms. However, the scientific literature does not provide definitive data or conclusions on how climate change might impact aeroallergens and subsequently the prevalence of allergenic illnesses in the U.S.

The IPCC reports with very high confidence [27] that climate change impacts on human health in U.S. cities will be compounded by population growth and an aging population. The CCSP reports that climate change has the potential to accentuate the disparities already evident in the American health care systems as many of the expected health effects are likely to fall disproportionately on the poor, the elderly, the disabled, and the uninsured.

Within settlements experiencing climate change stressors, certain parts of the population may be especially vulnerable based on their circumstances. These include the poor, the elderly, the very young, those already in poor health, the disabled, those living alone, those with limited rights and power (such as recent immigrants with limited English skills), and/or indigenous populations dependent on one or a few resources.

[27] According to the IPCC lexicon, ''very high confidence'' conveys at least a 9 out of 10 chance of being correct. ''High confidence'' conveys an 8 out of 10 chance of being correct, and ''medium confidence'' a 5 out of 10 chance.

These potential impacts of climate change have taken on added meaning in light of the risk that hurricanes are likely to become more severe with climate change, and in light of our heightened awareness about how vulnerable the U.S. Gulf Coast can be.

Some have argued that a positive endangerment finding for public health cannot be made because the health effects associated with elevated atmospheric concentrations of greenhouse gases occur via climate change, and not directly through inhalation or other exposure to the greenhouse gases themselves. These commenters argue that because ''climate'' is included in the definition of welfare, the Act requires that all effects which may flow from a welfare effect must themselves be considered a welfare effect. The Administrator disagrees with this narrow view of the endangerment criteria. Mortality and morbidity that result from the effects of climate change are clearly public health problems. It would be anomalous to argue that a person who is injured or dies from heat exhaustion or increased exposure to a pathogen has not suffered a health impact. In addition, tropospheric ozone is already regulated under the Act as a criteria air pollutant in part due to its adverse impacts on public health. It is estimated that climate change can exacerbate tropospheric ozone levels in some parts of the U.S. The Administrator rejects a position that would treat the adverse effects on the health of individuals caused by tropospheric ozone as something other than a public health threat because they are exacerbated by climate change.

4. Impacts on Public Welfare

The Act defines ''effects on welfare'' as including, but not limited to, ''effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being * * *'' CAA Section 302(h). It is clear that current and projected levels of greenhouse gases and resultant climate change are already adversely affecting, and will continue to adversely affect, public welfare within the meaning of the Act. As noted, the adverse effects of greenhouse gases are expected to increase over time with growing temperatures. This point holds for welfare as it does for health. In the future, the adverse effects will increase and perhaps accelerate; projected risks focus on the next several decades and out to 2100.

As heavy rainfall events are expected to become more intense, there is an increased risk of flooding, greater runoff and erosion, and thus the potential for adverse water quality effects.

Climate change will likely further constrain already over-allocated water resources in some sections of the U.S., increasing competition among agricultural, municipal, industrial, and ecological uses. Although current water management practices in the U.S. are generally advanced, particularly in the West, climate change increasingly creates conditions well outside of historical observations. Rising temperatures will diminish snowpack and increase evaporation, affecting seasonal availability of water. In the Great Lakes and major river systems, lower levels are likely to exacerbate challenges relating to water quality, navigation, recreation, hydropower generation, water transfers, and bi-national relationships. Higher water temperatures, increased precipitation intensity, and longer periods of low flows can exacerbate many forms of water pollution. Decreased water supply and lower water levels are likely to exacerbate challenges relating to navigation in the U.S.

CCSP concluded that, with increased CO_2 and temperature, the life cycle of grain and oilseed crops will likely progress more rapidly. But, as temperature rises, these crops will increasingly begin to experience failure, especially if climate variability increases and precipitation lessens or becomes more variable. Furthermore, the marketable yield of many horticultural crops—e.g., tomatoes, onions, fruits—is very likely to be more sensitive to climate change than grain and oilseed crops. The IPCC reported that moderate climate change in the early decades of the century is projected to increase aggregate yields of rain-fed agriculture in North America as a whole by 5–20 percent, but with important variability among regions. However, like CCSP, IPCC further stated that major challenges are projected for crops that are near the warm end of their suitable range or depend on highly utilized water resources.

Higher temperatures will very likely reduce livestock production during the summer season, but these losses will very likely be partially offset by warmer temperatures during the winter season.

Climate change has very likely increased the size and number of forest fires, insect outbreaks, and tree mortality in the interior west, the Southwest, and Alaska, and will continue to do so. An increased frequency of disturbance is at least as important to ecosystem function as incremental changes in temperature, precipitation, atmospheric CO_2, nitrogen deposition, and ozone pollution. IPCC reported that overall forest growth for North America as a whole will likely increase modestly (10–20 percent) as a result of extended growing seasons and elevated CO_2 over the next century, but with important spatial and temporal variation.

In addition to human health effects, tropospheric ozone increases as a result of temperature increases and other climatic changes can have significant adverse effects on crop yields, pasture and forest growth and species composition.

Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution. Sea level is rising along much of the U.S. coast, and the rate of change will increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding, and shoreline erosion. Coastal aquifers and estuaries are vulnerable to salt water intrusion due to rising sea levels, which could compromise water sources used for municipal drinking water, agricultural crops, and other human uses. Storm impacts are likely to be more severe, especially along the Gulf and Atlantic coasts. Salt marshes, other coastal habitats, and dependent species are threatened by sea-level rise, fixed structures blocking landward migration, and changes in vegetation. Population growth and rising value of infrastructure in coastal areas increases vulnerability to climate variability and future climate change.

Water infrastructure, including drinking water and wastewater treatment plants, and sewer and stormwater management systems, may be at greater risk of flooding, sea level rise and storm surge, low flows, and other factors that could impair functioning. For example, some of these impacts are already being experienced in Alaska, where rapidly melting permafrost has damaged and disrupted drinking water distribution systems and wastewater infrastructure.

Ocean acidification is projected to continue, resulting in the reduced biological production of marine calcifiers, including corals.

Climate change is likely to affect U.S. energy use (e.g., heating and cooling requirements), and energy production (e.g., effects on hydropower), physical infrastructures and institutional infrastructures. Climate change will likely interact with and possibly

exacerbate ongoing environmental change and environmental pressures in settlements, particularly in Alaska where indigenous communities are facing major environmental changes from sea ice loss and coastal erosion that threaten traditional ways of life.

Over the 21st century, changes in climate will cause some species to shift north and to higher elevations and fundamentally rearrange U.S. ecosystems. Differential capacities to adapt to range shifts and constraints from development, habitat fragmentation, invasive species, and broken ecological connections will alter ecosystem structure, composition, function, and services.

The Administrator acknowledges that as for human health, so too for welfare: moderate temperature increases may have some benefits, particularly for agriculture and forestry over the short term, as summarized above in this section and discussed in more detail in the Technical Support Document in Part IV, sections 9(a) and 10(a). This possibility is not inconsistent with a judgment that greenhouse gases in the atmosphere endanger welfare. Beneficial effects can coexist with harmful effects, and it is not necessary to reach a firm conclusion, for particular domains and sectors, about the net result in order to reach an overall conclusion in favor of endangerment.

5. The Administrator's Consideration of International Effects

The Administrator judges that the impacts to public health and welfare occurring within the U.S. alone warrant her proposed endangerment finding. In addition, the Administrator believes that consideration of climate change effects in other world regions adds support for today's proposal, but that consideration of international impacts is not necessary in order to reach a judgment that there is endangerment to public health and welfare. Thus, the Administrator does not now take a position on the legal question whether international effects, on their own, would be sufficient to support an endangerment finding. Some of the world's regions are expected to face greater impacts due to climate change because they are more vulnerable. Even apart from the effects of climate change on other world regions—effects which are considerable—the Administrator also believes many of these impacts could raise economic, trade, humanitarian and even national security issues for the U.S.

The IPCC identifies the most vulnerable world regions as the Arctic, because of high rates of projected warming on natural systems; Africa, especially the sub-Saharan region, because of current low adaptive capacity (e.g., lack of infrastructure and resources) as well as climate change; small islands, due to high exposure of population and infrastructure to risk of sea-level rise and increased storm surge; and Asian mega deltas, due to large populations and high exposure to sea level rise, storm surge and river flooding.

On a global basis, according to the IPCC, projected climate change-related impacts are likely to affect the health of millions of people, particularly those with low adaptive capacity, as a result of a number of factors including increased cardio respiratory diseases due to higher concentrations of ground-level ozone brought on by higher temperatures, and by more frequent and intense heat waves. Food production is expected to be much more vulnerable to climate change in poorer regions of the world compared to food production in the U.S. The IPCC also identified that the coasts around the world are experiencing the adverse consequences of hazards related to climate and sea level. Coastal settlements are highly vulnerable to extreme events, such as storms which impose substantial costs on coastal societies. Ecosystems and species around the world are very likely to show a wide range of vulnerabilities to climate change, depending on the extent to which climate change alters conditions that could cross critical thresholds. The most vulnerable ecosystems include coral reefs, sea-ice ecosystems, high-latitude boreal forests, and mountain ecosystems where there is no possibility of migrating to adapt to climate change.

Climate change impacts in certain regions of the world may exacerbate problems that raise humanitarian, trade and national security issues for the U.S. Climate change has been described as a potential threat multiplier regarding national security issues. This is because, as noted above, climate change can aggravate existing problems in certain regions of the world such as poverty, social tensions, general environmental degradation, and conflict over increasingly scarce water resources.

6. The Administrator's Consideration of Key Uncertainties

There are many inherent uncertainties associated with characterizing both the observed and projected risks and impacts to public health and welfare due to current and projected greenhouse gas concentrations. Both probability and severity are not easy to specify. It is difficult to attribute any single past event (hurricane, flood, drought, or heat wave) to elevated greenhouse gas concentrations even if it is understood that anthropogenic climate change has already made such events more likely or more extreme. The precise rate and magnitude of future climate change, for both the globe and for the U.S., remain uncertain, even in the hypothetical case where current greenhouse gas concentrations would remain constant over the next several decades. Projecting the exact magnitude of a particular impact due to climate change is difficult due to what are often long time frames to consider, the uncertain nature of how the system or sector will be affected by climate change, and uncertainties about how other factors (e.g., income levels, technologies, demographics) will change over time which can in turn affect the vulnerability of the system or sector to climate change.

Many uncertainties could push in the direction of either greater or lesser risks as they become better understood. EPA has acknowledged the possibility of beneficial effects on both health and welfare. Other possibilities include catastrophic events. Examples of such key uncertainties involve how the frequency of hurricanes and other extreme weather events may change in a changing climate, the potential to trigger thresholds for abrupt climate change (e.g., disintegration of the Greenland Ice Sheet or collapse of the West Antarctic Ice Sheet), and how responsive the climate ultimately will be to the heating effect being caused by anthropogenic greenhouse gases. Even if the probability of extremely high-impact events may be small, the existence of such high impact events, and the potential for other currently unknown catastrophic impacts that could plausibly result from record-high atmospheric greenhouse gas levels, substantially bolsters the case for an endangerment finding with respect to greenhouse gases.[28] These uncertainties will be with us for the foreseeable future. However, Congress expected the Administrator to consider uncertainties and extrapolate from limited data. It also recognized that there are inherent limitations and difficulties in information on public health and welfare, but nonetheless expected the

[28] A recent economic study that has received considerable attention in the climate change research community (Weitzman, The Review of Economics and Statistics, 2009) has determined that if the probability distribution of the magnitude of possible impacts has a ''fat tail'', then the expected utility of reducing the probability of that tail becomes astronomical. The study determined that anthropogenic climate change is a plausible candidate for such a ''fat tailed'' damage function.

Administrator to exercise her judgment based on the information available.

At the same time, there is a broad base of scientific evidence that has been reviewed extensively by the scientific community, which supports the findings discussed about how anthropogenic increases in greenhouse gases are affecting the climate and the key risks to public health and welfare that human-induced climate change pose. The Administrator believes that the scientific findings in totality provide compelling evidence of human-induced climate change, and that serious risks and potential impacts to public health and welfare have been clearly identified, even if they cannot always be quantified with confidence. The Administrator's proposed endangerment finding is based on weighing the scientific evidence, considering the uncertainties, and balancing any benefits to human health, society and the environment that may also occur. Given the evolution of climate change science over the past 15 years or more, the Administrator believes the evidence of discernible human influence on the global climate, and the risks that such climate change poses, has become more compelling, and therefore believes the evidence that there is endangerment to the public health and welfare of current and future generations has likewise become more compelling in step with our increasing understanding of the climate change problem.

7. Summary

The Administrator concludes that, in the circumstances presented here, the case for finding that greenhouse gases in the atmosphere endanger public health and welfare is compelling and, indeed, overwhelming. The scientific evidence described here is the product of decades of research by thousands of scientists from the U.S. and around the world. The evidence points ineluctably to the conclusion that climate change is upon us as a result of greenhouse gas emissions, that climatic changes are already occurring that harm our health and welfare, and that the effects will only worsen over time in the absence of regulatory action. The effects of climate change on public health include sickness and death. It is hard to imagine any understanding of public health that would exclude these consequences. The effects on welfare embrace every category of effect described in the Clean Air Act's definition of ''welfare'' and, more broadly, virtually every facet of the living world around us. And, according to the scientific evidence relied upon in making this finding, the probability of the consequences is shown to range from likely to virtually certain to occur. This is not a close case in which the magnitude of the harm is small and the probability great, or the magnitude large and the probability small. In both magnitude and probability, climate change is an enormous problem. The greenhouse gases that are responsible for it endanger public health and welfare within the meaning of the Clean Air Act.

IV. The Administrator's Cause or Contribute Finding

As noted above, the Administrator has proposed to define the air pollution for purposes of the endangerment finding to be the mix of six key greenhouse gases in the atmosphere. The Administrator must also define the air pollutant or pollutants for purposes of making the cause or contribute determination. In this section, the *air pollutant(s)* that may cause or contribute to the proposed definition of *air pollution* are discussed.

As noted earlier, to help appreciate the distinction between these terms, the air pollution can be thought of as the total, cumulative stock in the atmosphere. The air pollutants, on the other hand, are the emissions and can be thought of as the flow that changes the size of the total stock. EPA did not conduct climate modeling analyses to determine what fraction of global greenhouse gas concentrations are due to the emissions from section 202(a) source categories. Rather, consistent with prior practice and with current science, EPA used emissions as a perfectly reasonable proxy for contributions to atmospheric concentrations. Indeed, cumulative emissions are responsible for the cumulative change in the stock of concentrations in the atmosphere (i.e., the fraction of a country's or an economic sector's cumulative emissions compared to the world's greenhouse gas emissions over a long time period will be directly proportional to that fraction of the change in concentrations attributable to that country or economic sector); likewise, annual emissions are a perfectly reasonable proxy for annual incremental changes in atmospheric concentrations.

A. The Air Pollutant(s)

This section discusses the proposed definition of the air pollutant for the cause or contribute finding as the collective class of six greenhouse gases rather than the individual greenhouse gases.

1. Proposed Definition of Air Pollutant

When making a cause or contribute finding under section 202(a), the Administrator must first look at the emissions from the source category and decide how to define the air pollutant being evaluated. In this case, the source category emits four gases, which share common physical properties relevant to climate change: all are long-lived in the atmosphere; all become globally well mixed in the atmosphere; all trap outgoing heat that would otherwise escape to space; and all are directly emitted as greenhouse gases rather than forming as a greenhouse gas in the atmosphere after emission of a precursor gas. There are other gases which share these common properties which are not emitted by the section 202(a) source categories. Nonetheless, it is entirely appropriate for the Administrator to define the air pollutant in a manner that recognizes the shared relevant properties of all of these six gases, even though they are not all emitted from the source category before her.

The Administrator is proposing to define a single air pollutant that is the collective class of the six greenhouse gases. It is the Administrator's judgment that this collective approach for the contribution test is most consistent with the treatment of greenhouse gases by those studying climate change science and policy, where it has become common practice to evaluate greenhouse gases on a collective CO_2-equivalent basis. For example, under the UNFCCC, the U.S. and other Parties report their annual emissions of the six greenhouse gases in CO_2-equivalent units. This facilitates comparisons of the multiple greenhouse gases from different sources and from different countries, and provides a measure of the collective warming potential of multiple greenhouse gases. There are also several federal and state climate programs, such as EPA's Climate Leaders program and California's Climate Action Registry that encourage firms to report (and reduce) emissions of all six greenhouse gases. Furthermore, the Administrator recently signed (March 10, 2009) the Proposed Greenhouse Gas Mandatory Reporting Rule, which proposes the reporting of greenhouse gas emissions on a CO_2-equivalent basis above certain CO_2-equivalent thresholds, thereby also recognizing the common and collective treatment of the six greenhouse gases.

This proposed definition of air pollutant is not unique, as EPA has previously treated a class of substances with similar impacts on the environment as a single pollutant (e.g., particulate matter, volatile organic compounds). These six greenhouse gases are being considered collectively in the endangerment determination

because they share the same relevant properties regarding their effect on the global climate and the associated changes throughout the climate system that can result. Thus, the Administrator believes it is appropriate to consider the six greenhouse gases as constituents of a single air pollutant.

The Administrator recognizes that only four of the six greenhouse gases covered in the definition of air pollution are emitted by section 202(a) source categories. It is not unusual for a particular source category to emit only a subset of a class of substances that constitute a single air pollutant. For example, a source may emit only 20 of the possible 200 plus chemicals that meet the definition of volatile organic compound (VOC) in the regulations, but that source is evaluated based on its emissions of ''VOCs,'' and not its emissions of the 20 chemicals by name.

Nonetheless, the Administrator recognizes that each greenhouse gas could be considered a separate air pollutant. Thus, although proposing to define air pollutant as the class of six greenhouse gases, and basing the proposed contribution finding on that air pollutant, the Administrator also considered each greenhouse gas individually, as discussed below.

2. How the Definition of Air Pollutant in the Endangerment Determination Affects Section 202(a) Standards

The Administrator believes that she has significant discretion when establishing greenhouse gas emission standards under section 202(a) with respect to whether the greenhouse gases are treated as a single collective pollutant or each greenhouse gas is defined as a separate air pollutant. Under section 202(a), the Administrator is required to set ''standards applicable to the emission of any air pollutant'' that the Administrator determines causes or contributes to air pollution that endangers. If the Administrator defines the air pollutant as the collection of six greenhouse gases, and makes the appropriate cause or contribute and endangerment findings for section 202(a) sources, then she is called on to set standards applicable to the emission of this air pollutant. The term ''standards applicable to the emission of any air pollutant'' is not defined, and the Administrator has the discretion to interpret it in a reasonable manner to effectuate the purposes of section 202(a).

If the Administrator defines the air pollutant as the group of greenhouse gases, she believes she would have the discretion to set standards that either control the emissions of the group as a whole, and/or standards that control emissions of individual greenhouse gases, as constituents of the class. For example, it might be appropriate to set a standard that measures and controls the aggregate emissions of the group of greenhouse gases, weighted by CO_2 equivalent. Depending on the circumstances, however, it may be appropriate to set standards for individual gases, or some combination of group and individual standards. These and other similar approaches could appropriately be considered setting a standard or standards applicable to the emission of the group of greenhouse gases that are defined as the air pollutant. The Administrator would consider a variety of factors in determining what approach to take in setting the standard or standards; for example she would consider the characteristics of the vehicle or engine emissions, such as rate and variability, the kind and availability of control technology, and other matters relevant to setting standards under section 202(a). Likewise, taking into consideration the circumstances involved, the Administrator could determine that it was appropriate to set separate standards, a group standard, or some combination of those, in a case where each greenhouse gas was considered a separate air pollutant.[29]

B. Proposed Cause or Contribute Finding

1. Overview of Greenhouse Gas Emissions

In 2006, U.S. greenhouse gas emissions were 7,054 teragrams [30] of CO_2 equivalent [31] ($TgCO_2eq$). The dominant gas emitted is CO_2, mostly from fossil fuel combustion. Methane is the second largest component of U.S. emissions, followed by N_2O, and the fluorinated gases (HFCs, PFCs, and SF_6). Electricity generation is the largest emitting sector (2,378 $TgCO_2eq$ or 34 percent of total U.S. greenhouse gas emissions), followed by transportation (1,970 $TgCO_2eq$ or 28 percent) and industry (1,372 $TgCO_2eq$ or 19 percent). Land use, land use change and forestry offset almost 13 percent of total U.S. emissions through net sequestration. Total U.S. greenhouse gas emissions have increased by almost 15 percent between 1990 and 2006. The electricity generation and transportation sectors have contributed most to this increase.

Total global greenhouse gas emissions in 2005 (the most recent year for which data for all countries and all greenhouse gases are available) were 38,726 $TgCO_2eq$. This represents an increase in global greenhouse gas emissions of about 26 percent since 1990 (excluding land use, land use change and forestry). In 2005, total U.S. greenhouse gas emissions were responsible for 18 percent of global emissions, ranking only behind China, which was responsible for 19 percent of global greenhouse gas emissions.

2. Overview of Section 202(a) Source Categories and Cause or Contribute Analysis

The relevant mobile sources under section 202 (a)(1) of the Clean Air Act are ''*any class or classes of new motor vehicles or new motor vehicle engines, * * *.*'' CAA § 202(a)(1) (emphasis added). The motor vehicles and motor vehicle engines (hereinafter ''Section 202(a) source categories'') addressed are:

- Passenger cars
- Light-duty trucks
- Motorcycles
- Buses
- Medium/heavy-duty trucks

As noted earlier, in the past the requisite contribution findings have been proposed concurrently with proposing emission standards for the relevant mobile source category. Thus, the prior contribution findings often focused on a subset of the section 202(a) (or other section) source categories. Today's proposed cause or contribute finding, however, is for all of the section 202(a) source categories and the Administrator is considering emissions from all of these source categories in the proposed determination.

Sources covered by section 202(a) of the Act emit four of the six greenhouse gases that in combination comprise the air pollutant being considered in the cause or contribute analysis: Carbon

[29] At this time, a final positive endangerment finding would not make the air pollutant found to cause or contribute to air pollution that endangers a regulated pollutant under the CAA's Prevention of Significant Deterioration (PSD) program. See memorandum entitled ''EPA's Interpretation of Regulations that Determine Pollutants Covered By Federal Prevention of Significant Deterioration (PSD) Permit Program'' (Dec. 18, 2008). EPA is reconsidering this memorandum and will be seeking public comment on the issues raised in it. That proceeding, not this rulemaking, would be the appropriate venue for submitting comments on the issue of whether a final, positive endangerment finding under section 202(a) of the Act should trigger the PSD program, and the implications of the definition of air pollutant in that endangerment finding on the PSD program.

[30] One teragram (Tg) = 1 million metric tons. 1 metric ton = 1,000 kg = 1.102 short tons = 2,205 lbs.

[31] Long-lived greenhouse gases are compared and summed together on a CO_2 equivalent basis by multiplying each gas by its Global Warming Potential (GWPs), as estimated by IPCC. In accordance with UNFCCC reporting procedures, the U.S. quantifies greenhouse gas emissions using the 100-year time frame values for GWPs established in the IPCC Second Assessment Report.

dioxide, methane, nitrous oxide, and hydrofluorocarbons.[32] To support the Administrator's assessment, EPA has analyzed historical data of these greenhouse gases for motor vehicles and motor vehicle engines in the U.S. from 1990 to 2006. The source of the U.S. greenhouse gas emissions data is the *Inventory of U.S. Greenhouse Gas Emissions and Sinks:* 1990–2006, published in 2008 (hereinafter ''U.S. Inventory''). The source of global greenhouse gas emissions data, against which a number of comparisons are made, is the Climate Analysis Indicators Tool of the World Resources Institute (2007).[33]

There are a number of possible ways of assessing ''cause or contribute'' and no single approach is required or has been used exclusively in previous determinations under the Act. Because the air pollution against which the contribution is being evaluated is the mix of six greenhouse gas concentrations, the logical starting point for any contribution analysis is a comparison of the emissions of the air pollutant from the section 202(a) category to the total, global emissions of the six greenhouse gases. The Administrator recognizes that there are other valid comparisons that can and should be considered in evaluating whether emissions of the air pollutant cause or contribute to the combined concentration of the six greenhouse gases. To inform the Administrator's assessment, the following types of comparisons for both the collective and individual emissions of greenhouse gases from section 202(a) source categories are provided:

- As a share of total current global aggregate emissions of the six greenhouse gases included in the proposed definition of air pollution;
- As a share of total current U.S. aggregate emissions of the six greenhouse gases; and
- As a share of the total current global transportation emissions of the six greenhouse gases.

In addition, when reviewing each greenhouse gas as an individual pollutant, the Administrator also considered the following comparisons:

- As a share of current global emissions of that individual greenhouse gas;
- As a share of total section 202(a) source category emissions of the six greenhouse gases; and
- As a share of current U.S. emissions of that individual greenhouse gas, including comparisons to the magnitude of emissions of that greenhouse gas from other non-transport related source categories.

Note that for global comparisons, all emissions are from the year 2005, the most recent year for which data for all greenhouse gas emissions and all countries are available. For comparisons within the U.S., all emissions are for the year 2006, the most recent year for which U.S. data are currently available. All values for emission numbers represent total annual emissions. All annual emissions data are being considered on a CO_2 equivalent basis, which is a commonly accepted metric for comparing different greenhouse gases, both in the U.S. annual greenhouse gas Inventory and with international greenhouse gas inventories from other Parties to the UNFCCC.[34] Future projected emissions are not used in this cause or contribute analysis, because they are uncertain and current emissions data are a valid proxy for near-term emissions. This approach is consistent with how contribution has been assessed in previous actions under the Clean Air Act.

Some comments on the ANPR argued that when evaluating the contribution from new motor vehicles and engines, the Administrator needs to project what emissions would be after implementation of the fuel efficiency standards in the Energy Independence and Security Act of 2007 (EISA). Other comments noted that the Administrator should recognize that in the future the denominator of global aggregate emissions of greenhouse gases will increase as the numerator of new motor vehicle and engine emissions decreases. As noted above, the Administrator believes that the traditional practice of considering the recent motor vehicle emissions inventory as a surrogate for estimates for new motor vehicles and engines is appropriate. In general, the focus of the contribution test should be on current and near-term emissions. The current and near term emissions from the section 202(a) sources can be expected to impact atmospheric concentrations for many decades to come, given the long atmospheric life of the greenhouse gases. The Administrator is aware of the requirements of EISA, and she has concluded that the expected reductions in emissions from section 202(a) source categories would not affect her determination regarding cause or contribution. In addition to looking at absolute emissions comparisons, the Administrator also considered other relevant factors, as described below.

3. Proposed Finding That Emissions of the Collective Group of Six Greenhouse Gases Contributes to Air Pollution Which May Reasonably Be Anticipated To Endanger Public Health and Welfare

a. Total Greenhouse Gas Emissions From Section 202(a) Source Categories

As discussed above, the Administrator is proposing to define air pollutant for purposes of the contribution finding as the collective group of six greenhouse gases. Section 202(a) source categories emit four of the greenhouse gases (CO_2, CH_4, N_2O, and HFCs), therefore the emissions of the single air pollutant are the collective emissions of these four greenhouse gases. This section summarizes information on total section 202(a) source category emissions of greenhouse gases within that definition.[35]

In 2006, section 202(a) source categories collectively were the second largest greenhouse gas-emitting sector within the U.S. (behind the electricity generating sector), emitting 1,665 $TgCO_2eq$ and representing 24 percent of total U.S. greenhouse gas emissions (Table 1). Between 1990 and 2006, total greenhouse gas emissions from passenger cars decreased 0.9 percent, while emissions from light-duty trucks increased 57 percent, largely due to the increased use of sport-utility vehicles and other light-duty trucks.

Globally in 2005, section 202(a) source category greenhouse gas emissions represented 28 percent of global transport greenhouse gas emissions and 4.3 percent of total global greenhouse gas emissions (Table 2). The global transport sector was 14 percent of all global greenhouse gas emissions in 2005. If U.S. section 202(a) source category greenhouse gas emissions were ranked against total greenhouse gas emissions for entire countries, U.S. section 202(a) emissions would rank behind only China, the U.S. as a whole, Russia and India, and would rank ahead

[32] Emissions of hydrofluorocarbons result from the use of HFCs in cooling systems designed for passenger comfort, as well as auxiliary systems for refrigeration.

[33] WRI (2007) Climate Analysis Indicators Tool (CAIT). Available at *http://cait.wri.org.* Accessed February 20, 2009.

[34] Emissions of different greenhouse gases are compared using global warming potentials (GWPs). The GWP of a greenhouse gas is defined as the ratio of the time-integrated radiative forcing from the instantaneous release of 1 kilogram (kg) of a trace substance relative to that of 1 kg of a reference gas (IPCC 2001). The reference gas used is CO_2, and therefore GWP-weighted emissions are measured in teragrams of CO_2 equivalent ($TgCO_2eq.$).

[35] Detailed combined greenhouse gas emissions data for Section 202(a) source categories are presented in Appendix B of the Technical Support Document.

of Japan, Brazil, Germany and every other country in the world.

TABLE 1—SECTORAL COMPARISON TO TOTAL U.S. GREENHOUSE GAS (GHG) EMISSIONS ($TgCO_2E$)

U.S. Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202(a) GHG emissions	1231.9	1364.4	1568.1	1576.8	1617.9	1629.7	1667.4	1670.0	1665.4
Share of U.S. (%)	20.0%	21.0%	22.3%	22.8%	23.2%	23.3%	23.6%	23.4%	23.6%
Electricity Sector emissions	1859.1	1989.7	2328.9	2290.9	2300.4	2329.4	2363.4	2430.0	2377.8
Share of U.S. (%)	30.2%	30.6%	33.1%	33.1%	33.0%	33.3%	33.4%	34.1%	33.7%
Industrial Sector emissions	1460.3	1478.0	1432.9	1384.3	1384.9	1375.5	1388.9	1354.3	1371.5
Share of U.S. (%)	23.8%	22.8%	20.4%	20.0%	19.8%	19.7%	19.6%	19.0%	19.4%
Total US GHG emissions	6148.3	6494.0	7032.6	6921.3	6981.2	6998.2	7078.0	7129.9	7054.2

TABLE 2—COMPARISON TO GLOBAL GREENHOUSE GAS (GHG) EMISSIONS ($TgCO_2E$)

	2005	Sec 202(a) share
All US GHG emissions	7,130	23.4%
Global transport GHG emissions	5,909	28.3%
All global GHG emissions	38,726	4.3%

b. Proposed Contribution Finding for the Single Air Pollutant Comprised of the Collective Group of Six Greenhouse Gases

Based on the data summarized above, the Administrator proposes to find that the emissions of the defined air pollutant from new motor vehicles and engines contribute to the air pollution previously discussed. As noted above, the Administrator recognizes that only four of the six greenhouse gases covered in the definition of air pollution are emitted by section 202(a) source categories, and has made her determination based on the combined contribution of these four greenhouse gases. It is not unusual for a particular source category to emit only a subset of a class of substances that constitute a single air pollutant (for example, volatile organic compounds).

It is the Administrator's judgment that the collective greenhouse gas emissions from section 202(a) source categories are significant, whether the comparison is global (over 4 percent of total greenhouse gas emissions) or domestic (24 percent of total greenhouse gas emissions). The Administrator believes that consideration of the global context is important for the cause or contribute test but that the analysis should not solely consider the global context. Greenhouse gas emissions from section 202(a) source categories, or from any other U.S. source, will become globally mixed in the atmosphere, and thus will have an effect not only on the U.S. regional climate but on the global climate as a whole, and indeed for years and decades to come. The Administrator believes that these unique, global aspects of the climate change problem tend to support a finding that lower levels of emissions should be considered to contribute to the air pollution than might otherwise be considered appropriate when considering contribution to a local or regional air pollution problem.

Importantly, because no single greenhouse gas source category dominates on the global scale, many (if not all) individual greenhouse gas source categories could appear too small to matter, when, in fact, they could be very significant contributors in terms of both absolute emissions or in comparison to other similar source categories within the U.S. If the U.S. and the rest of the world are to combat the risks associated with global climate change, contributors must do their part even if their contributions to the global problem, measured in terms of percentage, are smaller than typically encountered when tackling solely regional or local environmental issues. Total U.S. greenhouse gas emissions make up about 18 percent of the world's greenhouse gas emissions, and individual sources within the U.S. will be subsets of that 18 percent. The Administrator is placing significant weight on the fact that section 202(a) source categories contribute to 24 percent of total U.S. greenhouse gas emissions for the proposed contribution finding.

4. Additional Consideration of Whether Each Greenhouse Gas as a Separate Air Pollutant Contributes to Air Pollution Which May Reasonably Be Anticipated To Endanger Public Health and Welfare

As noted above, the Administrator also considered whether emissions of individual greenhouse gas from section 202(a) source categories, separately, would contribute to the air pollution defined above. This section discussed the contribution of each of the four individual greenhouse gases emitted by Section 202(a) source categories.

a. Carbon Dioxide Emissions From Section 202(a) Source Categories

Carbon dioxide is emitted from motor vehicles and motor vehicle engines during the fossil fuel combustion process. During combustion, the carbon stored in the fuels is oxidized and emitted as CO_2 and smaller amounts of other carbon compounds.

In 1990, Section 202(a) source categories emitted 23 percent of total U.S. CO_2 emissions, behind only the electricity generation sector (36 percent). In 2006, Section 202(a) source categories remained the second largest sector, growing to 26 percent of total U.S. CO_2 emissions.

Carbon dioxide is the dominant greenhouse gas emitted from Section 202(a) source categories (94 percent of total U.S. Section 202(a) source category greenhouse gas emissions in 2006). Carbon dioxide emissions from these source categories grew by 32 percent between 1990 and 2006, largely due to increased carbon dioxide emissions from light-duty trucks (61 percent since 1990) and medium/heavy-duty trucks (76 percent).

In 2005, carbon dioxide from section 202(a) source categories in the U.S. were responsible for 4 percent of global aggregate greenhouse gas emissions (a similar percentage compared to the U.S. share of global greenhouse gas emissions when considering all greenhouse gas emissions from U.S. section 202(a) sources). Section 202(a) source category carbon dioxide emissions are a significantly larger share of global transportation greenhouse gas emissions (27 percent) than the corresponding share of all U.S. CO_2 emissions to the global total (18 percent), reflecting the comparatively larger size of the transport sector in the U.S. compared to the global average.

If the Administrator were to evaluate carbon dioxide as a separate air pollutant, she would consider the

emissions from section 202(a) source categories to contribute to the air pollution, placing primary weight on the fact that carbon dioxide is so dominant among all section 202(a) greenhouse gas emissions (94 percent) and contributes to a significant share of all U.S. carbon dioxide emissions (26 percent) and global greenhouse gas emissions (4 percent).

b. Methane Emissions From Section 202(a) Source Categories

Methane emissions from motor vehicles are a function of the methane content of the motor fuel, the amount of hydrocarbons passing uncombusted through the engine, and any post-combustion control of hydrocarbon emissions (such as catalytic converters).

In 2006, methane emissions from section 202(a) source categories were 0.11 percent of total greenhouse gas emissions from U.S. motor vehicles and motor vehicle engines. Methane emissions from these source categories decreased by 58 percent between 1990 and 2006, largely due to decreased methane emissions from passenger cars (62 percent) and light-duty trucks (51 percent). In 2006, methane emissions from these source categories equaled 0.32 percent of total U.S. methane emissions and 0.03 percent of total U.S. greenhouse gas emissions.

Methane emissions from Section 202(a) source categories were less than 0.01 percent of total global greenhouse gas emissions in 2005. When compared to the smaller subsets of global transportation emissions, and global methane emissions, section 202(a) source category methane emissions were about 0.03 percent in both cases in 2005.

If the Administrator were to evaluate methane as a separate air pollutant, she would consider the emissions from section 202(a) source categories to contribute to the air pollution. The Administrator would place primary weight on the same reason that the Administrator promotes the reduction of methane and other non-CO_2 greenhouse gas emissions from sources with relatively low but potent emissions, as manifested in its domestic methane partnership programs and the international Methane to Markets Partnership, which was launched in 2004. Specifically, these emissions are at a level that contributes to the climate change problem and there are valuable reductions available from these levels. As noted above, consideration of the global nature of greenhouse gas emissions and climate change means that a percentage contribution of specific gases and sectors would be expected to be much smaller than for previous rulemakings when the nature of the air pollution was national, regional or local.

c. Nitrous Oxide Emissions From Section 202(a) Source Categories

Nitrous oxide is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. Nitrous oxide (and nitrogen oxide (NO_X)) emissions from motor vehicles and motor vehicle engines are closely related to fuel characteristics, air-fuel mixes, combustion temperatures, and the use of pollution control equipment. For example, some types of catalytic converters installed to reduce motor vehicle NO_X, CO, and hydrocarbon emissions can promote the formation of nitrous oxide.

In 2006, nitrous oxide emissions from section 202(a) source categories accounted for 1.8 percent of total greenhouse gas emissions from U.S. motor vehicles and motor vehicle engines. Nitrous oxide emissions from these source categories decreased by 27 percent between 1990 and 2006, largely due to decreased emissions from passenger cars (39 percent) and light-duty trucks (10 percent). In 2006, nitrous oxide emissions from these source categories equaled 8.0 percent of total U.S. nitrous oxide emissions. In fact, Section 202(a) source categories are the second largest U.S source of N_2O, behind only agricultural soil management (which represented 72 percent of total nitrous oxide emissions in 2006).

In 2005, nitrous oxide emissions from U.S. section 202(a) source categories were 0.08 percent of total global greenhouse gas emissions. Also in 2005, U.S. section 202(a) sources accounted for 1.0 percent of global N_2O emissions and 0.6 percent of global transportation greenhouse gas emissions.

If the Administrator were to evaluate nitrous oxide as a separate air pollutant, she would consider the emissions from section 202(a) source categories to contribute to the air pollution, placing primary weight on the fact that nitrous oxide emissions from section these source categories are significant in terms of their contribution to U.S. (and global) emissions of that particular gas. Although Section 202 emissions of nitrous oxide appear small on a global basis, they were 8.0 percent of total U.S. N_2O emissions in 2006, second only to agricultural soil management (which represented 72 percent of total nitrous oxide emissions in 2006). In addition, as mentioned in the previous discussion of methane, given the vast number of sources and sectors that emit greenhouse gases around the world, even sources which represent a small percentage of U.S. or global emissions can be considered to contribute to the larger problem.

d. HFC Emissions From Section 202(a) Source Categories

Hydrofluorocarbons (a term which encompasses a group of eleven related compounds) are progressively replacing CFCs and HCFCs in section 202(a) cooling and refrigeration systems as they are being phased out under the Montreal Protocol and Title VI of the Clean Air Act. For example, HFC–134a has become a replacement for CFC–12 in mobile air conditioning systems. A number of HFC blends, containing multiple compounds, have also been introduced. The emissions pathway can be complex, with hydrofluorocarbons being emitted to the atmosphere during charging of cooling and refrigeration systems, during operation, and during decommissioning and disposal.

Section 202(a) source categories of hydrofluorocarbons accounted for 4.2 percent of total greenhouse gas emissions from U.S. motor vehicles and motor vehicle engines in 2006. Hydrofluorocarbons were not used in motor vehicles in 1990, but by 2006 emissions had increased to 70 $TgCO_2e$ (this represents an increase of 270 percent between 1995 and 2006). In 2006, hydrofluorocarbon emissions from these source categories equaled 56 percent of total U.S. hydrofluorocarbon emissions, making it the single largest source category of U.S. hydrofluorocarbon emissions.

In 2005, hydrofluorocarbons from section 202(a) source categories were 0.18 percent of total global greenhouse gas emissions. When compared to the smaller subset of global transportation emissions, section 202(a) source category hydrofluorocarbon emissions were 1.3 percent in 2005. However, U.S. section 202(a) HFC sources equaled 18 percent of global hydrofluorocarbon emissions, making it the largest source of global hydrofluorocarbon emissions.

If the Administrator were to evaluate hydrofluorocarbons as a separate air pollutant, she would consider the emissions from section 202(a) source categories to contribute to the air pollution, placing primary weight on the fact that hydrofluorocarbon emissions from these source categories are the largest U.S. and global source of that particular gas, and emissions have grown 270 percent since 1995. If the decision were made that these emissions do not contribute because hydrofluorocarbon emissions under section 202(a) make up just 0.18 percent

of global greenhouse gas emissions it would be inconsistent with the U.S. practice of encouraging hydrofluorocarbon emission reductions. Indeed, if the Administrator determined that hydrofluorocarbon emissions from section 202(a) source categories did not contribute, it would be unlikely that she would find contribution for hydrofluorocarbons from any other source of these (and other fluorinated) greenhouse gases. For these reasons, the Administrator believes the global context remains important to consider, but that more weight should placed on a contribution analysis done within the domestic context.

V. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is a ''significant regulatory action'' because it raises novel policy issues. Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action.

B. Paperwork Reduction Act

This action does not impose an information collection burden under the provisions of the *Paperwork Reduction Act,* 44 U.S.C. 3501 *et seq.* Burden is defined at 5 CFR 1320.3(b). The final endangerment finding would not impose an information collection request on any person.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this action on small entities, small entity is defined as: (1) A small business as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

Because this proposed action will not impose any requirements, the Administrator certifies that this proposed action will not have a significant economic impact on a substantial number of small entities. This proposed action will not impose any requirements on small entities. The endangerment and contribution findings do not in-and-of-themselves impose any new requirements but rather set forth the Administrator's determination on whether greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health or welfare, and whether emissions of greenhouse gases from new motor vehicles and engines contribute to this air pollution. Accordingly, the proposed action affords no opportunity for EPA to fashion for small entities less burdensome compliance or reporting requirements or timetables or exemptions from all or part of the proposal.

D. Unfunded Mandates Reform Act

This action contains no Federal mandates under the provisions of Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), 2 U.S.C. 1531–1538 for State, local, or tribal governments or the private sector. The action imposes no enforceable duty on any State, local or tribal governments or the private sector. Therefore, this action is not subject to the requirements of sections 202 or 205 of the UMRA.

This action is also not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments.

E. Executive Order 13132: Federalism

Executive Order 13132, entitled ''Federalism'' (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure ''meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.'' ''Policies that have federalism implications'' is defined in the Executive Order to include regulations that have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.''

This proposed endangerment determination does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. Thus, Executive Order 13132 does not apply to this rule.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications, as specified in Executive Order 13175 (65 FR 67249, November 9, 2000). Thus, Executive Order 13175 does not apply to this action.

G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

EPA interprets EO 13045 (62 FR 19885, April 23, 1997) as applying only to those regulatory actions that concern health or safety risks, such that the analysis required under section 5–501 of the EO has the potential to influence the regulation. This action is not subject to EO 13045 because it does not establish an environmental standard intended to mitigate health or safety risks. Although the Administrator considered health and safety risks as part of this proposed endangerment finding, the proposed finding itself does not impose a standard intended to mitigate those risks.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a ''significant energy action'' as defined in Executive Order 13211 (66 FR 28355 (May 22, 2001)), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. This action does not impose requirements on these activities.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law 104–113, 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use

available and applicable voluntary consensus standards.

This proposed rulemaking does not involve technical standards. Therefore, EPA is not considering the use of any voluntary consensus standards.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this proposed endangerment determination will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations. Nonetheless, when developing the proposed endangerment determination, the Administrator considered the impacts of climate change on minority or low-income populations.

Dated: April 17, 2009.

Lisa P. Jackson,

Administrator.

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