Office of Energy Projects

October 2018

Volume III – Appendices N-O

FERC/EIS-0278F

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC

Calcasieu Pass Project

Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Federal Energy Regulatory Commission
Office of Energy Projects
888 First Street, NE, Washington, DC 20426

Cooperating Agencies:

U.S. Environmental Protection Agency

U.S. Department of Transportation

U.S. Coast Guard

U.S. Department of Energy

U.S. Army Corps of Engineers

LIST OF APPENDICES

VOLUME II

VOLUME III

APPENDIX N

RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N
RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project

INDEX

APPENDIX N
RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
(cont'd)

Federal Agencies

FA1 – U.S. Department of the Interior, Office of Environmental Policy and Compliance

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
1001 Indian School Road NW, Suite 348
Albuquerque, New Mexico 87104

File 9043.1
ER 18/0291

August 13, 2018

VIA ELECTRONIC MAIL ONLY

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Subject: COMMENTS and RECOMMENDATIONS - Draft Environmental Impact Statement (DEIS) for the Proposed Calcasieu Pass Project, by Venture Global Calcasieu Pass, LLC (Venture Global); FERC Nos. CP15-550-000, CP15-551-000, and CP15-551-001

The U.S. Department of the Interior has reviewed the DEIS for the Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC Calcasieu Pass Project, dated June 2018, for the siting, construction, and operation of a natural gas liquefaction and storage facility, marine export terminal, pipeline, storage tanks, berthing docks, and a turning basin in Cameron Parish, Louisiana (hereafter referred to as the Calcasieu Pass Project).

The following comments by the U.S. Fish and Wildlife Service (FWS) are submitted in accordance with provisions of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), and the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661 *et seq.*) for FERC's consideration in preparing the Final EIS for this project.

General Comments

Threatened and Endangered Species (ESA)

FA1-1

As stated in section 4.7.1.5 of the DEIS, the FWS previously provided a not likely to adversely affect (NLAA) concurrence to Venture Global on September 24, 2016, and on November 1, 2016, for the federally-listed West Indian manatee, piping plover, and red knot. The FWS recommends that prior to construction the FERC contact the FWS regarding the ESA determination to ensure that new species have not been listed, new critical habitat has not been designated, or that no new information has been gained that could change the results of the consultation thus triggering re-initiation of ESA consultation. If the scope or location of the proposed project is changed significantly, consultation should occur as soon as such changes are made.

FA1-1 Prior to construction, the FERC or Venture Global will consult the U.S. Fish and Wildlife Service (FWS) to ensure that new species have not been listed, new critical habitat has not been designated, and that no new information has been gained that could change the results of the consultation (e.g., project changes).

Fish and Wildlife Coordination Act

The DEIS provides a good description of the study area. However, we are concerned that the text does not reflect the ongoing extensive coordination and development among Venture Global, the Louisiana Department of Wildlife and Fisheries (LDWF), and FWS regarding the cheniere habitat impacts assessment and restoration plan, nor associated impacts and benefits, as detailed in the following documents (available at the weblink below):

- October 3, 2017 letter from Venture Global to FWS, subject Preliminary Migratory Bird Habitat Mitigation Plan, Calcasieu Pass Terminal and TransCameron Pipeline Project
- February 21, 2018 letter from FWS to LDWF, subject Venture Global Calcasieu Pass, LLC, Cheniere Habitat Restoration and Migratory Bird Nesting Impact Mitigation Plan
- February 21, 2018, Final Cheniere Habitat Restoration Project Information Sheet
- Conservation Measures for Operation of Flare Stacks, FWS Louisiana Ecological Services Office, February 15, 2018
- Appendix A, October 3, 2017, Preliminary Migratory Bird Habitat Mitigation Plan and Shapefile Index for Migratory Bird Habitat Restoration Mapping
- November 2016, Migratory Bird Habitat Assessment and Species Observations, conducted by Natural Resource Group, an ERM Company, for the applicant

FA1-2

https://www.fws.gov/GISdownloads/R4/Louisiana%20ESO/Trahan/Venture%20Global%20-%20Calcasieu/Final%20VG%20Cheniere%20Habitat%20Restoration%20Plan/

FWS supports the cheniere restoration (preliminary migratory bird habitat mitigation plan) as proposed by Venture Global in its October 3, 2017, letter to restoring and protecting a total of 77 acres under the Cheniere Habitat Restoration Plan.

Because of the high importance attributed to maritime ridge/dune habitat for bird species of conservation concern and because this habitat type is considered to be in great decline, the FWS recommends that the elements of this plan be incorporated in the proposed action and impacts to cheniere habitat be thoroughly evaluated in this DEIS and mitigated. Specifically, we recommend that the five conservation measures provided in pages 3-4 of the February 21, 2018, letter be included in the scope of the EIS.

Specific Comments

Section 1.6, Permit, Approvals, and Regulatory Reviews

Under the Fish and Wildlife Coordination Act, the US Army Corps of Engineers and FERC are to consult with the FWS and the State fish and wildlife agencies and consider project effects to fish and wildlife resources for water projects, including dredging, equally with the project goal. We recommend including that statute in the list here as it is relevant to the coordination with the FWS and the LDWF and the development of the Cheniere Habitat Restoration Plan.

FA1-3

FA1-2 Venture Global Calcasieu Pass filed its preliminary Migratory Bird Habitat Mitigation Plan with the FERC as an attachment to their comments on the draft EIS (Accession Number 20180813-5059) and committed to continue consultation with the FWS and LDWF to finalize the Plan. The Plan is part of Venture Global's proposed action. Sections 4.6.1.3, 4.13.2.5, and 5.1.6 of the final EIS have been revised to address the Migratory Bird Habitat Mitigation Plan, including a recommendation for Venture Global Calcasieu Pass to file a copy of the final plan with FERC prior to construction. The Plan is also included in the final EIS as appendix M.

Venture Global responded to the five conservation measures suggested by the FWS (Accession No. 20180823-5067). Specifically, Venture Global Calcasieu Pass commits to:

1. Select species from the list provided by the FWS in consultation with staff from both the FWS and LDWF.
2. Include the FWS spacing recommendations for mast-producing and mid-story species in its design plans.
3. Develop a monitoring plan in consultation with the FWS and LDWF that defines success criteria, describes how criteria will be measured, and defines measures to be implemented if success criteria are not met.
4. Develop a monitoring plan in consultation with the FWS and LDWF that will include monitoring and management measures for invasive species control.
5. Implement the Migratory Bird Habitat Mitigation Plan, which has been filed with FERC, and is part of the proposed action.

FA1-3 Section 1.6 of the final EIS has been revised to include the Fish and Wildlife Coordination Act.

20180813-5179 FERC PDF (Unofficial) 8/13/2018 3:54:53 PM

3

Section 2.1, Terminal Facilities

FA1-4 The proposed Cheniere Habitat Restoration Plan and the area designated for restoration should be included as a feature of the proposed action. This will ensure that the plan is implemented and that loss and restoration of cheniere habitat is thoroughly evaluated.

Section 4.2, Soils and Sediments

FA1-5 It is our understanding that the topography of the temporary work space will be restored to pre-project conditions. This section should be revised to provide a detailed description of that proposed mitigation.

Section 4.5.1.3, Existing Vegetation Resources, Construction and Operation Impacts and Mitigation and Section 4.5.3.1 Coastal Live Oak-Hackberry Forest

FA1-6 Historically, upland areas within the terminal facilities included Chenier Plain Coastal Live Oak-Hackberry Forest Habitat (cheniere forest) as classified by LNHP's Natural Communities of Louisiana. Much of the area has been reduced to scrub-shrub and grassland habitat due to grazing practices; however there are a few areas of remnant forested habitat within the terminal and temporary work spaces. This section should be revised to address those impacts and the Cheniere Habitat Restoration Plan developed to offset those impacts.

Section 4.6.1, Wildlife Resources

FA1-7 The Venture Global LNG Facility is proposed within an area documented as a key migration route that receives peak densities (a birding hotspot) of most songbirds migrating across the Gulf of Mexico in the spring. It is located along the Calcasieu River floodplain, an essentially unbroken hardwood forest that is among the most important near-coast stopover areas for trans-Gulf migrant birds. We recommend this section include a discussion on the importance of this area as a key migration route for songbirds and that the Cheniere Habitat Restoration Plan be included in Section 4.6.1.2.

Section 4.6.1.3, Unique and Sensitive Wildlife Resources, Migratory Birds, Impacts and Mitigation

FA1-8 Gas flaring occurs at LNG facilities, and other industrial plants and oil rigs, during plant start up and shutdown events as well as during unplanned pressure release events. Nighttime attraction of lighting, in general, during inclement weather has proved to be a key liability for birds, and being that LNG facilities are located along the Gulf shoreline within the direct migratory path of neo-tropical songbirds, that threat could be even more pronounced. We recommend that guidance (Enclosure) developed by the FWS to assist with the design and operation of gas flare structures be incorporated to avoid and minimize impacts to migratory birds. (These guidelines were also provided in the February 21, 2018, letter cited above).

FA1-4 Refer to response to comment FA1-2.

FA1-5 Venture Global would follow the measures described in its Project-specific *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan), which can be viewed on eLibrary under Accession Number 20150904-5416. The Plan requires temporarily disturbed areas (including all temporary work spaces) to be restored to preconstruction conditions following completion of construction, including preconstruction contours and topography. A statement has been added to section 4.2.1.2 of the final EIS to reflect this. Additional details on post-construction restoration are found in the Plan. In addition, an Environmental Inspector (EI) would oversee implementation of the Plan, which also requires monitoring and reporting to ensure successful restoration of temporarily disturbed areas.

FA1-6 The FERC has reviewed the migratory bird habitat information provided by FWS in their draft EIS comments, including the 2017 FWS memorandum from the Louisiana Ecological Field Services Office that documents a FWS field inspection of habitat at select locations at the Terminal site. The FERC notes the remnant live oak trees scattered throughout sites identified by FWS as scrub shrub habitat (i.e., Site A and B in the 2017 memo). Information on these scattered live oaks has been included in final EIS sections 4.5.3.1, 4.6.1.1, and 4.6.1.3. Impacts on these scattered trees has also been noted in final EIS section 4.6.1.3. Venture Global Calcasieu Pass's Migratory Bird Habitat Mitigation Plan would also contribute to offsetting impacts on these scattered live oaks.

FA1-7 The final EIS *Unique and Sensitive Wildlife Resources* section (4.6.1.3) includes a subsection on important migratory bird areas, including information on the Louisiana Chenier Plain Important Bird Area (IBA). The description of this IBA in the final EIS includes information on its habitats, its support of migratory birds, and its importance as a stopover area for trans-Gulf migrant birds. See response to comment FA1-2 regarding the Migratory Bird Habitat Mitigation Plan.

FA1-8 Venture Global Calcasieu Pass commits to implementing the three measures suggested by FWS in their *Conservation Measures for Operation of Flare Stacks* for normal operation conditions at the Terminal as follows (Accession No. 20180823-5067). The measures would not apply to emergency shutdown or flaring events, or to start-up and commissioning procedures.

1. During normal operating conditions and regularly scheduled maintenance events, to the extent feasible, Venture Global Calcasieu Pass would avoid flaring at night, during low visibility conditions, and during peak migration seasons. With regard to lighting, and as discussed in the final EIS, Venture Global Calcasieu Pass developed a *Facility Lighting Plan* (Appendix 8C, Accession No. 20150904-5415) which includes mitigation measures for light pollution, consistent with FWS guidelines, including the use of diffusers, lenses, and shields to reduce glare and light pollution. Marking and lighting of specific Terminal components, including the stacks, must conform to Federal Aviation Administration (FAA) requirements. Lighting associated with specific structures within the Terminal are subject to FAA notification and compliance with FAA Circular AC70/7460-1L. Venture Global Calcasieu Pass would review the FWS communication tower guidance and incorporate the recommendations, where feasible, consistent with FAA requirements.
2. Venture Global Calcasieu Pass commits to installing anti-perching devices, such as cone-shaped mesh covers, on the Terminal flares.
3. Venture Global Calcasieu Pass is evaluating various options for deterrent devices, such as an air cannon, to keep birds away from flare stacks during flaring events and from other Project components, as necessary, during operations. Venture Global Calcasieu Pass would coordinate with the FWS regarding the deterrent devices selected and installed for the Project.

For FWS' suggestion of migration monitoring, as previously noted, Venture Global Calcasieu Pass would avoid flaring during peak migration seasons to the extent feasible for regularly scheduled maintenance events.

For FWS' suggestion of implementing a survey plan to determine if bird mortality occurred, Venture Global Calcasieu Pass will coordinate with the FWS to identify measures for assessing bird mortality, if any, following flare events.

FA1-9 This Section should also be revised to include the details of the proposed Cheniere Habitat Restoration Plan that has been developed in close coordination with Venture Global and the LDWF (referenced above). That plan would offset impacts to migratory songbirds as a result of the direct removal of stopover habitat and potential indirect impacts associated with the threat of artificial lighting. Without implementation of that plan we do not agree that impacts on migratory birds would not be significant as stated in the DEIS.

4.6.1.3, Unique and Sensitive Wildlife Resources, Species of Concern

FA1-10 The eastern black rail (*Laterallus jamaicensis s.sp.*), a Federally- and State-listed at-risk species, has a broad distribution inhabiting higher elevations of a variety of salt, brackish, and freshwater marsh habitats that can be tidally or non-tidally influenced. Recent surveys conducted within southwestern Louisiana has revealed that the eastern black rail occurs along the Cameron Parish coastline in both the breeding and non-breeding season. In the interest of conserving the eastern black rail, we encourage Venture Global to avoid and minimize project activities that would impact this at-risk species and its habitat.

Thank you for the opportunity to review and comment on this draft EIS. We commend the applicant's leadership and commitment to ensure the protection of species of conservation concern and the unique qualities of cheniere habitat. If you have any questions regarding the FWCA conservation measures contained in this letter, please contact Ms. Angela Trahan (337-291-3137) of this office. For all other questions, please contact Joshua Marceaux (337-774-5923).

Sincerely,

Stephen R. Spencer, PhD
Regional Environmental Officer

Enclosure

cc: FERC Service List

FA1-9 See response to comment FA1-2.

FA1-10 The eastern black rail has been incorporated into table 4.6.1.3-1 of the final EIS as a subspecies of black rail, a Bird of Conservation Concern. All migratory bird impact and mitigation discussions (including avoiding, minimizing, and offsetting migratory bird impacts) in the draft and final EISs are applicable to the eastern black rail.

Attachments to Comment FA1 – U.S. Department of the Interior, Office of Environmental Policy and Compliance

ENCLOSURE

Conservation Measures for Operation of Flare Stacks
Fish and Wildlife Service
Louisiana Ecological Services Office

February 15, 2018

Issue

Gas flaring occurs at liquefied natural gas (LNG) facilities, and other industrial plants and oil rigs, during plant start up and shutdown events as well as during unplanned pressure release events. The flame emitted to burn off flammable gas during a flaring event can attract birds especially at night. Nighttime attraction of lighting during inclement weather has proved to be a key liability for birds, and being that LNG facilities are located along the Gulf shoreline within the direct migratory path of Neotropical songbirds that threat could be even more pronounced. In September 2013, approximately 7,500, migrating songbirds were attracted to and killed by a flare at a LNG terminal in Saint John, New Brunswick, Canada. This event occurred during a foggy, low cloud cover, early fall evening along important migratory routes for songbirds creating conditions that are described as the perfect storm (Jenny Mandel, E&E reporter, *October 11, 2013*). Similar incidents have occurred at flares on offshore oil and gas installations.

The following guidance has been developed to assist with the design and operation of gas flare structures to avoid and minimize impacts to migratory birds. Conservation recommendations provided are discretionary activities to minimize or avoid adverse effects of a proposed action on migratory birds. They should in no way impede any emergency actions.

Conservation Measures

1. To minimize the potential impacts to migrating birds during a flare event:
   a. avoid flaring at night,
   b. avoid flaring during low visibility (i.e., fog, storm event),
   c. avoid flaring during peak spring (mid-March through April) and fall (September and October) migrations depending on the location; and,
   d. lighting around the facility and on the flare stacks should follow FWS communication tower guidance, http://www.fws.gov/migratorybirds/pdf/management/usfwscommunicationtowerguidance.pdf

2. Mortality of birds perching on flare stacks results from direct incineration or by inhalation of the toxic gas if the flare igniter fails to work properly. Consideration should be given to installing anti-perching devices on flare stacks to prevent raptors and other birds from using them as perch sites. Open vent stack equipment, such as heater-

treaters, separators, and dehydrator units, should be designed and constructed to prevent birds and bats from entering or nesting in or on such units, and to the extent practical, to discourage birds from perching on the stacks. Installing cone-shaped mesh covers on all open vents is one suggested method. Flat mesh covers are not expected to discourage perching and are not recommended.
<http://www.fws.gov/mountainprairie/contaminants/contaminants1f.html >

3. Consideration should be given to implementing an audible system (e.g. frightening device) that could also aid in deterring birds from the area during a flare event. Per the U.S. Department of Agriculture, Prevention and Control of Wildlife Damage (1994), useful frightening devices include broadcasted alarm and distress calls, pyrotechnics, exploders, and other miscellaneous auditory and visual frightening devices. No single technique can be depended upon to solve the problem. Numerous techniques must be integrated into a frightening program, and qualified knowledgeable personnel should be involved in the deterrent activities <http://icwdm.org/Handbook/birds/bird_e19.pdf>.

Migration Monitoring

Bird migration projections should be actively monitored, and maintenance activities (flaring events) should be planned to avoid peak migration periods and adverse weather conditions as much as possible. We recommend coordinating with U.S. Geological Survey (USGS), Radar Technology Program to develop a monitoring plan to determine peak migrations events in the area and how birds may be using the areas around the facility. Please contact, Wylie Barrow, Research Wildlife Biologist with USGS (barroww@usgs.gov, 337-266-8668).

Survey Plan

During all flaring events surveys similar to those conducted for communication towers should be conducted to determine if bird mortality has occurred. Please refer to the "Briefing Paper on the Need for Research into the Cumulative Impacts of Communication Towers on Migratory Birds and Other Wildlife in the United States" (link in 1.d. above) for examples of sampling methods. Survey plans should be reviewed by the FWS prior to implementation, and survey results should be provided to the FWS upon request.

Coordination
Should a mortality event occur, please contact Angela Trahan at 337/291-3137.

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Calcasieu Pass Project	)	Project Nos. CP15-550-000, CP15-551-000, and CP15-551-001
	)	
Calcasieu Parish, Louisiana	)	

Draft Environmental Impact Statement (DEIS) for the Proposed Calcasieu Pass Project, by Venture Global Calcasieu Pass, LLC (Venture Global);

Certificate of Service

I hereby certify that I have this day caused the foregoing document to be served upon each person designated on the official service list compiled by the Secretary in these proceedings.

Dated on this 13th day of August, 2018.

Stephen R. Spencer, Ph.D.
Regional Environmental Officer
U.S. Department of the Interior
1001 Indian School NW, Suite 348
Albuquerque NM 87104

FA2 - National Oceanic and Atmospheric Administration, National Marine Fisheries Service

ORIGINAL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

August 13, 2018 F/SER46/CG:jk
225/389-0508

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

Dear Secretary Bose:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Draft Environmental Impact Statement (DEIS) for the Federal Energy Regulatory Commission (FERC) Calcasieu Pass Project (Project docket numbers: CP15-550-000, CP15-551-000, and CP15-551-001) dated June 2018. Venture Global Calcasieu Pass, LLC requests authorization to site, construct, and operate a natural gas liquefaction and storage facility, and marine export terminal. The project is located on the eastern shore of the Calcasieu River near its confluence with the Gulf of Mexico in Cameron Parish, Louisiana. TransCameron Pipeline, LLC requests authorization to construct, install, and operate certain natural gas pipeline facilities also in Cameron Parish, Louisiana. The new liquefaction facilities would have a design production capacity of 12 million metric tons of liquefied natural gas (LNG) per annum for export.

Wetlands in the vicinity of the project area consist of tidally influenced salt marsh vegetated primarily by saltgrass and smooth cordgrass. Water bottoms in the project area are composed of a mixture of sand and mud substrates. The project is located in an area which has been identified as essential fish habitat (EFH) for various life stages of federally managed fishery species, including postlarval and juvenile life stages of red drum, brown shrimp, and white shrimp. The primary categories of EFH to be affected by project implementation include estuarine emergent wetlands, estuarine water column, and estuarine water bottoms. Detailed information on federally managed fisheries and their EFH is provided in the 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC). The generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; P. L. 104-297).

In addition to being designated as EFH for various federally managed fishery species, wetlands and water bottoms in the project area provide nursery and foraging habitats for a variety of economically important marine fishery species such as blue crab, gulf menhaden, spotted seatrout, sand seatrout, southern flounder, and striped mullet. Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). Wetlands in the project area also produce nutrients and detritus, important components of the aquatic food web, which contribute to the overall productivity of the Calcasieu Lake estuary.

Based on information contained in the DEIS, NMFS is concerned with some elements of the proposed project, and these concerns should be addressed in the Final EIS. The DEIS acknowledges the construction of the terminal facility and pipeline would result in the permanent impacts to 87.97 acres of EFH, including the permanent loss of 18.62 acres of EFH. As a result, Venture Global has developed a beneficial use of dredged materials (BUDM) plan, and while the FA2-1 mitigation offsets would exceed the impacts, it lacks a gapping and degradation plan for the retention dikes. Gapping and degradation are necessary to return ecosystem functions (i.e., tidal connectivity) and restore fishery access. Containment dikes should include a 25 foot gap at base elevation every 1000 feet at a minimum. Final elevation of the gaps should be based on adjacent intertidal marsh elevations. The gapping plan should be implemented within three year of construction completion. The NMFS will work closely with the applicant and FERC as the project progresses to ensure the appropriateness of the gapping plan. Additionally, the DEIS notes that construction of pipeline facilities would temporarily impact 74.95 acres of EFH, and permanently impact 4.7 acres of EFH. However, the estimate of a two to four year timeframe for FA2-2 the restoration/revegetation of the pipeline impact areas as described on page 4-111 would necessitate the need for mitigation due to temporal loss of ecosystems functions resulting from these impacts.

Section 305(b)(4)(A) of the Magnuson-Stevens Act requires NMFS to provide EFH conservation recommendations for any federal action or permit which may result in adverse impacts to EFH. Therefore, NMFS recommends the following to ensure the conservation of EFH and associated marine fishery resources:

EFH Conservation Recommendations

1. The FERC should require a gapping plan for the containment dikes to be implemented within three years. The plan should be included in the Final EIS.
2. FA2-3 The FERC should amend the mitigation plan to account for temporal loss associated with pipeline construction and include these changes in the Final EIS.
3. The FERC should modify the mitigation plan to include ten years monitoring of the beneficial use and mitigation areas. These changes should be included in the Final EIS.

Consistent with Section 305(b)(4)(B) of the Magnuson-Stevens Act and NMFS' implementing regulation at 50 CFR 600.920(k), your office is required to provide a written response to our EFH conservation recommendations within 30 days of receipt. Your response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the FA2-4 proposed activity. If your response is inconsistent with our EFH conservation recommendations, you must provide a substantive discussion justifying the reasons for not implementing the recommendations. If it is not possible to provide a substantive response within 30 days, the FERC should provide an interim response to NMFS, to be followed by the detailed response. The detailed response should be provided in a manner to ensure it is received by NMFS at least ten days prior to the final approval of the action.

2

FA2-1 Venture Global would have a gapping and degradation plan as part of their final compensatory mitigation plan that is approved by the U.S. Army Corps of Engineers (USACE) as part of the Section 404/10 permitting process. As Venture Global stated in its response to NMFS comments on the Section 404/10 permit application public notice for the Project, and as included in their August 2018 Compensatory Mitigation Plan/Beneficial Use of Dredged Material (CMP/BUDM) Plan (Accession No. 20180918-5091), Venture Global would – "*construct naturally-functioning intertidal marsh land, [and] measures will be implemented to ensure the containment dikes at the marsh creation/restoration area allow for tidal flow. As soon as spoil placement is completed, the berms will be degraded to the extent possible without risking spoil loss, to minimize the need for returning to the site with heavy equipment. The marsh/creation restoration area will be surveyed 30 days following the placement of fill material to ensure that the fill elevations are consistent with the design elevations. At that point, the containment dikes will be degraded to within 0.5 feet of the marsh fill level existing at the time. Also, 25-foot-wide gaps will be located at each tidal creek and spaced every 500 feet along the containment berms. These gaps will be cut as low as possible without risking the release of fill material. The gaps will be monitored during the first year following construction to ensure that they are degrading naturally. If the gaps do not show the necessary rate of natural degradation, they will be manually degraded to the lowest adjacent grade to ensure intertidal flow. This process will continue during subsequent monitoring events.*"

FERC anticipates additional details on the gapping and degradation plan would be included in Venture Global's CMP/BUDM that is approved by the USACE, and would include any input from NMFS as part of the USACE's required consultation with NMFS on EFH impacts. Venture Global Calcasieu Pass and TransCameron Pipeline must file documentation that they have received all applicable authorizations required under federal law, including the USACE, prior to construction of any project facilities.

FA2-2 It is the responsibility of the USACE to determine appropriate mitigation and how much is needed for the different types of impacts to waters and wetlands from construction of the Terminal and Pipeline. The USACE must also address EFH impacts as part of their Section 404/10 permitting process for the project and would need to address NMFS' concern on this same matter. Venture Global's Compensatory Mitigation Plan (Final EIS Appendix E) facilitates the creation/restoration of EFH in the form of high quality estuarine marsh at the East Cove Unit of the Cameron Prairie National Wildlife Refuge (CPNWR). Based on the Louisiana Rapid Assessment Methodology (LRAM), Venture Global would be required to create/restore 54.9 acres of marsh to compensate for the permanent wetland impacts (most of which is EFH) and temporary extended wetland impacts that are not being compensated for by a wetland bank. However, to maximize the mitigation acreage and use of high volume of dredged material, Venture Global is proposing to create/restore nearly 2.5 times the area of marsh LRAM requires, for a total of approximately 137 acres of marsh creation/restoration, all of which would be EFH. Venture Global's final mitigation plan approved by the USACE would also address temporary impacts on EFH along the Pipeline (approximately 56.9 acres). FERC requires that Venture Global have all federal authorizations prior to construction, including the USACE. The FERC also notes that the 2- to 4- year recovery period the comment references on draft EIS page 4-111 is discussed in the context of land use impacts and is the approximate time required to restore the entire pipeline right-of-way to pre-construction conditions, and is not the time to restore a waterbody or wetland ecosystem function to support fisheries. As stated in final EIS section 4.4.2.2, it is typical for emergent wetland vegetation in Project area to reestablish in 1-2 years. In addition, waterbodies crossed by the pipeline would be restored to previous flow patterns immediately following construction.

Further, FERC would monitor the Pipeline construction right-of-way until restoration is successful, and Venture Global would be required to file wetland monitoring reports and, if necessary, develop a remedial revegetation monitoring plan if wetlands do not revegetate within three years of construction. These requirements would minimize the temporary EFH impacts along the Pipeline.

FA2-3

1. See response to FA2-1.
2. See response to FA2-2.
3. Venture Global's May 2018 final Draft CMP/BUDM proposes 15 years of mitigation monitoring. In addition, it should be noted that it is the responsibility of the USACE to determine appropriate mitigation and the amount of time necessary to monitor the permittee-responsible mitigation site and activities. The USACE must also address EFH concerns as part of their Section 404/10 permitting process for the project and would need to address NMFS' concern on this same matter. FERC requires that Venture Global have USACE approval prior to construction.

FA2-4 In addition to the responses provided in FA2-1, FA2-2, and FA2-3, and consistent with Section 305(b)(4)(B) of the Magnuson-Stevens Act, FERC will respond to NMFS' EFH comments in the final EIS, as stated in FERC's letter to NMFS on September 11, 2018 (Accession No. 20180911-3013).

We appreciate your consideration of our comments. If you wish to discuss this project further or have questions concerning our recommendations, please contact Craig Gothreaux at (225) 389-0508, extension 204, or by email at Craig.Gothreaux@noaa.gov.

Sincerely,

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

c:
LDWF, Balkum, Hebert
LDNR, Morgan
USACE, Little
FWS, Soileau, Paille
EPA, Gutierrez
F/SER46, Swafford, Howard
F/SER4, Dale
Files

FA3 - U.S. Army Corps of Engineers, Regulatory Branch

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NEW ORLEANS DISTRICT
7400 LEAKE AVE
NEW ORLEANS LA 70118-3651

August 16, 2018

REPLY TO
ATTENTION OF

Operations Division
Regulatory Branch

SUBJECT: MVN-2014-2715-WII (Venture Global Calcasieu Pass LLC / TransCameron Pipeline LLC Calcasieu Pass Project) USACE comments on (DEIS) Docket NOS. CP15-550-000, CP15-551-000, CP15-551-001

Federal Energy Regulatory Commission (FERC)
Office of Energy Projects
Attn.: Ms. Shannon Crosley
Washington, DC 20426

Dear Ms. Crosley:

This is in reference to your request for comments from the New Orleans District, U.S. Army Corps of Engineers, Regulatory Branch (CEMVN) on your agency's Draft Environmental Impact Statement (DEIS) dated June 2018, relevant the Venture Global Calcasieu Pass LLC & TransCameron Pipeline LLC (VG LNG) / Calcasieu Pass Project.

On September 11, 2017, CEMVN received a DA permit application from Venture Global Calcasieu Pass, LLC for the subject proposal to construct a liquefied natural gas (LNG) export terminal and associated pipeline infrastructure, to be located in Cameron Parish, off of the Calcasieu River, near Cameron, Louisiana. Following our review of the subject DEIS, we would like to provide the following comments:

FA3-1 **DEIS Sec. (1.3.2)** - A single and complete DA application was submitted and received by this office on September 11, 2017, to include the entire project plan. This office worked with the applicant and the Department of Natural Resources, Office of Coastal Management (DNR, OCM), to acquire a compressed set of project plans on the facility and pipeline, which could be utilized for clearly posting our required 20 day public notice on the project. Upon receipt of the compiled plats, CEMVN posted our Joint Public Notice with the DEQ on the project, dated February 5, 2018 to initiate comments from the public and pertinent resource agencies. Any new information or comments received which may not have already been addressed by FERC, will be considered by the U.S. Army Corps of Engineers to determine whether to make, modify, condition, or deny a permit for this proposal. To make this decision, results and evaluations completed by FERC and any unaddressed comments received by CEMVN, are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and other public interest factors. Comments and assessments by FERC are also used by CEMVN in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act.

FA3-2 While the subject project is regulated by this office under *Section 10 of the River and Harbors Act (RHA) & Section 404 of the Clean Water Act (CWA);* due to its location on a USACE Federally maintained channel, it will also be regulated under *Section 14 RHA (408)*, necessitating a 33 USC 408 (Section 408) review. Section 14 RHA (Section 408)

FA3-1 Comment acknowledged.

FA3-2 Comment acknowledged.

FA3-2 authorizes the Secretary of the Army to grant permission to any private, public, tribal, or other federal entities for the temporary or permanent alteration or use of a USACE Civil Works project, if the Secretary determines that the alteration or use will not be injurious to the public interest and will not impair the usefulness of the project. Projects requiring 408 Permission and/or Decisions, typically also entail endorsements/acceptance from the local sponsor(s), Port(s), and/or pilots associations. In turn, the application will also be reviewed by this District's Real-Estate Branch as to its location at or near any lands which may have federal interests by the federal government, USACE. To date, the proposed project is still under review and a 408 Permission and/or Decision has not been issued.

FA3-3 **DEIS Sec. (1.5), (4.4), (4.5), (5.1.4), (5.1.5) -** On January 9, 2017, a Preliminary Jurisdictional Determination (PJD) on the project footprint, under file # MVN-2015-1846-SQ, was finalized and approved by this District's Regulatory Surveillance and Enforcement Section. A jurisdictional determination is a required and critical part of CEMVNs review process, and is utilized in our overall assessment of the proposal under the 404 (b)(1) guidelines and our final permit decision. Based on the PJD, and information submitted by the applicant, the proposed project will include temporary and permanent impacts to jurisdictional wetlands. At this time CEMVN and DNR, OCM are working with the applicant on their Needs and Alternatives Justification in order to further reduce adverse wetland impacts from the project.

FA3-4 **DEIS Sec. (1.6.7) -** Under CEMVN procedures and regulations, projects located within the Louisiana Coastal Zone, such as the VG LNG, CEMVN will require issuance of a state Coastal Use Permit and/or decision from DNR, OCM, prior to a permit decision being rendered by this office. In the circumstance of projects located within the Coastal Zone, joint permit reviews between CEMVN and DNR, OCM are managed and closely coordinated between the agencies, to include our public interest review process and any requirements of compensatory mitigation, should a permit be issued. DNR, OCM is still reviewing the application and working closely with the applicant to further reduce wetland impacts as practicable. Once attainable reduction of impacts is concluded and compensatory mitigation for unavoidable impacts to aquatic resources is acquired, satisfying both CEMVN and DNR, OCM standards, the state Coastal Use Permit will likely be issued.

FA3-5 **DEIS Sec. (1.6.6), (4.19) (5.1.10) -** By regulation, while CEMVN will primarily defer to FERC on their final effects determination relevant cultural resources under Sec 106 of the NHPA, CEMVN provides a copy of application's to our District Archeologist & Tribal Liaison for review, and as to ensure that our District's Sec 106 and/or Tribal requirements and standards have been met. This application and FERC's effects determination has been reviewed by CEMVN and our District Archeologist, and we concur with the FERC findings.

FA3-6 **DEIS Sec. (4.4.2) -** Under the 404 (b)(1) guidelines, should a DA permit decision be rendered in favor of the subject project by CEMVN, in coordination with DNR, OCM and any other interested state or federal agencies, a viable and approved compensatory mitigation plan will be required from the applicant, to offset any unavoidable direct or indirect impacts to wetlands and/or special aquatic sites. Additionally, CEMVN requires a Section 401 Water Quality Certification from the Louisiana Department of Environmental Quality (LDEQ), in order to issue our permit. At this time the application is still under review by the LDEQ and will likely be issued.

FA3-3 Comment acknowledged.

FA3-4 Comment acknowledged.

FA3-5 Comment acknowledged.

FA3-6 Comment acknowledged. The FERC notes that Louisiana Department of Environmental Quality (LDEQ) issued the 401 Water Quality Certification for the Project on June 11, 2018.

We hope that our comments will provide you with suitable and relevant information from this office, on your DEIS. You may be assured of our commitment to maintain coordination with your office throughout this review, and that we will perform an objective evaluation of this project and render an expeditious permit decision which fully complies with applicable laws and regulations under our program. If you have any questions, please feel free to contact me at (225) 342-3099 or at james.little.usace.army.mil.

Sincerely,

LITTLE.JAMES.WILLIAM.JR.1118205274

Digitally signed by LITTLE.JAMES.WILLIAM.JR.1118205274
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=LITTLE.JAMES.WILLIAM.JR.1118205274
Date: 2018.08.16 17:42:00 -05'00'

James W. Little, Jr.
Environmental Resource Specialist
Regulatory Branch

Enclosure

State Agencies

SA1 – Louisiana Department of Wildlife and Fisheries

JOHN BEL EDWARDS
GOVERNOR

JACK MONTOUCET
SECRETARY

PO BOX 98000 | BATON ROUGE LA | 70898

August 8, 2018

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., N.E., Room 1A
Washington, DC 20426

RE: *Docket Number: CP15-550-000 CP15-551-000, 001*
Applicant: Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Notice Date: June 26, 2018

Dear Ms. Bose:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the above referenced Draft Environmental Impact Statement (DEIS) for the proposed construction of the Venture Global Calcasieu Pass natural gas liquefaction and storage facility and the associated TranCameron Pipeline, in Cameron Parish, Louisiana. Based upon this review, the following has been determined:

Ecological Studies:

SA1-1 LDWF appreciates the opportunity to review the DEIS for the proposed Venture Global Calcasieu Pass natural gas liquefaction and storage facility and the TranCameron Pipeline. At this time, LDWF Ecological Studies' concerns for these projects have been stated and adequately addressed by the applicant in the notification process included under the Louisiana Department of Natural Resources, Office of Coastal Management's Coastal Use Permit application process (P20150857) as well as the U.S. Army Corps of engineers' Section 404 permitting process (MVN-2014-02715-WII). However, Ecological Studies would like to provide the attached letter of support for Venture Global's proposed Migratory Bird Habitat Mitigation Plan designed to

SA1-2 offset project related impacts to migratory bird habitat through the restoration of cheniere habitat adjacent to the proposed natural gas facility. Cheniere habitat is critically imperiled in the State of Louisiana and such restoration efforts will greatly benefit the wildlife that depend on it.

Oyster Seed Grounds:

SA1-3 LDWF Oyster Seed Grounds objects to any portion of this project that may impact the Calcasieu Lake Public Oyster Seed Area.

2000 QUAIL DRIVE BATON ROUGE, LA 70808 225-765-2800 WLF.LOUISIANA.GOV

SA1-1 Comment acknowledged.

SA1-2 The FERC acknowledges Louisiana Department of Wildlife and Fisheries' (LDWF) support of Venture Global's Migratory Bird Habitat Mitigation Plan.

SA1-3 LDWF oyster seed grounds will not be affected by the Project. Venture Global Calcasieu Pass has modified the dredge slurry pipeline route to avoid the public oyster seeding ground in Calcasieu Lake, as recommended by Louisiana Department of Natural Resources and LDWF (Accession No. 20180813-5059).

SA1-4

Louisiana Natural Heritage Program:
Manatee (*Trichechus manatus*) may occur in the surrounding water bodies of your site location. Manatees are large mammals inhabiting both fresh and salt water. Although most manatees are year round residents of Florida or Central America, they have been known to migrate to areas along the Atlantic and Gulf coast during the summer months. Manatee is an endangered species protected under the Endangered Species Act of 1973 and the Federal Marine Mammal Protection Act of 1972. In Louisiana, taking or harassment of a manatee is in violation of state and federal law. Critical habitat for manatee includes marine submergent vascular vegetation (sea-grass beds). Areas with sea-grass beds should be avoided during project activities if possible. Report all manatee sightings to the Louisiana Department of Wildlife and Fisheries at 225-765-2809 or 1-800-442-2511.

SA1-5

The database indicates a Coastal Live Oak-Hackberry Forest natural community record located within the project area. This community is considered critically imperiled in Louisiana with an S1 state rank. This community type formed on ancient abandoned beach ridges in Southwest Louisiana. These ridges are composed primarily of sand and shell, and are approximately 4 to 5 feet above sea level. This community, also known as a cheniere, is an important storm barrier, limiting salt water intrusion, and acts as a migratory staging/stopover site for Neo-tropical migratory birds. We advise you to take the necessary measures to avoid any impacts to this ecological community. If you have any questions or need additional information, please contact Chris Doffitt at 318-487-3412.

The Louisiana Department of Wildlife and Fisheries appreciates the opportunity to review and provide recommendations to you regarding this proposed activity. Please do not hesitate to contact Habitat Section biologist Zachary Chain at 225-763-3587 should you need further assistance.

Sincerely,

Randell S. Myers
Assistant Secretary

zc/cm/bh/cm

c: EPA Marine & Wetlands Section
USFWS Ecological Services

SA1-4 Potential Project impacts on the federally threatened and state endangered West Indian manatee are addressed in final EIS section 4.7.1.1. The potential impacts include disturbance or injury from pile driving noise and collisions with vessels. Venture Global and the FERC have consulted the U.S. Fish and Wildlife Service (FWS) on the Project's potential effects on the species and determined the Project *May Affect*, but *Not Likely to Adversely Affect* the species; the FWS concurred with this determination (Accession No. 20180813-5179). In addition, as stated in final EIS section 4.7.1.1, personnel would be instructed to call FWS and LDWF to report any manatee sightings or injured manatees during construction. In addition, and as stated in final EIS section 4.5.1.2, there is no submerged aquatic vegetation in the Project area that would be impacted by the Terminal facilities.

SA1-5 Final EIS section 4.5.3.1, addresses coastal live oak-hackberry forest communities at the Terminal site and along the Pipeline. As stated, during environmental surveys much of these vegetation communities no longer exist, as they have been heavily cleared to support cattle grazing, as well as sustaining damage from storms and hurricanes. In addition, final EIS section 4.5.3.1, acknowledges the Louisiana Natural Heritage Program's identification of this vegetation community at the Terminal site; however, during environmental surveys the area has been reduced to a small area (2-3 acres) of hackberry with no associated live oak. Despite the absence and degraded nature of coastal live oak-hackberry forest communities in the Project area, Venture Global Calcasieu Pass has developed a Migratory Bird Habitat Mitigation Plan to restore chenier habitats that will include these vegetation communities.

Attachment to Comment SA1 – Louisiana Department of Wildlife and Fisheries

JOHN BEL EDWARDS
GOVERNOR

JACK MONTOUCET
SECRETARY

PO BOX 98000 | BATON ROUGE LA | 70898

25 July 2018

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., N.E., Room 1A
Washington, DC 20426

RE: Support for Migratory Bird Habitat Mitigation Plan for the Calcasieu Pass Terminal and TransCameron Pipeline Project (CP15-550 CP15-551, 001)

Dear Ms. Bose,

The Louisiana Department of Wildlife and Fisheries (hereafter, "Department") appreciates the opportunities for proactive consultation with Venture Global Calcasieu Pass, L.L.C. (hereafter, "Venture Global") and our federal partners. Early consultation can be crucial for minimizing impacts to wildlife and their associated habitats. Throughout these consultations, Venture Global expressed interest in mitigating impacts to migratory birds, culminating in a Chenier Habitat Restoration Plan (Migratory Bird Habitat Mitigation Plan; hereafter, "Plan"), a joint effort between Venture Global and U.S. Fish and Wildlife Service's Lafayette Ecological Services (hereafter, "Service") staff. The full Plan and related materials are attached as Appendix 1.

For the Calcasieu Pass Terminal and TransCameron Pipeline Project, successful minimization of impacts to migratory birds must utilize a multi-prong approach including (1) alteration of the timing of work; (2) maintenance of buffers; (3) bird hazing or exclusion; (4) reduction of anthropogenic threats to birds on site; (5) additional consultation, as needed; and (6) both active and passive habitat restoration/management, etc. The permittee will restrict clearing of vegetation to the non-nesting period (see Plan for dates) and will survey for nesting birds prior to any clearing during the nesting season. Should nesting birds be detected, Venture Global will consult further with the Service and the Department. Buffers around active bird nests or colonies will be maintained and may be altered with additional consultation with the Service and the Department. The permittee will be proactive to prevent new nesting attempts during clearing, preparation, and construction phases; a list of acceptable hazing techniques are included in the Plan. Because birds may be drawn to bright lights and flares, a behavior shown to cause significant collision or incineration mortality in certain environmental conditions, the permittee should review and implement, where practicable, guidelines provided by the Service on 15 February 2018 (see also Appendix 1). Guidelines and recommendations provided by the Service and the Department may be revisited; the permittee should not hesitate to contact these agencies should additional consultation be required.

Returning impacted habitats to their original, pre-project states, where possible, or turning those into higher quality habitats should be paramount to the mitigation effort; substantial effort was expended to determine acceptable amounts of required mitigation to make whole the ecosystem in the project area. In particular, in southwest Louisiana, cheniers – ancient beach ridges (Owen 2008) – provide vital upland, wooded habitat

2000 QUAIL DRIVE BATON ROUGE, LA 70808 225-765-2800 WLF.LOUISIANA.GOV

"islands" in an otherwise largely wet, herbaceous landscape. In spring and fall each year, these small patches of coastal forest act as stopover sites and staging areas for Neotropical migratory landbirds; millions of birds of more than 80 species utilize these habitats each year (Barrow et al. 2005, Holcomb et al. 2015). In fact, despite their small size, cheniers, often referred to as "fire escapes" for migratory birds, are "utterly vital in emergency situations" and without which, "migrants are not likely to survive to continue migration" (Mehlman et al. 2005). Unfortunately, less than 5% of pre-settlement chenier landcover remains in Louisiana (Smith 1993). Given this rarity, chenier habitat is ranked G2 globally (= imperiled; vulnerable to extinction) and S1 in Louisiana (= critically imperiled; very vulnerable to extirpation; Holcomb et al. 2015). Venture Global has committed to restoration and management of 29.48 acres of wooded chenier in coastal Louisiana, likely one of the largest chenier restoration efforts in the state.

Overgrazing by livestock has reduced the ability of cheniers to recover by "changing species composition and by reducing the understory" (Barrow et al. 2005). Unfortunately, grazing occurs in almost all of the remaining cheniers in Louisiana, creating a significant challenge for restoration (Barrow et. al 2005). In addition to the aforementioned chenier restoration, the permittee has agreed to eliminate cattle grazing on 26.94 acres of upland. Although limited grazing may be permissible (permittee should remain receptive to adaptive management to maximize likelihood of achieving objectives), the contemporary grazing regime does not appear to be sustainable to this extremely rare habitat. Removal of cattle from this area should allow tree seedlings to mature, creating a viable stopover site for migratory birds by the end of the project life.

The Department strongly supports restoration of chenier forests and its associated habitats and wildlife. The Migratory Bird Habitat Mitigation Plan for the Calcasieu Pass Terminal and TransCameron Pipeline Project jointly created by the Service and Venture Global will recover more than 50 acres of a critically imperiled wildlife habitat, one that supports millions of migratory birds each year. The Department applauds the collaborative and proactive efforts of the Service and Venture Global in addressing mitigation for Neotropical migratory landbirds.

Please do not hesitate to contact Michael Seymour, nongame ornithologist, at 225-763-3554 for additional information or consultation.

Sincerely,

Randell S. Myers
Assistant Secretary

Enclosures

cc: FERC, Washington, D.C. (Attn: Nicholas Tackett)
USACE, New Orleans District, LA (Attn: James W. Little, Jr.)
LDWF, Natural Heritage Program, Baton Rouge, LA (Attn: Michael Seymour)
LDWF, Environmental Investigations, Baton Rouge, LA (Attn: Dave Butler)
LDNR, Office of Coastal Management, Baton Rouge, LA (Attn: Andi Zachary)
Venture Global Calcasieu Pass, Washington, D.C. (Attn: Peter Bell)

Companies and Organizations

CO1 – John W. Stone Oil Distributor, LLC

From: 'FERC eSubscription' <eSubscription@ferc.gov>
Sent: Thursday, July 05, 2018 5:21 AM
Subject: Supplemental/Additional Information submitted in FERC CP15-550-000 by John W. Stone Oil Distributor LLC.,et al.

On 7/5/2018, the following Filing was submitted to the Federal Energy Regulatory Commission (FERC), Washington D.C.:

Filer: John W. Stone Oil Distributor LLC.
John W. Stone Oil Distributor LLC. (as Agent)

Docket(s): CP15-550-000
Lead Applicant: Venture Global Calcasieu Pass, LLC
Filing Type: Supplemental/Additional Information
CO1-1 Description: Comment of John W. Stone Oil Distributor LLC. under CP15-550. Concern with the proposed turning basin as well as all marine operations. In particular the safety and security exclusionary zones, as well as the impact and mitigation plan for dispersion

To view the document for this Filing, click here
http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20180705-5003

To modify your subscriptions, click here: https://ferconline.ferc.gov/eSubscription.aspx

---
Please do not respond to this email.
Online help is available here:
http://www.ferc.gov/efiling-help.asp
or for phone support, call 866-208-3676.

1

CO1-1 Section 4.9.12.1 of the EIS evaluates potential impacts associated with the Project's contribution to shipping traffic, including the proposed turning basin and relationship to other marine operations in the Calcasieu River Ship Channel. The United States Coast Guard and the Lake Charles Pilot's Association are responsible for ensuring the Calcasieu River Ship Channel is safe and for managing vessel traffic. Section 4.9.12.1, subsection on Marine Transportation addresses LNG security zones for LNG carriers. Refer also to section 4.12.8 regarding LNG marine carriers and safety.

The EIS also evaluates potential safety and reliability issues in sections 4.12.6 and 4.12.7, including siting requirements to address toxic vapor dispersion and exclusion zones.


Untitled Map
Write a description for your map.
Stone Cameron
Untitled Path
Untitled Path
1141
82
Dewitt Rd
Stone Cameron
Gulf Beach Hwy
N

CO2 – RESTORE

RESTORE
P.O. BOX 233
LONGVILLE, LA 70652
(337)-725-3690
michaeltritico@yahoo.com

August 13, 2018

eFiling
www.ferc.gov
Federal Energy Regulatory Commission

Re: Docket Nos. CP15-550-000, CP15-551-000, and CP15-551- 001
OEP/DG2E/Gas Branch 1 Venture Global Calcasieu Pass, LLC. & TransCameron Pipeline, LLC.

Dear Federal Energy Regulatory Commission:

Thank you for the opportunity to submit comments on the Draft Environmental Impact Statement prepared for the Venture Global LNG project.

RESTORE is a small regional environmental group founded in 1974. Our first registered address was in Hackberry, Louisiana. Although we have changed locations we have always been extremely interested in all natural and manmade occurrences within the Calcasieu-Cameron ecosystem.

Many years ago, when the Trunkline LNG Project was up for comment, RESTORE submitted brief comments. I am not sure we sent them to FERC or whether we sent them to a Louisiana agency, but the primary concern we expressed at that time remains our primary concern today. That concern is the possibility of a conflagration that would kill or injure many people should there be a catastrophic failure to contain the massive amount of liquefied natural gas present at any of the LNG facilities.

CO2-1

As we have seen in recent LNG permitting documents for other companies, In this Draft Environmental Impact Statement there is very little coverage of the possibility of such a conflagration, how it could happen, and what it would do for what distance away from the source of the event. RESTORE is puzzled that such an important issue is so thinly addressed. We believe that is a major flaw in all of the companies' documentations and all of the State and Federal documents that the public sees, including this particular DEIS.

CO2-2

If I lived in or near the town of Cameron I would be nervous about my own safety as well as that of my friends and neighbors. The nearest thing to useful information about a possible big fire came only in one diagram, Figure 4.12.8.4-2 which seems to show that a "flammable vapor zone" extends all the way into the town of Cameron about a mile and a half from the Venture Global Facility.

On page 4-255 as I understand the narrative, the Coast Guard has an estimate that an LNG ship catastrophe could spread fire as far away as 2.2 miles.

CO2-3

I understand that the Coast Guard has a safety "exclusion zone" around moving LNG ships and I had thought that there is a similar concept as a safety buffer around the onshore facilities but nowhere in the DEIS did I see much more than a slight mention of such a thing, certainly no distance was given.

The numerous diagrams in Chapter 4 showing extent of impact zones from various onsite

CO2-1 Venture Global has completed significant and extensive studies and analyses of the safety and reliability of the proposed LNG Terminal as required by the Pipeline and Hazardous Materials Safety Administration (PHMSA) regulations (49 CFR 193) and a potential large LNG release at the Terminal was considered. A steel-reinforced concrete enclosure would provide containment for a release from an LNG storage container, and the radiant heat zones from a fire over this impounding area were assessed in EIS section 4.12.7. Also, a preliminary analysis and recommendations were included in EIS section 4.12.5 to ensure that the design of the LNG storage tanks, including the concrete enclosures, would address their ability to adequately withstand natural forces, such as potential seismic, stormwater, and wind loads, as well as other types of loads, such as those from an adjacent fire and overpressure and projectile loads from wind borne projectiles and ignition of design spills. Further, as discussed in EIS section 4.12.7, Venture Global would provide an additional layer of protection for retaining the liquid capacity of an LNG tank onsite by either sloped ground surface areas or by the storm surge berm and wall system surrounding the Terminal, which would not be an impoundment required by regulation. The Terminal's Emergency Response Plan would also have to satisfy the requirements for 49 CFR 193.2509(b)(3), which requires coordinating with appropriate local officials in the preparation of an emergency evacuation plan. This plan sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank.

CO2-2 LNG shipping began almost 60 years ago, and while groundings, allisions, and collisions have occurred, no known accidents involving LNG marine carriers have resulted in a breach of the LNG cargo tanks, which are surrounded by the ship hull and insulation layering. The hazard zones presented in final EIS figure 4.12.8.4-2 are theoretical zones for an intentional breach of a loaded LNG marine carrier. For the largest of these hazard zones, which represents flammable vapor dispersion, page 53 of the Sandia National Laboratories Report SAND2004-6258 states, "the potential for a large vapor dispersion from an intentional breach is highly unlikely." This is true, not only because risk reduction techniques would be applied by the United States Coast Guard (USCG) to protect the LNG marine carrier, but because any intentional act that would have enough energy to breach the cargo tank would also be expected to quickly ignite the LNG vapor. After being ignited, the vaporizing LNG spill would burn as a pool fire near the carrier rather than allowing a large vapor cloud to form and travel away from the pool source.

In addition, EIS section 4.12.9 discusses the EPAct 2005 requirement for an Emergency Response Plan to be approved by FERC prior to construction of an LNG terminal. Our recommendation in EIS section 4.12.5 requires this plan to include notification procedures as well as evacuation routes and methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit. This recommendation would also require that the Emergency Response Plan is developed in coordination with appropriate federal, state, county, and local emergency planning groups.

CO2-3 The referenced draft EIS section on page 4-255 relates to a flammable vapor dispersion zone for an intentional breach of an LNG marine carrier. See the response to CO2-2 above.

The USCG may require discretionary security zones around LNG marine carriers to limit the marine traffic traveling near the carrier. No security buffer zones would be required for the LNG Terminal outside of the LNG Terminal boundary: however, as discussed in EIS section 4.12.5, perimeter security systems, including fencing, cameras, intrusion detection, and patrols, are required to prevent unauthorized people from accessing the Terminal facilities.

As noted in final EIS section 4.12.7, the PHMSA promulgates and enforces the LNG safety regulations, including those for the design spills used for determining safety exclusion zones for the Terminal from LNG releases and for other siting requirements. In addition to "leakage source" design spills, PHMSA also considers a full guillotine rupture of an LNG storage tank withdrawal line as a design spill for this project. Final EIS Figures 4.12.7.3-2 and 4.12.7.3-3 demonstrate that the flammable vapor dispersion from the full rupture of this major LNG line would remain onsite and would not be as significant as many of the dispersion scenarios for the smaller-diameter leakage sources, depicted in subsequent final EIS figures. This is often true because a release from a very large opening would cause the line to rapidly depressurize to a lower pressure. The lower pressure allows the spill to fall to the ground more readily where it would be contained by containment systems specifically designed to capture spills and reduce the size of a vapor cloud that can form. Many smaller-diameter leakage sources that are too small to depressurize the piping can release liquid with higher pressures. These smaller diameter releases will travel much farther, break up into tiny droplets, and vaporize before reaching the ground causing a larger vapor cloud. Final EIS section 4.12.7 presents the most significant PHMSA safety exclusion zones that were calculated for the LNG releases, and all of the LNG exclusion zones would remain onsite.

CO2-3 equipment failure caused releases do not include any for major events, just relatively small releases. In a way that is misleading because it keeps the reviewer's focus limited and away from any big event.

CO2-4 One way that I can see for a conflagration to occur would be for a hurricane storm surge and its overlying waves to overtop the west wall that is supposed to prevent that from happening. It was unclear to me from the DEIS about whether or not the west side berm crest (26 feet above sea level as described on page 4-193) includes those waves. Regardless, page 4-198 says that the maximum storm surge at high tide would be 28.25 feet above sea level. Even if that includes the wind-blown waves, it is 2.25 feet over the west wall height as I understand it. That would allow a spilling over of sea water into the facility. The perimeter berm would then be counterproductive by acting as a bowl to keep the sea water inside the facility where it would short out the refrigeration system. Then what? As the LNG in the two giant tanks warms up it will expand greatly eventually bursting the two 200,000 cubic meter containments. Release of 400,000 cubic meters of LNG into a hurricane would likely create a blazing hurricane since lightning or static electricity or a spark from blowing transformers would ignite the vapor cloud even at 150 miles per hour. How far out would such a blowtorch extend? Certainly the nearest residents at 1.3 miles would have evacuated but any people taking shelter as usual in the old courthouse would be vulnerable to something never seen in Hurricanes Audrey, Rita, or Ike. Such a thing would be more than a conflagration.

CO2-5 The idea of waves atop a storm surge takes me back to Hurricane Audrey. My great-aunt, Alice Marshall, did not survive that storm. The storm surge not only hit her house east of town but even lifted it up through the old oak trees and began rolling it over and over like a barrel. Her husband survived but only through incredible strength clamoring over the rolling structure being carried north by the surge and its waves. Calculation of the maximum height of a storm surge event must include addition of the waves atop the surge itself.

CO2-6 Furthermore, as you point out on Page 4-198 there is one estimate that across the 30 year span of the lifetime of this facility sea level will rise by 2.44 feet. Should that actually develop I would think that the facility would have to be abandoned before 30 years.

CO2-7 RESTORE is concerned that FERC is missing an opportunity to assist the world in combating climate change caused by greenhouse gas emissions. At several places in the DEIS FERC pleads ignorance of any way to gauge the cumulative impacts of this LNG project and apparently all the many proposed LNG projects combined. This one facility will emit close to 4,000,000 tons a year of greenhouse gases (GHG) with zero permit restrictions from the State Department of Environmental Quality, U.S. EPA, FERC, or anyone else. Although it is acknowledged in the DEIS that GHG are contributing to sea level rise and hurricane impacts, to not use your authority to try to rein in these major sources of GHG is irresponsible.

CO2-8 Even two of your own Commissioners, on July 19, 2018, Richard Glick and Cheryl A. LaFleur, expressed the same concern that FERC is falling short of its legal obligation to address the climate change issue and should not be pleading inability to do something to help address the problem.

CO2-9 RESTORE hopes that the Final DEIS will contain some more robust consideration of the GHG problem along with some kind of proposed remedies or mitigation. (The fact that Venture Global is not alone in claiming that Carbon Capture and Sequestration is economically infeasible should not stop FERC from coming up with something concrete to alleviate that impediment. Since there could be three LNG facilities within a one mile radius in Cameron, plus four upstream, a dedicated GHG pipeline whose cost

CO2-4 Storm surge estimates used in the design of the Terminal account for wave action height, as well as flood elevations. As stated in EIS section 4.12.5, Venture Global Calcasieu Pass would have a levee and floodwall that range from 26 to 33 feet to protect against a combined storm surge and wave height of up to 28.25 feet. To address the waves that would overtop part of the western levee, Venture Global conducted a wave overtopping hazard analysis and found that for the 500-year return period event for the western levee, the mean overtopping rate would be 0.039 cubic feet per second per foot ($ft^3/s/ft$). A rate of 0.039 $ft^3/s/ft$ is less than what is expected to result in flooding and erosion and deterioration of a protected berm.

CO2-5 Comment acknowledged. As noted in CO2-4, wave action height is accounted for.

CO2-6 As stated in final EIS Staff Recommendation 33, FERC has recommended that Venture Global Calcasieu Pass file with the Secretary a surface maintenance plan, stamped and sealed by the professional engineer-of-record registered in Louisiana, for the perimeter berm which ensures the crest elevation relative to mean sea level will be maintained for the life of the Terminal considering, berm settlement, subsidence, and sea level rise. This recommendation would be for the life of the Terminal, regardless of the 30 year design life of the Terminal. In addition to FERC Staff Recommendation 33, FERC staff would conduct annual inspections of the Terminal and would check the adequacy of the perimeter berm considering the berm's elevation and overall condition of the berm's surface.

CO2-7 Refer to response to comment CO5-1 for further information regarding greenhouse gas emissions and the analyses conducted for this Project and others under FERC's regulatory purview.

CO2-8 FERC staff has addressed greenhouse gas emissions and climate change in accordance with NEPA and Commission policy.

CO2-9 FERC is a regulatory agency and does not propose, plan, or build projects. The suggested project would require a project proponent and a need/market. In addition, the analysis presented in the EIS discloses an assessment of the feasibility of a carbon capture and storage (CCS) system to LDEQ as part of the GHG permit application BACT analysis; this assessment is more appropriately managed and enforced by LDEQ. Refer to response to comment CO5-1 for further information regarding greenhouse gas emissions and the analyses conducted for this Project and others under FERC's regulatory purview.

CO2-9 and contents would be shared by all 7 companies, could collect CO and CO_2 and intersect in Calcasieu Parish where the "green pipeline" comes through from the east headed to the sequestration site in Texas. Now would be the time for FERC to call together all 7 companies and get them to participate in that idea.

CO2-10 Other air quality issues that were covered (inadequately) in the applicant's Louisiana Department of Environmental Quality Draft Part 70 and PSD Air Permits, are the ammonia emissions at 270 times the Minimum Emission Rate, and a ton of formaldehyde. RESTORE is especially concerned about the formaldehyde since it is a sensitizer causing people who breathe it to become allergic to other things and not know why. FERC should take a look at those two molecules in particular and see if there is some way that you can get Venture Global to reduce their emissions.

CO2-11 We agree with FERC's concern over dust emissions but concentrating on that several times in the DEIS while stepping lightly on other air quality problems like GHG, ammonia, and formaldehyde seems to indicate a derailed focus.

CO2-12 I was pleased to see much information on the impacts of dredging on aquatic organisms. For many years RESTORE has been trying to get agencies to consider the concept of restricting dredging during times of heavy migrations in the Calcasieu River/Estuary/Marsh/Ship Channel Ecosystem. It was especially rewarding to see the several times within the DEIS that FERC recognized a "window" during which special care would have to be taken to avoid interference with wildllife. For example, there is your discussion on Page 5-7 for fisheries protection during instream work in which you wanted a window of June 1 through November 30 but Venture Global wanted year-round for the Terminal construction and May 1 through September 30 for pipeline work. The conclusion you reached was to defer to the Louisiana Wildlife and Fisheries for guidance.

CO2-13 Many years ago, 1977 in fact, using data published by the Louisiana Wildlife and Fisheries, I drew a "Migratory Clock" diagram which I have submitted many times in always unsuccessful attempts to get agencies to recognize that there are many months of the year when dredging would have a lesser impact on aquatic organisms than the 3 times a year when there are major pulses of migration, each pulse involving numerous species in various life stages from egg to nauplii, to juveniles, to adults.

One such pulse begins around the time of the Vernal Equinox, early April and lasts until the end of May. Coming in from the Gulf are White Shrimp Adults, Brown Shrimp Adults, forage fish such as Menhaden, Atlantic Threadfin Shad, and Spot. Also moving in and out of the marshes and Ship Channel are Blue Crab Larvae.

A second major pulse occurs approaching the Autumnal Equinox, beginning in late August and going through all of September. Leaving the marsh are White Shrimp juveniles. Going back into the Gulf are White Shrimp Adults and Atlantic Threadfin Shad. Blue Crab Larvae again are being transported in and out of the Gulf. Going into the marsh are White Shrimp Post-larvae.

CO2-10 The modeling that was done for the LDEQ air permitting includes non-emergency emissions calculations for ammonia but does not evaluate the safety/hazards risks associated with toxic releases. Instead, the EIS includes an evaluation of vapor dispersion from the release of several constituents, including ammonia. Refer to EIS section 4.12.7.4 for the modeled information. The final EIS concludes that the Acute Exposure Guideline Level (AEGL)-2 and AEGL-3 toxic vapors would remain onsite, but the AEGL-1 toxic vapors would extend offsite. However, the toxicity effects associated with AEGL-1 concentrations are non-disabling and reversible and FERC recommended that Venture Global Calcasieu Pass develop emergency response plans with federal, state, and local agencies that includes procedures for notifying residents and recreational users within areas of potential hazard including, but not limited to, the calculated AEGL dispersion zones.

With regard to formaldehyde, the modeling completed for the LDEQ permits includes formaldehyde emissions from the turbines, boilers, and engines and is projected to be a few tons per year which would have a negligible off-site air quality impact. In addition, enforcement of the state air quality permit is more appropriately managed by and delegated to LDEQ.

CO2-11 Dust emissions are an immediate and controllable concern during construction and an impact the FERC can appropriately address. Other air emissions are the subject of regulatory requirements and technical review by EPA and LDEQ.

CO2-12 Comment acknowledged.

CO2-13 Comment acknowledged. The final EIS was revised to reflect the common name of "white shrimp" for the correctly stated scientific name of *Litopenaeus setiferus.*

As stated in final EIS section 4.3.2.3, Venture Global consulted with and requested approval from Louisiana Department of Wildlife and Fisheries (LDWF) for instream construction in warmwater fisheries year-round for the Pipeline and Terminal (and associated dredging). On August 17, 2018, LDWF responded to Venture Global's request and approved the year-round instream construction window as long as oyster seed grounds are avoided; the Project will not affect oyster seed grounds (Accession No. 20180913-5102).

Final EIS section 4.6.2.1 states that construction impacts on aquatic organisms (e.g., effects of turbidity) would vary by species, where highly mobile species would be able to avoid the affected area while smaller or sedentary species may not avoid exposure. The dredging effects would be temporary, lasting only the time necessary to complete the dredging. As stated in final EIS section 4.3.2.2, the U.S. Army Corps of Engineers conducts maintenance dredging in the Calcasieu River Ship Channel in the vicinity of the proposed Terminal site every 1 to 2 years, and therefore, aquatic species in the area of the proposed Terminal have been exposed and are likely accustomed to the effects of dredging.

The third major pulse of migrations begins in early November and goes through early December (the time of year when strong cold fronts come through and the Winter Solstice occurs.) Going back into the Gulf are White Shrimp Adults, Menhaden, and Spot. Coming in from the Gulf are Croakers.

Those organisms I mentioned above are simply representative ones. Others such as Brown Shrimp, Pink Shrimp, Redfish, Speckled Trout, Flounders, Squid, and many other species also take part in the three migratory pulses above. (Blue Shrimp are mentioned in the DEIS. I have never seen a Blue Shrimp.)

CO2-13

It seems reasonable to restrict dredging during those three times since that would still leave 3/4 of a year in which to do properly-scheduled dredging activities. Your DEIS does a good job of listing the adverse impacts of dredging and your recognition of the concept of special protective windows for helping Nature is very much appreciated.

I will try to attach a digital copy of the "Migratory Clock" to these comments. Even though the copy is smudged and not fully-legible I think it helps make the point about the times when dredging would be most and least harmful.

(RESTORE disagrees with FERC's unsubstantiated perception that any dredging effects would be minimal and temporary since the aquatic organisms are acclimated to the procedure.)

The concept of ballast water discharge from the ships during loading is considered not too significant since it will be discharged "low" in the Ship Channel water column, that is in the saltwater wedge that underlies the outflowing surface freshwater from upstream. That wedge is indeed very persistent. It had ruined irrigation water used for rice farming many miles north of

CO2-14

Lake Charles until a Salt Water Barrier was built north of the City of Lake Charles.

Whatever is in the ballast water will therefore be carried all the way past Lake Charles to the Barrier. What if a ship does not swap its ballast water for Gulf water 200 miles offshore? How will the facility or Coast Guard know that what is being discharged is not just seawater? Even if it is just seawater, that will exacerbate saltwater intrusion somewhat.

That thought brings up the possibility that the various LNG projects proposed, not just Venture Global, could interfere with two other projects that have been in planning stages for years and are approaching implementation:

CO2-15

One is fairly imminent: A Corps of Engineers project to try to prevent dredge spoil which has been deposited on the spoil bank islands that reach all along Calcasieu Lake, Ship Channel side, from washing back into the lake. That project will likely tie into another one, far more extensive and reaching all the way to Calcasieu Pass. That one is the Calcasieu Ship Channel Salinity Control Measures Project, current budget over $4 million. I do not have the official number that the Coastal Protection and Restoration Authority (CPRA) has assigned to that

CO2-14 Potential impacts of ballast water discharge are addressed in final EIS section 4.3.2.2. All LNG carriers are required to comply with federal ballast regulations to avoid and minimize impact of ballast water on the aquatic environment (USCG regulations at 33 CFR 151.2025). Further, Venture Global Calcasieu Pass would ensure that any visiting vessels possess documentation to demonstrate compliance with ballast water regulations and best management practices prior to allowing any ballast water to be discharged into the marine berthing area. Vessels that have operated outside of the U.S. Exclusive Economic Zone (EEZ) must retain their ballast water on board or undergo a mid-ocean (greater than 200 nm from shore and at a water depth greater than 6,562 feet) ballast water exchange in accordance with applicable regulations. Potential impacts on water quality due to ballast water discharge would include a temporary increase in salinity level in the immediate vicinity of the LNG berthing area. Because the proposed Terminal site and turning basin/berthing area are within the lower Calcasieu River Ship Channel (about 0.2 mile from the Gulf of Mexico), salinity differences are expected to be minor and may not be measurable under normal tidal cycles. Ballast water would be discharged near the bottom of the marine berth where relatively dense saltwater from the Gulf of Mexico characteristically underlies freshwater from inland sources. Furthermore, the volume of ballast water discharged during each LNG carrier visit to the LNG Terminal would represent a negligible influence on the overall system.

CO2-15 The *Calcasieu Ship Channel Salinity Control Measures Project* is part of a larger coastal restoration plan, as described in the State of Louisiana's First Amended RESTORE Plan that was approved by the Coastal Protection and Restoration Authority Board (CPRA) on January 18, 2018. The Plan is now pending formal acceptance by the U.S. Department of Treasury and the RESTORE Council. In July 2012, the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) established the Gulf Coast Ecosystem Restoration Council (Council). The RESTORE Act dedicates 80 percent of all administrative and civil penalties related to the Deepwater Horizon spill to a Gulf Coast Restoration Trust Fund and outlines a structure by which the funds can be utilized to restore and protect the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, coastal wetlands, and economy of the Gulf Coast region. The U.S. Department of the Treasury is responsible for issuing compliance and auditing procedures for the entire Act and procedures for two grant programs administered by Treasury. To date some of the preliminary studies for this Project have been funded and completed and the preliminary design options and engineering are under development. The funding and schedule for final designs and implementation have not yet been confirmed. It is not evident that all of the funding has been attained yet to implement this project. As such, while this project is considered in the cumulative section of the final EIS, it is not included in the cumulative impacts analysis in the final EIS.

The second cumulative project mentioned by the commentor was a plan that would prevent dredge spoil that has been deposited on the spoil bank islands along Calcasieu Lake, Ship Channel side, from washing back into the lake. FERC was unable to find a specific plan for this but it would be located outside the geographic region for cumulative impacts based on using the HUC-12 sub watershed for the cumulative impacts combined with the Project.

project but what I remember seeing recently is that there will be walls along the Ship Channel from the Gulf to the Intracoastal Waterway. Small boats will be able to get into and out of the Channel from adjacent waterbodies by going over "sills" that will be spaced every few miles along the walls. Big ships and salt water will be kept between the walls.

CO2-15 Of course, that will likely resurrect the controversy that developed over the placement of weirs in area marshes, structures meant to keep salt water out and fresh water in. Many people felt that the weirs were restricting the natural migrations of aquatic organisms and thereby making it harder to catch fish, shrimp, and crabs.

Should that Salinity Control Plan or one of its currently sidelined alternatives ever reach the construction stage, since the Calcasieu Pass will be a key location in whatever the Plan proposes, the proximity of the Venture Global and two other LNG facilities could well interfere with the engineering planning, construction, and operation of something that is sorely needed to reverse the ongoing burning influence of seawater on a formerly mostly freshwater ecosystem.

CO2-16 (The removal of the hemispherical sand bar at the mouth of the Calcasieu River by the lumber schooner industry in the 19th Century and the dredging of the River by shortsighted people in the 20th Century have ruined what was a grand example of Providence.)

That brings up what RESTORE considers to be a problem in the DEIS that can easily be remedied, and, in fact, turned to the Venture Global LNG company's advantage. In Section 4 of the DEIS at 4.10.3 there is not named but acknowledgment of a potentially historic site, #16M171 but it was considered "ineligible" for formal designation as such. Figure 1.1-1 seems to show that location very near the pipeline route. Then on page 5-22 the State Historic Preservation Office said that there were no historic properties onsite or nearby.

Yet that is the location of the VERY historic Gulf Biologic Station at Cameron. That station existed for about ten years at the turn of the 19th into the 20th Century. I believe that a hurricane wiped out the station and its scientists. I was privileged to be on a guided tour conducted by Mrs. Conway LeBleu prior to Hurricane Rita. The Historic Society was putting up a monument on Davis Road to commemorate the existence of the Station. All that was left at that time was rubble but it was an honor for me as a biologist to be able to stand where some CO2-17 pioneering scientists had worked to document for all time the baseline conditions of the lower Calcasieu! I had not known that there was such an ecological research station here, comparable at the time to the one at Chesapeake Bay and one on the California. Some of the scientists at the Cameron Station were veterans of those other advanced research facilities.

Years ago RESTORE and the Calcasieu Rod and Gun Club (all dead now except for Paul Yakupzack, first USFWS Ranger at the Cameron Prairie National Wildlife Refuge) managed to collect from the Tulane Rare Books Archive and the LSU Middleton Library's Louisiana Collection, most of the publications of the Gulf Biologic Station. We made copies and placed them in the Cameron Library, Central Library in Lake Charles, and the McNeese Fraser Library. Unfortunately, we hear that the Cameron copy may have been lost in Rita. Although the Fraser

CO2-16 Comment acknowledged.

CO2-17 Yes, archaeological site 16CM171 is the remains of the Gulf Biological Station at Cameron. The site was recorded by Venture Global's contractor, Natural Resources Group (NRG) in 2015. The remains of the site consist of brick building piers and two circular structures. NRG correctly identified the site as the remains of a biological research station. The Louisiana state legislature established the station, which was dedicated in 1902. During its period of operation, the State Bureau of Agriculture and Immigration published 15 scientific bulletins produced by the station. The legislature closed the station in 1910, and the property was returned to private ownership in 1912. The station was not destroyed by a hurricane, as claimed by RESTORE, but rather the buildings were torn down by workmen in 1938.

Site 16CM171 is within the footprint for the LNG terminal (not along the pipeline route as claimed by RESTORE). NRG evaluated the site as not eligible for the NRHP. The FERC staff and the Louisiana State Historic Preservation Officer agree with this determination. Because the site is not an historic property, no mitigation is required, in accordance with the regulations for implementing Section 106 of the NHPA (at 36 CFR 800).

Library suffered extensive damage, I think that the Station publications are safe. (The main library at UC Berkeley, where I first found the Station's works should still have the complete set.)

CO2-17 What could be done as a priceless mitigation would be for Venture Global to digitize a copy of all the publications done by the Gulf Biologic Station at Cameron. Then that could become a stand-alone website with links back to the Creole Nature Trail website, the Venture Global website, the Calcasieu/Cameron Tourist Bureau, and possible some scientific websites such as the ones for the LSU Center for Wetland Resources and the Estuary Center in Lafayette. That might be a kind of mitigation that the general public could see instead of just hear about. It would also be something that the young people of Cameron Parish could be proud of and emulate, since it was a unique ecological project long, long before "ecology" became a famous word and concept. Furthermore, just as I felt grateful to be able to stand where great scientists had once worked, likely so would other biologists. A sturdy, more hurricane resistant monument on Davis Road and even a plank walkway out to the rubble would be a tourist attraction for some people. Maybe someone with a strong metal detector could scour the rubble area to see if any artifacts got scattered by the storms through the years.

CO2-18 Several places in the DEIS confirm that the ecosystem has been gravely-damaged by cattle grazing. That is then used as an excuse for requiring lowered levels of mitigation by the company. That is fair, no doubt. However, RESTORE stands for Restore Explicit Symmetry To Our Ravaged Earth, or, in other words, "Put it back the way the Creator had it because He had it right." We would like to see a full and complete restoration of all human-ruined ecosystems on the planet.

CO2-19 I had some nostalgic thoughts about the cattle mess in Cameron as I read through the DEIS. I found it very sad that the rare and endangered Red Wolf was not mentioned in the DEIS whatsoever. The last population in the wild was in the West Calcasieu/Cameron Coastal Zone. Many years ago a young lady who was a RESTORE member testified that a Corps of Engineers plan to significantly widen the Gulf Intracoastal Waterway would put several stresses onto that remnant wolf population, beyond what was happening with the cattlemen shooting the animals. The young lady told of direct loss of habitat and making it harder for the wolf pups to swim across a widened waterway. She asked the Corps to relent.

What happened from that was sort of bittersweet. The Corps got the USFWS to do something. The USFWS captured all the red wolves they could and moved them to a remote island off the Eastern Seaboard. Protected there from gunners the pack flourished. Last I heard some of the new wolves have been transplanted to a wild area on the mainland of the East Coast.

Yet, even though that is a noble achievement on the part of the USFWS, RESTORE would like to see *Canis rufus* back home, someday. That day is far off to be sure. It will take the cattlemen's children coming to understand why the Creator had Red Wolves here in the first place: Each year during the coldest months in the lower Southern Plains, a large herd of bison would migrate down into Southwest Louisiana and Southeast Texas. They were heavy grazers in

CO2-18 Comment acknowledged.

CO2-19 Comment acknowledged. In 1980 the red wolf was considered biologically extinct in the wild by the FWS and LDWF considers the species extinct in Louisiana. While the red wolf's historic range included southern Louisiana, the species no longer exists in the state (a nonessential experimental population was established by FWS in North Carolina). Venture Global and FERC consulted the FWS and LDWF on rare, threatened, and endangered species in the project area. The red wolf is not a concern because the species does not occur or potentially occur in Louisiana.

The final EIS discloses chenier and marsh habitat impacts from construction of the Terminal and Pipeline. All current, existing chenier and marsh habitats would be restored to preconstruction conditions along the pipeline per the FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures*. In addition, Venture Global developed a preliminary Migratory Bird Habitat Mitigation Plan/Chenier Habitat Restoration Plan to restore and protect these areas, which will be finalized prior to construction.

the coastal dry prairies that transitioned away from the wet prairies (marshes) along the coast. To keep the bisons from exerting an extra herbivorous stress upon the edges of the marshes the Creator had a thin buffer ring of predators (Red Wolves) at the interface of the dry and wet prairies. As the bison would get too close to the marshes they would encounter the wolves and turn back north, soon to migrate back to Oklahoma as the weather warmed.

When cattlemen began bringing in herbivorous bovines to the Chenier Plain Coast the Red Wolves did their best to subtract those invasive animals from the ecosystem. That led to cattlemen maligning the wolves and all but exterminating them. Meanwhile the cattle force toward the centers of the marsh all native herbivores such as muskrats, insects, and some birds. Hence the acceleration of "ponding out" of the marshes, usually attributed to other, less political influences. CO2-19

Appendix E, Page E-3 makes clear the lack of wisdom displayed by the cattlemen when it shows that 86% of the region to be "low quality non-tidal cattle-grazed wetlands," permanently impacted.

RESTORE hopes that FERC will not shut the door on the possibility of remediation of the Cheniers and marshes which have been greatly-devalued by the shortsightedness of the cattle industry.

RESTORE very much appreciates FERC's attention to the adverse impacts of noise on people, wildlife, and fish. We also very much appreciate that Venture Global is considering bubble curtains, time-outs and ramp-ups for pile driving, and cushions between the piles and the drivers. For sound to disturb fish over 28 miles offshore is very telling. For the project to last for three years of that is disturbing to RESTORE so we do hope that the noise attenuation measures make a significant difference. Thank you for taking that problem seriously. CO2-20

Soil liquefaction and subsidence are mentioned in several places in the DEIS but are not considered serious issues.

It is not only natural earthquake events that could cause soil liquefaction. The pulses from pile driving or once the terminal would be in routine operation, the vibrations from its machinery could cause soil liquefaction. Since the big tanks will be on numerous 110 foot deep piles maybe that would prevent any kind of shifting. Still, I remember when I was a student at College Oaks Elementary School in Lake Charles, many years ago. Sometimes after a rain, at recess a bunch of us would go to a certain spot out in the playground and start jumping up and down in unison. Within a few minutes a natural trampoline would develop. The earth would get colloidal, something like Jello and we would have a grand old time teasing each other about how long before it turned into quicksand and swallowed up whoever happened to be on it at the time. I do not know if that same kind of dirt is in Cameron. I hope not. CO2-21

Section 1, 1.5.3, Page 1-13: The loss of access to the Jetty Fishing Pier, Pavilion, and RV Park is a shame. I was out there last week. It is a wonderful facility. Many families were CO2-22

CO2-20 Comment acknowledged.

CO2-21 The Terminal site geology has been characterized in detail through extensive geotechnical investigations. All critical components of the facility would be constructed on pilings and/or engineered foundation material to preclude soil liquefaction and extensive differential settlement. Liquefaction is a technical term used to describe how some soils, often sands and silts absent of clay, can behave like a liquid due to continued vibration and/or saturated soil conditions. Liquefaction is not likely to occur at the Terminal site. First, the soil testing performed at this site indicate the presence of cohesive clays. When subjected to a seismic load, the property of cohesion keeps clays from liberating into individual grains. Clay will instead deform and remain restricted in-situ. Second, liquefaction requires seismic activity to remove the water between individual soil grains to allow motion. Clays can absorb limited quantities of water, but individual clay grains are impermeable due to their extremely fine and uniform grain sizes. The presence of standing subsurface water among these clays is therefore inconsistent with established geoscientific principle, and therefore does not physically present the required environmental conditions for liquefaction to form. Finally, vibration caused by pile driving is insufficient in magnitude and duration to initiate a pre-liquefaction dewatering process.

CO2-22 Comment acknowledged. As noted in final EIS section 4.8.1.3, Venture Global Calcasieu Pass and TransCameron Pipeline entered into a cooperative endeavor agreement (the "CEA") with the Cameron Parish Police Jury in 2016 that contemplates the potential enhancement of recreational opportunities in the town and parish of Cameron. Pursuant to the CEA, Venture Global Calcasieu Pass would relocate the public boat launch from the current location to a new location off of Davis Road, as well as develop a new location for the RV facility.

CO2-22 enjoying it. Maybe, if there really will be provided a boat ride down there to replace the road access, families might enjoy that ride as a bonus experience. On the other hand, it is not likely that a shuttle service will be available for as many hours a day as is the road access.

CO2-23 Another disadvantage to no road access is the possibility of accidents requiring quick response by emergency medical technicians who might not be able to haul all of their ambulance-borne devices onto the shuttle and out to the injured person in time whereas road access is much more efficient in that kind of emergency.

CO2-24 Also, there were rods and reels leaned up against the recreational vehicles I saw, indicating that one reason those people chose that place to stay was that they could just walk over the dunes and cast out their bait. Having an RV parking spot away from the shore would negate that advantage provided by the current spot.

CO2-25 Section 2, Page 2-10: Having a private ferry service for Venture Global LNG workers could create some resentment during the frequent outages of the public ferry. If people stranded in line at the public ferry see other people getting to drive onto a "members only" private ferry, there is almost certainly going to be tension and complaints.

CO2-26 Section 3, Alternatives The No Action Alternative would be the one that most addresses a fundamental problem with the entire boom in natural gas and LNG projects. There is only one practical way to make the massive amounts of nitrogen fertilizer which is needed to feed the world's hungry people today and into the future. That way is called the Haber Process. It fixes nitrogen artificially because natural nitrogen fixation by legumes, lichens, and lightning simply does not supply enough to contribute to crop production. The methane used in the Haber Process is not used as a fuel but as a molecular building block, a ready source of easily-incorporated hydrogen for bonding to and fixing the nitrogen. Burning up all the LNG as fuel is a subtraction of that many meals for hungry people. Eventually, yes, maybe hundreds of years from now, when the methane is again considered rare, children will go hungry. That is a serious and avoidable impact.

CO2-27 Also in Section 3 it is interesting to me that 2 of the 5 locations evaluated and rejected as alternative sites look like they are sites where other companies have proposed LNG Terminals. Logically, if those sites are considered properly-rejected in this FERC DEIS then the permit proceedings for those sites should be suspended to save those other companies a lot of time, effort, and money.

CO2-28 As for subsidence, maybe the twenty-eight old oil wells within the property boundary have already exerted their influence and all subsidence associated with them has long since stabilized. However, that is a large number of wells with an unspecified amount of withdrawal. The Lockport Marsh by the Interstate 210 Bridge in Lake Charles is not exactly comparable since some of its wells may still be producing and since it is atop a salt dome, but the subsidence of that lush marsh during my lifetime, until it was actually an open waterbody, was dramatic and

CO2-23 Comment acknowledged. As discussed in final EIS section 2.4.1.2, Venture Global Calcasieu Pass would construct a new permanent service road (Southwest Service Road) to provide restricted access to Cameron Parish's Jetty Pier Facility. While not open to the public, this restricted use road is being provided as a result of discussions with local parish authorities who identified a need for land-based restricted access to the Jetty Pier Facility for public safety purposes. Refer also to final EIS section 4.9.9 regarding emergency services.

CO2-24 Comment acknowledged.

CO2-25 Comment acknowledged. As noted in the final EIS, the ferry between the Mudd Support Facility and the Terminal location will be a private, people-only, ferry used to carry construction workers to and from the work site, and will not serve public areas.

CO2-26 Comment acknowledged. The EIS evaluates a range of alternatives, including process alternatives in section 3 of the final EIS. The alternative process proposed is speculative and would not meet the purpose and scope of this EIS.

CO2-27 The alternative Terminal sites may be suitable for LNG facilities but did not meet the specific criteria for the Venture Global plan and scale of their facility. As shown in final EIS Table 3.3.2-1, four of the sites have insufficient land area and configuration (i.e., too small) for Venture Global's proposed Terminal facility. While these four sites have insufficient land area and configuration for Venture Global's proposed Terminal facility, it does not mean that the sites cannot accommodate smaller LNG terminals.

CO2-28 Ground settlement, subsidence, and long-term sea level rise have been taken into account in the design and layout of the proposed terminal. The potential for subsidence regarding any given oil well depends a variety of extraction factors (e.g. depth, volume and rate of recovery, extraction technique, proximity to other wells, and surrounding geology). It is noteworthy that oil and gas extraction do not necessarily leave voided space behind or cause subsidence. Any potential risk of subsidence posed by these wells would be highly localized. The oil wells described are not immediately adjacent to the project structures. The geotechnical consultant for this project has already recommended that a full-scale proof test be conducted to detect the presence of voids, and that a qualified engineer mitigate any such geohazards if found.

CO2-28 visible evidence of the surface effect of oil withdrawal from thousands of feet below the surface.

From the List of FERC Recommendations/Conditions at the end of Section 5:

CO2-29 The requirement by FERC that Venture Global have two Environmental Inspectors with authority to override contractors is very wise.

The loss of 304.7 acres of marsh, even though explained in the earlier sections of the DEIS, is definitely significant and the mitigation measures for that and other impacts are well-warranted.

CO2-30 There were several recommendations for the company to provide additional information prior to the end of the comment period (today) but I did not see those. Maybe they were on the FERC website, but if not, it would be good to let the public know when and where they may be reviewed prior to the Final EIS.

CO2-31 Recommendation #17 reemphasizes the concept of protective windows for special care of wildlife and fish. That concept should not be forgotten as the project moves forward. I will try momentarily to send you a copy of the "Migratory Clock." I was unable to attach it to this Word document.

Thank you again, FERC, for the opportunity to comment on this DEIS.

Sincerely,

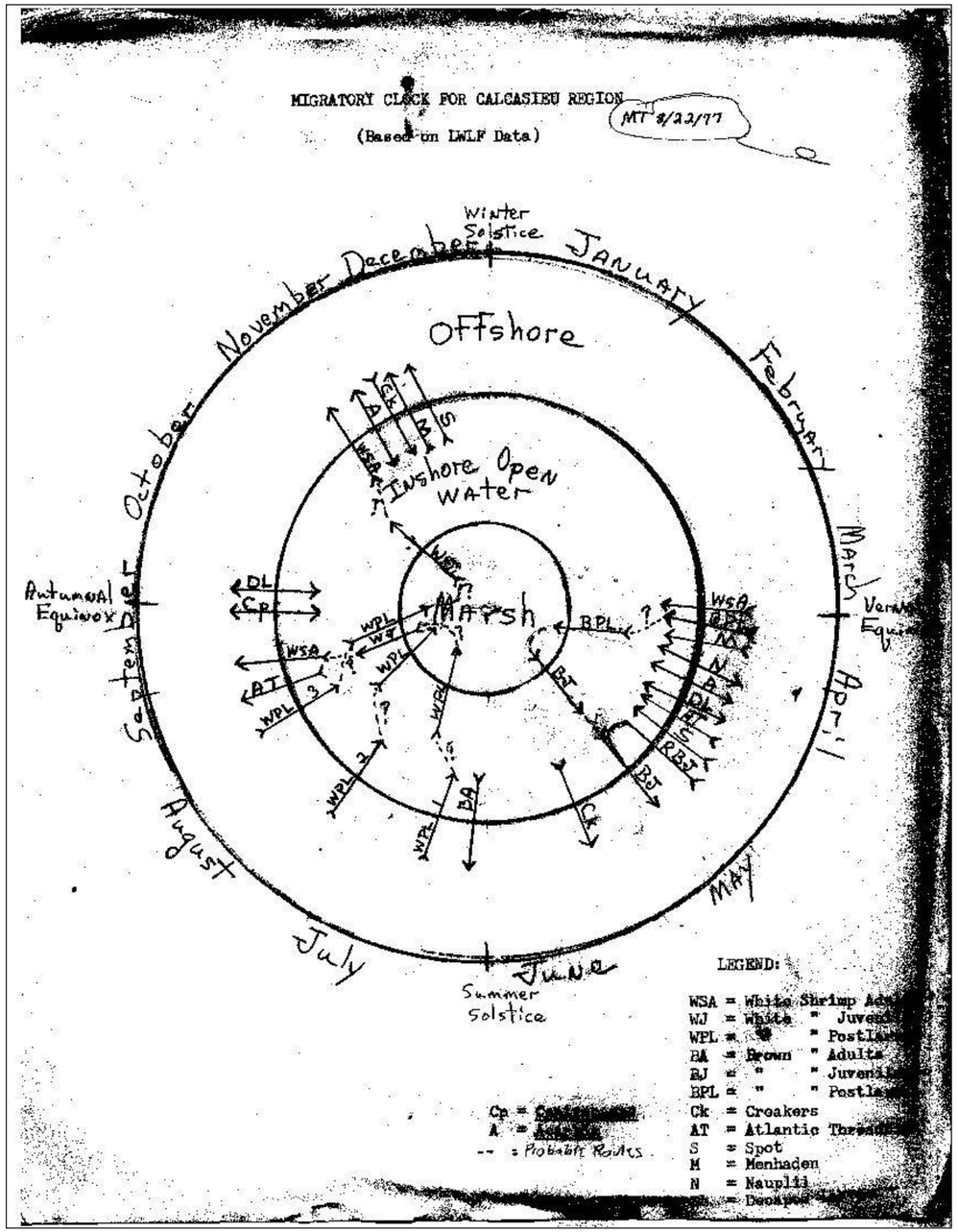
Michael Tritico, Biologist and President of RESTORE

Restore Explicit Symmetry To Our Ravaged Earth

CO2-29 Comments acknowledged. All permanent wetland impacts would be mitigated to offset lost wetland functions per Clean Water Action Section 404 permitting requirements and as detailed in Venture Global's Compensatory Mitigation Plan (CMP)/Beneficial Use of Dredged Material (BUDM) plan (final EIS Appendix E). With implementation of Project-specific Procedures and the CMP/BUDM, wetland impacts have been minimized to the extent practicable and would not be significant.

CO2-30 The FERC staff recommendations in the draft EIS requiring additional information from Venture Global by the end of the draft EIS public comment period were met by the applicant as part of their draft EIS comment filing on August 13, 2018. This information is available on eLibrary and is also addressed in this final EIS. In addition, Venture Global filed supplemental information in response to other comments received on the draft EIS.

CO2-31 Comment acknowledged. The FERC notes the commenter's submitted Migratory Clock for Calcasieu Region information. As stated in final EIS section 4.3.2.3 and comment response CO-13, Venture Global consulted with and requested approval from LDWF for instream construction in warmwater fisheries year-round for the Pipeline and Terminal (and associated dredging). On August 17, 2018, LDWF responded to Venture Global's request and approved the year-round instream construction window as long as oyster seed grounds are avoided; the Project will not affect oyster seed grounds (Accession No. 20180913-5102).


MIGRATORY CLOCK FOR CALCASIEU REGION
(Based on LWLF Data)
MT 8/22/77
Winter Solstice
December
JANUARY
February
March
April
May
June
July
August
September
October
November
Offshore
Inshore Open Water
Marsh
Autumnal Equinox
Vernal Equinox
Summer Solstice
LEGEND:
WSA = White Shrimp Adult
WJ = White " Juvenile
WPL = " " Postlarvae
BA = Brown " Adults
BJ = " " Juvenile
BPL = " " Postlarvae
Ck = Croakers
AT = Atlantic Threadfin
S = Spot
M = Menhaden
N = Nauplii
Cp = Copepods
A = Amphipods
-- = Probable Routes

CO3 – Cameron Lions Club

Written Comment Form
Calcasieu Pass Project Draft Environmental Impact Statement

MEETING LOCATION: Cameron Parish School Board Educational Conference Center
510 Marshall Street, Cameron, LA 70631 DATE: August 1, 2018 TIME: 4:00 – 7:00 p.m. CST

Name:	Stephanie D Rodrigue
Organization (if applicable):	[redacted]
Address:	[redacted]
City/State/Zip:	[redacted]

☑ Yes, include my name and address on the mailing list so I can receive information on the Calcasieu Pass Project EIS.

THANK YOU FOR YOUR INPUT.
PLEASE PRINT LEGIBLY.

Please see attached

**** continue on back for more space ****

Please leave form here, or mail your paper copy of comments to the following address. Be sure to reference the project docket number (CP15-550-000, CP15-551-000, and CP15-551-001):

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

All comments must be received or postmarked by August 13, 2018.

Post Office Box 751
Cameron, Louisiana 70631
337.540.4623
www.CameronLionsClub.com

August 1, 2018

Federal Energy Regulatory Commission
Public Comment Session/Environmental Impact Statement
Venture Global LNG Calcasieu Pass Project

Dear Commissioners,

CO3-1 Established in 1944, the Cameron Lions Club is the oldest civic organization in Cameron Parish and the only civic organization in the parish seat. Comprised of leaders and professionals, I speak on behalf of a membership of 40 significant stakeholders. At our Thursday, July 26 meeting, the attendees voted unanimously in support of the Venture Global LNG Calcasieu Pass Project and authorized me to speak on their behalf.

On September 24, 2005, Cameron Parish was decimated by Hurricane Rita and the rebuilding progress that had slowly begun was destroyed by Hurricane Ike on September 13, 2008. Coupled with an economic downfall, the fate of Cameron Parish as a coastal business presence was dismal, at best. Nearly a full 13 years later, empty slabs, shuttered businesses and unpaid FEMA worksheets still abound. But, there is a shining ray of hope that Cameron Parish will rise again, as a coastal energy hub that will fuel the world.

CO3-2 The residents of Cameron Parish that have persevered through multiple disasters want nothing less for the generations to come than a love for this land that is truly a sportsman's paradise and for them to recognize its worth as the perfect place to raise a family on land that has deep family roots. To that end, the projection of 130 direct jobs, 326 indirect jobs, and 1500 construction jobs at competitive LNG industry salaries, will give our young people a reason to return home to Cameron Parish. The Cameron Lions Club offers, as our most significant charitable endeavor, $25,000 to $30,000 in scholarships annually to Cameron Parish graduates, including graduate level scholarships. Whether as a welder or an engineer, a process technician or an executive administrator, Venture Global will offer positions that will compel our young people to live, work and play in Cameron Parish. Likewise, local private businesses will thrive, given the injection of significant income into the economy of Cameron Parish.

CO3-3 With that said, the Cameron Lions Club stands in full support of the Venture Global LNG Calcasieu Pass Project.

Sincerely,

Stephanie Rodrigue
President

CO3-1 Comment acknowledged.

CO3-2 Comment acknowledged.

CO3-3 Comment acknowledged.

CO4 – Latham & Watkins (on behalf of Venture Global)

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Comments on the Draft Environmental Impact Statement (DEIS)

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
	General/Global				
CO4-1	1	Production Capacity	-	Various statements identifying the design production capacity of the Terminal as 12 MTPA	The nameplate production capacity of the Terminal will be 10 MTPA, and the peak production capacity of the Terminal will be 12 MTPA. The Project is expected to produce up to 12 MTPA of LNG for export.
CO4-2	2	Pipeline	-	Length of the Pipeline	The length of the Pipeline is variously identified as 23.4 or 23.5 miles throughout the DEIS. The length is 23.4 miles.
CO4-3	3	Pipeline Route	-	Pipeline route	TransCameron Pipeline has adopted a minor route variation where the proposed pipeline enters the Terminal. Updated figures from Appendix B of the DEIS reflecting this change are provided in Attachment 1. Updated alignment sheets incorporating this change are provided in Attachment 2. The route variation does not materially change the land requirements or resource impacts for the Pipeline System as discussed in the DEIS.
CO4-4	4	Utility Dock	-	References to the "utility dock"	References to the "utility dock" throughout the DEIS should be changed to "utility platform" where they signify the firewater pump platform at the LNG berthing area and removed entirely where they do not. An on-site utility dock was originally proposed for marine offloading of construction materials/equipment but is no longer part of the Project.
CO4-5	5	Mitigation	-	Various references to Venture Global's CMP/BUDM Plan	The CMP/BUDM Plan that was provided to the FERC on September 26, 2017 will be finalized and submitted to the LDNR and COE during the mitigation review phase of the Section 404 and Coastal Use permitting. Venture Global's overall wetland impacts have been reduced through avoidance and minimization initiatives undertaken during the ongoing permit application review process. Other than this impact reduction, the only material change in the plan relates to the rerouting of the dredge slurry line to the Cameron Prairie National Wildlife Refuge, which is discussed elsewhere in this table. The rerouting of the dredge slurry line was undertaken to avoid the public oyster seeding ground in Calcasieu Lake, based on LDNR and LDWF recommendations.
CO4-6	6	Workforce	-	Various statements that no permanent employees will be required to operate the Pipeline	TransCameron Pipeline has determined that no more than five permanent employees will be required to support Pipeline operations. See pages 13 and 14 of this table (Socioeconomics) for updated figures.
CO4-7	7	Storm Surge Wall and Perimeter Berm	-	Crest elevation of the storm surge wall and perimeter berm	Several places in the DEIS describe the *height* of the storm surge wall and perimeter berm as 31.5 feet and 26 feet, respectively; for clarity, note that these measurements represent crest elevations above sea level for the storm surge wall and perimeter berm based on the North American Vertical Datum of 1988.
CO4-8	8	Construction Schedule	-	Construction schedule	The construction schedule for the Terminal is variously identified as 35 or 38 months throughout the DEIS. Venture Global anticipates that construction of the Terminal will be completed in approximately 36 to 38 months.
CO4-9	9	Terminal Property	-	Size of the parcel	The size of the parcel acquired for the terminal is variously identified as 828 or 828.6 acres throughout the DEIS. The size of the parcel is 828.6 acres.

1

CO4-1 Comment noted. The EIS provides further clarification regarding the production capacity of the terminal in section 1.1 and in a footnote on page 1-2. No change was made to the EIS.

CO4-2 The final EIS was updated to ensure consistency that the pipeline length is described as 23.4 miles in length. This change is reflected in section 1.4.1, table 2.6.4.2-1, sections 4.4.2.2, 4.9.12.2, 5.1.2, and 5.1.9.

CO4-3 Two of the alignment sheets have been replaced in appendix B-2 of the final EIS to reflect the minor revisions provided by Venture Global (Sheet 20 of 20 for the aerial map and Sheet 20 of 20 for the topographic map). This minor change does not alter the land requirements or impacts evaluated in the EIS.

CO4-4 The final EIS has been modified to remove reference to the utility dock since materials would not be offloaded at the Terminal but rather at existing marine support facility docks nearby. Changes have been made in sections 2.6.3.2, 3.3.2, 4.3.2.2, and 4.9.12.1.

CO4-5 The FERC received Venture Global's final CMP/BUDM in September 2018. The final EIS has been revised to reflect the latest wetland impact acreages. The rerouting of the dredge slurry line is addressed in response CO4-19.

CO4-6 The final EIS has been updated to indicate that no more than five permanent employees would be required to support Pipeline operations. This change is reflected in sections 4.9.1, 4.9.12.2, and 5.1.9. Refer also to response CO4-49 for changes in the Socioeconomics section of the final EIS.

CO4-7 The final EIS has been updated to indicate that the heights represent crest elevations above sea level based on the NAVD88. Changes have been made in final EIS sections 2.6.3.1 and 4.8.1.4.

CO4-8 The final EIS has been updated to indicate the construction schedule to be approximately 36- to 38-months. The changes are reflected in sections 4.6.2.1 and 4.8.1.3, table 4.9.1-2, sections 4.9.4, 4.9.7, 4.11.1.4, table 4.11.1.4-1, and sections 4.11.2.4, 5.1.8, and 5.1.9.

CO4-9 The final EIS has been updated to indicate the size of the parcel acquired for the terminal as 828.6 acres. This change is reflected in table 3.3.2-1, and sections 3.3.2.1 and 4.10.3.

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-10	10	Liquefaction Process Alternatives	-	Preferred process alternative for liquefying natural gas	References to the "IPSMR® Process" should be changed to the "SMR® Process" throughout the DEIS.
CO4-11	11	Gas Supply	-	Various statements that the Pipeline would bring feed gas to the Terminal from interconnections with ANR, Texas Eastern, and Bridgeline	Venture Global suggests revising these statements to say that the Pipeline is expected to bring feed gas to the Terminal from interconnections with ANR, Texas Eastern, and Bridgeline.
CO4-12	12	Wetland Impacts	-	Permanent impacts on wetlands	Permanent impacts on wetlands at the Terminal site are variously listed as 189.1 or 189.5 acres throughout the DEIS. The area of permanent impacts on wetlands at the Terminal site will be 129.3 acres.
	Executive Summary				
CO4-13	13	Land Use	9	"The Pipeline is located entirely on private lands, and no public lands are within 0.25 mile of the site."	The Pipeline crosses public lands, public waters, and public roads in addition to private lands. Therefore, Venture Global suggests changing this sentence as follows: *"In addition to private lands, the Pipeline would cross public lands, roads, and waters."*
CO4-14	14	Air Quality and Noise	12	"With the exception of the HDD activities, normal Pipeline construction would be limited to daytime hours, minimizing any impacts on nearby residences."	In addition to HDDs, round-the clock-construction will be required for dredging the marine berth area and the concrete pour for the Terminal tanks. Therefore, Venture Global suggests changing this sentence as follows: *"While some temporary activities, such as HDDs, dredging, and the concrete pour for the tanks, would require round-the-clock work, Terminal and Pipeline construction typically would occur during daytime hours, minimizing impacts on nearby residences."*
	Introduction				
CO4-15	15	Purpose and Need	1-5	Description of the purpose and need of the Project	Venture Global would like to update the purpose and need statement for the Project by including information previously submitted, as follows: The purpose of the Calcasieu Pass Terminal is to provide a cost-effective outlet for domestic natural gas by constructing a liquefaction and export terminal that would receive and liquefy natural gas for loading (as LNG) and export via ocean-going LNG carriers. The purpose of the TransCameron Pipeline is to supply feed gas to the Terminal. The Project is ideally located to provide access to abundant, reliable and affordable domestic supplies of natural gas. The Terminal's location on the Gulf of Mexico at the mouth of the Calcasieu River Ship Channel allows for efficient vessel access, is consistent with the existing industrial setting, and avoids densely populated areas. The Pipeline, which provides access to abundant domestic natural gas supplies via multiple upstream interconnecting pipelines, is co-located with existing rights-of-way for 86 percent of the total

CO4-10 The final EIS has been updated to remove reference to IPSMR® Process and instead refer to the correct process which is GE Oil & Gas SMR Process. This change is reflected in section 3.7.

CO4-11 This change has not been made in the final EIS. The Pipeline and interconnections are part of Venture Global's proposal and therefore evaluated in the EIS.

CO4-12 The 189.1 acres and 189.5 acres of impact are correct in the draft EIS sections where they are presented and are based on the methodology used in the Venture Global's Resource Reports and subsequent filings that support the EIS. For Land Use and Vegetation resources, the U.S. Geological Survey's (USGS) National Land Cover data is used to describe the full suite and full coverage of land cover, which includes various vegetation types, wetlands, and open water. The Wildlife section also reports these numbers because wildlife habitats are described based on the same USGS data. Wetland impact acres provided in the Wetlands section of the draft EIS are based on the on-the-ground field delineations conducted by Venture Global, which show the area of wetland impact more accurately and to be smaller than what the USGS data estimates. The one instance in the draft EIS where 189.5 acres is mentioned is correct because it includes wetlands (189.1 acres) and open water (0.4 acre).

The final EIS includes Venture Global's most recent wetland impact areas based on its September 18, 2018 filing.

CO4-13 The final EIS has been updated to indicate the Pipeline crosses Creole Nature Trail National Scenic Byway, roads, and waters. This change is reflected in the Executive Summary.

CO4-14 The paragraph in reference is describing the Pipeline construction activities, not the Terminal. The Executive Summary was revised to reflect the suggested change relevant to the Terminal construction.

CO4-15 Comment acknowledged. The project purpose and need is not an environmental issue to be addressed at length in the final EIS. No change has been made to the final EIS.

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
				route to minimize impacts on landowners, wetlands, and shoreline habitats. The main benefits associated with the Project are: 1) direct job creation through the need for up to 1,410 peak construction workers for the Terminal, 200 peak construction workers for the Pipeline, and approximately 130 and 5 permanent employees to operate the Terminal and Pipeline facilities, respectively, many of whom will be drawn from the local and regional workforce; 2) promotion of national security and positive foreign relations by increasing economic trade and ties with foreign partners; and 3) generation of significant local, state, and national economic benefits through substantial investment in new equipment and facilities, tax revenues, and improvements in the U.S. balance of trade. The DOE has authorized export of up to 12 MTPA of LNG by vessel to any country with which the U.S. currently has, or in the future will have, a free trade agreement. Venture Global has entered into long-term (20-year) contracts to supply up to 6 MTPA of LNG to BP, Edison, Galp, and Shell, each of which will take title to LNG at the LNG vessel intake manifold during loading at the marine berth. Venture Global continues commercial negotiations with other potential offtakers. Regarding the Pipeline, TransCameron conducted two binding open seasons (from July 27 to August 14, 2015 and May 2, 2016 to May 9, 2016) to solicit interest in firm interstate transportation service. Venture Global was the only bidder and expressed interest in the full capacity of the line. As a result, Venture Global and TransCameron entered into a binding precedent agreement pursuant to which Calcasieu Pass will have the right to transport up to 2,125,000 Dt/d of natural gas to the Terminal on a firm basis.
16	Water Quality Certification	1-8	Water Quality Certification	Venture Global notes that that the LDEQ issued a Water Quality Certification for the Project on June 11, 2018. A copy of the certification is provided with Attachment 3.
17	Public Notice and Comment	1-9	Information regarding FAST-41 compliance	Venture Global would like to highlight additional information that the Commission should consider in its assessment of public notice and comment. In June 2016, the Director of the Office of Energy Projects, in collaboration with Venture Global, designated the Project as a "covered project" under the Fixing America's Surface Transportation Act (FAST Act). Title 41 of the FAST Act, which was signed into law by President Barrack Obama in December 2015, created procedures to improve public access to information regarding major infrastructure projects, promote transparency in Federal permitting and the environmental review process, and increase permitting efficiency across agencies. The FAST Act also created the new Federal Permitting Improvement Steering Council and required the posting of key information regarding Federal permits associated with a covered project on a publicly-available, searchable Permitting Dashboard (www.permits.performance.gov). The required permitting and status information for the Project was posted on the Permitting Dashboard in June 2016 and is regularly updated as the Project moves forward.

CO4-16

CO4-16 The section in reference is describing the applicable permits and regulations but does not provide the status of each permit. Table 1.6.8-1 has been revised to include this information. Refer also to CO4-21.

CO4-17

CO4-17 Comment acknowledged. No change was made to the final EIS.

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-18	18	Nonjurisdictional Facilities	1-12	"The Project would require a short-term utility connection to the Entergy Corporation's existing electric distribution line along Davis Road."	Entergy corporation is not the local utility distributor in the Project area. Therefore, Venture Global suggests changing the sentence as follows: *"The Project would require a temporary utility connection to the local utility provider's existing electric distribution line along Davis Road."*
CO4-19	19	Nonjurisdictional Facilities	1-12	Nonjurisdictional facilities – dredge slurry line	Venture Global suggests adding an additional section to the description of nonjurisdictional facilities to align later sections of the EIS, which note that construction and operation of the dredge slurry line, which is part of the Project's CMP/BUDM Plan, would be under USACE and state authority. By way of update, discussions with the USACE and LDNR on the CMP/BUDM Plan have been progressing. Venture Global has finalized certain aspects of the plan and has moved the dredge slurry line to avoid the public oyster seeding ground in Calcasieu Lake, as recommended by the LDNR and LDWF. The revised route maximizes collocation along existing field roads and utility rights-of-way. A map depicting the current route of the dredge slurry line is provided in Attachment 4. The suggested additional section for the EIS is as follows: ***1.5.4 Temporary Dredge Slurry Line*** *As noted in sections 4.4.2.1 and 4.13.1.3, a temporary dredge slurry line would be used to move dredged material from the Terminal to a beneficial use site in the Cameron Prairie National Wildlife Refuge for marsh creation, in accordance with the Project's CMP/BUDM Plan. The material not used for marsh creation will be placed within a nearshore area located near the Terminal Site. The dredge slurry lines would be a temporary feature installed, used, and removed during the construction period only, and would be permitted through the USACE and other state agencies having jurisdiction. The lines would be installed, operated, and removed in compliance with all applicable federal and state regulations. All required environmental surveys needed to support permitting of the dredge slurry lines have been or will be completed as required by the USACE and/or applicable state agencies. For additional information see table 4.13.1.1-1.*
CO4-20	20	Nonjurisdictional Facilities	1-13	"The Project would require a connection to an existing water line owned and operated by Cameron Parish Water Works Division along Davis Road."	Venture Global suggests changing this sentence as follows: *"The Project may require a connection to an existing water line owned and operated by Cameron Parish Water Works Division along Davis Road."*
CO4-21	21	Permitting	1-16	Table 1.6.8-1	Venture Global has continued to proceed through the permitting process with Federal and state authorities. An updated permit table reflecting the current status of consultation and permitting as well as copies of permits recently issued to the Project are provided with Attachment 3.

CO4-18 The final EIS was revised to remove reference to Entergy as the local utility provider. This change was made in sections 2.3.5 and 4.9.10.

CO4-19 The final EIS was revised to add the proposed dredge slurry line to nonjurisdictional facilities. This change is reflected in new subsection 1.5.4.

CO4-20 The final EIS was revised to acknowledge that Venture Global *may* versus *would* require a connection to an existing water line along Davis Road. Based on the results of the *Chicot Aquifer Hydrogeologic and Source Evaluation*, it was confirmed that the aquifer can provide a sufficient volume of water for construction and operation purposes and with the installation of industrial water supply wells onsite, connection to a local municipal water supply may not be necessary. This change is reflected in section 1.5.2.

CO4-21 Table 1.6.8-1 in the final EIS has been updated to show the current status of permits and authorizations.

Item No.	Topic	Page(s) in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
Proposed Action				
22	Construction Support Facilities	2-6	"Venture Global Calcasieu Pass anticipates that the marine dock repair work will be addressed in a separate permit application and authorized by the LDNR through a coastal use permit and by the USACE through a general permit and is thus not included in this application."	Venture Global suggests revising this statement as follows: *"Venture Global Calcasieu Pass anticipates that the marine dock repair work will be authorized by the LDNR through a coastal use permit, the USACE through a general permit, and the Louisiana State Land Office through a commercial water bottom lease; therefore, the marine dock repair is not included in this application."*
23	Construction Support Facilities	2-9 to 2-9	Land requirements	Based on surveys, the land requirements for the construction support facilities listed in Table 2.4.1-1 and described in the text of the EIS should be updated as follows: • Liberty: 22.7 acres • Martin: 10.4 acres • DeHyCo: 8.7 acres • Mudd: 7.3 acres • Baker Hughes: 2.7 acres
24	Access Roads	2-10	"The road would be widened to 125 feet for approximately 0.6-mile from the intersection of the Martin Access Road to the Terminal's perimeter berm, and to 75 feet in width for approximately 0.4-mile from the Liberty Support Facility to the intersection of the Martin Access Road."	The Northeast Access Road would be 75-feet-wide from the intersection of the Martin Access Road to the Terminal's perimeter floodwall. Therefore, Venture Global suggests revising this statement to: *"The road would be widened to develop the Northeast Access Road, which would be 75-feet-wide along its full length from the intersection with Davis Road to the Terminal's perimeter floodwall."*

CO4-22

CO4-23

CO4-24

CO4-22 The final EIS was revised to explain why the marine dock repair is not included in this application. This change is reflected in section 2.1.10.

CO4-23 A footnote has been added to table 2.4.1-1 in the final EIS to indicate a 0.4 acre increase in final acreage for the construction support facilities.

CO4-24 The final EIS has been revised to reflect a 75-foot width for the entirety of the new Northeast Access Road. This change is reflected in section 2.4.1.2.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Comments on the Draft Environmental Impact Statement (DEIS)

Item No.	Topic	Page(s) in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-25	25 Land Requirements	2-11	"The ANR/Bridgeline Meter Station would be constructed at an interconnection point with these pipelines and adjacent to fenced and graveled natural gas processing facilities (requiring use of 1.3 acres of these facilities during operation). TransCameron Pipeline would construct three MLVs along the Pipeline, including one at milepost (MP) 0.0 at the ANR/Bridgeline Interconnect, one near MP 8.3, and one at the Terminal site. Because MLVs would be constructed within the Terminal site, interconnect site, and the permanent pipeline right-of-way, the construction and operation impacts are accounted for elsewhere. The pig launcher would be constructed at the meter station location; the pig receiver would be constructed at the Terminal site. No additional land is required for the pig launcher/receiver at either the ANR/Bridgeline Interconnect or the Terminal site."	Venture Global suggests revising this text as follows: *"The ANR/Bridgeline Meter Station is expected to be constructed at an interconnection point with these pipelines and adjacent to fenced and graveled natural gas processing facilities.* *TransCameron Pipeline is expected to construct three MLVs along the Pipeline, including one at milepost (MP) 0.0 at the ANR/Bridgeline Interconnect, one near MP 8.3, and one at the Terminal site. Because MLVs would be constructed within the Terminal site, interconnect site, and the permanent pipeline right-of-way, the construction and operation impacts are accounted for elsewhere. The pig launcher is expected to be constructed at the meter station location; the pig receiver is expected to be constructed at the Terminal site. No additional land is expected to be required for the pig launcher/receiver at either the ANR/Bridgeline Interconnect or the Terminal site."*
Alternatives				
CO4-26	26 Process Alternatives	3-16	"However, each LNG train for the proposed Project would have a capacity of 1.0 MTPA, and would be developed based on a staged approach of smaller gas volumes."	To be consistent with Venture Global's application and supplemental filings, as well as the project description provided in section 2.0 of the DEIS, Venture Global suggests changing "LNG trains" to "LNG blocks" in this statement. Additionally, as discussed in the Final Class II Air Modeling Report for the Terminal (filed on April 14, 2017), each of the 9 LNG blocks would have a nameplate capacity of 1.25 MTPA. Therefore, Venture Global suggests revising the statement as follows: *"However, each LNG block for the proposed Project would have a nameplate capacity of 1.25 MTPA, and would be developed based on a staged approach of smaller gas volumes."*

6

CO4-25 The final EIS has been revised as suggested by the comment. Changes are reflected in section 2.4.2.

CO4-26 Section 3.7 of the final EIS has been revised to include the nameplate capacity of the LNG blocks. The final EIS has been revised to replace "train" with "block" to be consistent with the terminology in Chapter 2. These changes are reflected in sections 3.7, 4.12.4, 4.12.7.3, and 5.1.14.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
	Geology				
CO4-27	27	Shoreline Erosion	4-4	Shoreline erosion	Venture Global suggests deleting Section 4.1.5.5 on shoreline erosion, which appears to be associated with the West Lateral (previously removed from the Project). The East Lateral is greater than 2,000 feet from the shoreline.
CO4-28	28	Depth of Cover	4-4	"The Pipeline is proposed north of SH 27/82, would be buried with 3 feet of cover, would have a concrete coating to prevent the pipeline from floating, and would be at least 150 feet from the shoreline."	If Section 4.1.5.5 is retained, Venture Global suggests revising this statement as follows: *"The Pipeline is proposed primarily north of SH 27/82, would be buried with a minimum of 3 feet of cover, would have a concrete coating to prevent the pipeline from floating, and would be at least 2,000 feet from the shoreline."*
	Soils and Sediments				
CO4-29	29	Environmental Site Assessments	4-11	"TransCameron Pipeline conducted an analysis to identify potential contaminated soils or hazardous waste. TransCameron Pipeline conducted several Phase I Environmental Site Assessments that did not reveal any evidence of spills, leaks, or releases such as distressed vegetation, stained or discolored soil, oil sheens, or unusual odors."	Phase I Environmental Site Assessments were conducted by Venture Global Calcasieu Pass for the Terminal and construction support facilities as discussed in Section 4.2.1.1. Phase I Environmental Site Assessments were not conducted by TransCameron Pipeline for the proposed Pipeline.
	Water Resources				
CO4-30	30	Municipal Water Supply Wells	4-14	"The municipal water is pumped from the upper Chicot aquifer through five municipal supply wells."	One of the municipal water wells in Cameron is shut down. There are now four active municipal supply wells.
CO4-31	31	Dredging	4-16	"The channel is maintained by the USACE at a depth of 40 feet and a width of 400 feet; in the vicinity of the Terminal, this requires dredging one to two times per fiscal year (USACE, 2015)."	Maintenance dredging of the channel in the vicinity of the Terminal has not historically been required. In fact, according to the *Calcasieu River and Pass, Louisiana Dredged Material Management Plan and Supplemental Environmental Impact Statement* (USACE, 2010), the Pass Channel of the Calcasieu River, which is adjacent to the proposed marine berth for the Terminal, "requires no dredging because strong tidal currents passing through this narrow inlet prevent the settling and accumulation of sediments." Therefore, Venture Global suggests revising this statement as follows: *"The channel is maintained by the USACE at a depth of 40 feet and a width of 400 feet; however, in the vicinity of the Terminal, maintenance dredging is not required due to strong currents that prevent the settling of sediments within the channel (USACE, 2010)."*

7

CO4-27 The final EIS has been revised to focus section 4.1.5.5 on coastal erosion and the potential to impact the lateral pipeline. This section was not removed in its entirety but rather modified to address preventative measures to reduce impacts on the integrity of the pipeline from coastal environment changes over time.

CO4-28 Refer to response CO4-27. The changes made to section 4.1.5.5 in the final EIS address this comment.

CO4-29 Section 4.2.2 of the final EIS was revised as suggested in the comment.

CO4-30 The final EIS has been updated to indicate that there are now only four municipal supply wells in Cameron since one has been shut down. This change is reflected in section 4.3.1.4.

CO4-31 The final EIS has been revised to describe the USACE dredging operations in the vicinity of the Terminal based on the 2010 USACE Environmental Impact Statement for the Calcasieu River & Pass Dredged Material Management Plan. This change is reflected in section 4.3.2.1.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
					Reference: U.S. Army Corps of Engineers. 2010. *Calcasieu River and Pass, Louisiana Dredged Material Management Plan and Supplemental Environmental Impact Statement.* Available online at: http://www.mvn.usace.army.mil/About/Projects/Calcasieu-DMMP/.
CO4-32	32	Surface Water Impacts	4-17	"The perimeter berm layout is designed to avoid permanent impacts on waterbodies and wetlands that lie outside the berm to the north and south of the Terminal site."	Venture Global suggests revising this statement to reference the east side of the Terminal site as follows: *"The perimeter wall layout is designed to avoid permanent impacts on waterbodies and wetlands that lie outside the wall to the north, south, and east of the Terminal site."*
CO4-33	33	Dredging	4-19	"The USACE and Lake Charles Harbor and Terminal District partner to conduct maintenance dredging of the Calcasieu River; in the vicinity of the proposed Terminal site, this maintenance dredging occurs one to two times per Fiscal Year (USACE, 2015)."	See Item No. 31 above.
CO4-34	34	Construction of Marine Facilities	4-20	"The LNG carriers would require suitable moorings and loading platforms to facilitate the transfer of LNG, and the material deliveries during construction and support vessels during operations would require suitable dockage."	The moorings and loading platforms would not be used to facilitate material deliveries during construction. Therefore, Venture Global suggests revising this statement as follows: *"The LNG carriers would require suitable moorings and loading platforms to facilitate the transfer of LNG, and support vessels during operations would require suitable dockage."*
CO4-35	35	Timing of Waterbody Crossings	4-25	"However, these impacts would be short-term and minor because in-stream construction activities would occur within 24 (minor waterbodies) to 48 hours (intermediate waterbodies)."	TransCameron Pipeline is requesting an additional modification from the FERC Procedures to exempt waterbodies crossed using the push method from the requirement to complete the crossing within 24 hours for minor waterbodies and 48 hours for intermediate waterbodies. See TransCameron Pipeline's response to Staff Recommendation No. 18, which includes a justification for the requested modification.

8

CO4-32 The final EIS has been updated to also indicate the perimeter wall was designed to avoid impacts on wetlands and waters to the east of the Terminal site. This change is reflected in section 4.3.2.2.

CO4-33 Refer to response CO4-31.

CO4-34 The final EIS has been updated to remove reference to the material deliveries during construction to the loading platforms. This change is reflected in section 4.3.2.2. This issue is also addressed in response CO4-4.

CO4-35 Additional information was provided in final EIS section 4.3.2 but staff recommendation #18 in the draft EIS (now #16 in the final EIS) remains since this applies to temporary sediment control under the Alternative Measures to FERC Procedures and would still apply.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
Wetlands				
36	Dredge Slurry Pipe	4-37	Route description	In consultation with staff from the LDNR and LDWF, Venture Global has modified its route for the temporary dredge slurry pipeline to the Cameron Prairie National Wildlife Refuge. Relative to the original route, the modified route avoids oyster resources in Calcasieu Lake, as recommended by both agencies, and also eliminates safety concerns associated with routing the dredge slurry pipeline through the Terminal construction area. As noted above, a figure depicting the route of the dredge slurry line is provided as Attachment 4. Venture Global suggests updating the description of the route for the dredge slurry pipe as follows: *"Placement of dredge material would be either through use of a hopper barge or a slurry pipe. The slurry pipe would be routed from the dredge area to the marsh restoration area(s) using a combination of floating, submerged, and land surface pipe sections. Starting at the marine berthing area, the slurry pipe would run north for about 0.8 mile along the Calcasieu Ship Channel, then follow Calcasieu Pass along the eastern shore of Monkey Island for about 1.8 miles to the north/northeast. The slurry pipe would then turn north for about 0.8 mile, crossing Calcasieu Pass and passing west of Cameron, then head east for 2.9 miles parallel to Amaco Road. The dredge slurry pipe would continue north for 0.9 mile to the dredge disposal site in the CPNWR. The temporary placement of the slurry pipe over existing substrate and on the river bed would not cause any change in the overall health or diversity of biotic communities. Pipe laid directly on the river bed within the navigation channel would be at a depth that would not interfere with deep draft vessels."*
Wildlife and Aquatic Resources				
37	Migratory Birds	4-55 to 4-59	Incidental take	Venture Global notes that recent memoranda from the FWS (dated December 22, 2017 and April 11, 2018) clarify that "the take of birds resulting from an activity is not prohibited by the MBTA when the underlying purpose of that activity is not to take birds."

CO4-36

CO4-37

9

CO4-36 The final EIS has been modified to include a revised description of the dredge slurry line route. This change is reflected in sections 4.4.2.1, 4.13.1.3, 4.13.2.6, and 14.3.2.8, and table 4.13.1.1-1.

CO4-37 Comment acknowledged. FERC is aware of the recent Migratory Bird Treaty Act guidance that clarifies the definition of take. No change was made to the final EIS.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) # n the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
38	Migratory Birds	4-59, 4-285	"To further mitigate impacts, at the Terminal site, and where practicable along the Pipeline Route, Venture Global would conduct clearing outside the migratory bird nesting window of March 1 to September 15." (page 4-59) "To minimize impacts on migratory birds that may use forested habitat in the Project area, Venture Global would conduct clearing activities outside of the migratory bird nesting window of March 1 to September 15 at the Terminal site, and where practicable along the pipeline route." (page 4-285)	Venture Global proposed, and the FWS approved, a migratory bird nesting window of March 1 to July 31. See Venture Global's response to Staff Recommendation No. 21.
39	Noise Impacts on Marine Mammals and Sea Turtles	4-57 to 4-59	Noise impacts on marine mammals and sea turtles	See Venture Global's response to Staff Recommendation No. 23, including the *Underwater Noise Mitigation Plan.* The plan provides an updated analysis of underwater noise impacts due to pile driving, including assumptions and supporting calculations.
40	Underwater Noise Impacts	4-69	Assumptions for the noise impact assessment	See Venture Global's response to Staff Recommendation No. 23, including the *Underwater Noise Mitigation Plan.* The plan provides an updated analysis of underwater noise impacts due to pile driving, including assumptions and supporting calculations.

10

CO4-38

CO4-39

CO4-40

CO4-38 The final EIS sections 4.6.1.3, 4.13.2.5, and 5.1.6 have been revised to include information on the Migratory Bird Nesting Impact Mitigation Plan and the Migratory Bird Habitat Mitigation Plan. These plans have also been attached to the final EIS as appendix M. Staff recommendation #21 in the draft EIS (now #18 in the final EIS) has been slightly modified.

CO4-39 Final EIS sections 4.6.2.1 has been revised with information from Venture Global Calcasieu Pass' draft Underwater Noise Mitigation Plan.

CO4-40 Final EIS sections 4.6.2.1 has been revised with information from Venture Global Calcasieu Pass' draft Underwater Noise Mitigation Plan.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
41	Coastal Marsh	4-73, 2-285	"The loss of 187.3 acres of coastal marsh associated with the Terminal facilities (including the LNG facility, the Northeast Access Road, and the Construction Support Centers) may also result in a decrease in food and nutrient production for aquatic wildlife in the watershed." (page 4-73) "The greatest contribution to cumulative impacts on wildlife habitat would result from the permanent loss of approximately 304.7 acres of marsh within the Terminal site, Terminal support facilities, access roads, and marine facility area." (page 4-285)	The project would result in the permanent loss of 170.4 acres of wetland at the Terminal site. Therefore, Venture Global suggests revising these statements as follows: *"The loss of 170.4 acres of coastal marsh associated with the Terminal facilities (including the LNG facility, the Northeast Access Road, and the Construction Support Centers) may also result in a decrease in food and nutrient production for aquatic wildlife in the watershed." (page 4-73)* *"The greatest contribution to cumulative impacts on wildlife habitat would result from the permanent loss of approximately 170.4 acres of marsh within the Terminal site, Terminal support facilities, access roads, and marine facility area." (page 4-285)*
42	Impacts on Marine Species	4-74	"Construction of the LNG Terminal would require 4,028 barge trips over the 35-month construction period."	Venture Global suggests revising this statement as follows: *"Construction of the LNG Terminal would require approximately 4,000 barge trips over the 36 to 38 month construction period."*
Threatened, Endangered, and Other Special Status Species				
43	Noise Impacts on Manatees	4-92 to 4-93	Noise impacts on manatees	See Venture Global's response to Staff Recommendation No. 23, including the *Underwater Noise Mitigation Plan*. The plan provides an updated analysis of underwater noise impacts due to pile driving, including assumptions and supporting calculations.

11

CO4-41 See response to CO4-12 regarding the permanent wetland impact areas. The final EIS includes Venture Global's most recent wetland impact areas based on their September 18, 2018 filing.

CO4-42 Final EIS section 4.6.2.1 has been revised as suggested.

CO4-43 Final EIS section 4.7.1.1 has been revised with information from Venture Global Calcasieu Pass' draft Underwater Noise Mitigation Plan.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-44	44	Consultation with the FWS	4-99	"As noted in table 1.6.8-1, the FWS provided concurrence to Venture Global dated September 24, 2016, and November 1, 2016 for species under FWS jurisdiction in the Project area (i.e., West Indian manatee, piping plover, and red knot). However, because this correspondence is more than one year old, this clearance should be updated with the FWS to confirm that no new species have been listed that could be present in the Project area."	Venture Global sent a letter to the FWS on July 31, 2018 requesting confirmation that no new species have been listed that could be present in the Project area. A copy of this letter is provided as Attachment 5. Venture Global will file the response from the FWS when received.
	Land Use, Recreation, and Visual Resources			
CO4-45	45	Existing Residences	4-103, 4-117	"The nearest residential property is approximately 0.9 mile east of the Terminal site." (page 4-103) "The nearest residential property is approximately 1 mile east of the Terminal site." (page 4-117)	The nearest potential residential property is NSA 1, located approximately 0.5 mile west of the Terminal site, measured from the nearest LNG berthing dock.
CO4-46	46	Planned Commercial Developments	4-103	"Commonwealth (formerly Waller Point) LNG, LLC and Southern California Telephone and Energy LNG, LLC (SCT&E) are each proposing to construct LNG Terminal facilities along the Calcasieu River Ship Channel within the vicinity of the proposed Project. However, they have not yet initiated pre-filing and therefore their development is speculative at this time."	Commonwealth LNG is currently in pre-filing.

12

CO4-44 Comment acknowledged. The FERC notes that the U.S. Department of Interior's comment letter on the draft EIS did not indicate any new species listed or critical habitat designated in the project area since Venture Global's previous consultation.

CO4-45 The final EIS was revised to reflect the nearest residential property to the Terminal site is 0.5 mile west of the site which would be consistent with the noise analysis. These changes are reflected in sections 4.8.1.2 and 4.9.3.

CO4-46 The final EIS was revised to reflect pre-filing has been initiated by Commonwealth LNG. This change is reflected in section 4.8.1.2. The current status is correct in section 4.13.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
47	Recreation and Special Interest Areas	4-103, 4-105	"The Davis Road Public Boat Launch and the Cameron Jetty Fishing Pier and Recreational Vehicle (RV) Facility are within 0.25 mile of the proposed Terminal." (page 4-103) "Additionally, as the distance to the Cameron Jetty fishing pier and the nearest beach are approximately 1 mile from the proposed Terminal, less of the facility would be visible." (page 4-105)	The Davis Road Public Boat Launch is adjacent to and southwest of the Terminal. The Cameron Jetty Fishing Pier and Recreational Vehicle Facility is located approximately 0.3 mile to the southwest of the Terminal, measured from the perimeter berm.
48	Visual Resources	4-104 to 4-105	"While the perimeter berm and wall are proposed for purposes of handling projected maximum flood cresting, they would also help partially obscure the industrial facilities on the Terminal site from offsite views, including partial obstruction of the proposed 200-foot high LNG tank."	Venture Global suggests revising this statement as follows: *"While the perimeter berm and wall are proposed for purposes of handling projected maximum flood cresting, they would also help partially obscure the industrial facilities on the Terminal site from offsite views, including partial obstruction of the proposed 180-foot-high LNG tanks."*
Socioeconomics				
49	Workforce	4-113	"During operation, Venture Global Calcasieu Pass anticipates adding approximately 130 full-time positions to operate the Terminal site facilities. No additional employees are anticipated for the Pipeline."	As noted above, no more than five employees would be required to operate the Pipeline. Therefore, Venture Global suggests revising this statement as follows: *"During operation, Venture Global Calcasieu Pass anticipates adding approximately 130 full-time positions to operate the Terminal site facilities and TransCameron Pipeline anticipates adding no more than 5 full-time positions to operate the Pipeline."* Similarly, for Table 4.9.1.2 on page 4-115, Venture Global suggests changing the number of permanent workers for the Pipeline to 5 and the total number of permanent workers for the Project to 135.
50	Training Program	4-117	"Venture Global met with some of these organizations and anticipates the creation of a training program to meet construction needs."	Venture Global suggests revising this statement as follows: *"Venture Global met with the SWLA Economic Development Alliance and anticipates the creation of a training program to meet construction needs."*
51	Tax Revenue	4-118	"It is anticipated that the Project would generate in excess of $20 million in local property tax revenue every year."	Venture Global suggests revising the statement as follows: *"It is anticipated that the Project would generate in excess of $20 million in local property tax revenue every year following the end of the abatement period."*

13

CO4-47 CO4-48 CO4-49 CO4-50 CO4-51

CO4-47 The final EIS was revised as suggested by the commenter. Changes are reflected in section 4.8.1.3.

CO4-48 The final EIS was revised to indicate a 180--foot high LNG tank. This change is reflected in section 4.8.1.4.

CO4-49 The final EIS was revised as suggested in section 4.9.1 and table 4.9.1-2.

CO4-50 The final EIS was revised as suggested in section 4.9.2.

CO4-51 The final EIS was revised as suggested in section 4.9.5.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Comments on the Draft Environmental Impact Statement (DEIS)

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-52	52	Vessel Traffic	4-122	"During operations, Venture Global Calcasieu Pass estimates up to 12 LNG carrier visits per month at the Terminal site. Twelve LNG carrier visits per month translates to three visits per week, plus turning operations."	The January 6, 2016 LOR and WSA from the USCG accounts for 200 port calls per year (a combination of inbound and outbound voyage). Therefore, Venture Global suggests revising this text as follows: *"During operations, Venture Global Calcasieu Pass estimates 12 to 16 LNG carrier visits per month at the Terminal site. Twelve to 16 LNG carrier visits per month translates to three to four visits per week, plus turning operations."*
CO4-53	53	Power Supply	4-125	"Entergy Corporation serves as the electric provider for the Project area. During construction at the Terminal site, Venture Global Calcasieu Pass would install a short utility line on site to provide electrical power, which would be in addition to that power provided by diesel-fired generators."	Entergy corporation is not the local utility distributor in the Project Area, and the primary power supply for construction of the Terminal would be from on-site generators. Therefore, Venture Global suggests revising this text as follows: *"During construction of the Terminal, the primary source of power would be diesel-fired generators; however, some power would be obtained from the local utility provider through the installation of a short utility line to the Terminal site."*
CO4-54	54	Vessel Traffic	4-130	"During operations, approximately 150 LNG carriers would call per year (a combination of inbound and outbound voyage)."	The January 6, 2016 LOR and WSA from the USCG accounts for 200 port calls per year (a combination of inbound and outbound voyage). Therefore, Venture Global suggests revising this text as follows: *"During operations, up to 200 LNG carriers would call per year (a combination of inbound and outbound voyage)."*
	Air Quality and Noise				
CO4-55	55	Air Quality Monitoring and Existing Air Quality	4-140	Table 4.11.1.2-2 indicates that the McNeese University monitoring station was used to represent background air quality for $PM_{2.5}$ and that the Baton Rouge monitoring station was used as background for CO and Pb.	The Final Class II Air Modeling Report (filed on April 14, 2017) used the LDEQ monitor at Vinton, Louisiana, to represent background for $PM_{2.5}$ (in part because the McNeese monitor has been discontinued). Table 4.11.1.2-2 should be revised to reflect use of the Vinton monitor (#220190009), which is located 35 miles NW of the Project. In addition, the Final Class II Air Modeling Report used the monitor at Nederland, Texas to represent background CO because that monitor is closer than the Baton Rouge monitor. The Nederland, Texas monitor (#482451035) is located 44 miles northwest of the Project. Note that Venture Global did not trigger monitoring for Pb, so no reference to a background monitor for Pb is needed; the Project does not exceed the PSD significant emission rate (SER) for lead.

CO4-52 The final EIS was revised as suggested in sections 4.3.2.2, 4.6.2.1, 4.9.7, and 5.13.

CO4-53 The final EIS was revised as suggested in section 4.9.10.

CO4-54 The final EIS was revised as suggested in sections 4.9.12.1 and 5.1.9.

CO4-55 Table 4.11.1.2-2 in the final EIS has been revised as requested by the commenter.

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-56	56	Air Quality Monitoring and Existing Air Quality	4-141	Table 4.11.1.2-3 provides the background quality for the Project area, using 2014-2016 design values for pollutants other than $PM_{2.5}$. For $PM_{2.5}$, data from 2012-2014 were used.	It is unclear whether the DEIS is attempting to show the most current design values for the Cameron/Calcasieu Parish areas in Table 4.11.1.2-3, or whether it is attempting to describe the background air quality information used in the Project modeling. If the former, then please revise the sentence above the table to read: *"The design values for ambient air quality concentrations for 2014 to 2016 are provided in Table 4.11.1.2-3 below."* Further, EPA has published a 2014-2016 design value for PM2.5. Thus, the table should be revised to use this updated data for $PM_{2.5}$ from the EPA, which shows the 2014-2016 design value for Lake Charles as 7.3 ug/m^3 for the annual standard and 16 ug/m^3 for the 24 hour standard. See: https://www.epa.gov/sites/production/files/2017-07/pm25_designvalues_20142016_final_07_14_17.xlsx. If instead the DEIS is attempting to show the background air information used in the Project modeling, Venture Global requests that a substitute table be provided that is consistent with the Final Class II Air Modeling Report, filed with the LDEQ and FERC on April 14, 2017. As noted above, that modeling report used the Vinton monitor to represent background ambient air quality for $PM_{2.5}$ and the Nederland, TX monitor as background for CO.
CO4-57	57	Greenhouse Gases	4-141 to 4-142	While the cumulative impact section of the DEIS (pages 4-293 to 4-295) discusses the GHG BACT analysis performed for the Terminal, the GHG section of the DEIS (pages 4-141 to 4-142) does not mention the BACT analysis at all. Moreover, the BACT discussion in the GHG section specifically states that it is for non-GHG NSR regulated pollutants.	Venture Global suggests moving the BACT discussion in the cumulative impacts section on pages 4-293 through 4-295 of the DEIS to the GHG discussion in the air quality section on pages 4-141 to 4-142 of the DEIS.
CO4-58	58	Regulatory Requirements for Air Quality	4-143	Table 4.11.1.3-1 summarizes the total Project emissions for each criteria pollutant and GHG for comparison to PSD thresholds.	The emission totals for PM_{10} and $PM_{2.5}$ should be revised to 241.85 tpy each and the total for CO should be revised to 1,228.48 tpy to correspond to the draft Title V and PSD permits proposed by LDEQ.
CO4-59	59	Regulatory Requirements for Air Quality	4-146	The second paragraph under New Source Performance Standards, Subpart A General Provisions, indicates that 40 CFR 60.18 applies to all four proposed flares.	The provisions of 40 CFR 60.18 do not apply to the marine flare. Venture Global suggests that the last sentence be revised as follows: *"The Project would have three flares subject to these requirements – the cold flare, the warm flare, and the low pressure vent flare."* Note that the marine loading flare is subject to PSD BACT requirements and Louisiana SIP requirements.

CO4-56 Table 4.11.1.2-3 in the final EIS has been revised to show design values as requested by the commenter.

CO4-57 The GHG BACT discussion was not moved as suggested because it would then be out of context in that section. Alternatively, a reference was added in section 4.11.1.2 to the GHG BACT analysis.

CO4-58 Table 4.11.1.3-1 in the final EIS has been revised as requested by the commenter.

CO4-59 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-60	60	Regulatory Requirements for Air Quality	4-146	The second paragraph under the heading for NSPS Subpart Kb indicates that the isopentane tank is subject to control requirements under this rule.	The permit application was updated to show that NSPS Kb is not applicable to the [iso] pentane storage drum/tank EQT 033 because the tank is pressurized and has an operating pressure that exceeds 204.9 kPa; thus, it does not require control under NSPS Kb per 40 CFR 60.110b(d)(2). The draft Title V permit reflects this conclusion. Venture Global requests that this paragraph be revised to indicate that NSPS Kb is not applicable to this tank.
CO4-61	61	Regulatory Requirements for Air Quality	4-147	The second paragraph under the heading for NSPS Subpart IIII indicates that there are 12 emergency generators, two firewater pump engines, and three generators associated with the concrete batch plants	The final air permit application and the draft permits proposed by LDEQ include five emergency generators, two firewater pump engines, and five generators associated with concrete batch plants. Venture Global requests that the equipment numbers be revised to correspond to the draft permits proposed by LDEQ.
CO4-62	62	Regulatory Requirements for Air Quality	4-147	In the third paragraph under the heading for NSPS Subpart KKKK, an "interim operating mode" is referenced.	Venture Global requests removal of the word "interim" from this description. This requirement will apply whenever the total heat input is > 50% natural gas.
CO4-63	63	Regulatory Requirements for Air Quality	4-147	The second paragraph under the heading for Subpart IIII indicates that there are 12 emergency generators, two firewater pump engines, and three generators associated with the concrete batch plants.	The final air permit application and the draft permits proposed by LDEQ include five emergency generators, two firewater pump engines, and five generators associated with concrete batch plants. Venture Global requests that the equipment numbers be revised to correspond to the draft permits proposed by LDEQ.
CO4-64	64	Regulatory Requirements for Air Quality	4-148	The second paragraph under the heading for Subpart ZZZZ indicates that there are 12 emergency generators, two firewater pump engines, and three generators associated with the concrete batch plants.	The final air permit application and the draft permits proposed by LDEQ include five emergency generators, two firewater pump engines, and five generators associated with concrete batch plants. Venture Global requests that the equipment numbers be revised to correspond to the draft permits proposed by LDEQ.
CO4-65	65	Construction Emissions and Mitigation	4-152	Table 4.11.1.4-1 includes emissions from the concrete batch plants.	Venture Global notes that the concrete batch plants were included in the Title V and PSD air permits for a period not to exceed two years from commencement of operation of each such batch plant.

16

CO4-60 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

CO4-61 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

CO4-62 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

CO4-63 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

CO4-64 Section 4.11.1.3 in the final EIS has been revised as requested by the commenter.

CO4-65 Comment noted. A footnote was however added to table 4.11.1.4-1 in the final EIS.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

	Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
CO4-66	66	Construction Emissions and Mitigation	4-152	Table 4.11.1.4-1 - emissions	There are several typos in the table that are all associated with the Terminal. In Year 2 emissions, the CO_2e for off-road construction equipment should be 50,918 tpy, not 80,918 tpy. In the Year 3 emissions, the CO_2e for on-road vehicles should be 97,923, not 97,780 tpy. In the Year 3 emissions, there is an extraneous "b" in the NOX for construction activity fugitive dust. In the Year 3 emissions, the PM_{10} for on-road vehicles should be 2.5 tpy, not 2.2 tpy. In the Year 3 emissions, the PM_{10} for marine vessels should be 15.5 tpy, not 14.6 tpy. Consequently, the subtotals / totals for CO_2e & PM_{10} are not correct.
CO4-67	67	Operational Emissions and Mitigation	4-155	Terminal	Because this section addresses the long-term air emissions during operation of the Project, in the Power Plant Facility, there will be one simple cycle combustion turbine, not five. In the Liquefaction Facility list, LNG storage tanks have been listed twice and there are no gas heaters. Because the concrete batch plants are temporary sources, operation of which is not to exceed two years, they are not emission sources in operations (consistent with Table 4.11.1.5-5).
CO4-68	68	Operational Emissions and Mitigation	4-156	The Table of Operational Emissions provides the total emissions for each criteria pollutant, GHGs, and total HAPs.	For operational emissions, the total tpy for NOX should be 476.54 and the total for CO should be 763.15 to correspond to the draft air permits issued by the LDEQ on July 5, 2018. Correspondingly, the facility total tpy for NOX should be 653.34 and the total for CO should be 779.25. Footnote (a) should be *"Totals for each pollutant represent the Terminal Power Plant Facility final turbine combined cycle operating mode."* The Title V & PSD draft permits were issued for EPA review and public comment on July 5, 2018. A public comment session was held in Cameron, Louisiana on August 9, 2018. Copies of the public notice materials and draft permits will be submitted to Staff under separate cover.
CO4-69	69	Air Preliminary Modelling Analysis	4-159	Table 4.11.1.6-1	There is a typo in this table. The preliminary modelled concentration for 1-hour SO_2 (last column in the table) is 6.0 $\mu g/m^3$ (not 56.0 $\mu g/m^3$).
CO4-70	70	Existing Noise Levels	4-169	The distances from the center of the noise producing equipment during operation of the Terminal should be updated to reflect the December 2016 FEED Noise Study.	The distances from the Terminal noise center to NSA #1 is approximately 5,000 feet to the southwest, not 3,000 feet; to PNR #2 is approximately 6,900 feet to the northeast, not 8,900 feet; and to PNR #4 is approximately 7,000 feet to the northeast, not 9,080 feet. The December 2016 FEED Noise Study was based on the June 2015 Pre-Construction Noise Survey. No additional field measurements were taken at that time.
	Cumulative Impacts				
CO4-71	71	Past, Present, and Reasonably Foreseeable	4-267 to 4-281	Past, Present, and Reasonably Foreseeable Projects	Venture Global suggests including Table 1.11-2 from its March 21, 2016 supplemental filing in the cumulative impacts section of the FEIS. A copy of the table is provided as Attachment 6.

17

CO4-66 Table 4.11.1.4-1 in the final EIS has been revised as requested by the commenter.

CO4-67 Section 4.11.1-5 in the final EIS has been revised as requested by the commenter.

CO4-68 Table 4.11.1.5-1 in the final EIS has been revised as requested by the commenter.

CO4-69 Table 4.11.1.6-1 in the final EIS has been revised as requested by the commenter.

CO4-70 Figure 4.11.2.2-1 in the final EIS was not changed. While the Venture Global noise survey used the term 'potential noise receptor' (PNR), FERC staff uses the standard term 'noise sensitive area' (NSA). For purposes of the EIS and as indicated by footnote 30, potential noise receptor and noise sensitive area have the same meaning. As such, the distances are correct in the final EIS.

CO4-71 Comment acknowledged. Table 4.13.1.1-1 in the final EIS has not been changed. The identification of potential cumulative issues is based on the geographic range by each resource, as described in table 4.13-1.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Comments on the Draft Environmental Impact Statement (DEIS) Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
	Projects			
72	Dredge Pipe	4-280	"The pipe would be routed from the Terminal site north within the Calcasieu River Ship Channel and the east fork of the Calcasieu River for approximately 5.9 miles to Calcasieu Lake, along the east and west banks of the channels with required crossings of the Federal Navigation Channel. The route would then run east along the south shoreline and then turn southeast into the CPNWR for mitigation restoration."	As noted above, Venture Global has modified the route for the temporary dredge slurry pipe to the BUDM/marsh restoration site in consultation with staff from the LDNR and LDWF. The modified route avoids oyster resources in Calcasieu Lake and eliminates safety concerns associated with routing the dredge slurry pipe through the Terminal construction area. Venture Global suggests updating the description of the route for the dredge slurry lines as follows: *"The slurry pipe to the BUDM/marsh restoration site would be routed north/northeast from the Terminal site for about 2.8 miles along the Calcasieu Ship Channel and Calcasieu Pass, then east/northeast for about 3.5 miles passing west and north of Cameron and paralleling Amaco Road, continuing north for about 0.9 mile into the CPNWR. The slurry pipe to the nearshore placement area would be routed south parallel to the Calcasieu Ship Channel and then crossover the breakwater jetty into the nearshore placement area. The length of the dredge slurry pipe to the nearshore area is about 0.8 mile."*
73	Water Supplies	4-282	"Venture Global Calcasieu Pass anticipates using existing municipal water supply sources to provide the required industrial and potable fresh water for construction of the Project."	Venture Global suggests revising this statement as follows: *"Venture Global Calcasieu Pass anticipates potentially using existing municipal water supply sources to provide a portion of the required industrial and potable fresh water for construction of the Project."*
74	Visual Resources	4-288	"Construction of the Terminal site would include ten single MR blocks; LNG storage facilities; boil-off, flash, and gas relief systems; two berthing docks, an electric generation facility; support buildings; and facility lighting."	Venture Global suggests revising this statement as follows: *"Construction of the Terminal site would include nine single MR blocks; LNG storage facilities; boil-off, flash, and gas relief systems; two berthing docks; an electric generation facility; support buildings; and facility lighting."*
75	Socioeconomics	4-289	"It is estimated that an average of 1,425 workers would be needed over the duration of 38 months beginning in 2018, peaking at 1,610 workers."	Venture Global suggests revising this statement as follows: *"It is estimated that an average of 1,425 workers would be needed over the duration of approximately 36 to 38 months beginning in 2019, peaking at 1,610 workers."*

18

CO4-72 Refer to response CO4-36.

CO4-73 The final EIS has been revised to address the potential use of a portion of the municipal water supply. This change is reflected in section 4.13.2.3. See also response CO4-20.

CO4-74 The final EIS has been revised to indicate nine vs. ten MR blocks. This change is reflected in section 4.13.2.8.

CO4-75 The final EIS has been revised to indicate the 36-38 month construction schedule and that this would not occur until 2019 vs. 2018. This change is reflected in section 4.13.2.9.

Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC
Calcasieu Pass Project
Docket Nos. CP15-550-000, CP15-551-000, CP15-551-001

Comments on the Draft Environmental Impact Statement (DEIS)

Item No.	Topic	Page(s) # in the DEIS	Statement(s)/Information in the DEIS	Venture Global/TransCameron's Comment
76	Land Transportation	4-291	"Venture Global Calcasieu Pass prepared a Traffic Management Plan in which it indicates preliminary plans for materials to be transported by barge and delivered to nearby existing aggregate storage and handling facilities prior to completion of the construction berth."	Venture Global Calcasieu Pass is not proposing to deliver materials to the construction berth. Therefore, Venture Global suggests modifying this statement as follows: *"Venture Global Calcasieu Pass prepared a Traffic Management Plan in which it indicates preliminary plans for materials to be transported by barge and delivered to nearby existing aggregate storage and handling facilities."*
Conclusions				
77	Geology	5-1	"Venture Global Calcasieu Pass and TransCameron Pipeline would design and construct the aboveground facilities at the liquefaction facility and the meter station at an elevation to minimize the potential impacts from flooding and sea level rise."	Venture Global suggests modifying this statement as follows: *"Venture Global Calcasieu Pass and TransCameron Pipeline would design and construct the aboveground facilities at the liquefaction facility and the meter station to minimize the potential impacts from flooding and sea level rise."*
78	Pilings	5-2	"Deep foundations would either be driven precast concrete piles or open-ended steel piles."	Venture Global suggests modifying this statement as follows: *"Deep foundations would either be driven pre-cast concrete piles, cast-in-place concrete piles, or open-ended steel piles."*

CO4-76
CO4-77
CO4-78

CO4-76 The final EIS has been revised to remove reference to a construction berth since materials would instead go to nearby marine support facility docks. This change is reflected in section 4.13.2.9.

CO4-77 The final EIS has been revised as suggested in section 5.1.1.

CO4-78 The final EIS has been revised as suggested in section 5.1.1.

Attachment to Comment CO4 – Latham & Watkins (on behalf of Venture Global)

Refer to FERC eLibrary filing Accession Number 20180813-5059

CO5 – Montana Environmental Information Center, Institute for Policy Integrity at New York University School of Law, Sierra Club

August 13, 2018

To: Federal Energy Regulatory Commission

Subject: Failure to Use the Social Cost of Greenhouse Gases in the Calcasieu Pass Project Draft Environmental Impact Statement—Docket Nos. CP15-550-000, CP15-551-000, CP-551-001

Submitted by: Montana Environmental Information Center, Institute for Policy Integrity at New York University School of Law, Sierra Club[1]

This draft environmental impact statement (DEIS), prepared by the Federal Energy Regulatory Commission (FERC), on the Calcasieu Pass Project, reviews the proposal by Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC to "site, construct, and operate a natural gas liquefaction and storage facility, and marine export terminal in Cameron Parish, Louisiana."[2] While the DEIS quantifies the tons of direct greenhouse gas emissions related to this project—almost 4 million metric tons of carbon dioxide per year from operations, plus hundreds of thousands of tons per year during construction—FERC fails to use the social cost of greenhouse gas metric to fully account for the climate effects of these emissions. FERC recapitulates flawed arguments used in other inadequate NEPA reviews to implicitly explain why the Commission refuses to use the social cost of greenhouse gases metric for the Calcasieu project. Specifically, FERC claims that it is impossible to determine the significance of this project's climate impacts.[3] Not only is this incorrect, but failing to meaningfully analyze a project's climate effects violates the National Environmental Protection Act (NEPA).

CO5-1 These comments begin by offering a more detailed rejection of FERC's arbitrary and misleading rationale for failing to use the social cost of greenhouse gases, before offering additional guidance on how to monetize climate effects consistent with the currently best available science and economics—specifically, by selecting a central estimate of global damages using a 3% or lower discount rate.

1. FERC Must Monetize the Social Cost of Greenhouse Gases in Its EIS

FERC details the alleged benefits of the proposed action, but neither includes a substantive discussion of the project's specific climate effects nor a monetization of the projected emissions as a way of assessing the project's contribution to climate damages. Although FERC does not include a fully monetized cost-benefit analyses in its NEPA reviews, FERC does monetize socioeconomic benefits in the DEIS.[4] Moreover, monetizing climate effects provides useful and necessary contextual information under NEPA regardless of whether all other costs and benefits have been monetized. As Commissioner LaFleur, one of the dissenting Commissioners in the Sabal Trail Pipeline remand order, noted, the Social Cost of

[1] Our individual organizations may separately submit other comments regarding other aspects of the DEIS.
[2] FERC, Draft Environmental Impact Statement for Venture Global Calcasieu Pass, LLC and TransCameron Pipeline, LLC Calcasieu Pass Project, Docket Nos. CP15-550-000, CP15-551-000, CP-551-001, June 2018. (Hereinafter "DEIS"), at 1.
[3] DEIS at 13.
[4] DEIS at Sec. 4.9.

CO5-1 The general nature of the comments is that greenhouse gas (GHG) emissions should be monetized because other socioeconomic costs and benefits are monetized in the EIS; quantifying the social cost of carbon (SCC) would give context to the climate damages associated with Project GHG emissions; SCC is appropriate for analyzing project-level emissions of the magnitude of the Venture Global Project; FERC must use the SCC tools that reflect currently available data and methodologies, and; FERC must quantify global damages associated with Project GHG emissions.

The SCC tool, as well as the Social Cost of Methane and Nitrous Oxide tools, estimates the monetized climate change damage associated with an incremental increase in carbon dioxide (CO_2) emissions in the given year. It estimates the cost today of future climate change damage, represented by a series of annual costs per metric ton of emissions discounted to present-day value.

As indicated in 62 FERC ¶ 61,233 *Order on Remand Reinstating Certificate and Abandonment Authorization for the Southeast Market Pipelines Project (SMP Order)* FERC staff does not use monetized cost-benefit analyses as part of the NEPA review. The Council on Environmental Quality (CEQ) does not require agencies to conduct a monetary cost-benefit analysis for NEPA review. Siting infrastructure involves making qualitative judgments between different resources as to which there is no agreed-upon quantitative value. As such, we do not conduct a monetary cost-benefit analysis in our NEPA review. The EIS did quantify some of the Venture Global Project's direct socioeconomic benefits (e.g., employment and tax payments) in section 4.9 because those benefits occur in units of dollars and are directly comprehensible in units of dollars. However, because Commission staff lack quantified information about all of the costs and benefits (present and future) of the Project, the final EIS does not use the limited available quantified benefits in a cost-benefit analysis to inform Commission staff's comparison of alternatives, choices of mitigation measures, or determination about the significance of the Venture Global Project's environmental impacts.

The FERC staff acknowledges that the SCC methodology does constitute a tool that can be used to estimate incremental physical climate change impacts, either on the national of global scale. The integrated assessment models underlying the SCC tool were developed to estimate certain global and regional physical climate change impacts due to incremental GHG emissions under specific socioeconomic scenarios. These models have regular updates and could be used in the analysis. However, the EPA states that "no consensus exists on the appropriate [discount] rate to use for analyses spanning multiple generations" and consequently, significant variation in output can result. The choice between a high discount rate of 7 percent (or higher) or a lower discount rate of 3 percent introduces substantial variation in SCC tool outputs. Additionally, there are no established criteria identifying the monetized values that are to be considered significant for NEPA reviews. Therefore, although the integrated assessment models could be run through a first phase to estimate global and regional physical climate change impacts from Venture Global Project-related GHG emissions, we would still have to arbitrarily determine what potential increase in atmospheric GHG concentration, rise in sea level, rise in sea water temperatures, and other calculated physical impacts would be significant for a particular pipeline and/or LNG project. Because we have no basis to designate a particular dollar figure calculated from the SCC tool as "significant," such action would be arbitrary and would not meaningfully inform either the NEPA conclusions or the public.

We recognize the availability of the SCC tool, but the Commission, in the Southeast Market Pipelines (SMP) Order, determined that it is not appropriate for use in project-level analyses (Accession No. 20180314-4005).

Carbon was developed to inform decisions on proposed actions and evaluate the significance of greenhouse gas emissions.[5]

Here, though FERC quantified the tons of direct greenhouse gas emissions from operations and construction, FERC nonetheless fails to discuss the actual, specific climate impacts of the project. FERC neither quantitatively nor qualitatively discusses the damages to which these additional tons of greenhouse gases would contribute. Meanwhile, FERC has monetized effects like millions of dollars' worth in tax revenue and payroll expenditures.[6] Failing to similarly monetize the climate costs of the project is inconsistent and arbitrary, and deprives the public and decisionmakers of the information and context they need to weigh all of the project's potential effects.

Below is a review of the case law on when it is arbitrary to fail to include the social cost of greenhouse gases in NEPA analysis, and an explanation of why a recent Executive Order does not change the need to monetize climate damages.

CO5-1 (cont'd)

NEPA Requires Monetizing Climate Effects If Other Costs and Benefits Are Monetized

NEPA requires "hard look" consideration of beneficial and adverse effects of each alternative option for major federal government actions. The U.S. Supreme Court has called the disclosure of impacts the "key requirement of NEPA," and held that agencies must "consider and disclose the actual environmental effects" of a proposed project in a way that "brings those effects to bear on [the agency's] decisions."[7] Courts have repeatedly concluded that an EIS must disclose relevant climate effects.[8] Though NEPA does not require a formal cost-benefit analysis,[9] agencies' approaches to assessing costs and benefits must be balanced and reasonable. Courts have warned agencies that "[e]ven though NEPA does not require a cost-benefit analysis," an agency cannot selectively monetize benefits in support of its decision while refusing to monetize the costs of its action.[10]

In *High Country Conservation Advocates v. Forest Service*, the U.S. District Court of Colorado found that it was "arbitrary and capricious to quantify the *benefits* of the lease modifications and then explain that a similar analysis of the *costs* was impossible when such an analysis was in fact possible."[11] The court explained that, to support a decision on coal mining activity, the agencies had "weighed several specific economic benefits—coal recovered, payroll, associated purchases of supplies and services, and royalties," but arbitrarily failed to monetized climate costs using the readily available social cost of

[5] Sabal Trail Remand Order at (Comm'r LaFleur, dissenting in part) at 3, available at https://www.ferc.gov/CalendarFiles/20180314230126-CP14-554-002.pdf.

[6] DEIS at 4-118. *See* Sabal Remand Order (Comm'r Glick, dissenting at 8) ("Rejecting this [SCC] tool on the grounds that the Commission has 'no basis for determining the significance' of the impact amounts is arbitrary and capricious, given that the Commission relies on similar analysis elsewhere in the EIS.").

[7] *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 96 (1983).

[8] As the Ninth Circuit has held: "[T]he fact that climate change is largely a global phenomenon that includes actions that are outside of [the agency's] control . . . does not release the agency from the duty of assessing the effects of *its* actions on global warming within the context of other actions that also affect global warming." *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1217 (9th Cir. 2008); *see also Border Power Plant Working Grp. v. U.S. Dep't of Energy*, 260 F. Supp. 2d 997, 1028-29 (S.D. Cal. 2003) (failure to disclose project's indirect carbon dioxide emissions violates NEPA).

[9] 40 C.F.R. § 1502.23 ("[T]he weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis.").

[10] *High Country Conservation Advocates v. Forest Service*, 52 F. Supp. 3d 1174, 1191 (D. Colo. 2014); *accord. MEIC v. Office of Surface Mining*, 15-106-M-DWM, at 40-46 (D. Mt., August 14, 2017) (holding it was arbitrary for the agency to quantify benefits in an EIS while failing to use the social cost of carbon to quantify costs, as well as arbitrary to imply there would be no effects from greenhouse gas emissions).

[11] 52 F. Supp. 3d at 1191.

2

CO5-1 (cont'd)

carbon protocol.[12] Similarly, in *Montana Environmental Information Center v. Office of Surface Mining* (*MEIC v. OSM*), the U.S. District Court of Montana followed the lead set by *High Country* and likewise held an environmental assessment to be arbitrary and capricious because it quantified the benefits of action (such as employment payroll, tax revenue, and royalties) while failing to use the social cost of carbon to quantify the costs.[13]

Both *High Country* and *MEIC v. OSM* were in line with *Center for Biological Diversity v. National Highway Traffic Safety Administration*.[14] In that case, the U.S. Court of Appeals for the Ninth Circuit ruled that, because the agency had monetized other uncertain costs and benefits of its vehicle fuel efficiency standard—like traffic congestion and noise costs—its "decision not to monetize the benefit of carbon emissions reduction was arbitrary and capricious."[15] Specifically, it was arbitrary to "assign[ ] no value to *the most significant benefit* of more stringent [vehicle fuel efficiency] standards: reduction in carbon emissions."[16] When an agency bases a rulemaking on cost-benefit analysis, it is arbitrary to "put a thumb on the scale by undervaluing the benefits and overvaluing the costs."[17]

A few other cases from different courts that have declined to rule against failures to use the social cost of carbon in NEPA analyses are all distinguishable by the scale of the action or by whether other effects were quantified and monetized in the analysis.[18] In particular, in *EarthReports v. FERC*, the D.C. Circuit never addressed or ruled on whether it is arbitrary to monetize benefits while not monetizing costs.[19] More recently, the D.C. Circuit confirmed that NEPA requires a rigorous analysis of climate effects and, in its remand to FERC, required the agency to explain and justify its position if it decides not to use the social cost of greenhouse gases.[20] FERC has now once again repeated that mistake of failing to address the relevance of the social cost of greenhouse gases.

In this DEIS, FERC devoted significant attention to the "economic benefits" of approving the project. In the Socioeconomic Impacts section, FERC claims that "The Project would boost local economies by creating jobs, purchasing construction materials locally, hiring local firms and contractors, and directly or indirectly supporting other regional suppliers in the industry."[21] FERC monetizes economic benefits, including millions in tax revenue, incomes, and purchasing.[22] FERC specifically refers to these effects as the project's "positive economic benefits."[23]

---

[12] *Id.*

[13] 15-106-M-DWM, at 40-46, Aug. 14, 2017 (also holding that it was arbitrary to imply that there would be zero effects from greenhouse gas emissions).

[14] Three other cases from different courts that have declined to rule against failures to use the social cost of carbon in NEPA analyses are all distinguishable by the scale of the action or by whether other effects were quantified and monetized in the analysis. *See League of Wilderness Defenders v. Connaughton*, No. 3:12-cv-02271-HZ (D. Ore., Dec. 9, 2014*); EarthReports v. FERC*, 15-1127, (D.C. Cir. July 15, 2016); *WildEarth Guardians v. Zinke*, 1:16-CV-00605-RJ, at 23-24, (D. N.M. Feb. 16, 2017).

[15] 538 F.3d 1172, 1203 (9th Cir. 2008).

[16] *Id.* at 1199.

[17] *Id.* at 1198.

[18] *See League of Wilderness Defenders v. Connaughton*, No. 3:12-cv-02271-HZ (D. Ore., Dec. 9, 2014*); EarthReports v. FERC*, 15-1127, (D.C. Cir. July 15, 2016); *WildEarth Guardians v. Zinke*, 1:16-CV-00605-RJ, at 23-24, (D. N.M. Feb. 16, 2017).

[19] 828 F.3d at 956 (basing its ruling on alleged uncertainty over the discount rate and lack of clear significance thresholds).

[20] *Sierra Club v. FERC*, No. 16-1329, 2017 WL 3597014, at *10 (D.C. Cir. Aug. 22, 2017).

[21] DEIS at 4-118.

[22] *Id.*

[23] *Id.; see also* DEIS at 5-20. ("The Project would boost local economies by creating jobs, purchasing construction materials locally, hiring local firms and contractors, and directly or indirectly supporting other regional suppliers in the industry. During construction, worker income would generate state income tax and worker spending would generate state sales tax. With additional spending and the employment of workers, ripple effects would perpetuate throughout the communities. The estimated 130 full-time workers hired during operation would likely spend a portion of their combined earnings in the Project

Because FERC has monetized the economic benefits of the project, it must treat the climate costs with proportional analytical rigor and apply the social cost of greenhouse gas metrics. Moreover, in obligating agencies to take "hard look" at projects' climate impacts, NEPA requires more than simply disclosing the volume of anticipated emissions.[24] As discussed further below, under NEPA, agencies must provide details on discrete effects of a project's impacts within the relevant context. The social cost of greenhouse gases provides this critical information.

The importance of this "hard look" consideration is not lost on all members of the Commission. FERC Commissioner Glick, in his dissenting opinion to the Sabal Trail Pipeline remand order, strongly condemns the Commission's wholly inadequate treatment of that pipeline's climate effects: "Willful ignorance of readily available analytical tools to support an enhanced qualitative assessment for the single largest environmental threat in our lifetime will undermine informed public comments and informed decisionmaking."[25]

The Social Cost of Greenhouse Gases Metrics Give Necessary Context to Climate Damages

CO5-1 (cont'd)

FERC makes no effort to satisfy its NEPA obligations to provide the public and decisionmakers with a meaningful discussion of the project's climate impacts. According to the DEIS, "[t]here is no standard methodology to determine whether, and to what extent, a project's incremental contribution to GHG emissions would result in physical effects on the environment for the purposes of evaluating the Project's impacts on climate change, either locally or nationally." [26] It goes on to claim that there is no way to assess the damages of the emissions from the project. However, the social cost of greenhouse gases metric was designed to do just that, attribute discrete climate effects to additional tons of greenhouse gas emissions from proposed actions or projects.

Monetizing climate damages provides the informational context required by NEPA, while a purely quantitative estimate of tons or a qualitative description of discrete climate effects like sea-level rise provide little context. Courts review NEPA documents "under an arbitrary and capricious standard," which requires "a reasonably thorough discussion of the significant aspects of the probable environmental consequences," to "foster both informed decisionmaking and informed public participation."[27] In particular, "the impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impact analysis that NEPA requires," and it is arbitrary to fail to "provide the necessary contextual information about the cumulative and incremental environmental impacts."[28]

To "provide the necessary contextual information," economic theory shows that one useful tool is monetization of environmental impacts. As Professor Cass Sunstein has explained, drawing from the work of recent Nobel laureate economist Richard Thaler, a well-documented mental heuristic called "probability neglect" causes people to irrationally reduce small probability risks entirely down to zero.[29] In this case, for example, many decisionmakers and interested citizens would wrongly reduce down to zero the climate risks associated with emissions that FERC calculates here because FERC indicates that there is no way to assess the damage from a single project and implies that their impact is negligible. Yet

area, supporting local economies by purchasing goods and services and paying rents and mortgages, all of which would generate direct and indirect socioeconomic benefits.").

[24] *Supra* notes 7-8.

[25] Glick opinion at 8.

[26] DEIS at 4-294.

[27] *Ctr. for Biological Diversity*, 538 F.3d at 1194 (citations omitted). *See also Montana Envtl. Info. Ctr. v. Office of Surface Mining*, cv 15-106-M-DWM, at 12-13 (D.Mt., Aug. 14, 2017).

[28] *Ctr. for Biological Diversity,* 538 F.3d at 1217; *see also Montana Envtl. Info. Ctr.,* cv 15-106-M-DWM at 45.

[29] Cass R. Sunstein, *Probability Neglect: Emotions, Worst Cases, and Law*, 112 Yale L. J. 61, 63, 72 (2002).

CO5-1 (cont'd)

the monetized expected cost of the climate risks associated with the millions of tons of additional emissions per year—representing damages of hundreds of millions of dollars—is less likely overlooked. As the Environmental Protection Agency's website explains, "abstract measurements" of so many tons of greenhouse gases can be rather inscrutable for the public, unless "translat[ed] . . . into concrete terms you can understand."[30] Monetization contextualizes the significance of the additional tons of emissions.

Similarly, non-monetized effects are often irrationally treated as worthless.[31] On several occasions, courts have struck down administrative decisions for failing to give weight to non-monetized effects.[32] Most relevantly, in *Center for Biological Diversity v. NHTSA*, the U.S. Court of Appeals for the Ninth Circuit found it arbitrary and capricious to give zero value "to the most significant benefit of more stringent [fuel economy] standards: reduction in carbon emissions."[33]

FERC is required by NEPA to provide enough context to ensure that the public and decisionmakers would not overlook the associated climate risks. Monetization is one way that FERC could provide the necessary context to foster both informed decisionmaking and informed public participation.[34] By comparison, simply tallying the volume of emissions fails to give the public and decisionmakers the required information about the magnitude of discrete climate effects from those emissions. The social cost of greenhouse gas metric provides that necessary context.

New Executive Order Encourages Continued Monetization of the Social Cost of Greenhouse Gases

Executive Order 13,783 officially disbanded the Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) and withdrew its technical support documents that underpinned their range of estimates.[35] Nevertheless, Executive Order 13,783 assumes that federal agencies will continue to "monetiz[e] the value of changes in greenhouse gas emissions" and instructs agencies to ensure such estimates are "consistent with the guidance contained in OMB Circular A-4."[36] Consequently, while FERC and other federal agencies no longer benefit from ongoing technical support from the IWG on use of the social cost of greenhouse gases, by no means does the new Executive Order imply that agencies should not monetize important effects in their regulatory analyses or environmental impact statements. In fact, Circular A-4 instructs agencies to monetize costs and benefits whenever feasible.[37] The Executive Order does not prohibit agencies from relying on the same choice of models as the IWG, the same inputs and assumptions as the IWG, the same statistical methodologies as the IWG, or the same ultimate values as derived by the IWG. To the contrary, because the Executive Order requires consistency with Circular A-4, as agencies follow the Circular's standards for using the best available data and methodologies, they will necessarily choose similar data, methodologies, and estimates as the IWG, since the IWG's work

[30] EPA, Greenhouse Gas Equivalencies Calculator, https://web.archive.org/web/20180212182940/https:/www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (last updated Sept. 2017).

[31] Richard Revesz, *Quantifying Regulatory Benefits,* 102 Cal. L. Rev. 1424, 1434-35, 1442 (2014).

[32] *See id.* at 1428, 1434.

[33] 538 F.3d at 1199.

[34] While the regulations promulgated by the Council on Environmental Quality to implement NEPA do not require a "monetary cost-benefit analysis," 40 C.F.R. § 1502.23, monetization nevertheless remains an available tool for contextualizing information. As the Council on Environmental Quality has explained, monetization may be "appropriate and relevant" and, in particular, "the Federal social cost of carbon . . . provides a harmonized, interagency metric that can give decision makers and the public useful information for their NEPA review." CEQ, *Final Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* 32-33 & fn.86 (2016), *available* at https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf.

[35] Exec. Order. No. 13,783 § 5(b), 82 Fed. Reg. 16,093 (Mar. 28, 2017).

[36] *Id.* § 5(c).

[37] OMB, Circular A-4 at 27 (2003) ("You should monetize quantitative estimates whenever possible.").

5

CO5-1 (cont'd)

continues to represent the best available estimates.[38] The Executive Order does not preclude agencies from using the same range of estimates as developed by the IWG, so long as the agency explains that the data and methodology that produced those estimates are consistent with Circular A-4 and, more broadly, with standards for rational decisionmaking.

Similarly, the Executive Order's withdrawal of the CEQ guidance on greenhouse gases does not —and legally cannot—remove agencies' statutory requirement to fully disclose the environmental impacts of greenhouse gas emissions. As CEQ explained in its withdrawal, the "guidance was not a regulation," and "[t]he withdrawal of the guidance does not change any law, regulation, or other legally binding requirement."[39] In other words, when the guidance originally recommended the appropriate use of the social cost of greenhouse gases in environmental impact statements,[40] it was simply explaining that the social cost of greenhouse gases is consistent with longstanding NEPA regulations and case law, all of which are still in effect today.

As explained in the final sections of these comments, the IWG's estimates of the social cost of greenhouse gases are, in fact, already consistent with the Circular A-4 and represent the best existing estimates of the lower bound of the range for the social cost of greenhouse gases. Therefore, the IWG estimates or those of a similar or higher value[41] should be used in regulatory analyses and environmental impact statements.

2. The Social Cost of Greenhouse Gas Metric Is Appropriate for a Project-Level EIS with Emissions of this Magnitude

Although FERC admits that operations emissions would contribute to climate change, the Commission claims that because it "[t]here is no standard methodology to determine whether, and to what extent, a project's incremental contribution to GHG emissions would result in physical effects on the environment for the purposes of evaluating the Project's impacts on climate change, either locally or nationally."[42] This same spurious argument was made in the Sabal Trail remand order. One dissenting opinion to that

[38] Richard L. Revesz et al., *Best Cost Estimate of Greenhouse Gases*, 357 SCIENCE 6352 (2017) (explaining that, even after Trump's Executive Order, the social cost of greenhouse gas estimate of around $50 per ton of carbon dioxide is still the best estimate).

[39] 82 Fed. Reg. 16,576, 16,576 (Apr. 5, 2017).

[40] *See* CEQ, *Revised Draft Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* at 16 (Dec. 2014), *available at* https://obamawhitehouse.archives.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf ("When an agency determines it appropriate to monetize costs and benefits, then, although developed specifically for regulatory impact analyses, the Federal social cost of carbon, which multiple Federal agencies have developed and used to assess the costs and benefits of alternatives in rulemakings, offers a harmonized, interagency metric that can provide decisionmakers and the public with some context for meaningful NEPA review. When using the Federal social cost of carbon, the agency should disclose the fact that these estimates vary over time, are associated with different discount rates and risks, and are intended to be updated as scientific and economic understanding improves."); *see also* CEQ, *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* at 33 n.86 (Aug. 2016), *available at* https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf.

[41] *See, e.g.*, Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (explaining that current estimates omit key damage categories and, therefore, are very likely underestimates).

[42] DEIS at 4-294. *But see* Sabal Remand Order at 48 ("[W]e accept that the Social Cost of Carbon methodology does constitute a tool that can be used to estimate incremental physical climate change impacts.").

order, from Commissioner LaFleur,[43] rejects the Commission's claims that it is unable to determine the significance of greenhouse gas emissions.

Despite FERC's claims in the Sabal Trail remand order that the social cost of greenhouse gases only apply to rulemakings,[44] the social cost of greenhouse gas methodology is well suited to measure the marginal climate damages of individual projects. These protocols were developed to assess the cost of actions with "marginal" impacts on cumulative global emissions, and the metrics estimate the dollar figure of damages for one extra unit of greenhouse gas emissions. This marginal cost is calculated using integrated assessment models. These models translate emissions into changes in atmospheric greenhouse concentrations, atmospheric concentrations into changes in temperature, and changes in temperature into economic damages. A range of plausible socio-economic and emissions trajectories are used to account for the scope of potential scenarios and circumstances that may actually result in the coming years and decades. The marginal cost is attained by first running the models using a baseline emissions trajectory, and then running the same models again with one additional unit of emissions. The difference in damages between the two runs is the marginal cost of one additional unit. The approach assumes that the marginal damages from increased emissions will remain constant for small emissions increases relative to gross global emissions. In other words, the monetization tools are in fact perfectly suited to measuring the marginal effects of individual projects or other discrete agency actions.

CO5-1
(cont'd)

The Tons of Greenhouse Gas Emissions at Stake Here Are Clearly Significant

FERC quantifies the operational emissions from this project could reach nearly 4 million metric tons per year. But FERC refuses to take the straightforward next step of applying the social cost of greenhouse gas values to those quantified tons. In the Calcasieu DEIS, FERC implies that it does not monetize the effects of the project's downstream emissions because it is not possible to attribute significance to a single project's emissions, saying "we cannot find a suitable method to attribute discrete environmental effects to GHG emissions."[45]

While there may not be a bright-line test for significance, the emissions FERC estimates for this project are clearly significant and warrant monetization. This is especially true since, once emissions have been quantified, the additional step of monetization through application of the Interagency Working Group's 2016 estimates entails a simple arithmetic calculation.[46] Importantly, members of the Commission have recently made clear that "the Commission must take a 'hard look' at climate change – the ultimate environmental impact."[47] FERC Commissioner Glick, in his dissenting opinion to the Sabal Trail Pipeline remand order, states that "[c]limate change is the single most significant threat to humanity, fundamentally threatening our environment, economy, national security and human health. It is difficult

[43] Sabal Trail Remand Order, Comm'r LaFleur dissent at 2. *See also* Comm'r LaFleur, dissenting in part, at 4 (SCC "is a scientifically-derived tool to translate tonnage of carbon dioxide or other GHGs to the cost of long-term climate harm.... [W]e are able to estimate what the long-term consequence of a ton of carbon dioxide emissions is likely to be, by use of the Social Cost of Carbon tool."); Comm'r Glick dissent at 8 ("[T]he output from the Social Cost of Carbon tool can serve as an indicator of the climate change impacts ... informing the overall qualitative evaluation under NEPA as well as the public interest balancing under the NGA"; rejecting this tool on grounds that FERC has no basis for determining significance is arbitrary and capricious.).

[44] *Id.* at 491.

[45] DEIS at 4-294.

[46] Agencies simply need to multiply their estimate of tons in each year by the IWG's 2016 values for the corresponding year of emissions (adjusted for inflation to current dollars). If the emissions change occurs in the future, agencies would then discount the products back to present value.

[47] Comm'r Glick, dissenting, at 5.

to understand how NEPA's demand that an agency take a 'hard look' at the environmental impacts of its actions can be satisfied if the impacts of GHG emissions are ignored."[48]

In *High Country*, the District Court for the District of Colorado found that it was arbitrary for the Forest Service not to monetize the "1.23 million tons of carbon dioxide equivalent emissions [from methane] the West Elk mine emits annually."[49] That suggests a threshold for monetization far below what FERC estimates here. In *MEIC v. OSM*, the District Court for the District of Montana found it was arbitrary for the Office of Surface Mining not to monetize the 23.16 million metric tons, which constituted "approximately 0.35 percent of the total U.S. emissions."[50] In *Center for Biological Diversity*, the Ninth Circuit found that it was arbitrary for the Department of Transportation not to monetize the 35 million metric ton difference in lifetime emissions from increasing the fuel efficiency of motor vehicles:[51] given the estimated lifetime of vehicles sold in the years 2008-2011 (sometimes estimated at about 15 years on average), this could represent as little two million metric tons per year. In a recent environmental impact statement from the Bureau of Ocean Energy Management published in August 2017, the agency explained that the social cost of carbon was "a useful measure" to apply to a NEPA analysis of an action anticipated to have a difference in greenhouse gas emissions compared to the no-action baseline of about 25 million metric tons over a 5-year period,[52] or about 5 million metric tons per year.

CO5-1 (cont'd)

FERC's estimates of direct emissions from this project's operations and construction alone are comparable to those above cases where monetization of emissions has been found useful or legally required. FERC does not estimate the indirect greenhouse gas emissions from ultimate combustion of the gas liquefied and stored at the Calcasieu facility. The project's upstream and downstream emissions will also be highly significant and should also be quantified and monetized. Yet even without counting any indirect emissions, the direct emissions alone warrant monetization.

Under any reasonable application of the social cost of greenhouse gas metrics, the emissions from the Calcasieu project will cause hundreds of millions of dollars in climate damages. Tellingly, FERC had no problem concluding in its DEIS that it was appropriate to monetize, for example, the $500 million in estimated payroll from construction and operation (in addition to millions of dollars of other monetized economic benefits).[53] A potential climate cost of hundreds of millions of dollars is also significant, particularly in the context of a document the very purpose of which is to evaluate a project's *environmental* impacts.

3. FERC Must Use Current Estimates of the Social Cost of Greenhouse Gases That Reflect the Best Available Data and Methodologies

As explained above, FERC is required to monetize the climate effects of the increased greenhouse gas emissions predicted to occur under the Calcasieu project. When FERC monetizes those climate effects, it must use estimates of the social cost of carbon and social cost of methane that reflect the best available data and methodologies.

In 2016, the IWG published updated central estimates for the social cost of greenhouse gases: $50 per ton of carbon dioxide, $1440 per ton of methane, and $18,000 per ton of nitrous oxide (in 2017 dollars

[48] Sabal Trail Remand Order, Glick Opinion at 3.
[49] 52 F. Supp. 3d at 1191 (quoting an e-mail comment on the draft statement for the quantification of tons).
[50] *MEIC v. Office of Surface Mining* at 36-37.
[51] 538 F.3d at 1187.
[52] BOEM, *Liberty Development and Production Plan Draft EIS* at 3-129, 4,50 (2017) (89,940,000 minus 64,570,000 is about 25 million).
[53] DEIS at 4-118.

CO5-1 (cont'd)

for year 2020 emissions).[54] Agencies must continue to use estimates of a similar or higher value[55] in their regulatory analyses and environmental impact statements. In particular, when estimating the social cost of greenhouse gases, agencies must use multiple peer-reviewed models, a global estimate of climate damages, and a 3% or lower discount rate for the central estimate. These methodological approaches are consistent with NEPA's directive that agencies adopt a global perspective and consider the effects of their actions on future generations.

This section discusses the appropriate use of models, the need to use a global estimate of climate damages, and the proper treatment of uncertainty. The need to use a 3% or lower discount rate for the central estimate is discussed in the section above.

Agencies Must Not Rely on a Single Model, but Must Use Multiple, Peer-Reviewed Models

NEPA requires "scientific accuracy" in environmental impact statements, and agencies must "insure the professional integrity, including scientific integrity, of the discussions and analyses."[56] As the U.S. Court of Appeals for the Tenth Circuit has explained, NEPA requires agencies to use "the best available scientific information."[57] OMB's *Circular A-4* provides helpful guidance on the standards for accuracy in monetizing costs and benefits. *Circular A-4* requires agencies to use "the best reasonably obtainable scientific, technical, and economic information available. To achieve this, you should rely on peer-reviewed literature, where available."[58]

Since the IWG first issued the federal social cost of carbon protocol in 2010, this methodology has relied on the three most cited, most peer-reviewed integrated assessment models (IAMs). These three IAMs—called DICE (the Dynamic Integrated Model of Climate and the Economy[59]), FUND (the Climate Framework for Uncertainty, Negotiation, and Distribution[60]), and PAGE (Policy Analysis of the Greenhouse Effect[61])—draw on the best available scientific and economic data to link physical impacts to the economic damages of each marginal ton of greenhouse gas emissions. As noted previously, each model translates emissions into changes in atmospheric greenhouse gas concentrations, atmospheric concentrations into temperature changes, and temperature changes into economic damages, which can then be adjusted according to a discount rate. These three models have been combined with inputs derived from peer-reviewed literature on climate sensitivity, socio-economic and emissions trajectories, and discount rates. The results of the three models have been given equal weight in federal agencies' estimates and have been run through statistical techniques like Monte Carlo analysis to account for uncertainty.

---

[54] U.S. Interagency Working Group on the Social Cost of Greenhouse Gases, "Technical support document: Technical update of the social cost of carbon for regulatory impact analysis under executive order 12866 & Addendum: Application of the methodology to estimate the social cost of methane and the social cost of nitrous oxide" (2016), *available at* https://obamawhitehouse.archives.gov/omb/oira/social-cost-of-carbon.

[55] *See, e.g.*, Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (explaining that current estimates omit key damage categories and, therefore, are very likely underestimates).

[56] 40 C.F.R. § 1502.24.

[57] *Custer Cty. Action Ass'n v. Garvey*, 256 F.3d 1024, 1034 (10th Cir. 2001).

[58] OMB, Circular A-4, at 17.

[59] William D. Nordhaus, *Estimates of the social cost of carbon: concepts and results from the DICE-2013R model and alternative approaches*, 1 JOURNAL OF THE ASSOCIATION OF ENVIRONMENTAL AND RESOURCE ECONOMISTS 1 (2014).

[60] David Anthoff & Richard S.J. Tol, THE CLIMATE FRAMEWORK FOR UNCERTAINTY, NEGOTIATION AND DISTRIBUTION (FUND), TECHNICAL DESCRIPTION, VERSION 3.6 (2012), *available at* http://www.fund-model.org/versions.

[61] Chris Hope, *The Marginal Impact of CO_2 from PAGE2002: An Integrated Assessment Model Incorporating the IPCC's Five Reasons for Concern*, 6 INTEGRATED ASSESSMENT J. 19 (2006).

CO5-1
(cont'd)

In a 2017 report, the National Academies of Sciences (NAS) recommended future improvements to this methodology. Specifically, over the next five years the NAS recommends unbundling the four essential steps in the IAMs into four separate "modules": a socio-economic and emissions scenario module, a climate change module, an economic damage module, and a discount rate module.[62] Unbundling these four steps into separate modules could allow for easier, more transparent updates to each individual component in order to better reflect the best available science and capture the full range of uncertainty in the literature. These four modules could be built from scratch or drawn from the existing IAMs. Either way, the integrated modular framework envisioned by NAS for the future will require significant time and resource commitments from federal agencies.

In the meantime, the NAS has supported the continued near-term use of the existing social cost of greenhouse gas estimates based on the DICE, FUND, and PAGE models, as used by federal agencies to date.[63] In short, DICE, FUND, and PAGE continue to represent the state-of-the-art models. The Government Accountability Office found in 2014 that the estimates derived from these models and used by federal agencies are consensus-based, rely on peer-reviewed academic literature, disclose relevant limitations, and are designed to incorporate new information via public comments and updated research.[64] In fact, the social cost of greenhouse gas estimates used in federal regulatory proposals and EISs have been subject to over 80 distinct public comment periods.[65] The economics literature confirms that estimates based on these three IAMs remain the best available estimates.[66] In 2016, the U.S. Court of Appeals for the Seventh Circuit held the estimates used to date by agencies are reasonable.[67] Just last month, the District of Montana rejected an agency's Environmental Assessment for failure to incorporate the federal social cost of carbon estimates into its cost-benefit analysis of a proposed mine expansion.[68]

Regardless of Executive Order 13,783's withdrawal of the guidance requiring federal agencies to rely on IWG's technical support documents to estimate the social cost of greenhouse gases, IWG's choice of DICE, FUND, and PAGE, its use of inputs and assumptions, and its statistical analysis still represent the state-of-the-art approach based on the best available, peer-reviewed literature. This approach satisfies both NEPA's and Circular A-4's requirements for information quality and transparency. Therefore, in complying with the Executive Order's instructions to ensure that social cost of greenhouse gas estimates are consistent with Circular A-4, agencies will necessarily have to rely on models like DICE, FUND, and PAGE, to use the same or similar inputs and assumptions as the IWG, and to apply statistical analyses like Monte Carlo.

---

[62] Nat'l Acad. Sci., Eng. & Medicine, *Valuing Climate Damages: Updating Estimates of the Social Cost of Carbon Dioxide* 3 (2017) [hereinafter "NAS, Second Report"] (recommending an "integrated modular approach").

[63] Specifically, NAS concluded that a near-term update was not necessary or appropriate and the current estimates should continue to be used while future improvements are developed over time. Nat'l Acad. Sci., Eng. & Medicine, *Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update* 1 (2016) [hereinafter "NAS, First Report"].

[64] Gov't Accountability Office, *Regulatory Impact Analysis: Development of Social Cost of Carbon Estimates* (2014).

[65] Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Columbia J. Envtl. L. 203 (2017), at Appendix A.

[66] *E.g.*, Richard G. Newell et al., *Carbon Market Lessons and Global Policy Outlook*, 343 SCIENCE 1316 (2014); Bonnie L. Keeler et al., *The Social Costs of Nitrogen*, 2 SCIENCE ADVANCES e1600219 (2016); Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (co-authored with Nobel Laureate Kenneth Arrow, among others).

[67] *Zero Zone*, 832 F.3d at 679 (7th Cir. 2016) (finding that the agency "acted reasonably" in using global estimates of the social cost of carbon, and that the estimates chosen were not arbitrary or capricious).

[68] *Montana Envtl. Info. Cent.*, 2017 WL 3480262,at *12-15, 19.

CO5-1 (cont'd)

The unavoidable fact is that DICE, FUND, and PAGE are still the dominant, most peer-reviewed models,[69] and most estimates in the literature continue to rely on those models.[70] Each of these models has been developed over decades of research, and has been subject to rigorous peer review, documented in the published literature. While other models exist, they lack DICE's, FUND's, and PAGE's long history of peer review or exhibit other limitations. For example, the World Bank has created ENVISAGE, which models a more detailed breakdown of market sectors,[71] but unfortunately does not account for non-market impacts and so would omit a large portion of significant climate effects. Models like ENVISAGE are therefore not currently appropriate choices under the criteria of Circular A-4.[72]

An approach based on multiple, peer-reviewed models (like DICE, FUND, and PAGE) is more rigorous and more consistent with Circular A-4 than reliance on a single model or estimate. DICE, FUND, and PAGE each include many of the most significant climate effects, use appropriate discount rates and other assumptions, address uncertainty, are based on peer-reviewed data, and are transparent.[73] However, each IAM also has its own limitations and is sensitive to its own assumptions. No model fully captures all the significant climate effects.[74] By giving weight to multiple models—as the IWG did—agencies can balance out some of these limitations and produce more robust estimates.[75]

Finally, while agencies should be careful not to cherry-pick a single estimate from the literature, it is noteworthy that various estimates in the literature are consistent with the numbers derived from a weighted average of DICE, FUND, and PAGE—namely, with a central estimate of about $40 per ton of carbon dioxide, and a high-percentile estimate of about $120, for year 2015 emissions (in 2016 dollars, at a 3% discount rate). The latest central estimate from DICE's developers is $87 (at a 3% discount rate);[76] from FUND's developers, $12;[77] and from PAGE's developers, $123, with a high-percentile estimate of $332.[78]

---

[69] *See* Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12,866* at 7 (July 2015) ("DICE, FUND, and PAGE are the most widely used and widely cited models in the economic literature that link physical impacts to economic damages for the purposes of estimating the SCC."), *citing* Nat'l Acad. Sci., Eng. & Medicine, *Hidden Cost of Energy: Unpriced Consequences of Energy Production and Use* (2010) ("the most widely used impact assessment models").

[70] R.S. Tol, *The Social Cost of Carbon*, 3 Annual Rev. Res. Econ. 419 (2011); T. Havranek et al., *Selective Reporting and the Social Cost of Carbon*, 51 Energy Econ. 394 (2015).

[71] World Bank, *The Environmental Impact and Sustainability Applied General Equilibrium (ENVISAGE) Model* (2008), *available at* http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1193838209522/Envisage7b.pdf.

[72] Similarly, Intertemporal Computable Equilibrium System (ICES) does not account for non-market impacts. *See* https://www.cmcc.it/models/ices-intertemporal-computable-equilibrium-system. Other models include CRED, which is worthy of further study for future use. Frank Ackerman, Elizabeth A. Stanton & Ramón Bueno, *CRED: A New Model of Climate and Development*, 85 Ecological Economics 166 (2013). Accounting for omitted impacts more generally, E.A. Stanton, F. Ackerman, R. Bueno, *Reason, Empathy, and Fair Play: The Climate Policy Gap*, (Stockholm Environment Inst. Working Paper 2012-02), find a doubling of the SCC using the CRED model.

[73] While sensitivity analysis can address parametric uncertainty within a model, using multiple models helps address structural uncertainty.

[74] *See* Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* 5 (Cost of Carbon Project Report, 2014), http://costofcarbon.org/.

[75] Moore, F., Baldos, U., & Hertel, T. (2017). Economic impacts of climate change on agriculture: a comparison of process-based and statistical yield models. *Environmental Research Letters*.

[76] William Nordhaus, *Revisiting the Social Cost of Carbon*, Proc. Nat'l Acad. Sci. (2017) (estimate a range of $21 to $141).

[77] D. Anthoff & R. Tol, *The Uncertainty about the Social Cost of Carbon: A Decomposition Analysis Using FUND*, 177 Climatic Change 515 (2013).

[78] C. Hope, *The social cost of CO2 from the PAGE09 model*, 39 Economics (2011); C. Hope, *Critical issues for the calculation of the social cost of CO2*, 117 *Climatic Change*, 531 (2013).

CO5-1 (cont'd)

In fact, much of the literature suggests that a central estimate of $40 per ton is a very conservative *underestimate* of the true social cost of carbon. A 2013 meta-analysis of the broader literature found a mean estimate of $59 per ton of carbon dioxide,[79] and a soon-to-be-published update by the same author finds a mean estimate of $108 (at a 1% discount rate).[80] A 2015 meta-analysis—which sought out estimates besides just those based on DICE, FUND, and PAGE—found a mean estimate of $83 per ton of carbon dioxide.[81] Various studies relying on expert elicitation[82] from a large body of climate economists and scientists have found mean estimates of $50 per ton of carbon dioxide,[83] $96-$144 per ton of carbon dioxide,[84] and $80-$100 per ton of carbon dioxide.[85] There is a growing consensus in the literature that even the best existing estimates of the social cost of greenhouse gases may severely underestimate the true marginal cost of climate damages.[86] Overall, a central estimate of $40 per ton of carbon dioxide at a 3% discount rate, with a high-percentile estimate of about $120 for year 2015 emissions, is consistent with the best available literature; if anything, the best available literature supports considerably higher estimates.[87]

Similarly, a comparison of international estimates of the social cost of greenhouse gases suggests that a central estimate of $40 per ton of carbon dioxide is a very conservative value. Sweden places the long-term valuation of carbon dioxide at $168 per ton; Germany calculates a "climate cost" of $167 per ton of carbon dioxide in the year 2030; the United Kingdom's "shadow price of carbon" has a central value of $115 by 2030; Norway's social cost of carbon is valued at $104 per ton for year 2030 emissions; and various corporations have adopted internal shadow prices as high as $80 per ton of carbon dioxide.[88]

Indeed, a number of our organizations have previously commented on ways in which the IWG's approach could be improved to more accurately reflect the true social cost of greenhouse gases. For instance, the IWG's values should reflect risk aversion and account for the additional price that society is

---

[79] R. Tol, *Targets for Global Climate Policy: An Overview*, 37 J. Econ. Dynamics & Control 911 (2013).

[80] R. Tol, *Economic Impacts of Climate Change* (Univ. Sussex Working Paper No. 75-2015, 2015).

[81] S. Nocera et al., *The Economic Impact of Greenhouse Gas Abatement through a Meta-Analysis: Valuation, Consequences and Implications in terms of Transport Policy*. 37 Transport Policy 31 (2015).

[82] Circular A-4, at 41, supports use of expert elicitation as a valuable tool to fill gaps in knowledge.

[83] Scott Holladay & Jason Schwartz, *Economists and Climate Change* 43 (Inst. Policy Integrity Brief, 2009 (directly surveying experts about the SCC).

[84] Peter Howard & Derek Sylvan, *The Economic Climate: Establishing Expert Consensus on the Economics of Climate Change* (Inst. Policy Integrity Working Paper 2015/1) (using survey results to calibrate the DICE-2013R damage function).

[85] R. Pindyck, *The Social Cost of Carbon Revisited* (Nat'l Bureau of Econ. Res. No. w22807, 2016) ($80-$100 is the trimmed range of estimates at a 4% discount rate; without trimming of outlier responses, the estimate is $200).

[86] *E.g.,* Howard & Sylvan, *supra* note 84; Pindyck, *supra* note 85. The underestimation results from a variety of factors, including omitted and outdated climate impacts (including ignoring impacts to economic growth and tipping points), simplified utility functions (including ignoring relative prices), and applying constant instead of a declining discount rate. *See* Howard, *supra* note 74; Revesz et al., *supra* note 66; J.C. Van Den Bergh & W.J. Botzen, A Lower Bound to the Social Cost of CO2 Emissions, 4 Nature Climate Change 253 (2014) (proposing $125 per metric ton of carbon dioxide in 1995 dollars, or about $200 in today's dollars, as the lower bound estimate). *See also* F.C. Moore & D.B. Diaz, *Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy*, 5 Nature Climate Change 127 (2015) (concluding the SCC may be six times higher after accounting for potential growth impacts of climate change). Accounting for both potential impacts of climate change on economic growth and other omitted impacts, S. Dietz and N. Stern find a two- to seven-fold increase in the SCC. *Endogenous growth, convexity of damage and climate risk: how Nordhaus' framework supports deep cuts in carbon emissions*. 125 *The Economic Journal* 574 (2015).

[87] Note that the various estimates cited in the paragraph have not all been converted to standard 2017$, and may not all reflect the same year emissions. Nevertheless, the magnitude of this range suggests that $40 per ton of year 2015 emissions is a conservative estimate.

[88] *See* Howard & Schwartz, *supra* note 65, at Appendix B. All these estimates are in 2016$.

willing to pay to avoid uncertainty around increasingly more severe impacts from climate change.[89] In addition, noted Harvard economist Martin Weitzmann has observed, the three IAMs assume a relatively smooth upward slope in economic damages even as global climates increase well past critical tipping points. An improved social cost of greenhouse gases could reflect modified damage functions that better address tipping points.[90]

For these reasons, the IWG's estimates are very likely to underrepresent the true impact that greenhouse gas emissions have on society, and we strongly encourage further efforts to make those efforts more robust. Nevertheless, the IWG's approach represents the best and most rigorous effort that the U.S. government has engaged in thus far to realistically estimate the social cost of greenhouse gases. As such, agencies must incorporate those values into their rulemaking analyses; simply refusing to monetize the greenhouse gas emissions of their actions, as FERC has done in this case, does not pass legal or technical muster.

A Global Estimate of Climate Damages Is Required by NEPA

CO5-1 (cont'd)

NEPA contains a provision on "International and National Coordination of Efforts" that broadly requires that "all agencies of the Federal Government *shall* . . . recognize the worldwide and long-range character of environmental problems."[91] Using a global social cost of greenhouse gases to analyze and set policy fulfills these instructions. Furthermore, the Act requires agencies to, "where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment."[92] By continuing to use the global social cost of greenhouse gases to spur reciprocal foreign actions, federal agencies "lend appropriate support" to the NEPA's goal of "maximize[ing] international cooperation" to protect "mankind's world environment." Furthermore, not only is it consistent with Circular A-4 and best economic practices to estimate the global damages of U.S. greenhouse gas emissions in regulatory analyses and environmental impact statements, but no existing methodology for estimating a "domestic-only" value is reliable, complete, or consistent with Circular A-4.

From 2010 through 2016, federal agencies based their regulatory decision and NEPA reviews on global estimates of the social cost of greenhouse gases. Though agencies often also disclosed a "highly speculative" range that tried to capture exclusively U.S. climate costs, emphasis on a global value was recognized as more accurate given the science and economics of climate change, as more consistent with best economic practices, and as crucial to advancing U.S. strategic goals.[93]

---

[89] *See, e.g.,* Howarth, R. B., Gerst, M. D., & Borsuk, M. E., 2014. *Risk mitigation and the social cost of carbon*. Global Environmental Change 24, 123-131.

[90] Weitzmann, M.L., *GHG Targets as Insurance Against Catastrophic Climate Damages*, National Bureau of Economic Research Working Paper No. 16136, 12-16 (2010).

[91] 42 U.S.C. § 4332(2)(f) (emphasis added).

[92] *Id.; see also Environmental Defense Fund v. Massey*, 986 F.2d 528, 535 (D.C. Cir. 1993) (confirming that Subsection F is mandatory); Natural Resources Defense Council v. NRC, 647 F.2d 1345, 1357 (D.C. Cir. 1981) ("This NEPA prescription, I find, looks toward cooperation, not unilateral action, in a manner consistent with our foreign policy."); *cf.* COUNCIL ON ENVIRONMENTAL QUALITY, GUIDANCE ON NEPA ANALYSIS FOR TRANSBOUNDARY IMPACTS (1997), *available at* http://www.gc.noaa.gov/documents/transguide.pdf; Exec. Order No. 12,114, *Environmental Effects Abroad of Major Federal Actions*, 44 Fed. Reg. 1957 §§ 1-1, 2-1 (Jan. 4, 1979) (applying to "major Federal actions . . . having significant effects on the environment outside the geographical borders of the United States," and enabling agency officials "to be informed of pertinent environmental considerations and to take such considerations into account . . . in making decisions regarding such actions").

[93] *See generally* Howard & Schwartz, *supra* note 65.

Opponents of climate regulation challenged the global number in court and other forums, and often attempted to use Circular A-4 as support.[94] Specifically, opponents have seized on Circular A-4's instructions to "focus" on effects to "citizens and residents of the United States," while any significant effects occurring "beyond the borders of the United States . . . should be reported separately."[95] Importantly, despite this language and such challenges, the U.S. Court of Appeals for the Seventh Circuit had no trouble concluding that a global focus for the social cost of greenhouse gases was reasonable:

> AHRI and Zero Zone [the industry petitioners] next contend that DOE [the Department of Energy] arbitrarily considered the global benefits to the environment but only considered the national costs. They emphasize that the [statute] only concerns "national energy and water conservation." In the New Standards Rule, DOE did not let this submission go unanswered. It explained that climate change "involves a global externality," meaning that carbon released in the United States affects the climate of the entire world. According to DOE, national energy conservation has global effects, and, therefore, those global effects are an appropriate consideration when looking at a national policy. Further, AHRI and Zero Zone point to no global costs that should have been considered alongside these benefits. Therefore, DOE acted reasonably when it compared global benefits to national costs.[96]

CO5-1 (cont'd)

Circular A-4's reference to effects "beyond the borders" confirms that it is appropriate for agencies to consider the global effects of U.S. greenhouse gas emissions. While Circular A-4 may suggest that most typical decisions should focus on U.S. effects, the Circular cautions agencies that special cases call for different emphases:

> [Y]ou cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment. ***Different regulations may call for different emphases*** in the analysis, ***depending on the nature and complexity*** of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions.[97]

In fact, Circular A-4 elsewhere assumes that agencies' analyses will not always be conducted from purely the perspective of the United States, as one of its instructions only applies "as long as the analysis is conducted from the United States perspective,"[98] suggesting that in some circumstances it is appropriate for the analysis to be global. For example, EPA and DOT have adopted a global perspective on the analysis of potential monopsony benefits to U.S. consumers resulting from the reduced price of foreign oil imports following energy efficiency increases, and EPA assesses the global potential for leakage of greenhouse gas emissions owing to U.S. regulation.[99]

Perhaps more than any other issue, the nature of the issue of climate change requires precisely such a "different emphasis" from the default domestic-only assumption. To avoid a global "tragedy of the

[94] Ted Gayer & W. Kip Viscusi, *Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic versus Global Approaches*, 10 Rev. Envtl. Econ. & Pol'y 245 (2016) (citing Circular A-4 to argue against a global perspective on the social cost of carbon); *see also, e.g.*, Petitioners Brief on Procedural and Record-Based Issues at 70, in *West Virginia v. EPA*, case 15-1363, D.C. Cir. (filed February 19, 2016) (challenging EPA's use of the global social cost of carbon).

[95] Circular A-4 at 15. Note that A-4 slightly conflates "accrue to citizens" with "borders of the United States": U.S. citizens have financial and other interests tied to effects beyond the borders of the United States, as discussed further below.

[96] Zero Zone v. Dept. of Energy, 832 F.3d 654, 679 (7th Cir. 2016),

[97] Circular A-4 at 3 (emphasis added).

[98] *Id.* at 38 (counting international transfers as costs and benefits "as long as the analysis is conducted from the United States perspective").

[99] *See* Howard & Schwartz, *supra* note 65, at 268-69.

commons" that could irreparably damage all countries, including the United States, every nation should ideally set policy according to the global social cost of greenhouse gases.[100] Climate and clean air are global common resources, meaning they are freely available to all countries, but any one country's use—i.e., pollution—imposes harms on the polluting country as well as the rest of the world. Because greenhouse pollution does not stay within geographic borders but rather mixes in the atmosphere and affects climate worldwide, each ton emitted by the United States not only creates domestic harms, but also imposes large externalities on the rest of the world. Conversely, each ton of greenhouse gases abated in another country benefits the United States along with the rest of the world.

If all countries set their greenhouse emission levels based on only domestic costs and benefits, ignoring the large global externalities, the aggregate result would be substantially sub-optimal climate protections and significantly increased risks of severe harms to all nations, including the United States. Thus, basic economic principles demonstrate that the United States stands to benefit greatly if all countries apply global social cost of greenhouse gas values in their regulatory decisions and project reviews. Indeed, the United States stands to gain hundreds of billions or even trillions of dollars in direct benefits from efficient foreign action on climate change.[101]

CO5-1 (cont'd)

In order to ensure that other nations continue to use global social cost of greenhouse gas values, it is important that the United States itself continue to do so.[102] The United States is engaged in a repeated strategic dynamic with several significant players—including the United Kingdom, Germany, Sweden, and others—that have already adopted a global framework for valuing the social cost of greenhouse gases.[103] For example, Canada and Mexico have explicitly borrowed the IWG's global SCC metric to set their own fuel efficiency standards.[104] For the United States to now depart from this collaborative dynamic by reverting to a domestic-only estimate would undermine the country's long-term interests and could jeopardize emissions reductions underway in other countries, which are already benefiting the United States.

For these and other reasons, the IWG properly relied on global estimates to develop its SCC metric, and many federal agencies have since relied on this global metric to evaluate and justify their decisions. At the same time, some agencies have, in addition to the global estimate, also disclosed a "highly speculative" estimate of the domestic-only effects of climate change. In particular, the Department of Energy always includes a chapter on a domestic-only value of carbon emissions in the economic analyses supporting its energy efficiency standards; EPA has also often disclosed similar estimates.[105] Such an approach is consistent with Circular A-4's suggestion that agencies should usually disclose domestic effects separately from global effects. However, as we have discussed, reliance on a domestic-only methodology would be inconsistent with both the inherent nature of climate change and the standards of Circular A-4. Consequently, it is appropriate under Circular A-4 for agencies to continue to rely on

[100] *See* Garrett Hardin, *The Tragedy of the Commons*, 162 Science 1243 (1968) ("[E]ach pursuing [only its] own best interest . . . in a commons brings ruin to all.").

[101] Policy Integrity, *Foreign Action, Domestic Windfall: The U.S. Economy Stands to Gain Trillions from Foreign Climate Action* (2015), http://policyintegrity.org/files/publications/ForeignActionDomesticWindfall.pdf

[102] *See* Robert Axelrod, *The Evolution of Cooperation* 10-11 (1984) (on repeated prisoner's dilemma games).

[103] *See* Howard & Schwartz, *supra* note 65, at Appendix B.

[104] *See* Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24, 147 Can. Gazette pt. II, 450, 544 (Can.), *available at* http://canadagazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html ("The values used by Environment Canada are based on the extensive work of the U.S. Interagency Working Group on the Social Cost of Carbon."); Jason Furman & Brian Deese, *The Economic Benefits of a 50 Percent Target for Clean Energy Generation by 2025*, White House Blog, June 29, 2016 (summarizing the North American Leader's Summit announcement that U.S., Canada, and Mexico would "align" their SCC estimates).

[105] Howard & Schwartz, *supra* note 65, at 220-21.

global estimates of the social cost of greenhouses to justify their regulatory decisions or their choice of alternatives under NEPA.

Moreover, no current methodology can accurately estimate a "domestic-only" value of the social cost of greenhouse gases. OMB, the National Academies of Sciences, and the economic literature all agree that existing methodologies for calculating a "domestic-only" value of the social cost of greenhouse gases are deeply flawed and result in severe and misleading underestimates. In developing the social cost of carbon, the IWG did offer some such domestic estimates. Using the results of one economic model (FUND) as well as the U.S. share of global gross domestic product (GDP), the group generated an "approximate, provisional, and ***highly speculative***" range of 7–23% of the global social cost of carbon as an estimate of the purely direct climate effects to the United States.[106] Yet, as the IWG itself acknowledged, this range is almost certainly an underestimate because it ignores significant, indirect costs to trade, human health, and security that are likely to "spill over" into the United States as other regions experience climate change damages, among other effects.[107]

CO5-1 (cont'd)

Neither the existing IAMs nor a share of global GDP are appropriate bases for calculating a domestic-only estimate. The IAMs were never designed to calculate a domestic SCC, since a global SCC is the economic efficient value. FUND, like other IAMS, includes some simplifying assumptions: of relevance, FUND and the other IAMs are not able to capture the adverse effects that the impacts of climate change in other countries will have on the United States through trade linkages, national security, migration, and other forces.[108] This is why the IWG characterized the domestic-only estimate from FUND as a "highly speculative" underestimate. Similarly, a domestic-only estimate based on some rigid conception of geographic borders or U.S. share of world GDP will fail to capture all the climate-related costs and benefits that matter to U.S. citizens.[109] U.S. citizens have economic and other interests abroad that are not fully reflected in the U.S. share of global GDP. GDP is a "monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time."[110] GDP therefore does not reflect significant U.S. ownership interests in foreign businesses, properties, and other assets, as well as consumption abroad including tourism,[111] or even the 8 million Americans living abroad.[112] At the same time, GDP is also over-inclusive, counting productive operations in the United States that are owned by foreigners. Gross National Income (GNI), by contrast, defines its scope not by location but by ownership interests.[113] However, not only has GNI fallen out of favor as a

[106] INTERAGENCY WORKING GROUP ON SOCIAL COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12,866 at 11 (2010) (emphasis added).

[107] *Id.* (explaining that the IAMs, like FUND, do "not account for how damages in other regions could affect the United States (e.g., global migration, economic and political destabilization").

[108] *See, e.g.*, Dept. of Defense, *National Security Implications of Climate-Related Risks and a Changing Climate* (2015), *available at* http://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery.

[109] A domestic-only SCC would fail to "provide to the public and to OMB a careful and transparent analysis of the anticipated consequences of economically significant regulatory actions." Office of Information and Regulatory Affairs, *Regulatory Impact Analysis: A Primer* 2 (2011).

[110] Tim Callen, *Gross Domestic Product: An Economy's All*, IMF, http://www.imf.org/external/pubs/ft/fandd/basics/gdp.htm (last updated Mar. 28, 2012).

[111] "U.S. residents spend millions each year on foreign travel, including travel to places that are at substantial risk from climate change, such as European cities like Venice and tropical destinations like the Caribbean islands." David A. Dana, *Valuing Foreign Lives and Civilizations in Cost-Benefit Analysis: The Case of the United States and Climate Change Policy* (Northwestern Faculty Working Paper 196, 2009), http://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1195&context=facultyworkingpapers.

[112] Assoc. of Americans Resident Oversees, https://www.aaro.org/about-aaro/6m-americans-abroad. Admittedly 8 million is only 0.1% of the total population living outside the United States.

[113] *GNI, Atlas Method (Current US$)*, THE WORLD BANK, http://data.worldbank.org/indicator/NY.GNP.ATLS.CD.

16

CO5-1 (cont'd)

metric used in international economic policy,[114] but using a domestic-only SCC based on GNI would make the SCC metrics incommensurable with other costs in regulatory impact analyses, since most regulatory costs are calculated by U.S. agencies regardless of whether they fall to U.S.-owned entities or to foreign-owned entities operating in the United States.[115] Furthermore, both GDP and GNI are dependent on what happens in other countries, due to trade and the international flow of capital. The artificial constraints of both metrics counsel against a rigid split based on either U.S. GDP or U.S. GNI.[116]

Of course, there already are and will continue to be significant, quantifiable, localized effects of climate change. For example, a peer-reviewed EPA report, *Climate Change in the United States: Benefits of Global Action*, found that by the end of the century, the U.S. economy could face damages of $110 billion annually in lost labor productivity alone due to extreme temperatures, plus $11 billion annually in agricultural damages, $180 billion in losses to key economic sectors due to water shortages, and $5 trillion in damages U.S. coastal property.[117] But the existence of those examples of quantifiable estimates of localized damages does not mean that the current IAMs are able to extrapolate a U.S.-only number that accurately reflects total domestic damages—especially since, as already explained, the IAMs do not reflect spill overs.

As a result, in 2015, OMB concluded, along with several other agencies, that "good methodologies for estimating domestic damages do not currently exist."[118] Similarly, the NAS recently concluded that current IAMs cannot accurately estimate the domestic social cost of greenhouse gases, and that estimates based on U.S. share of global GDP would be likewise insufficient.[119] William Nordhaus, the developer of the DICE model, cautioned earlier this year that "regional damage estimates are both incomplete and poorly understood," and "there is little agreement on the distribution of the SCC by region."[120] In short, any domestic-only estimate will be inaccurate, misleading, and out of step with the best available economic literature, in violation of Circular A-4's standards for information quality.

For more details on the justification for a global value of the social cost of greenhouse gases, please see Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Columbia J. Envtl. L. 203 (2017). Another strong defense of the global valuation as consistent with best economic practices appears in a letter published in a recent issue of *The Review of Environmental Economics and Policy*, co-authored by the late Nobel laureate economist Kenneth Arrow.[121]

---

[114] *Id*.

[115] U.S. Office of Management and Budget & Secretariat General of the European Commission, *Review of Application of EU and US Regulatory Impact Assessment Guidelines on the Analysis of Impacts on International Trade and Development* 13 (2008).

[116] Advanced Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,354, 44,415 (July 30, 2008) ("Furthermore, international effects of climate change may also affect domestic benefits directly and indirectly to the extent U.S. citizens value international impacts (e.g., for tourism reasons, concerns for the existence of ecosystems, and/or concern for others); U.S. international interests are affected (e.g., risks to U.S. national security, or the U.S. economy from potential disruptions in other nations).").

[117] EPA, *Climate Change in the United States: Benefits of Global Action* (2015).

[118] In November 2013, OMB requested public comments on the social cost of carbon. In 2015, OMB along with the rest of the Interagency Working Group issued a formal response to those comments. Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12,866* at 36 (July 2015) [hereinafter, OMB 2015 Response to Comments].

[119] NAS Second Report, *supra* note 62, at 53.

[120] William Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PNAS 1518, 1522 (2017).

[121] Richard Revesz, Kenneth Arrow et al., *The Social Cost of Carbon: A Global Imperative*, 11 REEP 172 (2017).

CO5-1
(cont'd)

There Is Clear Consensus on Using a 3% or Lower (or Declining) Discount Rate as a Central Estimate

In the Southeast Market Pipeline draft supplemental EIS, which this group commented on last year, FERC cites a 2013 EPA factsheet for the proposition that there is such a lack of consensus around the appropriate discount rate that the resulting range of estimates of the social cost of greenhouse gases is too wide to be helpful.[122] Not only was this line of thinking rejected by the Ninth Circuit in *Center for Biological Diversity*—"while . . . there is a range of values, the value of carbon emissions reduction is certainly not zero"[123]—but the range of values recommended by the Interagency Working Group[124] and endorsed by the National Academies of Sciences[125] is rather manageable. In 2016, the IWG recommended values at discount rates from 2.5% to 5%, calculated as between $12 and $62 for year 2020 emissions.[126] Numerous federal agencies have had no difficulty either applying this range in their environmental impact statements or else focusing on the central estimate at a 3% discount rate.[127] Most recently, in August 2017, the Bureau of Ocean Energy Management applied the IWG's range of estimates calculated at three discount rates (2.5%, 3%, and 5%) to its environmental impact statement for an offshore oil development plan,[128] and called this range of estimates "a useful measure to assess the benefits of CO_2 reductions and inform agency decisions."[129]

More importantly, there is widespread consensus that a central estimate calculated at a 3% or lower discount rate, or else using a declining discount rate, is most appropriate, while a 7% discount rate would be wholly inappropriate in the context of intergenerational climate damages. Because of the long lifespan of greenhouse gases and the long-term or irreversible consequences of climate change, the effects of today's emissions changes will stretch out over the next several centuries. The time horizon for an agency's analysis of climate effects, as well as the discount rate applied to future costs and benefits, determines how an agency treats future generations. Current central estimates of the social cost of greenhouse gases are based on a 3% discount rate and a 300-year time horizon. Executive Order 13,783 disbanded the Interagency Working Group in March 2017 and instructs agencies to reconsider the "appropriate discount rates" when monetizing the value of climate effects.[130] By citing the official

[122] Southeast Market EIS at 5. *But see* Sabal Remand Order (Comm'r LaFleur, dissenting in part) ("[T]he Commission could estimate the appropriate discount rate or to use more than one discount rate in our calculations or to provide a range of numbers for consideration."); *id.* (Comm'r Glick, dissenting) ("perceived technical challenges including the presence of assumptions or unknowns, such as discount rate, ... does not diminish the Commission's responsibility to provide a qualitative assessment, rather the Commission simply must make a disclosure 'so that readers can take the resulting estimates with the appropriate amount of salt.'").

[123] 538 F.3d at 1200.

[124] *See* Interagency Working Group on the Social Cost of Greenhouse Gases, *Technical Update* (2016) (hereinafter 2016 TSD).

[125] *See* National Academies of Sciences, *Assessment of Approaches to Updating the Social Cost of Carbon* (2016) (hereinafter First NAS Report) (endorsing continued near-term use of the IWG numbers; in 2017, the NAS recommended moving to a declining discount rate, *see* National Academies of Sciences, *Valuing Climate Damages* (2017) (hereinafter Second NAS Report).

[126] 2016 TSD. The values given here are in 2007$. The IWG also recommended a 95th percentile value of $123.

[127] BLM, *Envtl. Assessment—Waste Prevention, Prod. Subject to Royalties, and Res. Conservation* at 52 (2016); BLM, *Final Envtl. Assessment: Little Willow Creek Protective Oil and Gas Lease*, DOI-BLM-ID-B010-2014-0036-EA, at 82 (2015); Office of Surface Mining, *Final Envtl. Impact Statement—Four Corners Power Plant and Navajo Mine Energy Project* at 4.2-26 to 4.2-27 (2015) (explaining the social cost of greenhouse gases "provide[s] further context and enhance[s] the discussion of climate change impacts in the NEPA analysis."); U.S. Army Corps of Engineers, *Draft Envtl. Impact Statement for the Missouri River Recovery Mgmt. Project* at 3-335 (2016); U.S. Forest Serv., *Rulemaking for Colorado Roadless Areas: Supplemental Final Envtl. Impact Statement* at 120-123 (Nov. 2016) (using both the social cost of carbon and social cost of methane relating to coal leases); NHTSA EIS, *Available at* http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/FINAL_EIS.pdf at 9-77.

[128] BOEM, *Liberty Development Project: Draft Environmental Impact Statement*, at 4-247 (2017).

[129] *Id.* at 3-129.

[130] Executive Order 13,783 § 5(c).

guidance on typical regulatory impact analyses (namely, Circular A-4), the Order implicitly called into question the IWG's choice not to use a 7% discount rate. However, use of a 7% discount would not only be inconsistent with best economic practices but would violate NEPA's required consideration of impacts on future generations.

NEPA requires agencies to weigh the "relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity," as well as "any irreversible and irretrievable commitments of resources."[131] That requirement is prefaced with a congressional declaration of policy that explicitly references the needs of future generations:

> The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment . . . declares that it is the continuing policy of the Federal Government . . . to use all practicable means and measures . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and **future generations** of Americans.[132]

CO5-1 (cont'd)

When the Congressional Conference Committee adopted that language, it reported that the first "broad national goal" under the statute is to "fulfill the responsibilities of each generation as trustee of the environment for future generations. It is recognized in this [congressional] statement [of policy] that each generation has a responsibility to improve, enhance, and maintain the quality of the environment *to the greatest extent possible for the continued benefit of future generations*."[133]

Because applying a 7% discount rate to the social cost of greenhouse gases could drop the valuation essentially to $0, use of such a rate effectively ignores the needs of future generations. Doing so would arbitrarily fail to consider an important statutory factor that Congress wrote into the NEPA requirements.

Moreover, a 7% discount rate is inconsistent with best economic practices, including under Circular A-4. In 2015, OMB explained that "Circular A-4 is a ***living document***. . . . [T]he use of ***7 percent is not considered appropriate*** for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A-4 itself. "[134] While Circular A-4 tells agencies generally to use a 7% discount rate in addition to lower rates for typical rules,[135] the guidance does not intend for default assumptions to produce analyses inconsistent with best economic practices. Circular A-4 clearly supports using lower rates to the exclusion of a 7% rate for the costs and benefits occurring over the extremely long, 300-year time horizon of climate effects.

Circular A-4 clearly requires agency analysts to do more than rigidly apply default assumptions: "You cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment."[136] As such, analysis must be "based on the best reasonably obtainable scientific, technical, and economic information available,"[137] and agencies must "*[u]**se sound***

---

[131] 42 U.S.C. § 4332(2)(C).
[132] 42 U.S.C.A. § 4331.
[133] See 115 Cong. Rec. 40419 (1969) (emphasis added); *see also* same in Senate Report 91-296 (1969).
[134] Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12,866* at 36 (July 2015) [hereinafter, OMB 2015 Response to Comments].
[135] Circular A-4 at 36 ("For regulatory analysis, you should provide estimates of net benefits using both 3 percent and 7 percent....If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent.").
[136] *Id.* at 3.
[137] *Id.* at 17.

CO5-1
(cont'd)

and defensible values or procedures to monetize benefits and costs, and ensure that key analytical assumptions are defensible."[138] Rather than assume a 7% discount rate should be applied automatically to every analysis, Circular A-4 requires agencies to justify the choice of discount rates for each analysis: "[S]tate in your report what assumptions were used, *such as . . . the discount rates* applied to future benefits and costs," and explain "clearly how you arrived at your estimates."[139] Based on Circular A-4's criteria, there are numerous reasons why applying a 7% discount rate to climate effects that occur over a 300-year time horizon would be unjustifiable.

First, basing the discount rate on the **consumption rate of interest** is the correct framework for analysis of climate effects; a discount rate based on the private return to capital is inappropriate. Circular A-4 does suggest that 7% should be a "default position" that reflects regulations that primarily displace capital investments; however, the Circular explains that "[w]hen regulation primarily and directly affects private consumption . . . *a lower discount rate is appropriate*."[140] The 7% discount rate is based on a private sector rate of return on capital, but private market participants typically have short time horizons. By contrast, climate change concerns the public well-being broadly. Rather than evaluating an optimal outcome from the narrow perspective of investors alone, economic theory requires analysts to make the optimal choices based on societal preferences and social discount rates. Moreover, because climate change is expected to largely affect large-scale consumption, as opposed to capital investment,[141] a 7% rate is inappropriate.

In 2013, OMB called for public comments on the social cost of greenhouse gases. In its 2015 Response to Comment document,[142] OMB (together with the other agencies from the IWG) explained that

> the consumption rate of interest is the correct concept to use . . . as the impacts of climate change are measured in consumption-equivalent units in the three IAMs used to estimate the SCC. This is consistent with OMB guidance in Circular A-4, which states that when a regulation is expected to primarily affect private consumption—for instance, via higher prices for goods and services—it is appropriate to use the consumption rate of interest to reflect how private individuals trade-off current and future consumption.[143]

The Council of Economic Advisers similarly interprets Circular A-4 as requiring agencies to choose the appropriate discount rate based on the nature of the regulation: "[I]n Circular A-4 by the Office of Management and Budget (OMB) the appropriate discount rate to use in evaluating the net costs or benefits of a regulation depends on whether the regulation primarily and directly affects private

[138] *Id.* at 27 (emphasis added).
[139] *Id.* at 3 (emphasis added).
[140] *Id.* at 33 (emphasis added).
[141] "There are two rationales for discounting future benefits—one based on consumption and the other on investment. The consumption rate of discount reflects the rate at which society is willing to trade consumption in the future for consumption today. Basically, we discount the consumption of future generations because we assume future generations will be wealthier than we are and that the utility people receive from consumption declines as their level of consumption increases. . . . The investment approach says that, as long as the rate of return to investment is positive, we need to invest less than a dollar today to obtain a dollar of benefits in the future. Under the investment approach, the discount rate is the rate of return on investment. If there were no distortions or inefficiencies in markets, the consumption rate of discount would equal the rate of return on investment. There are, however, many reasons why the two may differ. As a result, using a consumption rather than investment approach will often lead to very different discount rates." Maureen Cropper, *How Should Benefits and Costs Be Discounted in an Intergenerational Context?*, 183 RESOURCES 30, 33.
[142] Note that this document was not withdrawn by Executive Order 13,783.
[143] OMB 2015 Response to Comments, *supra* note 134, at 22.

CO5-1 (cont'd)

consumption or private capital."[144] The NAS also explained that a consumption rate of interest is the appropriate basis for a discount rate for climate effects.[145] For this reason, 7% is an inappropriate choice of discount rate for the impacts of climate change.

Second, **uncertainty over the long time horizon** of climate effects should drive analysts to select a lower discount rate. As an example of when a 7% discount rate is appropriate, Circular A-4 identifies an EPA rule with a 30-year timeframe of costs and benefits.[146] By contrast, greenhouse gas emissions generate effects stretching out across 300 years. As Circular A-4 notes, while "[p]rivate market rates provide a reliable reference for determining how society values time within a generation, but for extremely long time periods no comparable private rates exist."[147]

Circular A-4 discusses how uncertainty over long time horizons drives the discount rate lower: "the longer the horizon for the analysis," the greater the "uncertainty about the appropriate value of the discount rate," which supports a lower rate.[148] Circular A-4 cites the work of renowned economist Martin Weitzman and concludes that the "certainty-equivalent discount factor corresponds to ***the minimum discount rate having any substantial positive probability***."[149] The NAS makes the same point about discount rates and uncertainty.[150]

Third, a 7% percent discount rate would be inappropriate for climate change because it is based on **outdated data and diverges from the current economic consensus**. Circular A-4 requires that assumptions—including discount rate choices—are "based on the best reasonably obtainable scientific, technical, and economic information available."[151] Yet Circular A-4's own default assumption of a 7% discount rate was published 14 years ago and was based on data from decades ago.[152] Circular A-4's guidance on discount rates is in need of an update, as the Council of Economic Advisers detailed earlier this year after reviewing the best available economic data and theory:

---

[144] Council of Econ. Advisers, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate* at 1 (CEA Issue Brief, 2017), *available at* https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf. In theory, the two rates would be the same, but "given distortions in the economy from taxation, imperfect capital markets, externalities, and other sources, the SRTP and the marginal product of capital need not coincide, and analysts face a choice between the appropriate opportunity cost of a project and the appropriate discount rate for its benefits." *Id.* at 9. The correct discount rate for climate change is the social return to capital (i.e., returns minus the costs of externalities), not the private return to capital (which measures solely the returns).

[145] NAS Second Report, *supra*, at 28; see also Kenneth Arrow et al., Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?, 272 Science 221 (1996) (explaining that a consumption-based discount rate is appropriate for climate change).

[146] Circular A-4 at 34. See also OMB 2015 Response to Comments, *supra* note 134, at 21 ("While most regulatory impact analysis is conducted over a time frame in the range of 20 to 50 years").

[147] Circular A-4 at 36.

[148] *Id.*

[149] *Id.* (emphasis added); *see also* CEA, *supra* note 144, at 9: "Weitzman (1998, 2001) showed theoretically and Newell and Pizer (2003) and Groom et al. (2007) confirm empirically that discount rate uncertainty can have a large effect on net present values. A main result from these studies is that if there is a persistent element to the uncertainty in the discount rate (e.g., the rate follows a random walk), then it will result in an effective (or certainty-equivalent) discount rate that declines over time. Consequently, lower discount rates tend to dominate over the very long term, regardless of whether the estimated investment effects are predominantly measured in private capital or consumption terms (see Weitzman 1998, 2001; Newell and Pizer 2003; Groom et al. 2005, 2007; Gollier 2008; Summers and Zeckhauser 2008; and Gollier and Weitzman 2010)."

[150] NAS Second Report, *supra* note 62, at 27.

[151] CEQ regulations implementing NEPA similarly require that information in NEPA documents be "of high quality" and states that "[a]ccurate scientific analysis . . . [is] essential to implementing NEPA." 40 C.F.R. § 1500.1(b).

[152] The 7% rate was based on a 1992 report; the 3% rate was based on data from the thirty years preceding the publication of Circular A-4 in 2003. Circular A-4 at 33.

CO5-1 (cont'd)

> The discount rate guidance for Federal policies and projects was last revised in 2003. Since then a general reduction in interest rates along with a reduction in the forecast of long-run interest rates, warrants serious consideration for a reduction in the discount rates used for benefit-cost analysis.[153]

In addition to recommending a value below 7% as the discount factor based on private capital returns, the Council of Economic Advisers further explains that, because long-term interest rates have fallen, a discount rate based on the consumption rate of interest "should be at most 2 percent,"[154] which further confirms that applying a 7% rate to a context like climate change would be wildly out of step with the latest data and theory. Similarly, recent expert elicitations—a technique supported by Circular A-4 for filling in gaps in knowledge[155]—indicate that a growing consensus among experts in climate economics for a discount rate between 2% and 3%; 5% represents the upper range of values recommended by experts, and few to no experts support discount rates greater than 5% being applied to the costs and benefits of climate change.[156] Tellingly, none of the integrated assessment models (DICE, FUND, and PAGE) used to build the IWG's estimates of the social cost of greenhouse gases uses a 7% discount rate. Based on current economic data and theory, the most appropriate discount rate for climate change is 3% or lower.

Fourth, Circular A-4 requires more of analysts than giving all possible assumptions and scenarios equal attention in a sensitivity analysis; if alternate assumptions would fundamentally change the decision, Circular A-4 requires analysts to select the **most appropriate assumptions from the sensitivity analysis**.

Circular A-4 indicates that significant intergenerational effects will warrant a special sensitivity analysis focused on discount rates even lower than 3%:

> Special ethical considerations arise when comparing benefits and costs across generations. . . It may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations. . . If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent.[157]

Elsewhere in Circular A-4, OMB clarifies that sensitivity analysis should not result in a rigid application of all available assumptions regardless of plausibility. Circular A-4 instructs agencies to depart from default assumptions when special issues "call for different emphases" depending on "the sensitivity of the benefit and cost estimates to the key assumptions."[158] More specifically:

---

[153] CEA, *supra* note 144, at 1; *id.* at 3 ("In general the evidence supports lowering these discount rates, with a plausible best guess based on the available information being that the lower discount rate should be at most 2 percent while the upper discount rate should also likely be reduced."); *id.* at 6 ("The Congressional Budget Office, the Blue Chip consensus forecasts, and the Administration forecasts all place the ten year treasury yield at less than 4 percent in the future, while at the same time forecasting CPI inflation of 2.3 or 2.4 percent per year. The implied real ten year Treasury yield is thus below 2 percent in all these forecasts.").

[154] *Id.* at 1.

[155] Circular A-4 at 41.

[156] Peter Howard & Derek Sylvan, *The Economic Climate: Establishing Expert Consensus on the Economics of Climate Change* (Inst. Policy Integrity Working Paper 2015/1); M.A. Drupp, et al., *Discounting Disentangled: An Expert Survey on the Determinants of the Long-Term Social Discount Rate* (London School of Economics and Political Science Working Paper, May 2015) (finding consensus on social discount rates between 1-3%).

[157] Circular A-4 at 35-36.

[158] *Id.* at 3.

> If benefit or cost estimates depend heavily on certain assumptions, you should make those assumptions explicit and carry out *sensitivity analyses using plausible alternative assumptions*. If the value of net benefits changes from positive to negative (or vice versa) or if the relative ranking of regulatory options changes with alternative plausible assumptions, you should conduct further analysis to determine ***which of the alternative assumptions is more appropriate***.[159]

In other words, if using a 7% discount rate would fundamentally change the agency's decision compared to using a 3% or lower discount rate, the agency must evaluate which assumption is most appropriate. Since OMB, the Council of Economic Advisers, the National Academies of Sciences, and the economic literature all conclude that a 7% rate is inappropriate for climate change, agencies should select a 3% or lower rate. Applying a 7% rate to climate effects cannot be justified "based on the best reasonably obtainable scientific, technical, and economic information available" and is inconsistent with the proper treatment of uncertainty over long time horizons.

CO5-1 (cont'd)

Finally, to the extent there is uncertainty around the discount rate over long periods of time, the growing economic consensus supports shifting to a declining discount rate framework. Circular A-4 contemplates the use of declining discount rates in its reference to the work of Weitzman.[160] As the Council of Economic Advisers explained earlier this year, Weitzman and others developed the foundation for a declining discount rate approach, wherein rates start relatively higher for near-term costs and benefits but steadily decline over time according to a predetermined schedule until, in the very long-term, very low rates dominate due to uncertainty.[161] The National Academies of Sciences' report also strongly endorses a declining discount rate approach due to uncertainty.[162] In other words, the rational response to a concern about uncertainty over the discount rate is not to abandon the social cost of greenhouse gas methodology, but to apply declining discount rates and to treat the estimates calculated at a constant 3% rate as conservative lower-bound estimates.

One possible schedule of declining discount rates was proposed by Weitzman.[163] It is derived from a broad survey of top economists and other climate experts and explicitly incorporates arguments around interest rate uncertainty. Work by Arrow *et al*, Cropper *et al*, and Gollier and Weitzman, among others,

---

[159] *Id*. at 42 (emphasis added).

[160] Circular A-4, at page 36, cites to Weitzman's chapter in Portney & Weyant, eds. (1999); that chapter, at page 29, recommends a declining discount rate approach: "a sliding-scale social discounting strategy" with the rate at 3-4% through year 25; then around 2% until year 75; then around 1% until year 300; and then 0% after year 300.

[161] CEA, *supra* note 144, at 9 ("[A]nother way to incorporate uncertainty when discounting the benefits and costs of policies and projects that accrue in the far future—applying discount rates that decline over time. This approach uses a higher discount rate initially, but then applies a graduated schedule of lower discount rates further out in time. The first argument is based on the application of the Ramsey framework in a stochastic setting (Gollier 2013), and the second is based on Weitzman's 'expected net present value' approach (Weitzman 1998, Gollier and Weitzman 2010). In light of these arguments, the governments of the United Kingdom and France apply declining discount rates to their official public project evaluations.").

[162] NAS Second Report, *supra*.

[163] Martin L. Weitzman, *Gamma Discounting*, 91 AM. ECON. REV. 260, 270 (2001). Weitzman's schedule is as follows:

1-5 years	6-25 years	26-75 years	76-300 years	300+ years
4%	3%	2%	1%	0%

similarly argue for a declining interest rate schedule and lay out the fundamental logic.[164] Another schedule of declining discount rates has been adopted by the United Kingdom.[165]

The technical appendix on discounting attached to these comments more thoroughly reviews the various schedules of declining discount rates available for agencies to select and explains why agencies not only can but should adopt a declining discount framework to address uncertainty. An additional technical appendix on uncertainty explains in detail why uncertainty around the social cost of greenhouse gas points toward higher values. Shifting to a declining discount rate framework would increase the social cost of greenhouse gases.[166] Consequently, a central estimate calculated at 3% should be considered a lower-bound of the social cost of greenhouse gases. But even providing a lower-bound estimate of the social cost of greenhouse gases helps inform decisionmakers and the public, and FERC is required by NEPA to provide some monetization of climate damages, consistent with economic best practices.

CO5-1 (cont'd)

Similarly, a 300-year time horizon is required by best economic practices. In 2017, the National Academies of Sciences issued a report stressing the importance of a longer time horizon for calculating the social cost of greenhouse gases. The report states that, "[i]n the context of the socioeconomic, damage, and discounting assumptions, the time horizon needs to be long enough to capture the vast majority of the present value of damages."[167] The report goes on to note that the length of the time horizon is dependent "on the rate at which undiscounted damages grow over time and on the rate at which they are discounted. Longer time horizons allow for representation and evaluation of longer-run geophysical system dynamics, such as sea level change and the carbon cycle."[168] In other words, after selecting the appropriate discount rate based on theory and data (in this case, 3% or below), analysts should determine the time horizon necessary to capture all costs and benefits that will have important net present values at the discount rate. Therefore, a 3% or lower discount rate for climate change implies the need for a 300-year horizon to capture all significant values. NAS reviewed the best available, peer-reviewed scientific literature and concluded that the effects of greenhouse gas emissions over a 300-year period are sufficiently well established and reliable as to merit consideration in estimates of the social cost of greenhouse gases.[169]

Agencies Should Follow the Social Cost of Greenhouse Gas Protocol's Treatment of Uncertainty

The approach developed and utilized by the IWG remains the best methodology, based on the best currently available scientific and economic data. In particular, the IWG modeled the uncertainty over the

[164] Kenneth J. Arrow et al., *Determining Benefits and Costs for Future Generations*, 341 SCIENCE 349 (2013); Kenneth J. Arrow et al., *Should Governments Use a Declining Discount Rate in Project Analysis?*, REV ENVIRON ECON POLICY 8 (2014); Maureen L. Cropper et al., *Declining Discount Rates*, AMERICAN ECONOMIC REVIEW: PAPERS AND PROCEEDINGS (2014); Christian Gollier & Martin L. Weitzman, *How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?* 107 ECONOMICS LETTERS 3 (2010).

[165] Joseph Lowe, H.M. Treasury, U.K., Intergenerational Wealth Transfers and Social Discounting: Supplementary Green Book Guidance 5 (2008), *available at* http://www.hm-treasury.gov.uk/d/4(5).pdf. The U.K. declining discount rate schedule that subtracts out a time preference value is as follows:

0-30 years	31-75 years	76-125 years	126-200 years	201-300 years	301+ years
3.00%	2.57%	2.14%	1.71%	1.29%	0.86%

[166] This assumes the use of reasonable values in the Ramsey equation. But in general, as compared to a constant discount rate, a declining rate approach should decrease the effective discount rate.

[167] NAS Second Report, *supra* note 62, at 78.

[168] *Id.*

[169] NAS First Report, *supra* note 63, at 32.

value of the equilibrium climate sensitivity parameter using the Roe and Baker distribution calibrated to the IPCC reports. Using well-established analytic tools to capture and reflect uncertainty, including a Monte Carlo simulation to randomly select the equilibrium climate sensitivity parameter and other uncertainty parameters selected by the model developers, the IWG quantitatively modeled the uncertainty underlying how greenhouse gas emissions affect temperature. Rather than guess about "a range of potential global temperature changes that may result," NHTSA must undertake a quantitative assessment of uncertainty and can rely on the same models and methodologies as the IWG to connect each ton of greenhouse gases avoided or emitted as a result of the CAFE standards with the associated global climate effects.[170]

To further deal with uncertainty, the IWG recommended to agencies a range of four estimates: three central or mean-average estimates at a 2.5%, 3%, and 5% discount rate respectively, and a 95th percentile value at the 3% discount rate. While the IWG's technical support documents disclosed fuller probabilities distributions, these four estimates were chosen by agencies to be the focus for decisionmaking. In particular, application of the 95th percentile value was not part of an effort to show the probability distribution around the 3% discount rate; rather, the 95th percentile value serves as a methodological shortcut to approximate the uncertainties around low-probability but high-damage, catastrophic, or irreversible outcomes that are currently omitted or undercounted in the economic models.

CO5-1 (cont'd)

The shape of the distribution of climate risks and damages includes a long tail of lower-probability, high-damage, irreversible outcomes due to "tipping points" in planetary systems, inter-sectoral interactions, and other deep uncertainties. Climate damages are not normally distributed around a central estimate, but rather feature a significant right skew toward catastrophic outcomes. In fact, a 2015 survey of economic experts concludes that catastrophic outcomes are increasingly likely to occur.[171] Because the three integrated assessment models that the IWG's methodology relied on are unable to systematically account for these potential catastrophic outcomes, a 95th percentile value was selected instead to account for such uncertainty. There are no similarly systematic biases pointing in the other direction which might warrant giving weight to a low-percentile estimate. Consequently, in any treatment of uncertainty, NHTSA should give sufficient attention to the long tail on the probability distribution that extends into high temperature ranges and catastrophic damages.

Additionally, the 95th percentile value addresses the strong possibility of widespread risk aversion with respect to climate change. The integrated assessment models do not reflect that individuals likely have a higher willingness to pay to reduce low-probability, high-impact damages than they do to reduce the likelihood of higher-probability but lower impact damages with the same expected cost. Beyond individual members of society, governments also have reasons to exercise some degree of risk aversion to irreversible outcomes like climate change.

In short, the 95th percentile estimate attempts to capture risk aversion and uncertainties around lower-probability, high-damage, irreversible outcomes that are currently omitted or undercounted by the models. There is no need to balance out this estimate with a low-percentile value, because the reverse assumptions are not reasonable:

---

[170] NHTSA may have used other methodologies for quantitative assessment of uncertainty in the past.

[171] Policy Integrity, *Expert Consensus on the Economics of Climate Change* 2 (2015), *available at* http://policyintegrity.org/files/publications/ExpertConsensusReport.pdf [hereinafter *Expert Consensus*] ("Experts believe that there is greater than a 20% likelihood that this same climate scenario would lead to a 'catastrophic' economic impact (defined as a global GDP loss of 25% or more)."). *See also* Robert Pindyck, *The Social Cost of Carbon Revisited* (National Bureau of Economic Research, No. w22807, 2016).

25

- There is no reason to believe the public or the government will be systematically risk seeking with respect to climate change.[172]
- The consequences of overestimating the risk of climate damages (i.e., spending more than we need to on mitigation and adaptation) are not nearly as irreversible as the consequences of underestimating the risk of climate damage (i.e., failing to prevent catastrophic outcomes).
- Though some uncertainties might point in the direction of lower social cost of greenhouse gas values, such as those related to the development of breakthrough adaptation technologies, the models already account for such uncertainties around adaptation; on balance, most uncertainties strongly point toward higher, not lower, social cost of greenhouse gas estimates.[173]

CO5-1 (cont'd)

- There is no empirical basis for any "long tail" of potential benefits that would counteract the potential for extreme harm associated with climate change.

Moreover, even the best existing estimates of the social cost of greenhouse gases are likely underestimated because the models currently omit many significant categories of damages—such as depressed economic growth, pests, pathogens, erosion, air pollution, fire, dwindling energy supply, health costs, political conflict, and ocean acidification—and because of other methodological choices.[174] There is little to no support among economic experts to give weight to any estimate lower than the 5% discount rate estimate.[175] Rather, even a discount rate at 3% or below likely continues to underestimate the true social cost of greenhouse gases.

The National Academies of Sciences did recommend that the IWG document its full treatment of uncertainty in an appendix and disclose low-probability as well as high-probability estimates of the social cost of greenhouse gases.[176] However, that does not mean it would be appropriate for individual agencies to rely on low-percentile estimates to justify decisions. While disclosing low-percentile estimates as a sensitivity analysis may promote transparency, relying on such an estimate for

---

[172] As a 2009 survey revealed, the vast majority of economic experts support the idea that "uncertainty associated with the environmental and economic effects of greenhouse gas emissions increases the value of emission controls, assuming some level of risk-aversion." *See Expert Consensus, supra* note 171, at 3 (citing 2009 survey).

[173] *See* Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014). R. Tol, *The Social Cost of Carbon*, 3 Annual Rev. Res. Econ. 419 (2011) ("[U]ndesirable surprises seem more likely than desirable surprises. Although it is relatively easy to imagine a disaster scenario for climate change—for example, involving massive sea level rise or monsoon failure that could even lead to mass migration and violent conflict—it is not at all easy to imagine that climate change will be a huge boost to human welfare.").

[174] *See* Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, *supra* note 173; Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014); Frances C. Moore & Delavane B. Diaz, *Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy*, 5 NATURE CLIMATE CHANGE 127 (2015) (demonstrating SCC may be biased downward by more than a factor of six by failing to include the climate's effect on economic growth).

[175] The existing estimates based on the 5% discount rate already provides a lower-bound; indeed, if anything the 5% discount rate is already far too conservative as a lower-bound. A recent survey of 365 experts on the economics of climate change found that 90% of experts believe a 3% discount rate or lower is appropriate for climate change; a 5% discount rate falls on the extremely high end of what experts would recommend. *Expert Consensus, supra* note 171, at 21; *see also* Drupp, M.A., et al. *Discounting Disentangled: An Expert Survey on the Determinants of the Long-Term Social Discount Rate* (London School of Economics and Political Science Working Paper, May 2015) (finding consensus on social discount rates between 1-3%). Only 8% of the experts surveyed believe that the central estimate of the social cost of carbon is below $40, and 69% of experts believed the value should be at or above the central estimate of $40. *Expert Consensus, supra* note 171, at 18.

[176] Nat'l Acad. Of Sci., *Assessment of Approaches to Updating the Social Cost of Carbon* 49 (2016) ("[T]he IWG could identify a high percentile (e.g., 90th, 95th) and corresponding low percentile (e.g., 10th, 5th) of the SCC frequency distributions on each graph.").

decisionmaking—in the face of contrary guidance from the best available science and economics on uncertainty and risk—would not be a "credible, objective, realistic, and scientifically balanced" approach to uncertainty.

More generally, agencies in general—and FERC in this particular instance—should remember that uncertainty is *not* a reason to abandon the social cost of greenhouse gas methodologies; quite the contrary uncertainty supports higher estimates of the social cost of greenhouse gases, because most uncertainties regarding climate change entail tipping points, catastrophic risks, and unknown unknowns about the damages of climate change. Because the key uncertainties of climate change include the risk of irreversible catastrophes, applying an options value framework to the regulatory context strengthens the case for ambitious regulatory action to reduce greenhouse gas emissions. There are numerous well-established, rigorous analytical tools available to help agencies characterize and quantitatively assess uncertainty, such as Monte Carlo simulations, and the IWG's social cost of greenhouse gas protocol incorporates those tools. For more details, please see the attached technical appendix on uncertainty.

Sincerely,

CO5-1 (cont'd)

Denise Grab, Western Regional Director, Institute for Policy Integrity, NYU School of Law*

Anne Hedges, Deputy Director, Montana Environmental Information Center

Peter H. Howard, Ph.D., Economic Director, Institute for Policy Integrity, NYU School of Law*

Iliana Paul, Policy Associate, Institute for Policy Integrity, NYU School of Law*

Andres Restrepo, Staff Attorney, Sierra Club

Richard L. Revesz, Director, Institute for Policy Integrity, NYU School of Law*

Jason A. Schwartz, Legal Director, Institute for Policy Integrity, NYU School of Law*

For any questions regarding these comments, please contact jason.schwartz@nyu.edu.
* No part of this document purports to present New York University School of Law's views, if any.

Attached:
Technical Appendices on Uncertainty and Discounting

Joint Comments to FERC on Using the Social Cost of Greenhouse Gases to Weigh Climate Impacts of New Natural Gas Transportation Facilities in Environmental Analyses and in Reviews of Public Convenience and Necessity (Docket No. PL18-1-000) (submitted July 25, 2018)

27

Technical Appendix: Uncertainty

CO5-1 (cont'd)

Contrary to the arguments made by many opposed to strong federal climate action, uncertainty about the full effects of climate change *raises* the social cost of greenhouse gases and warrants *more* stringent climate policy.[177] Integrated assessment models (IAMs) currently used to calculate the SCC show that the net effect of uncertainty about economic damage resulting from climate change, costs of mitigation, future economic development, and many other parameters raises the SCC compared to the case where models simply use our current best guesses of these parameters.[178] Even so, IAMs still underestimate the impact of uncertainty on the SCC by not accounting for a host of fundamental features of the climate problem: the irreversibility of climate change, society's aversion to risk and other social preferences, option value, and many catastrophic impacts.[179] Rather than being a reason not to take action, uncertainty increases the SCC and should lead to more stringent policy to address climate change.[180]

Types of Uncertainty in the IAMs

IAMs incorporate two types of uncertainty: parametric uncertainty and stochastic uncertainty. Parametric uncertainty covers uncertainty in model design and inputs, including the selected parameters, correct functional forms, appropriate probability distribution functions, and model structure. With learning, these uncertainties should decline over time as more information becomes available.[181] Stochastic uncertainty is persistent randomness in the economic-climate system, including various environmental phenomena such as volcanic eruptions and sun spots.[182] Uncertainties are present in each component of the IAMs: socio-economic scenarios, the simple climate model, the damage and abatement cost functions, and the social welfare function (including the discount rate).[183]

---

[177] Peterson (2006) states "Most modeling results show (as can be expected) that there is optimally more emission abatement if uncertainties in parameters or the possibility of catastrophic events are considered." Peterson, S. (2006). Uncertainty and economic analysis of climate change: A survey of approaches and findings. *Environmental Modeling & Assessment*, *11*(1), 1-17.

[178] Tol, R. S. (1999). Safe policies in an uncertain climate: an application of FUND. *Global Environmental Change*, *9*(3), 221-232; Peterson, S. (2006). Uncertainty and economic analysis of climate change: A survey of approaches and findings. *Environmental Modeling & Assessment*, *11*(1), 1-17; IWG, 2016 TSD, *supra*.

[179] Pindyck, R. S. (2007). Uncertainty in environmental economics. *Review of environmental economics and policy*, *1*(1), 45-65; Golub, A., Narita, D., & Schmidt, M. G. (2014). Uncertainty in integrated assessment models of climate change: Alternative analytical approaches. *Environmental Modeling & Assessment*, *19*(2), 99-109; Lemoine, D., & Rudik, I. (2017). Managing Climate Change Under Uncertainty: Recursive Integrated Assessment at an Inflection Point. *Annual Review of Resource Economics* 9:18.1-18.26.

[180] *See* cites *supra* note 179.

[181] Learning comes in multiple forms: passive learning of anticipated information that arrives exogenous to the emission policy (such as academic research), active learning of information that directly stems from the choice of the GHG emission level (via the policy process), and learning of unanticipated information (Kann and Weyant, 2000; Lemoine and Rudik, 2017).

[182] Kann, A., & Weyant, J. P. (2000). Approaches for performing uncertainty analysis in large-scale energy/economic policy models. *Environmental Modeling & Assessment*, *5*(1), 29-46; Peterson (2006), *supra* note 177; Golub et al. *supra* note 179.

A potential third type of uncertainty arises due to ethical or value judgements: normative uncertainty. Peterson (2006) *supra* note 177; Heal, G., & Millner, A. (2014). Reflections: Uncertainty and decision making in climate change economics. *Review of Environmental Economics and Policy*, *8*(1), 120-137. For example, there is some normative debate over the appropriate consumption discount rate to apply in climate economics, though widespread consensus exists that using the social opportunity cost of capital is inappropriate (see earlier discussion). Preference uncertainty should be modeled as a declining discount rate over time (see earlier discussion), not using uncertain parameters. Kann & Weyant, *supra* note 182.

[183] Peterson (2006), *supra* note 177; Pindyck (2007), *supra* note 179; Heal & Millner, *supra* note 182.

When modeling climate change uncertainty, scientists and economists have long emphasized the importance of accounting for the potential of catastrophic climate change.[184] Catastrophic outcomes combine several overlapping concepts including unlucky states of the world (i.e., bad draws), deep uncertainty, and climate tipping points and elements.[185] Traditionally, IAM developers address uncertainty by specifying probability distributions over various climate and economic parameters. This type of uncertainty implies the possibility of an especially bad draw if multiple uncertain parameters turn out to be lower than we expect, causing actualclimate damages to greatly exceed expected damages.

CO5-1 (cont'd)

Our understanding of the climate and economic systems is also affected by so-called "deep uncertainty," which can be thought of as uncertainty over the true probability distributions for specific climate and economic parameters.[186] The mean and variance of many uncertain climate phenomena are unknown due to lack of data, resulting in "fat-tailed distributions"—i.e., the tail of the distributions decline to zero slower than the normal distribution. Fat-tailed distributions result when the best guess of the distribution is derived under learning.[187] Given the general opinion that bad surprises are likely to outweigh good surprises in the case of climate change,[188] modelers capture deep uncertainty by selecting probability distributions with a fat upper tail which reflects the greater likelihood of extreme events.[189] The possibility of fat tails increases the likelihood of a "very" bad draw with high economic costs, and can result in a very high (and potentially infinite) expected cost of climate change (a phenomenon known as the dismal theory).[190]

Climate tipping elements are environmental thresholds where a small change in climate forcing can lead to large, non-linear shifts in the future state of the climate (over short and long periods of time) through positive feedback (i.e., snowball) effects.[191] Tipping points refer to economically relevant thresholds after which change occurs rapidly (i.e., Gladwellian tipping points), such that opportunities for adaptation and intervention are limited.[192] Tipping point examples include the reorganization of the Atlantic meridional overturning circulation (AMOC) and a shift to a more persistent El Niño regime in the

[184] Nordhaus, W. D. (2008). A question of balance: Weighing the options on global warming policies. Yale University Press; Kopp, R. E., Shwom, R. L., Wagner, G., & Yuan, J. (2016). Tipping elements and climate–economic shocks: Pathways toward integrated assessment. *Earth's Future*, *4*(8), 346-372.

[185] Kopp et al. (2016), *supra* note 184.

[186] *Id.*

[187] Nordhaus, W. D. (2009). An Analysis of the Dismal Theorem (No. 1686). Cowles Foundation Discussion Paper; Weitzman, M. L. (2011). Fat-tailed uncertainty in the economics of catastrophic climate change. Review of Environmental Economics and Policy, 5(2), 275-292; Pindyck, R. S. (2011). Fat tails, thin tails, and climate change policy. *Review of Environmental Economics and Policy*, *5*(2), 258-274.

[188] Mastrandrea, M. D. (2009). Calculating the benefits of climate policy: examining the assumptions of integrated assessment models. Pew Center on Global Climate Change Working Paper; Tol, R. S. (2012). On the uncertainty about the total economic impact of climate change. *Environmental and Resource Economics*, *53*(1), 97-116.

[189] Weitzman (2011), *supra* note 187, makes clear that "deep structural uncertainty about the unknown unknowns of what might go very wrong is coupled with essentially unlimited downside liability on possible planetary damages. This is a recipe for producing what are called 'fat tails' in the extreme of critical probability distributions."

[190] Weitzman, M. L. (2009). On modeling and interpreting the economics of catastrophic climate change. The Review of Economics and Statistics, 91(1), 1-19; Nordhaus (2009), *supra* note 187; Weitzman (2011), *supra* note 187.

[191] Tipping elements are characterized by: (1) deep uncertainty, (2) absence from climate models, (3) larger resulting changes relative to the initial change crossing the relevant threshold, and (4) irreversibility. Kopp et al. (2016), *supra* note 184.

[192] *Id.*

CO5-1 (cont'd)

Pacific Ocean.[193] Social tipping points—including climate-induced migration and conflict—also exist. These various tipping points interact, such that triggering one tipping point may affect the probabilities of triggering other tipping points.[194] There is some overlap between tipping point events and fat tails in that the probability distributions for how likely, how quick, and how damaging tipping points will be are unknown.[195] Accounting fully for these most pressing, and potentially most dramatic, uncertainties in the climate-economic system matter because humans are risk averse and tipping points—like many other aspects of climate change—are, by definition, irreversible

How IAMs and the IWG Account for Uncertainty

Currently, IAMs (including all of those used by the IWG) capture uncertainty in two ways: deterministically and through uncertainty propagation. For the deterministic method, the modeler assumes away uncertainty (and thus the possibility of bad draws and fat tails) by setting parameters equal to their most likely (median) value. Using these values, the modeler calculates the median SCC value. Typically, the modeler conducts sensitivity analysis over key parameters—one at a time or jointly—to determine the robustness of the modeling results. This is the approach employed by Nordhaus in the preferred specification of the DICE model[196] used by the IWG.

Uncertainty propagation is most commonly carried out using Monte Carlo simulation. In these simulations, the modeler randomly draws parameter values from each of the model's probability distributions, calculates the SCC for the draw, and then repeats this exercise thousands of times to calculate a mean social cost of carbon.[197] Tol, Anthoff, and Hope employ this technique in FUND and PAGE—as did the IWG (2010, 2013, and 2016)—by specifying probability distributions for the climate and economic parameters in the models. These models are especially helpful for assessing the net effect of different parametric and stochastic uncertainties. For instance, both the costs of mitigation and the damage from climate change are uncertain. Higher costs would warrant less stringent climate policies, while higher damages lead to more stringent policy, so theoretically, the effect of these two factors on climate policy could be ambiguous. Uncertainty propagation in an IAM calibrated to empirically motivated distributions, however, shows that climate damage uncertainty outweighs the effect of cost uncertainty, leading to a stricter policy when uncertainty is taken into account than when it is ignored.[198]

[193] *Id.;* Kriegler, E., Hall, J. W., Held, H., Dawson, R., & Schellnhuber, H. J. (2009). Imprecise probability assessment of tipping points in the climate system. *Proceedings of the national Academy of Sciences*, *106*(13), 5041-5046; Diaz, D., & Keller, K. (2016). A potential disintegration of the West Antarctic Ice Sheet: Implications for economic analyses of climate policy. *The American Economic Review*, *106*(5), 607-611. See Table 1 of Kopp et al. (2016) *supra* note 184, for a full list of known tipping elements and points.

[194] Kriegler et al. (2009), *supra* note 193; Cai, Y., Lenton, T. M., & Lontzek, T. S. (2016). Risk of multiple interacting tipping points should encourage rapid CO2 emission reduction; Kopp et al. (2016) *supra* note 184.

[195] Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* 5 (Cost of Carbon Project Report, 2014), http://costofcarbon.org/; Kopp et al. (2016) *supra* note 184.

[196] Nordhaus, W. & Sztorc, P. (2013). DICE 2013: Introduction & User's Manual. Retrieved from Yale University, Department of Economics website: http://www.econ.yale.edu/~nordhaus/homepage/documents/Dicemanualfull

[197] In alternative calculation method, the modeler "performs optimization of polices for a large number of possible parameter combinations individually and estimates their probability weighted sum." Golub et al. *supra* note 179. In more recent DICE-2016, Nordhaus conducts a three parameter analysis using this method to determine a SCC confidence interval. Given that PAGE and FUND model hundred(s) of uncertainty parameters, this methodology appears limited in the number of uncertain variables that can be easily specified.

[198] Tol (1999), *supra* note 178, in characterizing the FUND model, states, "Uncertainties about climate change impacts are more serious than uncertainties about emission reduction costs, so that welfare-maximizing policies are stricter under uncertainty than under certainty."

This can be seen in the resulting right-skewed distribution of the SCC (see Figure 1 in IWG (2016)) where the mean (Monte Carlo) SCC value clearly exceeds the median (deterministic) SCC value.

The IWG was rigorous in addressing uncertainty. First, it conducted Monte Carlo simulations over the above IAMs specifying different possible outcomes for climate sensitivity (represented by a right skewed, fat tailed distribution to capture the potential of higher than expected warming). It also used scenario analysis: five different emissions growth scenarios and three discount rates. Second, the IWG (2016) reported the various moments and percentiles—including the 95th percentile—of the resulting SCC estimates. Third, the IWG put in place an updating process, e.g., the 2013 and 2016 revisions, which updates the models as new information becomes available.[199] As such, the IWG used the various tools that economists have developed over time to address the uncertainty inherent in estimating the economic cost of pollution: reporting various measures of uncertainty, using Monte Carlo simulations, and updating estimates as evolving research advances our knowledge of climate change. Even so, the IWG underestimate the SCC by failing to capture key features of the climate problem.

CO5-1 (cont'd)

Current IAMs Underestimate the SCC by Failing to Sufficiently Model Uncertainty

Given the current treatment of uncertainty by the IWG (2016) and the three IAMs that they employ, the IWG (2016) estimates represent an underestimate of the SCC. DICE clearly underestimates the true value of the SCC by effectively eliminating the possibility of bad draws and fat tails through a deterministic model that relies on the median SCC value. Even with their calculation of the mean SCC, the FUND and PAGE also underestimate the metric's true value by ignoring key features of the climate-economic problem. Properly addressing the limitations of these models' treatment of uncertainty would further increase the SCC.

First, current IAMs insufficiently model catastrophic impacts. DICE fails to model both the possibility of bad draws and fat tails by applying the deterministic approach. Alternatively, FUND and PAGE ignore deep uncertainty by relying predominately on the thin-tailed triangular and gamma distributions.[200] The IWG (2010) only partially addresses this oversight by replacing the ECS parameter in DICE, FUND, and PAGE with a fat-tailed, right-skewed distribution calibrated to the IPCC's assumptions (2007), even though many other economic and climate phenomenon in IAMs are likely characterized by fat tails, including climate damages from high temperature levels, positive climate feedback effects, and tipping points.[201] Recent work in stochastic dynamic programming tends to better integrate fat tails – particularly with respect to tipping points (see below) – and address additional aversion to this type of

[199] IWG (2010).

[200] Howard (2014), *supra* note 195. While both FUND and PAGE employ thin tailed distributions, the resulting distribution of the SCC is not always thin-tailed. In PAGE09, the ECS parameter is endogenous, such that the distribution of the ECS has a long tail following the IPCC (2007). *See* Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., & Miller, H. L. (2007). Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change. *Cambridge, UK and New York: Cambridge University Press, 996p*. Similarly, while Anthoff and Tol do not explicitly utilize fat-tail distributions, the distribution of net present welfare from a Monte Carlos simulation is fat tailed. Anthoff, D., & Tol, R. S. (2014). The Climate Framework for Uncertainty, Negotiation and Distribution (FUND): Technical description, Version 3.8. Available at www.fund-model.org. Explicitly modeling parameter distributions as fat tailed may further increase the SCC.

[201] Weitzman (2011), *supra* note 187; Kopp et al. (2016) *supra* note 184.

31

CO5-1 (cont'd)

uncertainty (also known as ambiguity aversion); doing so can further increase the SCC under uncertainty.[202]

In contrast to their approach to fat tails, the IAMs used by the IWG (2010; 2013; 2016) sometimes address climate tipping points, though they do not apply state-of-the-art methods for doing so. In early versions of DICE (DICE-2010 and earlier), Nordhaus implicitly attributes larger portions of the SCC to tipping points by including certainty equivalent damages of catastrophic events - representing two-thirds to three-quarter of damages in DICE – calibrated to an earlier Nordhaus (1994) survey of experts.[203] In PAGE09, Hope also explicitly models climate tipping points as a singular, discrete event (of a 5% to 25% loss in GDP) that has a probability (which grows as temperature increases) of occurring in each time period.[204] Though not in the preferred versions of the IAMs employed by the IWG, some research also integrates specific tipping points into these IAMs finding even higher SCC estimates.[205] Despite the obvious methodological basis for addressing tipping points, the latest versions of DICE[206] and FUND exclude tipping points in their preferred specifications. Research shows that if these models were to correctly account for the full range of climate impacts—including tipping points—the resulting SCC estimates would increase.[207]

The IWG approach also fails to include a risk premium—that is, the amount of money society would require in order to accept the uncertainty (i.e., variance) over the magnitude of warming and the resulting damages from climate change relative to mean damages (IWG, 2010; IWG, 2015)). The mean of a distribution, which is a measure of a distribution's central tendency, represents only one descriptor or

[202] Lemoine, D., & Traeger, C. P. (2016a). Ambiguous tipping points. *Journal of Economic Behavior & Organization*, *132*, 5-18; Lemoine & Rudik (2017), *supra* note 179. IAM modelers currently assume that society is equally averse to known unknown and known unknowns. Lemoine & Traeger, *id*.

[203] Nordhaus, W. D., & Boyer, J. (2000). Warning the World: Economic Models of Global Warming. MIT Press (MA); Nordhaus, W. D. (2008). A question of balance: Weighing the options on global warming policies. Yale University Press; Howard (2014), *supra* note 195; Kopp et al. (2016) *supra* note 184.

[204] Hope (2006) also calibrated a discontinuous damage function in PAGE-99 used by IWG (2010). Howard (2014), *supra* note 195.

[205] Kopp et al. (2016) *supra* note 184.

[206] For DICE-2013 and DICE-2016, Nordhaus calibrates the DICE damage function using a meta-analysis based on estimates that mostly exclude tipping point damages. Howard, P. H., & Sterner, T. (2016). Few and Not So Far Between: A Meta-analysis of Climate Damage Estimates. *Environmental and Resource Economics*, 1-29.

[207] Using FUND, Link and Tol (2010) find that a collapse of the AMOC would decrease GDP (and thus increase the SCC) by a small amount. Earlier modeling of this collapse in DICE find a more significance increase. Keller, K., Tan, K., Morel, F. M., & Bradford, D. F. (2000). Preserving the ocean circulation: implications for climate policy. *Climatic Change*, *47*, 17-43; Mastrandrea, M. D., & Schneider, S. H. (2001). Integrated assessment of abrupt climatic changes. *Climate Policy*, *1*(4), 433-449; Keller, K., Bolker, B. M., & Bradford, D. F. (2004). Uncertain climate thresholds and optimal economic growth. *Journal of Environmental Economics and management*, *48*(1), 723-741. With respect to thawing of the permafrost, Hope and Schaefer (2016), Economic impacts of carbon dioxide and methane released from thawing permafrost. *Nature Climate Change*, *6*(1), 56-59, and Gonzalez-Eguino and Neumann (2016), González-Eguino, M., & Neumann, M. B. (2016). Significant implications of permafrost thawing for climate change control. *Climatic Change*, *136*(2), 381-388, find increases in damages (and thus an increase in the SCC) when integrating this tipping element into the PAGE09 and DICE-2013R, respectively. Looking at the collapse of the West Antarctic Ice sheet, Nicholls et al. (2008) find a potential for significant increases in costs (and thus the SCC) in FUND. Nicholls, R. J., Tol, R. S., & Vafeidis, A. T. (2008). Global estimates of the impact of a collapse of the West Antarctic ice sheet: an application of FUND. *Climatic Change*, *91*(1), 171-191. Ceronsky et al. (2011) model three tipping points (collapse of the Atlantic Ocean Meridional Overturning Circulation, large scale dissociation of oceanic methane hydrates; and a high equilibrium climate sensitivity parameter), and finds a large increase in the SCC in some cases. Ceronsky, M., Anthoff, D., Hepburn, C., & Tol, R. S. (2011). *Checking the price tag on catastrophe: The social cost of carbon under non-linear climate response* (No. 392). ESRI working paper.

CO5-1 (cont'd)

"moment" of a distribution's shape. Each IAM parameter and the resulting SCC distributions have differing levels of variance (i.e., spread around the mean), skewness (i.e., a measure of asymmetry), and kurtosis (which, like skewness, is another descriptor of a distribution's tail) as well as means.[208] It is generally understood that people are risk averse in that they prefer input parameter distributions and (the resulting) SCC distributions with lower variances, holding the mean constant.[209] While the IWG assumes a risk-neutral central planner by using a constant discount rate (setting the risk premium to zero), this assumption does not correspond with empirical evidence,[210] current IAM assumptions,[211] the NAS (2017) recommendations, nor with the IWG's own discussion (2010) of the possible values of the elasticity of the marginal utility of consumption. Evidence from behavioral experiments indicate that people and society are also averse to other attributes of parameter distributions – specifically to the thickness of the tails of distributions – leading to an additional ambiguity premium (Heal and Millner, 2014).[212] Designing IAMs to properly account for the risk and ambiguity premiums from uncertain climate damages would increase the resulting SCC values they generate.

Even under the IWG's current assumption of risk neutrality, the mean SCC from uncertainty propagation excludes the (real) option value of preventing marginal CO_2 emissions.[213] Option value reflects the value of future flexibility due to uncertainty and irreversibility; in this case, the irreversibility of CO2 emissions due to their long life in the atmosphere.[214] If society exercises the option of emitting an additional unit

[208] Golub, A., & Brody, M. (2017). Uncertainty, climate change, and irreversible environmental effects: application of real options to environmental benefit-cost analysis. *Journal of Environmental Studies and Sciences*, 1-8; see Figure 1 in IWG (2016).

[209] In other words, society prefers a narrow distribution of climate damages around mean level of damages X to a wider distribution of damages also centered on the same mean of X because they avoid the potential for very high damages even at the cost of eliminating the chance of very low damages.

[210] IWG, 2010, at fn 22; Cai et al., 2016, *supra* note 194, at 521.

[211] The developers of each of the three IAMs used by the IWG (2010; 2013; 2016) assume a risk aversion society. Nordhaus and Sztorc, 2013, *supra;* Anthoff, D., & Tol, R. S. (2010). The Climate Framework for Uncertainty, Negotiation and Distribution (FUND): Technical description, Version 3.5. Available at www.fund-model.org; Anthoff, D., & Tol, R. S. (2014). The Climate Framework for Uncertainty, Negotiation and Distribution (FUND): Technical description, Version 3.8. Available at www.fund-model.org; Hope, C. (2013). Critical issues for the calculation of the social cost of CO2: why the estimates from PAGE09 are higher than those from PAGE2002. *Climatic Change*, *117*(3), 531-543.

[212] According to Heal and Millner (2014), *supra*, there is an ongoing debate of whether ambiguity aversion is rational or a behavioral mistake. Given the strong possibility that this debate is unlikely to be resolved, the authors recommend exploring both assumptions.

[213] Arrow, K. J., & Fisher, A. C. (1974). Environmental preservation, uncertainty, and irreversibility. *The Quarterly Journal of Economics*, 312-319; Dixit, A.K., Pindyck, R.S., 1994. *Investment Under Uncertainty*. Princeton University Press, Princeton, NJ; Traeger, C. P. (2014). On option values in environmental and resource economics. *Resource and Energy Economics*, *37*, 242-252.

In the discrete emission case, there are two overlapping types of option value: real option value and quasi-option value. Real option value is the full value of future flexibility of maintaining the option to mitigate, and mathematically equals the maximal value that can be derived from the option to [emit] now or later (incorporating learning) less the maximal value that can be derived from the possibility to [emit] now or never. Traeger, C. P. (2014). On option values in environmental and resource economics. *Resource and Energy Economics*, *37*, 242-252, equation 5. Quasi-option value is the value of future learning conditional on delaying the emission decision, which mathematically equals the value of mitigation to the decision maker who anticipates learning less the value of mitigation to the decision maker who anticipates only the ability to delay his/her decision, and not learning. *Id.* The two values are related, such that real option value can be decomposed into:

$$\mathrm{DPOV} = \mathbf{Max}\{QOV + SOV - \mathbf{Max}\{NPV, 0\}, 0\} = \mathbf{Max}\{QOV + SOV - \mathrm{SCC}, 0\}$$

where DPOV is the real option value, QOV is quasi-option value, SOV is simple option value (the value of the option to emit in the future condition on mitigating now), and NPV is the expected net present value of emitting the additional unit or the mean SCC in our case. *Id.*

[214] Even if society drastically reduced CO2 emissions, CO2 concentrations would continue to rise in the near future and many impacts would occur regardless due to lags in the climate system. Pindyck, R. S. (2007). Uncertainty in environmental economics. *Review of environmental economics and policy*, *1*(1), 45-65.

33

CO5-1 (cont'd)

of CO2 emissions today, "we will lose future flexibility that the [mitigation] option gave" leading to possible "regret and...a desire to 'undo'" the additional emission because it "constrains future behavior."[215] Given that the SCC is calculated on the Business as Usual (BAU) emission pathway, option value will undoubtedly be positive for an incremental emission because society will regret this emission in most possible futures.

Though sometimes the social cost of carbon and a carbon tax are thought of as interchangeable ways to value climate damages, agencies should be careful to distinguish two categories of the literature. The first is the economic literature that calculates the optimal carbon tax in a scenario where the world has shifted to an optimal emissions pathway. The second is literature that assesses the social cost of carbon on the business-as-usual (BAU) emissions pathway; the world is currently on the BAU pathway, since optimal climate policies have not been implemented. There are currently no numerical estimates of the risk premium and option value associated with an incremental emission on the BAU emissions path. Although there are stochastic dynamic optimization models that implicitly account for these two values, they analyze *optimal,* sequential decision making under climate uncertainty.[216] By nature of being optimization models (instead of policy models), these complex models focus on calculating the optimal tax and not the social cost of carbon, which differ in that the former is the present value of marginal damages on the optimal emissions path rather than on the BAU emissions path.[217] While society faces the irreversibility of emissions on the BAU emissions path when abatement is essentially near zero (i.e., far below the optimal level even in the deterministic problem),[218] the stochastic dynamic optimization model must also account for a potential counteracting abatement cost irreversibility – the sunk costs of investing in abatement technology if we learn that climate change is less severe than expected – by the nature of being on the optimal emissions path that balances the cost of emissions and abatement. In the optimal case, uncertainty and irreversibility of abatement *can theoretically* lead to a lower optimal emissions tax, unlike the social cost of carbon. The difference in the implication for the optimal tax and the SCC means that the stochastic dynamic modeling results are less applicable to the SCC.

What can we learn from new literature on stochastic dynamic programming models?

Bearing in mind the limitations of stochastic dynamic modeling, some new research provides valuable insights that are relevant to calculation of the social cost of greenhouse gases. The new and growing stochastic dynamic optimization literature implies that the IWG's SCC estimates are downward biased. The literature is made up of three models – real option, finite horizon, and infinite horizon models – of which the infinite time horizon (i.e., stochastic dynamic programming (SDP)) models are the most

[215] Pindyck (2007).

[216] Kann & Weyant, *supra;* Pindyck (2007), *supra;* Golub et al. (2014), *supra*.

[217] Nordhaus (2014) makes this difference clear when he clarifies that "With an optimized climate policy...the SCC will equal the carbon price...In the more realistic case where climate policy is not optimized, it is conventional to measure the SCC as the marginal damage of emissions along the actual path. There is some inconsistency in the literature on the definition of the path along which the SCC should be calculated. This paper will generally define the SCC as the marginal damages along the baseline path of emissions and output and not along the optimized emissions path." Nordhaus, W. (2014). Estimates of the social cost of carbon: concepts and results from the DICE-2013R model and alternative approaches. *Journal of the Association of Environmental and Resource Economists*, *1*(1/2), 273-312.

[218] On the BAU path, emissions far exceed their optimal level even without considering uncertainty. As a consequence, society is likely to regret an additional emission of CO2 in most future states of the world. Alternatively, society is unlikely to regret current abatement levels unless the extremely unlikely scenarios that there is little to no warming and/or damages from climate change.

CO5-1
(cont'd)

comprehensive for analyzing the impact of uncertainty on optimal sequential abatement policies.[219] Recent computational advancements in SDP are helping overcome the need for strong simplifying assumptions in this literature for purpose of tractability. Traditionally, these simplifications led to unrealistically fast rates of learning – leading to incorrect outcomes – and difficulty in comparing results across papers (due to differing uncertain parameters, models of learning, and model types). Even so, newer methods still only allow for a handful of uncertain parameters compared to the hundreds of uncertain parameters in FUND and PAGE. Despite these limitations, the literature supports the above finding that the SCC, if anything, increases under uncertainty.[220]

First, uncertainty increases the optimal emissions tax under realistic parameter values and modeling scenarios. While the impact of uncertainty on the optimal emissions tax (relative to the deterministic problem) depends on the uncertain parameters considered, the type of learning, and the model type (real option, finite horizon, and infinite horizon), the optimal tax clearly increases when tipping points or black swan events are included in stochastic optimization problems.[221] For SDP models, uncertainty tends to strengthen the optimal emissions path relative to the determinist case even without tipping points,[222] and these results are strengthened under realistic preference assumptions.[223] Given that there is no counter-balancing tipping abatement cost,[224] the complete modeling of climate uncertainty – which fully accounts for tipping points and fat tails – increases the optimal tax. Uncertainty leads to a stricter optimal emissions policy even if with irreversible mitigation costs, highlighting that the SCC would also increase when factoring in risk aversion and irreversibility given that abatement costs are very low on the BAU emissions path.

Second, given the importance of catastrophic impacts under uncertainty (as shown in the previous paragraph), the full and accurate modeling of tipping points and unknown knowns is critical when modeling climate change. The most sophisticated climate-economic models of tipping points – which include the possibility of multiple correlated tipping points in stochastic dynamic IAMs – find an increase in the optimal tax by 100%[225] to 800%[226] relative to the deterministic case without them. More realistic modeling of tipping points will also increase the SCC.

---

[219] Kann and Weyant, 2000, *supra;* Pindyck, 2007, *supra;* Golub et al., 2014, *supra*.

[220] Kann and Weyant, 2000, *supra;* Pindyck, 2007, *supra;* Golub et al., 2014, *supra;* Lemoine and Rudik, 2017, supra. Comparing the optimal tax to the mean SCC is made further difficult by the frequent use of DICE as the base from which most stochastic dynamic optimization models are built. As a consequence, deterministic model runs are frequently the base of comparison for these models (Lemoine and Rudik, 2017).

[221] The real options literature tends to find an increase in the optimal emissions path under uncertainty relative to the deterministic case (Pindyck, 2007), though the opposite is true when modelers account for the possibility of large damages (i.e., tipping point or black swan events) even with a risk-neutral society (Pindyck, 2007; Golub et al., 2014). Solving finite horizon models employing non-recursive methods, modelers find that the results differ depending on the model of learning – the research demonstrates stricter emission paths under uncertainty without learning (with emission reductions up to 30% in some cases) and the impact under passive learning has a relatively small impact due the presence of sunken mitigation investment costs - except when tipping thresholds are included (Golub et al., 2014).

[222] Using SDP, modelers find that uncertainty over the equilibrium climate sensitivity parameter generally increases the optimal tax by a small amount, though the magnitude of this impact is unclear (Golub et al., 2014; Lemoine and Rudik, 2017). Similarly, non-catastrophic damages can have opposing effects dependent on the parameters changed, though emissions appear to decline overall when you consider their uncertainty jointly.

[223] Pindyck, 2007; Golub et al., 2017; Lemoine and Rudik, 2017

[224] Pindyck, 2007

[225] Lemoine, D., & Traeger, C. P. (2016b). Economics of tipping the climate dominoes. *Nature Climate Change*.

[226] Cai et al., 2016

35

CO5-1 (cont'd)

Finally, improved modeling of preferences will amplify the impact of uncertainty on the SCC. Adopting Epstein-Zin preferences that disentangle risk aversion and time preferences can significantly increase the SCC under uncertainty.[227] Recent research has shown that accurate estimation of decisions under uncertainty crucially depends on distinguishing between risk and time preferences.[228] By conflating risk and time preferences, current models substantially understate the degree of risk aversion exhibited by most individuals, artificially lowering the SCC. Similarly, adopting ambiguity aversion increase the SCC, but to a much lesser extent than risk aversion.[229] Finally, allowing for the price of non-market goods to increase with their relative scarcity can amplify the positive effect that even small tipping points have on the SCC if the tipping point impacts non-market services.[230] Including more realistic preference assumptions in IAMs would further increase the SCC under uncertainty.

Introducing stochastic dynamic modeling (which captures option value and risk premiums), updating the representation of tipping points, and including more realistic preference structures in traditional IAMs will – as in the optimal tax – further increase the SCC under uncertainty

Conclusion: Uncertainty Raises the Social Cost of Greenhouse Gases

Overall, the message is clear: climate uncertainty is *never* a rationale for ignoring the SCC or shortening the time horizon of IAMs. Instead, our best estimates suggest that increased variability implies a higher SCC and a need for more stringent emission regulations.[231] Current omission of key features of the climate problem under uncertainty (the risk and climate premiums, option value, and fat tailed probability distributions) and incomplete modeling of tipping points imply that the SCC will further increase with the improved modeling of uncertainty in IAMs.

[227] Cai et al., 2016; Lemoine and Rudik, 2017. The standard utility function adopted in IAMs with constant relative risk version implies that the elasticity of substitution equals the inversion of relative risk aversion. As a consequence, the society's preferences for the intra-generational distribution of consumption, the intergenerational distribution of consumption, and risk aversion hold a fixed relationship. For purposes of stochastic dynamic programming, this is problematic because this assumption conflates intertemporal consumption smoothing and risk aversion. Botzen, W. W., & van den Bergh, J. C. (2014). Specifications of social welfare in economic studies of climate policy: overview of criteria and related policy insights. *Environmental and Resource Economics*, *58*(1), 1-33. By adopting the Epstein-Zinn utility function which separates these two parameters, modelers can calibrate them according to empirical evidence. For example, Cai et al. (2016) replace the DICE risk aversion of 1.45 and elasticity parameter of 1/1.45 with values of 3.066 and 1.5, respectively.

[228] James Andreoni & Charles Sprenger, *Risk Preferences Are Not Time Preferences*, 102 AM. ECON. REV. 3357–3376 (2012).

[229] Lemoine, D., & Traeger, C. P. (2016b). Economics of tipping the climate dominoes. *Nature Climate Change.*; Lemoine and Rudik, 2017

[230] Typically, IAMs assume constant relative prices of consumption goods. Gerlagh, R., and B.C.C. Van der Zwaan. 2002. "Long-term substitutability between environmental and man-made goods." *Journal of Environmental Economics and Management* 44(2):329-345; Sterner, T., and U.M. Persson. 2008. "An Even Sterner Review: Introducing Relative Prices into the Discounting Debate." *Review of Environmental Economics and Policy* 2(1):61-76. By replacing the standard isoelastic utility function in IAMs with a nested CES utility function following Sterner and Persson (2008), Cai et al. (2015) find that even a relatively small tipping point (i.e., a 5% loss) can substantially increase the SCC in the stochastic dynamic setting. Cai, Y., Judd, K. L., Lenton, T. M., Lontzek, T. S., & Narita, D. (2015). Environmental tipping points significantly affect the cost– benefit assessment of climate policies. *Proceedings of the National Academy of Sciences*, *112*(15), 4606-4611.

[231] Golub et al. (2014) states "The most important general policy implication from the literature is that despite a wide variety of analytical approaches addressing different types of climate change uncertainty, none of those studies supports the argument that no action against climate change should be taken until uncertainty is resolved. On the contrary, uncertainty despite its resolution in the future is often found to favor a stricter policy."

Technical Appendix: Discounting

The Underlying IAMs All Use a Consumption Discount Rate

CO5-1 (cont'd)

Employing a consumption discount rate would also ensure that the U.S. government is consistent with the assumptions employed by the underlying IAM models: DICE, FUND, and PAGE. Each of these IAMs employs consumption discount rates calibrated using the standard Ramsey formula (Newell, 2017). In DICE-2010, the elasticity of the pure rate of time preference is 1.5 and an elasticity of the marginal utility of consumption (η) of 2.0. Together with its assumed per capita consumption growth path, the average discount rate over the next three hundred years is 2.4%.[232] However, more recent versions of DICE (DICE-2013R and DICE-2016) update η to 1.45; this implies an increase of the average discount rate over the timespan of the models to between 3.1% and 3.2% depending on the consumption growth path.[233] In FUND 3.8 and (the mode values in) PAGE09, both model parameters are equal to 1.0. Based on the assumed growth rate of the U.S. economy (without climate damages), the average U.S. discount rate in FUND 3.8 is 2.0% over the timespan of the model (without considering climate damages). Unlike FUND 3.8, PAGE09 specifies triangular distributions for both parameters with a pure rate of time preference of between 0.1 and 2 with a mean of 1.03 and an elasticity of the marginal utility of consumption of between 0.5 and 2 with a mean 1.17. Using the PAGE09's mode values (without accounting for climate damages), the average discount rate over the timespan of the models is approximately 3.3% with a range of 1.2% to 6.5%. Rounding up the annual growth rate over the last 50 years to approximately 2%,[234] the range of best estimates of the SDR implied in the short-run by these three models is approximately 3% (PAGE09's mode estimate and FUND 3.8) to 4.4% (DICE-2016), though the PAGE09 model alone implies a range of 1.1% to 6.0% with a central estimate of 3%. The range of potential consumption discount rates in these IAMs is relatively consistent with IWG (2010; 2013; 2016) in the short-run, though the discount rates of the IAMs employed by the IWG decline over time (due to declining growth rates over time) implying a potential upward bias to the IWG consumption discount rates.

A Declining Discount Rate is Justified to Address Discount Rate Uncertainty

A strong consensus has developed in economics that the appropriate way to discount intergenerational benefits is through a declining discount rate (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014).[235] Not only are declining discount rate theoretically correct, they are actionable (i.e., doable given our current knowledge) and consistent with OMB's *Circular A-4*. Perhaps the best reason to adopt a declining discount rate is the simple fact that there is considerable uncertainty around which discount rate to use. The uncertainty in the rate points directly to the need to use a declining rate, as the impact of the uncertainty grows exponentially over time such that the

[232] Due to a slowing of global growth, DICE-2010 implies a declining discount rate schedule of 5.1% in 2015, 3.9% from 2015 to 2050; 2.9% from 2055 to 2100; 2.2% from 2105 to 2200, and 1.9% from 2205 to 2300. This would be a steeper decline if Nordhaus accounted for the positive and normative uncertainty underlying the SDR.

[233] Due to a slowing of global growth, DICE-2016 implies a declining discount rate schedule of 5.1% in 2015, 4.7% from 2015 to 2050; 4.1% from 2055 to 2100; 3.1% from 2105 to 2200, and 2.5% from 2205 to 2300.

[234] According to the World Bank, the average global and United States per capita growth rates were 1.7% and 1.9%, respectively.

[235] Arrow et al. (2014) at 160-161 states that "We have argued that theory provides compelling arguments for using a declining certainty-equivalent discount rate," and concludes the paper by stating "Establishing a procedure for estimating a [declining discount rate] for project analysis would be an improvement over the OMB's current practice of recommending fixed discount rates that are rarely updated."

CO5-1 (cont'd)

correct discount rate is not an arithmetic average of possible discount rates.[236] Uncertainty about future discount rates could stem from a number of sources particularly salient in the context of climate change, including uncertainty about future economic growth, consumption, the consumption rate of interest, and preferences. Additionally, economic theory shows that if there is debate or disagreement over which discount rate to use, this should lead to the use of a declining discount rate (Weitzman, 2001; Heal & Millner, 2014). Though, the range of potential discount rates is limited by theory to potential consumption discount rates (see earlier discussion), which is certainly less than 7%.

There is a consensus that declining discount rates are appropriate for intergenerational discounting

Since the IWG undertook its initial analysis and before the most recent estimates of the SCC, a large and growing majority of leading climate economists consensus (Arrow et al., 2013) has come out in favor of using a declining discount rate for climate damages to reflect long-term uncertainty in interest rates. This consensus view is held whether economists favor descriptive (i.e., market) or prescriptive (i.e., normative) approaches to discounting (Freeman et al., 2015). Several key papers (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014) outline this consensus and present the arguments that strongly support the use of declining discount rates for long-term benefit-cost analysis in both the normative and positive contexts. Finally, in a recent survey of experts on the economics of climate change, Howard and Sylvan (2015), found that experts support using a declining discount rate relative to a constant discount rate at a ratio of approximately 2 to 1.

Economists have recently highlighted two main motivations for using a declining discount rate, which we elaborate on in what follows. First, if the discount rate for a project is fixed but uncertain, then the certainty-equivalent discount rate will decline over time, meaning that benefits should be discounted using a declining rate.[237] Second, uncertainty about the growth rate of consumption or output also implies that a declining discount rate should be used, so long as shocks to consumption are positively correlated over time.[238] In addition to these two arguments, other motivations for declining discount rates have long been recognized. For instance, if the growth rate of consumption declines over time, the Ramsey rule[239] for discounting will lead to a declining discount rate.[240]

---

[236] Karp (2005) states that mathematical "intuition for this result is that as [time] increases, smaller values of r in the support of the distribution are relatively more important in determining the expectation of e–rt" where r is the constant discount rate." Or as Hepburn et al. (2003) puts it, "The intuition behind this idea is that scenarios with a higher discount rate are given less weight as time passes, precisely because their discount factor is falling more rapidly" over time.

[237] This argument was first developed in Weitzman (1998) and Weitzman (2001).

[238] *See, e.g.,* Gollier (2009).

[239] The Ramsey discount rate equation for the social discount rate is $r = \delta + \eta * g$ where r is the social discount rate, δ is the pure rate of time preference, η is the aversion to inter-generational inequality, and g is the growth rate of per capita consumption. For the original development, *see*, Ramsey, F. P. (1928). A Mathematical Theory of Saving. *The Economic Journal*, *38*(152).

[240] Higher growth rates lead to higher discounting of the future in the Ramsey model because growth will make future generations wealthier. If marginal utility of consumption declines in consumption, then, one should more heavily discount consumption gains by wealthier generations. Thus, if growth rates decline over time, then the rate at which the future is discounted should also decline. *See, e.g.,* Arrow et al. (2014) at 148. It is standard in IAMs to assume that the growth rate of consumption will fall over time. *See, e.g.,* Nordhaus (2017) at 1519, "Growth in global per capita output over the 1980–2015 period was 2.2% per year. Growth in global per capita output from 2015 to 2050 is projected at 2.1% per year, whereas that to 2100 is projected at 1.9% per year." Similarly, Hope (2011) at 22 assumes that growth will decline. For instance, in the U.S., growth is 1.9% per year in 2008 and declines to 1.7% per year by 2040. Using data provided by Dr. David Anthoff (one of the founders of FUND), FUND assumes that the global growth rate was 1.8% per year from 1980–2015 period, 1.4% per year from 2015 to 2050 and 2015 to 2100, and then dropping to 1.0% from 2100 to 2200 and then 0.7% from 2200 to 2300.

In the descriptive setting adopted by the IWG (2010), economists have demonstrated that calculating the expected net present value of a project is equivalent to discounting at a declining certainty equivalent discount rate when (1) discount rates are uncertain, and (2) discount rates are positively correlated (Arrow et al., 2014 at 157). Real consumption interest rates are uncertain given that there are no multi-generation assets to reflect long-term discount rates and the real returns to all assets—including government bonds—are risky due to inflation and default risk (Gollier & Hammitt, 2014). Furthermore, recent empirical work analyzing U.S. government bonds demonstrates that they are positively correlated over time; this empirical work has estimated several declining discount rate schedules that the IWG can use (Cropper et al., 2014; 2014; Arrow et al., 2013; Arrow et al., 2014; Jouini and Napp, 2014; Freeman et al. 2015).

CO5-1 (cont'd)

Currently when evaluating projects, the U.S. government applies the descriptive approach using constant rates of 3% and 7% based on the private rates of return on consumer savings and capital investments. As discussed previously, applying a capital discount rate to climate change costs and benefits is inappropriate (Newell, 2017). Instead, analysis should focus on the uncertainty underlying the future consumption discount rate (Newell, 2017). Past U.S. government analyses (IWG, 2010; IWG, 2013; IWG, 2016) modeled three consumption discount rates reflecting this uncertainty. If the U.S. government correctly returns its focus on multiple consumption discount rates, then the expected net present value argument given above implies that a declining discount rate is the appropriate way to perform discounting. As an alternative, given that the Ramsey discount rate approach is the appropriate methodology in intergenerational settings, the U.S. government could use a fixed, low discount rate as an approximation of the Ramsey equation following the recommendation of Marten et al. (2015); see our discussion on Martin et al. 2015). This is roughly IWG (2010)'s goal for using the constant 2.5% discount rate.

If the normative approach to discounting is used in the future (i.e., the current approach of IAMs), economists have demonstrated that an extended Ramsey rule[241] implies a declining discount rate when (1) the growth rate of per capita consumption is stochastic,[242] and (2) consumption shocks are positively correlated over time (or their mean or variances are uncertain) (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014).[243] While a constant adjustment downwards (known as

[241] If the future growth of consumption is uncertainty with mean μ and variance σ^2, an extended Ramsey equation $r = \delta + \eta * \mu - 0.5\eta^2\sigma^2$ applies where r is the social discount rate, δ is the pure rate of time preference, η is the aversion to inter-generational inequality, and g is the growth rate of per capita consumption. Gollier (2012, Chapter 3) shows that we can rewrite the extended discount rate as $r = \delta + \eta * g - 0.5\eta(\eta + 1)\sigma^2$ where g is the growth rate of expected consumption and $\eta + 1$ is prudence.

[242] The IWG assumption of five possible socio-economic scenarios implies an uncertain growth path.

[243] The intuition of this result requires us to recognize that the social planner is prudent in these models (i.e., saves more when faces riskier income). When there is a positive correlation between growth rates in per capita consumption, the representative agent faces more cumulative risk over time with respect to the "duration of the time spent in the bad state." (Gollier et al., 2008). In other words, "the existence of a positive correlation in the changes in consumption tends to magnify the long-term risk compared to short-term risks. This induces the prudent representative agent to purchase more zero-coupon bonds with a long maturity, thereby reducing the equilibrium long-term rate." (Gollier, 2007). Mathematically, the intuition is that under prudence, the third term in the extended Ramsey equation (*see* footnote 323) is negative, and a "positive [first-degree stochastic] correlation in changes in consumption raises the riskiness of consumption at date T, without changing its expected value. Under prudence, this reduces the interest rate associated to maturity T" (Gollier et al., 2007) by "increasing the strength of the precautionary effect" in the extended Ramsey equation (Arrow et al., 2014; Cropper et al., 2014).

39

CO5-1 (cont'd)

the precautionary effect[244]) can be theoretically correct when growth rates are independent and identically distributed (Cropper et al., 2014), empirical evidence supports the two above assumptions for the United States, thus implying a declining discount rate (Cropper et al., 2014; Arrow et al., 2014; IPCC, 2014).[245] We should further expect this positive correlation to strengthen over time due to the negative impact of climate change on consumption, as climate change causes an uncertain permanent reduction in consumption (Gollier, 2009).[246]

Several papers have estimated declining discount rate schedules for specific values of the pure rate of time preference and elasticity of marginal utility of consumption (e.g., Arrow et al., 2014), though recent work demonstrates that the precautionary effect increases and discount rates decrease further when catastrophic economic risks (such as the Great Depression and the 2008 housing crisis) are modeled (Gollier & Hammitt, 2014; Arrow et al., 2014). It should be noted that this decline in discount rates due to uncertainty in the global growth path is in addition to that resulting from a declining central growth path over time (Nordhaus, 2014; Marten, 2015).[247]

Additionally, a related literature has developed over the last decade demonstrating that normative uncertainty (i.e., heterogeneity) over the pure rate of time preference (δ)—a measure of impatience—also leads to a declining social discount rate (Arrow et al., 2014; Cropper et al., 2014; Freeman and Groom, 2016). Despite individuals differing in their pure rate of time preference (Gollier and Zeckhauser, 2005), an equilibrium (consumption) discount exists in the economy. In the context of IAMs, modelers aggregate social preferences (often measured using surveyed experts) by calibrating the preferences of a representative agent to this equilibrium (Millner and Heal, 2015; Freeman and Groom, 2016). The literature generally finds a declining social discount rate due to a declining collective pure rate of time preference (Gollier and Zeckhauser, 2005; Jouini et al., 2010; Jouini and Napp, 2014; Freeman and Groom, 2016).[248] The heterogeneity of preferences and the uncertainty surrounding economic growth hold simultaneously (Jouini et al., 2010; Jouini and Napp, 2014), leading to potentially two sources of declining discount rates in the normative context.

Declining Rates are Actionable and Time-Consistent

[244] The precautionary effect measures aversion to future "wiggles" in consumption (i.e., preference for consumption smoothing) (Traeger, 2014).

[245] Essentially, the precautionary effect increases over time when shocks to the growth rate are positively correlated, implying that future societies require higher returns to face the additional uncertainty (Cropper et al., 2014; Arrow et al., 2014; IPCC, 2014).

[246] Due to the deep uncertainty characterizing future climate damages, some analysts argue that the stochastic processes underlying the long-run consumption growth path cannot be econometrically estimated (Weitzman, 2007; Gollier, 2012). In other words, economic damages, and thus future economic growth, are ambiguous. Agents must then form subjectivity probabilities, which may be better interpreted as a belief (Cropper et al., 2014). Again, theory shows that ambiguity leads to a declining discount rate schedule by Jensen's inequality (Cropper et al., 2014).

[247] A common assumption in IAMs is that global growth will slow over time leading to a declining discount rate schedule over time; *see* footnote 7. Uncertainty over future consumption growth and heterogeneous preferences (discussed below) would lead to a more rapid decline in the social discount rate.

[248] The intuition for declining discount rates due to heterogeneous pure rates of time preference is laid out in Gollier and Zeckhauser (2005). In equilibrium, the least patient individuals trade future consumption to the most patient individuals for current consumption, subject to the relative value of their tolerance for consumption fluctuations. Thus, while public policies in the near term mostly impact the most impatient individuals (i.e., the individuals with the most consumption in the near term), long-run public policies in the distant future are mostly going to impact the most patient individuals (i.e., the individuals with the most consumption in the long-run).

CO5-1 (cont'd)

There are multiple declining discount rate schedules from which the U.S. government can choose, of which several are provided in Arrow et al. (2014) and Cropper et al. (2014). One possible declining interest rate schedule for consideration by the IWG is the one proposed by Weitzman (2001).[249] It is derived from a broad survey of top economists in context of climate change, and explicitly incorporates arguments around interest rate uncertainty.[250] Other declining discount rate schedule include Newell and Pizer (2003); Groom et al. (2007); Freeman et al. (2015). Many leading economists support the United States government adopting a declining discount rate schedule (Arrow et al., 2014; Cropper et al., 2014). Moreover, the United States would not be alone in using a declining discount rate. It is standard practice for the United Kingdom and French governments, among others (Gollier & Hammitt, 2014; Cropper et al., 2014). The U.K. schedule explicitly subtracts out an estimated time preference.[251] France's schedule is roughly similar to the United Kingdom's. Importantly, all of these discount rate schedules yield lower present values than the constant 2.5% discount rate employed by IWG (2010), suggesting that even the lowest discount rate evaluated by the IWG is too high.[252] The consensus of leading economists is that a declining discount rate schedule should be used, harmonious with the approach of other countries like the United Kingdom. Adopting such a schedule would likely increase the SCC substantially from the administration's 3% estimate, potentially up to two to three fold (Arrow et al., 2013; Arrow et al., 2014; Freeman et al., 2015).

A declining discount rate motived by discount rate or growth rate uncertainty avoids the time inconsistency problem that can arise if a declining pure rate of time preference (δ) is used. *Circular A-4* cautions that "[u]sing the same discount rate across generations has the advantage of preventing time-inconsistency problems."[253] A time inconsistent decision is one where a decision maker changes his or her plan over time, solely because time has passed. For instance, consider a decision maker choosing whether to make an investment that involves an up-front payment followed by future benefits. A time consistent decision maker would invest in the project if it had a positive net-present value, and that decision would be the same whether it was made 10 years before investment or 1 year before investment. A time inconsistent decision maker might change his or her mind as the date of the investment arrived, despite no new information becoming available. Consider a decision maker who has a declining pure rate of time preference (δ) trying to decide whether to invest in a project that has large up-front costs followed by future benefits. 10 years prior to the date of investment, the decision maker will believe that this project is a relatively unattractive investment because both the benefits and costs would be discounted at a low rate. Closer to the date of investment, however, the costs would be

[249] Weitzman (2001)'s schedule is as follows: 4% for 1-5 years; 3% for 6-25 years; 2% for 26-75 years; 1% for 76-300 years; and 0% for 300+ years.

[250] Freeman and Groom (2014) demonstrate that this schedule only holds if the heterogeneous responses to the survey were due to differing ethical interpretations of the corresponding discount rate question. A recent survey by Drupp et al. (2015) – which includes Freeman and Groom as co-authors – supports the Weitzman (2001) assumption.

[251] The U.K. declining discount rate schedule that subtracts out a time preference value is as follows (Lowe, 2008): 3.00% for 0-30 years; 2.57% for 31-75 years; 2.14% for 76-125 years; 1.71% for 126- 200 years; 1.29% for 201- 300 years; and 0.86% for 301+ years.

[252] Using the IWG's 2010 SCC model, Johnson and Hope (2012) find that the U.K. and Weitzman schedules yield SCCs of $55 and $175 per ton of CO_2, respectively, compared to $35 at a 2.5% discount rate. Because the 2.5% discount rate was included by the IWG (2010) to proxy for a declining discount rate, this result indicates that constant discount rate equivalents may be insufficient to address declining discount rates.

[253] *Circular A-4* at 35.

CO5-1 (cont'd)

relatively highly discounted, possibly leading to a reversal of the individual's decision. Again, the discount rate schedule is time consistent as long as δ is constant.

The arguments provided here for using a declining consumption discount rate are not subject to this time inconsistency critique. First, time inconsistency occurs if the decision maker has a declining pure rate of time preference, not due to a decreasing discount rate term structure.[254] Second, uncertainty about growth or the discount rate avoids time inconsistency because uncertainty is only resolved in the future, after investment decisions have already been made. As the NAS (2017) notes, "One objection frequently made to the use of a declining discount rate is that it may lead to problems of time inconsistency....This apparent inconsistency is not in fact inconsistent....At present, no one knows what the distribution of future growth rates...will be; it may be different or the same as the distribution in 2015. Even if it turns out to be the same as the distribution in 2015, that realization is new information that was not available in 2015."[255]

We should note that time-inconsistency is not a reason to ignore heterogeneity (i.e., normative uncertainty) over the pure rate of time preference (δ). If the efficient declining discount rate schedule is time-inconsistent, the appropriate solution is to select the best time-consistent policy. Millner and Heal (2014) do just this by demonstrating that a voting procedure – whereby the median voter determines the collective preference – is: (1) time consistent, (2) welfare enhancing relative to the non-commitment, time-inconsistent approach, and (3) preferred by a majority of agents relative to all other time-consistent plans. Due to the right skewed distribution of the pure rate of time preference and the social discount rate as shown in all previous surveys (Weitzman, 2001; Drupp et al., 2015; Howard and Sylvan, 2015), the median is less than the mean social discount rate (and pure rate of time preference); the mean social discount rate is what holds in the very short-run under various aggregation methods, such as Weitzman (2001) and Freeman and Groom (2015). Combining an uncertain growth rate and heterogeneous preference together implies a declining discount rate starting at a lower value in the short-run. In addition to the reasons discussed earlier in the comments, this is another reason to exclude a discount rate as high as 7%.

There is an economic consensus on the appropriateness of employing a consumption discount rate (and the inappropriateness of a capital discount rate) in the context of climate change

There is a strong consensus among economists that it is theoretically correct to use consumption discount rates in the intergenerational setting of climate change, such as in the calculation of the SCC. Similarly, there is a strong consensus that a capital discount rate is inappropriate according to "good economics" (Newell, 2017).[256] This consensus holds across panels of experts on the social cost of carbon (NAS, 2017); surveys of experts on climate change and discount rates (Weitzman, 2001; Drupp et al.,

[254] Gollier (2012) states "It is often suggested in the literature that economic agents are time inconsistent if the term structure of the discount rate is decreasing. This is not the case. What is crucial for time consistency is the constancy of the rate of impatience, which is a cornerstone of the classic analysis presented in this book. We have seen that this assumption is compatible with a declining monetary discount rate."

[255] NAS Second Report, *supra* note 62, at 182.

[256] The former co-chair of the National Academy of Sciences' Committee on Assessing Approaches to Updating the Social Cost of Carbon – Richard Newell (2017) – states that "[t]hough the addition of an estimate calculated using a 7 percent discount rate is consistent with past regulatory guidance under OMB *Circular A-4*, there are good reasons to think that such a high discount rate is inappropriate for use in estimating the SCC...It is clearly inappropriate, therefore, to use such modeling results with OMB's 7 percent discount rate, which is intended to represent the historical before-tax return on private capital...This is a case where unconsidered adherence to the letter of OMB's simplified discounting approach yields results that are inconsistent with and ungrounded from good economics."

CO5-1 (cont'd)

2015; Howard and Sylvan, 2015; and Pindyck, 2016); the three most commonly cited IAMs employed in calculating the federal SCC; and the government's own analysis (IWG, 2010; CEA, 2017). For more analysis of this issue, see the discussion in the main body our Comments on the inappropriateness using a discount rate premised on the return to capital in intergenerational settings.

Attachments to Comment CO5 –Montana Environmental Information Center, Institute for Policy Integrity at New York University School of Law, Sierra Club

July 25, 2018

To: Federal Energy Regulatory Commission

Docket: No. PL18–1–000

Subject: **Using the Social Cost of Greenhouse Gases to Weigh the Climate Impacts of New Natural Gas Transportation Facilities in Environmental Analyses and in Reviews of Public Convenience and Necessity**

The following comments on the appropriate use of the social cost of greenhouse gases in the certification of new interstate natural gas facilities are submitted jointly by the Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Natural Resources Defense Council, Sierra Club, and Union of Concerned Scientists.

Our organizations may separately and independently submit other comments on other issues raised by the Notice of Inquiry.[1] In particular, our organizations may submit other comments on when and how the tons of greenhouse gas emissions from natural gas transportation projects should be quantified in environmental assessments and environmental impact statements under the National Environmental Policy Act (NEPA) as well as in the review of public convenience and necessity under the Natural Gas Act (NGA), including arguments on why upstream and downstream emissions should be quantified, and on the best available data and methodologies for quantifying those emissions.

These joint comments focus instead on why and how the climate damages associated with greenhouse gas emissions should be monetized once the tons of emissions have been quantified. By monetizing climate damages, FERC can fulfill its legal obligations under NEPA to take a hard look at the incremental climate impacts of a project and to provide sufficient context to inform decisionmakers and the public of the consequences of alternative courses of action. Furthermore, by monetizing climate damages, FERC fulfills the goal under the NGA of reasonably and fully evaluating all factors bearing on the public interest. Neither quantifying the volume of emissions nor calculating a percentage of sectoral, regional, or national emissions is alone sufficient to fulfill these purposes. Regardless of legal obligations, monetizing damages can conveniently facilitate FERC's determination of whether the multitude of climate effects from a project's greenhouse gas emissions are cumulatively significant.

FERC's past arguments against using the social cost of greenhouse gas metrics all have straightforward rebuttals:

- There is a strong consensus about the appropriate discount rate to use to monetize future climate damages: specifically, a 3% or lower rate, and definitely not a 7% rate.
- Monetization of climate damages conveniently facilitates the very dilemma that FERC cites as an obstacle to using the social cost of greenhouse gases—namely, weighing the significance of effects.
- Monetization of climate damages is useful and appropriate regardless of whether FERC implements a full cost-benefit analysis in either its environmental reviews or its public convenience and necessity reviews.

[1] 83 Fed. Reg. 18,020 (Apr. 25, 2018).

- Monetization of climate damages is appropriate not just in rulemakings, but to facilitate any comparison of alternatives, including the required alternatives analysis under NEPA as well as the review of public convenience and necessity under the NGA.
- A global perspective that accounts for how international spillovers and foreign reciprocity affect U.S. welfare is appropriate under both NEPA and the NGA.

To monetize climate damages, the federal Interagency Working Group (IWG)'s 2016 estimates of the social cost of greenhouse gas continue to reflect the best available science and economics, and—notwithstanding a recent executive order disbanding the group[2]—federal agencies should continue to use estimates of a similar or higher value.[3] FERC should use not just the IWG's 2016 estimates of the social cost of carbon, but also the IWG's 2016 estimates of the social cost of methane and social cost of nitrous oxide.

These comments primarily respond to question C.7 of the Notice of Inquiry, as well as the elements of questions C.3 and C.4 that ask about evaluating the significance of impacts.

I. Monetizing Climate Damages Fulfills the Obligations and Goals of NEPA and the NGA

When a project has climate consequences that must be assessed under NEPA, monetizing the climate damages fulfills an agency's legal obligations under NEPA in ways that simple quantification of tons of greenhouse gas emissions cannot. Similarly, if FERC has already quantified greenhouse gas emissions to weigh directly in its review of public convenience and necessity, monetizing the associated climate damages will fulfill the goals of the NGA.

NEPA requires "hard look" consideration of beneficial and adverse effects of each alternative option for major federal government actions. The U.S. Supreme Court has called the disclosure of impacts the "key requirement of NEPA," and held that agencies must "consider and disclose the *actual environmental effects*" of a proposed project in a way that "brings those effects to bear on [the agency's] decisions."[4] Courts have repeatedly concluded that an environmental impact statement must disclose relevant climate effects.[5] NEPA requires "a reasonably thorough discussion of the significant aspects of the probable environmental consequences," to "foster both informed decisionmaking and informed public

[2] Exec. Order No. 13,783 § 5, 82 Fed. Reg. 16,093 (Mar. 28, 2017), disbands the IWG and instructs "agencies" to use the "best available science and economics," "consistent with the guidance contained in OMB Circular A-4," to "monetize[e] the value of changes in greenhouse gas emissions." First, the IWG's 2016 estimates are consistent with the best available science and economics, and with Circular A-4, as explained *infra*. Second, neither Circular A-4 nor, presumably, Executive Order 13,783 is strictly binding on an independent agency such as FERC.

[3] A higher value is appropriate because, while the 2016 estimates from the IWG draw from the best available data, *see* Richard L. Revesz et al., *Best Cost Estimate of Greenhouse Gases*, 357 Science 6352 (2017), the IWG estimates nevertheless omit key damage categories and are widely recognized as almost certainly severe underestimates of actual climate damages, *see, e.g.* Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 Nature 173 (2014) (co-authored with Nobel laureate Kenneth Arrow); R.S. Pindyck, *The Social Cost of Carbon Revisited* (Nat'l Bureau of Econ. Res. Working Paper w22807, 2016) (estimating the social cost of carbon as between $100 and $200 per metric ton, based on expert elicitation to capture willingness to pay to avoid catastrophes).

[4] *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 96 (1983) (emphasis added); *see also* 40 C.F.R. § 1508.8(b) (requiring assessment of the "ecological," "economic," "social," and "health" "*effects*") (emphasis added).

[5] As the Ninth Circuit has held: "[T]he fact that climate change is largely a global phenomenon that includes actions that are outside of [the agency's] control . . . does not release the agency from the duty of assessing the effects of *its* actions on global warming within the context of other actions that also affect global warming." *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1217 (9th Cir. 2008); *see also Border Power Plant Working Grp. v. U.S. Dep't of Energy*, 260 F. Supp. 2d 997, 1028-29 (S.D. Cal. 2003) (failure to disclose project's indirect carbon dioxide emissions violates NEPA).

participation."[6] In particular, "[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impact analysis that NEPA requires," and it is arbitrary to fail to "provide the necessary contextual information about the cumulative and incremental environmental impacts."[7] Furthermore, the analyses included in environmental assessments and impact statements "cannot be misleading."[8] An agency must provide sufficient informational context to ensure that decisionmakers and the public will not misunderstand or overlook the magnitude of a proposed action's climate risks compared to the no action alternative. As this section explains, by only quantifying the volume of greenhouse gas emissions, agencies fail to assess and disclose the actual climate consequences of an action and misleadingly present information in ways that will cause decisionmakers and the public to overlook important climate consequences. Using the social cost of greenhouse gas metrics to monetize climate damages fulfills NEPA's legal obligations in ways that quantification alone cannot.

Similarly, monetizing climate damages advances the NGA's goals of reasoned decisionmaking. To assess whether a project is "required by present or future public convenience and necessity,"[9] FERC must "evaluate *all factors* bearing on the public interest."[10] Relevant factors include any "adverse effects" to "general societal interests," and specifically include "environmental impacts" beyond just those experienced by landowners and the surrounding community, extending to cover the range of "other environmental issues considered under the National Environmental Policy Act."[11] When FERC "articulate[s] the critical facts upon which it relies" to review public convenience and necessity, "[a] passing reference to relevant factors . . . is not sufficient to satisfy the Commission's obligation to carry out 'reasoned' and 'principled' decisionmaking. [Courts] have repeatedly required the Commission to 'fully articulate the basis for its decision.'"[12] Consequently, when FERC weighs a project's climate consequences directly into its review of public convenience and necessity, monetization using the social cost of greenhouse gas metrics achieves the goal of fully articulating a relevant factor, while quantification alone would obscure important details.

FERC Must Assess Actual Incremental Climate Impacts, Not Just the Volume of Emissions

The tons of greenhouse gases emitted by a project are not the "actual environmental effects" (under NEPA), nor are they the relevant "factors bearing on the public interest" (under the NGA). Rather, the actual effects and relevant factors are the incremental climate impacts caused by those emissions, including:[13]

[6] *Ctr. for Biological Diversity*, 538 F.3d at 1194 (citations omitted).

[7] *Id.* at 1217.

[8] *High Country Conservation Advocates v. U.S. Forest Service*, 52 F. Supp. 3d 1174, 1182 (D. Colo. 2014); *accord. Johnston v. Davis*, 698 F.2d 1088, 1094-95 (10th Cir. 1983) (disapproving of "misleading" statements resulting in "an unreasonable comparison of alternatives"); *Hughes River Watershed Conservancy v. Glickman*, 81 F.3d 437, 446 (4th Cir. 1996) ("For an EIS to serve these functions" of taking a hard look and allowing the public to play a role in decisionmaking, "it is essential that the EIS not be based on misleading economic assumptions"); *see also Sierra Club v. Sigler*, 695 F.2d 957, 979 (5th Cir. 1983) (holding that an agency's "skewed cost-benefit analysis" was "deficient under NEPA"); *see generally Bus. Roundtable v. SEC*, 647 F.3d 1144, 1148-49 (D.C. Cir. 2011) (criticizing an agency for "inconsistently and opportunistically fram[ing] the costs and benefits of the rule" and for "fail[ing] adequately to quantify the certain costs or toe explain why those costs could not be quantified").

[9] 15 U.S.C. § 717f(e).

[10] *Missouri Public Serv. Comm'n v. FERC*, 234 F. 3d 36, 38 (D.C. Cir. 2000) (quoting *Atlantic Ref. Co. v. Public Serv. Comm'n*, 360 U.S. 378, 391 (1959)) (emphasis added).

[11] 88 FERC ¶ 61,227, Statement of Policy at pp.23-24 (Sept. 15, 1999). *See, e.g., Minisink Residents for Envtl. Pres. v. FERC*, 762 F.3d 97, 101 (D.C. Cir. 2014) ("listing "conservation" and "environmental . . . issues" as the NGA's "subsidiary purposes").

[12] *Missouri Public Serv. Comm'n*, 234 F.3d at 40, 41 (citations omitted).

[13] These impacts are all included to some degree in the three integrated assessment models (IAMs) used by the IWG (namely, the DICE, FUND, and PAGE models), though some impacts are modeled incompletely, and many other important damage

- property lost or damaged by sea-level rise, coastal storms, flooding, and other extreme weather events, as well as the cost of protecting vulnerable property and the cost of resettlement following property losses;
- changes in energy demand, from temperature-related changes to the demand for cooling and heating;
- lost productivity and other impacts to agriculture, forestry, and fisheries, due to alterations in temperature, precipitation, CO_2 fertilization, and other climate effects;
- human health impacts, including cardiovascular and respiratory mortality from heat-related illnesses, changing disease vectors like malaria and dengue fever, increased diarrhea, and changes in associated pollution;
- changes in fresh water availability;
- ecosystem service impacts;
- impacts to outdoor recreation and other non-market amenities; and
- catastrophic impacts, including potentially rapid sea-level rise, damages at very high temperatures, or unknown events.

Even in combination with a general, qualitative discussion of climate change, by calculating only the tons of greenhouse gases emitted or a percent comparison to sectoral or national emissions, an agency fails to meaningfully assess the actual incremental impacts to property, human health, productivity, and so forth.[14] An agency therefore falls short of its legal obligations and statutory objectives by focusing just on volume estimates. Similarly, courts have held that just quantifying the acres of timber to be harvested or the miles of road to be constructed does not constitute a "description of *actual* environmental effects," even when paired with a qualitative "list of environmental concerns such as air quality, water quality, and endangered species," when the agency fails to assess "the degree that each factor will be impacted."[15]

categories are currently omitted from these IAMs. *Compare* Interagency Working Group on the Social Cost of Carbon, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis* at 6-8, 29-33 (2010), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf [hereinafter 2010 TSD]; *with* Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014), http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf. For other lists of actual climate effects, including air quality mortality, extreme temperature mortality, lost labor productivity, harmful algal blooms, spread of west nile virus, damage to roads and other infrastructure, effects on urban drainage, damage to coastal property, electricity demand and supply effects, water supply and quality effects, inland flooding, lost winter recreation, effects on agriculture and fish, lost ecosystem services from coral reefs, and wildfires, *see* EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2017); U.S. Global Change Research Program, *Climate Science Special Report: Fourth National Climate Assessment* (2017); EPA, *Climate Change in the United States: Benefits of Global Action* (2015); Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate* (2018).

[14] *See High Country*, 52 F. Supp. 3d at 1190 ("Beyond quantifying the amount of emissions relative to state and national emissions and giving general discussion to the impacts of global climate change, [the agencies] did not discuss the impacts caused by these emissions."); *Mont. Envtl. Info. Ctr. v. U.S. Office of Surface Mining*, 274 F. Supp. 3d 1074, 1096–99 (D. Mont. 2017) (rejecting the argument that the agency "reasonably considered the impact of greenhouse gas emissions by quantifying the emissions which would be released if the [coal] mine expansion is approved, and comparing that amount to the net emissions of the United States").

[15] *Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 387 F.3d 989, 995 (9th Cir. 2004) ("A calculation of the total number of acres to be harvested in the watershed is . . . not a sufficient description of the actual environmental effects that can be expected from logging those acres."); *see also Oregon Natural Res. Council v. Bureau of Land Mgmt.*, 470 F.3d 818 (9th Cir. 2006).

By monetizing climate damages using the social cost of greenhouse gas metrics, FERC can satisfy the legal obligations and statutory goals to assess the incremental and actual effects bearing on the public interest. The social cost of greenhouse gas methodology calculates how the emission of an additional unit of greenhouse gases affects atmospheric greenhouse concentrations, how that change in atmospheric concentrations changes temperature, and how that change in temperature incrementally contributes to the above list of economic damages, including property damages, energy demand effects, lost agricultural productivity, human mortality and morbidity, lost ecosystem services and non-market amenities, and so forth.[16] The social cost of greenhouse gas tool therefore captures the factors that actually affect public welfare and assesses the degree of impact to each factor, in ways that just estimating the volume of emissions cannot.

Climate Damages Depend on Stock and Flow, But Volume Estimates Only Measure Flow

The climate damage generated by each additional ton of greenhouse gas emissions depends on the background concentration of greenhouse gases in the global atmosphere. Once emitted, greenhouse gases can linger in the atmosphere for centuries, building up the concentration of radiative-forcing pollution and affecting the climate in cumulative, non-linear ways.[17] As physical and economic systems become increasingly stressed by climate change, each marginal additional ton of emissions has a greater, non-linear impact. The climate damages generated by a given amount of greenhouse pollution is therefore a function not just of the pollution's total volume but also the year of emission, and with every passing year an additional ton of emissions inflicts greater damage.[18]

As a result, focusing just on the volume or rate of emissions is insufficient to reveal the incremental effect on the climate. The change in the rate of emissions (flow) must be assessed given the background concentration of emissions (stock). A percent comparison to national emissions is perhaps even more misleading. A project that adds 23 million additional tons per year of carbon dioxide would have contributed to 0.43% of total U.S. carbon dioxide emissions in the year 2012.[19] In the year 2014, that same project with the same carbon pollution would have contributed to just 0.41% of total U.S. carbon dioxide emissions—a seemingly smaller relative effect, since the total amount of U.S. emissions increased from 2012 to 2014.[20] However, because of rising background concentrations of global greenhouse gas stock, and because of growing stresses in physical and economic systems, the marginal climate damages per ton of carbon dioxide (as measured by the social cost of carbon) increased from $33 in 2012 to $35 in 2014 (in 2007$).[21] Consequently, those 23 million additional tons would have caused marginal climate damages costing $759 million in the year 2012, but by 2014 that same 23 million tons would have caused $805 million in climate damages. To summarize: the percent comparison to national emissions misleadingly implied that a project adding 23 million more tons of carbon dioxide would have a relatively less significant effect in 2014 than in 2012, whereas monetizing climate damages

[16] 2010 TSD, *supra* note 13, at 5.

[17] Carbon dioxide also has cumulative effects on ocean acidification, in addition to cumulative radiative-forcing effects.

[18] *See* 2010 TSD, *supra* note 13, at 33 (explaining that the social cost of greenhouse gas estimates grow over time).

[19] Total U.S. carbon dioxide emissions in 2012 were 5,366.7 million metric tons (for all greenhouse gases, emissions were 6,529 MMT CO2 eq). *See* EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016* at ES-6, tbl. ES-2 (2018).

[20] Total U.S. carbon dioxide emissions in 2014 were 5,568.8 million metric tons (and for all greenhouse gases, 6,763 MMT CO2 eq.) *Id.*

[21] Interagency Working Group on the Social Cost of Greenhouse Gases, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis* at 25 tbl. A1 (2016) (calculating the central estimate at a 3% discount rate), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf [hereinafter 2016 TSD].

would accurately reveal that the emissions in 2014 were much more damaging than the emissions in 2012—almost $50 million more.

Capturing how marginal climate damages change as the background concentration changes is especially important because NEPA and the NGA require assessing both present and future impacts. For example, the NGA requires considering "present" and "future" convenience and necessity,[22] and FERC must consider both potentially positive and negative environmental outcomes.[23] Different project alternatives can have different greenhouse gas consequences over time. Most simply, different alternatives could have different start dates or other consequential changes in timing. Furthermore, a project's relative greenhouse gas effect compared to other alternatives or to the no-action *status quo* can change over time as the fuel mix in the overall market changes.[24] For the reasons explained above, calculating volumes or percentages is insufficient to accurately compare the climate damages of project alternatives with varying greenhouse gas emissions over time.

By factoring in projections of the increasing global stock of greenhouse gases as well as increasing stresses to physical and economic systems, the social cost of greenhouse gas metrics enable accurate and transparent comparisons of projects with varying greenhouse gas emissions over time.

Monetization Provides the Required Informational Context that Volume Estimates Lack

NEPA requires sufficient informational context; the NGA requires a reasoned explanation of factors and more than "passing references." Yet without proper context, numbers like 23 million metric tons of carbon dioxide, or 0.42% of national emissions, will be misinterpreted by people as meaningless, as zero. FERC has admitted as much in its Notice of Inquiry, explaining that "calculating a proposed project's emissions as a percentage of sector, nationwide, or global emissions" will "[g]enerally" be "too low to be considered meaningful because project emissions would be miniscule compared to nationwide or global emissions."[25] Indeed, in a country of over 300 million people and over 6.5 billion tons of annual greenhouse gas emissions, it is far too easy to make highly significant effects appear relatively "miniscule." For example, presenting all weather-related deaths as less than 0.1% of total U.S. deaths makes the risk of death by weather event sound trivial, but in fact that figure represents over 2,000 premature deaths per year[26]—hardly an insignificant figure.[27]

Economic theory explains why monetization is a much better tool than volume estimates or percent comparisons to provide the necessary contextual information on climate damages. For example, many decisionmakers and interested citizens would wrongly reduce down to zero the climate risks associated with 0.42% of total U.S. emissions, simply due to the leading zero before the decimal in that percentage. As Professor Cass Sunstein has explained—drawing from the work of recent Nobel laureate economist

[22] 15 U.S.C. § 717f(e).

[23] *See, e.g., Myersville Citizens for a Rural Community v. FERC*, 783 F.3d 1301, 1309 (D.C. Cir. 2015).

[24] *See* U.S. Energy Info. Admin., *Annual Energy Outlook 2018 with Projections to 2050* at 84 (2018) (projecting coal's share of electricity generation to decline over time, while renewables' share increases).

[25] 83 Fed. Reg. at 18,029.

[26] *Compare* Nat'l Ctr. for Health Stat., Ctrs. for Disease Control & Prevention, *Death Attributed to Heat, Cold, and Other Weather Events in the United States, 2006-2010* at 1 (2014) (reporting about 2000 weather-related deaths per year) *with* Nat'l Ctr. for Health Stat., *Deaths and Mortality*, https://www.cdc.gov/nchs/fastats/deaths.htm (reporting about 2.7 million U.S. deaths per year total).

[27] The public willingness to pay to avoid mortality is typically estimated at around $9.6 million (in 2016$). E.g., 83 Fed. Reg. 12,086, 12,098 (Mar. 19, 2018) (U.S. Coast Guard rule using the Department of Transportation's value of statistical life in a recent analysis of safety regulations). Losing 2,000 lives prematurely to weather-related events is equivalent to a loss of public welfare worth over $19 billion per year.

Richard Thaler—a well-documented mental heuristic called "probability neglect" causes people to irrationally reduce small probability risks entirely down to zero.[28] People have significant "difficulty understanding a host of numerical concepts, especially risks and probabilities."[29] Reducing 23 million tons of additional carbon dioxide emissions to 0.42% of national emissions misleadingly makes the climate impacts appear vanishingly small. By comparison, by applying the social cost of carbon dioxide (about $50 per ton in 2017$), decisionmakers and the public can readily comprehend that 23 million tons of carbon dioxide emitted in the year 2020 will generate over $1 billion in climate damages.

Similarly, many people will be unable to distinguish the significance of project alternatives or scenario analyses with different emissions: for example, 23 million metric tons versus 8.36 million metric tons.[30] As the Environmental Protection Agency's website explains, "abstract measurements" of so many tons of greenhouse gases can be rather inscrutable for the public, unless "translat[ed] . . . into concrete terms you can understand."[31] Abstract volume estimates fail to give people the required informational context due to another well-documented mental heuristic called "scope neglect." Scope neglect, as explained by Nobel laureate Daniel Kahneman, among others, causes people to ignore the size of a problem when estimating the value of addressing the problem. For example, in one often-cited study, subjects were unable to meaningfully distinguish between the value of saving 2,000 migratory birds from drowning in uncovered oil ponds, as compared to saving 20,000 birds.[32]

Scope neglect means many decisionmakers and members of the public would be unable to meaningfully distinguish between the climate risks of 23 million metric tons of carbon emissions versus the climate risks of 8.36 million metric tons. While decisionmakers and the public certainly can discern that one number is higher, without any context it may be difficult to weigh the relative magnitude of the climate risks. In contrast, the different climate risks would have been readily discernible through application of the social cost of greenhouse gas metrics. In this example, the difference between the two scenarios is $732 million per year in climate damages.

In general, non-monetized effects are often irrationally treated as worthless.[33] On several occasions, courts have struck down administrative decisions for failing to give weight to non-monetized effects.[34] Most relevantly, in *Center for Biological Diversity v. NHTSA*, the U.S. Court of Appeals for the Ninth Circuit found it arbitrary and capricious to give zero value "to the most significant benefit of more stringent [fuel economy] standards: reduction in carbon emissions."[35] Monetizing climate damages provides the informational context required by NEPA and the NGA, whereas a simple tally of emissions

[28] Cass R. Sunstein, *Probability Neglect: Emotions, Worst Cases, and Law*, 112 Yale L. J. 61, 63, 72 (2002).

[29] Valerie Reyna & Charles Brainerd, *Numeracy, Ratio Bias, and Denominator Neglect in Judgments of Risk and Probability*, 18 Learning & Individual Differences 89 (2007).

[30] These numbers are taken from the Supplemental Environmental Impact Statement for the Southeast Market Pipelines Project, specifically the greenhouse gas estimates for the full burn analysis versus the net PTE analysis. Different project alternatives considered by FERC, especially if alternatives included different capacity pipelines, could just as easily have different emission estimates.

[31] EPA, *Greenhouse Gas Equivalencies Calculator*. *Available at* https://web.archive.org/web/20180212182940/https:/www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (last updated Sept. 2017) ("Did you ever wonder what reducing carbon dioxide (CO_2) emissions by 1 million metric tons means in everyday terms? The greenhouse gas equivalencies calculator can help you understand just that, translating abstract measurements into concrete terms you can understand.").

[32] Daniel Kahneman et al., *Economic Preferences or Attitude Expressions? An Analysis of Dollar Responses to Public Issues*, 19 J. Risk & Uncertainty 203, 212-213 (1999).

[33] Richard Revesz, *Quantifying Regulatory Benefits*, 102 Cal. L. Rev. 1424, 1434-35, 1442 (2014).

[34] *See id.* at 1428, 1434.

[35] 538 F.3d at 1199.

volume and rote, qualitative, generic description of climate change are misleading and fail to give the public and decisionmakers the required information about the magnitude of discrete climate effects.[36]

Climate Effects Must Be Monetized If Other Costs and Benefits Are Monetized

Though NEPA does not always require a full and formal cost-benefit analysis,[37] agencies' approaches to assessing costs and benefits must be balanced and reasonable. Courts have warned agencies, for example, that "[e]ven though NEPA does not require a cost-benefit analysis," an agency cannot selectively monetize benefits in support of its decision while refusing to monetize the costs of its action.[38]

In *High Country Conservation Advocates v. Forest Service*, the U.S. District Court of Colorado found that it was "arbitrary and capricious to quantify the *benefits* of the lease modifications and then explain that a similar analysis of the *costs* was impossible when such an analysis was in fact possible."[39] The court explained that, to support a decision on coal mining activity, the agencies had "weighed several specific economic benefits—coal recovered, payroll, associated purchases of supplies and services, and royalties," but arbitrarily failed to monetized climate costs using the readily available social cost of carbon protocol.[40] Similarly, in *Montana Environmental Information Center v. Office of Surface Mining* (*MEIC v. OSM*), the U.S. District Court of Montana followed the lead set by *High Country* and likewise held an environmental assessment to be arbitrary and capricious because it quantified the benefits of action (such as employment payroll, tax revenue, and royalties) while failing to use the social cost of carbon to quantify the costs.[41]

High Country and *MEIC v. OSM* were simply the latest applications of a broader line of case law in which courts find it arbitrary and capricious to apply inconsistent protocols for analyzing some effects compared to others, especially when the inconsistency obscures some of the most significant effects.[42] For example, in *Center for Biological Diversity v. National Highway Traffic Safety Administration*, the U.S.

[36] *See* 42 U.S.C. § 4332(2)(B) (requiring agencies to "identify and develop methods and procedures . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations").

[37] 40 C.F.R. § 1502.23 ("[T]he weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis."); *but see e.g.*, *Sierra Club v. Sigler*, 695 F.2d 957, 978-79 (5th Cir. 1983) (holding that NEPA "mandates at least a broad, informal cost-benefit analysis," and so agencies must "fully and accurately" and "objectively" assess environmental, economic, and technical costs); *Chelsea Neighborhood Ass'ns v. U.S. Postal Serv.*, 516 F.2d 378, 387 (2d Cir. 1975) ("NEPA, in effect, requires a broadly defined cost-benefit analysis of major federal activities."); *Calvert Cliffs' Coordinating Comm. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1113 (D.C. Cir. 1971) ("NEPA mandates a rather finely tuned and 'systematic' balancing analysis" of "environmental costs" against "economic and technical benefits"); *Nat'l Wildlife Fed. v. Marsh*, 568 F. Supp. 985, 1000 (D.D.C. 1983) ("The cost-benefit analysis of NEPA is concerned primarily with environmental costs. . . . A court may examine the cost-benefit analysis only as it bears upon the function of insuring that the agency has examined the environmental consequences of a proposed project.").

[38] *High Country Conservation Advocates*, 52 F. Supp. 3d at 1191; *accord. MEIC v. Office of Surface Mining*, 274 F. Supp. 3d at 1094-99 (holding it was arbitrary for the agency to quantify benefits in an EIS while failing to use the social cost of carbon to quantify costs, as well as arbitrary to imply there would be no effects from greenhouse gas emissions).

[39] 52 F. Supp. 3d at 1191.

[40] *Id.*

[41] 274 F. Supp. 3d at 1094-99 (also holding that it was arbitrary to imply that there would be zero effects from greenhouse gas emissions).

[42] Other cases from different courts that have declined to rule against failures to use the social cost of carbon in NEPA analyses are all distinguishable by the scale of the action or by whether other effects were quantified and monetized in the analysis. *See League of Wilderness Defenders v. Connaughton*, No. 3:12-cv-02271-HZ (D. Ore., Dec. 9, 2014); *EarthReports v. FERC*, 15-1127, (D.C. Cir. July 15, 2016); *WildEarth Guardians v. Zinke*, 1:16-CV-00605-RJ, at 23-24, (D. N.M. Feb. 16, 2017).

Court of Appeals for the Ninth Circuit ruled that, because the agency had monetized other uncertain costs and benefits of its vehicle fuel efficiency standard—like traffic congestion and noise costs—its "decision not to monetize the benefit of carbon emissions reduction was arbitrary and capricious."[43] Specifically, it was arbitrary to "assign[ ] no value to *the most significant benefit* of more stringent [vehicle fuel efficiency] standards: reduction in carbon emissions."[44] When an agency bases a decision on cost-benefit analysis, it is arbitrary to "put a thumb on the scale by undervaluing the benefits and overvaluing the costs."[45] Similarly, the U.S. Court of Appeals for the District of Columbia Circuit has chastised agencies for "inconsistently and opportunistically fram[ing] the costs and benefits of the rule [and] fail[ing] adequately to quantify certain costs or to explain why those costs could not be quantified"[46]; and the U.S. Court of Appeals for the Tenth Circuit has remanded an environmental impact statement because "unrealistic" assumptions "misleading[ly]" skewed comparison of the project's positive and negative effects.[47]

FERC's environmental impact statements regularly monetize "economic benefits" similar to those highlighted in *High Country* and *MEIC*, including direct and indirect labor income, expenditures, tax revenues, and other "long-term benefits to the local and regional economy."[48] Unlike other agencies, FERC may not always calculate total output or consumer valuation of the increased gas throughput, in terms of the market value of the amount of gas transported. But when it does calculate and tout other economic benefits, FERC cannot inconsistently monetize some economic benefits but fail to use a readily available protocol to monetize important environmental costs.

EarthReports *and* Minisink *Are Distinguishable*

In *EarthReports v. FERC*, the U.S. Court of Appeals for the D.C. Circuit had excused FERC's failure to use the social cost of carbon in a 2014 environmental assessment of a liquefied natural gas facility because of (1) the alleged lack of consensus about the appropriate discount rates, (2) the alleged disconnect between the tool and actual environmental impacts, and (3) the alleged lack of criteria for significance.[49] Advancements in the economic literature, in FERC's own understanding of the social cost of greenhouse gases, and in the case law since the 2014 environmental assessment at stake in *EarthReports* all make that case now distinguishable.

First, to the extent there ever was a lack of consensus about the appropriate discount rate, recent reports from the National Academies of Sciences, among other sources, make clear that a 3% discount rate or lower—or optimally a declining discount rate—are appropriate, while a 7% discount rate is wholly inappropriate. As discussed further below in these comments in a section on the discount rate, the first basis for the decision in *EarthReports* no longer holds true.

Second, FERC now admits that "[o]n further review, we accept that the Social Cost of Carbon methodology does constitute a tool that can be used to estimate incremental physical climate change impacts."[50] A longer discussion of FERC's concession on physical impacts appears below in these comments in a section on significance, but, in short, the second basis for the decision in *EarthReports*—the alleged disconnect between the tool and actual environmental impacts—no longer holds true.

[43] 538 F.3d 1172, 1203 (9th Cir. 2008).
[44] *Id.* at 1199.
[45] *Id.* at 1198.
[46] *Bus. Roundtable v. SCC*, 647 F.3d 1144, 1148-49 (D.C. Cir. 2011)
[47] *Johnston v. Davis*, 698 F.2d 1088, 1094–95 (10th Cir. 1983)
[48] E.g., FERC, *Final Environmental Impact Statement for Southeast Market Pipelines Project* at 3-185 to 3-214 (2015).
[49] 828 F.3d 949, 956 (D.C. Cir. 2016).
[50] 162 FERC ¶ 61,233 (Mar. 14, 2018) [hereinafter Sabal Remand Order] at para. 48.

The third basis for the decision in *EarthReports*, the alleged lack of criteria for significance, is also wrong, for reasons explained further below. But it is especially notable that additional case law since *EarthReports* has made clear that it is arbitrary to tout the monetized upside of a project in an environmental assessment or impact statement while refusing to apply available tools to monetize the project's costs. Crucially, the court in *EarthReports* never considered or ruled on the need for parity in the treatment of costs and benefits. By translating costs and benefits into the common metric of money, monetization facilitates comparing the significance of various effects. FERC and other agencies routinely translate economic benefits like employment effects into monetized terms to gauge their significance; the significance of monetizable costs, like climate damages, should be gauged on the same basis.

Another case, *Minisink Residents for Environmental Preservation and Safety v. FERC*, is also distinguishable on the facts.[51] The D.C. Circuit disagreed with petitioners' argument that NEPA required FERC to "focus[ ] more" than it had "on the monetary costs and benefits of the respective proposals."[52] However, in that case, FERC's "fail[ure] to undertake a more fulsome cost-benefit analysis"[53] did not constitute a failure to consider the actual, relevant impacts of the project. Petitioners' complaint was that, in comparing two project alternatives, FERC had not explicitly compared monetized estimates of long-term operating costs and savings against monetized estimates of capital costs; petitioners also cited insufficient supporting data for the estimates of capital costs.[54] In other words, petitioners wanted FERC to base its choice between alternatives on a summing of monetized costs and cost-savings, to use a monetized cost-benefit equation as the exclusive tool for weighing the relevant factors that the agency had identified.[55] That is a very different argument than the one made here, which is that by failing to monetize climate damages using the social cost of greenhouse gases, FERC in fact fails to give any weight to the actual, incremental effects of climate change. As explained further below, FERC can use the social cost of greenhouse gases without necessarily conducting a full cost-benefit analysis. Because climate damages are diffused geographically and temporally and vary with increasing stock concentrations, monetization is especially crucial to capture the actual environmental impacts of greenhouse gas emissions. Unlike the *Minisink* petitioners' complaints about under-analyzed operating costs, failing to consider the actual incremental climate impacts of a project in an environmental impact statement is not mere "flyspecking"[56]—rather, it goes to the heart of the hard look requirement. And whereas the *Minisink* petitioners did not identify an alternate methodology for estimating the operating and capital costs, a readily available and widely accepted tool exists to monetize climate damages: the social cost of greenhouse gases.

[51] 762 F.3d 97 (D.C. Cir. 2014).
[52] *Id.* at 112.
[53] *Id.*
[54] Pet'rs Reply Brief at 12, 2013 WL 5935149; Pet'r Opening Brief at 42, 2013 WL 5935148; see also Respondent Brief at 35, 2013 WL 5935151 ("Residents assert that the Commission violated NEPA by failing to include in the Environmental Assessment a cost-benefit analysis that compares the cost of the Project versus the Wagoner Alternative.").
[55] Reply Brief, *supra* note 54, at 12 ("Over a 30-year project lifetime, the reduced operating expenses readily exceed the capital costs of Wagoner if they are fifty percent more and come close to offsetting the capital costs of Wagoner if it costs twice as much."); Opening Brief, *supra* note 54, at 42-43 ("EA lacks any rigorous analysis of whether the savings in fuel costs over the life of the project make the Wagoner project more cost effective overall [after comparison to the capital costs].").
[56] Note that the *Minisink* case concerned an environmental assessment, and the court acknowledged that the requirements to monetize costs and benefits may be different for environmental impact statements. 762 F.3d at 112 ("[W]e disagree that NEPA requires such an approach, particularly where only an environmental assessment, rather than an environment impact statement, is involved."). *See also supra* note 40, listing several cases explaining that NEPA requires at least an informal cost-benefit assessment.

Finally, at most *EarthReports* and *Minisink* gave FERC some deference constrained by rationality, and FERC can always change its mind based on the current record and within the standards of rationality. Based on everything that FERC now knows about the social cost of greenhouse gas metrics, FERC should use the tool in both environmental reviews under NEPA and in reviews of public convenience and necessity.

Regardless of Legal Obligations, Monetizing Climate Damages Is Helpful and Easy

FERC has often complained that "there is no standard established by international or federal policy, or by a recognized scientific body that the Commission could rely on in determining whether project-specific GHG emissions are significant."[57] Yet by applying the social cost of greenhouse gases, the common metric of money provides the very framework for assessing significance that FERC is looking for. While the relative significance of 20,000 additional tons of carbon dioxide per year versus 2 million additional tons per year may be somewhat challenging to discern, the relative significance of $1 million per year in climate damages versus $100 million per year in climate damages is much easier to discern. Determining the significance of $100 million in annual climate damages versus $1 million still requires FERC to exercise its professional judgment, but that is no different than how FERC routinely applies its judgment to determine the significance of impacts to landowners, the local community, or the tax base. Compared to volume estimates, the monetized figures of climate damage are also easier to weigh against reasonable judgments about a project's other qualitative, quantitative, or monetized costs and benefits. And as discussed above, using the social cost of greenhouse gases may be especially helpful when comparing alternatives with varying emission levels across time.

The value of the additional information generated by applying the social cost of greenhouse gas metrics easily outweighs the cost of the minimal effort required to apply the metrics. Once the tons of carbon dioxide, methane, and nitrous oxide emissions have already been quantified, monetization simply requires multiplying the tons emitted in a given year by that year's values for the social cost of carbon, methane, or nitrous oxide, and further multiplying by a standard discount formula to produce the present value.[58] Reliable estimates of the social cost of greenhouse gases are readily available, from the 2016 technical support document issued by the federal Interagency Working Group on the Social Cost of Greenhouse Gases (IWG). FERC either can focus on IWG's central estimates or else has the option of also using the additional range of three other estimates from the IWG to conduct sensitivity analyses. The continuing validity of IWG's 2016 estimates is discussed further below.

For example, suppose that FERC has already calculated that a project will emit 23 million metric tons of carbon dioxide per year. FERC can then multiply by the social cost of carbon for each year of emissions. For year 2020 emissions, IWG's central estimate of climate damages is $42 per ton in 2007$, which equals $51 per ton in 2017$. $23MMTCO_2$* $51/MTCO_2$ = $1.17 billion in climate damages from emissions in year 2020. Discounting back to present value in the year 2018 at a 3% discount rate gives a present value of about $1.05 billion in climate damages expected from the carbon pollution that the project will emit in the year 2020. By summing such estimates for each year of operations of the project, a total present-value estimate of the project's expected climate damages is readily calculated.

[57] *E.g.*, 83 Fed. Reg. at 18,029.

[58] Depending on which dollar-year values FERC uses for other calculations, it may also need to inflate the estimates, since the Interagency Working Group numbers are given in year 2007$. The Bureau of Labor Statistics provides an easy-to-use CPI Inflation Calculator, https://data.bls.gov/cgi-bin/cpicalc.pl.

II. FERC's Past Objections to the Social Cost of Greenhouse Gases Do Not Withstand Scrutiny

In its Order on Remand Reinstating Certification for the Southeast Market Pipelines Project, as well as in other orders and NEPA reviews, FERC has articulated various objections to using the social cost of greenhouse gas metrics. All of those objections are easily rebutted and so should not inhibit FERC from adopting a policy of using the social cost of greenhouse gas metrics to monetize the climate damages of any quantified greenhouse gas emissions.

A Strong Consensus Exists to Use a 3% or Lower (or Declining) Discount Rate for a Central Estimate

In the Southeast Market Pipeline supplemental EIS, FERC cites a 2013 EPA factsheet for the proposition that there is such a lack of consensus around the appropriate discount rate that the resulting range of estimates of the social cost of greenhouse gases is too wide to be helpful.[59] Not only was this line of thinking rejected by the Ninth Circuit in *Center for Biological Diversity*—"while . . . there is a range of values, the value of carbon emissions reduction is certainly not zero"[60]—but the range of values recommended by the Interagency Working Group[61] and endorsed by the National Academies of Sciences[62] is rather manageable. In 2016, the IWG recommended values at discount rates from 2.5% to 5%, calculated as between $12 and $62 for year 2020 emissions.[63] Numerous federal agencies have had no difficulty either applying this range in their environmental impact statements or else focusing on the central estimate at a 3% discount rate.[64] Most recently, in August 2017, the Bureau of Ocean Energy Management applied the IWG's range of estimates calculated at three discount rates (2.5%, 3%, and 5%) to its environmental impact statement for an offshore oil development plan,[65] and called this range of estimates "a useful measure to assess the benefits of CO_2 reductions and inform agency decisions."[66]

More importantly, there is widespread consensus that a central estimate calculated at a 3% or lower discount rate, or else using a declining discount rate, is most appropriate, while a 7% discount rate would be wholly inappropriate in the context of intergenerational climate damages. Because of the long lifespan of greenhouse gases and the long-term or irreversible consequences of climate change, the effects of today's emissions changes will stretch out over the next several centuries. The time horizon

[59] FERC, *Final Supplemental Environmental Impact Statement: Southeast Market Pipelines Project* at 8 (2018). *But see* Sabal Remand Order (Comm'r LaFleur, dissenting in part) ("[T]he Commission could estimate the appropriate discount rate or to use more than one discount rate in our calculations or to provide a range of numbers for consideration."); *id.* (Comm'r Glick, dissenting) ("[P]erceived technical challenges including the presence of assumptions or unknowns, such as discount rate, . . . does not diminish the Commission's responsibility to provide a qualitative assessment, rather the Commission simply must make a disclosure 'so that readers can take the resulting estimates with the appropriate amount of salt.'").

[60] 538 F.3d at 1200.

[61] *See* 2016 TSD, *supra* note 21.

[62] *See* National Academies of Sciences, *Assessment of Approaches to Updating the Social Cost of Carbon* (2016) [hereinafter First NAS Report] (endorsing continued near-term use of the IWG numbers); in 2017, the NAS recommended moving to a declining discount rate, *see* National Academies of Sciences, *Valuing Climate Damages* (2017) [hereinafter Second NAS Report].

[63] 2016 TSD, *supra* note 21. The values given here are in 2007$. The IWG also recommended a 95th percentile value of $123.

[64] E.g., BLM, *Envtl. Assessment—Waste Prevention, Prod. Subject to Royalties, and Res. Conservation* at 52 (2016); BLM, *Final Envtl. Assessment: Little Willow Creek Protective Oil and Gas Lease*, DOI-BLM-ID-B010-2014-0036-EA, at 82 (2015); Office of Surface Mining, *Final Envtl. Impact Statement—Four Corners Power Plant and Navajo Mine Energy Project* at 4.2-26 to 4.2-27 (2015) (explaining the social cost of greenhouse gases "provide[s] further context and enhance[s] the discussion of climate change impacts in the NEPA analysis."); U.S. Army Corps of Engineers, *Draft Envtl. Impact Statement for the Missouri River Recovery Mgmt. Project* at 3-335 (2016); U.S. Forest Serv., *Rulemaking for Colorado Roadless Areas: Supplemental Final Envtl. Impact Statement* at 120-123 (Nov. 2016) (using both the social cost of carbon and social cost of methane relating to coal leases).

[65] BOEM, *Liberty Development Project: Draft Environmental Impact Statement*, at 4-247 (2017).

[66] *Id.* at 3-129.

for an agency's analysis of climate effects, as well as the discount rate applied to future costs and benefits, determines how an agency treats future generations. Current central estimates of the social cost of greenhouse gases are based on a 3% discount rate and a 300-year time horizon. Executive Order 13,783 disbanded the Interagency Working Group in March 2017 and instructs agencies to reconsider the "appropriate discount rates" when monetizing the value of climate effects.[67] By citing the official guidance on typical regulatory impact analyses (namely, *Circular A-4*), the Order implicitly called into question the IWG's choice not to use a 7% discount rate. In its Sabal Remand Order, FERC suggests that the Executive Order may require use of a "7 percent (or higher)" discount rate.[68] However, use of a 7% discount would not only be inconsistent with best economic practices but would violate both NEPA's and NGA's requirements to consider impacts on future generations.

NEPA requires agencies to weigh the "relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity," as well as "any irreversible and irretrievable commitments of resources."[69] That requirement is prefaced with a congressional declaration of policy that explicitly references the needs of future generations:

> The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment . . . declares that it is the continuing policy of the Federal Government . . . to use all practicable means and measures . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and **future generations** of Americans.[70]

When the Congressional Conference Committee adopted that language, it reported that the first "broad national goal" under the statute is to "fulfill the responsibilities of each generation as trustee of the environment for future generations. It is recognized in this [congressional] statement [of policy] that each generation has a responsibility to improve, enhance, and maintain the quality of the environment *to the greatest extent possible for the continued benefit of future generations.*"[71]

Similarly, the NGA requires weighing both "the present or *future* public convenience and necessity."[72] FERC has interpreted this broadly to require consideration of "the effects of the project on *all* the affected interests."[73]

Because applying a 7% discount rate to the social cost of greenhouse gases could drop the valuation essentially to $0, use of such a rate effectively ignores the needs of future generations. Doing so would arbitrarily fail to consider an important statutory factor that Congress wrote into the requirements of both NEPA and the NGA.

Moreover, a 7% discount rate is inconsistent with best economic practices, including under Circular A-4. In 2015, OMB explained that "Circular A-4 is a ***living document***. . . . [T]he use of ***7 percent is <u>not</u> considered appropriate*** for intergenerational discounting. There is wide support for this view in the

[67] Exec. Order No. 13,783 § 5(c).
[68] Sabal Remand Order at para. 49; *see also id.* at para. 46.
[69] 42 U.S.C. § 4332(2)(C).
[70] 42 U.S.C. § 4331.
[71] *See* 115 Cong. Rec. 40419 (1969) (emphasis added); *see also* same in S. Rep. No. 91-296 (1969).
[72] 15 U.S.C. § 717f(e).
[73] 88 FERC ¶ 61,227 at p. 23.

academic literature, and it is recognized in Circular A-4 itself. "[74] While Circular A-4 tells agencies generally to use a 7% discount rate in addition to lower rates for typical rules,[75] the guidance does not intend for default assumptions to produce analyses inconsistent with best economic practices. Circular A-4 clearly supports using lower rates to the exclusion of a 7% rate for the costs and benefits occurring over the extremely long, 300-year time horizon of climate effects.

Circular A-4 requires agency analysts to do more than rigidly apply default assumptions: "You cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment."[76] As such, analysis must be "based on the best reasonably obtainable scientific, technical, and economic information available,"[77] and agencies must "***[u]se sound and defensible values*** or procedures to monetize benefits and costs, and ensure that key analytical assumptions are defensible."[78] Rather than assume a 7% discount rate should be applied automatically to every analysis, Circular A-4 requires agencies to justify the choice of discount rates for each analysis: "[S]tate in your report what assumptions were used, *such as . . . the discount rates* applied to future benefits and costs," and explain "clearly how you arrived at your estimates."[79] Based on Circular A-4's criteria, there are numerous reasons why applying a 7% discount rate to climate effects that occur over a 300-year time horizon would be unjustifiable.

First, basing the discount rate on the **<u>consumption rate of interest</u>** is the correct framework for analysis of climate effects; a discount rate based on the private return to capital is inappropriate. Circular A-4 does suggest that a 7% rate should be a "default position" for regulations that primarily displace capital investments; however, the Circular explains that "[w]hen regulation primarily and directly affects private consumption . . . *a lower discount rate is appropriate*."[80] The 7% discount rate is based on a private sector rate of return on capital, but private market participants typically have short time horizons. By contrast, climate change concerns the public well-being broadly. Rather than evaluating an optimal outcome from the narrow perspective of investors alone, applying economic theory to climate policy requires analysts to make the optimal choices based on societal preferences and social discount rates. Moreover, because climate change is expected to largely affect large-scale consumption, as opposed to capital investment,[81] a 7% rate is inappropriate.

[74] Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12,866* at 36 (July 2015) [hereinafter, OMB 2015 Response to Comments].
[75] Office of Mgmt. & Budget, *Circular A-4* at 36 (2003) ("For regulatory analysis, you should provide estimates of net benefits using both 3 percent and 7 percent....If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent.").
[76] *Id.* at 3.
[77] *Id.* at 17.
[78] *Id.* at 27 (emphasis added).
[79] *Id.* at 3 (emphasis added).
[80] *Id.* at 33 (emphasis added).
[81] "There are two rationales for discounting future benefits—one based on consumption and the other on investment. The consumption rate of discount reflects the rate at which society is willing to trade consumption in the future for consumption today. Basically, we discount the consumption of future generations because we assume future generations will be wealthier than we are and that the utility people receive from consumption declines as their level of consumption increases. . . . The investment approach says that, as long as the rate of return to investment is positive, we need to invest less than a dollar today to obtain a dollar of benefits in the future. Under the investment approach, the discount rate is the rate of return on investment. If there were no distortions or inefficiencies in markets, the consumption rate of discount would equal the rate of return on investment. There are, however, many reasons why the two may differ. As a result, using a consumption rather than investment approach will often lead to very different discount rates." Maureen Cropper, *How Should Benefits and Costs Be Discounted in an Intergenerational Context?*, 183 RESOURCES 30, 33.

In 2013, OMB called for public comments on the social cost of greenhouse gases. In its 2015 Response to Comment document,[82] OMB (together with the other agencies from the IWG) explained that

> the consumption rate of interest is the correct concept to use . . . as the impacts of climate change are measured in consumption-equivalent units in the three IAMs used to estimate the SCC. This is consistent with OMB guidance in Circular A-4, which states that when a regulation is expected to primarily affect private consumption—for instance, via higher prices for goods and services—it is appropriate to use the consumption rate of interest to reflect how private individuals trade-off current and future consumption.[83]

The Council of Economic Advisers similarly interprets Circular A-4 as requiring agencies to choose the appropriate discount rate based on the nature of the regulation: "[I]n Circular A-4 by the Office of Management and Budget (OMB) the appropriate discount rate to use in evaluating the net costs or benefits of a regulation depends on whether the regulation primarily and directly affects private consumption or private capital."[84] The National Academies of Sciences also explained that a consumption rate of interest is the appropriate basis for a discount rate for climate effects.[85] For this reason, 7% is an inappropriate choice of discount rate for the impacts of climate change.[86] Finally, each of the three integrated assessment models upon which the social cost of greenhouse gas estimates are based—DICE, FUND, and PAGE—uses consumption discount rates; a capital discount rate is thus inconsistent with the underlying models. For these reasons, 7% is an inappropriate choice of discount rate for the impacts of climate change.

Second, **uncertainty over the long time horizon** of climate effects should drive analysts to select a lower discount rate. As an example of when a 7% discount rate is appropriate, Circular A-4 identifies an EPA rule with a 30-year timeframe of costs and benefits.[87] By contrast, greenhouse gas emissions generate effects stretching out across 300 years. As Circular A-4 notes, while "[p]rivate market rates provide a reliable reference for determining how society values time within a generation, but for extremely long time periods no comparable private rates exist."[88]

[82] Note that this document was not withdrawn by Executive Order 13,783.

[83] OMB 2015 Response to Comments, *supra* note 74, at 22.

[84] Council of Econ. Advisers, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate* at 1 (CEA Issue Brief, 2017), *available at* https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf. In theory, the two rates would be the same, but "given distortions in the economy from taxation, imperfect capital markets, externalities, and other sources, the SRTP and the marginal product of capital need not coincide, and analysts face a choice between the appropriate opportunity cost of a project and the appropriate discount rate for its benefits." *Id.* at 9. The correct discount rate for climate change is the social return to capital (i.e., returns minus the costs of externalities), not the private return to capital (which measures solely the returns).

[85] NAS Second Report, *supra* note 62, at 28; *see also* Kenneth Arrow et al., *Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?*, 272 Science 221 (1996) (explaining that a consumption-based discount rate is appropriate for climate change).

[86] *See also* this article by the former chair of the NAS panel on the social cost of greenhouse gases: Richard Newell, *Unpacking the Administration's Revised Social Cost of Carbon*, Oct. 10, 2017, http://www.rff.org/blog/2017/unpacking-administration-s-revised-social-cost-carbon ("It is clearly inappropriate, therefore, to use such modeling results with OMB's 7 percent discount rate."); *see also* Comments from Robert Pindyck, to BLM, on the Social Cost of Methane in the Proposed Suspension of the Waste Prevention Rule, BLM-2017-0002-16107 (submitted Nov. 5, 2017) (explaining that 3%, not 7%, is the appropriate discount rate).

[87] Circular A-4 at 34. *See also* OMB 2015 Response to Comments, *supra* note 74, at 21 ("While most regulatory impact analysis is conducted over a time frame in the range of 20 to 50 years . . . ").

[88] Circular A-4 at 36.

Circular A-4 discusses how uncertainty over long time horizons drives the discount rate lower: "the longer the horizon for the analysis," the greater the "uncertainty about the appropriate value of the discount rate," which supports a lower rate.[89] Circular A-4 cites the work of renowned economist Martin Weitzman and concludes that the "certainty-equivalent discount factor corresponds to ***the minimum discount rate having any substantial positive probability***."[90] The NAS makes the same point about discount rates and uncertainty.[91] In fact, as discussed more below and in the technical appendix on discounting, uncertainty over the discount rate is best addressed by adopting a declining discount rate framework.

Third, a 7% discount rate **ignores catastrophic risks and the welfare of future generations**. As demonstrated in the frequency distribution graphs included in some agencies' recent and misguided attempts to calculate the social cost of greenhouse gases at a 7% discount rate,[92] the 7% rate truncates the long right-hand tail of social costs relative to the 3% rate's distribution. The long right-hand tail represents the possibility of catastrophic damages. The 7% discount rate effectively assumes that present-day Americans are barely willing to pay anything at all to prevent medium- to long-term catastrophes. This assumption violates statutory duties under NEPA and the NGA to protect the future needs of Americans. At the same time, the 7% distribution also misleadingly exaggerates the possibility of negative estimates of the social cost of greenhouse gases.[93] A negative social cost of greenhouse gases implies a discount rate so high that society is willing to sacrifice serious impacts to future generations for the sake of small, short-term benefits (such as slightly and temporarily improved fertilization for agriculture). Again, this assumption contravenes statutory responsibilities to protect the welfare of future Americans.

Fourth, a 7% discount rate would be inappropriate for climate change because it is based on **outdated data and diverges from the current economic consensus**. Circular A-4 requires that assumptions—including discount rate choices—are "based on the best reasonably obtainable scientific, technical, and economic information available."[94] Yet Circular A-4's own default assumption of a 7% discount rate was published 14 years ago and was based on data from decades ago.[95] Circular A-4's guidance on discount rates is in need of an update, as the Council of Economic Advisers detailed in 2017 after reviewing the best available economic data and theory:

> The discount rate guidance for Federal policies and projects was last revised in 2003. Since then a general reduction in interest rates along with a reduction in the forecast of

[89] *Id.*

[90] *Id.* (emphasis added); *see also* CEA, *supra* note 84, at 9: "Weitzman (1998, 2001) showed theoretically and Newell and Pizer (2003) and Groom et al. (2007) confirm empirically that discount rate uncertainty can have a large effect on net present values. A main result from these studies is that if there is a persistent element to the uncertainty in the discount rate (e.g., the rate follows a random walk), then it will result in an effective (or certainty-equivalent) discount rate that declines over time. Consequently, lower discount rates tend to dominate over the very long term, regardless of whether the estimated investment effects are predominantly measured in private capital or consumption terms (see Weitzman 1998, 2001; Newell and Pizer 2003; Groom et al. 2005, 2007; Gollier 2008; Summers and Zeckhauser 2008; and Gollier and Weitzman 2010)."

[91] NAS Second Report, *supra* note 62, at 27.

[92] *E.g.*, EPA, *Estimated Cost Savings and Forgone Benefits Associated with the Proposed Rule, "Oil and Natural Gas: Emission Standards for New, Reconstructed, and Modified Sources: Stay of Certain Requirements"* at 19 (Oct. 17, 2017).

[93] In the Monte Carlo simulation data from EPA, the 7% discount rate doubles the frequency of negative estimates compared to the 3% discount rate simulations, from a frequently of 4% to 8%.

[94] CEQ regulations implementing NEPA similarly require that information in NEPA documents be "of high quality" and states that "[a]ccurate scientific analysis . . . [is] essential to implementing NEPA." 40 C.F.R. § 1500.1(b).

[95] The 7% rate was based on a 1992 report; the 3% rate was based on data from the thirty years preceding the publication of Circular A-4 in 2003. Circular A-4 at 33.

> long-run interest rates, warrants serious consideration for a reduction in the discount rates used for benefit-cost analysis.[96]

In addition to recommending a value below 7% as the discount factor based on private capital returns, the Council of Economic Advisers further explains that, because long-term interest rates have fallen, a discount rate based on the consumption rate of interest "should be at most 2 percent."[97] The latest OMB updates to Circular A-94, the document on which Circular A-4 based its discount rates,[98] also show that more up-to-date long-run discount rates are historically low. In the February 2018 update to Circular A-94's discount rates, OMB found that the real, 30-year discount rate is 0.6 percent,[99] the lowest rate since the OMB began tracking the number.[100] Notably, OMB also shows that the current real interest rate is negative for maturities less than 7 years.[101]

These low interest rates further confirm that applying a 7% rate to a context like climate change would be wildly out of step with the latest data and theory. Similarly, recent expert elicitations—a technique supported by Circular A-4 for filling in gaps in knowledge[102]—indicate that a growing consensus among experts in climate economics for a discount rate between 2% and 3%; 5% represents the upper range of values recommended by experts, and few to no experts support discount rates greater than 5% being applied to the costs and benefits of climate change.[103] Based on current economic data and theory, the most appropriate discount rate for climate change is 3% or lower.

Fifth, Circular A-4 requires more of analysts than giving all possible assumptions and scenarios equal attention in a sensitivity analysis; if alternate assumptions would fundamentally change the decision, Circular A-4 requires analysts to select the **most appropriate assumptions from the sensitivity analysis**.

Circular A-4 indicates that significant intergenerational effects will warrant a special sensitivity analysis focused on discount rates even lower than 3%:

> Special ethical considerations arise when comparing benefits and costs across generations. . . It may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations. . . If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent.[104]

[96] CEA, *supra* note 84, at 1; *id.* at 3 ("In general the evidence supports lowering these discount rates, with a plausible best guess based on the available information being that the lower discount rate should be at most 2 percent while the upper discount rate should also likely be reduced."); *id.* at 6 ("The Congressional Budget Office, the Blue Chip consensus forecasts, and the Administration forecasts all place the ten year treasury yield at less than 4 percent in the future, while at the same time forecasting CPI inflation of 2.3 or 2.4 percent per year. The implied real ten year Treasury yield is thus below 2 percent in all these forecasts.").

[97] *Id.* at 1.

[98] Circular A-4 at 33.

[99] OMB Circular A-94 Appendix C (2018).

[100] https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/a94/dischist-2017.pdf.

[101] Circular A-94 Appendix C.

[102] Circular A-4 at 41.

[103] Peter Howard & Derek Sylvan, *The Economic Climate: Establishing Expert Consensus on the Economics of Climate Change* (Inst. Policy Integrity Working Paper 2015/1); M.A. Drupp, et al., *Discounting Disentangled: An Expert Survey on the Determinants of the Long-Term Social Discount Rate* (London School of Economics and Political Science Working Paper, May 2015) (finding consensus on social discount rates between 1-3%).

[104] Circular A-4 at 35-36.

Elsewhere in Circular A-4, OMB clarifies that sensitivity analysis should not result in a rigid application of all available assumptions regardless of plausibility. Circular A-4 instructs agencies to depart from default assumptions when special issues "call for different emphases" depending on "the sensitivity of the benefit and cost estimates to the key assumptions."[105] More specifically:

> If benefit or cost estimates depend heavily on certain assumptions, you should make those assumptions explicit and carry out *sensitivity analyses using plausible alternative assumptions*. If the value of net benefits changes from positive to negative (or vice versa) or if the relative ranking of regulatory options changes with alternative plausible assumptions, you should conduct further analysis to determine ***which of the alternative assumptions is more appropriate***.[106]

In other words, if using a 7% discount rate would fundamentally change the agency's decision compared to using a 3% or lower discount rate, the agency must evaluate which assumption is most appropriate. Since OMB, the Council of Economic Advisers, the National Academies of Sciences, and the economic literature all conclude that a 7% rate is inappropriate for climate change, agencies should select a 3% or lower rate. Applying a 7% rate to climate effects cannot be justified "based on the best reasonably obtainable scientific, technical, and economic information available" and is inconsistent with the proper treatment of uncertainty over long time horizons.

Finally, to the extent there is uncertainty around the discount rate over long periods of time, the growing economic consensus supports shifting to a declining discount rate framework. Circular A-4 contemplates the use of declining discount rates in its reference to the work of Weitzman.[107] As the Council of Economic Advisers explained earlier this year, Weitzman and others developed the foundation for a declining discount rate approach, wherein rates start relatively higher for near-term costs and benefits but steadily decline over time according to a predetermined schedule until, in the very long-term, very low rates dominate due to uncertainty.[108] The National Academies of Sciences' report also strongly endorses a declining discount rate approach due to uncertainty.[109] In other words, the rational response to a concern about uncertainty over the discount rate is not to abandon the social cost of greenhouse gas methodology, but to apply declining discount rates and to treat the estimates calculated at a constant 3% rate as conservative lower-bound estimates.

One possible schedule of declining discount rates was proposed by Weitzman.[110] It is derived from a broad survey of top economists and other climate experts and explicitly incorporates arguments around interest rate uncertainty. Work by Arrow *et al*, Cropper *et al*, and Gollier and Weitzman, among others,

[105] *Id.* at 3.

[106] *Id.* at 42 (emphasis added).

[107] Circular A-4, at page 36, cites to Weitzman's chapter in Portney & Weyant, eds. (1999); that chapter, at page 29, recommends a declining discount rate approach: "a sliding-scale social discounting strategy" with the rate at 3-4% through year 25; then around 2% until year 75; then around 1% until year 300; and then 0% after year 300.

[108] CEA, *supra* note 84, at 9 ("[A]nother way to incorporate uncertainty when discounting the benefits and costs of policies and projects that accrue in the far future—applying discount rates that decline over time. This approach uses a higher discount rate initially, but then applies a graduated schedule of lower discount rates further out in time. The first argument is based on the application of the Ramsey framework in a stochastic setting (Gollier 2013), and the second is based on Weitzman's 'expected net present value' approach (Weitzman 1998, Gollier and Weitzman 2010). In light of these arguments, the governments of the United Kingdom and France apply declining discount rates to their official public project evaluations.").

[109] NAS Second Report, *supra* note 62.

[110] Martin L. Weitzman, *Gamma Discounting*, 91 AM. ECON. REV. 260, 270 (2001). Weitzman's schedule is as follows:

1-5 years	6-25 years	26-75 years	76-300 years	300+ years
4%	3%	2%	1%	0%

similarly argue for a declining interest rate schedule and lay out the fundamental logic.[111] Another schedule of declining discount rates has been adopted by the United Kingdom.[112]

The technical appendix on discounting attached to these comments more thoroughly reviews the various schedules of declining discount rates available for agencies to select and explains why agencies not only can but should adopt a declining discount framework to address uncertainty. An additional technical appendix on uncertainty explains in detail why uncertainty around the social cost of greenhouse gas points toward higher values. Shifting to a declining discount rate framework would increase the social cost of greenhouse gases.[113] Consequently, a central estimate calculated at 3% should be considered a lower-bound of the social cost of greenhouse gases. But even providing a lower-bound estimate of the social cost of greenhouse gases helps inform decisionmakers and the public, and FERC is required by NEPA to provide some monetization of climate damages, consistent with economic best practices.

Similarly, a 300-year time horizon is required by best economic practices. In 2017, the National Academies of Sciences issued a report stressing the importance of a longer time horizon for calculating the social cost of greenhouse gases. The report states that, "[i]n the context of the socioeconomic, damage, and discounting assumptions, the time horizon needs to be long enough to capture the vast majority of the present value of damages."[114] The report goes on to note that the length of the time horizon is dependent "on the rate at which undiscounted damages grow over time and on the rate at which they are discounted. Longer time horizons allow for representation and evaluation of longer-run geophysical system dynamics, such as sea level change and the carbon cycle."[115] In other words, after selecting the appropriate discount rate based on theory and data (in this case, 3% or below), analysts should determine the time horizon necessary to capture all costs and benefits that will have important net present values at the discount rate. Therefore, a 3% or lower discount rate for climate change implies the need for a 300-year horizon to capture all significant values. NAS reviewed the best available, peer-reviewed scientific literature and concluded that the effects of greenhouse gas emissions over a 300-year period are sufficiently well established and reliable as to merit consideration in estimates of the social cost of greenhouse gases.[116]

The Social Cost of Greenhouse Gas Metrics Provides a Tool to Assess the Significance of Individual Physical Impacts

In *EarthReports*, FERC had argued that the social cost of greenhouse gas "tool does not measure the actual incremental impacts of a project on the environment."[117] FERC now admits that statement was

[111] Kenneth J. Arrow et al., *Determining Benefits and Costs for Future Generations*, 341 SCIENCE 349 (2013); Kenneth J. Arrow et al., *Should Governments Use a Declining Discount Rate in Project Analysis?*, REV ENVIRON ECON POLICY 8 (2014); Maureen L. Cropper et al., *Declining Discount Rates*, AMERICAN ECONOMIC REVIEW: PAPERS AND PROCEEDINGS (2014); Christian Gollier & Martin L. Weitzman, *How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?* 107 ECONOMICS LETTERS 3 (2010).

[112] Joseph Lowe, H.M. Treasury, U.K., Intergenerational Wealth Transfers and Social Discounting: Supplementary Green Book Guidance 5 (2008), *available at* http://www.hm-treasury.gov.uk/d/4(5).pdf. The U.K. declining discount rate schedule that subtracts out a time preference value is as follows:

0-30 years	31-75 years	76-125 years	126-200 years	201-300 years	301+ years
3.00%	2.57%	2.14%	1.71%	1.29%	0.86%

[113] This assumes the use of reasonable values in the Ramsey equation. But in general, as compared to a constant discount rate, a declining rate approach should decrease the effective discount rate.

[114] NAS Second Report, *supra* note 62, at 78.

[115] *Id.*

[116] NAS First Report, *supra* note 62, at 32.

[117] *See* Sabal Remand Order para. 47.

wrong, and the metric does capture the incremental physical impacts of climate change.[118] Nevertheless, FERC continues to repeat that "there is no standard methodology to determine how a project's relatively small incremental contribution to GHGs would translate into physical effects on the global environment."[119] Such statements are also wrong. The social cost of greenhouse gas methodology is well suited to measure the marginal climate damages of individual projects. These protocols were developed to assess the cost of actions with "marginal" impacts on cumulative global emissions, and the metrics estimate the dollar figure of damages for one extra unit of greenhouse gas emissions. This marginal cost is calculated using integrated assessment models. These models translate emissions into changes in atmospheric greenhouse concentrations, atmospheric concentrations into changes in temperature, and changes in temperature into economic damages. A range of plausible socio-economic and emissions trajectories are used to account for the scope of potential scenarios and circumstances that may actually result in the coming years and decades. The marginal cost is attained by first running the models using a baseline emissions trajectory, and then running the same models again with one additional unit of emissions. The difference in damages between the two runs is the marginal cost of one additional unit. The approach assumes that the marginal damages from increased emissions will remain constant for small emissions increases relative to gross global emissions. In other words, the monetization tools are in fact perfectly suited to measuring the marginal effects of individual projects or other discrete agency actions.

Going forward, FERC should scrub from its environmental reviews and orders any misleading statements about the supposed lack of a methodology to link a single project's emissions with global climate change. Instead, FERC should more consistently acknowledge that the social cost of greenhouse gas methodology (and the underlying integrated assessment models) can link the marginal emissions of a single project to the incremental physical impacts of climate change.

Despite FERC's occasional (if inconsistent) acknowledgment that the social cost of greenhouse gas methodology can capture incremental physical impacts, FERC has continued to insist that "although the integrated assessment models could be run through a first phase to estimate . . . physical climate change impacts . . ., we would still have to arbitrarily determine what potential increase in atmospheric GHG concentration, rise in sea level, rise in sea water temperatures, and other calculated physical impacts would be significant for that particular pipeline project."[120] More generally, FERC claims there is a lack of any "standard" or "criteria" to determine the significance of a project's greenhouse gas emissions, and insists that "any attempt by the Commission to create a significance threshold would be arbitrary."[121] FERC also suggests that monetizing the climate damages will not help, "because we have no basis to designate a particular dollar figure . . . as 'significant.'"[122] Finally, FERC insists that applying the social cost of greenhouse metric is useless, because "any two projects with the same capacity" would "contribute identically to global climate change" anyway, and thus monetization reveals no difference in

[118] *Id.* at para. 48.

[119] E.g., FERC, *Environmental Assessment: Rivervale South to Market Project* at 59 (2018). *See also* 83 Fed. Reg. at 18,029 (noting "the difficulty in identifying the extent to which a specific action or project may contribute to overall climate change, given that climate change results from the cumulative buildup of carbon dioxide and other GHGs, rather than from the incremental emissions of any one project.").

[120] Sabal Remand Order at para. 48.

[121] 83 Fed. Reg. at 18,029 ("[T]here is no standard established by international or federal policy, or by a recognized scientific body that the Commission could rely on in determining whether project-specific GHG emissions are significant.")

[122] Sabal Remand Order at para. 51; *see also id.* at para. 50.

significance between the effects of the alternatives.[123] Throughout this line of argument about significance, FERC repeatedly misunderstands the value of using the social cost of greenhouse gas tool.

First, a key advantage of using the social cost of greenhouse gas tool is that each physical impact—such as sea-level rise and increasing temperatures—need not be assessed in isolation. Instead, the social cost of greenhouse gas tool conveniently groups together the multitude of climate impacts and, consistent with NEPA regulations,[124] enables agencies to assess whether all those impacts are cumulatively significant and to then compare those impacts with other impacts or alternatives using a common metric.

Second, contrary to how FERC characterizes our position in the Notice of Inquiry, neither in these comments nor in past comments submitted jointly on the social cost of greenhouse gases do our organizations "argue that all projects relying on fossil fuels should be considered to cause a significant impact on climate change."[125] Rather, we argue that FERC should use its reasonable judgment to assess whether monetized climate damages are significant, especially in light of other costs and benefits. While the relative significance of 20,000 additional tons per year of carbon dioxide versus 2 million additional tons per year may be challenging to discern, the relative significance of $1 million per year in climate damages versus $100 million per year in climate damages is much easier to discern, especially when compared to FERC's reasonable judgments about the project's other qualitative, quantitative, and monetized costs and benefits. While judging the significance of $100 million in climate damages will require FERC's professional judgment, by monetizing the effects, FERC will be in familiar territory, as the Commission routinely evaluates the relative importance of millions, hundreds of millions, and billions of dollars' worth of costs and benefits in many contexts. Using the social cost of greenhouse gas metrics helps FERC apply its expertise and judgment as an economic regulator to the climate context.

Third, FERC takes an overly narrow view when it suggests that the social cost of greenhouse gas metrics yield little insight into comparing the significance of two projects with identical capacity. Even assuming that is true,[126] FERC is not required to look only at projects with identical capacity.[127] To the contrary, FERC is required to look at least at a no-action alternative under NEPA.[128] Furthermore, FERC is able to assess a broad range of alternatives, including pipelines with different capacities, and the social cost of greenhouse gas metric is an exceedingly useful tool to compare the impacts of such projects. Additionally, even projects of the same capacity could have different estimates of public benefits, and the social cost of greenhouse gas metric would allow FERC to more transparently weigh those estimated benefits against climate costs.

Finally, while there may not be a bright-line test for significance, several cases suggest that, minimally, projects with estimated emissions of over 1 million tons of carbon dioxide-equivalent emissions per year warrant monetization—and projects with fewer emissions may have significant climate damages as well.

[123] *Id.* at para. 51.
[124] 40 C.F.R. § 1508.27(b)(7) (explaining that actions can be significant if related to individually insignificant but cumulatively significant impacts).
[125] 83 Fed. Reg. at 18,029.
[126] In fact, different projects with the same capacity could have, for example, somewhat different upstream emissions or direct emissions, depending on such operational decisions as managing methane releases during extraction, limiting carbon dioxide emissions during construction, or controlling methane leaks along the pipeline; leaks may also vary with pipeline length.
[127] Note that FERC misstates the standard under NEPA when the Notice of Inquiry say that "an agency need only evaluate alternatives that can satisfy the purpose and need of the proposed project." 83 Fed. Reg. at 18,022.
[128] 40 C.F.R. § 1502.14 (requiring agencies to "[r]igorously explore and objectively evaluate all reasonable alternatives," including "reasonable alternative not within the jurisdiction of the lead agency" and, minimally, "the alternative of no action").

In *High Country*, the U.S. District Court for the District of Colorado found that it was arbitrary for the Forest Service not to monetize the "1.23 million tons of carbon dioxide equivalent emissions [from methane] the West Elk mine emits annually."[129] That suggests that emissions in that range are significant and warrant monetization. In *Montana Environmental Information Center*, the U.S. District Court for the District of Montana found it was arbitrary for the Office of Surface Mining not to monetize the 23.16 million metric tons per year from that mine expansion.[130] In *Center for Biological Diversity*, the U.S. Court of Appeals for the Ninth Circuit found that it was arbitrary for the Department of Transportation not to monetize the 35 million metric ton difference in lifetime emissions from increasing the fuel efficiency of motor vehicles:[131] given the estimated lifetime of vehicles sold in the years 2008-2011 (sometimes estimated at about 15 years on average), this could represent two million metric tons per year. In a recent environmental impact statement from the Bureau of Ocean Energy Management published in August 2017, the agency explained that the social cost of carbon was "a useful measure" to apply to a NEPA analysis of an action anticipated to have a difference in greenhouse gas emissions compared to the no-action baseline of about 25 million metric tons over a 5-year period,[132] or about 5 million metric tons per year.

Monetizing Climate Damages Is Appropriate and Useful Regardless of Whether Every Effect Can Be Monetized in a Full Cost-Benefit Analysis

FERC has argued that while the social cost of greenhouse gas metrics are useful in the context of a cost-benefit analysis,[133] FERC ostensibly "does not conduct a monetary cost-benefit analysis in its NEPA review,"[134] and its assessment of public convenience and necessity in pipeline certifications is "qualitative" only—"we do not monetize."[135] According to FERC, adding the social cost of greenhouse gases to either the NEPA review or the certification review would require quantifying and monetizing "all" of the project's other positive and negative effects.[136] Similarly, the Notice of Inquiry assumes that using the social cost of greenhouse gases will necessitate that FERC "acquire complete information to appropriately quantify all of the monetized costs/negative impacts and monetized benefits of a proposed project."[137] This is wrong for two reasons. First, FERC does quantify and monetize other non-climate effects in both its NEPA analyses and its reviews of public convenience and necessity. Second, monetizing one key impact still provides useful information for decisonmakers and the public even when monetizing other impacts is not feasible. The social cost of greenhouse gases enables a more accurate and transparent comparison of alternatives along the dimension of climate impacts even if other costs and benefits cannot be quantified, and "breakeven analysis" could provide a framework for making decisions when some effects but not others are monetized.

First, FERC does at times rely on both quantified and monetized values to inform its NEPA analyses and its reviews of public convenience and necessity. As discussed above, FERC's environmental impact

[129] 52 F. Supp. 3d at 1191 (quoting an e-mail comment on the draft statement for the quantification of tons).
[130] *Mont. Envtl. Info. Ctr. v. U.S. Office of Surface Mining*, 274 F. Supp. 3d 1074, 1094 (D. Mont. 2017).
[131] 538 F.3d at 1187.
[132] BOEM, *Liberty Development and Production Plan Draft EIS* at 3-129, 4,50 (2017) (89,940,000 minus 64,570,000 is about 25 million).
[133] *Final Supplemental EIS for Southeast Market Pipelines Project* at 8 ("The SCC tool may be useful for rulemakings or comparing regulatory alternatives using cost-benefit analyses where the same discount rate is consistently applied.")
[134] Sabal Remand Order, para. 40.
[135] *Id.* at para. 43.
[136] *Id.* at para. 41; *id.* at para. 44 ("We do not monetize the social benefits of the proposed project itself, which would be necessary to appropriately balance against the Social Cost of Carbon tool's monetized damages.").
[137] 83 Fed. Reg. at 18,032.

statements regularly monetize "economic benefits" including direct and indirect labor income, expenditures, tax revenues, and other "long-term benefits to the local and regional economy."[138] Nothing about those economic benefits suggests a stronger case for monetizing them than for monetizing climate costs. Employment effects, for example, could easily be presented quantitatively as changes in job-years rather than monetized as labor income, or could be discussed qualitatively in terms of the general effect on regional and sectoral labor markets. Agencies instead monetize the labor income to help explain employment effects with the kind of informational context that the public and decisionmakers need to understand the nature and degree of the effect. But the same is true of the social cost of greenhouse gas metrics, as discussed at length above in these comments.

Examples from past NGA reviews also show that, contrary to FERC's claims of qualitative-only assessments, FERC does rely on quantitative and monetized data to weigh public convenience and necessity, and has done so without necessarily undertaking a full cost-benefit analysis. For example, in 2012 FERC issued a certificate of public convenience and necessity to Millennium Pipeline Company to construct and operate the Minisink Compressor Project.[139] FERC concluded that "the benefits of the project" justified "the minimal adverse effect on existing shippers, other pipelines and their captive customers."[140] To make that determination, FERC had asked Millennium to "explain how [the company] will protect the shippers on the existing system from any rate impact or costs."[141] In response, Millennium submitted a spreadsheet listing quantitative data on loads and monetized fuel cost forecasts.[142] This quantitative and monetized data with respect to possible adverse effects surely informed FERC's majority decision to issue the certificate of public convenience and necessity. Furthermore, FERC's order compared two alternative options by quantitatively considering acres of forested land impacted (47.61 acres versus 0.4 acres), sensitive wetlands impacts (11 versus 0), and special status species impacts (5 versus 1).[143] Similarly, Chairman Wellinghoff's dissent from that order preferred an alternative to the proposed compressor project in part because of monetized estimates of the $1.6 million difference in annual fuel costs.[144] Even without a full cost-benefit analysis, FERC considered quantitative and monetized data to determine the public convenience and necessity.

Second, climate damages can and should be monetized even if other costs and benefits are harder to quantify or monetize and so must be discussed qualitatively. Many effects can readily be quantified and monetized, and agencies should generally do so when feasible; other effects, like water quality, are notoriously difficult to quantify and monetize, due to the geographically idiosyncratic nature of individual water bodies. Greenhouse gases, by comparison, have the same impact on climate change no matter where they are emitted, and those impacts are readily monetized using the social cost of greenhouse methodology. Regardless of whether all other effects can be monetized, using the social cost of greenhouse gases provides useful and necessary information to the public and decisionmakers. In particular, whether or not other effects are monetized, using the social cost of greenhouse gases will facilitate comparison between alternative options along the dimension of climate change. As discussed

[138] E.g., FERC, *Final Environmental Impact Statement for Southeast Market Pipelines Project* at 3-185 to 3-214 (2015).
[139] 140 FERC ¶ 61,045 (July 17, 2012) (docket CP11-515-000). *See also supra*, explaining and distinguishing the D.C. Circuit's ruling in *Minisink*: there, the court never said that monetized costs and benefits were inappropriate or irrelevant to FERC's NEPA analyses, but only that a fully monetized cost-benefit analysis was not required, such that FERC did not need to base its decision solely on the summation of monetized costs and benefits.
[140] 140 FERC ¶ 61,045 at para. 15.
[141] Millennium Response to FERC Staff Data Requests, submitted Sept. 30, 2011 to docket CP11-515-000 (see request No. 2(c)).
[142] *Id.* (attachment DR-AR-2.xlxs).
[143] 140 FERC ¶ 61,045 at para. 27; *see also Minisink Residents for Envtl. Pres. v. FERC*, 762 F.3d 97, 107 n.5 (D.C. Cir. 2014) (recounting the quantitative comparison of two alternatives).
[144] 140 FERC ¶ 61,045: Wellinghoff dissent at page 2.

above, different alternatives could have varying greenhouse gas consequences over time, and monetization provides the best means of comparing project alternatives along the dimension of climate change.

Moreover, analytical frameworks exist to weigh qualitative effects alongside monetized effects. For example, while NEPA regulations do state that if there are "important qualitative considerations," then the ultimate "weighing of the merits and drawbacks of the various alternatives" should not be displayed exclusively as a "monetary cost-benefit analysis," nevertheless NEPA regulations also acknowledge that when monetization of costs and benefits is "relevant to the choice among environmentally different alternatives," "that analysis" can be presented alongside "any analyses of unquantified environmental impacts, values, and amenities."[145] In other words, the monetization of some impacts does not require the monetization of all impacts.

The Office of Management and Budget's *Circular A-4*[146] guidance to agencies on conducting economic analysis also provides a framework for weighing monetized and qualitative costs and benefits, called break-even analysis:

> It will not always be possible to express in monetary units all of the important benefits and costs. When it is not, the most efficient alternative will not necessarily be the one with the largest quantified and monetized net-benefit estimate. In such cases, you should exercise professional judgment in determining how important the non-quantified benefits or costs may be in the context of the overall analysis. If the non-quantified benefits and costs are likely to be important, you should carry out a "threshold" analysis to evaluate their significance. Threshold or "break-even" analysis answers the question, "How small could the value of the non-quantified benefits be (or how large would the value of the non-quantified costs need to be) before the rule would yield zero net benefits?" In addition to threshold analysis you should indicate, where possible, which non-quantified effects are most important and why.[147]

Even without using something as formal as a break-even analysis, it is clear that monetizing climate damages provides useful information whether or not every effect can be monetized in a full cost-benefit analysis.

Monetization Is Appropriate and Useful in Any Decision with Significant Climate Impacts, Not Just Regulations and Not Just Direct Production Authorizations

FERC argues that the social cost of greenhouse gas tool is only "appropriate[ ]" for "regulators whose responsibilities are tied more directly" to "authoriz[ing] a quantity of coal, oil, or natural gas production from federal lands," or "directly control[ling] whether some quantity of fossil fuels is burned."[148] In contrast, FERC argues that its certifications have "no direct connection to the production or end use of natural gas."[149]

First, it is unclear why FERC believes that the Department of Energy's appliance efficiency standards—which FERC cites as an appropriate context for the use of the social cost of greenhouse gases—are that different from FERC's pipeline certifications. Contrary to FERC's assertion, the Department of Energy does not "directly control whether some quantity of fossil fuels is burned." Rather, appliance efficiency

[145] 40 C.F.R. § 1502.23.
[146] Though FERC is not bound by Executive Order 12,866, and though *Circular A-4* focuses on agencies' regulatory analyses under Executive Order 12,866, the document nevertheless more generally has distilled best practices on economic analysis and is a useful guide to all agencies undertaking an assessment of costs and benefits.
[147] OMB, Circular A-4 at 2 (2003).
[148] Sabal Remand Order, para. 37.
[149] *Id.* at para. 38.

standards alter how much energy is required to operate an appliance, thus changing the fuel cost to consumers per unit of operation. The appliance efficiency standards only change greenhouse gas emissions by changing consumer demand for energy, as mediated by changing prices and by the fuel mix of the electricity generators and other energy sources that supply the consumers. Quite similarly, FERC's pipeline certifications affect greenhouse gas emissions by changing the supply, price, and demand of natural gas. It is notable that the Department of Energy has routinely used the social cost of greenhouse gases to monetize the climate effects of its appliance efficiency standards, and the U.S. Court of Appeals for the Seventh Circuit has ruled that the Department of Energy's use of the social cost of greenhouse gas estimates in analyzing and setting such standards was reasonable.[150]

Second, FERC is ignoring other uses of the social cost of greenhouse gas tool by agencies outside of direct authorizations of fossil fuel production or direct controls of combustion. For example, the Pipeline and Hazardous Materials Safety Administration has used the social cost of methane and social cost of carbon in analyses of regulations that will affect the accidental or intentional release or flaring of natural gas.[151] The Army Corps of Engineers has used the social cost of carbon when its river management plans could affect hydropower generation and so indirectly "leads to an increase in thermal power generation to meet the demand, which increases carbon dioxide, methane, and nitrous oxide emissions."[152] And the Environmental Protection Agency has used the social cost of carbon to assess its regulation of coal power plants' water pollution,[153] which does not "directly control" the air emissions from burning fossil fuels, but rather only changes the price of operations that combust fossil fuels. Agencies have appropriately used the social cost of greenhouse gas metrics in a variety of contexts where their actions will directly or indirectly affect climate change.

Ultimately, the question raised by FERC is one of quantification, not monetization: namely, how many tons of emissions should be attributed to FERC's certification reviews. If quantifiable changes in greenhouse gas emissions are appropriately attributed to actions taken by FERC, then the climate damages associated with those quantified emission changes should also be monetized.

As for the related implication that the social cost of greenhouse gas metrics may be used only in regulatory impact analyses,[154] that misunderstands the nature of the estimates. Though the federal Interagency Working Group originally developed its estimates of the social cost of greenhouse gases to harmonize the metrics used by agencies in their various regulatory impact analyses, there is nothing in the numbers' development that would limit applications to other decisionmaking contexts. The social cost of greenhouse gases measures the marginal cost of any additional unit of greenhouse gases emitted into the atmosphere. The government action that precipitated that unit of emissions—a regulation, the granting of a permit, or a project approval—is irrelevant to the marginal climate damages caused by the

[150] Zero Zone v. Dept. of Energy, 832 F.3d 654, 679 (7th Cir. 2016).

[151] PHMSA, *Preliminary Regulatory Impact Assessment: Safety of Gas Transmission and Gathering Pipelines* (2016), https://www.regulations.gov/document?D=PHMSA-2011-0023-0117; PHMSA, *Regulatory Impact Analysis: Pipeline Safety: Expanding the Use of Excess Flow Valves in Gas Distribution Systems* (2015), https://www.regulations.gov/document?D=PHMSA-2011-0009-0030.

[152] U.S Army Corps, *Draft Missouri River Recovery Management Plan & Environmental Impact Statement* at 3-335 (2016), https://cdm16021.contentdm.oclc.org/digital/collection/p16021coll7/id/3095 (further explaining that the "social cost of carbon (SCC) value was used to approximate a monetary value associated with carbon emissions").

[153] Effluent Limitation Guidelines and Standards for the Steam Electric Power Generating Point Source Category, 80 Fed. Reg. 67,838, 67,880 (finalized Nov. 3, 2015) (applying the social cost of carbon based on "the change in the profile of electricity generation due to the relatively higher cost to generate electricity at plants incurring compliance costs"); National Pollutant Discharge Elimination System: Cooling Water Intake Structures at Existing Facilities, 79 Fed. Reg. 48,300, 48,304 (Aug. 15, 2014).

[154] *Final Supplemental EIS for Southeast Market Pipelines Project* at 8 ("The SCC tool may be useful for rulemakings . . . .")

emissions. Whether emitted by a leaking pipeline or the extraction process, whether emitted because of a regulation or a resource management decision, whether emitted in Alaska or Maine, the marginal climate damages per unit of emissions remain the same. Indeed, the social cost of greenhouse gases has been used by many federal and state agencies in environmental impact reviews[155] and in resource management decisions.[156]

Uncertainty Supports Higher Social Cost of Greenhouse Gas Estimates, and Is Never a Reason to Abandon the Metric

FERC complains that "[w]ithout complete information," the social cost of greenhouse gases is "based on multiple assumptions" and so is "[m]isleading."[157] In fact, it would be much more misleading to not monetize climate damages and so risk treating them as worthless. More generally, uncertainty is *not* a reason to abandon the social cost of greenhouse gas methodologies;[158] quite the contrary, uncertainty supports higher estimates of the social cost of greenhouse gases, because most uncertainties regarding climate change entail tipping points, catastrophic risks, and unknown unknowns about the damages of climate change. Because the key uncertainties of climate change include the risk of irreversible catastrophes, applying an options value framework to the regulatory context strengthens the case for ambitious regulatory action to reduce greenhouse gas emissions.

There are numerous well-established, rigorous analytical tools available to help agencies characterize and quantitatively assess uncertainty, such as Monte Carlo simulations, and the IWG's social cost of greenhouse gas protocol incorporates those tools. To further deal with uncertainty, the IWG recommended to agencies a range of four estimates: three central or mean-average estimates at a 2.5%, 3%, and 5% discount rate respectively, and a 95th percentile value at the 3% discount rate. While the IWG's technical support documents disclosed fuller probabilities distributions, these four estimates were chosen by agencies to be the focus for decisionmaking. In particular, application of the 95th percentile value was not part of an effort to show the probability distribution around the 3% discount rate; rather, the 95th percentile value serves as a methodological shortcut to approximate the uncertainties around low-probability but high-damage, catastrophic, or irreversible outcomes that are currently omitted or undercounted in the economic models.

The shape of the distribution of climate risks and damages includes a long tail of lower-probability, high-damage, irreversible outcomes due to "tipping points" in planetary systems, inter-sectoral interactions, and other deep uncertainties. Climate damages are not normally distributed around a central estimate, but rather feature a significant right skew toward catastrophic outcomes. In fact, a 2015 survey of

[155] For example, in August 2017, the Bureau of Ocean Energy Management called the social cost of carbon "a useful measure to assess the benefits of CO2 reductions and inform agency decisions," and applied the metric in an environmental impact statement to monetize the emissions difference of about 5 million metric tons per year between the proposed oil and gas development project and the no-action baseline, *Draft Environmental Impact Statement—Liberty Development Project in the Beaufort Sea, Alaska* at 3-129, 4-50 (2017). More generally, agencies have used IWG's social cost of greenhouse gas estimates not only in scores of rulemakings but also in NEPA analyses for resource management decisions. *See* Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Columbia J. Envtl. L. 203, 270-84 (2017) (listing all uses by federal agencies through July 2016).

[156] States have used the social cost of greenhouse gases in decisions about electricity planning. *See* Iliana Paul et al., *The Social Cost of Greenhouse Gases and State Policy: A Frequently Asked Questions Guide* (Policy Integrity Report, 2017), http://policyintegrity.org/files/publications/SCC_State_Guidance.pdf.

[157] Sabal Remand Order, para 41.

[158] *Center for Biological Diversity v. NHTSA*, 538 F.3d 1172, 1200 (9th Cir. 2008) ("[W]hile the record shows that there is a range of values, the value of carbon emissions reductions is certainly not zero.").

economic experts concludes that catastrophic outcomes are increasingly likely to occur.[159] Because the three integrated assessment models that the IWG's methodology relied on are unable to systematically account for these potential catastrophic outcomes, a 95th percentile value was selected instead to account for such uncertainty. There are no similarly systematic biases pointing in the other direction which might warrant giving weight to a low-percentile estimate.

Additionally, the 95th percentile value addresses the strong possibility of widespread risk aversion with respect to climate change. The integrated assessment models do not reflect that individuals likely have a higher willingness to pay to reduce low-probability, high-impact damages than they do to reduce the likelihood of higher-probability but lower impact damages with the same expected cost. Beyond individual members of society, governments also have reasons to exercise some degree of risk aversion to irreversible outcomes like climate change.

The National Academies of Sciences did recommend that the IWG document its full treatment of uncertainty in an appendix and disclose low-probability as well as high-probability estimates of the social cost of greenhouse gases.[160] However, that does not mean it would be appropriate for individual agencies to rely on low-percentile estimates to justify decisions. While disclosing low-percentile estimates as a sensitivity analysis may promote transparency, relying on such an estimate for decisionmaking—in the face of contrary guidance from the best available science and economics on uncertainty and risk—would not be a "credible, objective, realistic, and scientifically balanced" approach to uncertainty, as required by Circular A-4.[161]

In short, the 95th percentile estimate attempts to capture risk aversion and uncertainties around lower-probability, high-damage, irreversible outcomes that are currently omitted or undercounted by the models. There is no need to balance out this estimate with a low-percentile value, because the reverse assumptions are not reasonable:

- There is no reason to believe the public or the government will be systematically risk seeking with respect to climate change.[162]
- The consequences of overestimating the risk of climate damages (i.e., spending more than we need to on mitigation and adaptation) are not nearly as irreversible as the consequences of underestimating the risk of climate damage (i.e., failing to prevent catastrophic outcomes).
- Though some uncertainties might point in the direction of lower social cost of greenhouse gas values, such as those related to the development of breakthrough adaptation technologies, the models already account for such uncertainties around adaptation; on balance, most uncertainties strongly point toward higher, not lower, social cost of greenhouse gas estimates.[163]
- There is no empirical basis for any "long tail" of potential benefits that would counteract the potential for extreme harm associated with climate change.

Moreover, even the best existing estimates of the social cost of greenhouse gases are likely underestimated because the models currently omit many significant categories of damages—such as depressed economic growth, pests, pathogens, erosion, air pollution, fire, dwindling energy supply, health costs, political conflict, and ocean acidification, as well as tipping points, catastrophic risks, and unknown unknowns—and because of other methodological choices.[164]

Consequently, uncertainty suggests an even higher social cost of greenhouse gases and so is not a reason to abandon the metric, which would misleadingly suggest that climate damages are worthless. For more details, please see the attached technical appendix on uncertainty.

A Global Perspective on the Social Cost of Greenhouse Gases Is Required to Capture All Factors Bearing on U.S. Public Welfare

FERC has suggested that, following a recent executive order, perhaps a domestic-only estimate of the social cost of greenhouse gases would be required.[165] Even more extremely, FERC has suggested that because "[t]he ability to determine localized impacts from greenhouse gases by use of these models is not possible at this time," therefore "[i]t would be inappropriate to run the integrated assessment models to estimate global and broad regional physical climate change impacts from the project."[166] This is false. Not only is FERC statutorily required to consider the worldwide character of environmental problems, but attempting to calculate a domestic-only estimate of the social cost of greenhouse gases would ignore how U.S. welfare is directly impacted through international spillover effects, foreign reciprocity, and the extraterritorial interests of U.S. residents.

NEPA contains a provision on "International and National Coordination of Efforts" that broadly requires that "all agencies of the Federal Government *shall* . . . recognize the worldwide and long-range character of environmental problems."[167] Using a global social cost of greenhouse gases to analyze and set policy fulfills these instructions. Furthermore, the Act requires agencies to, "where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of

---

[159] Policy Integrity, *Expert Consensus on the Economics of Climate Change* 2 (2015), *available at* http://policyintegrity.org/files/publications/ExpertConsensusReport.pdf [hereinafter *Expert Consensus*] ("Experts believe that there is greater than a 20% likelihood that this same climate scenario would lead to a 'catastrophic' economic impact (defined as a global GDP loss of 25% or more)."). *See also* Robert Pindyck, *The Social Cost of Carbon Revisited* (National Bureau of Economic Research, No. w22807, 2016).

[160] Nat'l Acad. Of Sci., *Assessment of Approaches to Updating the Social Cost of Carbon* 49 (2016) ("[T]he IWG could identify a high percentile (e.g., 90th, 95th) and corresponding low percentile (e.g., 10th, 5th) of the SCC frequency distributions on each graph.").

[161] Circular A-4 at 39.

[162] As a 2009 survey revealed, the vast majority of economic experts support the idea that "uncertainty associated with the environmental and economic effects of greenhouse gas emissions increases the value of emission controls, assuming some level of risk-aversion." *See Expert Consensus, supra* note 159, at 3 (citing 2009 survey).

[163] *See* Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014). R. Tol, *The Social Cost of Carbon*, 3 Annual Rev. Res. Econ. 419 (2011) ("[U]ndesirable surprises seem more likely than desirable surprises. Although it is relatively easy to imagine a disaster scenario for climate change—for example, involving massive sea level rise or monsoon failure that could even lead to mass migration and violent conflict—it is not at all easy to imagine that climate change will be a huge boost to human welfare.").

[164] *See* Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, *supra* note 163; Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014); Frances C. Moore & Delavane B. Diaz, *Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy*, 5 NATURE CLIMATE CHANGE 127 (2015) (demonstrating SCC may be biased downward by more than a factor of six by failing to include the climate's effect on economic growth).

[165] Sabal Remand Order, para. 46, 49.

[166] 163 FERC ¶ 61,128, para. 68-69 (New Market Project Order Denying Rehearing, May 18, 2018).

[167] 42 U.S.C. § 4332(2)(f) (emphasis added). In the Notice of Inquiry, FERC writes that cumulative impacts "must occur within the same geographic area and same time period in which the proposed project's impacts will occur." 83 Fed. Reg. at 18,023. Note that, for purposes of global climate change, the relevant geographic area is the earth, and the relevant time period is the foreseeable future.

mankind's world environment."[168] By continuing to use the global social cost of greenhouse gases to spur reciprocal foreign actions, federal agencies "lend appropriate support" to the NEPA's goal of "maximize[ing] international cooperation" to protect "mankind's world environment." Furthermore, not only is it consistent with Circular A-4 and best economic practices to estimate the global damages of U.S. greenhouse gas emissions in regulatory analyses and environmental impact statements, but no existing methodology for estimating a "domestic-only" value is reliable, complete, or consistent with Circular A-4.

From 2010 through 2016, federal agencies based their regulatory decision and NEPA reviews on global estimates of the social cost of greenhouse gases. Though agencies sometimes also disclosed a "highly speculative" range that tried to capture exclusively U.S. climate costs, emphasis on a global value was recognized as more accurate given the science and economics of climate change, as more consistent with best economic practices, and as crucial to advancing U.S. strategic goals.[169]

Opponents of climate regulation challenged the global number in court and other forums, and often attempted to use Circular A-4 as support.[170] Specifically, opponents have seized on Circular A-4's instructions to "focus" on effects to "citizens and residents of the United States," while any significant effects occurring "beyond the borders of the United States . . . should be reported separately."[171] Importantly, despite this language and such challenges, the U.S. Court of Appeals for the Seventh Circuit had no trouble concluding that a global focus for the social cost of greenhouse gases was reasonable:

> AHRI and Zero Zone [the industry petitioners] next contend that DOE [the Department of Energy] arbitrarily considered the global benefits to the environment but only considered the national costs. They emphasize that the [statute] only concerns "national energy and water conservation." In the New Standards Rule, DOE did not let this submission go unanswered. It explained that climate change "involves a global externality," meaning that carbon released in the United States affects the climate of the entire world. According to DOE, national energy conservation has global effects, and, therefore, those global effects are an appropriate consideration when looking at a national policy. Further, AHRI and Zero Zone point to no global costs that should have been considered alongside these benefits. Therefore, DOE acted reasonably when it compared global benefits to national costs.[172]

[168] 42 U.S.C. § 4332(2)(f); *see also Environmental Defense Fund v. Massey*, 986 F.2d 528, 535 (D.C. Cir. 1993) (confirming that Subsection F is mandatory); Natural Resources Defense Council v. NRC, 647 F.2d 1345, 1357 (D.C. Cir. 1981) ("This NEPA prescription, I find, looks toward cooperation, not unilateral action, in a manner consistent with our foreign policy."); *cf.* COUNCIL ON ENVIRONMENTAL QUALITY, GUIDANCE ON NEPA ANALYSIS FOR TRANSBOUNDARY IMPACTS (1997), *available at* http://www.gc.noaa.gov/documents/transguide.pdf; Exec. Order No. 12,114, *Environmental Effects Abroad of Major Federal Actions*, 44 Fed. Reg. 1957 §§ 1-1, 2-1 (Jan. 4, 1979) (applying to "major Federal actions . . . having significant effects on the environment outside the geographical borders of the United States," and enabling agency officials "to be informed of pertinent environmental considerations and to take such considerations into account . . . in making decisions regarding such actions").

[169] *See generally* Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Columbia J. Envtl. L. 203 (2017).

[170] Ted Gayer & W. Kip Viscusi, *Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic versus Global Approaches*, 10 Rev. Envtl. Econ. & Pol'y 245 (2016) (citing Circular A-4 to argue against a global perspective on the social cost of carbon); *see also, e.g.*, Petitioners Brief on Procedural and Record-Based Issues at 70, in *West Virginia v. EPA*, case 15-1363, D.C. Cir. (filed February 19, 2016) (challenging EPA's use of the global social cost of carbon).

[171] Circular A-4 at 15. Note that A-4 slightly conflates "accrue to citizens" with "borders of the United States": U.S. citizens have financial and other interests tied to effects beyond the borders of the United States, as discussed further below.

[172] Zero Zone v. Dept. of Energy, 832 F.3d 654, 679 (7th Cir. 2016).

Circular A-4's reference to effects "beyond the borders" confirms that it is appropriate for agencies to consider the global effects of U.S. greenhouse gas emissions. While Circular A-4 may suggest that most typical decisions should focus on U.S. effects, the Circular cautions agencies that special cases call for different emphases:

> [Y]ou cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment. ***Different regulations may call for different emphases*** in the analysis, ***depending on the nature and complexity*** of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions.[173]

In fact, Circular A-4 elsewhere assumes that agencies' analyses will not always be conducted from purely the perspective of the United States, as one of its instructions only applies "as long as the analysis is conducted from the United States perspective,"[174] suggesting that in some circumstances it is appropriate for the analysis to be global. For example, EPA and DOT have adopted a global perspective on the analysis of potential monopsony benefits to U.S. consumers resulting from the reduced price of foreign oil imports following energy efficiency increases, and EPA assesses the global potential for leakage of greenhouse gas emissions owing to U.S. regulation.[175]

Perhaps more than any other issue, the nature of the issue of climate change requires precisely such a "different emphasis" from the default domestic-only assumption. To avoid a global "tragedy of the commons" that could irreparably damage all countries, including the United States, every nation should ideally set policy according to the global social cost of greenhouse gases.[176] Climate and clean air are global common resources, meaning they are freely available to all countries, but any one country's use—i.e., pollution—imposes harms on the polluting country as well as the rest of the world. Because greenhouse pollution does not stay within geographic borders but rather mixes in the atmosphere and affects climate worldwide, each ton emitted by the United States not only creates domestic harms, but also imposes large externalities on the rest of the world. Conversely, each ton of greenhouse gases abated in another country benefits the United States along with the rest of the world.

If all countries set their greenhouse emission levels based on only domestic costs and benefits, ignoring the large global externalities, the aggregate result would be substantially sub-optimal climate protections and significantly increased risks of severe harms to all nations, including the United States. Thus, basic economic principles demonstrate that the United States stands to benefit greatly if all countries apply global social cost of greenhouse gas values in their regulatory decisions and project reviews. Indeed, the United States stands to gain hundreds of billions or even trillions of dollars in direct benefits from efficient foreign action on climate change.[177]

In order to ensure that other nations continue to use global social cost of greenhouse gas values, it is important that the United States itself continue to do so.[178] The United States is engaged in a repeated strategic dynamic with several significant players—including the United Kingdom, Germany, Sweden,

[173] Circular A-4 at 3 (emphasis added).

[174] *Id.* at 38 (counting international transfers as costs and benefits "as long as the analysis is conducted from the United States perspective").

[175] *See* Howard & Schwartz, *supra* note 169, at 268-69.

[176] *See* Garrett Hardin, *The Tragedy of the Commons*, 162 Science 1243 (1968) ("[E]ach pursuing [only its] own best interest . . . in a commons brings ruin to all.").

[177] Policy Integrity, *Foreign Action, Domestic Windfall: The U.S. Economy Stands to Gain Trillions from Foreign Climate Action* (2015), http://policyintegrity.org/files/publications/ForeignActionDomesticWindfall.pdf

[178] *See* Robert Axelrod, *The Evolution of Cooperation* 10-11 (1984) (on repeated prisoner's dilemma games).

and others—that have already adopted a global framework for valuing the social cost of greenhouse gases.[179] For example, Canada and Mexico have explicitly borrowed the IWG's global SCC metric to set their own fuel efficiency standards.[180] For the United States to now depart from this collaborative dynamic by reverting to a domestic-only estimate would undermine the country's long-term interests and could jeopardize emissions reductions underway in other countries, which are already benefiting the United States.

For these and other reasons, the IWG properly relied on global estimates to develop its SCC metric, and many federal agencies have since relied on this global metric to evaluate and justify their decisions. At the same time, some agencies have, in addition to the global estimate, also disclosed a "highly speculative" estimate of the domestic-only effects of climate change. In particular, the Department of Energy always includes a chapter on a domestic-only value of carbon emissions in the economic analyses supporting its energy efficiency standards; EPA has also often disclosed similar estimates.[181] Such an approach is consistent with Circular A-4's suggestion that agencies should usually disclose domestic effects separately from global effects. However, as we have discussed, reliance on a domestic-only methodology would be inconsistent with both the inherent nature of climate change and the standards of Circular A-4. Consequently, it is appropriate under Circular A-4 for agencies to continue to rely on global estimates of the social cost of greenhouses to justify their regulatory decisions or their choice of alternatives under NEPA.

Moreover, no current methodology can accurately estimate a "domestic-only" value of the social cost of greenhouse gases. OMB, the National Academies of Sciences, and the economic literature all agree that existing methodologies for calculating a "domestic-only" value of the social cost of greenhouse gases are deeply flawed and result in severe and misleading underestimates. In developing the social cost of carbon, the IWG did offer some such domestic estimates. Using the results of one economic model (FUND) as well as the U.S. share of global gross domestic product (GDP), the group generated an "approximate, provisional, and ***highly speculative***" range of 7–23% of the global social cost of carbon as an estimate of the purely direct climate effects to the United States.[182] Yet, as the IWG itself acknowledged, this range is almost certainly an underestimate because it ignores significant, indirect costs to trade, human health, and security that are likely to "spill over" into the United States as other regions experience climate change damages, among other effects.[183]

Neither the existing IAMs nor a share of global GDP are appropriate bases for calculating a domestic-only estimate. The IAMs were never designed to calculate a domestic SCC, since a global SCC is the economic efficient value. FUND, like other IAMS, includes some simplifying assumptions: of relevance, FUND and the other IAMs are not able to capture the adverse effects that the impacts of climate change in other countries will have on the United States through trade linkages, national security, migration,

[179] *See* Howard & Schwartz, *supra* note 169, at Appendix B.

[180] *See* Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24, 147 Can. Gazette pt. II, 450, 544 (Can.), *available at* http://canadagazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html ("The values used by Environment Canada are based on the extensive work of the U.S. Interagency Working Group on the Social Cost of Carbon."); Jason Furman & Brian Deese, *The Economic Benefits of a 50 Percent Target for Clean Energy Generation by 2025*, White House Blog, June 29, 2016 (summarizing the North American Leader's Summit announcement that U.S., Canada, and Mexico would "align" their SCC estimates).

[181] Howard & Schwartz, *supra* note 169, at 220-21.

[182] INTERAGENCY WORKING GROUP ON SOCIAL COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12,866 at 11 (2010) (emphasis added).

[183] *Id.* (explaining that the IAMs, like FUND, do "not account for how damages in other regions could affect the United States (e.g., global migration, economic and political destabilization").

and other forces.[184] This is why the IWG characterized the domestic-only estimate from FUND as a "highly speculative" underestimate. Similarly, a domestic-only estimate based on some rigid conception of geographic borders or U.S. share of world GDP will fail to capture all the climate-related costs and benefits that matter to U.S. citizens.[185] U.S. citizens have economic and other interests abroad that are not fully reflected in the U.S. share of global GDP. GDP is a "monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time."[186] GDP therefore does not reflect significant U.S. ownership interests in foreign businesses, properties, and other assets, as well as consumption abroad including tourism,[187] or even the 8 million Americans living abroad.[188] At the same time, GDP is also over-inclusive, counting productive operations in the United States that are owned by foreigners. Gross National Income (GNI), by contrast, defines its scope not by location but by ownership interests.[189] However, not only has GNI fallen out of favor as a metric used in international economic policy,[190] but using a domestic-only SCC based on GNI would make the SCC metrics incommensurable with other costs in regulatory impact analyses, since most regulatory costs are calculated by U.S. agencies regardless of whether they fall to U.S.-owned entities or to foreign-owned entities operating in the United States.[191] Furthermore, both GDP and GNI are dependent on what happens in other countries, due to trade and the international flow of capital. The artificial constraints of both metrics counsel against a rigid split based on either U.S. GDP or U.S. GNI.[192]

Of course, there already are and will continue to be significant, quantifiable, localized effects of climate change.[193] For example, a peer-reviewed EPA report, *Climate Change in the United States: Benefits of Global Action*, found that by the end of the century, the U.S. economy could face damages of $110 billion annually in lost labor productivity alone due to extreme temperatures, plus $11 billion annually in agricultural damages, $180 billion in losses to key economic sectors due to water shortages, and $5

[184] *See, e.g.*, Dept. of Defense, *National Security Implications of Climate-Related Risks and a Changing Climate* (2015), *available at* http://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery.

[185] A domestic-only SCC would fail to "provide to the public and to OMB a careful and transparent analysis of the anticipated consequences of economically significant regulatory actions." Office of Information and Regulatory Affairs, *Regulatory Impact Analysis: A Primer* 2 (2011).

[186] Tim Callen, *Gross Domestic Product: An Economy's All*, IMF, http://www.imf.org/external/pubs/ft/fandd/basics/gdp.htm (last updated Mar. 28, 2012).

[187] "U.S. residents spend millions each year on foreign travel, including travel to places that are at substantial risk from climate change, such as European cities like Venice and tropical destinations like the Caribbean islands." David A. Dana, *Valuing Foreign Lives and Civilizations in Cost-Benefit Analysis: The Case of the United States and Climate Change Policy* (Northwestern Faculty Working Paper 196, 2009), http://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1195&context=facultyworkingpapers.

[188] Assoc. of Americans Resident Oversees, https://www.aaro.org/about-aaro/6m-americans-abroad. Admittedly 8 million is only 0.1% of the total population living outside the United States.

[189] *GNI, Atlas Method (Current US$)*, THE WORLD BANK, http://data.worldbank.org/indicator/NY.GNP.ATLS.CD.

[190] *Id.*

[191] U.S. Office of Management and Budget & Secretariat General of the European Commission, *Review of Application of EU and US Regulatory Impact Assessment Guidelines on the Analysis of Impacts on International Trade and Development* 13 (2008).

[192] Advanced Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,354, 44,415 (July 30, 2008) ("Furthermore, international effects of climate change may also affect domestic benefits directly and indirectly to the extent U.S. citizens value international impacts (e.g., for tourism reasons, concerns for the existence of ecosystems, and/or concern for others); U.S. international interests are affected (e.g., risks to U.S. national security, or the U.S. economy from potential disruptions in other nations).").

[193] *See generally* U.S. Global Change Research Program, *Climate Science Special Report: Fourth National Climate Assessment* (2017) (substantiating that significant climate impacts are already underway in the United States and are project to worsen); *see also, e.g.*, Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate* (2018).

trillion in damages U.S. coastal property.[194] But the existence of those examples of quantifiable estimates of localized damages does not mean that the current IAMs are able to extrapolate a U.S.-only number that accurately reflects total domestic damages—especially since, as already explained, the IAMs do not reflect spill overs.

As a result, in 2015, OMB concluded, along with several other agencies, that "good methodologies for estimating domestic damages do not currently exist."[195] Similarly, the NAS recently concluded that current IAMs cannot accurately estimate the domestic social cost of greenhouse gases, and that estimates based on U.S. share of global GDP would be likewise insufficient.[196] William Nordhaus, the developer of the DICE model, cautioned earlier this year that "regional damage estimates are both incomplete and poorly understood," and "there is little agreement on the distribution of the SCC by region."[197] In short, any domestic-only estimate will be inaccurate, misleading, and out of step with the best available economic literature, in violation of Circular A-4's standards for information quality.

For more details on the justification for a global value of the social cost of greenhouse gases, please see Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Columbia J. Envtl. L. 203 (2017). Another strong defense of the global valuation as consistent with best economic practices appears in a letter published in a recent issue of *The Review of Environmental Economics and Policy*, co-authored by the late Nobel laureate economist Kenneth Arrow.[198]

III. FERC Should Use the Interagency Working Group's 2016 Estimates of the Social Cost of Carbon, Methane, and Nitrous Oxide

In 2016, the IWG published updated central estimates for the social cost of greenhouse gases: $50 per ton of carbon dioxide, $1440 per ton of methane, and $18,000 per ton of nitrous oxide (in 2017 dollars for year 2020 emissions).[199] Agencies must continue to use estimates of a similar or higher[200] value in their analyses and decisionmaking. A recent Executive Order disbanding the IWG does not change the fact that the IWG estimates still reflect the best available data and methodologies.

IWG's Methodology Is Rigorous, Transparent, and Based on Best Available Data

Beginning in 2009, the IWG assembled experts from a dozen federal agencies and White House offices to "estimate the monetized damages associated with an incremental increase in carbon emissions in a

[194] EPA, *Climate Change in the United States: Benefits of Global Action* (2015); *see also* EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2017) (quantifying physical and economic damages to multiple U.S. sectors, but acknowledging that only a "small portion of the impacts of climate change are estimated").

[195] In November 2013, OMB requested public comments on the social cost of carbon. In 2015, OMB along with the rest of the Interagency Working Group issued a formal response to those comments. Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12,866* at 36 (July 2015) [hereinafter, OMB 2015 Response to Comments].

[196] Nat'l Acad. Sci., *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide* at 53 (2017).

[197] William Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PNAS 1518, 1522 (2017).

[198] Richard Revesz, Kenneth Arrow et al., *The Social Cost of Carbon: A Global Imperative*, 11 REEP 172 (2017).

[199] U.S. Interagency Working Group on the Social Cost of Greenhouse Gases, "Technical support document: Technical update of the social cost of carbon for regulatory impact analysis under executive order 12866 & Addendum: Application of the methodology to estimate the social cost of methane and the social cost of nitrous oxide" (2016), available at https://obamawhitehouse.archives.gov/omb/oira/social-cost-of-carbon.

[200] See, e.g., Richard L. Revesz et al., Global Warming: Improve Economic Models of Climate Change, 508 NATURE 173 (2014) (explaining that current estimates omit key damage categories and, therefore, are very likely underestimates).

given year" based on "a defensible set of input assumptions that are grounded in the existing scientific and economic literature."[201] IWG's methods combined three frequently used models built to predict the economic costs of the physical impacts of each additional ton of carbon.[202] The models together incorporate such damage categories as: agricultural and forestry impacts, coastal impacts due to sea level rise, impacts from extreme weather events, impacts to vulnerable market sectors, human health impacts including malaria and pollution, outdoor recreation impacts and other non-market amenities, impacts to human settlements and ecosystems, and some catastrophic impacts.[203] IWG ran these models using a baseline scenario including inputs and assumptions drawn from the peer-reviewed literature, and then ran the models again with an additional unit of carbon emissions to determine the increased economic damages.[204] IWG's social cost of carbon estimates were first issued in 2010 and have been updated several times to reflect the latest and best scientific and economic data.[205]

Following the development of estimates for carbon dioxide, the same basic methodology was used in 2016 to develop the social cost of methane and social cost of nitrous oxide—estimates that captures the distinct heating potential of methane and nitrous oxide emissions.[206] These additional metrics used the same economic models, the same treatment of uncertainty, and the same methodological assumptions that IWG applied to the social cost of carbon, and these new estimates underwent rigorous peer-review.[207]

IWG's methodology has been repeatedly endorsed by reviewers. In 2014, the U.S. Government Accountability Office concluded that IWG had followed a "consensus-based" approach, relied on peer-reviewed academic literature, disclosed relevant limitations, and adequately planned to incorporate new information through public comments and updated research.[208] In 2016 and 2017, the National Academies of Sciences issued two reports that, while recommending future improvements to the methodology, supported the continued use of the existing IWG estimates.[209] And in 2016, the U.S. Court of Appeals for the Seventh Circuit held that the Department of Energy's reliance on IWG's social cost of carbon was reasonable.[210] It is, therefore, unsurprising that leading economists and climate policy experts have endorsed the Working Group's values as the best available estimates.[211]

[201] IWG, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866* (2010) ("2010 TSD"). *Available at* https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.

[202] *Id.* at 5. These models are DICE (the Dynamic Integrated Model of Climate and the Economy), FUND (the Climate Framework for Uncertainty, Negotiation, and Distribution), and PAGE (Policy Analysis of the Greenhouse Effect).

[203] *Id.* at 6-8.

[204] *Id.* at 24-25.

[205] IWG, *Technical Update of the Social Cost of Carbon* at 5–29 (2016). *Available at* https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/ scc_tsd_final_clean_8_26_16.pdf.

[206] *See* 2016 IWG Addendum at 2.

[207] *Id.* at 3.

[208] Gov't Accountability Office, *Regulatory Impact Analysis: Development of Social Cost of Carbon Estimates* 12-19 (2014). Available at http://www.gao.gov/assets/670/665016.pdf.

[209] Nat'l Acad. Sci., Engineering & Med., *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide* 3 (2017), https://www.nap.edu/read/24651/chapter/1; Nat'l Acad. Sci., Engineering & Med., *Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update* 1–2 (2016); https://www.nap.edu/read/21898/chapter/1.

[210] *Zero Zone,* 832 F.3d at 679.

[211] See, e.g., Richard Revesz et al., *Best Cost Estimate of Greenhouse Gases*, 357 Science 655 (2017); Michael Greenstone et al., *Developing a Social Cost of Carbon for U.S. Regulatory Analysis: A Methodology and Interpretation*, 7 Rev. Envtl. Econ. & Pol'y 23, 42 (2013); Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 Nature 173 (2014) (co-authored with Nobel Laureate Kenneth Arrow, among others).

A Recent Executive Order Does Not Change the Requirements to Monetize Climate Damages

In March 2017, President Trump disbanded the IWG and withdrew their technical support documents.[212] Nevertheless, Executive Order 13,783 assumes that federal agencies will continue to "monetiz[e] the value of changes in greenhouse gas emissions" and instructs agencies to ensure such estimates are "consistent with the guidance contained in OMB Circular A-4."[213] Consequently, while federal agencies no longer benefit from ongoing technical support from the IWG on use of the social cost of greenhouse gases, by no means does the new Executive Order imply that agencies should not monetize important effects in their environmental impact statements. The Executive Order does not prohibit agencies from relying on the same choice of models as the IWG, the same inputs and assumptions as the IWG, the same statistical methodologies as the IWG, or the same ultimate values as derived by the IWG. To the contrary, because the Executive Order requires consistency with Circular A-4, as agencies follow the Circular's standards for using the best available data and methodologies, they will necessarily choose similar data, methodologies, and estimates as the IWG, since the IWG's work continues to represent the best available estimates.[214] The Executive Order does not preclude agencies from using the same range of estimates as developed by the IWG, so long as the agency explains that the data and methodology that produced those estimates are consistent with Circular A-4 and, more broadly, with standards for rational decisionmaking.

Similarly, the Executive Order's withdrawal of the Council on Environmental Quality's guidance on greenhouse gases,[215] does not—and legally cannot—remove agencies' statutory requirement to fully disclose the environmental impacts of greenhouse gas emissions. As the Council on Environmental Quality explained in its withdrawal, the "guidance was not a regulation," and "[t]he withdrawal of the guidance does not change any law, regulation, or other legally binding requirement."[216] In other words, when the guidance originally recommended the appropriate use of the social cost of greenhouse gases in environmental impact statements,[217] it was simply explaining that the social cost of greenhouse gases is consistent with longstanding NEPA regulations and case law, all of which are still in effect today.

Notably, some agencies under the Trump administration have continued to use the IWG estimates even following the Executive Order. For example, in August 2017, the Bureau of Ocean Energy Management called the social cost of carbon "a useful measure" and applied it to analyze the consequences of offshore oil and gas drilling.[218] And in July 2017, the Department of Energy used the IWG's estimates for

[212] Exec. Order No. 13,783 § 5(b), 82 Fed. Reg. 16,093 (Mar. 28, 2017).

[213] *Id.* § 5(c).

[214] *See* Richard L. Revesz et al., *Best Cost Estimate of Greenhouse Gases*, 357 SCIENCE 6352 (2017) (explaining that, even after Trump's Executive Order, the social cost of greenhouse gas estimate of around $50 per ton of carbon dioxide is still the best estimate).

[215] Exec. Order 13,783 § 3(c)

[216] 82 Fed. Reg. 16,576, 16,576 (Apr. 5, 2017).

[217] *See* CEQ, *Revised Draft Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* at 16 (Dec. 2014), *available at* https://obamawhitehouse.archives.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf ("[A]lthough developed specifically for regulatory impact analyses, the Federal social cost of carbon, which multiple Federal agencies have developed and used to assess the costs and benefits of alternatives in rulemakings, offers a harmonized, interagency metric that can provide decisionmakers and the public with some context for meaningful NEPA review.").

[218] *Draft Environmental Impact Statement—Liberty Development Project in the Beaufort Sea, Alaska* at 3-129.

carbon and methane emissions to analyze energy efficiency regulation, describing the social cost of methane as having "undergone multiple stages of peer review."[219]

As FERC has noted,[220] two agencies have developed new "interim" values of the social cost of greenhouse gases following the Executive Order. Relying on faulty economic theory, these "interim" estimates drop the social cost of carbon from $50 per ton in year 2020 down to as little as $1 per ton, and drop the social cost of methane from $1420 per ton in year 2020 down to $58. These "interim" estimates are inconsistent with accepted science and economics; the IWG's 2016 estimates remain the best available estimates. The IWG's methodology and estimates have been repeatedly endorsed by reviewers as transparent, consensus-based, and firmly grounded in the academic literature. By contrast, the "interim" estimates ignore the interconnected, global nature of our climate-vulnerable economy, and obscure the devastating effects that climate change will have on younger and future generations. The problems with these approaches to the discount rate and the global estimate are discussed above, and for more on the myriad problems with EPA's interim numbers, see our Joint Comments to EPA on Flawed Estimates of the Social Cost of Carbon in the Proposed Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources.[221]

Sincerely,

Susanne Brooks, Director of U.S. Climate Policy and Analysis, Environmental Defense Fund
Tomás Carbonell, Senior Attorney and Director of Regulatory Policy, Environmental Defense Fund
Rachel Cleetus, Ph.D., Lead Economist and Climate Policy Manager, Union of Concerned Scientists
Denise Grab, Western Regional Director, Institute for Policy Integrity, NYU School of Law*
Jayni Hein, Policy Director, Institute for Policy Integrity, NYU School of Law*
Peter H. Howard, Ph.D., Economic Director, Institute for Policy Integrity, NYU School of Law*
Benjamin Longstreth, Senior Attorney, Natural Resources Defense Council
Kelly Martin, Director, Beyond Dirty Fuels Campaign, Sierra Club
Martha Roberts, Senior Attorney, Environmental Defense Fund
Iliana Paul, Policy Associate, Institute for Policy Integrity, NYU School of Law*
Richard L. Revesz, Director, Institute for Policy Integrity, NYU School of Law*
Jason A. Schwartz, Legal Director, Institute for Policy Integrity, NYU School of Law*
Peter Zalzal, Director of Special Projects and Senior Attorney, Environmental Defense Fund

For any questions regarding these comments, please contact:

Jason A. Schwartz, Legal Director, Institute for Policy Integrity
139 MacDougal Street, 3rd Floor, New York, NY 10012
jason.schwartz@nyu.edu

*No part of this document purports to present New York University School of Law's views, if any.

[219] Energy Conservation Program: Energy Conservation Standards for Walk-In Cooler and Freezer Refrigeration Systems, 82 Fed. Reg. 31,808, 31,811, 31,857 (July 10, 2017).

[220] Sabal Order Remand, para 46.

[221] *Available at* http://policyintegrity.org/documents/042618_Joint_SCC_Comment_on_CPP.pdf.

TECHNICAL APPENDIX: UNCERTAINTY

Contrary to the arguments made by many opposed to strong federal climate action, uncertainty about the full effects of climate change *raises* the social cost of greenhouse gases and warrants *more* stringent climate policy.[222] Integrated assessment models (IAMs) currently used to calculate the SCC show that the net effect of uncertainty about economic damage resulting from climate change, costs of mitigation, future economic development, and many other parameters raises the SCC compared to the case where models simply use our current best guesses of these parameters.[223] Even so, IAMs still underestimate the impact of uncertainty on the SCC by not accounting for a host of fundamental features of the climate problem: the irreversibility of climate change, society's aversion to risk and other social preferences, option value, and many catastrophic impacts.[224] Rather than being a reason not to take action, uncertainty increases the SCC and should lead to more stringent policy to address climate change.[225]

Types of Uncertainty in the IAMs

IAMs incorporate two types of uncertainty: parametric uncertainty and stochastic uncertainty. Parametric uncertainty covers uncertainty in model design and inputs, including the selected parameters, correct functional forms, appropriate probability distribution functions, and model structure. With learning, these uncertainties should decline over time as more information becomes available.[226] Stochastic uncertainty is persistent randomness in the economic-climate system, including various environmental phenomena such as volcanic eruptions and sun spots.[227] Uncertainties are present in each component of the IAMs: socio-economic scenarios, the simple climate model, the damage and abatement cost functions, and the social welfare function (including the discount rate).[228]

[222] Sonja Peterson, *Uncertainty and economic analysis of climate change: A survey of approaches and findings*, 11 Environmental Modeling & Assessment 1-17 (2006) ("Most modeling results show (as can be expected) that there is optimally more emission abatement if uncertainties in parameters or the possibility of catastrophic events are considered.").

[223] Richard SJ Tol, Safe policies in an uncertain climate: an application of FUND, 9 *Global Environmental Change* 221-232 (1999); Peterson 2006 *supra* note 222.

[224] Robert S Pindyck, *Uncertainty in environmental economics*, 1 Review of environmental economics and policy 45-65 (2007); Alexander Golub, Daiju Narita, and Matthias GW Schmidt, *Uncertainty in integrated assessment models of climate change: Alternative analytical approaches*, 19 Environmental Modeling & Assessment 99-109 (2014); Lemoine, Derek, and Ivan Rudik, *Managing Climate Change Under Uncertainty: Recursive Integrated Assessment at an Inflection Point*, 9 Annual Review of Resource Economics 18.1-18.26 (2017).

[225] *See* cites *supra* note 224.

[226] Learning comes in multiple forms: passive learning of anticipated information that arrives exogenous to the emission policy (such as academic research), active learning of information that directly stems from the choice of the GHG emission level (via the policy process), and learning of unanticipated information. Antje Kann & John P. Weyant, *Approaches for performing uncertainty analysis in large-scale energy/economic policy models*, 5 Environmental Modeling & Assessment 29-46 (2000); Derek Lemoine & Ivan Rudik, *Managing Climate Change Under Uncertainty: Recursive Integrated Assessment at an Inflection Point*, 9 *Annual Review of Resource Economics* 18.1-18.26 (2017).

[227] A potential third type of uncertainty arises due to ethical or value judgements: normative uncertainty. Peterson (2006) *supra* note 222; Geoffrey Heal & Antony Millner, *Reflections: Uncertainty and decision making in climate change economics*, 8 Review of Environmental Economics and Policy 120-137 (2014). For example, there is some normative debate over the appropriate consumption discount rate to apply in climate economics, though widespread consensus exists that using the social opportunity cost of capital is inappropriate (see earlier discussion). Preference uncertainty should be modeled as a declining discount rate over time (see earlier discussion), not using uncertain parameters. Kann & Weyant, *supra* note 226 and Golub et al. *supra* note 224.

[228] Peterson (2006), *supra* note 222; Pindyck (2007), *supra* note 224; Heal & Millner 2014, *supra* note 227.

When modeling climate change uncertainty, scientists and economists have long emphasized the importance of accounting for the potential of catastrophic climate change.[229] Catastrophic outcomes combine several overlapping concepts including unlucky states of the world (i.e., bad draws), deep uncertainty, and climate tipping points and elements.[230] Traditionally, IAM developers address uncertainty by specifying probability distributions over various climate and economic parameters. This type of uncertainty implies the possibility of an especially bad draw if multiple uncertain parameters turn out to be lower than we expect, causing actual climate damages to greatly exceed expected damages.

Our understanding of the climate and economic systems is also affected by so-called "deep uncertainty," which can be thought of as uncertainty over the true probability distributions for specific climate and economic parameters.[231] The mean and variance of many uncertain climate phenomena are unknown due to lack of data, resulting in "fat-tailed distributions"—i.e., the tail of the distributions decline to zero slower than the normal distribution. Fat-tailed distributions result when the best guess of the distribution is derived under learning.[232] Given the general opinion that bad surprises are likely to outweigh good surprises in the case of climate change,[233] modelers capture deep uncertainty by selecting probability distributions with a fat upper tail which reflects the greater likelihood of extreme events.[234] The possibility of fat tails increases the likelihood of a "very" bad draw with high economic costs, and can result in a very high (and potentially infinite) expected cost of climate change (a phenomenon known as the dismal theory).[235]

Climate tipping elements are environmental thresholds where a small change in climate forcing can lead to large, non-linear shifts in the future state of the climate (over short and long periods of time) through positive feedback (i.e., snowball) effects.[236] Tipping points refer to economically relevant thresholds after which change occurs rapidly (i.e., Gladwellian tipping points), such that opportunities for adaptation and intervention are limited.[237] Tipping point examples include the reorganization of the Atlantic meridional overturning circulation (AMOC) and a shift to a more persistent El Niño regime in the Pacific Ocean.[238] Social tipping points—including climate-induced migration and conflict—also exist.

[229] William Nordhaus, A Question of Balance: Weighing the Options on Global Warming Policies (2008); Robert E. Kopp, Rachael L. Shwom, Gernot Wagner, and Jiacan Yuan, Tipping elements and climate–economic shocks: Pathways toward integrated assessment, 4 *Earth's Future* 346-372 (2016).

[230] Kopp et al. (2016), *supra* note 229.

[231] *Id.*

[232] William Nordhaus, *An Analysis of the Dismal Theorem* (Cowles Foundation Discussion Paper No. 1686, 2009); Martin L. Weitzman, *Fat-tailed uncertainty in the economics of catastrophic climate change*, 5 Review of Environmental Economics and Policy 275-292 (2011). Robert S Pindyck, *Fat tails, thin tails, and climate change policy*, 5 Review of Environmental Economics and Policy 258-274 (2011).

[233] Michael D Mastrandrea, Calculating the benefits of climate policy: examining the assumptions of integrated assessment models (Pew Center on Global Climate Change Working Paper, 2009); Richard SJ Tol, On the uncertainty about the total economic impact of climate change, 53 Environmental and Resource Economics 97-116 (2012).

[234] Weitzman (2011), *supra* note 232, makes clear that "deep structural uncertainty about the unknown unknowns of what might go very wrong is coupled with essentially unlimited downside liability on possible planetary damages. This is a recipe for producing what are called 'fat tails' in the extreme of critical probability distributions."

[235] Martin L Weitzman, *On modeling and interpreting the economics of catastrophic climate change*, 91 The Review of Economics and Statistics 1-19 (2009); Nordhaus (2009), *supra* note 232; Weitzman (2011), *supra* note 232.

[236] Tipping elements are characterized by: (1) deep uncertainty, (2) absence from climate models, (3) larger resulting changes relative to the initial change crossing the relevant threshold, and (4) irreversibility. Kopp et al. (2016), *supra* note 229.

[237] *Id.*

[238] *Id.*; Elmar Kriegler, Jim W. Hall, Hermann Held, Richard Dawson, and Hans Joachim Schellnhuber, Imprecise probability assessment of tipping points in the climate system, 106 *Proceedings of the national Academy of Sciences* 5041-5046 (2009);

These various tipping points interact, such that triggering one tipping point may affect the probabilities of triggering other tipping points.[239] There is some overlap between tipping point events and fat tails in that the probability distributions for how likely, how quick, and how damaging tipping points will be are unknown.[240] Accounting fully for these most pressing, and potentially most dramatic, uncertainties in the climate-economic system matter because humans are risk averse and tipping points—like many other aspects of climate change—are, by definition, irreversible

How IAMs and the IWG Account for Uncertainty

Currently, IAMs (including all of those used by the IWG) capture uncertainty in two ways: deterministically and through uncertainty propagation. For the deterministic method, the modeler assumes away uncertainty (and thus the possibility of bad draws and fat tails) by setting parameters equal to their most likely (median) value. Using these values, the modeler calculates the median SCC value. Typically, the modeler conducts sensitivity analysis over key parameters—one at a time or jointly—to determine the robustness of the modeling results. This is the approach employed by Nordhaus in the preferred specification of the DICE model[241] used by the IWG.

Uncertainty propagation is most commonly carried out using Monte Carlo simulation. In these simulations, the modeler randomly draws parameter values from each of the model's probability distributions, calculates the SCC for the draw, and then repeats this exercise thousands of times to calculate a mean social cost of carbon.[242] Tol, Anthoff, and Hope employ this technique in FUND and PAGE—as did the IWG (2010, 2013, and 2016)[243]—by specifying probability distributions for the climate and economic parameters in the models. These models are especially helpful for assessing the net effect of different parametric and stochastic uncertainties. For instance, both the costs of mitigation and the damage from climate change are uncertain. Higher costs would warrant less stringent climate policies, while higher damages lead to more stringent policy, so theoretically, the effect of these two factors on climate policy could be ambiguous. Uncertainty propagation in an IAM calibrated to empirically motivated distributions, however, shows that climate damage uncertainty outweighs the effect of cost uncertainty, leading to a stricter policy when uncertainty is taken into account than when it is ignored.[244]

Delavane Diaz & Klaus Keller, A potential disintegration of the West Antarctic Ice Sheet: Implications for economic analyses of climate policy, 106 *The American Economic Review* 607-611 (2016). See Table 1 of Kopp et al. (2016) *supra* note 229, for a full list of known tipping elements and points.

[239] Kriegler et al. (2009), *supra* note 238; Cai, Yongyang, Timothy M. Lenton, and Thomas S. Lontzek, *Risk of multiple interacting tipping points should encourage rapid CO2 emission reduction*, 6 Nature Climate Change 520-525 (2016); Kopp et al. (2016) *supra* note 229.

[240] Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* 5 (Cost of Carbon Project Report, 2014), http://costofcarbon.org/; Kopp et al. (2016) *supra* note 229.

[241] *See* Nordhaus, W., & Sztorc, P. (2013). DICE 2013R: Introduction and user's manual.

[242] In alternative calculation method, the modeler "performs optimization of polices for a large number of possible parameter combinations individually and estimates their probability weighted sum." Golub et al. *supra* note 224. In more recent DICE-2016, Nordhaus conducts a three parameter analysis using this method to determine a SCC confidence interval. Given that PAGE and FUND model hundred(s) of uncertainty parameters, this methodology appears limited in the number of uncertain variables that can be easily specified.

[243] Interagency Working Group on Social Cost of Carbon, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12,866 (2010). Interagency Working Group on Social Cost of Carbon, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12,866 (2013). Interagency Working Group on Social Cost of Carbon, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12,866 (2016).

[244] Tol (1999), *supra* note 223, in characterizing the FUND model, states, "Uncertainties about climate change impacts are more serious than uncertainties about emission reduction costs, so that welfare-maximizing policies are stricter under uncertainty than under certainty."

This can be seen in the resulting right-skewed distribution of the SCC (see Figure 1 in IWG (2016)) where the mean (Monte Carlo) SCC value clearly exceeds the median (deterministic) SCC value.

The IWG was rigorous in addressing uncertainty. First, it conducted Monte Carlo simulations over the above IAMs specifying different possible outcomes for climate sensitivity (represented by a right skewed, fat tailed distribution to capture the potential of higher than expected warming). It also used scenario analysis: five different emissions growth scenarios and three discount rates. Second, the IWG (2016)[245] reported the various moments and percentiles—including the 95th percentile—of the resulting SCC estimates. Third, the IWG put in place an updating process, e.g., the 2013 and 2016 revisions, which updates the models as new information becomes available.[246] As such, the IWG used the various tools that economists have developed over time to address the uncertainty inherent in estimating the economic cost of pollution: reporting various measures of uncertainty, using Monte Carlo simulations, and updating estimates as evolving research advances our knowledge of climate change. Even so, the IWG underestimate the SCC by failing to capture key features of the climate problem.

Current IAMs Underestimate the SCC by Failing to Sufficiently Model Uncertainty

Given the current treatment of uncertainty by the IWG (2016) and the three IAMs that they employ, the IWG (2016) estimates represent an underestimate of the SCC. DICE clearly underestimates the true value of the SCC by effectively eliminating the possibility of bad draws and fat tails through a deterministic model that relies on the median SCC value. Even with their calculation of the mean SCC, the FUND and PAGE also underestimate the metric's true value by ignoring key features of the climate-economic problem. Properly addressing the limitations of these models' treatment of uncertainty would further increase the SCC.

First, current IAMs insufficiently model catastrophic impacts. DICE fails to model both the possibility of bad draws and fat tails by applying the deterministic approach. Alternatively, FUND and PAGE ignore deep uncertainty by relying predominately on the thin-tailed triangular and gamma distributions.[247] The IWG (2010) only partially addresses this oversight by replacing the ECS parameter in DICE, FUND, and PAGE with a fat-tailed, right-skewed distribution calibrated to the IPCC's assumptions (2007), even though many other economic and climate phenomenon in IAMs are likely characterized by fat tails, including climate damages from high temperature levels, positive climate feedback effects, and tipping points.[248] Recent work in stochastic dynamic programming tends to better integrate fat tails – particularly with respect to tipping points (see below) – and address additional aversion to this type of uncertainty (also known as ambiguity aversion); doing so can further increase the SCC under uncertainty.[249]

---

[245] IWG (2016) *supra* note 243.

[246] IWG (2010) *supra* note 243.

[247] Howard (2014), *supra* note 240. While both FUND and PAGE employ thin tailed distributions, the resulting distribution of the SCC is not always thin-tailed. In PAGE09, the ECS parameter is endogenous, such that the distribution of the ECS has a long tail following the IPCC (2007). *See* Z Chen, M Marquis, KB Averyt, M Tignor, & HL Miller, Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change (2007). Similarly, while Anthoff and Tol do not explicitly utilize fat-tail distributions, the distribution of net present welfare from a Monte Carlos simulation is fat tailed. David Anthoff & Richard S. J. Tol, The Climate Framework for Uncertainty, Negotiation, and Distribution (FUND), Technical Description, Version 3.8 (2014). Explicitly modeling parameter distributions as fat tailed may further increase the SCC.

[248] Weitzman (2011), *supra* note 232; Kopp et al. (2016) *supra* note 229.

[249] Derek Lemoine & Christian P. Traeger, *Ambiguous tipping points*, 132 Journal of Economic Behavior & Organization 5-18 (2016); Lemoine & Rudik (2017), *supra* note 224. IAM modelers currently assume that society is equally averse to known unknown and known unknowns. Lemoine & Traeger, *id*.

In contrast to their approach to fat tails, the IAMs used by the IWG (2010; 2013; 2016) sometimes address climate tipping points, though they do not apply state-of-the-art methods for doing so. In early versions of DICE (DICE-2010 and earlier), Nordhaus implicitly attributes larger portions of the SCC to tipping points by including certainty equivalent damages of catastrophic events - representing two-thirds to three-quarter of damages in DICE – calibrated to an earlier Nordhaus (1994) survey of experts.[250] In PAGE09, Hope also explicitly models climate tipping points as a singular, discrete event (of a 5% to 25% loss in GDP) that has a probability (which grows as temperature increases) of occurring in each time period.[251] Though not in the preferred versions of the IAMs employed by the IWG, some research also integrates specific tipping points into these IAMs finding even higher SCC estimates.[252] Despite the obvious methodological basis for addressing tipping points, the latest versions of DICE[253] and FUND exclude tipping points in their preferred specifications. Research shows that if these models were to correctly account for the full range of climate impacts—including tipping points—the resulting SCC estimates would increase.[254]

The IWG approach also fails to include a risk premium—that is, the amount of money society would require in order to accept the uncertainty (i.e., variance) over the magnitude of warming and the resulting damages from climate change relative to mean damages (IWG, 2010; IWG, 2015)). The mean of a distribution, which is a measure of a distribution's central tendency, represents only one descriptor or "moment" of a distribution's shape. Each IAM parameter and the resulting SCC distributions have differing levels of variance (i.e., spread around the mean), skewness (i.e., a measure of asymmetry), and

[250] William Nordhaus & Joseph Boyer, Warning the World: Economic Models of Global Warming (2000); Nordhaus (2008) *supra* note 264; Howard (2014), *supra* note 240; Kopp et al. (2016) *supra* note 229.

[251] Hope (2006) also calibrated a discontinuous damage function in PAGE-99 used by IWG (2010); see Chris Hope, *The Marginal Impact of CO_2 from PAGE2002: An Integrated Assessment Model Incorporating the IPCC's Five Reasons for Concern*, 6 INTEGRATED ASSESSMENT J. 19 (2006). Howard (2014), *supra* note 240.

[252] Kopp et al. (2016) *supra* note 229.

[253] For DICE-2013 and DICE-2016, Nordhaus calibrates the DICE damage function using a meta-analysis based on estimates that mostly exclude tipping point damages. Peter H Howard & Thomas Sterner, *Few and Not So Far Between: A Meta-analysis of Climate Damage Estimates*, 68 Environmental and Resource Economics 1-29 (2016).

[254] Using FUND, Link and Tol (2011) find that a collapse of the AMOC would decrease GDP (and thus increase the SCC) by a small amount. Earlier modeling of this collapse in DICE find a more significance increase. P. Michael Link & Richard SJ Tol, Estimation of the economic impact of temperature changes induced by a shutdown of the thermohaline circulation: an application of FUND, 104 *Climatic Change* 287-304 (2011); Klaus Keller, Kelvin Tan, François MM Morel, & David F. Bradford, *Preserving the Ocean Circulation: Implications for Climate Policy*, 47 Climatic Change 17-43 (2000); Michael D Mastrandrea & Stephen H. Schneider, *Integrated assessment of abrupt climatic changes*, 1 Climate Policy 433-449 (2001); Klaus Keller, Benjamin M. Bolker, & David F. Bradford, *Uncertain climate thresholds and optimal economic growth*, 48 Journal of Environmental Economics and management 723-741 (2004). With respect to thawing of the permafrost, Hope and Schaefer (2016) and Gonzalez-Eguino and Neumann (2016) find increases in damages (and thus an increase in the SCC) when integrating this tipping element into the PAGE09 and DICE-2013R, respectively. Chris Hope & Kevin Schaefer. *Economic impacts of carbon dioxide and methane released from thawing permafrost*, 6 Nature Climate Change 56-59 (2016); Mikel González-Eguino & Marc B. Neumann, *Significant implications of permafrost thawing for climate change control*, 136 Climatic Change 381-388 (2016). Looking at the collapse of the West Antarctic Ice sheet, Nicholls et al. (2008) find a potential for significant increases in costs (and thus the SCC) in FUND. Robert J Nicholls, Richard SJ Tol, & Athanasios T. Vafeidis, Global estimates of the impact of a collapse of the West Antarctic ice sheet: an application of FUND, 91 *Climatic Change* 171-191 (2008). Ceronsky et al. (2011) model three tipping points (collapse of the Atlantic Ocean Meridional Overturning Circulation, large scale dissociation of oceanic methane hydrates; and a high equilibrium climate sensitivity parameter), and finds a large increase in the SCC in some cases. Megan Ceronsky, David Anthoff, Cameron Hepburn, and Richard SJ Tol, *Checking the price tag on catastrophe: The social cost of carbon under non-linear climate response* (ESRI working paper No. 392, 2011).

kurtosis (which, like skewness, is another descriptor of a distribution's tail) as well as means.[255] It is generally understood that people are risk averse in that they prefer input parameter distributions and (the resulting) SCC distributions with lower variances, holding the mean constant.[256] While the IWG assumes a risk-neutral central planner by using a constant discount rate (setting the risk premium to zero), this assumption does not correspond with empirical evidence,[257] current IAM assumptions,[258] the NAS (2017) recommendations, nor with the IWG's own discussion (2010) of the possible values of the elasticity of the marginal utility of consumption. Evidence from behavioral experiments indicate that people and society are also averse to other attributes of parameter distributions – specifically to the thickness of the tails of distributions – leading to an additional ambiguity premium (Heal and Millner, 2014).[259] Designing IAMs to properly account for the risk and ambiguity premiums from uncertain climate damages would increase the resulting SCC values they generate.

Even under the IWG's current assumption of risk neutrality, the mean SCC from uncertainty propagation excludes the (real) option value of preventing marginal CO_2 emissions.[260] Option value reflects the value of future flexibility due to uncertainty and irreversibility; in this case, the irreversibility of CO2 emissions due to their long life in the atmosphere.[261] If society exercises the option of emitting an additional unit of CO2 emissions today, "we will lose future flexibility that the [mitigation] option gave" leading to possible "regret and…a desire to 'undo'" the additional emission because it "constrains future

[255] Alexander Golub & Michael Brody, *Uncertainty, climate change, and irreversible environmental effects: application of real options to environmental benefit-cost analysis*, 7 Journal of Environmental Studies and Sciences 7 519-526 (2017); see Figure 1 in IWG (2016) supra note 243.

[256] In other words, society prefers a narrow distribution of climate damages around mean level of damages X to a wider distribution of damages also centered on the same mean of X because they avoid the potential for very high damages even at the cost of eliminating the chance of very low damages.

[257] IWG, 2010 *supra* note 243, at fn 22; Cai et al., 2016, *supra* note 239, at 521.

[258] The developers of each of the three IAMs used by the IWG (2010; 2013; 2016) assume a risk aversion society. Nordhaus and Sztorc 2013 *supra* note 241; Anthoff & Tol (2013) *supra* note 247; DAVID ANTHOFF & RICHARD S. J. TOL, THE CLIMATE FRAMEWORK FOR UNCERTAINTY, NEGOTIATION, AND DISTRIBUTION (FUND), TECHNICAL DESCRIPTION, VERSION 3.5 (2010); Chris Hope, *Critical issues for the calculation of the social cost of CO2: why the estimates from PAGE09 are higher than those from PAGE2002*, 117 CLIM. CHANGE 531–543 (2013) at 539.

[259] According to Heal and Millner (2014) *supra* note 227, there is an ongoing debate of whether ambiguity aversion is rational or a behavioral mistake. Given the strong possibility that this debate is unlikely to be resolved, the authors recommend exploring both assumptions.

[260] Kenneth J Arrow & Anthony C. Fisher, *Environmental preservation, uncertainty, and irreversibility*, 88 The Quarterly Journal of Economics 312-319 (1974); Avinash K Dixit and Robert S Pindyck, Investment under uncertainty (1994); Christian P Traeger, On option values in environmental and resource economics, 37 Resource and Energy Economics 242-252 (2014).

In the discrete emission case, there are two overlapping types of option value: real option value and quasi-option value. Real option value is the full value of future flexibility of maintaining the option to mitigate, and mathematically equals the maximal value that can be derived from the option to [emit] now or later (incorporating learning) less the maximal value that can be derived from the possibility to [emit] now or never. Traeger (2014) *supra* note 295, equation 5. Quasi-option value is the value of future learning conditional on delaying the emission decision, which mathematically equals the value of mitigation to the decision maker who anticipates learning less the value of mitigation to the decision maker who anticipates only the ability to delay his/her decision, and not learning. *Id.* The two values are related, such that real option value can be decomposed into:

$$\text{DPOV} = \mathbf{Max}\{QOV + SOV - \mathbf{Max}\{NPV, 0\}, 0\} = \mathbf{Max}\{QOV + SOV - \text{SCC}, 0\}$$

where DPOV is the real option value, QOV is quasi-option value, SOV is simple option value (the value of the option to emit in the future condition on mitigating now), and NPV is the expected net present value of emitting the additional unit or the mean SCC in our case. *Id.*

[261] Even if society drastically reduced CO_2 emissions, CO_2 concentrations would continue to rise in the near future and many impacts would occur regardless due to lags in the climate system. Robert S Pindyck, *Uncertainty in environmental economics*, 1 Review of environmental economics and policy 45-65 (2007).

behavior."[262] Given that the SCC is calculated on the Business as Usual (BAU) emission pathway, option value will undoubtedly be positive for an incremental emission because society will regret this emission in most possible futures.

Though sometimes the social cost of carbon and a carbon tax are thought of as interchangeable ways to value climate damages, agencies should be careful to distinguish two categories of the literature. The first is the economic literature that calculates the optimal carbon tax in a scenario where the world has shifted to an optimal emissions pathway. The second is literature that assesses the social cost of carbon on the business-as-usual (BAU) emissions pathway; the world is currently on the BAU pathway, since optimal climate policies have not been implemented. There are currently no numerical estimates of the risk premium and option value associated with an incremental emission on the BAU emissions path. Although there are stochastic dynamic optimization models that implicitly account for these two values, they analyze *optimal,* sequential decision making under climate uncertainty.[263] By nature of being optimization models (instead of policy models), these complex models focus on calculating the optimal tax and not the social cost of carbon, which differ in that the former is the present value of marginal damages on the optimal emissions path rather than on the BAU emissions path.[264] While society faces the irreversibility of emissions on the BAU emissions path when abatement is essentially near zero (i.e., far below the optimal level even in the deterministic problem),[265] the stochastic dynamic optimization model must also account for a potential counteracting abatement cost irreversibility – the sunk costs of investing in abatement technology if we learn that climate change is less severe than expected – by the nature of being on the optimal emissions path that balances the cost of emissions and abatement. In the optimal case, uncertainty and irreversibility of abatement *can theoretically* lead to a lower optimal emissions tax, unlike the social cost of carbon. The difference in the implication for the optimal tax and the SCC means that the stochastic dynamic modeling results are less applicable to the SCC.

What can we learn from new literature on stochastic dynamic programming models?

Bearing in mind the limitations of stochastic dynamic modeling, some new research provides valuable insights that are relevant to calculation of the social cost of greenhouse gases. The new and growing stochastic dynamic optimization literature implies that the IWG's SCC estimates are downward biased. The literature is made up of three models – real option, finite horizon, and infinite horizon models – of which the infinite time horizon (i.e., stochastic dynamic programming (SDP)) models are the most comprehensive for analyzing the impact of uncertainty on optimal sequential abatement policies.[266] Recent computational advancements in SDP are helping overcome the need for strong simplifying assumptions in this literature for purpose of tractability. Traditionally, these simplifications led to unrealistically fast rates of learning – leading to incorrect outcomes – and difficulty in comparing results

[262] Pindyck (2007) *supra* note 224.

[263] Kann & Weyant *supra* note 226; Pindyck (2007) *supra* note 224; Golub et al. (2014) *supra* note 224.

[264] Nordhaus (2014) makes this difference clear when he clarifies that "With an optimized climate policy…the SCC will equal the carbon price…In the more realistic case where climate policy is not optimized, it is conventional to measure the SCC as the marginal damage of emissions along the actual path. There is some inconsistency in the literature on the definition of the path along which the SCC should be calculated. This paper will generally define the SCC as the marginal damages along the baseline path of emissions and output and not along the optimized emissions path." William D. Nordhaus, *Estimates of the Social Cost of Carbon: Concepts and Results from the DICE-2013R Model and Alternative Approaches*, 1 J. Assoc. Environ. Resour. Econ. 1 (2014).

[265] On the BAU path, emissions far exceed their optimal level even without considering uncertainty. As a consequence, society is likely to regret an additional emission of CO2 in most future states of the world. Alternatively, society is unlikely to regret current abatement levels unless the extremely unlikely scenarios that there is little to no warming and/or damages from climate change.

[266] Kann & Weyant *supra* note 226; Pindyck (2007) *supra* note 224; Golub et al. (2014) *supra* note 224.

across papers (due to differing uncertain parameters, models of learning, and model types). Even so, newer methods still only allow for a handful of uncertain parameters compared to the hundreds of uncertain parameters in FUND and PAGE. Despite these limitations, the literature supports the above finding that the SCC, if anything, increases under uncertainty.[267]

First, uncertainty increases the optimal emissions tax under realistic parameter values and modeling scenarios. While the impact of uncertainty on the optimal emissions tax (relative to the deterministic problem) depends on the uncertain parameters considered, the type of learning, and the model type (real option, finite horizon, and infinite horizon), the optimal tax clearly increases when tipping points or black swan events are included in stochastic optimization problems.[268] For SDP models, uncertainty tends to strengthen the optimal emissions path relative to the determinist case even without tipping points,[269] and these results are strengthened under realistic preference assumptions.[270] Given that there is no counter-balancing tipping abatement cost,[271] the complete modeling of climate uncertainty – which fully accounts for tipping points and fat tails – increases the optimal tax. Uncertainty leads to a stricter optimal emissions policy even if with irreversible mitigation costs, highlighting that the SCC would also increase when factoring in risk aversion and irreversibility given that abatement costs are very low on the BAU emissions path.

Second, given the importance of catastrophic impacts under uncertainty (as shown in the previous paragraph), the full and accurate modeling of tipping points and unknown knowns is critical when modeling climate change. The most sophisticated climate-economic models of tipping points – which include the possibility of multiple correlated tipping points in stochastic dynamic IAMs – find an increase in the optimal tax by 100%[272] to 800%[273] relative to the deterministic case without them. More realistic modeling of tipping points will also increase the SCC.

Finally, improved modeling of preferences will amplify the impact of uncertainty on the SCC. Adopting Epstein-Zin preferences that disentangle risk aversion and time preferences can significantly increase the SCC under uncertainty.[274] Recent research has shown that accurate estimation of decisions under

[267] Kann & Weyant *supra* note 226; Pindyck (2007) *supra* note 224; Golub et al. (2014) *supra* note 224; Lemoine & Rudik 2017 supra note 224. Comparing the optimal tax to the mean SCC is made further difficult by the frequent use of DICE as the base from which most stochastic dynamic optimization models are built. As a consequence, deterministic model runs are frequently the base of comparison for these models (Lemoine & Rudik, *id*).

[268] The real options literature tends to find an increase in the optimal emissions path under uncertainty relative to the deterministic case (Pindyck 2007 *supra* note 224), though the opposite is true when modelers account for the possibility of large damages (i.e., tipping point or black swan events) even with a risk-neutral society (Pindyck 2007 *supra* note 224; Golub et al 2014 *supra* note 224). Solving finite horizon models employing non-recursive methods, modelers find that the results differ depending on the model of learning – the research demonstrates stricter emission paths under uncertainty without learning (with emission reductions up to 30% in some cases) and the impact under passive learning has a relatively small impact due the presence of sunken mitigation investment costs - except when tipping thresholds are included (Golub et al 2014 *supra* note 224).

[269] Using SDP, modelers find that uncertainty over the equilibrium climate sensitivity parameter generally increases the optimal tax by a small amount, though the magnitude of this impact is unclear (Golub et al. (2014) *supra* note 224; Lemoine & Rudik 2017 supra note 224). Similarly, non-catastrophic damages can have opposing effects dependent on the parameters changed, though emissions appear to decline overall when you consider their uncertainty jointly.

[270] Pindyck (2007) *supra* note 224; Golub et al. (2014) *supra* note 224; Lemoine & Rudik 2017 supra note 224.

[271] Pindyck (2007) *supra* note 224.

[272] Derek Lemoine & Christian P. Traeger, *Economics of tipping the climate dominoes*. 6 Nat. Clim. Chang. 514-519 (2016).

[273] Cai et al. 2016 *supra* note 239.

[274] Cai et al. 2016 *supra* note 239; Lemoine & Rudik 2017 supra note *259*. The standard utility function adopted in IAMs with constant relative risk version implies that the elasticity of substitution equals the inversion of relative risk aversion. As a consequence, the society's preferences for the intra-generational distribution of consumption, the intergenerational

uncertainty crucially depends on distinguishing between risk and time preferences.[275] By conflating risk and time preferences, current models substantially understate the degree of risk aversion exhibited by most individuals, artificially lowering the SCC. Similarly, adopting ambiguity aversion increase the SCC, but to a much lesser extent than risk aversion.[276] Finally, allowing for the price of non-market goods to increase with their relative scarcity can amplify the positive effect that even small tipping points have on the SCC if the tipping point impacts non-market services.[277] Including more realistic preference assumptions in IAMs would further increase the SCC under uncertainty.

Introducing stochastic dynamic modeling (which captures option value and risk premiums), updating the representation of tipping points, and including more realistic preference structures in traditional IAMs will – as in the optimal tax – further increase the SCC under uncertainty

Conclusion: Uncertainty Raises the Social Cost of Greenhouse Gases

Overall, the message is clear: climate uncertainty is *never* a rationale for ignoring the SCC or shortening the time horizon of IAMs. Instead, our best estimates suggest that increased variability implies a higher SCC and a need for more stringent emission regulations.[278] Current omission of key features of the climate problem under uncertainty (the risk and climate premiums, option value, and fat tailed probability distributions) and incomplete modeling of tipping points imply that the SCC will further increase with the improved modeling of uncertainty in IAMs.

distribution of consumption, and risk aversion hold a fixed relationship. For purposes of stochastic dynamic programming, this is problematic because this assumption conflates intertemporal consumption smoothing and risk aversion. WJ Wouter Botzen & Jeroen CJM van den Bergh, *Specifications of social welfare in economic studies of climate policy: overview of criteria and related policy insights*, 58 Environmental and Resource Economics 1-33 (2014). By adopting the Epstein-Zinn utility function which separates these two parameters, modelers can calibrate them according to empirical evidence. For example, Cai et al. (2016) *supra* note 239 replace the DICE risk aversion of 1.45 and elasticity parameter of 1/1.45 with values of 3.066 and 1.5, respectively.

[275] James Andreoni & Charles Sprenger, *Risk Preferences Are Not Time Preferences*, 102 Am. Econ. Rev. 3357–3376 (2012).

[276] Lemoine & Traeger (2016) *supra* note 307.

[277] Typically, IAMs assume constant relative prices of consumption goods. Reyer Gerlagh & B. C. C. Van der Zwaan, *Long-term substitutability between environmental and man-made goods*, 44 Journal of Environmental Economics and Management 329-345 (2002); Thomas Sterner & U. Martin Persson, *An even sterner review: Introducing relative prices into the discounting debate*, 2 Review of Environmental Economics and Policy 61-76 (2008). By replacing the standard isoelastic utility function in IAMs with a nested CES utility function following Sterner and Persson (2008), Cai et al. (2015) find that even a relatively small tipping point (i.e., a 5% loss) can substantially increase the SCC in the stochastic dynamic setting. Yongyang Cai, Kenneth L. Judd, Timothy M. Lenton, Thomas S. Lontzek, & Daiju Narita, *Environmental tipping points significantly affect the cost– benefit assessment of climate policies*, 112 Proc. Natl. Acad. Sci. 4606-4611 (2015).

[278] Golub et al. (2014) *supra* note 224 states "The most important general policy implication from the literature is that despite a wide variety of analytical approaches addressing different types of climate change uncertainty, none of those studies supports the argument that no action against climate change should be taken until uncertainty is resolved. On the contrary, uncertainty despite its resolution in the future is often found to favor a stricter policy." *See also* Comments from Robert Pindyck, to BLM, on the Social Cost of Methane in the Proposed Suspension of the Waste Prevention Rule (submitted Nov. 5, 2017) ("Specifically, my expert opinion about the uncertainty associated with Integrated Assessment Models (IAMs) was used to justify setting the SC-CH4 to zero until this uncertainty is resolved. That conclusion does not logically follow and I have rejected it in the past, and I reiterate my rejection of that view again here. While at this time we do not know the Social Cost of Carbon (SCC) or the Social Cost of Methane with precision, we do know that the correct values are well above zero…Because of my concerns about the IAMs used by the now-disbanded Interagency Working Group to compute the SCC and SC-CH4, I have undertaken two lines of research that do not rely on IAMs…[They lead] me to believe that the SCC is larger than the value estimated by the U.S. Government."

TECHNICAL APPENDIX: DISCOUNTING

The Underlying IAMs All Use a Consumption Discount Rate

Employing a consumption discount rate would also ensure that the U.S. government is consistent with the assumptions employed by the underlying IAM models: DICE, FUND, and PAGE. Each of these IAMs employs consumption discount rates calibrated using the standard Ramsey formula (Newell, 2017). In DICE-2010, the elasticity of the pure rate of time preference is 1.5 and an elasticity of the marginal utility of consumption (η) of 2.0. Together with its assumed per capita consumption growth path, the average discount rate over the next three hundred years is 2.4%.[279] However, more recent versions of DICE (DICE-2013R and DICE-2016) update η to 1.45; this implies an increase of the average discount rate over the timespan of the models to between 3.1% and 3.2% depending on the consumption growth path.[280] In FUND 3.8 and (the mode values in) PAGE09, both model parameters are equal to 1.0. Based on the assumed growth rate of the U.S. economy (without climate damages), the average U.S. discount rate in FUND 3.8 is 2.0% over the timespan of the model (without considering climate damages). Unlike FUND 3.8, PAGE09 specifies triangular distributions for both parameters with a pure rate of time preference of between 0.1 and 2 with a mean of 1.03 and an elasticity of the marginal utility of consumption of between 0.5 and 2 with a mean 1.17. Using the PAGE09's mode values (without accounting for climate damages), the average discount rate over the timespan of the models is approximately 3.3% with a range of 1.2% to 6.5%. Rounding up the annual growth rate over the last 50 years to approximately 2%,[281] the range of best estimates of the SDR implied in the short-run by these three models is approximately 3% (PAGE09's mode estimate and FUND 3.8) to 4.4% (DICE-2016), though the PAGE09 model alone implies a range of 1.1% to 6.0% with a central estimate of 3%. The range of potential consumption discount rates in these IAMs is relatively consistent with IWG (2010; 2013; 2016) in the short-run, though the discount rates of the IAMs employed by the IWG decline over time (due to declining growth rates over time) implying a potential upward bias to the IWG consumption discount rates.

A Declining Discount Rate is Justified to Address Discount Rate Uncertainty

A strong consensus has developed in economics that the appropriate way to discount intergenerational benefits is through a declining discount rate (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014).[282] Not only are declining discount rate theoretically correct, they are actionable (i.e., doable given our current knowledge) and consistent with OMB's *Circular A-4*. Perhaps the best reason to adopt a declining discount rate is the simple fact that there is considerable uncertainty around which discount rate to use. The uncertainty in the rate points directly to the need to use a declining rate, as the impact of the uncertainty grows exponentially over time such that the

[279] Due to a slowing of global growth, DICE-2010 implies a declining discount rate schedule of 5.1% in 2015, 3.9% from 2015 to 2050; 2.9% from 2055 to 2100; 2.2% from 2105 to 2200, and 1.9% from 2205 to 2300. This would be a steeper decline if Nordhaus accounted for the positive and normative uncertainty underlying the SDR.

[280] Due to a slowing of global growth, DICE-2016 implies a declining discount rate schedule of 5.1% in 2015, 4.7% from 2015 to 2050; 4.1% from 2055 to 2100; 3.1% from 2105 to 2200, and 2.5% from 2205 to 2300.

[281] According to the World Bank, the average global and United States per capita growth rates were 1.7% and 1.9%, respectively.

[282] Arrow et al. (2014) at 160-161 states that "We have argued that theory provides compelling arguments for using a declining certainty-equivalent discount rate," and concludes the paper by stating "Establishing a procedure for estimating a [declining discount rate] for project analysis would be an improvement over the OMB's current practice of recommending fixed discount rates that are rarely updated."

correct discount rate is not an arithmetic average of possible discount rates.[283] Uncertainty about future discount rates could stem from a number of sources particularly salient in the context of climate change, including uncertainty about future economic growth, consumption, the consumption rate of interest, and preferences. Additionally, economic theory shows that if there is debate or disagreement over which discount rate to use, this should lead to the use of a declining discount rate (Weitzman, 2001; Heal & Millner, 2014). Though, the range of potential discount rates is limited by theory to potential consumption discount rates (see earlier discussion), which is certainly less than 7%.

There is a consensus that declining discount rates are appropriate for intergenerational discounting

Since the IWG undertook its initial analysis and before the most recent estimates of the SCC, a large and growing majority of leading climate economists consensus (Arrow et al., 2013) has come out in favor of using a declining discount rate for climate damages to reflect long-term uncertainty in interest rates. This consensus view is held whether economists favor descriptive (i.e., market) or prescriptive (i.e., normative) approaches to discounting (Freeman et al., 2015). Several key papers (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014) outline this consensus and present the arguments that strongly support the use of declining discount rates for long-term benefit-cost analysis in both the normative and positive contexts. Finally, in a recent survey of experts on the economics of climate change, Howard and Sylvan (2015), found that experts support using a declining discount rate relative to a constant discount rate at a ratio of approximately 2 to 1.

Economists have recently highlighted two main motivations for using a declining discount rate, which we elaborate on in what follows. First, if the discount rate for a project is fixed but uncertain, then the certainty-equivalent discount rate will decline over time, meaning that benefits should be discounted using a declining rate.[284] Second, uncertainty about the growth rate of consumption or output also implies that a declining discount rate should be used, so long as shocks to consumption are positively correlated over time.[285] In addition to these two arguments, other motivations for declining discount rates have long been recognized. For instance, if the growth rate of consumption declines over time, the Ramsey rule[286] for discounting will lead to a declining discount rate.[287]

In the descriptive setting adopted by the IWG (2010), economists have demonstrated that calculating the expected net present value of a project is equivalent to discounting at a declining certainty

[283] Karp (2005) states that mathematical "intuition for this result is that as [time] increases, smaller values of r in the support of the distribution are relatively more important in determining the expectation of e–rt" where r is the constant discount rate." Or as Hepburn et al. (2003) puts it, "The intuition behind this idea is that scenarios with a higher discount rate are given less weight as time passes, precisely because their discount factor is falling more rapidly" over time.

[284] This argument was first developed in Weitzman (1998) and Weitzman (2001).

[285] *See, e.g.,* Gollier (2009).

[286] The Ramsey discount rate equation for the social discount rate is $r = \delta + \eta * g$ where r is the social discount rate, δ is the pure rate of time preference, η is the aversion to inter-generational inequality, and g is the growth rate of per capita consumption. For the original development, *see*, Ramsey, F. P. (1928). A Mathematical Theory of Saving. *The Economic Journal*, *38*(152).

[287] Higher growth rates lead to higher discounting of the future in the Ramsey model because growth will make future generations wealthier. If marginal utility of consumption declines in consumption, then, one should more heavily discount consumption gains by wealthier generations. Thus, if growth rates decline over time, then the rate at which the future is discounted should also decline. *See*, *e.g.,* Arrow et al. (2014) at 148. It is standard in IAMs to assume that the growth rate of consumption will fall over time. *See*, *e.g.,* Nordhaus (2017) at 1519, "Growth in global per capita output over the 1980–2015 period was 2.2% per year. Growth in global per capita output from 2015 to 2050 is projected at 2.1% per year, whereas that to 2100 is projected at 1.9% per year." Similarly, Hope (2011) at 22 assumes that growth will decline. For instance, in the U.S., growth is 1.9% per year in 2008 and declines to 1.7% per year by 2040. Using data provided by Dr. David Anthoff (one of the founders of FUND), FUND assumes that the global growth rate was 1.8% per year from 1980–2015 period, 1.4% per year from 2015 to 2050 and 2015 to 2100, and then dropping to 1.0% from 2100 to 2200 and then 0.7% from 2200 to 2300.

equivalent discount rate when (1) discount rates are uncertain, and (2) discount rates are positively correlated (Arrow et al., 2014 at 157). Real consumption interest rates are uncertain given that there are no multi-generation assets to reflect long-term discount rates and the real returns to all assets—including government bonds—are risky due to inflation and default risk (Gollier & Hammitt, 2014). Furthermore, recent empirical work analyzing U.S. government bonds demonstrates that they are positively correlated over time; this empirical work has estimated several declining discount rate schedules that the IWG can use (Cropper et al., 2014; 2014; Arrow et al., 2013; Arrow et al., 2014; Jouini and Napp, 2014; Freeman et al. 2015).

Currently when evaluating projects, the U.S. government applies the descriptive approach using constant rates of 3% and 7% based on the private rates of return on consumer savings and capital investments. As discussed previously, applying a capital discount rate to climate change costs and benefits is inappropriate (Newell, 2017). Instead, analysis should focus on the uncertainty underlying the future consumption discount rate (Newell, 2017). Past U.S. government analyses (IWG, 2010; IWG, 2013; IWG, 2016) modeled three consumption discount rates reflecting this uncertainty. If the U.S. government correctly returns its focus on multiple consumption discount rates, then the expected net present value argument given above implies that a declining discount rate is the appropriate way to perform discounting. As an alternative, given that the Ramsey discount rate approach is the appropriate methodology in intergenerational settings, the U.S. government could use a fixed, low discount rate as an approximation of the Ramsey equation following the recommendation of Marten et al. (2015); see our discussion on Martin et al. 2015). This is roughly IWG (2010)'s goal for using the constant 2.5% discount rate.

If the normative approach to discounting is used in the future (i.e., the current approach of IAMs), economists have demonstrated that an extended Ramsey rule[288] implies a declining discount rate when (1) the growth rate of per capita consumption is stochastic,[289] and (2) consumption shocks are positively correlated over time (or their mean or variances are uncertain) (Arrow et al., 2013; Arrow et al., 2014; Gollier & Hammitt, 2014; Cropper et al., 2014).[290] While a constant adjustment downwards (known as the precautionary effect[291]) can be theoretically correct when growth rates are independent and identically distributed (Cropper et al., 2014), empirical evidence supports the two above assumptions for the United States, thus implying a declining discount rate (Cropper et al., 2014; Arrow et al., 2014; IPCC,

[288] If the future growth of consumption is uncertainty with mean μ and variance σ^2, an extended Ramsey equation $r = \delta + \eta * \mu - 0.5\eta^2\sigma^2$ applies where r is the social discount rate, δ is the pure rate of time preference, η is the aversion to inter-generational inequality, and g is the growth rate of per capita consumption. Gollier (2012, Chapter 3) shows that we can rewrite the extended discount rate as $r = \delta + \eta * g - 0.5\eta(\eta + 1)\sigma^2$ where g is the growth rate of expected consumption and $\eta + 1$ is prudence.

[289] The IWG assumption of five possible socio-economic scenarios implies an uncertain growth path.

[290] The intuition of this result requires us to recognize that the social planner is prudent in these models (i.e., saves more when faces riskier income). When there is a positive correlation between growth rates in per capita consumption, the representative agent faces more cumulative risk over time with respect to the "duration of the time spent in the bad state." (Gollier et al., 2008). In other words, "the existence of a positive correlation in the changes in consumption tends to magnify the long-term risk compared to short-term risks. This induces the prudent representative agent to purchase more zero-coupon bonds with a long maturity, thereby reducing the equilibrium long-term rate." (Gollier, 2007). Mathematically, the intuition is that under prudence, the third term in the extended Ramsey equation (*see* footnote 323) is negative, and a "positive [first-degree stochastic] correlation in changes in consumption raises the riskiness of consumption at date T, without changing its expected value. Under prudence, this reduces the interest rate associated to maturity T" (Gollier et al., 2007) by "increasing the strength of the precautionary effect" in the extended Ramsey equation (Arrow et al., 2014; Cropper et al., 2014).

[291] The precautionary effect measures aversion to future "wiggles" in consumption (i.e., preference for consumption smoothing) (Traeger, 2014).

2014).[292] We should further expect this positive correlation to strengthen over time due to the negative impact of climate change on consumption, as climate change causes an uncertain permanent reduction in consumption (Gollier, 2009).[293]

Several papers have estimated declining discount rate schedules for specific values of the pure rate of time preference and elasticity of marginal utility of consumption (e.g., Arrow et al., 2014), though recent work demonstrates that the precautionary effect increases and discount rates decrease further when catastrophic economic risks (such as the Great Depression and the 2008 housing crisis) are modeled (Gollier & Hammitt, 2014; Arrow et al., 2014). It should be noted that this decline in discount rates due to uncertainty in the global growth path is in addition to that resulting from a declining central growth path over time (Nordhaus, 2014; Marten, 2015).[294]

Additionally, a related literature has developed over the last decade demonstrating that normative uncertainty (i.e., heterogeneity) over the pure rate of time preference (δ)—a measure of impatience—also leads to a declining social discount rate (Arrow et al., 2014; Cropper et al., 2014; Freeman and Groom, 2016). Despite individuals differing in their pure rate of time preference (Gollier and Zeckhauser, 2005), an equilibrium (consumption) discount exists in the economy. In the context of IAMs, modelers aggregate social preferences (often measured using surveyed experts) by calibrating the preferences of a representative agent to this equilibrium (Millner and Heal, 2015; Freeman and Groom, 2016). The literature generally finds a declining social discount rate due to a declining collective pure rate of time preference (Gollier and Zeckhauser, 2005; Jouini et al., 2010; Jouini and Napp, 2014; Freeman and Groom, 2016).[295] The heterogeneity of preferences and the uncertainty surrounding economic growth hold simultaneously (Jouini et al., 2010; Jouini and Napp, 2014), leading to potentially two sources of declining discount rates in the normative context.

Declining Rates are Actionable and Time-Consistent

There are multiple declining discount rate schedules from which the U.S. government can choose, of which several are provided in Arrow et al. (2014) and Cropper et al. (2014). One possible declining interest rate schedule for consideration by the IWG is the one proposed by Weitzman (2001).[296] It is derived from a broad survey of top economists in context of climate change, and explicitly incorporates

[292] Essentially, the precautionary effect increases over time when shocks to the growth rate are positively correlated, implying that future societies require higher returns to face the additional uncertainty (Cropper et al., 2014; Arrow et al., 2014; IPCC, 2014).

[293] Due to the deep uncertainty characterizing future climate damages, some analysts argue that the stochastic processes underlying the long-run consumption growth path cannot be econometrically estimated (Weitzman, 2007; Gollier, 2012). In other words, economic damages, and thus future economic growth, are ambiguous. Agents must then form subjectivity probabilities, which may be better interpreted as a belief (Cropper et al., 2014). Again, theory shows that ambiguity leads to a declining discount rate schedule by Jensen's inequality (Cropper et al., 2014).

[294] A common assumption in IAMs is that global growth will slow over time leading to a declining discount rate schedule over time; *see* footnote 7. Uncertainty over future consumption growth and heterogeneous preferences (discussed below) would lead to a more rapid decline in the social discount rate.

[295] The intuition for declining discount rates due to heterogeneous pure rates of time preference is laid out in Gollier and Zeckhauser (2005). In equilibrium, the least patient individuals trade future consumption to the most patient individuals for current consumption, subject to the relative value of their tolerance for consumption fluctuations. Thus, while public policies in the near term mostly impact the most impatient individuals (i.e., the individuals with the most consumption in the near term), long-run public policies in the distant future are mostly going to impact the most patient individuals (i.e., the individuals with the most consumption in the long-run).

[296] Weitzman (2001)'s schedule is as follows: 4% for 1-5 years; 3% for 6-25 years; 2% for 26-75 years; 1% for 76-300 years; and 0% for 300+ years.

arguments around interest rate uncertainty.[297] Other declining discount rate schedule include Newell and Pizer (2003); Groom et al. (2007); Freeman et al. (2015). Many leading economists support the United States government adopting a declining discount rate schedule (Arrow et al., 2014; Cropper et al., 2014). Moreover, the United States would not be alone in using a declining discount rate. It is standard practice for the United Kingdom and French governments, among others (Gollier & Hammitt, 2014; Cropper et al., 2014). The U.K. schedule explicitly subtracts out an estimated time preference.[298] France's schedule is roughly similar to the United Kingdom's. Importantly, all of these discount rate schedules yield lower present values than the constant 2.5% discount rate employed by IWG (2010), suggesting that even the lowest discount rate evaluated by the IWG is too high.[299] The consensus of leading economists is that a declining discount rate schedule should be used, harmonious with the approach of other countries like the United Kingdom. Adopting such a schedule would likely increase the SCC substantially from the administration's 3% estimate, potentially up to two to three fold (Arrow et al., 2013; Arrow et al., 2014; Freeman et al., 2015).

A declining discount rate motived by discount rate or growth rate uncertainty avoids the time inconsistency problem that can arise if a declining pure rate of time preference (δ) is used. *Circular A-4* cautions that "[u]sing the same discount rate across generations has the advantage of preventing time-inconsistency problems."[300] A time inconsistent decision is one where a decision maker changes his or her plan over time, solely because time has passed. For instance, consider a decision maker choosing whether to make an investment that involves an up-front payment followed by future benefits. A time consistent decision maker would invest in the project if it had a positive net-present value, and that decision would be the same whether it was made 10 years before investment or 1 year before investment. A time inconsistent decision maker might change his or her mind as the date of the investment arrived, despite no new information becoming available. Consider a decision maker who has a declining pure rate of time preference (δ) trying to decide whether to invest in a project that has large up-front costs followed by future benefits. 10 years prior to the date of investment, the decision maker will believe that this project is a relatively unattractive investment because both the benefits and costs would be discounted at a low rate. Closer to the date of investment, however, the costs would be relatively highly discounted, possibly leading to a reversal of the individual's decision. Again, the discount rate schedule is time consistent as long as δ is constant.

The arguments provided here for using a declining consumption discount rate are not subject to this time inconsistency critique. First, time inconsistency occurs if the decision maker has a declining pure rate of time preference, not due to a decreasing discount rate term structure.[301] Second, uncertainty

[297] Freeman and Groom (2014) demonstrate that this schedule only holds if the heterogeneous responses to the survey were due to differing ethical interpretations of the corresponding discount rate question. A recent survey by Drupp et al. (2015) – which includes Freeman and Groom as co-authors – supports the Weitzman (2001) assumption.

[298] The U.K. declining discount rate schedule that subtracts out a time preference value is as follows (Lowe, 2008): 3.00% for 0-30 years; 2.57% for 31-75 years; 2.14% for 76-125 years; 1.71% for 126- 200 years; 1.29% for 201- 300 years; and 0.86% for 301+ years.

[299] Using the IWG's 2010 SCC model, Johnson and Hope (2012) find that the U.K. and Weitzman schedules yield SCCs of $55 and $175 per ton of CO_2, respectively, compared to $35 at a 2.5% discount rate. Because the 2.5% discount rate was included by the IWG (2010) to proxy for a declining discount rate, this result indicates that constant discount rate equivalents may be insufficient to address declining discount rates.

[300] *Circular A-4* at 35.

[301] Gollier (2012) states "It is often suggested in the literature that economic agents are time inconsistent if the term structure of the discount rate is decreasing. This is not the case. What is crucial for time consistency is the constancy of the rate of impatience, which is a cornerstone of the classic analysis presented in this book. We have seen that this assumption is compatible with a declining monetary discount rate."

about growth or the discount rate avoids time inconsistency because uncertainty is only resolved in the future, after investment decisions have already been made. As the NAS (2017) notes, "One objection frequently made to the use of a declining discount rate is that it may lead to problems of time inconsistency....This apparent inconsistency is not in fact inconsistent....At present, no one knows what the distribution of future growth rates...will be; it may be different or the same as the distribution in 2015. Even if it turns out to be the same as the distribution in 2015, that realization is new information that was not available in 2015."[302]

We should note that time-inconsistency is not a reason to ignore heterogeneity (i.e., normative uncertainty) over the pure rate of time preference (δ). If the efficient declining discount rate schedule is time-inconsistent, the appropriate solution is to select the best time-consistent policy. Millner and Heal (2014) do just this by demonstrating that a voting procedure – whereby the median voter determines the collective preference – is: (1) time consistent, (2) welfare enhancing relative to the non-commitment, time-inconsistent approach, and (3) preferred by a majority of agents relative to all other time-consistent plans. Due to the right skewed distribution of the pure rate of time preference and the social discount rate as shown in all previous surveys (Weitzman, 2001; Drupp et al., 2015; Howard and Sylvan, 2015), the median is less than the mean social discount rate (and pure rate of time preference); the mean social discount rate is what holds in the very short-run under various aggregation methods, such as Weitzman (2001) and Freeman and Groom (2015). Combining an uncertain growth rate and heterogeneous preference together implies a declining discount rate starting at a lower value in the short-run. In addition to the reasons discussed earlier in the comments, this is another reason to exclude a discount rate as high as 7%.

There is an economic consensus on the appropriateness of employing a consumption discount rate (and the inappropriateness of a capital discount rate) in the context of climate change

There is a strong consensus among economists that it is theoretically correct to use consumption discount rates in the intergenerational setting of climate change, such as in the calculation of the SCC. Similarly, there is a strong consensus that a capital discount rate is inappropriate according to "good economics" (Newell, 2017).[303] This consensus holds across panels of experts on the social cost of carbon (NAS, 2017); surveys of experts on climate change and discount rates (Weitzman, 2001; Drupp et al., 2015; Howard and Sylvan, 2015; and Pindyck, 2016); the three most commonly cited IAMs employed in calculating the federal SCC; and the government's own analysis (IWG, 2010; CEA, 2017). For more analysis of this issue, see the discussion in the main body our Comments on the inappropriateness using a discount rate premised on the return to capital in intergenerational settings.

[302] NAS Second Report, *supra* note 62, at 182.

[303] The former co-chair of the National Academy of Sciences' Committee on Assessing Approaches to Updating the Social Cost of Carbon – Richard Newell (2017) – states that "[t]hough the addition of an estimate calculated using a 7 percent discount rate is consistent with past regulatory guidance under OMB *Circular A-4*, there are good reasons to think that such a high discount rate is inappropriate for use in estimating the SCC...It is clearly inappropriate, therefore, to use such modeling results with OMB's 7 percent discount rate, which is intended to represent the historical before-tax return on private capital...This is a case where unconsidered adherence to the letter of OMB's simplified discounting approach yields results that are inconsistent with and ungrounded from good economics."

Individuals

IND1 – Mark Cutrera

Written Comment Form
Calcasieu Pass Project Draft Environmental Impact Statement

MEETING LOCATION: Cameron Parish School Board Educational Conference Center
510 Marshall Street, Cameron, LA 70631 DATE: August 1, 2018 TIME: 4:00 – 7:00 p.m. CST

Name: MARK CUTRERA
Organization (if applicable):
Address: [redacted]
City/State/Zip: [redacted]

☑ Yes, include my name and address on the mailing list so I can receive information on the Calcasieu Pass Project EIS.

THANK YOU FOR YOUR INPUT.
PLEASE PRINT LEGIBLY.

IND1-1 I WORK FOR UTILITY COMPANY AND SUPPORT THIS PROJECT. THAT WOULD HELP THE COMMUNITY AND UTILITY COMPANIES. CAMERON, LA. HAS BEEN NEEDING A MAJOR FACILITY LIKE THIS ONE FOR A LONG TIME. I FULL SUPPORT VENTURE GLOBAL PROJECT!!

**** continue on back for more space ****

Please leave form here, or mail your paper copy of comments to the following address. Be sure to reference the project docket number (CP15-550-000, CP15-551-000, and CP15-551-001):

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

All comments must be received or postmarked by August 13, 2018.

IND1-1 Comment acknowledged.

IND2 – Darrell Williams

Written Comment Form
Calcasieu Pass Project Draft Environmental Impact Statement

MEETING LOCATION: Cameron Parish School Board Educational Conference Center
510 Marshall Street, Cameron, LA 70631 DATE: August 1, 2018 TIME: 4:00 – 7:00 p.m. CST

Name: DARRELL WILLIAMS
Organization (if applicable): CAMERON PARISH POLICE JURY
Address: [redacted] BUSINESS P.O. BOX 1280
City/State/Zip: [redacted] BUSINESS CAMERON, LA 70631

☐ Yes, include my name and address on the mailing list so I can receive information on the Calcasieu Pass Project EIS.

THANK YOU FOR YOUR INPUT.
PLEASE PRINT LEGIBLY.

IND2-1 FULL SUPPORT OF THE VENTURE GLOBAL CALCASIEU PASS PROJECT. PLEASE SEE ATTACHED STATEMENT

**** continue on back for more space ****

Please leave form here, or mail your paper copy of comments to the following address. Be sure to reference the project docket number (CP15-550-000, CP15-551-000, and CP15-551-001):

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

All comments must be received or postmarked by August 13, 2018.

IND2-1 Comment acknowledged.

IND2-2

My name is Darrell Williams. I am a resident of Grand Lake, LA and have been an employee of the Cameron Parish Police Jury for 30 years, currently serving as the Parish Secretary/Assistant Administrator. I am here to express my full support for the Venture Global Calcasieu Pass Project. I have a son who will graduate from Grand Lake High School next year. I have a daughter who will graduate from college next spring. Because of the emergence of the LNG industry, this proposed facility, and other facilities like this operating in Cameron Parish, they will have opportunities for them to compete for high paying jobs and make their home in Cameron Parish. The future of Cameron Parish depends on economic opportunity and Venture Global, and this industry, is providing that. Venture Global has worked with Cameron Parish to not only mitigate, but improve, any impacts to tourism and other aspects that are important to our way of life. Our success as a Parish depends on improving economic opportunity, educational opportunity, and our quality of life in a changing world. Projects like Venture Global can provide that if we are smart and work together. For the future of young people to live in Cameron Parish and thrive, I fully support this project.

Darrell Williams

[redacted]

[redacted]

IND2-2 Comment acknowledged.

IND3 – Paula Flynn

20180816-0012 FERC PDF (Unofficial) 08/16/2018

ORIGINAL

FILED
SECRETARY OF THE
COMMISSION
2018 AUG 16 P 2:56
FEDERAL ENERGY
REGULATORY COMMISSION

Written Comment Form
Calcasieu Pass Project Draft Environmental Impact Statement

MEETING LOCATION: Cameron Parish School Board Educational Conference Center
510 Marshall Street, Cameron, LA 70631 DATE: August 1, 2018 TIME: 4:00 – 7:00 p.m. CST

Name: Paula Flynn
Organization (if applicable):
Address: [redacted]
City/State/Zip: [redacted]

☑ Yes, include my name and address on the mailing list so I can receive information on the Calcasieu Pass Project EIS.

THANK YOU FOR YOUR INPUT.
PLEASE PRINT LEGIBLY.

IND3-1 I am writing in opposition to this project. I have not seen anywhere in plan a plan to control the introduction of invasive species, which have posed a huge challenge to deteriorating wetlands and coastal areas in the Barataria basin region and the Delta region. Also,
IND3-2 a concern exists as to the over-building of LNG infrastructure on the LA coast. Valuable wetlands and habitat will be destroyed for temporary gain.
IND3-3 In addition, it is simply hazardous to conduct such operations in the path of potential hurricanes, which are predicted to become more intense as time goes on. We should look at locating this facility further inland.

**** continue on back for more space ****

Please leave form here, or mail your paper copy of comments to the following address. Be sure to reference the project docket number (CP15-550-000, CP15-551-000, and CP15-551-001):

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

All comments must be received or postmarked by August 13, 2018.

IND3-1 The potential for impacts from exotic or invasive plant species was evaluated in section 4.5.2 of the final EIS. Venture Global would construct the Project in compliance with its Project-specific Plan and Procedures, and *Noxious Weed and Invasive Species Plant Management Plan* (Noxious Weed Plan). Venture Global filed the plan with FERC on August 13, 2018, and also provided the plan to the NRCS and LDWF. On August 21 and 29, 2018, the NRCS and LDWF, respectively, provided comments on the plan in regard to limiting non-native species recolonization, seed mixes, weed and invasive plant treatment methods, and duration of treatment and monitoring activities. Venture Global is still coordinating with these agencies in regard to their comments on the plan; therefore we included a recommendation for Venture Global to file a final Noxious Weed Plan with the Secretary for our review and approval. With implementation of the measures in Venture Global's Plan, Procedures, and Noxious Weed Plan, construction and operation of the Terminal and Pipeline, we conclude in final EIS section 4.5.2 that the project would have minimal effects on the introduction, establishment, and spread of invasive plant species.

IND3-2 The LNG market would determine how many LNG facilities would actually be built in Louisiana. Similar to the Project's wetland impacts and mitigation, permanent wetland impacts from other LNG projects on the Louisiana coast would be required to obtain a Clean Water Act Section 404 permit, develop a wetland compensatory mitigation plan, and receive approval from the USACE. Wetland impacts from construction and operation of the Terminal and Pipeline are addressed in final EIS section 4.4; cumulative wetland impacts from other projects (including other LNG projects) in the project area are addressed in final EIS section 4.13.2.4. Venture Global Calcasieu Pass submitted its Section 404 permit application and draft compensatory wetland mitigation plan (final EIS Appendix E) to the USACE. The draft mitigation plan proposes a combination of wetland mitigation banking and marsh creation/restoration to offset the Project's permanent wetland impacts and to ensure no net loss of wetland functions.

IND3-3 Comment acknowledged. As noted in section 4.12.5 of the final EIS, the "FERC staff evaluated Venture Global Calcasieu Pass' geotechnical and structural design information to ensure the site preparation and foundation designs are appropriate for the underlying soil characteristics and to ensure the structural design of the Terminal facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practice." As a result of that review, a number of staff recommendations were made to require that Venture Global Calcasieu Pass submit additional engineering plans and specifications for OEP review prior to initial site preparation, construction of the final design and commencement of service. Refer to section 5.2 of the final EIS, recommendations 34-114. Notably, the project would be protected from hurricane storm surge with a perimeter berm/wall structure designed to withstand severe hurricane effects, with future potential sea level rise taken into account.

Venture Global considered several sites for the proposed Project, including three sites at least 23 miles inland (see final EIS table 3.3.2-1). These inland sites did not meet all the criteria necessary for the proposed Project.

Public Meeting Transcript

PM1 – Public Meeting Transcript

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

VENTURE GLOBAL CALCASIEU PASS, LLC
TRANSCAMERON PIPELINE, LLC

DOCKET NOS.: CP15-550-000, CP15-551-000,
AND CP15-551-001

PUBLIC MEETING
CALCASIEU PASS PROJECT
* *
Taken at Cameron Parish School Board,
Educational Conference Center, 510 Marshall Street,
Cameron, Louisiana, on August 1, 2018, beginning at
3:35 p.m.

APPEARANCES:

REPRESENTING FERC:

MS. SHANNON CROSLEY

MS. KIMBERLY BOSE

REPORTED BY:

GAYNELL MOORE-HEBERT, CCR

LAURA LEACH

Well, I'm just here for support of the Venture Global Project and -- and Cameron Parish. We live in Calcasieu. And I am chairman of a small group called Cameron Answers. And we exist strictly for one purpose, and that is to support and encourage Cameron to return to the community that it used to be and to be all that it can be. And I just want to say that in the nine years we've been working with the Police Jury and all, we've had a chance to get to know the people of Cameron. We've had a chance to meet the people with Venture Global, and I'm very convinced that they want what is best for Cameron Parish and for Louisiana as a whole and certainly, for this whole five parish area in which we live.

PM1-1

I've had an opportunity to go to their offices in Washington, D.C. and visit with them when they were down here and I'm very impressed with the way they have handled their business, the way they have expressed interest in everything, every aspect of what's going to be happening in this area. And I just came down for the support of the project. That's it. Thank you so much.

PM1-1 Comment acknowledged.

RYAN BOURRIAQUE

Ryan Bourriaque, Cameron Parish Administrator. I'm sure that the staff of FERC is very familiar with Cameron Parish. We've had Chenier and Cameron LNG both go through construction and receive FERC permits for import and export facilities. Both of those facilities are located in western Cameron Parish. And here tonight we're very pleased to see a facility potentially being located on the eastern side of Cameron Parish. We are certainly starting to embrace our role in the global energy market with $30 billion of investment ongoing and another 24 in various stages of permitting.

PM1-2

We're ecstatic for Venture Global. We have worked very diligently with this company to address community and civic impacts. Many of those issues were referenced in the 695 page draft EIS. The Cooperative Endeavor Agreement that we negotiated to specifically address access to the jetty pier facility, the recreational vehicles park, and then supplement issues with a new restaurant and a marina. So, we feel that even though there will be temporary impacts because of the construction, we feel that the negotiation and

PM1-2 Comment acknowledged.

the cooperation between our agency and the company will result in enhanced opportunities for recreation and tourism in Cameron Parish.

When I look at some of the numbers and everybody likes talking about the numbers, you know, I already threw out the dollar values; but 1,500 jobs -- construction jobs in a parish of only 6,800 people, you know, that's pretty interesting. Some of your locals are going to get some of those jobs. Maybe not all of them, but some of them. 130 permanent jobs. Again, when

PM1-2 you're looking at a very rural parish, to see an influx of 130 jobs in one investment and an average salary of $70,000 per employee, that's wonderful.

It's no secret to anyone, our parish has gone through Hurricanes Rita and Ike. And in fact, next month will be the ten-year anniversary of Ike. We've -- I've -- in my position, I've been appointed administrator since January of '14. I grew up here. When -- when FERC had their first hearing here, I think in 2015, I referenced my two daughters. And so, those -- those children were the sixth generation of my family to grow up on the same piece of property in this parish. And

so, since then we've added a third to the mix. So, now I have a second-grader, a kindergartner and a 11-month-old, who will celebrate her first birthday August 18th. And this is what makes me most excited is that they're going to have opportunities in this parish because of investments that Venture Global is going to make.

So, after reviewing all of -- all of the information and I did read the majority of the draft EIS. I skipped some of the technical engineering portions. But I enjoyed Chapter 5. It was fairly easy to read. I think what I'm -- my takeaway was, you know, outside of the numbers and outside of the impacts, this company and this investment will allow an opportunity for our culture and heritage to survive, allow an opportunity for our students, for our school systems, and for my kids to have a chance to live and work here. And that means a whole lot to me. It makes me very proud to have even been involved in this process.

PM1-2

And so, on behalf of the Policy Jury, you know, we voice our full support of the project and think that many of the minimal issues discussed can all be mitigated and resolved amicably.

They're issues, not problems. And people can resolve issues. And so, we hope that this could be a very expeditious process to finalize -- to finalize the review.

PM1-2

DAVY DOXEY

I just want to make a statement. I'm happy y'all are about at the last public meeting. And so, we can get on and get this project started. Anyway, I'm very happy about it. I have no problem with the company at all being -- living here, too. I live a couple miles away. So, I looked over everything; and they're going to cool everything with fans instead of water. That helps us a lot because our water's kind of low. And that's about all I've got.

PM1-3

DARRYL FARQUE

The only thing I have to tell FERC -- and you're going to probably hear this throughout the whole ordeal this afternoon -- we need to expedite their permit and let it move. Your environmental study has been done. It's complete. Venture will do anything it takes to make the environmental safe in their project. They're a family to us.

PM1-4

PM1-3 Comment acknowledged.

PM1-4 Comment acknowledged.

They're friends, family. It's getting bigger and tighter and tighter. We need them to come to this parish.

We've got a big downfall with two major hurricanes here. We've got two LNGs up -- trying to go up and run now. We've got Cheniere LNG. We've got the Cameron LNG. Now we need Venture. Venture needs to be on this side of the river. Venture needs to be rolling. FERC needs to get ahead, and let's expedite that permit very quickly. And I'm talking about expedite, expedite, expedite. It needs to be done fast. It needs to get going. They have spent their money. They have done their time. They're going to do whatever it takes to have this facility up and running shortly, and we need y'all's help. We really do. We need your help here, and we need to expedite it very quickly.

PM1-4

Thank y'all. Thank y'all very much for coming to Cameron Parish. We welcome y'all to our parish. I am the vice president of the Cameron Parish Police Jury. My chairman couldn't be here today. He is working. So, I come in his place. And from behalf of myself and the Cameron Parish Police Jury, thank y'all for coming. Thanks for

PM1-4 listening. We really appreciate it. Thank y'all.

CHARLEY LEMONS
Cameron Parish Superintendent of Schools

I've been in my current position for about two months; and one of the things that when I got hired here, knowing the potential for the possible LNGs really excited me because one of the things in this parish, obviously, with the hurricanes PM1-5 and, you know, the population has not replenished. It's kind of -- and to know Cameron and these other communities pre-hurricane, it's kind of disheartening. But my hope or my -- I guess my wish is that maybe some of these LNGs coming in will revive these small towns. I think for the most part the communities are open to them. They're in support of them. There may be some that aren't. But for the most part, they are.

I know on behalf of the School Board, we are very supportive of them and the opportunities they're going to bring into the parish.

JAKE FONTENOT

PM1-6 I guess it's why we want this project to

PM1-5 Comment acknowledged.

PM1-6 Comment acknowledged.

pass. I'm a school teacher. I teach 9th through 12th grade vocational education and we're sending kids all over the state for jobs and I just think this is -- what better way to get them encouraged to go to school and get a job with the industry that could come with this project.

So, that's why I really wanted to come and speak and say, you know, we're small; but I see the growth. I teach at South Cameron High School.

PM1-6

My wife teaches there. My oldest son and his wife both teach there. And we're just really rooted to the community; and we want to see, you know, more industry coming back. We were there before Rita. We saw the industry we had before Rita. We know what we can have. We know the people that we have. We see the children that we're teaching. And like I said, they're traveling all over the country to go to jobs when they could be here at home; and we know it could be here at home. We know the kids we can produce, and we just want to support getting a project started here.

HOWARD ROMERO

PM1-7

The first thing I'd like to say that I'm fully in support of the project of Venture Global.

PM1-7 Comment acknowledged.

Parish people as well it is to Venture Global. So, I encourage you guys to -- and I know you got hard work to do. I've dealt with you guys with FERC, and I know it's a process. But if you can speed it up, we'd take it a little early. So, thank you for all what you've done; and let's move forward.

PM1-7

TERRY BEARD

I'm Terry Beard. I'm also the police juror of District 4 at Cameron Parish. I live in Sweetlake on the north end of the parish, but I lived in Cameron for 23 years. I lost my home and everything in Hurricane Rita, and I didn't come back. I lived here -- in the 23 years I lived here, I watched Cameron die and come back twice, you know, because of the oilfield. And now the oilfield's gone. Everything's in east Texas and west Texas. And this -- we welcome anyone who wants to come into Cameron and do this. We welcome them because we need it.

And Venture, they're good for -- they're good for the community and they're good for the parish. They've really stepped out to help us in any way. And far as tax-wise, community-wise, it's a win-

PM1-8

PM1-8 Comment acknowledged.

PM1-8

win situation for us. And I can't see anything negative about it. My thing is we need to keep our kids here. We need to -- they need a future. We need jobs, and this is just a start for us. And like I said, I'm -- they're welcome. I want them here and to provide a future for our children.

SHEILA MILLER

With the investment, I think it's over $4 million -- $4 billion. $4 billion. And I just want to say that I'm president of the School Board, and that we are so looking forward to having you all in the parish. And our -- our school system -- our school that is actually in the project area has much room to grow far as population. So, we have an open door, you know, welcoming party. Our parish cannot operate without these industries, not only Venture Global but the other industries as well. Our oil and gas has gone to nothing. And we -- we just so look forward to having everyone here.

PM1-9

And I think we've been in contact with -- I've been to Washington, D.C. twice, so I've been to your place twice. We discussed the needs of

PM1-9 Comment acknowledged.

our students. They have come with some curriculum information that, you know, where our kids need to go, where our kids need to be so that, I mean, we look forward to that. And I know that just at the project school that is near -- the nearest school, closest to the project, we started some -- we invested in some welding booths and trying to get our kids prepared to -- for the construction part of it. So, we look forward to having you all. And I hope that all the FERC permits go through and they're granted because it's our salvation in Cameron Parish.

PM1-9

And in my district, I don't serve a big, large district but I did get 80 percent of the votes in my district and I have not had one constituent that talked negatively about Venture Global and locating in Cameron. So, with that being said, they're looking forward to job opportunities. Our kids -- I mean, I have a son that's 30 years old that went to Texas A&M to be a ship captain. So, I mean, this is like, you know, Christmas to him. And he's looking forward to having the channel deepened and widened and that kind of thing; and hopefully, one day he'll be able to move back home.

PM1-9

So, those are the kinds of people that we want back in our community to help grow. And it's our future, so I appreciate anything that, you know, you all can do to help move the process along.

CAPTAIN BRETT PALMER

PM1-10

I'm Captain Brett Palmer. I'm the president of the Lake Charles Pilots. We've been working with Venture Global since 2014 during the initial concept of the facility. We've worked with them on their simulations for the proof of concept -- what I call the proof of concept of actually bringing the ships in, designing the turn basin, mooring the vessels. We worked on traffic management concepts. We worked on the waterway suitability study. We believe that this is a great facility for Cameron Parish and we've even looked at some of the impact and we can't see any negative impact to other stakeholders along the channel. And we fully support the facility. Thank you.

STEPHANIE RODRIGUE

PM1-11

I'm Stephanie Rodrigue. I'm a resident of

PM1-10 Comment acknowledged.

PM1-11 Comment acknowledged.

Cameron Parish. In fact, I'm about three and a half miles from here, my home. I'm here today as president of the Cameron Lions Club as well as the former superintendent of schools for Cameron Parish. Last Thursday, the Cameron Parish Lions Club voted unanimously to support this project.

One of our main charitable endeavors as a Lions Club is to encourage our young people to go to college or to some type of post secondary education, whether it's college or vocational

PM1-11

school, whatever that might be, whatever fits them best. But of course, we do that in hopes that they will return to this parish.

On September 24, 2005, Hurricane Rita destroyed this community. On September 13, 2008, the little bit of rebuilding that was done was destroyed by Hurricane Ike. So, we're left -- and you may have seen driving up here -- we're left with slabs. We're left with shuttered businesses. And we're left with many FEMA worksheets that are yet to be paid. The future was very dismal for Cameron Parish, especially for lower Cameron Parish where we are today, until the idea of making this parish a hub for LNG, for the energy industry, returning Cameron Parish to its presence

as a coastal industrial hub once again through the thought of LNGs -- multiple LNGs in these communities. Our -- our Lions Club fully supports the Calcasieu Pass Project -- this Venture Global-Calcasieu Pass Project because we feel that we need the economic impact. More than anything, we need a reason for our -- our children to graduate and return.

This is a wonderful place. It's a sportsman's paradise. It's, you know, everything you can imagine and more when it comes to a place

PM1-11

to raise a family. Great schools. Schools as the centers of the communities. Active churches. But we don't have anything for our young people to encourage them to return. We also have many local businesses that struggle because there's so few of us here. You know, there are certainly far less than the 6,000 reported residents of Cameron Parish. The numbers in reality is far smaller. And many of these local businesses will benefit from the injection of competitive LNG salaries into our economy. We -- you know, the numbers of construction jobs, I think 1,500, around 130 plus in direct jobs, another maybe 300 or so in indirect jobs, those numbers are staggering when

we think of where we are and where we can be in a few short years.

So, with all of that said, you know, that is our support. Venture Global is already a true friend to Cameron Parish. Of course, because of the property there, they're mitigating -- there's an RV park and a boat launch. That's going to be moved just right down this road next to -- next -- just around the corner from this building. They're mitigating that as a part -- as an agreed upon mitigation. But in addition to that, they're also going to provide a marina and a restaurant. They are doing that of their own goodwill. Not because they are compelled to do that in the project agreement. So, that's, you know, another example. They have -- they're not even up and running and they've injected funds into our Lions Club scholarship program. We have our annual fishing festival this weekend. They're the title sponsor. They've made their presence known in a very, very positive way.

PM1-11

In 2003, I believe, I was a curricula specialist for the school district before I became superintendent; and at that time, we were preparing for the onset of Cheniere. Before

Sempra, which is now Cameron LNG, became a reality, we were planning on how can we educate our students for the type of positions. And I understand it's a -- it's a wide array of jobs, but the specific ones that are specific to LNG, you know, process technicians, those type of positions. We were actually in discussion of all of that when Hurricane Rita came ashore right down the road here in Cameron Parish. And then after that with all the schools -- we -- the Cameron Parish School District was the highest damaged -- impacted damages for the entire Hurricane Rita. We were kind of in the shadows of Hurricane Katrina. So, not a very well-known storm, but a very sad storm for us. And, you know, all of our temporary fixes, as I said, were destroyed in Ike. But in that interim we never lost sight of the fact that we needed to educate our students for this LNG industry that we thought was forthcoming.

PM1-11

So, I don't just have the knowledge of this; but I have the knowledge of the other two LNG industries. Every time something's been mitigated from an environmental standpoint, it's better than it was before. When oyster beds were replaced by Cameron LNG, the oyster -- the fishermen saw an

increase in their catch -- their oyster catches. The shrimp industry, same thing. You know, all of those types of perhaps negative environmental impacts that you think that industry would bring, none of that comes to fruition. In fact, we see a better steward of the environment than existed before.

But it does -- the -- it brings an awareness of the environment. I think that's a very positive impact because when you start talking about an industry coming into pretty much virgin land, you automatically think of a negative impact. Well, in fact, the impacts -- the impacts have been positive. I feel certain they will continue to be. But I think it's important that this brought our environment to a higher level of knowledge, a higher level -- you know, just an awareness that wasn't there before. And -- and just the change in how we educate students, the change in the programing. You know, Sowela, the community college in Lake Charles has added huge curriculums to meet the ever changing -- the changing needs of the LNG industry. And I know that even though I've -- I left the school district in 2014, obviously, because I am here and

PM1-11

I'm very much involved in the community and I'm a very acute stakeholder. I see all the positive ways that education is changing Cameron Parish to prepare our students for this. Again, always because we want them to come back and live and work and play in Cameron Parish. And I feel that this particular Venture Global project has all of the right pieces coming together that can make that happen.

PM1-11

So, I thank you for the opportunity to express my opinion.

CLAIR HEBERT MARCEAUX

PM1-12

Simply want to, as director of the Cameron Parish Port Harbor and Terminal District, provide no opposition to the project, especially in light of the draft environmental impact statement. We serve at the Cameron Parish Port Harbor and Terminal District as the legislatively authorized public Port Authority.

GERTRUDE SAVOY

PM1-13

I'm Gertrude Ann Savoy; and it will be a blessing for LNG plant to be built in Cameron, Louisiana, so it can help people come home and to

PM1-12 Comment acknowledged.

PM1-13 Comment acknowledged.

PM1-13

get Cameron back on its feet where it used to be, probably better than it ever was.

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceeding before the FEDERAL ENERGY REGULATORY COMMISSION in the Matter of:

Name of Proceeding: Calcasieu Pass Project

Docket No.: CP15-550-000
Place: Cameron, Louisiana
Date: Wednesday, August 1, 2018

were held as herein appears, and that this is the original transcript thereof for the file of the Federal Energy Regulatory Commission, and is a full correct transcription of the proceedings.

Gaynell Moore-Hebert
Official Reporter

APPENDIX O

INDEX

APPENDIX O
INDEX

APPENDIX O
INDEX

APPENDIX O
INDEX

APPENDIX O
INDEX