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Center for Climate Change Law

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Consideration of Climate Change in Federal EISs, 2009 - 2011

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Offshore Platform Holly, SouthEllwood Field, CA. Credit: DOE

Contents

Introduction

Purpose of analysis

The National Environmental Policy Act (NEPA) requires the preparation of Environmental Impact Statements (EISs) for major federal actions that may have a significant effect on the environment. Historically, the environmental impacts addressed in EISs have included such conventional impacts as air and water pollution, threats to wildlife and its habitat and the cumulative impacts of a development on its surroundings. In recent years, climate change has become an increasingly prominent subject of discussion in EISs. However, the global nature of the issue and uncertainty regarding specific effects make the analysis of climate change impacts particularly challenging. In 2010, the Council on Environmental Quality (CEQ) published draft guidance on the analysis of greenhouse gas emissions and climate change in EISs prepared by federal agencies. While the draft guidance is nonbinding, federal agencies have begun to incorporate consideration of climate change and greenhouse gas emissions into EISs.

In the absence of binding guidance, federal agencies have developed widely varying procedures for addressing climate change in EISs. The Center for Climate Change Law (CCCL) has prepared a database of 227 EISs that substantively address climate change-related impacts, covering the period from January 1, 2009 through December 31, 2011.[1] The database records the state, lead agency and type of project and discusses and categorizes the climate change-related impacts considered in each EIS. While most federal agencies now address climate change to some extent in EIS preparation, the specific impacts considered and the methodology used in analysis vary greatly between agencies.

The database prepared by CCCL identifies five major categories of environmental impacts related to climate change that are discussed in EISs. The database includes all EISs prepared during the period that substantively address at least one of the five impact categories. CCCL also produced a matrix that summarizes overall patterns in EIS preparation by various federal agencies and examines the extent to which agencies quantitatively calculated greenhouse gas emissions, conducted life-cycle analysis and addressed cumulative climate change impacts. A comparison of agency approaches to EIS scope and methodology shows widely varying treatment of climate change impacts. Agencies differ in the methods used to calculate emissions and assess their significance. In addition, the types of indirect impacts addressed and the extent to which the impacts of climate change on the project are included vary.

[1] The database includes only those EISs which were freely accessible online during the period of research. Some EISs listed in the Federal Register are not available online, and others are available online only until a final decision on the proposed action is reached, after which the web pages where they were posted are taken down by the preparing agency.

Background

Current Federal and State Guidance on Climate Change Considerations in EISs

On February 18, 2010, the Council on Environmental Quality published *Draft NEPA Guidance on consideration of climate change and GHG emissions*.[2] These proposed nonbinding guidelines provide guidance to the preparers of EISs on addressing greenhouse gas emissions and climate change. While the draft guidance is instructive, until it is finalized, the weight accorded to the guidelines remains at the discretion of each agency. The draft guidance suggests a threshold level of direct GHG emissions of 25,000 metric tons annually as an indicator that the climate impacts of a project warrant analysis under NEPA. For long-term projects that have annual emissions of less than 25,000 metric tons, the guidance encourages federal agencies to consider whether the project's cumulative long-term emissions might still warrant analysis.

The draft guidance does not call for a comprehensive review of climate change impacts in all cases, instead urging preparing agencies to be judicious in determining the likely scale of the impacts and limiting their analysis to impacts that can be reliably quantified. The guidance suggests that EISs should address climate mitigation and adaptation measures when considering project alternatives, and that EISs should consider emissions from all stages of a project's life cycle when feasible, including indirect or induced emissions from vehicles and material supply chains whenever initial scoping indicates that they might be significant. The guidance proposes that EISs should also address the impacts of climate change on a project's environment when relevant. The guidance does not consider GHG emissions in EISs for federal land and resource management actions. Although CEQ asked for and received comments on this topic, it has not yet acted on the issue.

Some federal agencies have issued internal guidance for addressing climate change in EISs, adopting various procedures in the absence of finalized CEQ rules. For example, in February 2010 the Department of Interior issued *Secretarial Order 3226,* a guidance document which requires all bureaus within the Department to include climate change analysis in their EISs and Resource Management Plans.[3]

Similarly, the U.S. Forest Service (USFS) issued a guidance document entitled *Climate Change Considerations in Project Level NEPA Analysis* in January 2009,[4] which outlines basic concepts and practices for use by the agency when considering climate change in EISs. Like the CEQ

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[2] Council on Environmental Quality, 2010. *Draft NEPA Guidance on consideration of climate change and GHG emissions*. http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf

[3] United States Department of the Interior, 2010. *Secretarial Order 3226*.

[4] United States Forest Service, 2009. *Climate Change Considerations in Project Level NEPA Analysis*

draft guidance, the USFS guidance calls for EIS preparers to consider both the effects of agency actions on global climate change and the effects of climate change on a proposed project.

The Federal Aviation Administration has also issued interim guidance for considering greenhouse gases and climate under NEPA.[5] This guidance, most recently updated in January 2012, suggests that EISs prepared by FAA should calculate greenhouse gas emissions, but does not call for any substantive analysis of the potential impacts of these emissions on climate change. Instead, it suggests that EISs state project emissions as a percentage of U.S. and global emissions and provide no further discussion of climate change, given the lack of scientific methods to determine the impact of a specific action on global climate.

Other federal agencies have issued internal directives, which do not provide comprehensive formal guidance but nonetheless address some aspects of climate change. For example, the U.S. Army Corps of Engineers released guidance in July 2009 which calls for consideration of the effects of climate change on sea level rise in the planning and management of all coastal projects under the agency's jurisdiction. The Federal Highway Administration has also issued interim guidance which suggests that state transportation departments incorporate climate change impacts into their NEPA analyses, without providing specific criteria for doing so.[6]

CCCL Study

Method of Analysis

The database prepared by CCCL identifies five major categories of environmental impacts related to climate change that are discussed in EISs,[7] including direct operational impacts, purchased electricity, induced trips, construction impacts, and the impact of climate change on the project.[8] These categories for analysis are based on those proposed by CCCL Director Michael Gerrard in a 2008 article.[9] The database includes all EISs prepared under NEPA during the period which were freely accessible online at the time this study was carried out and substantively address at least one of the following impact categories.

Direct operational impacts: This category includes smokestack emissions from the facility; fugitive emissions such as methane escaping from oil and gas wells; emissions of methane and

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[5] Federal Aviation Administration, 2012. *Considering Greenhouse Gases and Climate Under the National Environmental Policy Act (NEPA): Interim Guidance.*

[6] Federal Highway Administration, 2008. *Integrating Climate Change into the Transportation Planning Process*

[7] Center for Climate Change Law at Columbia Law School. 2011. *Analysis of Environmental Impact Statements shows widely varying treatment of Climate Change Risks.* http://blogs.law.columbia.edu/climatechange/2011/12/05/analysis-of-environmental-impact-statements-shows-widely-varying-treatment-of-climate-change-risks/

[8] The database includes a sixth category, impact of climate change on water resources. This is a subset of the fifth category, which includes all impacts of climate change on a project.

[9] Michael B. Gerrard. 2008. "Climate Change and the Environmental Impact Review Process." Natural Resources & Environment. Vol. 22 No. 3 p. 20. http://www.arnoldporter.com/resources/documents/NR&E-Winter2008_Article_MGerrard.pdf

nitrous oxide from agricultural operations; methane from landfills and wastewater treatment plants; and impacts on carbon "sinks," such as forests, agricultural soils and wetlands.

***Purchased electricity**:* This category includes greenhouse gases emitted in generating the electricity that is produced off-site and purchased by the facility. For renewable power projects which feed electricity into the grid, the amount of conventionally generated electricity which might potentially be displaced can be measured as a sort of emissions credit for the project, offsetting construction or operational emissions. However, this calculation assumes that fossil-fuel power generating stations will reduce output as a result, when in reality the new project may add extra capacity.

Induced trips: This category encompasses vehicle and transit emissions from any trips resulting from project construction and operation and the transport of freight to and from the project. This category includes employee, customer, and vendor travel and the transport of raw materials, manufactured goods, and other freight to and from the facility. For highway projects, induced trips include the effect of the completed project on traffic patterns and congestion.

***Construction impacts**:* This category includes the greenhouse gas emissions from extracting and fabricating the construction materials and from the equipment used at the construction site.

***Impact of climate change on the project**:* This category includes the effects of rising sea levels and water tables, increased flooding, extreme weather events, greater temperature variations, water shortages, reduced snowpack and other occurrences that require adaption.

For the purposes of the database, an EIS was considered to address an impact category when it included analysis of the potential impacts specific to the proposed project. EISs that stated in generic terms that projects of a given type might be expected to result in a certain category of impacts without providing any project-specific information, were not considered to address the impact category. However, EISs that addressed an impact category in purely qualitative terms without providing quantitative analysis were considered to address the impact.

Research Questions Addressed in Agency Matrix

The information contained in the database was summarized in a separate matrix, which identifies patterns in EIS preparation by various federal agencies. For each agency, the matrix lists the number of environmental impact statements produced in the given period which covered each of the impact categories described above.[10] The matrix also includes comments on the scope and methodology of the impact analysis used in EIS preparation by each agency, which address the following questions:

[10] Center for Climate Change Law at Columbia Law School. 2011. *EIS Impact Categories Covered by Federal Agency*.

Calculation methods and significance findings: Were greenhouse gas emissions quantified using project-specific calculations, estimated using generic figures or simply described in qualitative terms?

Project impact categories included: Did the EIS include a complete life-cycle analysis of direct and indirect emissions, ranging from the impacts of resource extraction, transport, construction or processing and final use? Were both upstream and downstream impacts addressed?

Cumulative context of climate change impacts: Did the EIS discuss the broader context of climate change? Did consideration of impacts of climate change include discussion of the cumulative impacts of climate change on the project?

Summary of Findings

A comparison of agency approaches to EIS scope and methodology shows widely varying treatment of climate change impacts. While some agencies exhaustively calculate emissions using specific figures, others provide only very general estimates or conclude that emissions are not significant enough to warrant calculation. Full life-cycle analysis of emissions is rare, and while some agencies include indirect impacts such as purchased electricity and induced trips, many others do not.

Discussion of the impacts of climate change also varies greatly. While some EISs emphasize scientific uncertainty about the scope and nature of future climate impacts, others provide projections of potential long-term impacts at the national, regional and project level.

Methods for Calculating Emissions and Assessing Significance

Within any category of direct or indirect greenhouse gas emissions, agencies employ a variety of methodological approaches in their calculations and analysis. While some agencies exhaustively calculate emissions using specific figures, others provide only very general estimates or conclude that emissions are not significant enough to warrant calculation. Almost without exception, nearly all agencies assert that the contribution to global climate change from any individual project is too small to be considered significant relative to the scale of the problem. Many EISs also cite the lack of available scientific methods for attempting to calculate the climate impacts of a specific project.

Impact Categories Addressed

In EISs where they are applicable, some impact categories are considered much more frequently than others. While direct operational emissions are often considered in EISs when applicable (excluding land management and forestry EISs), evaluation of other indirect emissions resulting from a project is less common. Very few EISs include full life-cycle emissions analysis,

encompassing construction, induced trips, original production of materials used and final consumption of materials produced.

Some agencies state that according to their interpretation of the CEQ guidance, analysis of indirect emissions is not required. For example, The Bureau of Ocean Energy Management, Regulation and Enforcement notes in response to public comments on oil leasing EISs that it considers emissions from end use of the fuel extracted to be outside the required EIS scope.[11]

Consideration of climate change impacts on projects

While greenhouse gas emissions from projects are frequently addressed in EISs, the effects of climate change on the proposed projects are considered far less often. Preparing agencies face considerable scientific uncertainty about the severity and exact nature of climate change impacts at the regional level, and projections are even more difficult at the local level. EISs often briefly analyze the impacts of climate change on the region or locality in which the project is located without addressing the direct impacts of climate change on the project itself. Climate impacts in the project region are often discussed in order to consider their effect on a resource which the project might also impact.

Findings by Agency

Department of Energy

EISs prepared by the Department of Energy (DOE) consistently include calculations of direct project emissions. For large stationary emitters such as coal-fired power plants, project-specific emissions are always calculated. For these large emitters, EISs sometimes recognize that the project may make up a large portion of the total emissions produced by a given state or region, and that the project may therefore be significant in the context of regional efforts to limit emissions.[12]

EISs for power generation facilities prepared by DOE sometimes consider indirect impacts such as upstream emissions from the mining of the coal burned in the plants.[13] The upstream emissions from coal-fired power generation facilities depend on the distance which the coal must be transported and the method of transport, as well as the manner in which the coal is mined. The type of coal used also affects the direct operational emissions of the plant.

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[11] Bureau of Ocean Energy Management, Regulation and Enforcement. *Outer Continental Shelf Oil and Gas Leasing Program.* 2010. Section 5, page 155. See appendix. In response to a comment, the agency claims that the effect of halting the project on end consumption is uncertain, and that oil not produced would be extracted elsewhere instead.

[12] U.S. Department of Energy, *Kemper County Integrated Combined Cycle Gasification Project Environmental Impact Statement.* 2010. Vol. 1, Ch. 6, sec. 3, p 586**.** See appendix.

[13] *Id.*

Discussion of the cumulative impacts of climate change is uncommon in EISs prepared by DOE and is limited to a general description of potential regional impacts and vulnerabilities without reference to the project itself. DOE also jointly prepares many EISs with BLM for solar power projects on federal land, and these EISs often consider the impacts of climate change on the project sites, which are typically in arid areas.

Nuclear Regulatory Commission

For nuclear power projects reviewed by the Nuclear Regulatory Commission (NRC), operational emissions are always addressed, and may be calculated or simply found to be insignificant. EISs often use only generic figures for emissions and may not calculate plant-specific emissions.[14]

Until recently, NRC EISs have not included indirect emissions from induced vehicle trips or construction and maintenance of the nuclear facility. However, some more recent EISs do include these categories.[15]

While some NRC EISs discuss indirect impacts such as life cycle emissions from the extraction and enrichment of uranium or disposal of nuclear fuel, these are usually not quantified, due to the uncertainties involved.

Climate impacts on projects addressed in EISs produced by the NRC primarily involve water. EISs for coastal nuclear reactors discuss projected sea level rise, increased storm intensity and the potential impacts of both factors on reactor sites. EISs for the relicensing of inland nuclear generation stations also discuss the impact of decreased water availability on reactors' cooling systems, which often draw from nearby fresh water bodies and assess the impact of future water scarcity on plant operations.

Bureau of Land Management

Most Bureau of Land Management (BLM) EISs calculate project-specific operational emissions, while fewer calculate construction and induced trip emissions. Finally, calculation of emissions from electricity generation is rare. Twenty-seven of thirty-two BLM EISs analyzed the impact of direct operational emissions.

EISs for projects produced by the BLM frequently include emissions from induced trips, construction, maintenance and land use change. More than half of the BLM EISs in the database included construction emissions and emissions from purchased electricity.

In EISs for mining projects, downstream emissions from end-use combustion are often not calculated. When end-use combustion emissions are calculated, EISs often note that it is difficult

[14] Nuclear Regulatory Commission. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 41, Regarding Cooper Nuclear Station*. 2010. Section 6.2 page 202.
[15] Nuclear Regulatory Commission. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 46, Regarding Seabrook Station.* 2011. See appendix.

to determine where the resource extracted will ultimately be used, which complicates the analysis of end-use emissions.[16] The distance which the resource is transported and the manner in which it is combusted both affect the level of emissions which results. If these emissions are considered, generic figures are often used, describing the emissions which typically result from a particular type of coal.

EISs for solar projects on BLM land (often prepared jointly with DOE) are frequently the most thorough. Solar power project EISs sometimes calculate the emissions which could be offset by the project, analyzing the emissions from existing facilities supplying the regional power grid and calculating the emissions reductions that would result if power generated by these facilities were displaced by electricity from the new solar project.[17]

BLM EISs often discuss the impacts of climate change on the project or its immediate vicinity. EISs for projects in desert areas are likely to discuss the impacts of climate change and temperature increase on the surrounding ecosystem, but analysis of impacts is often limited to their effect on the environment rather than on the project.[18]

U.S. Forest Service

Land management, agriculture and forestry EISs produced by the U.S. Forest Service rarely calculate direct emissions, instead employing qualitative descriptions of potential emissions sources and sinks and providing analysis of their significance level.[19] Most USFS EISs do not involve the construction of a facility, but rather the implementation of a land management action. Although the cumulative nature of climate change is acknowledged, the impacts of any specific project are usually judged to be insignificant given the global scale of the issue. USFS EISs often focus on the effects of land management decisions on carbon sinks such as soil and vegetation and the possible effects of climate change on ecosystems.[20]

EISs produced by USFS typically analyze the effects of climate change on drought and temperature change and the resulting impacts on forestry and wildlife. Of 33 Forest Service EISs published since January 2009 which mention climate change, 19 consider water-related climate change impacts. These EISs outline climate change scenarios and their effects on forest health and productivity, including the effects of increased variability of precipitation and drought.

U.S. Fish and Wildlife Service

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[16] Bureau of Land Management, *Wright Area Coal Lease Environmental Impact Statement*, Ch. 3 p 323; Ch. 4 p130. See appendix.
[17] Bureau of Land Management. *Final Environmental Impact Statement for the Palen Solar Power Project*. 2011 Sec. 4.3 pages1-16. See appendix.
[18] *Id.*
[19] U.S. Forest Service. *Record of Decision and Final Environmental Impact Statement: Big Moose Vegetation Management Project.* 2011. Section F p 325. See appendix.
[20] U.S. Forest Service. *Cobbler II Timber Sale and Fuels Reduction Project Final Environmental Impact Statement*. 2010. Ch. 3 p156-163. See appendix.

U.S. Fish and Wildlife Service (USFWS) EISs rarely calculate emissions and rely on qualitative descriptions of the emissions consequences of proposed actions, usually judged to be insignificant. Impact categories addressed are generally limited to emissions from changes in vegetation management, and induced trips are not included. The full life cycle of emissions embodied in carbon sources and sinks is usually not analyzed.

EISs which involve oil and gas development in wildlife refuges constitute an important exception to the usual treatment of climate change in USFWS EISs. These EISs attempt to quantify the potential emissions from the development of oil and gas fields.[21]

USFWS EISs address the impacts of climate change on a project primarily as they relate to specific plant and animal species. EISs address the effects of climate change on the habitat, food resources and behavior of individual species, especially those federally listed as endangered or threatened.[22] Analysis of the impact of climate change on a project is often limited to a brief discussion of climate impacts on wildlife species or vegetation as a secondary or compounding impact. These species are discussed primarily in terms of their vulnerability to non-climate-related impacts from the project (such as habitat loss or noise), and climate change is mentioned as an additional factor that might increase the cumulative impact on the species.

Federal Aviation Administration

EISs prepared by the Federal Aviation Administration (FAA) often provide project emissions from aviation traffic as a percentage of overall US emissions, a practice which is included in internal agency guidance.[23] The very small figure that results is used as a basis for the conclusion that the project will have no significant impact on climate change.

The FAA EISs include very minimal consideration of GHG emissions. EISs for Philadelphia and Palm Beach airports consider only aircraft emissions and nothing else, but do not quantify them, simply noting that operations (current flight traffic at the airport) constitute X percent of total US air traffic and assuming that emissions are proportional. Although the projects are supposed to increase airport capacity, the GHG discussions make no reference to the issue of emissions additionality (presumably increased trips would be diverted from elsewhere, but this is not stated). Only one EIS, for TF Green Airport in Rhode Island, considers any GHG emissions other than from aircraft—in this case, it includes those from construction and from facility operation.

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[21] U.S. Fish and Wildlife Service. *Yukon Flats Land Exchange Final Environmental Impact Statement.* 2010. Sec. 4 p. 42-44.

[22] U.S. Fish and Wildlife Service. *Desert National Wildlife Complex, Final Comprehensive Conservation Plan and Environmental Impact Statement.* 2010. Sec. 5 p 9.

[23] Federal Aviation Administration, 2012. *Considering Greenhouse Gases and Climate under the National Environmental Policy Act (NEPA): Interim Guidance.*

Consideration of indirect emissions in FAA EISs is very limited. No FAA EISs include full life-cycle analysis of the fuel consumed by aircraft or airport facilities. While no EISs address emissions from induced land vehicle trips or purchased electricity, several do include construction emissions from airport expansion projects.

Airport EISs rarely address the impacts of climate change on the project, although many airports are located in low-lying wetland or floodplain areas which might be increasingly vulnerable to inundation due to climate change. Of five FAA EISs published since January 2009 which mention climate change, none analyze climate impacts on the airport. For example, a 2011 EIS for the expansion of Palm Beach Airport in Florida briefly addresses airport emissions but makes no mention of the potential impacts of climate change on the project, despite the airport's coastal location and the region's projected vulnerability to sea level rise and increased storm intensity.[24]

U.S. Army and U.S. Navy

In EISs produced by the U.S. Navy and U.S. Army for large military facilities and training activities, emissions are often calculated and presented as a percentage of overall U.S. emissions. Although discussing emissions in this context sometimes allows the emissions to be judged insignificant, most EISs do address the issue of climate change in substantial detail, and many recognize that combined emissions from military facilities contribute significantly to cumulative U.S. emissions.[25] Army and Navy EISs usually refer to the ambitious emissions reduction plans that have been adopted by the military and present the specific project as part of that larger strategy.

Army and Navy EISs generally do not include many indirect impacts. They address direct emissions from military operations and facilities and sometimes include induced trips, but do not usually consider purchased electricity and construction emissions. The issue of fuel consumption and its particular relevance to military actions is addressed, but full life-cycle analysis of fuel production and transport is not included.[26]

The U.S. Navy addresses sea level rise and increased storm intensity in its EISs for coastal bases and installations because of the potential for these climate change impacts to affect future base operation and security. Some EISs note that climate change may ultimately require major adaptation measures or relocation of some facilities to higher elevations or less vulnerable sites

[24] Federal Aviation Administration. *Palm Beach International Airport Project, Construction and Operation of Proposed Airfield Improvements.* 2011. Ch 5 p 23-25. See Appendix.
[25] U.S. Navy, *Guam and Commonwealth of the Northern Mariana Islands Military Relocation*. 2010. Sec. 4.4.3, pages 91-93. See appendix.
[26] U.S. Army. *Programmatic Environmental Impact Statement for the Realignment, Growth, and Stationing of Army Aviation Assets*. 2011.

in order to maintain viability.[27] To a lesser degree, the Army also considers the impacts of climate change on military installations in terms of their potential effects on national security.

U.S. Army Corps of Engineers

EISs produced by the U.S. Army Corps of Engineers (USACE) often calculate project-specific direct emissions in detail. However, like many other agencies, USACE typically asserts that emissions from the proposed project would not have a significant impact on global climate change and cites the lack of available methodology to assess a particular project's significance.

Indirect emissions are frequently considered in USACE EISs. A full life cycle analysis of emissions is often included, covering indirect emissions from electricity use, induced trips and construction and maintenance activities.[28]

The U.S. Army Corps of Engineers often considers the impact of climate change on projects, particularly those involving ports and coastal waterways. These EISs consider the likely impacts of sea level rise and increased storm intensity and discuss mitigation measures.[29] USACE EISs may also consider the impact of climate change on drinking water supplies and inland waterways and wetlands. Although they often cite high scientific uncertainty about the degree of sea level rise, some EISs use detailed climate models to make specific projections about future impacts.

Bureau of Reclamation

EISs produced by the Bureau of Reclamation (BR) often calculate operational emissions from the operation of pumps and treatment facilities for water supply projects.[30] Roughly half of the BR EISs address some form of direct emissions.

Some BR EISs also include indirect emissions from the construction and maintenance of water projects, such as emissions from dredging. While EISs produced by the agency sometimes mention indirect emissions from induced trips or purchased electricity, these are usually not calculated, but rather are described qualitatively.

The Bureau of Reclamation often addresses the impacts of climate change on agency projects. Most commonly, climate change impacts on water resource availability are addressed in EISs related to the management of water pumping and diversion schemes. Of eleven BR water project EISs produced since January 2009 which mention climate change, five address climate impacts on water.

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[27] U.S. Navy, *Guam and Commonwealth of the Northern Mariana Islands Military Relocation*. 2010. Sec. 4.4.3, pages 91-93. See appendix.
[28] U.S. Army Corps of Engineers. *Folsom South of U.S. 50 Specific Plan Project Environmental Impact Statement.* 2010. See appendix.
[29] U.S. Army Corps of Engineers. *Mississippi River Gulf Outlet Ecosystem Restoration Environmental Impact Statement.* 2010. P. 160, 186, 193. See appendix.
[30] Bureau of Reclamation. *Los Vaqueros Reservoir Expansion Project Environmental Impact Statement*. 2009. See appendix.

EISs for reservoir projects in California routinely analyze the potential impacts of climate change on water resources in detail, addressing decreased precipitation and runoff, increased demand for drinking water and irrigation, effects on the aquatic ecosystem from increased water temperature and increased risk of wildfires.[31] These EISs review projections regarding future water scarcity in California and the impacts of inadequate irrigation on agriculture, predicting that several rivers will not be able to meet their minimum flow requirements and that water usage plans will need to be reevaluated. These EISs also address the potential for future drought to reduce water quality in addition to availability.

Federal Highway Administration

EIS produced by the Federal Highway Administration (FHWA) often focus on emissions from vehicular traffic and the changes in induced trips, travel patterns and congestion that might result from a highway project. However, there is no uniform treatment of these emissions in EISs. Some highway project EISs calculate emissions impacts from construction and from increased traffic based on projected vehicle miles traveled. Some assert no change in overall traffic emissions, while others simply describe emissions qualitatively as insignificant.

While induced trips and emissions from the operation of construction equipment are often addressed in FHWA EISs, other upstream and downstream sources of indirect emissions are only occasionally analyzed. EISs for highway projects rarely consider the embodied emissions in the materials used. For example, upstream emissions from the production of cement are usually not included.

EISs prepared for new highway projects generally do not address the impacts of climate change on the project. Of eighteen highway EISs published since January 2009 which mention climate change, only four consider the impact of climate change on the project. Impacts addressed in these four EISs include temperature and precipitation changes, altered seasonal river flow and increased flooding.[32] One EIS notes that structural stress from temperature variability caused by climate change is likely to increase damage to roads and other transport infrastructure.[33]

Discussion of Findings

Presentation of information on climate change in EISs

Agencies have developed many different ways of incorporating analysis of climate change into EISs. While many EISs include a chapter, section or appendix which specifically addresses

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[31] *Id.*

[32] Federal Highway Administration. *Interstate 5 Columbia River Crossing Project Environmental Impact Statement.* 2011; *CUY-90-Innerbelt Highway Project Environmental Impact Statement,* 2009; *Circ-Williston Transportation Project Final Environmental Impact Statement*, 2010; *Alaskan Way Viaduct Replacement Project Final Environmental Impact Statement*, 2011.

[33] Federal Highway Administration. *CUY-90-Innerbelt Highway Project Environmental Impact Statement.* 2009. See appendix.

climate change, the issue may also be included in sections on air quality, energy use and project alternatives. Many EISs note the EPA's finding following *Massachusetts v. EPA* that greenhouse gases constitute an air pollutant that endangers public health and welfare, and include them in the same section which analyzes project impact on air quality and public health. Some EISs which do not explicitly include analysis of climate change impacts nonetheless evaluate greenhouse gas emissions indirectly as part of a section devoted to energy consumption. These analyses address consumption of fuel and electricity by the project, often focusing on costs and energy efficiency.

General discussion of the regulatory and scientific context of climate change is usually included in EISs and often references the CEQ guidance, as well as any relevant directives from the preparing agency and state in which the project is located. However, EISs which address greenhouse gas emissions only in sections on energy use or air quality usually do not discuss the regulatory or scientific context, and may analyze emissions without addressing their impacts on climate change.

While some EISs include detailed analysis of the impacts of several alternatives to the proposed project, this typically includes only a qualitative comparison of the emissions levels from alternatives, when the issue is addressed at all. However, a few EISs include tables which calculate estimated emissions from each alternative and present them for comparison. As noted above, renewable energy projects often evaluate their emissions relative to fossil fuel alternatives that might be displaced, although the project could add capacity without displacing existing production. However, EISs for coal-fired power generating stations rarely address renewable energy as a potential alternative.

Specific impacts of climate change on project types

While greenhouse gas emissions from projects are frequently addressed in EISs, the effects of climate change on the proposed projects are considered far less often. Preparing agencies face considerable scientific uncertainty about the severity and exact nature of climate change impacts at the regional level, and projections are even more difficult at the local level. Infrastructure project EISs often briefly analyze the impacts of climate change on the region or locality in which the project is located without addressing the direct impacts of climate change on the project itself. Climate impacts in the project region are often discussed in order to consider their effect on a resource which the project might also impact. For example, an EIS for a project which adversely impacts surrounding wetlands may also address climate change impacts on the wetland and consider the cumulative effect of both climate and project impacts on the wetland.

The degree to which impacts of climate change on a project are included correlates more with project type and location than with the preparing agency. The potential effects of climate change on a project are most likely to be considered for coastal or water-related projects (irrigation and reservoirs, ports, bridges, waterfront development), military projects and land management or forestry EISs. Most commonly, impacts such as sea level rise and flooding are included for

projects in coastal locations and water supply projects. Many types of coastal infrastructure are vulnerable to sea level rise and increased storm intensity, including ports, coastal nuclear reactors and military facilities. Projects in marine or coastal settings are likely to consider the effects of sea level rise and increased storm intensity, as well as impacts on marine habitats from rising sea temperatures. However, these impacts are often considered not in relation to the project itself, but rather to its surrounding environment.

In EISs which do not involve coastal sites or water projects, analysis of the impact of climate change on a project is often limited to a brief discussion of climate impacts on wildlife species or vegetation as a secondary or compounding impact. Projects in desert areas, such as solar energy projects or transmission lines, are also likely to discuss the impacts of climate change and temperature increase on the surrounding ecosystem, although impact analyses are often limited to their effect on the environment rather than on the project.

Agency Approaches

The varying methods for analyzing climate change presented in the database reflect the disparate approaches that federal agencies have taken in addressing the issue in the absence of binding CEQ guidance. While most agencies cite the CEQ draft guidance, the guidance gives agencies great discretion to decide when analysis of climate impacts is warranted and how the significance of climate impacts is determined. Agencies are free to use their own criteria to determine that climate impacts are insignificant, or to assert that analysis of climate change is outside the necessary scope of an EIS.

The level of thoroughness with which EISs address climate change is closely tied to the preparing agency, the project type, and the state in which the project is located. EISs prepared in states such as California and Washington, which have robust state environmental review laws, are likely to include much more extensive analysis of climate change. Most of the EISs which addressed all five impact categories were for projects in California. The federal agencies which prepared these EISs often partnered with state agencies and followed the requirements of the California Environmental Quality Act, which at times requires a more detailed discussion of climate change impacts than NEPA. A similar phenomenon is apparent in the state of Washington, where many EISs go beyond the federal requirements.

Certain federal agencies consistently produce EISs which address climate change in substantial detail. The US Army Corps of Engineers, the Department of Energy, the Bureau of Land Management and the Bureau of Reclamation stand out among federal agencies for the number of EISs they have produced which include detailed and thorough analysis of climate impacts. However, it is difficult to make comparisons across agencies and project types, given the very different criteria and needs which are addressed in EISs. Agencies such as USFS, USFWS and NOAA must consider a different set of questions about climate impacts related to land and resource management which have little in common with the issues that must be addressed by

EISs for power generation and infrastructure projects. EISs for certain project types are more likely to consider climate impacts because the success and viability of these projects are often closely tied to the effects of climate change. Among these are coastal projects, because of their vulnerability to sea level rise, and water supply projects, because of the impact of climate change on precipitation, snowmelt and water availability. However, this is not always the case, as EISs for some other project types which are closely related to issues of greenhouse gas emissions, such as agricultural or public transit projects, include very little analysis of climate change.

Conclusion

CCCL's research reveals disparate treatment of climate change impacts in federal EISs, with significant variation correlating with state, agency and project type. Not surprisingly, many agencies focus on the types of climate impacts which correlate most closely to their jurisdiction. The Bureau of Reclamation pays greater attention to climate impacts on water supply than it does to emissions, while the Forest Service emphasizes carbon sinks and flows over induced trips. CCCL's research reveals widely varying agency approaches to EIS scope and methodology when addressing climate change impacts. Agencies differ in the methods used to calculate emissions and assess their significance, the types of indirect impacts addressed and the extent to which the impacts of climate change on the project are included. Although the treatment of climate change in environmental impact assessment is still in the early stages of development, many federal agencies are beginning to include more comprehensive analysis of project impacts on climate change and the impacts of climate change on federal actions.

References

Bureau of Land Management. 2010. *Wright Area Coal Lease Environmental Impact Statement*, Ch. 3 p. 323; Ch. 4 p.130. http://www.blm.gov/pgdata/etc/medialib/blm/wy/information/NEPA/hpdo/Wright-Coal/feis.Par.67516.File.dat/07chap3.pdf

Bureau of Land Management. 2011. *Final Environmental Impact Statement for the Palen Solar Power Project*. Sec. 4.3 p.1-16. http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/palmsprings/Palen_Solar_Power_Project.Par.98678.File.dat/Vol1_Palen%20PA-FEIS_ch4.pdf

Bureau of Ocean Energy Management, Regulation and Enforcement. 2010. *Outer Continental Shelf Oil and Gas Leasing Program.* Sec. 5, p. 155. http://www.boemre.gov/5-year/2007-2012FEIS/Chapter4A-BImpactsProposedAction.pdf

Bureau of Reclamation. 2009. *Los Vaqueros Reservoir Expansion Project Environmental Impact Statement*. Ch. 5, p.12. http://www.lvstudies.com/documents.asp

Center for Climate Change Law at Columbia Law School. 2011. *Consideration of Climate Change in Environmental Impact Statements prepared under the National Environmental Policy Act.* http://www.law.columbia.edu/null/download?&exclusive=filemgr.download&file_id=61459

Center for Climate Change Law at Columbia Law School. 2011. *EIS Impact Categories Covered by Federal Agency*. http://www.law.columbia.edu/null/download?&exclusive=filemgr.download&file_id=61460

Council on Environmental Quality, 2010. *Draft NEPA Guidance on consideration of climate change and GHG emissions*. http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf

Department of Energy. 2010. *Kemper County Integrated Combined Cycle Gasification Project*. Vol. 1, Ch. 6, sec. 3, p. 586. http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EIS-0409-FEIS-01-2010.pdf

Department of the Interior, 2010. *Secretarial Order 3226*. http://elips.doi.gov/elips/0/doc/144/Page1.aspx

Federal Aviation Administration. 2012. *Considering Greenhouse Gases and Climate under the National Environmental Policy Act (NEPA): Interim Guidance.*

Federal Aviation Administration. 2011. *Palm Beach International Airport Project, Construction and Operation of Proposed Airfield Improvements.* Ch. 5 p. 23-25. http://www.pbia-eis.com/pdf/final-eis/Chapter%205.0.pdf

Federal Highway Administration, 2008. *Integrating Climate Change into the Transportation Planning Process.* http://www.fhwa.dot.gov/hep/climatechange/climatechange.pdf

Federal Highway Administration. 2009. *CUY-90-Innerbelt Highway Project Environmental Impact Statement.* p. 31. http://www.dot.state.oh.us/projects/ClevelandUrbanCoreProjects/Innerbelt/FEIS/CIB%20FEIS%207-21-09.pdf

Federal Highway Administration. 2011. *Interstate 5 Columbia River Crossing Project Environmental Impact Statement.* Sec. 3, p. 445. http://www.columbiarivercrossing.org/FileLibrary/FINAL_EIS_PDFs/CRC_FEIS_Chapter3_S19_Cumulative_Effects.pdf

Michael B. Gerrard, "Climate Change and the Environmental Impact Review Process," *Natural Resources & Environment*, Winter 2008, pp. 20-24

http://www.arnoldporter.com/resources/documents/NR&E-Winter2008_Article_MGerrard.pdf

Nuclear Regulatory Commission. 2010. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 41, Regarding Cooper Nuclear Station*. 2010. Sec. 6.2 p. 202.

Nuclear Regulatory Commission. 2011. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 46, Regarding Seabrook Station.* 2011. Sec. 4-61, p. 191. http://pbadupws.nrc.gov/docs/ML1121/ML11213A024.pdf

U.S. Army Corps of Engineers. 2010. *Mississippi River Gulf Outlet Ecosystem Restoration Study*. p. 160,186, 193. http://www.mrgo.gov/ProductList.aspx?ProdType=study&folder=1320

U.S. Army Corps of Engineers. 2010. *Folsom South of U.S. 50 Specific Plan Project Environmental Impact Statement.* Sec. 3A4, p. 44-45. http://ftp.folsom.ca.us/soi/Folsom_DEIR-DEIS_DRAFT.pdf

U.S. Fish and Wildlife Service. 2010. *Desert National Wildlife Complex, Final Comprehensive Conservation Plan and Environmental Impact Statement*. Sec. 5 p. 9. http://www.fws.gov/desertcomplex/pdf/07_Final_CCP-EIS_Ch5_20090814.pdf

U.S. Forest Service, 2009. *Climate Change Considerations in Project Level NEPA Analysis* http://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf

U.S. Forest Service. 2010. *Cobbler II Timber Sale and Fuels Reduction Project Final Environmental Impact Statement*. Ch. 3 p.156-163. http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/61203_FSPLT2_028115.pdf

U.S. Forest Service. 2011. *Record of Decision and Final Environmental Impact Statement: Big Moose Vegetation Management Project.* Sec. F p. 325. http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/50537_FSPLT2_035259.pdf

U.S. Navy. 2010. *Guam and Commonwealth of the Northern Mariana Islands Military Relocation.* Sec. 4.4.3, p. 91-93. http://www.guambuildupeis.us/documents/final/volume_7/Vol_07_Ch04_Cumulative_Impacts.pdf

Appendix: Example EIS quotes and summaries

The following section contains a selection of EISs which provide examples of the approaches taken by federal agencies in addressing various project types and impact categories. First, several examples are given of EISs which address direct or indirect project emissions to varying degrees. (Only excerpts are given here. Please see the database for full text.) While the Palm Beach airport EIS is exceptional for the minimal consideration given to a major source of emissions, the other examples in this category, although not exhaustive, are generally thorough relative to other EISs for comparable projects. This section is followed by a sampling of EISs which address the impacts of climate change on the project, and a final section which includes examples of EISs that address climate change impacts on freshwater resources in particular. The latter two sections illustrate the great diversity of climate impacts which may be considered in EISs. While all EISs in these two sections are notable for their thoroughness relative to other comparable projects, the types of climate effects which they discuss are representative of those which frequently recur in similar impact discussions.

EISs which address direct or indirect project emissions

Palm Beach Airport Expansion

A 2011 EIS for the expansion of Palm Beach Airport in Florida frames aviation emissions as a percentage of overall U.S. emissions, but does not quantify the specific emissions of the project.

It makes no mention of the potential impacts of climate change on the project, despite the airport's coastal location and the region's projected vulnerability to sea level rise and increased storm intensity.

> According to most international studies and reviews, aviation emissions comprise a small, but potentially important percentage of anthropogenic GHGs and other emissions that contribute to climate change. The Intergovernmental Panel on Climate Change (IPCC) estimates that global aircraft emissions account for about 3.5 percent of the total quantity of GHG from human activities. In terms of U.S. contribution, the U.S. General Accounting Office (GAO) reports that aviation accounts "for about three percent of total U.S. GHG emissions from human sources" compared with other industrial sources, including the remainder of the transportation sector (23 percent) and industry (41 percent).
>
> The scientific community is developing areas of further study to enable them to more precisely estimate aviation's effects on the global atmosphere. The FAA is currently leading or participating in several efforts intended to clarify the role that commercial aviation plays in GHGs and climate change. The most comprehensive and multi-year program geared towards quantifying climate change effects of aviation is the Aviation Climate Change Research Initiative (ACCRI) funded by the FAA and the National Aeronautics and Space Administration (NASA).[34]

Outer Continental Shelf Oil and Gas Leasing Program:

This programmatic EIS produced by the Bureau of Ocean Energy Management, Regulation and Enforcement contains a brief discussion of emissions from rig operations on leases. There is no discussion of indirect emissions from eventual refining or combustion of fuels extracted. Emissions from the project are presented as a small fraction of total U.S. or global emissions and are therefore claimed to be insignificant. The EIS does include substantial discussion of the effects of climate change on project sites. It addresses adaptation of marine species to rising sea temperatures and adaptation of indigenous populations in arctic regions.

> Rapid and long-term impacts from climate change would likely disrupt long-standing, traditional hunting and gathering practices that promote health and cultural identity. Because of the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, arctic communities would experience significant cultural stresses in addition to major impacts to population, employment, and local infrastructure (MMS, 2004a).

[34]Federal Aviation Administration. *Palm Beach International Airport Project, Construction and Operation of Proposed Airfield Improvements.* 2011. Ch 5 p 23-25.

Poleward shifts in distribution of marine populations can be expected with increasing water temperatures. Species temperature preferences and overall habitat requirements would determine the extent of potential distribution shifts. For some species, the habitat requirements related to spawning and nursery areas can limit adaptation, which could result in loss of populations. Temperature changes may also affect the food web dynamics of the ecosystem. For example, substantial shifts in the distribution of small pelagic fishes such as herring and mackerel off the east coast of the United States can be expected. This would affect the forage base for many piscivorous (fish eating) fishes, marine mammals, and sea birds.

Climate models generally predict a rise in temperatures in the Gulf Coastal States this century. This would result in higher summertime heat index values and greater power demand for air conditioning (NAST, 2000). Model predictions of precipitation are less certain. In general, the models predict a slight decrease in precipitation in coastal areas, while model predictions vary widely in the upland areas, with one predicting an increase in precipitation and another a decrease. The models also predict more intense rainfall events and a higher frequency of droughts (Twilley et al., 2001).

Significant increases or decreases of river runoff would affect salinity and water circulation. Increased runoff would likely deliver increased amounts of nutrients such as nitrogen and phosphorous to estuaries, while also increasing the stratification between warmer fresher and colder saltier water (Boesch et al., 2000). This would increase the potential for algal blooms that deplete the water of oxygen and increase stresses on sea grasses, fish, shellfish and benthic communities. A significant increase in discharge from the Mississippi River could cause an expansion of the hypoxic zone in the Gulf of Mexico off Louisiana. Decreased runoff could diminish flushing, decrease the size of estuarine nursery zones, and allow an increase in predators and pathogens (Boesch et al., 2000). Permanent reductions of freshwater flows in rivers could substantially reduce biological productivity in Mobile Bay, Apalachicola Bay, Tampa Bay, and the lagoons of Texas (Twilley et al., 2001). More frequent or longer lasting droughts and reduced freshwater inflows could increase the salinity in coastal ecosystems, resulting in a decline in mangrove and seagrasses habitats.

Sea-level rise would affect the availability and distribution of high-quality freshwater because many Gulf Coast aquifers are susceptible to saltwater intrusion. Wetlands and mangroves are highly productive systems that are strongly linked to fisheries productivity. These habitats provide important nursery and habitat functions to many important fish and shellfish populations. Infilling, subsidence, altered hydrology, and a decrease in sediment supply have caused dramatic losses of wetlands in the region. With sea-level rise, wetland losses would likely be accelerated, particularly in coastal Louisiana, which would threaten the region's fisheries and agriculture. Loss of wetlands would have adverse effects on coastal navigation and infrastructure. While offshore oil

and gas development may not be directly affected, indirect effects may occur due to stresses on coastal industrial infrastructure affected by sea-level rise. With rising sea-surface temperatures as a result of global warming, it is likely that there will be an increase in the intensity of hurricanes (IPCC, 2007). An increase in hurricane activity would adversely affect oil and gas production in the Gulf due to platform shutdowns associated with such events. Even without an increase in hurricane activity, damage to the coastline from storms could be aggravated due to the loss of wetlands and barrier islands which would otherwise act as buffers.

Many Gulf of Mexico commercial fish populations are already subject to stresses, and global climate change may aggravate the impacts of ongoing and future commercial fishing and human use of the coastal zone. Fish, including shellfish, respond directly to climate fluctuations, as well as to changes in their biological environment including predators, prey, species interactions, disease, and fishing pressure. Fish are not only influenced by temperature and salinity conditions but also by mixing and transport processes. Climate would only be one of several factors that regulate fish abundance and distribution. Projected changes in water temperatures, salinity, and currents can affect the growth, survival, reproduction, and spatial distribution of marine fish species and of the prey, competitors, and predators that influence the dynamics of these species (Watson et al., 1998). Changes in primary production levels in the ocean because of climate change may affect fish stock productivity. However, it is still unclear how climate-induced changes in primary productivity would affect the next trophic link, zooplankton. Changes in zooplankton biomass are known to affect fish productivity.

Recreational fishing is a highly valued activity that could have losses in some regions because of climate-induced changes in fisheries. The net economic effect of changes in recreational fishing opportunities because of climate-induced changes in fisheries is dependent on whether projected gains in cool- and warm-water fisheries offset losses in cold-water fisheries. Anadromous species, such as striped bass, rely on marine and freshwater aquatic systems at different points in their life cycles. Projected changes in marine and freshwater temperatures, ocean currents, and freshwater flows are more likely to impact growth, survival, reproduction, and spatial distribution of these species than of other species.

The survival, health, migration, and distribution of marine mammals and sea turtles may be impacted by projected changes in climate through impacts on their food supply and breeding habitats. The availability of necessary habitats and prey species that results from climate change will have the greatest impact on marine mammal and sea turtle populations that are already under endangered species status. Marine mammal calving and pupping grounds and sea turtle nesting beaches would be threatened by rising sea level (Watson et al., 1998).

> A number of mitigation strategies could be adopted by operators with the goal to reduce greenhouse gas emissions from OCS oil and gas development activities. Use of more energy-efficient engines, turbines, and boilers would reduce CO2 emissions. Use of gas instead of diesel fuel to provide power on platforms would significantly reduce emissions. However, many operators already primarily rely on produced gas once production starts. More efficient scheduling of transport of material and personnel could lower service vessel CO2 emissions by reducing the number of vessel and helicopter trips. Application of optimum power settings on vessels would reduce fuel use and, hence, greenhouse gas emissions.[35]

A response to a comment from the Center for Biological Diversity addressed in section 5:

> It is difficult to evaluate the effect of the 2007-2012 program on consumption. Consumption of oil and gas is driven by a variety of factors including energy costs, energy efficiency, economic factors, demography, and weather or climate.
>
> If the proposed leasing program does not occur, the MMS projects that about 95 percent of the lost oil production would be replaced by a combination of imports, fuel switching, and increased onshore production (see the discussion in Section IV.I—No Action Alternative and Table IV-27). For natural gas, about 84 percent of the lost production would be made up by fuel switching, increased onshore production, and imports. The remaining 5 percent of the oil and 16 percent of the natural gas resource that would not be developed is expected to trigger some modest conservation measures, which would have some benefits in terms of reduced greenhouse gas emissions. However, this benefit could be offset by a boost in CO2 emissions from tanker transport as a consequence of a greater reliance on oil imports. More importantly, if there is a significant switch from natural gas to oil as a result of lost OCS gas production, the benefits from conservation measures could be offset since oil combustion causes more CO2 emissions than gas does.[36]

<u>Wright Area Coal Lease</u>

This EIS produced by the Bureau of Land Management for a coal-mining project in Wyoming presents the role of greenhouse gas emissions in affecting climate change as an ongoing controversy involving considerable uncertainty. The analysis considers the emissions generated in the coal extraction process, the indirect emissions when that coal is combusted for power generation and the impacts of climate change on the project site.

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[35] Bureau of Ocean Energy Management, Regulation and Enforcement. *Outer Continental Shelf Oil and Gas Leasing Program.* 2010. Sec. 4, p. 6-12.
[36] Bureau of Ocean Energy Management, Regulation and Enforcement. *Outer Continental Shelf Oil and Gas Leasing Program.* 2010. Sec. 5, p. 155.

There has been, and continues to be, considerable scientific investigation and discussion as to the causes of recently increasing global mean temperatures and whether a warming trend will continue.

As discussed in Chapter 1, BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine. WDEQ, with oversight from OSM, has regulatory authority in issuing permits to mine coal in Wyoming.

If the coal in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts is leased and mined, so-called GHG emissions from the mining operations would be released into the atmosphere. A discussion of emissions and by-products that are generated by burning coal to produce electricity, and a more complete discussion of the global warming and climate change phenomena is included in this EIS.

The use of the coal after it is mined is not determined at the time of leasing; however, almost all of the coal that is currently being mined in the Wyoming PRB is being used by coal-fired power plants to generate electricity.

Emissions inventories included emissions from all sources, including all types of carbon fuels used in the mining operations, electricity used on site (i.e., lighting for facilities, roads, and operations and electrically powered equipment and conveyors) and mining processes (i.e., blasting, coal fires caused by spontaneous combustion and methane released from exposed coal seams). An additional category, which was not included in the emissions estimates for the three applicant mines due to a lack of information, is rail transport, both on-site and in moving coal to the buyers.

The expected CO2e emissions that occurred in 2007 for the mines that have not completed emissions inventories were estimated by assuming the CO2e emission ratios (CO2e/million tons of coal produced, CO2e/million bank cubic yards of overburden moved, and CO2e/acres of disturbance) for the mines that completed emissions inventories would be equivalent to those mines that have not. The correlations were based on the 2007 coal production, overburden production, and disturbance acres (facilities plus active pit acres) for three source types (fuel, electricity, and mining process) at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines (WWC 2009).

The increases in CO2e emissions are expected to result from the additional fuels (especially diesel) that would be used in consideration of the increased coal and

overburden haul distances, as well as increased use of electricity and explosives related to increasing overburden thicknesses.[37]

Palen Solar Power Project

This EIS produced by the Bureau of Land Management for a solar project in California considers indirect emissions from construction, operation, maintenance and induced trips. While operational emissions are addressed, the project is projected to create a net reduction in emissions, due to the offset achieved by renewable power generation. Cumulative impacts of climate change on the area are extensively addressed, including impacts on snowmelt, water resources and local ecology.

> For the proposed action and alternatives, this section analyzes the potential for construction-, operation-, maintenance- and decommissioning-related activities to emit GHGs and, thereby, contribute meaningfully to global warming in light of the combined emissions of other broad-scale causes of climate change…Although it is doubtful that this individual project, standing alone, could result in significant climate change effects, this analysis considers the "incremental impact" of project emissions as a possible contributor, together with the incremental impacts of other past, present, and reasonably foreseeable actions, to cause global climate change, which intrinsically is a cumulative issue. Mitigation measures are considered…[A]gencies under the U.S. Department of the Interior are required to consider potential impact areas associated with climate change, including potential changes in flood risk, water supply, sea level rise, wildlife habitat and migratory patterns, invasion of exotic species, and potential increases in wildfires.
>
> The project would provide a new, utility-scale source of solar energy to complement existing and proposed sources of renewable energy. When the sun shines and electricity is generated by the project, the real-time output required from fossil fuel plants would be reduced by the amount of renewable generation going into the electrical grid. As a result, operation of the project would cause a measurable decrease in GHG emissions from fossil fuel plants."[38]
>
> The power produced by the project would offset power production by fossil-based power plants, which can range from 0.35 to 1.0 MT CO2 per MWh. The electric power produced from the project would be imported onto California's power grid, and would be used preferentially to conventional fossil fuel based power generation, including natural gas combined cycle plants, natural gas single cycle peaking plants, and power imported

[37] Bureau of Land Management, Wright Area Coal Lease Environmental Impact Statement, Ch. 3 p 323; Ch. 4 p130-133.
[38] Bureau of Land Management. *Final Environmental Impact Statement for the Palen Solar Power Project*. 2011 Sec. 4.3 p.1-16.

from other states, which may include power from coal-fired plants. Therefore, the Project would provide a direct benefit to climate change – namely the offset of up to approximately 1,000,000 MWh/yr of carbon dioxide-emitting power derived from existing/conventional fossil fuel power plants. Additionally, assuming that reductions in demand for existing fossil power would reduce demands for the natural gas and coal feedstocks used for those power plants, some degree of offset of upstream carbon dioxide, methane, nitrous oxide, and other GHG emissions associated with natural gas and coal extraction and transport, will also be realized. Therefore, implementation of the Project will provide direct and indirect benefits that counter the potential effects of climate change. The Project supports and is part of a transition towards increased in-State, national, and global renewable power production, which is a key component towards the mitigation of climate change.

Estimates of the potential effects of climate change on the frequency and amount of rainfall in the west vary; however, most studies concur that in the desert southwest, some degree of reduction of precipitation would occur…These scenarios could result in moderate to substantial effects on water supply availability, and could affect the ability of water rights holders along the Colorado River to divert their full entitlements.

In the event that climate change results in reduced precipitation within the project area and its vicinity, some degree of associated reduction in groundwater recharge from rainfall could occur. This situation would not result in increased water requirements by the proposed action, and would not result in additional groundwater pumping during project construction or operations. Therefore, even with potential reductions in total precipitation volume associated with future climate change, no increase in pumping would be required as a result of the effects of climate change.[39]

EISs which address the impacts of climate change on a project

Mississippi River Gulf Outlet Ecosystem Restoration

A 2010 EIS prepared by the U.S. Army Corps of Engineers for the Mississippi River Gulf Outlet Ecosystem Restoration Study in Louisiana provides a comprehensive analysis of climate change impacts on sea level rise (SLR) under several scenarios. This coastal wetlands restoration plan considers the likely impacts of SLR on wetlands in the Mississippi delta, including submersion, subsidence and shoreline retreat, and discusses mitigation measures which may reduce wetlands loss. It also considers the effect of intensified storm surges, risks to the New Orleans metropolitan area, and the effect of saltwater intrusion on freshwater habitat and drinking water supply. While citing high scientific uncertainty about the degree of SLR, the EIS uses available

[39] Bureau of Land Management. *Final Environmental Impact Statement for the Palen Solar Power Project*. 2011 Sec. 4.3 p. 43.

modeling techniques to produce projections through the end of the century and calls for further study of the issue.

> Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea level (MSL). Coastal marshes may accrete at a rate that keeps pace with a slow rate of SLR; however, as the rate of SLR increases, coastal marshes cannot maintain their elevation, and they submerge and are transformed to open water. Some Louisiana marshes are able to survive current SLR conditions; increased SLR may approach or cross this critical threshold (USGS website).
>
> Engineering Circular No. 1165-2-211 dated July 1, 2009, provides USACE guidance for incorporating the direct and indirect physical effects of projected future RSLR in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects. The National Research Council's (NRC's) 1987 report *Responding to Changes in Sea Level: Engineering Implications* recommends a multiple scenario approach to deal with key uncertainties for which no reliable or credible probabilities can be obtained. In the context of USACE planning, multiple scenarios address uncertainty and help to develop better risk-informed alternatives. The final array of alternatives were evaluated using "low," "intermediate," and "high" rates of future RSLR for both "with" and "without" project conditions as shown in table 2-34.[40]

Seabrook Nuclear Station Relicensing

A 2011 EIS produced by the Nuclear Regulatory Commission for the relicensing of the Seabrook Nuclear Station in New Hampshire addresses the impacts of sea level rise, storm intensity and rising temperatures. The EIS addresses the relationship between climate change and SLR and analyzes SLR impacts including potential damage to the reactor from storm surges or flooding of nuclear fuel storage areas. In addition to risks to reactor safety and security posed by SLR, the EIS also addresses impacts on marine ecology and the threat posed to water supplies from saltwater intrusion.

> Implications of global climate change—including implications for severe weather and storm intensity—are important to coastal communities and to critical infrastructure such as Seabrook. Based on findings to date, published by the Intergovernmental Panel on Climate Change (IPCC), potential impacts from warming of the climate system include expansion of sea water volume; decreases in mountain glaciers and snow cover resulting in sea level rise; changes in arctic temperatures and ice; changes in

[40] U.S. Army Corps of Engineers. *Mississippi River Gulf Outlet Ecosystem Restoration Environmental Impact Statement.* 2010. Pages 160, 186, 193.

precipitation, ocean salinity, and wind patterns; and changes in extreme weather (Solomon et al., 2007).

Sea level is expected to continue to rise. While there is great uncertainty, scientists have predicted that sea levels are expected to rise between 3–4 ft (0.9–1.2 m) by the end of this century, while a renewed license for Seabrook would expire in 2050. Changes in sea level, at any one coastal location, depend not only on the increase in the global average sea level but on various regional geomorphic, meteorological, and hydrological factors (USGCRP, 2009). At Seabrook, all critical structures are located at a finished grade elevation of 20 ft (6.1 m) above 25 MSL (FPLE, 2008).

The potential cumulative effects of climate change on the Gulf of Maine and Hampton-Seabrook Estuary could result in a variety of changes that would affect aquatic resources. The environmental factors of significance identified by the U.S. Global Change Research Program (USGCRP) (2009) include temperature increases and sea level rise. Warming sea temperatures may influence the abundance and distribution of species, as well as earlier spawning times. For example, USGCRP (2009) projects that lobster populations will continue to shift northward in response to warming sea temperatures. Atlantic cod, which were subject to intense fishing pressure and other biological stressors, are likely to be adversely affected by the warmer temperatures since this species inhabits cold waters (USGCRP, 2009). USGCRP (2009) projects that the Georges Bank Atlantic cod fishery is likely to be diminished by 2100. NMFS (2009) analyzed fish abundance data from 1968–2007 and determined that the range of several species of fish is moving northward or deeper, likely in response to warming sea temperatures.

Warmer temperatures can also lead to earlier spawning since spawning time is often correlated with a distinct temperature range. Seabrook monitoring studies showed a shift in blue mussel spawning times (NAI, 2010). From 1996–2002, and select years from 2002–2009, the greatest blue mussel larval density occurred in mid-April, whereas the greatest blue mussel larval density occurred in late April in the 1970s, 1980s, and early 1990s. Sea level rise could result in dramatic effects to nearshore communities, including the reduction or redistribution of kelp, eelgrass, and wetland communities. Aquatic vegetation is particularly susceptible to sea level rise since it is immobile and cannot move to shallower areas. In addition, most species grow within a relatively small range of water depth in order to receive sufficient light to photosynthesize while escaping predation.

The ocean absorbs nearly one-third of the CO2 released into the atmosphere (NOAA, 2011). As atmospheric CO2 increases, there is a concurrent increase in CO2 levels in the ocean (NOAA, 2011). Ocean acidification is the process by which CO2 is absorbed by the ocean, forming carbonic and carbolic acids that increase the acidity of ocean water. More acidic water can lead to a decrease in calcification (or a softening) of

shells for bivalves (e.g., soft shell clams), decreases in growth, and increases in mortality in marine species (Nye, 2010). The extent and magnitude of climate change impacts to the aquatic resources of the Gulf of Maine and the Hampton-Seabrook Estuary are an important component of the cumulative assessment analyses and could be substantial.

GHG stationary emission sources at the station include primarily auxiliary boilers, small and large emergency diesel generators, a diesel-powered engine-driven air compressor, and miscellaneous portable equipment. These combustion sources are designed for efficiency and operated using good combustion practices on a limited basis throughout the year (i.e., often only for testing). Other combustion-related GHG emission sources at Seabrook include commuter, visitor, support, and delivery vehicle traffic within, to, and from the plant.

Because the plant emits significantly less GHGs than a fossil fuel-fired power plant, continued operation of Seabrook would have net beneficial impacts on global climate change. [41]

Guam and Commonwealth of the Northern Mariana Islands Military Relocation

In a 2010 EIS, the U.S. Navy analyzes the effects of sea level rise and increased storm intensity on the expansion of a naval base on the island of Guam and the construction of a deepwater docking facility for aircraft carriers. The Guam EIS recognizes the island's extreme vulnerability to climate change and SLR. The EIS also discusses SLR in the context of broader security concerns, noting that "in 2008, the National Intelligence Council judged that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels." The EIS includes substantial analysis of adaptation and resilience to climate change impacts (4.4.3).

The change in climate conditions caused by GHG resulting from the burning of fossil fuels from both stationary and mobile sources and landfilling is a global effect, and requires that the emissions be assessed on a global scale. Therefore, the disclosure of localized increments has limited or no weight in addressing climate change. The proposed action mainly involves the relocation of the military operations that are already occurring in the West Pacific region; therefore, fossil fuel burning activities in the West Pacific region are unlikely to change significantly. Consequently, overall global GHG emissions are likely to remain near the current level on a regional or global scale under the proposed action, resulting in an insignificant cumulative impact to global climate change. No specific GHG emission mitigation measures are warranted.

[41] Nuclear Regulatory Commission. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 46, Regarding Seabrook Station.* 2011. Ch 4-61, p. 191-194.

Projections made for Guam indicate that sea level rises of up to 39 in (100 cm) would result in a few low lying areas of Apra Harbor being inundated (DoD and DOE 2010). The Navy acknowledges there is the potential for their existing and future coastal facilities to be adversely affected by sea level rise, inundations from more extreme storm events and other consequences of climate change. However, predictive models on future sea level rise are subject to variability, due in part to unknown future greenhouse gas emissions. The variability increases with the period of time being assessed. Risk assessment methodologies and technologies are being developed to predict the potential impacts of climate change on existing Navy coastal facilities. As new design criteria relevant to climate change are adopted by the Navy, they will be incorporated into project design. Projects in Guam are designed to include tsunami, typhoon, wind, and earthquake conditions. The preferred aircraft carrier wharf deck elevation of 14 ft (4 m) is higher than the adjacent Alpha and Bravo Wharves' elevation of 10 ft (3 m). This elevation was designed to withstand anticipated storm surge events, not sea level rise; however, the design elevation may accommodate a change in sea level if the projected 39 in (100 cm) rise mentioned above is realized (NAVFAC Pacific 2010). The Inner Apra Harbor wharf improvements do not alter the original wharf design; the elevations are not altered. These facilities could be at risk from sea level rise. No mitigation measures are proposed.

As is outlined in the Quadrennial Defense Review Report (QDR) of February 2010, DoD would need to adjust to the impacts of climate change on our facilities and military capabilities. Although the United States has significant capacity to adapt to climate change, it will pose challenges for civil society and DoD alike, particularly in light of the nation's extensive coastal infrastructure. In 2008, the National Intelligence Council judged that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels.

Guam and the CNMI would have some unique adaptation issues to evaluate and consider. The U.S.Global Climate Research Program (USGCRP) report, "Global Climate Change Impacts in the U.S." reviewed the unique impacts of Climate Change on Islands. According to the report, climate change presents U.S.-affiliated islands with unique challenges. Small islands are vulnerable to sea-level rise, coastal erosion, extreme weather events, coral reef bleaching, ocean acidification, and contamination of freshwater resources with saltwater. The islands have experienced rising temperatures and sea level in recent decades. Projections for the rest of this century suggest continued increases in air and ocean surface temperatures in both the Pacific and Caribbean, an overall decrease in rainfall in the Caribbean, an increased frequency of heavy downpours nearly everywhere, and increased rainfall during the summer months (rather than the normal rainy season in the winter months) for the Pacific islands. Hurricane wind speeds and rainfall rates are likely to increase with continued warming. Island coasts would be at

> increased risk of inundation due to sea-level rise and storm surge with major implications for coastal communities, infrastructure, natural habitats, and resources.
>
> The report goes on to illustrate that island communities, infrastructure, and ecosystems are vulnerable to coastal inundation due to sea-level rise and coastal storms. Flooding would become more frequent and coastal land would be permanently lost as the sea inundates low-lying areas and the shorelines erode. Loss of land would affect living things in coastal ecosystems. Hurricanes and other storm events cause major impacts to island communities including loss of life, damage to infrastructure and other property, and contamination of freshwater supplies. With further warming, hurricane and typhoon peak wind intensities and rainfall are likely to increase, which, combined with sea-level rise, would cause higher storm surge levels.[42]

CUY-90-Innerbelt Highway Project

A 2009 EIS for a highway construction project in Cleveland, Ohio asserts that analysis of greenhouse gas emissions is unnecessary, but discusses the impacts of climate change on transportation infrastructure. The EIS cites a report from the National Academy of Sciences Transportation Research Board which found that in northern inland areas such as Ohio, increased temperature extremes are likely to damage transportation infrastructure. More frequent freezes and thaws and extreme heat are expected to degrade the integrity of pavement and bridges and result in increased maintenance costs. Impacts of this type are expected to affect roadways throughout the entire northern United States.

> FHWA does not believe it is informative at this point to consider greenhouse gas emissions as part of the project level planning and development process. Greenhouse gases are quantitatively and qualitatively different from other motor vehicle emissions, and their magnitude and breadth appear to require a different approach to address their potential climate impacts. First, HC and other criteria pollutant emissions are of concern, and thus regulated, in individual metropolitan or smaller areas. The climate impacts of CO2 emissions, on the other hand, are global in nature. From a NEPA perspective, it is analytically problematic to conduct a project level cumulative effects analysis of greenhouse gas emissions on a global-scale problem. Secondly, criteria pollutant emissions last in the atmosphere for perhaps months; CO2 emissions remain in the atmosphere far longer - over 100 years - and therefore require a much more sustained, intergenerational effort. Finally, due to the interactions between elements of the transportation system as a whole, project-level emissions analyses would be less informative than ones conducted at regional, state, or national levels. Because of these concerns, FHWA concludes that we cannot usefully evaluate CO2 emissions in the same way that we address other vehicle emissions. The NEPA process is meant to concentrate

[42] U.S. Navy, *Guam and Commonwealth of the Northern Mariana Islands Military Relocation*. 2010. Sec. 4.4.3, pages 91-93.

on the analyses of issues that can be truly meaningful to the consideration of project alternatives, rather than simply "amassing" data. In the absence of a regional or national framework for considering the implications of a project-level GHG analysis, we feel that such an analysis would not inform project decision-making, while adding administrative burden.

Regarding the effects of global climate change on the project, it should be noted that no comprehensive inventory exists of U.S. transportation infrastructure vulnerable to climate change impacts, the potential extent of that exposure, or the potential damage costs. Most studies that examine impacts of global climate change have, to date, focused on the coastal areas of the United States. However, we can surmise that there will be some impacts from climate change on transportation infrastructure beyond the coastal areas, including Ohio.

The TRB Special Report 290, "Potential Impacts of Climate Change on U.S. Transportation" states that, "*Projected warming temperatures and more heat extremes will affect all surface transportation modes. In many northern states,* [such as Ohio]*, for example, warming winter temperatures will bring about reductions in snow and ice removal costs, lessen adverse environmental impacts from the use of salt and chemicals on roads and bridges, extend the construction season, and improve the mobility and safety of passenger and freight travel through reduced winter hazards. Expected increases in temperature extremes, however, will have less positive impacts. More freeze–thaw conditions may occur, creating frost heaves and potholes on road and bridge surfaces and resulting in load restrictions on certain roads to minimize the damage. With the expected earlier onset of seasonal warming, the period of springtime load restrictions may be reduced in some areas but is likely to expand in others with shorter winters but longer thaw seasons. Longer periods of extreme heat may compromise pavement integrity (e.g., softening asphalt and increasing rutting from traffic); and cause thermal expansion of bridge joints, adversely affecting bridge operation and increasing maintenance costs."*[43]

Interstate 5 Columbia River Crossing Project

Climate impacts are considered in a 2011 EIS for the Interstate 5 Columbia River Crossing Project, a bridge and highway proposal in Vancouver, Washington. The EIS evaluates climate change projections specific to the region, identifies the variable conditions which are expected to result from climate change, and assesses the project's resiliency to climate change impacts. Impacts addressed include temperature and precipitation changes, altered seasonal river flow, and increased flooding. The vulnerability of the Columbia River Bridge to these impacts is assessed, and a bridge design is proposed which would accommodate higher floodwater levels.

[43] Federal Highway Administration. *CUY-90-Innerbelt Highway Project Environmental Impact Statement.* 2009. p. 31.

The EIS includes a section on Climate Change and Adaptation Measures (3-445). Resiliency assessment was conducted in accordance with Washington State DOT Guidance.

Light rail is operated by electricity. Although light rail vehicles do not emit CO2 during travel, the process of converting primary energy sources (e.g., coal, natural gas, etc.) to electricity does. In the DEIS, the electricity demand was assumed to be provided by Portland General Electric (PGE) and Clark Public Utilities (CPU). Data specific to PGE and CPU operations regarding the distribution of primary energy sources and emission factors for each primary energy source were used to calculate the CO2e emissions. In this FEIS, the PGE and CPU specific data were substituted with data from EPA's Emission and Generation Resource Integrated Database (eGRID). eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the U.S. eGRID is unique in that it links air emissions data, including CO2e, methane, and nitrous oxide emissions, with electricity generation data for United States power plants.

The reductions in GHG emissions associated with the LPA result from three primary factors. First, the LPA would toll the I-5 crossing, which is expected to decrease the number of cars crossing the River compared to the No-Build Alternative. Second, the LPA provides light rail transit that is expected to divert a portion of personal vehicular travel demand to transit. Third, the LPA decreases congestion on I-5, which increases average speeds and improves fuel efficiency. Since the fuel efficiency of passenger vehicles typically improves as speeds increase (up to approximately free flow conditions), less fuel would be consumed and a reduced amount of GHGs would be emitted.

The CRC project team followed the WSDOT Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations. The team received technical support from the WSDOT Air/Noise/Energy Program to evaluate existing climate change projections, identify the variable conditions expected as a result of climate change, and assess the project's resiliency to climate change impacts. Recognizing that the effects of climate change may alter the function, sizing, and operation of the LPA, the CRC project team evaluated research conducted by the University of Washington's Climate Impacts Group (CIG) to ensure that the LPA is designed to perform under the variable conditions expected as a result of climate change. Based on the best available science, the effects of climate change in the project area are projected as follows:

•It is highly likely that as a result of natural- and human-caused climate change, average annual air temperatures will increase.

•Warmer winter temperatures in the Columbia River Basin will result in lowered snowpack and higher winter base flows. Lower base flows are expected in the spring and

summer months, and an increased likelihood of more intense storms may increase the chance of flooding.

•Average annual precipitation is likely to stay within the range of 20th century variability.

•Sea level rise in the Pacific Northwest will vary with regional rates of uplift, but would be similar to the global average increase of 1.3 feet by 2100.

•Climate change could negatively impact salmon and trout populations in the Columbia River Basin. However, climate change–induced impacts are anticipated to be less severe than human activities that destroy or degrade freshwater habitat (Bisson 2008).

The project team considered the information on climate change with regard to preliminary design and potential for changes in the surrounding natural environment. As part of its standard design, the LPA has incorporated features that will provide greater resilience and function with the potential effects brought on by climate change."

In addition, the consideration of climate change projections is an important element in the long-term sustainability of the project. Specifically, the CRC Sustainability Strategy specifies LPA activities to "design, construct, maintain, and operate the project to resiliently adapt to climate change." As detailed in the Strategy, the following aspects of the LPA consider the anticipated effects of climate change, and/or incorporate elements to improve the project's resilience to anticipated climate change–induced impacts. The LPA bridge design will accommodate projected climate change–induced rise in the Columbia River's high water levels.[44]

Cobbler II Timber Harvest EIS

A 2010 EIS for the Cobbler II timber sales and fuel reduction project in Oregon's Umatilla National Forest addresses various climate change scenarios and their effects on forest health and productivity. The EIS discusses the effects of increased variability in precipitation and harsher droughts, which are expected to increase stress on vulnerable species and lead to more frequent and severe wildfires.

The context of this climate change analysis is that Cobbler project planning area is too small for a direct evaluation of potential climate change effects caused by the proposed actions. Our current understanding of climate science suggests it is difficult to establish a cause-and-effect relationship between proposed actions and climate change at a project scale. Therefore, no attempt was made to use climate change as an issue during

[44] Federal Highway Administration. *Interstate 5 Columbia River Crossing Project Environmental Impact Statement.* 2011. Sec. 3, p.445.

the NEPA process, and no indicators were established for comparing potential climate change effects between alternatives.

Cobbler II project activities do not convert forested land into a developed condition and they do not deforest the land. Given the IPCC findings and the small scale and limited impacts of this project on vegetation cover, the incremental contribution to greenhouse gas (GHG) and climate change is so small it's not measurable and not significant.

The 2007 IPCC report also summarizes recommended sector-specific key mitigation "technologies and practices". For the forestry sector, those available include afforestation, reforestation, forest management, reduced deforestation, harvested wood product management, and use of forestry products for bioenergy to replace fossil fuel use. Cobbler II project is consistent with these recommendations because it proposes management of the forest for resilience to disturbance and reforestation of regeneration harvest areas. Depending on the markets, some of the products may be used to produce bioenergy.

Climate change already has very likely altered forest fires, insect outbreaks and tree mortality in the U.S. interior west (Ryan et al. 2008), and future effects are expected to be greater (Climate Change Resource Center 2009). Scientists are using models to try to show the possible range of changes that may occur in the future in forests. Model predictions range widely as to the likelihood of specific changes in western American forests within their modeling timelines. There is consensus that while climate is changing, novel ecosystems will arise, as individual species are expected to respond to climate change differently, and not as the currently observed plant assemblages (Ryan et al. 2008). Further, although quantitative models can estimate a range of potential directions and magnitudes of environmental changes and forest responses in the future, models rarely can predict the future with the level of accuracy and precision needed by resource managers (Millar et al. 2007).

Many climate change scenarios include an increase in winter precipitation but increased temperatures and increased frequency of summer drought, which may result in more moisture stress in forest environments (Spittlehouse and Stewart 2003). This may cause reduced growth and decreased vigor of forest stands. Declines in vigor may make forests more susceptible to large-scale pest attacks and more frequent or severe fires. Existing plant species or genotypes may be poorly adapted to future climate conditions. Being relatively long-lived, the forest trees living today will probably compose much of the forests of the next century. Long-term adaptation to climate changes will require healthy and productive forests in the short term (Millar et al. 2007). Maintaining forest ecosystems in the face of progressive climate change will require silvicultural systems to manage declining and disturbed stands (Spittlehouse and Stewart 2003).

> Forest managers will need options to choose from while under the uncertainty of future climate conditions in their regions. No single adaptation approach will fit all forest regions. Good options could include practices focused on forestalling climate change effects by building resistance and resilience into current ecosystems, and on managing for change by enabling plants, animals, and ecosystems to adapt to climate change. Better and more widespread implementation of already known practices that reduce the impact of existing stressors represents a strategy that can be used while uncertainty about future conditions is high. Increased emphasis on current efforts to reduce the impact of existing stressors on National Forests represents a ‘‘no regrets’’ strategy. Efforts to mitigate existing stressors would address current management needs, and potentially reduce future interactions of these stressors with climate change. (Joyce et al. 2009)

> Increasingly, land managers are being asked to consider the potential carbon consequences of forest management activities. This section discusses issues associated with carbon storage and sequestration, carbon stocks and fluxes, and possible interactions between activities that would be expected to cause short-term reductions in carbon stocks (such as thinning and prescribed fire) in order to avoid potentially large carbon emissions from wildfire and other stand-replacing disturbance processes in the future.

> Increased burning of fossil fuels (coal, oil and its refined products including gasoline, and natural gas) since the beginning of the Industrial Revolution has resulted in increased levels of carbon dioxide (CO2) in the atmosphere. As CO2, methane and other greenhouse gases accumulate, they contribute to a host of changes referred to as the greenhouse effect, global warming, or climate change.[45]

Big Moose Vegetation Management Project

This EIS produced by the U.S. Forest Service for a vegetation management project in Colorado is typical in its treatment of emissions and climate impacts. It mentions but does not quantify emissions and carbon sequestration impacts of forest management practices. It discusses the potential ecological impacts of climate change, but emphasizes uncertainties. Appendix F p 325 contains the following:

> There are currently gaps in information about the timing, scale, and location of specific climate change impacts. Climate models lack the ability to provide projections at a detailed scale that are most useful to land managers and local and regional planners (Kimbell 2007; Kimbell 2009).

> There is a lack of critical information to determine the stresses of a warming climate and carbon dioxide on plant growth. To face this uncertainty, the primary focus

[45] U.S. Forest Service. *Cobbler II Timber Sale and Fuels Reduction Project Final Environmental Impact Statement*. 2010. Ch. 3 p156-163.

of climate change efforts on National Forest System lands is to facilitate the adaptation of ecosystems to the effects of these changes (Kimbell 2009).

In response, the Forest Service developed a Strategic Framework for Responding to Climate Change (USDA Forest Service 2008) and identified a policy goal of integrating climate change considerations, as appropriate, into Forest Service program guidance. The Forest Service then developed a guidance paper called Climate Change Considerations in Project Level NEPA Analysis (USDA Forest Service 2009). The guidance paper suggests considering two types of climate change effects at the project level when appropriate: 1) effects of climate change on a proposed project, and 2) effects of a proposed project on climate change. These are separately discussed below relative to this project.

The National Environmental Policy Act (NEPA) does not specifically require analysis of how environmental factors, such as global climate change, might impact a proposed action. Nevertheless, vegetation management is intended to promote plant vigor and is considered beneficial to long-term ecosystem maintenance and productivity under the applicable Forest Plan direction. Proper vegetation management should maintain or increase the adaptive capacity of ecosystems to possible climate change effects by promoting greater resilience to droughts, insect and disease agents, and wildland fire.[46]

EISs which address impacts of climate change on water resources

Los Vaqueros Reservoir Expansion Project

A 2009 EIS produced by the Bureau of Reclamation for the Los Vaqueros Reservoir Expansion Project in California. The project supplies water to maintain environmental standards in rivers and tributaries in the San Francisco Bay Area. The impacts of climate change on snowpack, precipitation and runoff, flooding and sea level rise are analyzed. The EIS reviews projections regarding future water scarcity in California's Central Valley and the impacts of inadequate irrigation on agriculture.

The analysis predicts that several rivers including the Sacramento will not be able to meet their minimum flow requirements and that water usage plans will need to be reevaluated. In anticipation of more extreme flooding, the EIS calls for intake and pumping stations to be designed to withstand higher floodwaters. The EIS also addresses the potential for future drought to reduce water quality in addition to availability.

[46] U.S. Forest Service. *Record of Decision and Final Environmental Impact Statement: Big Moose Vegetation Management Project.* 2011. Section F p 325.

Current research generally indicates that the most probable impacts of climate change on water resources would be related to increased peak winter flows and decreased spring and early summer runoff. As discussed above, these changes in water flow would result in less water available for capture through the CVP and SWP, as well as through other local water projects and diversions.

Without substantial changes in water management, it is, therefore, likely that climate change could lead to reduced deliveries to water contractors north and south of the Delta who rely on water supplies from the SWP, the CVP, and local sources.

Climate change most likely would reduce spring and early summer snowmelt, while increasing water discharged during winter months, from the standpoint of water supply, it would be useful to have additional screened, winter pumping capacity in the Delta. Such additional pumping capacity would facilitate retention and storage of storm season flood flows.

Operations of the Delta were also examined under future climate change conditions with and without an expanded Los Vaqueros Reservoir. As expected, the response to climate change is mixed, depending on the assumptions and models used. Generally, available water supplies would decrease in drier years and would be mixed in wetter years, reflecting wetter conditions but earlier runoff. Generally, water quality conditions would degrade somewhat, especially in drier years, but water quality standards would still be met.

Operations of an expanded Los Vaqueros Reservoir respond in the following ways to climate change scenarios:

• The reservoir storage would tend to be lower in drier periods because of degraded water quality and reduced water availability. This indicates that stored water would be used more frequently in drier periods. Modeling also indicates that a modest increase of about 150 cfs in intake capacity over the amount planned for the proposed project would more than offset this effect of reduced storage levels. Such additional intake capacity could be considered in the future if climate change leads to the drier scenarios.

• The reservoir would tend to be at higher levels in wetter scenarios because of improved water quality and increased winter flows.[47]

Folsom South of US 50 Plan

[47] Bureau of Reclamation. *Los Vaqueros Reservoir Expansion Project Environmental Impact Statement*. 2009. Ch. 5, p.12-14.

This EIS for a land development plan produced by the U.S. Army Corps of Engineers includes a literature overview and extended discussion of climate change adaptation and resilience related to California's water supply system. (P3A4-44-45)

> Tanaka et al. (2006) explored the ability of California's water supply system to adapt to long-term climatic and demographic changes using the California Value Integrated Network (CALVIN), a statewide economic engineering optimization model of water supply management. The results show agricultural water users in the Central Valley are the most sensitive to climate change, particularly under the driest and warmest scenario (i.e., PCM 2100) predicting a 37% reduction of Central Valley agricultural water deliveries and a rise in Central Valley water scarcity costs by $1.7 billion. Although the results of the study are only preliminary, they suggest that California's water supply system appears "physically capable of adapting to significant changes in climate and population, albeit at a significant cost" (Tanaka et al. 2006). Such adaptation would entail changes in California's groundwater storage capacity, water transfers, and adoption of new technology.[48]

The EIS notes that mitigation alone will not be adequate to meet environmental goals and discusses policy and technological adaptations to water scarcity, as well as the relative vulnerability of different consumers, especially those in the agricultural sector.

> Based on the conclusions of current literature regarding California's ability to adapt to global climate change, it is reasonably expected that over time, the state's water system will be modified to be able to address the projected climate changes, e.g., under dry and/or warm climate scenarios (DWR 2006). Although coping with climate change effects on California's water supply could come at a considerable cost, based on a thorough investigation of the issue, it is reasonably expected that statewide implementation of some, if not several, of the wide variety of adaptation measures available to the state, will likely enable California's water system to reliably meet future water demands. For example, traditional water supply reservoir operations may be used, in conjunction with other adaptive actions, to offset the impacts of global warming on water supply (Medellin et al. 2006; see also Tanaka et al. 2006 and Lund et al. 2003). Other adaptive measures include better urban and agricultural water use efficiency practices, conjunctive use of surface and ground waters, desalination, and water markets and portfolios (Medellin et al. 2006; see also Lund et al. 2003, Tanaka et al. 2006). More costly statewide adaptation measures could include construction of new reservoirs and enhancements to the state's levee system (CEC 2003). As described by Medellin et al.

[48] U.S. Army Corps of Engineers. 2010. *Folsom South of U.S. 50 Specific Plan Project Environmental Impact Statement.* Sec. 3A4, p. 44-45.

2006, with adaptation to the climate, the water deliveries to urban centers are expected to decrease by only 1%, with Southern California shouldering the brunt of this decrease.[49]

Kemper County Integrated Combined Cycle Gasification Project

This DOE EIS for a power plant in Mississippi details direct emissions from plant operations at full capacity with various levels of CO2 capture, incidental emissions from support, maintenance and lignite mining, and emissions from construction. It also calculates lost carbon sequestration from land use changes from mining operations.

Based on a study of life cycle GHG emissions from IGCC power systems (Reuther *et al.*, 2004), DOE estimates that plant operations support, maintenance, and lignite mining could increase annual GHG emissions attributable to the operation of the generating station by approximately 130,000 tons (for a total of approximately 2.0 to 2.8 million tons annually). Total emissions of GHGs from construction activities would be approximately 430,000 tons of CO2 equivalents (approximately 15 to 22 percent of 1 year's operating emissions).

GHG emissions from the coal-mining operations would primarily result from the combustion of diesel fuel in mining equipment and off-road vehicles. The mining equipment would include loaders, large dump trucks, dozers, backhoes, graders, and hydraulic shovels. Emissions were conservatively estimated based on a 7-day-perweek, 24-hour-per-day operating schedule, and a best guess as to the number of pieces of equipment and the percent of time that they would be used. For comparative purposes, the annual emissions of CO2 from mining operations were estimated at approximately 45,000 tons. These emissions would represent less than 2 percent of the annual Kemper County IGCC Project emissions.

Annual emissions of GHGs from construction activities were estimated to be approximately 27,000 tons of CO2 (i.e., approximately 1 percent of 1 year's operating emissions of the IGCC facility). Operating at full capacity with beneficial use of CO2 for EOR and geologic storage, the facility would constitute one of the larger point sources of CO2 emissions in Mississippi. Neither federal law nor Mississippi law place limits on CO2 emissions on sources such as the Kemper County IGCC Project, and generally there are few economic incentives or regulatory requirements for utilities to reduce emissions of GHGs from their power plants at this time. However, the federal government is considering several approaches to addressing global warming by limiting emissions of GHGs, including regulating them under the CAA.

[49] U.S. Army Corps of Engineers. 2010. *Folsom South of U.S. 50 Specific Plan Project Environmental Impact Statement.* Sec. 3A4, p. 44-45.

The GHGs emitted by the Kemper County IGCC Project would add a relatively small increment to emissions of these gases in the United States and the world. Overall GHG emissions in the United States during 2007 totaled approximately 7,881.6 million tons (7,150.1 million metric tonnes) of CO2-equivalents, including approximately 6,727.8 million tons (6,103.4 million metric tonnes) of CO2. These emissions resulted primarily from fossil fuel combustion and industrial processes. Approximately 42 percent of CO2 emissions came from the generation of electrical power (EPA, 2009). By way of comparison, annual operational emissions of GHGs from the proposed generating station would equal approximately 0.04 percent of the United States' total 2007 emissions.

The release of anthropogenic GHGs and their potential contribution to global warming are inherently cumulative phenomena. That is, emissions of GHGs from the proposed power plant by themselves would not have a direct impact on the global, regional, or local environment. Similarly, current scientific methods do not allow one to correlate emissions from a specific source with a particular change in either local or global climates.[50]

[50] Department of Energy. 2010. *Kemper County Integrated Combined Cycle Gasification Project*. Vol. 1, Ch. 6, sec. 3, p. 586-589.