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Keystone XL: Greenhouse Gas Emissions Assessments in the Draft Environmental Impact Statement

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Summary

On June 25, 2013, President Obama announced a national "Climate Action Plan" to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases (GHG), as well as to encourage adaptation to expected climate change. During his speech, the President made reference to the proposed Keystone XL Pipeline and stated that an evaluation of the project's impacts on climate change would factor into the U.S. State Department's national interest determination. The State Department, in the March 2013 *Draft Environmental Impact Statement (DEIS)* for the Keystone XL Pipeline, reports estimates for both the direct (i.e., operational) and indirect (i.e., associated with crude oil production and use) GHG emissions that would be attributable to the proposed project. The *DEIS* finds that "the proposed Project would be responsible for incremental GHG emissions in the range of 0.07 ... 5.3 [million metric tons of CO_2 equivalent] annually." These emissions would represent an increase of 0.001%-0.08% over the domestic GHG emissions totals of 6,822 $MMTCO_2e$ in 2010. The State Department bases its findings on the following conclusions: (1) approval or denial of the proposed pipeline is unlikely to have a substantial impact on the rate of development in the oil sands, or on the amount of heavy crude oil refined in the Gulf Coast area in the long term, (2) denial of the proposed pipeline is offset entirely by the expansion of new rail and pipeline infrastructure in North America in the long term, and (3) the cumulative impact of the proposed pipeline would be the additional oil sands production that would become economical given the marginal cost savings afforded by the project over non-pipeline transport.

Many industry stakeholders, the Canadian and Albertan governments, and proponents of the proposed pipeline have generally supported the State Department's findings. They contend that the demand for the oil sands resource, as well as the economic incentives for producers and the Canadian governments, is too significant to dampen production. However, the U.S. Environmental Protection Agency (EPA), among other stakeholders, has questioned several of the conclusions put forth by the *DEIS* and recommended that the State Department revisit the analysis. Opponents of the project argue that the Keystone XL Pipeline may have greater impacts than projected in the *DEIS* if certain State Department assumptions were to differ, including projections for global crude oil markets, rail transport costs, new project costs, refinery inputs, and carbon pricing policies. Members of Congress remain divided on the merits of the proposed project, as many have expressed support for the potential energy security and economic benefits, while others have expressed reservations about its potential environmental impacts. Though Congress, to date, has had no direct role in permitting the pipeline's construction, it may have oversight stemming from federal environmental statutes that govern the review. Further, Congress may seek to influence the State Department's permitting process or to assert direct congressional authority over approval through new legislation.

On January 31, 2014, the State Department released the *Final Environmental Impact Statement (FEIS)* for the Keystone XL Pipeline, which contained revised analysis and estimates. For a detailed review of these findings, see CRS Report R43415, *Keystone XL: Greenhouse Gas Emissions Assessments in the Final Environmental Impact Statement*, by (name redacted) .

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Background

In 2008—and again in 2012—the Canadian company TransCanada submitted to the U.S. Department of State an application for a Presidential Permit authorizing construction and operation of pipeline facilities to import crude oil across the U.S.-Canada border. The proposed Keystone XL Pipeline would transport crude oil derived from Canadian oil sands[1] deposits in Alberta as well as crude oil produced from the Bakken region in North Dakota and Montana to a market hub in Nebraska for further delivery to U.S. Gulf Coast refineries. A decision to issue or deny the Presidential Permit on the project is based on the U.S. Department of State's determination of whether the proposed pipeline serves the national interest. A national interest determination rests on a number of factors, including energy security; foreign policy; environmental, social, and economic impacts; and compliance with relevant federal regulations.

On June 25, 2013, President Obama announced a national "Climate Action Plan" to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases (GHG), as well as to encourage adaptation to expected climate change.[2] During his speech, the President made reference to the proposed Keystone XL Pipeline and stated that an evaluation of the pipeline's impact on climate change would factor into the State Department's national interest determination:

> Allowing the Keystone pipeline to be built requires a finding that doing so would be in our nation's interest. And our national interest will be served only if this project does not significantly exacerbate the problem of carbon pollution. The net effects of the pipeline's impact on our climate will be absolutely critical to determining whether this project is allowed to go forward.[3]

Both supporters and opponents of the proposed Keystone XL Pipeline reacted positively to the President's comments, signaling that an assessment of the net effects of the pipeline's impact on the climate—as well as the significance of those effects—is still under intense debate.

[1] The resource has been referred to by several terms, including "oil sands," "tar sands," and, most technically, "bituminous sands." This report uses the term "oil sands" because of its widespread use in both U.S. government agency and academic literature. Oil sands are formations of loose sand or consolidated sandstone containing naturally occurring mixtures of sand, clay, water, and a dense and extremely viscous form of petroleum called "bitumen." This report uses the term "oil sands crudes" as an abbreviation for all crude oils that are derived from oil sands bitumen in the Western Canadian Sedimentary Basin (WCSB). Further, the term "reference crudes" is used as an abbreviation for all other global crude oil resources against which the oil sands crudes are compared. Most reports suggest that the form of oil sands crude that would likely be transported through the proposed pipeline is "diluted bitumen," or "dilbit." Dilbit is bitumen that is blended with lighter hydrocarbons, typically natural gas condensates, to create a lighter, less viscous, and more easily transportable material. For more discussion on the resource, see CRS Report R42611, *Oil Sands and the Keystone XL Pipeline: Background and Selected Environmental Issues*, coordinated by (name redact ed).

[2] For an analysis of the Obama Administration's Climate Action Plan, see CRS Report R43120, *President Obama's Climate Action Plan*, coordinated by (name redacted).

[3] White House, "Remarks by the President on Climate Change," Georgetown University, Washington, DC, June 25, 2013, http://www.whitehouse.gov/the-press-office/2013/06/25/remarks-president-climate-change.

The State Department's GHG Emissions Assessment

The effects of the proposed Keystone XL Pipeline on climate change could be analyzed, in part, by an assessment of the GHG emissions attributable to the project. Such an analysis could encompass a variety of activities and implications relative to the pipeline, including the GHG emissions associated with the proposed pipeline's construction and operation, as well as the GHG emissions attributable to the crude oils that would be transported through the pipeline. An assessment would be dependent upon many factors, most notably, the availability and quality of GHG emissions data for the industry, the scope of industry activities included within the assessment, and the assumptions made about how to model these activities. Many secondary considerations may also impact an assessment. These include assumptions regarding global crude oil markets, refinery inputs and outputs, transport options, economics, policy considerations, and the end-use consumption of petroleum products. Different values attached to these varying factors return different estimates for the GHG emissions attributable to the construction and operation of the proposed pipeline as well as the crude oils transported through it.

A number of publicly available studies have attempted to assess the GHG emissions of crude oils derived from Canadian oil sands deposits ("oil sands crudes"). Some of these studies have also made estimates for the GHG emissions attributable to the crude oils that would be transported through the proposed pipeline. The State Department, in its March 2013 *Draft Environmental Impact Statement (DEIS)* for the Keystone XL Pipeline, has produced one such assessment.[4] As the *DEIS* will be a primary component for the national interest determination, this report focuses on the State Department's analysis and comments on its methodology and conclusions. Where applicable, the report supplements the *DEIS* analysis with relevant additional information. As the State Department's assessment is based on the findings of several published studies of oil sands crudes, this report also comments on their respective methodologies and conclusions. For a more extensive investigation of the GHG emissions assessments of oil sands crudes and their comparison to other global crude oils ("reference crudes"), see CRS Report R42537, *Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions*, by (name redacted).

Reported Findings

The *DEIS* includes an analysis of the GHG emissions that would be attributable to the proposed Keystone XL Pipeline. It reports both "direct" GHG emissions from the construction and operation of the proposed pipeline as well as "indirect" emissions attributed to the production and use of the oil sands crudes that would be transported through the proposed pipeline. The State Department defines the indirect GHG emissions as "incremental GHG emissions." This value is generated by examining the full GHG emissions profile of oil sands crudes (i.e., the aggregate GHG emissions released by all activities from the extraction of the resource to the end-use combustion of refined fuels), comparing this profile to those of other reference crudes it may displace in U.S. refineries, and then estimating the difference between a scenario where the proposed Keystone XL Pipeline is constructed and a scenario where it is not. Thus, for the

[4] U.S. Department of State, *Keystone XL Project, Draft Supplementary Environmental Impact Statement,* March 1, 2013. In this report, CRS refers to this document as the *Draft Environmental Impact Statement (DEIS),* as the submission of a new permit application is understood to reinitiate the National Environmental Policy Act process. For further explanation, see CRS Report R41668, *Keystone XL Pipeline Project: Key Issues*, by (name redacted) et al.

purposes of its analysis, the State Department incorporates the direct emissions attributed to the operation of the pipeline into the reported incremental indirect emissions.[5]

Based on its review of the available GHG emissions assessments, as well as an analysis of North American crude oil transport infrastructure and global crude oil markets*,* the State Department finds the following:[6]

- Approval or denial of the proposed Project is unlikely to have a substantial impact on the rate of development in the oil sands, or on the amount of heavy crude oil refined in the Gulf Coast area.
- If the proposed Keystone XL Pipeline were not built, but other proposed pipelines were (e.g., the Northern Gateway, the Trans Mountain expansion, and the TransCanada proposal to ship crude oil east to Ontario), there would be a 0.4%-0.6% reduction in Canadian oil sands production by 2030, and a decrease in the incremental indirect life-cycle GHG emissions of oil sands production in the range of 0.07-0.83 million metric tons of carbon dioxide equivalents ($MMTCO_2e$) annually.[7]
- If all proposed pipelines were denied, there would be a 2%-4% reduction in Canadian oil sands production by 2030, and a decrease in the incremental indirect life-cycle GHG emissions of oil sands production in the range of 0.35-5.30 $MMTCO_2e$ annually.

In summary, the *DEIS* reports that the proposed Keystone XL Pipeline "would be responsible for incremental GHG emissions in the range of 0.07 ... 5.30 $MMTCO_2e$ annually," and places these numbers in context by noting U.S. GHG emissions totaled 6,822 $MMTCO_2e$ in 2010 (excluding emissions/removals from land use, land-use change, and forestry), and global CO_2 emissions from fuel combustion totaled 30,326 $MMCO_2e$.[8] The incremental pipeline emissions would represent an increase of 0.001%-0.08% over the total domestic GHG inventory for the United States in 2010 and would be equivalent, at most, to the annual GHG emissions from the energy used in a little over 1 million passenger vehicles or the annual CO_2 emissions from the energy used in a little over a quarter million homes in the United States.[9]

See **Table A-1** for a summary of this estimate as well as other selected pipeline scenarios and their GHG equivalencies.

[5] Direct GHG emissions from the annual operation of a pipeline are commonly included in many life-cycle assessments—including those referenced in the *DEIS*. Thus, the *DEIS* does not incorporate their reported values for direct emissions into their reported values for indirect emissions. Nevertheless, it is worth noting that the *DEIS* estimates direct initial construction emissions of 0.24 $MMTCO_2e$ due to land use changes, electricity use, and fuels for construction vehicles and other mobile sources; and direct pipeline operation emissions of 3.19 $MMTCO_2e$/year due to electricity for pumping stations, fuels for maintenance and inspection vehicles, and fugitive emissions. *DEIS,* 4.15-106.

[6] *DEIS,* ES-15, and 4.15-106.

[7] "Carbon dioxide equivalent" is a metric used to compare emissions of various greenhouse gases based upon their global warming potential as indexed against one unit of carbon dioxide.

[8] *DEIS,* 4.15-106. The State Department notes that these figures were sourced from the U.S. Environmental Protection Agency (EPA) and the International Energy Agency (IEA) respectively.

[9] The *DEIS* employs these specific GHG equivalencies when summarizing the GHG emissions estimates for the pipeline. This report follows suit in each instance where GHG emissions estimates are reported. Equivalencies are based on EPA, "Greenhouse Gas Equivalencies Calculator," http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

Methodology

> The proposed Project would be responsible for incremental GHG emissions in the range of 0.07 ... 5.30 MMTCO_2e annually.

How does the State Department calculate this estimate, and what does it say about the cumulative effects of the pipeline?

1. Emissions Profiles of Oil Sands Crudes

State Department Calculations

The State Department's first step in calculating the GHG emissions attributable to the proposed pipeline is to develop a "life-cycle assessment" of the Canadian oil sands resource. Life-cycle assessment (LCA) is an analytic method used for evaluating and comparing the environmental impacts of various products (in this case, the climate change implications of a petroleum resource). LCAs can be used in this way to identify, quantify, and track emissions of carbon dioxide and other GHG emissions arising from the development of the resource, and to express them in a single, universal metric of carbon dioxide equivalent (CO_2e) GHG emissions per unit of fuel or fuel use. This figure is commonly referred to as the "emissions intensity" of the fuel. The results of an LCA can be used to evaluate the GHG emissions intensity of various stages of the fuel's life-cycle, as well as to compare the emissions intensity of one type of fuel or method of production to another. Emissions intensities modeled by LCAs are delimited by the scope of activities chosen to be in the assessment. Many LCAs are based on a set of boundaries commonly referred to as "cradle-to-grave," or, in the case of transportation fuels such as petroleum, "Well-to-Wheels" (WTW). WTW assessments focus on the emissions associated with the entire life-cycle of the fuel, from extraction, transport, and refining of crude oil; to the distribution of refined product to retail markets (e.g., gasoline, diesel, jet fuel); to the combustion of the fuel in end-use vehicles. The State Department has chosen a WTW assessment for the *DEIS.* Other analyses have used different sets of boundaries to compare the relative impact of oil sands crudes against reference crudes. Other choices include Well-to-Tank (WTT) or Well-to-Refinery Gate (WTR), and each establish different (i.e., more specific) life-cycle boundaries to evaluate emissions. Inclusion of the final combustion phase allows for the most complete picture of petroleum's impact on GHG emissions, as this phase can contribute up to 70%-80% of WTW emissions. However, other boundaries can be used to highlight the differences in emissions associated with particular stages as well as experiment with certain boundary assumptions.[10]

A number of publicly available studies have attempted to assess the life-cycle GHG emissions intensity of oil sands crudes. The State Department—in conjunction with the consultancy firm ICF International LLC—in the Keystone XL Project's August 2011 *Final Environmental Impact Statement* employs the results of four published LCAs in its analysis. The use of these studies is reproduced in the March 2013 *DEIS* conducted by the State Department and the contractor

[10] The choice of boundaries is an important component to any LCA and can lead to vastly differing reported results. For example, the U.S. Environmental Protection Agency (EPA) makes note of this distinction in the agency's comments on the *DEIS:* "The *DEIS* reports that life-cycle GHG emissions from oil sands crude could be 81% greater than emissions from the average crude refined in the U.S. in 2005 on a well-to-tank basis, and 17% greater on a well-to-wheels basis." EPA, "Comments on the *Draft Supplemental Environmental Impact Statement for the Keystone XL project*," April 22, 2013, http://www.epa.gov/compliance/nepa/keystone-xl-project-epa-comment-letter-20130056.pdf.

Environmental Resources Management. The four LCAs used by the State Department—Jacobs 2009, TIAX 2009, NETL 2008, and NETL 2009[11]—employ slightly different design parameters, input assumptions, and industry data to model the GHG emissions intensities of oil sands crudes. Thus, each returns slightly different findings.[12] As one example, the U.S. Department of Energy's assessment (NETL 2009) looks at both oil sands mining and in situ production techniques,[13] and examines the GHG emissions profiles for the extraction, transportation, and refining of these crudes into gasoline, diesel, and jet fuel products. NETL reports the average GHG emissions intensity of oil sands crudes to be 106.3 grams of carbon dioxide equivalent for each megajoule of energy released by its combustion as gasoline (gCO_2e/MJ LHV gasoline).[14] NETL compares this result to a baseline value of 91 gCO_2e/MJ LHV gasoline, which it reports as "the weighted average of transportation fuels sold or distributed in the United States in 2005."[15] Overall, the four LCAs return emissions estimates for several different types of oil sands production techniques in the range of 101-120 gCO_2e/MJ LHV gasoline. The State Department uses these results to report the following key finding in the *DEIS:*

> Combustion of fossil fuels, including petroleum-based products such as crude oil, is a major source of global GHG emissions, which contribute to human-induced climate change. [Western Canadian Sedimentary Basin] crudes are more GHG-intensive than the other heavy crudes they would replace or displace in U.S. refineries, and emit an estimated 17 percent more GHGs on a life-cycle [WTW] basis than the average barrel of crude oil refined in the United States in 2005.[16]

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[11] The *DEIS* focuses on three primary life-cycle assessments: Jacobs Consultancy, *Life Cycle Assessment Comparison of North American and Imported Crudes*, 2009 (Jacobs 2009); TIAX LLC, *Comparison of North American and Imported Crude Oil Lifecycle GHG Emissions*, 2009 (TIAX 2009); National Energy Technology Laboratory, *Development of Baseline Data and Assessment of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels,* November 26, 2008 (NETL 2008); and National Energy Technology Laboratory, *An Evaluation of the Extraction, Transport and Refining of Imported Crude Oils and the Impact of Life Cycle Greenhouse Gas Emissions*, March 27, 2009 (NETL 2009).

[12] For a detailed analysis of the LCAs, their design features, and their findings, see CRS Report R42537, *Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions*, by (name redacted).

[13] Oil sands are produced through two primary extraction methods: conventional strip-mining ("mining") and steam/solvent-assisted drilling ("in situ").

[14] NETL 2009 reports values in $kgCO_2e$/MMBtu lower heating value (LHV) gasoline. The State Department converts these values with factors of 1,055 MJ LHV gasoline/MMBtu and 1,000 g/kg. NETL 2009 specifies certain design parameters and input assumptions for their analysis, including the weighted average of Canadian oil sands transported to the United States, the allocation of co-product emissions to the co-products themselves, and the use of linear relationships to relate GHG emissions from refining operations based on API gravity and sulfur content. Further, the study assumptions do not state a steam-to-oil ratio for in situ extraction, do not include upstream fuel production, do not include infrastructure or land-use changes, and do not specify cogeneration, but do include emissions from venting, flaring, and fugitives.

[15] This baseline is from National Energy Technology Laboratory, *Development of Baseline Data and Assessment of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels*, November 26, 2008 (NETL 2008). It assesses "the average life cycle GHG profile for transportation fuels sold or distributed in the United States in 2005 [and] is determined based on the weighted average of fuels produced in the U.S. plus fuels imported into the U.S. minus fuels produced in the U.S. but exported to other countries for use" (NETL 2008, p. ES-5). It includes Canadian oil sands crudes, but does not include emissions from some of the most carbon-intensive imported crude oils (e.g., Venezuelan Heavy) due to modeling uncertainties (NETL 2008, p. ES-7; NETL 2009, p. ES-2). The baseline value is consistent with the definitions for "baseline life-cycle greenhouse gas emissions" as used in the Energy Independence and Security Act (EISA) of 2007 and the U.S. Renewable Fuel Standards Program of 2010.

[16] *DEIS*, ES-15. EPA, in its comments on the *DEIS,* focuses on the NETL 2009 results and the comparison against the 2005 baseline. EPA, "Comments," op. cit., p. 2.

Evaluation Considerations

The State Department references several third-party sources for the raw data on the GHG emissions intensities of oil sands crudes. Thus, the *DEIS* is less an independent and original assessment, than a comparative analysis of multiple other studies, each presenting significant variations in both reported findings and input assumptions. Life-cycle assessment has emerged as an influential methodology for collecting, analyzing, and comparing the GHG emissions and climate change implications of various hydrocarbon resources. However, because of the complex life-cycle of fuels and the large number of analytical design features that are needed to model their emissions, LCAs retain many uncertainties. As noted previously, the NETL 2009 LCA—from which the State Department sources many of the estimates for oil sands crudes—has many specified design parameters and input assumptions. The LCA is also four years old and utilizes data that are over eight years old (e.g., GHG emissions intensities of the oil sands crudes are compared against a 2005 U.S. baseline). Opponents to the Keystone XL Pipeline are critical of many of the exclusions in the NETL 2009 LCA, including the tightly delimited boundaries and the omission of co-product emissions (e.g., petroleum coke).[17] The *DEIS* states that "adjusting the NETL results to include other product emissions could increase the differential in incremental emissions from WCSB oil sands compared to the 2005 U.S. average crude oils by roughly 30 percent."[18] Conversely, proponents of the Keystone XL Pipeline point to the many recent advances in energy efficiency and GHG mitigation technologies that Canadian oil sands producers have made.[19] They highlight the 2012 formation of the Canada's Oil Sands Innovation Alliance (COSIA), an industry group focused on accelerating the pace of improvement in environmental performance through collaborative action and innovation. They note also that the government of Alberta has implemented policies to help mitigate and reduce the GHG emissions associated with oil sands production. These include (1) a mandatory GHG intensity reduction program for large industrial emitters,[20] (2) a fund for clean energy investment that is capitalized by the reduction program, and (3) dedicated funding for the construction of large-scale carbon capture and sequestration (CCS) facilities.[21] Proponents suggest that these and other advances may make the GHG emissions intensity estimates for oil sands crudes more in line with other reference crudes.

[17] For a list of NETL 2009 input assumptions, see footnote 14. For a more detailed analysis of the input assumptions made by the NETL 2009 LCA, see CRS Report R42537, *Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions*, by (name redacted). For other commentary on the effects of co-product omission, see, for example, Oil Change International, "Petroleum Coke: The Coal Hiding in the Tar Sands," January 17, 2013, http://priceofoil.org/2013/01/17/petroleum-coke-the-coal-hiding-in-the-tar-sands/.

[18] *DEIS,* 4.15-106. EPA makes reference to this passage in its comments. EPA, "Comments," op. cit., p. 2.

[19] For examples, see CAPP, "Oil Sands Today: GHG Emissions," http://www.oilsandstoday.ca/topics/ghgemissions/Pages/default.aspx.

[20] See Government of Alberta, Climate Change and Emissions Management Amendment Act, http://www.qp.alberta.ca/574.cfm?page=2007_139.cfm&leg_type=Regs&isbncln=9780779738151.

[21] Government of Alberta, *Alberta's Oil Sands Fact Sheet: Carbon Capture and Storage*, http://www.oilsands.alberta.ca/FactSheets/Carbon_Capture_FSht_June_2012_Online.pdf.

2. Total Emissions Attributable to the Proposed Pipeline

State Department Calculations

The second step in the State Department's analysis is to determine the total, or "gross," GHG emissions that would be attributable to the crude oils transported through the proposed pipeline. Because the throughput of a pipeline is commonly expressed in barrels per day (bpd), the GHG emissions intensities for the various oil sands crudes must be converted into a value that can be assigned to a barrel. This calculation requires an understanding of the mix of oil sands inputs that goes into a barrel at the start of the pipeline as well as the yield of refined products that are produced from a barrel at the end of the pipeline. Further, an estimate must be made for how many barrels of crude oil would be transported annually through the proposed pipeline.[22]

While implicit in its analysis, the State Department does not report a value for the total, or "gross," annual GHG emissions attributable to the crude oil transported through the proposed pipeline. Without access to the State Department's input assumptions and conversion factors, CRS cannot calculate a value for these emissions that would be consistent with the findings in the *DEIS.*

Evaluation Considerations

Third-party analyses have produced estimates which could be used to determine the total, or "gross," GHG emissions that would be attributable to the crude oils transported through the proposed pipeline. For example, IHS CERA's 2012 study, *Oil Sands, Greenhouse Gases, and U.S. Oil Supply: Getting the Numbers Right-2012 Update,*[23] compares the data from various published LCAs to determine the WTW GHG emissions for oil sands and other reference crudes on a "per barrel of refined product basis." IHS CERA estimates emissions for an "average of oil sands crudes refined in the United States in 2011" to be in the range of 517-547 kg CO_2e/barrel of refined products (or, 9%-12% higher than an average barrel refined in the United States). Based on these results, and assuming that the full 830,000 bpd pipeline capacity is used to transport only oil sands crudes to Gulf Coast refineries, the total life-cycle GHG emissions attributable to the oil sands crudes transported through the proposed pipeline would range from 157 to 166 $MMTCO_2$e a year. These emissions would represent an increase of 2.3%-2.4% over the total domestic GHG inventory for the United States in 2010, and would be equivalent to the annual GHG emissions from the energy used in 32.7 million to 34.6 million passenger vehicles or the annual CO_2 emissions from the energy used in 8.1 million to 8.5 million homes in the United States. (See **Table A-1** for a summary of selected pipeline scenarios and their GHG equivalencies.)

[22] As noted in many places in the *DEIS,* the initial throughput of the proposed Keystone XL Pipeline is projected to be 830,000 barrels of crude per day (bpd). Some of the proposed capacity is targeted for Bakken crude oil production in North Dakota and Montana. However, for the purposes of many of the GHG emissions estimates in the *DEIS*, the full 830,000 bpd capacity is assumed to be oil sands crude. See *DEIS* 4.15-105.

[23] IHS CERA, *Special Report: Oil Sands, Greenhouse Gases, and US Oil Supply: Getting the Numbers Right—2012 Update,* November 2012, http://www.ihs.com/products/cera/energy-industry/oil-sands-dialogue.aspx. IHS CERA 2012 is a meta-analysis which analyzes the results of the existing and publicly available life-cycle assessments, including the Jacobs 2009, TIAX 2009, and NETL 2009, among others. Like any LCA, IHS CERA 2012 employs certain design parameters, input assumptions, and industry data to model the GHG emissions intensities of oil sands crudes. It reports results from both a "tight" and a "wide" boundary model, the wide boundary includes GHG emissions that occur outside of the crude production or refining facilities, such as emissions from producing and processing natural gas used in oil production or emissions from off-site electricity production.

3. Incremental Emissions Attributable to the Proposed Pipeline (Adjusted for Refinery Inputs)

State Department Calculations

In order to determine a value for the "incremental" life-cycle GHG emissions attributable to the proposed pipeline, the State Department considers a scenario wherein the crude oils transported through the proposed pipeline would displace an equivalent volume of other crude oils currently processed at the Gulf Coast refineries. Hence, the difference in their respective GHG emissions profiles would return a value for the "increment." If oil sands crudes were determined to be slightly more emissions-intensive than the current mix of crude oils in Gulf Coast refineries, they would be responsible for those additional GHG emissions above the current level.

The *DEIS* uses the findings from the NETL 2009, Jacobs 2009, and TIAX 2009 LCAs to compare GHG emissions profiles for Canadian oil sands crudes against three reference crudes: Venezuelan Bachaquero, Mexican Maya, and Middle Eastern Sour. Bachaquero and Maya are chosen with the assumption that as the heavy crudes currently in the input mix at U.S. refineries, they are likely to be the first displaced by an increased use of oil sands crudes. Middle Eastern Sour is chosen with the assumption that as the world's balancing crude, it may ultimately be the one that is backed out of the world market by increased production of the oil sands. In each case, the GHG emissions profile for oil sands crudes is higher than that of the reference crude. Based on the results, and with the assumption that Gulf Coast refinery capacity is held constant, the *DEIS* then calculates the difference in GHG emissions that would be attributable to oil sands crudes if the full 830,000 bpd capacity of the proposed pipeline displaced an equal volume of the reference crudes in Gulf Coast refineries. For example, using the findings from Jacobs 2009, oil sands crudes transported by the pipeline would add an additional 3.7 $MMTCO_2e$ GHG emissions a year if they displaced Venezuelan crudes; whereas using the findings from NETL 2009, oil sands crudes transported by the pipeline would add an additional 20.7 $MMTCO_2e$ GHG emissions a year if they displaced Middle Eastern crudes.[24] Because uncertainty remains as to which reference crudes would be displaced, the *DEIS* reports "the full range of incremental GHG emissions associated with the displacement of the reference crudes by the WCSB oil sands crude as 3.3 to 20.8 $MMTCO_2e$ a year across the three studies."[25] These emissions would represent an increase of 0.05%-0.30% over total domestic GHG inventory for the United States in 2010. The *DEIS* states this overall range "is equivalent to annual GHG emissions from combusting fuels in approximately 770,800 to 4,312,500 passenger vehicles or the CO_2 emissions from combusting fuels used to provide the energy consumed by approximately 190,400 to 1,065,400 homes for one year."[26] (See **Table A-1**.)

[24] Jacobs 2009 data return incremental GHG emissions values for the pipeline as 3.7, 4.4, and 11.1 $MMTCO_2e$ annually for Canadian oil sands crude over Venezuelan, Mexican, and Middle Eastern crudes, respectively; TIAX 2009 data return values of 4.0, 13.4, and 16.7 respectively; and NETL 2009 data return values of 19.5, 13.8, and 20.7 respectively. The *DEIS* also makes reference to NETL 2009's baseline value and reports that incremental emissions from oil sands crudes would be 18.7 $MMTCO_2e$ annually in comparison to the average barrel of crude refined in the United States in 2005. EPA focuses on this baseline comparison in its comments to the *DEIS.*

[25] There appears to be a discrepancy in reporting in the *DEIS:* the analysis provided in *Appendix W* reports "3.7 to 20.7 $MMTCO_2e$ annually" (p. 65). The analysis as summarized in Section 4.15 reports "3.3 to 20.8 $MMTCO_2e$ annually" (p. 4.15-106). CRS is unable to rationalize this discrepancy; however, based on the EPA equivalencies reported in both sections (which are identical), CRS assumes that the data from *Appendix W* are correct, and that the findings as reported in the "Cumulative Impacts" section should be adjusted to the values of 3.7 to 20.7 $MMTCO_2e$ annually.

[26] *DEIS, Appendix W,* p. 65. The EPA GHG equivalences, as reported, correspond to the values of 3.7 to 20.7 $MMTCO_2e$ annually.

Evaluation Considerations

For some, an evaluation of the total, or "gross," life-cycle GHG emissions of the oil sands crudes transported through the proposed pipeline would serve as an adequate assessment of the pipeline's impact on the climate.[27] For others, this value must be adjusted by the GHG emissions profiles of the crude oils they are projected to displace in U.S. Gulf Coast refineries. This adjustment is based on two determining factors: (1) the assumption that the refinery capacity and the input mix at Gulf Coast facilities is held constant, and (2) the choice of reference crudes to be displaced.

First, the assumption that refinery capacity and crude oil inputs are held constant is backed by the State Department's market analysis, which finds that the "approval or denial of the proposed Project is unlikely to have a substantial impact ... on the amount of heavy crude oil refined in the Gulf Coast area."[28] The *DEIS* notes that U.S. refinery throughput has remained constant over recent years, and that "U.S. refineries have not materially changed ... indeed, the major projects that have gone ahead both in [the Midwest] PADD 2 and on the Gulf Coast (PADD 3) have been geared to increasing heavy crudes processing. Having made significant investments in equipment to process heavy sour crude, refiners have strong [economic] incentive to obtain such crudes."[29] Thus, the *DEIS* determines that (1) no new capacity would be added or installed on the Gulf Coast to refine the additional crude oils made available from the proposed pipeline, (2) oil refineries optimized for heavy crudes would only process heavy crudes, (3) oil sands imports would only displace other heavy imports, and (4) any growing domestic light oil production from shale or tight oil plays—in the Bakken, the Eagle Ford, or others—would only displace light crude imports. Further, the *DEIS* assumes that the projected drop-off in domestic tight oil production by the late 2020s would dissuade Gulf Coast refiners optimized for processing heavier crudes from switching.[30] But critics of the State Department's analysis argue that increased transport of oil sands crudes out of Canada could serve to optimize operating capacity at Gulf Coast refineries or even encourage an expansion in investments. They maintain that any additional production capacity (of oil sands crudes or others) would not simply substitute for current levels, but add to them, increasing the incremental, or "net," GHG emissions attributable to the proposed pipeline. Similarly, these commentators have pointed to recent evidence showing that domestic light oil production is not only backing out imported light crudes but also displacing the market for heavier crudes.[31] They contend that this switch, even in the short to medium term, could have significant impacts on the use of oil sands crudes in U.S. refineries and the GHG emissions attributable to the sector.[32]

[27] For example, see Oil Change International, *Cooking the Books: How The State Department Analysis Ignores the True Climate Impact of the Keystone XL Pipeline,* April 2013.

[28] *DEIS,* ES-15.

[29] *DEIS,* 1.4-14.

[30] The 2013 AEO early release version projects a relatively rapid increase in U.S. total crude oil production, spurred by shale developments, followed by a peak and decline, such that by the late 2020's the outlook is little changed from that in the 2010 AEO.

[31] EIA has recently noted that U.S. tight oil could be priced at such a sustained discount that it would be "sufficient to encourage its use in refineries along the Gulf Coast that are optimized for heavier crudes." EIA, "This Week in Petroleum," May 1, 2013.

[32] Natural Resources Defense Council et al, "Request for Supplemental Environmental Impact Statement for the TransCanada Keystone XL Pipeline Based on Significant New Information," Submitted to the U.S. Department of State, June 24, 2013, p. 10.

Second, a determination of which reference crudes would be displaced at Gulf Coast refineries is left open by the State Department's analysis, as the *DEIS* reports a range of values for several different scenarios. Nevertheless, determining the emissions intensities of reference crudes requires calculations similar to those performed on the oil sands, and thus harbors many of the same uncertainties. In addition, the quality of the data and the transparency in presentation for many of the reference crudes are not as robust as data on the oil sands. Some, even, have yet to be modeled (e.g., Bakken tight oil).[33] This is primarily a function of changing conditions as well as the difficulty in accessing necessary data from the field. A lack of equivalence can impede the ability to make meaningful comparisons. Comparisons are also complicated by the fact that emissions factors for Canadian oil sands crudes and reference crudes will change over time, and it is not clear how these changes will impact their respective GHG emissions. On one hand, secondary and tertiary recovery techniques will become more common in conventional oil, increasing the GHG emissions of reference crudes. In contrast, oil sands surface mining is expected to have a relatively constant energy intensity for a long period of time, and in situ techniques may be expected to become more efficient. Exploration for new oil reservoirs will also continue (with the possibility of commercializing both greater and lesser emissions-intensive resources), while the location and extent of Canadian oil sands is well understood.

4. Incremental Emissions Attributable to the Proposed Pipeline (Adjusted for Market Factors)

State Department Calculations

The State Department's final step in calculating the GHG emissions attributable to the proposed pipeline is to consider the effects that projected changes in market factors might have on the production of oil sands crudes. In the end, the State Department aims to calculate a value for the difference in overall GHG emissions between two primary scenarios: one in which the proposed Keystone XL Pipeline is built, and one in which it is not. This difference returns a value for the "incremental GHG emissions" for which "the proposed Project would be responsible." These scenarios are based on various market projections and modeling assumptions. The steps in the State Department's calculations are as follows:

Determining a "business-as-usual" scenario. The State Department begins by referencing several third-party market projections/forecasts for both current and future crude oil prices and production volumes. These include analyses from the U.S. Department of Energy, Energy Information Administration (EIA), the Canadian Association of Petroleum Producers (CAPP), and Canada's National Energy Board (NEB).[34] Each projection reaches out to the period 2030-2035. The business-as-usual scenario for Canadian oil sands producers is one in which "the industry and market react based on normal commercial incentives."[35] Thus, it is assumed that

[33] Light, sweet crude oil from the Bakken may be less emissions-intensive to refine, but activities such as hydraulic fracturing and the venting or flaring of associated gas may add to the life-cycle emissions during its production.

[34] U.S. Energy Information Administration, *Annual Energy Outlook with Projections to 2035,* DOE/EIA-0383, 2011; U.S. Energy Information Administration, *International Energy Outlook 2011;* Canadian Association of Petroleum Producers, *Crude Oil Forecast, Markets, and Pipelines,* June 2012; and National Energy Board, *Canada's Energy Future: Energy Supply and Demand Projections to 2035,* 2011. The State Department bases many of its calculations on the CAPP 2012 outlook which estimates "that by 2030 oil sands raw bitumen production will increase to 5.3 million bpd, up from 1.7 million in 2011." *DEIS,* 1.4-53.

[35] *DEIS,* 1.4-5

projects currently proposed, approved, and under construction will go forward, and that adequate takeaway capacity will be available to Canadian oil sands producers to allow for announced production targets. Estimating the effects of not constructing adequate takeaway capacity becomes the "counterfactual" scenario the *DEIS* must calculate.

Determining a "no expansion" scenario. The State Department reports that no new pipeline capacity has been added to the oil sands region since 2011 and that existing pipeline capacity could be fully utilized by 2016.[36] The *DEIS* further notes that other proposed pipeline projects (e.g., the Enbridge Northern Gateway project to Kitimat, British Columbia, and the Kinder Morgan Trans Mountain pipeline expansions to the Canadian West Coast) "face significant opposition from various groups, and ... may continue to be delayed."[37] Thus, for the purposes of the *DEIS* analysis, the State Department chooses to assess a "no expansion" scenario which assumes that pipeline capacity would be frozen at 2010 levels for at least 20 years along three routes: (1) from the WCSB to the United States; (2) from the WCSB to the Canadian West Coast; and (3) from PADD 2 (Midwest) to PADD 3 (Gulf Coast) in the United States.

Assessing the potential for rail capacity. In the event that no new pipelines are constructed, rail and other non-pipeline transport options would be tasked with accommodating any production growth. Based on the CAPP 2012 outlook for Canadian production (a projected 3.6 million bpd increase by 2030), rail would need to expand by approximately 175,000 bpd each year to 2030 in order to keep up with (and prevent shut-in of) the increases in Western Canadian crude supplies.[38] To assess if this expansion is credible, the State Department reviews the recent example of rail takeaway for crude oil in the Bakken (an expansion of 700,000 bpd over four years between 2009 and 2012, or an increase of 175,000 bpd annually) and the past example of rail takeaway for coal in the Powder River basin (a total expansion of 6.7 million bpd equivalents over 28 years between 1980 and 2008, or an increase of 240,000 bpd equivalents annually). Based on this evidence, the *DEIS* concludes that "there is no indication that the rail logistics system would not be able to continue to scale up at this rate, or more, over many years."[39]

Assessing the incremental cost of rail versus pipeline transport. The *DEIS* estimates the cost for rail transport to the Gulf Coast to be approximately $15.50 per barrel.[40] This is compared to CAPP's estimate for pipeline tariff for the same transport of approximately $8-$9.50 per barrel. Based on future cost saving assumptions which the State Department projects for rail transport, the *DEIS* concludes "that the incremental increase in cost of rail compared to pipeline transport is $5 per barrel."[41]

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[36] *DEIS*, 1.4-26. Other sources have full utilization in 2014. Goldman Sachs, "Getting the Oil Out of Canada: Heavy Oil Diffs Expected to Stay Wide and Volatile," June 2, 2013.

[37] *DEIS*, 1.4-26.

[38] This estimate is based on rail capacity being 200,000 bpd in 2013 and increasing from that amount. Other sources have current capacity at 150,000 bpd, of which 60%-80% is lighter crudes from conventional production. Goldman Sachs, op. cit.

[39] *DEIS*, 1.4-46.

[40] The State Department investigates two scenarios for transport in a "no expansion" scenario and estimates costs as follows: (1) Rail costs from Lloydminster, Saskatchewan, to Stroud, OK, on Canadian Northern-Union Pacific-Stillwater Central Railroad and Canadian Pacific-BNSF-Stillwater Central Railroad and then existing pipeline to the Gulf Coast area (estimated $13.00-$13.75 per barrel cost); and rail costs from Lloydminster, Saskatchewan to Prince Rupert, British Columbia, then tanker to the Gulf Coast area via the Panama Canal (estimated $15.39-$17.39 per barrel), *DEIS*, 2.2-9 to 2.2-26.

[41] *DEIS*, 1.4-51. The future cost saving assumptions are addressed as follows:

(continued...)

Determining the effects that the incremental cost of rail transport may have on oil sands production. To assess the potential impacts that a $5 change in the cost of transportation would have on the rate of production, the *DEIS* turns to the market projections in EIA's 2011 International Energy Outlook (IEO). The IEO projects crude oil production for three price cases (i.e., high, low, and reference price projections), and "oil sands/bitumen (Canada)" production figures are reported for each price case. Comparing the reported production volume for each price, the State Department calculates the change in volume for every $5 increment in price. Assuming that "a change in oil price can be considered equivalent to a change in costs," the *DEIS* determines that a $5 increment in cost would cause a decrease in oil sands production of approximately 90,000 bpd in 2030 (or 2.1% of the projected volume for that year). The *DEIS* performs a similar calculation using the NEB/CAPP projections to report a decrease of approximately 210,000 bpd in 2030 (or 4% of the projected volume for that year). Thus, the *DEIS* reports that "if all proposed pipelines were denied, there would be a 2%-4% reduction in Canadian oil sands production by 2030."[42]

The State Department then focuses on a scenario wherein only the Keystone XL Pipeline is not built, such that only the 830,000 bpd capacity would be subject to the $5 cost increase and the 2%-4% reduction in volume. In this instance, the *DEIS* reports a "20,000 to 30,000 bpd" change, or "0.4% - 0.6% reduction in Canadian oil sands production by 2030" "if the proposed Keystone XL Pipeline project were not built, but other proposed pipelines were."[43]

Calculating the incremental GHG emissions for which the proposed Project would be responsible. Having calculated the decreases in oil sands production attributable to the lack of pipeline infrastructure, the *DEIS* uses these values to estimate the GHG emissions attributable to the proposed Keystone XL pipeline, and reports the following:

> ... should the proposed Project be denied, a 0.4 to 0.6 percent reduction in WCSB production could occur by 2030, and in the scenario of all pipeline projects not being built, a 2 to 4 percent decrease in WCSB oil sands production could occur. This infers that of the 3.3 to 20.8 MMTCO2e[44] annual incremental GHG emissions, the proposed Project would be responsible for incremental GHG emissions in the range of 0.07 to 0.83 MMTCO2e annually, and in the scenario where all pipelines were not constructed, the incremental GHG emissions would be 0.35 to 5.3 MMTCO2e annually.[45]

(...continued)

> Despite estimates for larger differences in price [of rail transport versus pipeline transport], $5 was selected for this analysis in part because if no pipelines are available then larger producers would utilize rail delivery options and it would be expected that they would get better prices than the most expensive rail estimates, and because of the opportunity for at least some portion of producers to take advantage shipping railbit or raw bitumen [i.e., shipping bitumen by rail can be done with less diluent than shipping it by pipeline, thus avoiding the costs of acquiring diluents, paying the tariff to transport the diluents (as part of dilbit), and, indirectly, having the diluent returned to source (Alberta) for reuse].

[42] *DEIS,* ES-15, and 4.15-106.

[43] *DEIS,* ES-15, and 4.15-106.

[44] As outlined in footnote 25, there is a discrepancy in reporting in the *DEIS.* The discrepancy would affect the final incremental GHG emissions as reported in this paragraph.

[45] *DEIS,* 4.15-106. Assuming a decrease in total oil sands production of 90,000-210,000 bpd if no pipelines were built, or 20,000-30,000 bpd if only the Keystone XL pipeline was not built, the State Department backs these volumes out of the 830,000 bpd proposed capacity of the Keystone XL pipeline and "replaces" them with the reference crudes presumed to take their place at U.S. refineries. The range of the incremental GHG emissions calculated for the oil sands (continued...)

These emissions would represent an increase of 0.001%-0.078% over the total domestic GHG inventory for the United States in 2010 and would be equivalent to the annual GHG emissions from the energy used in 14,500 to 1,104,100 passenger vehicles or the annual CO_2 emissions from the energy used in 3,600 to 272,700 homes in the United States. (See **Table A-1** for a summary of selected pipeline scenarios and their GHG equivalencies.)

Evaluation Considerations

The State Department bases its market analysis on 2011 projections for the 2030 production profile of the oil sands and other benchmark crudes. The "reference case"—or "business as usual"—scenario for these projections is made under the assumption that industry and market forces react based on normal commercial incentives. The construction of adequate takeaway capacity to accommodate projected production growth is commonly understood to be a normal commercial operation. Thus, instead of modeling how the construction of the proposed pipeline might affect the short- to medium-term growth of the industry, the State Department chooses instead to model how industry and market forces may react to the denial of the proposed project in the medium to long term. This is posited as the counterfactual scenario against which the reference case is compared. The *DEIS* concludes that if the proposed pipeline is denied, the rate of development in the oil sands and the amount of heavy crude oil refined in the Gulf Coast area is unlikely to be substantially impacted because the market would likely respond by adding broadly comparable transport capacity *over time.* This claim is supported by two assumptions: (1) that rail and other non-pipeline transport options can fully accommodate all future projected growth of the oil sands in the medium to long term, and (2) that at no point would the global price of oil fall—or the marginal cost of production increase—such that investment in new oil sands projects will be deemed uneconomical (i.e., below the breakeven cost of production).

The Capacity Argument. The State Department notes that while no new additional pipeline capacity has been added from Canada into the United States or to the Canadian West Coast since 2011, a number of projects are proposed, including those entailing modifications and/or use of existing rights of way. While the *DEIS* appropriately recognizes that some proposed projects (e.g., the Enbridge Northern Gateway project, and the Kinder Morgan Trans Mountain expansion) may experience delays, it also recognizes that many interstate pipelines that do not cross international borders face less regulatory review (e.g., the Enbridge Flanagan South and Trunkline conversion, among others). For these reasons, the *DEIS* considers an assessment which assumes that pipeline capacity would be frozen at 2010 levels as "unlikely."[46] Nevertheless, for the purposes of its analysis, the State Department examines options for transporting all new production of oil sands crudes by rail and other non-pipeline transport options. It surmises that scaling up transport is logistically and economically feasible based on past and present evidence in the Powder River Basin and the Bakken. Given the identified commercial demand for oil sands crudes in Gulf Coast refineries, the *DEIS* concludes that the market would respond by adding sufficient transport capacity over time. Critics, however, disagree, as expansion would require significant infrastructure development, including loading and unloading facilities, tract capacity,

(...continued)

over these reference crudes [i.e., 3.3-20.8 $MMTCO_2e$, as calculated in Step 3 of this report] is assigned to the portions which these volumes represent out of the proposed 830,000 bpd capacity. This returns a value for incremental GHG emissions attributable to each substituted volume.

[46] *DEIS,* 1.4-32

and rail tank car availability.[47] The State Department grants that "if the rate of production is substantially higher than indicated in the CAPP 2012 forecast, and if there are delays in the delivery of new rail cars and terminals ... it is possible that some short-term shut-in [until third quarter of 2017] of WCSB heavy crude could occur." (An emissions estimate for this scenario is included in **Table A-1**.)[48] This short- to medium-term reduction is supported by other market analyses of the oil sands (e.g., CIBC, TD Economics, Goldman Sachs, and IEA).[49] IEA reports that the failure to build needed oil sands pipelines—particularly Keystone XL—could result in persistent price discounts and slow expansion of the sector; and Goldman Sachs estimates that rail capacity would peak at 500,000 bpd over the next three to four years, further noting that most of the current and future shipments would be light crude oil, not oil sands crudes.[50] Most of the third-party market analyses do not report conditions for the medium to long term, as some assume that transport logistics would be worked out by the market in the long term and others do not speculate.

The Cost Argument. To assess the potential impact of increased production costs on the oil sands (whether transportation costs or others), the State Department reviews information regarding "breakeven costs" for different types of oil sands projects. The "breakeven cost" is often expressed as the lowest price of a benchmark crude that is necessary to enable a potential production project to cover all its costs and earn a commercial rate of return on capital employed—typically 10%-15%. A long-term increase in production costs acts as an increase in the breakeven costs for producers. The State Department posits the argument that if the cost of production for new oil sands projects were to raise above the breakeven cost for an extended period of time, conditions would lend themselves to a potential decrease in oil sands production and a dampening of future investment. To assess if this scenario may occur, the State Department references the Canadian NEB's breakeven costs for new oil sands projects. NEB reports breakeven costs at $51-$61 per barrel for new in situ crude; $66-$76 per barrel for mining (without upgrader); and $86-$96 per barrel for mining (with upgrading).[51] Comparing these breakeven costs to price projections of benchmark crudes, the State Department reports that based on AEO 2013 projections, both Brent and WTI prices are above the band of breakeven costs for in situ and for mining without upgrading for all years through 2040, and that based on WEO

[47] Critics of the State Department's analysis argue that comparisons to the Bakken are not merited, as significant differences exist between the two resources (e.g., Bakken oil is closer, lighter, and does not require special equipment or handling; further, Rail cars carrying tar-sands oil cost more to run because they must be heated, and they cannot carry as much, because the oil is much heavier than typical crude). As for comparisons with the Powder River Basin, many differences exist between current global crude oil and historical coal markets with respect to production and consumption which may problematize this comparison.

[48] *DEIS,* 1.4-48. With the State Department's estimates of a potential reduction of "80,000 to 120,000 bpd over three years (2015, 2016, and 2017)" (*DEIS,* 1.4-49), CRS uses *DEIS* methodology to calculate a scenario for "the incremental and additional emissions attributable to the proposed Keystone XL Pipeline in 2015-2017 if rail capacity is limited and no new pipeline is in place." GHG emissions estimates for this scenario would be 19.0-42.4 MMTCO$_2$e.

[49] Canadian Imperial Bank of Commerce, "Too Much of A Good Thing: A Deep Dive Into The North American Energy Renaissance," Institutional Equity Research Industry Update, August 15, 2012; TD Economics, "Pipeline Expansion is a National Priority," Special Report, December 17, 2012; Goldman Sachs, op. cit.; International Energy Agency, " Medium-Term Oil Market Report," May 14, 2013.

[50] IEA, op. cit.; Goldman Sachs, op. cit., "We estimate that rail capacity is currently about 150,000 b/d of crude oil from Western Canada to the United States, and is expected to grow to at least 200,000 b/d in 2014 and potentially as high as 500,000 b/d over the next 3-4 years. A majority of current rail flow is for light crude oil, since transporting bitumen/WCS carries additional logistical hurdles vis-à-vis light ... Of the 150,000 b/d of crude transported by rail in 2013, we estimate that no more than 40% is likely to be heavy (and this number could prove closer to 20%)." p. 15.

[51] National Energy Board, op. cit. These prices are expressed in terms of West Texas Intermediate price in 2011 dollars.

projections, oil prices are above the breakeven costs for all projects from 2015 through 2035. With this, the *DEIS* concludes that most oil sands projects have breakeven costs low enough that incremental increases in production costs (including transportation costs) would not curtail future development.

Critics of the State Department's analysis note that the *DEIS* accurately characterizes the current market conditions encountered by oil sands producers but fails to adequately assess the full range of potential market scenarios. Critics highlight the *DEIS* analysis which states that

> ... discounts for the marker heavy grade WCS have been growing in recent months. Prior to the advent of current logistics constraints, WCS discounts versus Brent were generally of the order of $15–$20/barrel, (primarily reflecting differences in refining values of the two crudes. These discounts deepened to the $30–$40 per barrel range in 2011 and through much of 2012. Recently, the discount widened further to the $50–$60 per barrel range.... [T]he severe pricing discounts indicate these crudes are not able to move further and access coastal markets, notably in the Gulf Coast where their value would match that of heavy Venezuelan crudes and Mexican crudes such as Mayan.[52]

They argue that the State Department's market analysis fails to properly account for the short- to medium-term effects of these discounts on future production estimates and fails to consider the uncertainties that are inherent in all cost and price projections. They note that recent estimates of oil sands production costs have increased over those reported in the *DEIS*,[53] current rail transport costs are higher than those reported in the *DEIS* (an emissions estimate for this scenario is included in **Table A-1**),[54] and benchmark crude oil price projections are lower than those reported in the *DEIS*[55]—all conditions that would place downward pressure on oil sands development and investment.

In regard to these competing projections, it is the time horizon that is the most significant difference between the State Department's market analysis and those critical of the analysis. The State Department focuses on the year 2030, at which point market forces may have the opportunity to resolve many of the short-term obstacles to oil sands development currently

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[52] *DEIS,* 1.4-59

[53] Canadian Energy Research Institute (CERI), *Canadian Oil Sands Supply Costs and Development Projects* (2012-2046), May 2013. CERI found that year over year breakeven costs for new tar sands projects have continued to increase. In particular, 2013 break-even costs for new in situ projects reached $77.85 per barrel (6.3% higher than 2012), breakeven costs for new standalone mines reached $99.49 per barrel (13.2% higher than 2012) and new mines w/ upgraders required $103.16 per barrel (10.9% higher than 2012).

[54] Southern Pacific Resource Corporation has reported that it will pay $31 a barrel to move its product (SAGD Dilbit) from Fort McMurray to a Louisiana refinery compared with $8 for pipeline shipping if that was available. *Railpage*, "Alberta Bitumen Makes it to Mississippi by Rail," January 8, 2013, http://www.railpage.com.au/news/article-11942/. CRS calculates a scenario for "incremental emissions attributable to the proposed Keystone XL Pipeline in 2030 if rail supported all new production growth and the incremental cost of rail over pipeline is $23." GHG emissions estimates for this scenario would be 1.7-20.8 $MMTCO_2e$.

[55] IEA, *Medium Term Market Report*, shows global oil production may reach significantly higher levels than their 2011 estimates, forecasting that global oil prices would trend downward to reach $93 a barrel. The Chicago Market Exchange Group supports a lower oil price scenario, anticipating Brent crude prices to decline from their current levels of $106 per barrel in August 2013 to $86 per barrel in December 2019. They also anticipate WTI price levels to decline to $78 a barrel by 2021. These prices are substantially below those considered in the *DEIS,* which projected Brent crude prices would approach $130 a barrel in 2020 and WTI prices would exceed $100 a barrel. IEA, op. cit. p. 18; Chicago Market Exchange (CME) Group, Brent Crude Oil Last-Day Financial Futures, (accessed July 24, 2013); and CME Group, Light Sweet Crude Oil (WTI) Futures, (accessed July 24, 2013).

encountered by producers (e.g., lack of transport infrastructure, price discounts, and competition from U.S. tight oil). Others, however, have focused on shorter-term analyses which, in some cases, have returned projections of higher costs and lower prices. They stress that these obstacles suggest continued challenges for investment and development in the sector. Whether short-term obstacles translate into longer-term challenges is dependent upon the outcome of many of the projections and variables outlined in this analysis. The construction of pipeline infrastructure is one such variable.

Concluding Observations

President Obama has stated that an evaluation of the "net effects of the pipeline's impact on our climate" in order to determine if the project would "significantly exacerbate the problem of carbon pollution"[56] would factor into the State Department's national interest determination for the proposed Keystone XL Pipeline.

For many, the net effects of the pipeline's impact on climate are tied explicitly to its impact on the rate of development in the oil sands. Proponents of the proposed pipeline support a market analysis which concludes that the approval or denial of the proposed pipeline is unlikely to have a substantial impact on the rate of development in the oil sands, or on the amount of heavy crude oil refined in the Gulf Coast area. They argue that as long as there is strong global demand for petroleum products (whether from the United States, China, India, or the developing world), resources such as the Canadian oil sands will be produced and shipped to markets using whatever route is available. They see future investment affected only in scenarios where the global price of oil falls below the breakeven cost of production for an extended period of time. They see current production affected only in scenarios that assume all pipeline transport capacity is frozen and no other transport capacity (such as rail or tanker) is available.[57] There are 5.4 million bpd of oil sands projects currently under construction or regulatory review (i.e., three times 2012 production levels),[58] and these projects are being developed under current conditions. They contend that incentives are too great for oil sands producers and the Canadian and Albertan governments to leave the oil in the ground; and that once the oil is extracted, the market would likely respond by adding adequate transport capacity over time. They maintain that a single pipeline (in and of itself) would not affect the long-term development of the oil sands, and thus a single pipeline (in and of itself) would not affect long-term GHG emissions from the sector. Furthermore, they estimate that GHG emissions intensities for the Canadian oil sands are currently within range of many other heavy crude oils, and that in the future Canadian oil sands emissions intensities will only decrease (due to efficiencies and technological advances), while those of other crudes around the world will likely increase (due to a heavier resource base).

Others maintain that Canadian oil sands are currently the most GHG emissions intensive crudes in production (due to the energy intensity required to extract and refine the resource), and that future oil sands deposits will only become more difficult and costly to access. Further, they argue that there is nothing presumed or inevitable about the rate of expansion for the Canadian oil sands.[59] Current oil sands projects face a challenging financial environment, and production costs

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[56] White House, "Remarks by the President on Climate Change," op. cit.

[57] Scenario results as indicated by the Ensys 2010 WORLD Model in the market analysis for the 2011 *FEIS.*

[58] The Oil Sands Developers Group, *Oil Sands Project List,* Updated as of September 2012.

[59] For arguments, see, for example, NRDC, op. cit., and Oil Change International, op. cit.

and price differentials are comparatively higher for oil sands crudes, making new investment sensitive to changes in production costs and global prices. Critics highlight the many reported instances where current price discounts for oil sands crudes have dampened investment and project development. They stress that oil market projections and transportation options are rife with uncertainty, and that the proposed Keystone XL Pipeline could have a much more significant impact on expansion if a number of key variables differ from the State Department's assumptions. These variables include lower global oil prices than projected; higher rail costs than projected; higher new project costs than expected; greater competition from shale oil and tight oil plays; and future carbon pricing or procurement policies. They argue that the State Department has failed to adequately assess these other possible scenarios, and claim that many of these could upset the breakeven costs for project development and dampen investment in the industry. A decrease or delay in investment would affect the timing and capacity of new oil sands projects. Any decrease or delay in production could have significant impacts on the rate of growth in global GHG emissions by allowing more time for the promulgation of climate policies, the development of adaptation strategies, and the migration to renewable technologies.

For still others, the net effect of the proposed pipeline does not rest solely on the fate of oil sands production in Canada, but on the direction of U.S. energy policy. They argue that while many of the decisions that may affect the development of the oil sands will be made by the market and the national and provincial governments of Canada, the choice of whether or not to approve the permit for the proposed Keystone XL Pipeline is an opportunity for the U.S. government to signal its future direction. These stakeholders have pushed for a national policy that moves the United States away from a reliance on fossil fuels. They see the decision to build the proposed pipeline as a 50-year-long commitment to a carbon-based economy and its resulting GHG emissions. As EPA notes in its comments to the *DEIS,* given the 50-year lifetime of new infrastructure projects such as the proposed pipeline, "the additional CO_2e from oil sands crude transported by the pipeline could be as much as 935 million metric tons."[60] Opponents of the proposed pipeline contend that with meaningful action on climate policy slowed or stalled in Congress, the courts, and, to some extent, the regulatory agencies (i.e., local, state, and federal environmental and land-use agencies), the sole remaining outlet to leverage a low-carbon energy policy is single action initiatives on such items as infrastructure permits. They have actively opposed the permit for the proposed Keystone XL Pipeline knowing that it may set a precedent; for if the project is allowed to go forward, it may be the case that no future infrastructure project would be held accountable for its indirect and cumulative GHG emissions.

On January 31, 2014, the State Department released the *Final Environmental Impact Statement (FEIS)* for the Keystone XL Pipeline, which contained revised analysis and estimates. For a detailed review of these findings see CRS Report R43415, *Keystone XL: Greenhouse Gas Emissions Assessments in the Final Environmental Impact Statement*, by (name redacted) .

[60] EPA, "Comments," op. cit., p. 2. EPA's estimate is calculated by extrapolating over 50 years the annual incremental GHG emissions reported by the NETL 2009 data for oil sands crudes versus the 2005 baseline reference crudes. The calculation does not incorporate the State Department's market analysis.

Appendix. GHG Estimates for Selected Scenarios

Table A-1. Life-Cycle GHG Emissions Estimates for Selected Pipeline Scenarios

(All life-cycle GHG emissions estimates calculated using *DEIS* methodology, except where noted)

Scenario	Annual GHG Emissions Estimates ($MMTCO_2e$)	Percent of Annual GHG Emissions for U.S. (2010)	Equivalent to Annual GHG Emissions from:
Total, or Gross, Emissions from the Production and Use of Canadian Oil Sands (2011).[a]	325.8-345.0	4.78%-5.06%	67.9-71.9 million vehicles or 16.8-17.8 million homes
Total, or Gross, Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline.[b]	156.6-165.7	2.34%-2.47%	32.6-34.5 million vehicles or 8.0-8.5 million homes
Incremental Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline vs. 2005 US Average (*DEIS*, 4.15-105).	18.7	0.27%	3.9 million vehicles or 1.0 million homes
Incremental Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline vs. Middle Eastern Sour (*DEIS*, 4.15-105).	11.1-20.7	0.16%-0.30%	2.3-4.3 million vehicles or 0.6-1.1 million homes
Incremental Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline vs. Mexican Maya (*DEIS*, 4.15-105).	4.4-13.8	0.06%-0.20%	0.9-2.9 million vehicles or 0.2-0.7 million homes
Incremental Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline vs. Venezuelan Bachaquero (*DEIS*, 4.15-105).	3.7-4.0	0.05%-0.06%	0.8 million vehicles or 0.2 million homes
Incremental Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline vs. the Full Range of Reference Crudes (*DEIS*, 4.15-106).	3.3-20.8	0.05%-0.30%	0.8-4.3 million vehicles or 0.2-1.1 million homes
Incremental and Additional Emissions Attributable to the Proposed Keystone XL Pipeline in 2015-2017 if Rail Capacity is Limited and No New Pipeline is in Place.[c]	19.0-42.4	0.28%-0.62%	3.9-8.8 million vehicles or 1.0-2.2 million homes
Incremental Emissions Attributable to the Proposed Keystone XL Pipeline in 2030 if Rail Supported All New Production Growth and the Incremental Cost of Rail over Pipeline is $23.[d]	1.7-20.8	0.02%-0.30%	354,000-4,312,500 vehicles or 87,000-1,065,000 homes
Incremental Emissions Attributable to the Proposed Keystone XL Pipeline in 2030 if Rail Supported All New Production Growth and the Incremental Cost of Rail over Pipeline is $5 (*DEIS*, 4.15-106).	0.35-5.30	0.005%-0.078%	72,900-1,104,100 vehicles or 18,000-272,700 homes
Incremental Emissions Attributable to the Proposed Keystone XL Pipeline in 2030 if Rail only Needed to Support the Proposed Project's Capacity and the Incremental Cost of Rail over Pipeline is $5 (*DEIS*, 4.15-106).	0.07-0.83	0.001%-0.012%	14,500-172,900 vehicles or 3,600-42,700 homes

Source: CRS, compiled from data in U.S. Department of State, *Keystone XL Project, Draft Supplementary Environmental Impact Statement,* March 1, 2013; IHS CERA, *Special Report: Oil Sands, Greenhouse Gases, and US Oil Supply: Getting the Numbers Right—2012 Update,* November 2012; and U.S. Environmental Protection Agency, *Greenhouse Gas Equivalencies Calculator,* accessed July 22, 2013.

Notes: The table retains the *DEIS* use of the reported incremental range of "3.3-20.8." See explanation in footnote 25.

a. "Total Emissions from the Production and Use of Canadian Oil Sands (2011)" calculated using *DEIS* values for 2011 WCSB production volumes and IHS CERA 2012 Well-to-Wheel GHG emissions estimates for "average oil sands produced (2011)."

b. "Total Emissions from Oil Sands Crudes Transported through the Proposed Keystone XL Pipeline" calculated using the proposed project's 830,000 bpd capacity and IHS CERA 2012 Well-to-Wheel GHG emissions estimates for "average oil sands refined in the United States (2011)."

c. "Incremental and Additional Emissions Attributable to the Proposed Keystone XL Pipeline in 2015-2017 if Rail Capacity is Limited and No New Pipeline is in Place" calculated using *DEIS* production estimates for 2015-17 (*DEIS,* 1.4-49; see footnote 48).

d. "Incremental Emissions Attributable to the Proposed Keystone XL Pipeline in 2030 if Rail Supported All New Production Growth and the Incremental Cost of Rail over Pipeline is $23" calculated using the incremental cost of rail transport reported by Southern Pacific Resource Corporation (see footnote 54).

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