REBUTTAL EXPERT REPORT
OF
MARK JACOBSON, Ph.D.

Response to Howard J. Herzog, James L. Sweeney, and David G. Victor

Kelsey Cascadia Rose Juliana; Xiuhtezcatl Tonatiuh M.,
through his Guardian Tamara Roske-Martinez; et al.,
Plaintiffs,

v.

The United States of America; Donald Trump,
in his official capacity as President of the United States; et al.,
Defendants.

IN THE UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

(Case No.: 6:15-cv-01517-TC)

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TABLE OF ACRONYMS AND ABBREVIATIONS

100RElec:	100% renewable electricity
BAU:	business as usual
CCST:	California Council on Science and Technology
CO_2:	carbon dioxide
CSP:	concentrated solar power
CST:	concentrated solar thermal
DOE:	United States Department of Energy
EIA:	United States Energy Information Administration
EMF:	Energy Modeling Forum (hosted by Stanford University)
IPCC:	United Nations Intergovernmental Panel on Climate Change
kW:	kilowatt (measure of electric power)
kWh:	kilowatt hour
NREL:	National Renewable Energy Laboratory
O&M:	operations and maintenance
OCGT:	open cycle gas turbine generator
PNAS:	Proceedings of the National Academy of Sciences of the United States of America
PV:	photovoltaic
RE:	renewable energy
UTES:	underground thermal energy storage
WWS:	wind, water, and sunlight

INTRODUCTION

I, Mark Jacobson, have been retained by Plaintiffs in the above-captioned matter to provide expert testimony about the feasibility of transitioning the United States of America to 100% clean and renewable energy in all energy sectors by mid-century, including whether this transition would remedy the constitutional violations alleged in the First Amended Complaint in this case. I have reviewed the expert reports made by Howard J. Herzog (August 13, 2018), James L. Sweeney (August 13, 2018), John P. Weyant (August 13, 2018), and David G. Victor (August 13, 2018).

The opinions expressed in this response are my own and are based on the data and facts available to me at the time of writing. All opinions expressed herein are to a reasonable degree of scientific certainty, unless otherwise specifically stated. Should additional relevant or pertinent information become available, I reserve the right to supplement the discussion and findings in this expert report in this action

RESPONSE TO HOWARD J. HERZOG EXPERT REPORT

1. Qualifications of Howard J. Herzog

In my opinion, Howard Herzog is not an expert on renewable energy. He admittedly has no publications in this area, aside from in geothermal energy, and does not have a Ph.D. degree. Howard Herzog has a B.S and M.S. in Chemical Engineering plus a "Chemical Engineer's Degree" from MIT.[1] A "Chemical Engineer's Degree" is not a Ph.D. degree as he admits he did not complete a Ph.D. dissertation, which is the cornerstone of a Ph.D. degree.

Howard Herzog also admits his work is focused on carbon capture and sequestration, which has nothing to do with renewable energy sources, integrating renewable energy into the electric grid, storage of renewable energy, electric appliances, demand response, electricity transmission, or the cost of renewable energy. He has some expertise in geothermal energy, which is not a topic he disputes in his testimony.

2. Summary of Responses to Herzog

Herzog's claims are erroneous or exaggerated in every area he examines and have zero impact on the conclusions of Jacobson et al. (2018) or Jacobson et al. (2015b), namely that it is possible to transition the United States to 100% clean, renewable energy by 2050 in all energy sectors while balancing power demand with supply and storage over time. The main barriers are social and political, not technical or economic. The main specific flaws in Herzog's analysis are as follows:

A) Herzog's claim that the hydrogen costs in Jacobson et al. (2015b) and (2018) are overestimated is false and based on the following errors in his calculations:

[1] https://globalchange.mit.edu/about-us/personnel/herzog-howard-j

1. First, he neglected to increase the lifetime and decrease the annual operations and maintenance (O&M) costs of the hydrogen electrolyzer and hydrogen compressor upon decreasing the use factor in his own calculations. This error alone negates virtually any claim he has that changing the use factor (the fraction of time the electrolyzer will actually be in use in a given year) will change costs.

2. Second, he failed to account for the fact that the electrolyzers used for energy would also be used for producing non-energy hydrogen in the U.S., thus the use factor will never be so low as he claims.

3. Third, he failed to account for the fact that the electrolyzer and compressor costs are only ~31% of hydrogen system costs, so the cost implications of this equipment being used 20% or 50% of the time is relatively minor compared to the full operating cost of the whole system.

4. Fourth, he failed to compare his revised costs with the social cost of fossil fuels.

5. Fifth, he failed to account for the fact that the Jacobson et al. (2015b) and (2018) hydrogen system conversion efficiencies were conservative.

6. Sixth, Herzog erroneously used a private cost of capital rather than the social discount rate, as discussed below under the response to lines 283-284.

B) Herzog's cost analysis of Underground Thermal Energy Storage (UTES) is entirely erroneous. As shown herein, the estimates of UTES costs in Jacobson et al. (2015b) and (2018) are NOT underestimated. Herzog relies entirely on the cost claims of Clack et al. (2017) for his UTES cost estimate. Clack et al. (2017) erred because, not only did the authors use the wrong data from Sibbitt et al. (2012) and a currency exchange rate for the wrong year, but they more importantly misunderstood the definition of "maximum deliverable-kWh-th" as used in Jacobson et al. (2015b). Herzog compounded this error by failing to account for economies of scale of larger systems and failing to adjust costs due to a learning curve extrapolated to the 2020-2050 time frame.

C) Herzog erroneously assumes that the cost of capital used in the Jacobson et al. (2015b) and (2018) studies should be the private cost of capital. This is not only wrong, but Herzog compounded the error by failing to treat fossil fuel costs consistently. The Jacobson et al. studies are partial social-cost analyses, which mean that all costs are from the perspective of society over a long period, which in turn entails a social discount rate for intergenerational projects for ALL costs. It is misleading for Herzog to try to re-define the studies to something they are not – private cost analyses – and, on top of that, apply one set of interest rates for WWS systems without using the same interest rates for business as usual (BAU) systems. Please see response to lines 283-284 below for a discussion.

D) Herzog's transmission analysis is erroneous. Much of Herzog's analysis is based on his incorrect assumption about the cost of capital, as detailed in response to lines 283-284.

He further inaccurately assumes that capacity factors (the amount a system is actually used compared with the maximum amount it could be used) of long distance transmission with 100% WWS will be less than 40% when peer-reviewed references and common sense indicate otherwise. He then inaccurately assumes an economic lifetime when the proper lifetime for a social cost analysis is the actual physical lifetime of the equipment. Finally, Herzog's own calculation of transmission costs is only 16% different from that from Jacobson et al., and this difference is trivial given the relatively small cost of transmission in the overall system.

E) Herzog's claim that we did not constrain hydropower when adding turbines to existing dams is both moot (because we have successful alternative scenarios in which we do not add turbines) and false (because in the scenarios where turbines are added, hydropower is constrained by the annual average amount of water in each reservoir). Further, Herzog's claim that our assumption about increasing the peak discharge rate of hydropower is unreasonable is directly contradicted by the United States Bureau of Reclamation, which states, "The uprating of existing hydroelectric generator and turbine units at powerplants is one of the most immediate, cost-effective, and environmentally acceptable means of developing additional electric power," and its costs of "$69 per kilowatt…compares to an average cost for providing new peaking capacity through oil-fired generators of more than $400 per kilowatt." (US Department of the Interior, 2005)

3. Detailed Responses to Herzog

Specific responses are provided below, referenced by the lines in Mr. Herzog's report where the claim is located.

Lines 77-78:

"It is my expert opinion that Jacobson's conclusions are based on insufficient facts and data, and the incorrect application of generally accepted methods."

Response: Herzog is not an expert in renewable energy systems, energy storage, nor nationwide grid load balancing. He has no peer-reviewed published papers on renewable energy systems, let alone systems with high penetrations of renewables. He is also not an economist nor does he have an economics degree or training sufficient to analyze this work in my opinion.

Lines 92-94:

"Second, it is my expert opinion that Jacobson's proposed timelines for building, installing, and deploying the necessary facilities and infrastructure to transition to his proposed energy system are unrealistic"

Response: Corporate giants Apple and Google have already transitioned 100% of their own operations to renewable energy as of 2018; California has transitioned 30% of its electric power. Examples exist throughout the world of an ongoing transition. For example, five countries - Iceland (100%), Costa Rica (99%), Norway (98%), Tajikistan (95%), and Paraguay (100%) - have either 100% or near 100% of their electric power

already coming from renewables. (Click Energy, 2017) The transition needs to be sped up through effective policies and making people more aware of what is possible.

Lines 97-99:

"Third, it is generally accepted that three criteria are necessary to demonstrate, in Jacobson's own words, a "solution to the grid reliability problem" (Jacobson et al. 2015b, page 15060). Jacobson fails to demonstrate that his 100% WWS system satisfies these criteria, specifically…" (followed by lines 100-117)

Response: These criticisms mimic the debunked criticisms of Clack et al. (2017) and Heard et al. (2011). These criticisms were debunked in two independent, multi-authored peer-reviewed papers, Diesendorf and Elliston, 2018 and Brown et al., 2018.

Diesendorf and Elliston (2018) states in part:

> "(This study) finds that the main critiques (Heard et al., Clack et al.) published in scholarly articles and books contain factual errors, questionable assumptions, important omissions, internal inconsistencies, exaggerations of limitations and irrelevant arguments. Some widely publicized critiques select criteria that are inappropriate and/or irrelevant to the assessment of energy technologies, ignore studies whose results contradict arguments in the critiques, and fail to assess the sum total of knowledge provided collectively by the published studies on 100RElec [100% renewable electricity], but instead demand that each individual study address all the critiques' inappropriate criteria. We find that the principal barriers to 100RElec are neither technological nor economic, but instead are primarily political, institutional and cultural."

The Diesendorf and Elliston article further states, with respect to Clack et al. (2017) which Professors Sweeney, Weyant, and Victor co-authored:

> "Our assessment is that Jacobson et al. [78] have clearly refuted all but one of Clack et al. [33] error claims. The exception is Jacobson's assumption of a huge and unrealistic increase in hydro capacity by installing additional turbines on existing dams, in order to assist in balancing variable RElec. However, this is a minor 'error', because a large part of the additional hydro could be replaced by alternatives such as CST [Concentrated Solar Thermal] with thermal storage, OCGTs [Open Cycle Gas Turbine generators] fueled by renewable hydrogen or ammonia, new off-river pumped hydro and batteries. Of particular concern is that PNAS published the Clack et al. [33] article as a Research Report instead of a Letter to the Editor, although the article contained no original research – it only criticized a genuine research paper with claims that generally don't stand up to examination."

Lines 118-122.

"Fourth, it is my expert opinion that Jacobson's work failed to reliably apply principles and techniques of cost estimation. Specifically, Jacobson's Expert Report, and his

supporting analyses in Jacobson et al. (2015b) and Jacobson et al. (2018), fail to conform to best practices in cost estimation, including modeling the cost of capital, estimating total capital costs, determining capacity factors, indexing year dollars, and accounting for macroeconomic impacts (Section 4.5)."

Response: Herzog has not examined the spreadsheets associated with the Jacobson et al. papers. The Jacobson et al. papers model the cost of capital over time in a social cost analysis, estimate total capital cost, determine capacity factors, index year dollars, and account for macroeconomic impacts. Further, Herzog erroneously uses the private cost of capital in this social cost analysis.

Lines 133-135:

"Jacobson fails to provide all of the inputs and outputs underpinning his models, and therefore my assessment is limited to the information included in his Expert Report, and that which is publically available."

Response: All inputs and outputs of the Jacobson et al. studies are and have been publicly available online as Excel spreadsheets and supplemental information files hosted at a publicly available website.[2]

Lines 138-142:

"I am not the only scholar to have concerns with the data, methods, and findings posited by Jacobson. Scholars, including those who have performed peer review on Jacobson's publications, have reached conclusions similar to my own. Specifically Clack et al. (2017) and Heard et al. (2017) noted the following about Jacobson et al. (2015b), which Jacobson asserts is the foundation of his Expert Report:"

Response: As referenced in response to line 97, the inaccuracies contained within both Clack et al. (2017) and Heard et al. (2017) have been thoroughly debunked by independent, multi-author expert peer reviewed articles (Diesendorf and Elliston, 2018; Brown et al., 2018). The inaccuracies in Clack et al. were further addressed in an article (Jacobson et al., 2017) published simultaneously with their article. My coauthors and I went even further to illuminate the misconceptions by authoring a line-by-line response to their criticisms. (Jacobson et al., 2017)

Inaccurate claims about Jacobson et al. (PNAS, 2015b) authored by Ken Caldeira (2018) were also debunked in detail in Jacobson (2018).

Lines 183-186:

"In my view, given the timing required for these considerations, and for construction itself, it is improbable that sufficient solar and wind capacity can be constructed to meet U.S. energy demand within the timeline proposed by Jacobson in his Expert Report."

Response: Herzog has no expertise on the buildout times of renewables and merely

[2] https://web.stanford.edu/group/efmh/jacobson/Articles/I/WWS-50-USState-plans.html
https://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/combining.html

waves his hands claiming it cannot be done. Regardless, Herzog is confusing what has been done in the past with what can be done. He also fails to recognize that five countries (listed above) have already achieved 100% or near 100% renewables in their electric power sectors, and California and Hawai‘i both have laws requiring effectively 100% renewables by 2045, five years before the deadline proposed in the Jacobson et al. studies.

Lines 198-200:

"Figure 1 below (which shows installed capacity per year per capita) supports my contention that the build-out necessary to meet Jacobson's proposed transition to 100% WWS by 2050 is an order of magnitude greater on a per capita basis than recent build-outs undertaken by the U.S., Germany, and China."

Response: Past build-out times of renewable, coal, or nuclear have nothing to do with what is possible in the future since past build outs were not motivated by an international emergency to transition to renewable energy. Further, the metric used in Herzog's figure (installed capacity per year per capita) is a misleading metric, as discussed in great detail in Lovins et al. (2018), a peer-reviewed study.

Lines 229-236:

"Specifically, my analysis indicates that Jacobson's underlying assumptions about energy storage, demand response, and the dispatching of hydroelectric power, the three primary strategies that his LOADMATCH model uses to match electricity supply and demand at all times, are not simply unrealistic, but also unsubstantiated. This model also was reviewed by Heard et al. (2017); their assessment of the model as follows: "Although this work scored [the highest mark] for a fine-grained timescale simulation, the results of such a simulation are likely to be meaningless because the underlying assumptions are unrealistic" (Heard et al., 2017, page 1130)."

Response: Heard et al. never reviewed the Jacobson et al. (2018) article and the claims within the Heard et al. article were addressed by two independent, multi-authored peer-reviewed articles described under response to line 97.

Further, LOADMATCH uses additional strategies and options beyond what Herzog claims, as described in Jacobson et al. (2018). This study uses multiple scenarios to explore a variety of methods to solve the problem of load balancing with a high proportion of renewable generation. One scenario uses heat pumps instead of relying on any heat and cold storage; two scenarios use batteries, and two scenarios provide load balancing without using any new hydropower turbines at all.

Lines 243-246:

"As shown in Figure 2, (reproduced from Jacobson et al., 2015b (page 15062), Jacobson et al. (2015b) rely primarily on hydrogen storage and underground thermal energy storage (UTES) as their storage mechanisms to ensure sufficient supplies of electricity exist to meet demand for electricity at all times."

Response: Jacobson et al. (2018) clearly show that, throughout the world, it is possible to solve the problem with zero thermal energy storage of any type (UTES and others) and zero hydrogen for industry (only for transportation).

Lines 265-267:

"The capacity factors used by Jacobson in his analysis are overestimated by a factor of approximately eight, which yields an underestimation in hydrogen storage system costs by a factor of over five."

Response: This claim is wrong because the capacity factor (use factor) of hydrogen is absolutely not the value claimed by Herzog. Even if it were, Herzog more importantly failed to account for the fact that if hydrogen electrolyzer and compressor use factors were $1/8^{th}$ as much as proposed, their lifetimes would be around 8 times longer (80-120 years rather than 10-15 years) and their O&M costs would also be on the order of $1/8^{th}$ as much (0.19%/year of capital costs rather than 1.5%/year of capital costs). As such, the cost per kg of H_2 would be only slightly different. This is quantified shortly.

Second, Herzog's estimate of capacity factor incorrectly assumes the only use of the electrolyzers is to produce hydrogen for energy. However, in the U.S., over 10 million metric tonnes (10 Tg) of hydrogen is already produced for other purposes (US Department of Energy, 2018).

Hydrogen is currently and will in the future be produced for other applications as well, including to make ammonia for agricultural fertilizer and intermediates in the production of plastics and pharmaceuticals. Hydrogen is also used to hydrogenate oils to form fats to use in margarine, for example. Hydrogen is further used as a protective atmosphere for making flat glass sheets in the glass industry and as a flushing gas in the manufacture of silicon chips (Royal Society of Chemistry, accessed August, 2018)

When the electrolyzers in Jacobson et al. (2015b) are not producing energy, they will use industrial-demand electricity, already accounted for in Jacobson et al. (2015b) and (2018), to produce hydrogen for other applications. It is incorrect to assume, as Herzog did, that they are sitting idle, so his estimate of use factor is wrong.

As stated, even if the use factor is lower than proposed, this only means the electrolyzer and compressor will last longer, so their costs over the longer term are similar to if the use factor is higher. This has been proven by running simulations with much lower use factors, thus corresponding lower annual O&M costs and longer lifetimes (see calculations below).

Third, as shown in the Supplemental Information of Jacobson et al. (2018), the electrolyzer plus compressor cost per kg-H_2 is ~31% the system cost for North America (most of the rest is storage cost), and the overall cost of H_2 is ~0.47 cents/kWh (Case A). So, even if the electrolyzer plus compressor costs were 5 times higher and lifetimes and O&M costs were not adjusted, which they need to be for the aforementioned reason, the overall system cost would be only 0.6 cents/kWh higher (11.1 instead of 10.5 cents/kWh)

for the overall cost of energy among all energy sectors.

However, in fact, because electrolyzer and compressor lifetimes are longer and O&M costs, lower, with lower use factors, a factor of 5 reduction in the use factor increases hydrogen electrolysis plus compression costs only 0.08 cents/kWh, increasing the overall cost from 10.51 to 10.59 cents/kWh, or 0.7%.

Fourth, Herzog fails to compare the WWS social cost with the fossil social cost. The social cost of a fossil fuel system is at least 38.3 cents/kWh as described in Jacobson et al. (2018). In comparison, the WWS all-energy cost is 10.51-10.59 cents/kWh. As such, the social cost of fossils per kWh is still ~3.6 times that of WWS. Since WWS uses half the energy as an equivalent fossil system, the social cost to consumers is still around one-seventh to one-eighth that of a fossil fuel system.

Fifth, Jacobson et al. (2018) were conservative in their H_2 cost estimates, stating in the Supplemental Information: "Whereas, these are older estimates for conversion efficiency, we maintain them to ensure we do not overestimate hydrogen production due to other uncertainties in the analysis."

Herzog also claims that capital cost multipliers should be a factor of 3 to 5 for an electrolyzer, compressor, and storage system instead of 1.2 to 1.3 as cited by Jacobson et al. (2018). Herzog appears to have just made up the number 3-5. He provides no reference whatsoever for this figure for this hydrogen system. Actual references contradict this number, as discussed in the response to Lines 291-292.

As such, Herzog's claim that the Jacobson et al. cost estimates for H_2 were high is exaggerated by over an order of magnitude because of substantial errors made in Herzog's analysis. The claim and analysis thus have zero impact on the conclusions of Jacobson et al. (2018) or Jacobson et al. (2015b).

Herzog also admits he is unaware of the differences between the two studies with respect to H_2 (Herzog Dep. August 23, 2018). Jacobson et al. (2015b) included H_2 for energy in industry and Jacobson et al. (2018) did not. In addition, the 2018 study assumes less hydrogen in transportation than in the 2015b study.

Lines 283-284:

"The cost of capital used in Jacobson's analysis is underestimated by a factor of approximately three to four."

Response: Herzog misrepresents the Jacobson et al. studies. By stating that the cost of capital used in the Jacobson et al. (2015b) and (2018) studies should be the private cost of capital, Herzog misrepresents the type of studies done. The Jacobson et al. studies are not private cost studies, but are partial social-cost analyses. This means that all costs are from the perspective of society, which in turn entails a social discount rate for ALL costs. The studies are not, and were never intended to be, analyses from the perspective a private financier.

The literature is replete with social cost analyses. Social discount rates for intergenerational projects are in the range of 1% to 3% per year as cited in the Jacobson et al. papers.

It is also important to note that it is incoherent to analyze some kinds of costs with a private discount rate and others with a social discount rate, as Herzog has done. Doing so leads to misleading conclusions.

It is also incoherent to apply a private cost of capital to some WWS costs but not apply the same costs to the fossil fuel costs, as Herzog has suggested. Herzog has artificially inflated the WWS costs with an erroneous cost of capital but has not applied the same interest rate to BAU fossil fuel costs. Given Herzog's expertise in engineering, this error is concerning.

Lines 291-292:

"The multiplier factor applied to the major pieces of equipment in the hydrogen storage system is too small."

Response: Herzog provides no proof of this claim for a hydrogen system but rather cites an irrelevant 1968 reference textbook that considers an entirely different system and his own opinion, although Herzog does not have expertise with hydrogen systems. The cost range of hydrogen storage system cost used by Jacobson et al. is referenced from a U.S. Department of Energy reference[3] and likely overstates the costs since it provides cost values for 2020 rather than a much lower cost in 2050. Further, the installation factor (the assumed cost of installation) is referenced to an independent review panel consisting of four professionals from the U.S. Department of Energy's National Renewable Energy Laboratory (NREL)[4] who specifically determined the installation factor with a mean of 1.3 and a low value of 1.2. Jacobson et al. (2018) used the range 1.2-1.3 assuming installation is efficient by 2050.

This result is further reasonably supported by DOE's H2A Production analysis model[5], which gives an overall installation factor for a hydrogen production facility (including site preparation (materials and labor), engineering and design cost, permitting cost, contingency costs, equipment cost, and installation cost). This model determined the factor for installation alone as 1.12. The overall factor applied to capital cost was 1.36-1.52, nothing close to a factor of 4 assumed by Herzog. The difference between the high and low is the contingency cost, which could even be unnecessary.

Lines 324-329:

"My assessment indicates that Jacobson fails to adequately demonstrate the practicality and feasibility of UTES on a scale necessary to achieve a 100% clean, renewable energy system for all energy sectors by 2050, with about 80% conversion by 2030. In my view,

[3] https://www.hydrogen.energy.gov/pdfs/review12/st_plenary_stetson_2012_o.pdf
[4] https://www.nrel.gov/docs/fy14osti/58564.pdf
[5] https://www.hydrogen.energy.gov/h2a_production.html

Jacobson fails to adequately document the full suite of costs associated with UTES; and, for costs that Jacobson cites, he fails to adequately demonstrate cost reasonableness."

Response: Herzog's claims are moot, because Jacobson et al. (2018) shows that it is possible to obtain 100% WWS without the use of any UTES or with a mix of UTES and heat pumps. Further, Herzog's factual criticisms about the treatment of UTES in Jacobson et al. (2015b) are incorrect as discussed in the specific responses about UTES further down.

Lines 417-418:

"In my view, Jacobson overestimates the amount of demand response available."

Response: Herzog is not an expert on demand response and has published no papers on this subject. Demand response is used widely today to shift times of peak demand.

Lines 463-465:

"Second, there are constraints on the dispatch of hydroelectric dams for a variety of reasons, including environmental concerns and water use issues. These constraints limit the ability to flexibly dispatch hydroelectric power as a load balancing tool."

Response: With regard to existing hydroelectric facilities, they are already used throughout the United States, particularly along the West Coast, for peaking power. This is well established:

"Hydroelectric Dams are intentionally variable; they can generate less during off-peak and quickly respond to peak demands, consequently hydroelectricity may function as load following or a peaking plant and with sufficient water, a baseload plant." (Wikipedia, Peaking Power Plant)

Lines 467-472:

"In my view, in his models, Jacobson has overestimated the role of hydroelectric power in balancing supply and demand to achieve a 100% clean, renewable energy system for all energy sectors by 2050, with about 80% conversion by 2030. Specifically, in my view, Jacobson fails to apply appropriate capacity constraints to address the practical realities of how much and when hydroelectric power can meet energy demand.[24]"

Response: Jacobson et al. (2018) Cases A and C do not rely at all on increasing the peak discharge rate (capacity) of hydropower. Those cases assume existing capacity, illustrating the transition can be accomplished without any modification of hydropower, so the issue is moot.

Further, in Case B of Jacobson et al. (2018) and in Jacobson et al. (2015b), where turbines are added to existing conventional hydropower facilities, hydropower is absolutely constrained by the current annually averaged amount of water behind reservoirs in the United States.

Further, as discussed below, Herzog does not appear to recognize the difference between nameplate capacity and installed capacity of hydropower systems and instead assumes the two are the same, thereby misrepresenting the capacity constraints in Jacobson et al. (2015b) and Jacobson et al. (2018) Case B.

Page 15, Footnote 24:

"Ken Caldeira, a scholar with the Carnegie Institution for Science at Stanford University, wrote a detailed blog analyzing Jacobson et al. use of hydroelectric power, concluding: "Whether you call failure to impose a suitable capacity constraint on maximum hydro generation in each time period a "modeling error" is up to you, but that would seem to be an entirely reasonable interpretation based on the available facts."[6]

Response: Herzog fails to point out that Caldeira misrepresented the differences between installed capacity and nameplate capacity of hydropower systems, thereby misrepresenting the methods used by Jacobson et al. (2015b). Herzog also failed to provide the detailed response to Caldeira, which has been publicly available on the internet.[7]

Caldeira's specific claim referred to by Herzog was: "The operation of the LOADMATCH model is inconsistent with the maximum power generating capacity of hydropower facilities explicitly stated in Jacobson *et al.* (PNAS, 2015) and in the companion paper, Jacobson *et al.* (E&ES, 2015) upon which the generating capacities are based"

This statement is provably false. As stated in my response to Caldeira, "The PNAS paper itself (Figures 2B, 4B, S4B, and S5B; Table 2; Table S2) and the associated hydropower data itself[8] prove beyond any doubt that the model was intended to [be] dispatched far beyond the installed capacity while keeping the annual average power production under the maximum potential value (installed capacity) of 87.48 GW." There was absolutely no modeling error.

In addition, Caldeira and Herzog both misinterpret the difference between *installed capacity* and *nameplate capacity* with respect to hydropower systems. As I describe in an online errata[9]:

The "installed capacity" of a hydropower plant is its "production capacity based either on its rated (nameplate) capacity or actual (practically determined) capacity"[10]. It is also "(electricity) The maximum runoff of a hydroelectric facility that can be constantly maintained and utilized by equipment[11]. For this study, installed capacity of hydropower

[6] https://kencaldeira.wordpress.com/2018/02/28/mzj-hydro-explainer/amp/"
[7] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/18-03-04-RespCaldeira.pdf
[8] https://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/Hyd roTimeSeriesPNAS2015.xlsx
[9] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/Clarification-PNAS15.pdf
[10] Business Dictionary, Installed capacity: definition, http://www.businessdictionary.com/definition/installed-capacity.html, Accessed June 2, 2018.
[11] Free Dictionary, Installed capacity: definition, https://encyclopedia2.thefreedictionary.com/Installed+Capacity, Accessed June 2, 2018.

is defined as its practically-determined capacity limited by the maximum amount of water that can pass through turbines in the annual average and set to the contemporary hydropower nameplate capacity (87.48 GW). Thus, the installed capacity as defined here is the maximum *potential* annually averaged hydropower discharge rate and is held constant between today and 2050. The *actual* annually averaged discharge rate of hydropower in this study for 2050 is 45.92 GW, which is much less than the 87.48 GW maximum *potential* annually averaged discharge rate (installed capacity). More specifically, Installed capacity of hydropower is the maximum average power a hydropower facility can generate limited by the average water availability and its flow rate through turbines (e.g., Rahi and Kumar, 2016; Business Dictionary; Free Dictionary), whereas nameplate capacity is the maximum power limited by the size of the turbines themselves. Thus, installed capacity is always less than or equal to nameplate capacity. Table S2 of Jacobson et al. (2015b) states that the installed capacity of hydropower in 2013 and proposed for 2050 were 87.42 and 87.48 GW, respectively, thus virtually identical. That is because installed capacities for both years were assumed to equal the 2013 nameplate capacity of hydropower. Thus, the maximum potential annual average flow rate of water through turbines in 2050 was constrained to equal that through turbines in 2013.

Table 3 of Rahl and Kumar (2016) clearly indicate that installed capacity is based on the annual average flow rate of water. They also clearly show that the installed capacity depends on the maximum average water flow rate, head, and powerhouse efficiency.

Figures 2B, 4B, S4B, and S5B of Jacobson et al. (2015b) show instantaneous discharge rates much higher than the installed capacity given in their Table S2. That is because the instantaneous discharge rate is limited by the nameplate capacity of hydropower, whereas the annual average discharge rate is limited by the installed capacity. Thus, there is no inconsistency whatsoever between Figures 2B, 4B, 24B, and S5B of Jacobson et al. (2015b) and the installed capacities given Table S2 of the same paper.

Despite the fact that the text in Jacobson et al. (2015b) was not clear how hydropower was treated and the study neglected the cost of the additional turbines, there was no model error and the costs were subsequently accounted for as described in the clarification, published online.[12] Further, all authors of the Clack et al. (2015) paper were informed ahead of publication of their article exactly what was done with respect to the hydropower assumption, and this was also described to the first author in writing more than a year before publication of that article, yet all authors of the Clack et al. paper, including Profs. Sweeney, Weyant, and Victor, consciously chose to publish their paper misstating what was done in the Jacobson et al. (2015b) paper. The misstatements of fact in the Clack et al. paper coauthored by Profs. Sweeney, Weyant, and Victor and described in detail at http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/18-02-Correction.pdf.

[12] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/Clarification-PNAS15.pdf

Lines 509-516:

"Finally, there is the matter of cost. In Jacobson et al. (2018), Jacobson claims a 3% increase to total energy costs for the 100% WWS energy system when referring to the case presented in Jacobson et al. (2015b). My assessment is that this estimate is too low. In my view, the estimate presented in Clack et al. (2017) of a 24% increase is more realistic, but my experience suggests that even this estimate may be too low. In summary, Jacobson makes assumptions about the possibility of increasing peak hydropower discharge rates, but offers no technical justification. He does not present a single study of an existing dam to show whether this increase is even feasible."

Response: Herzog's conclusions are contradicted by data. The U.S. Bureau of Reclamation examined data from uprated hydropower facilities in the U.S. and calculated the cost of adding turbines to existing dams as $69/kW, far less than the $385/kW that even we assumed in Jacobson et al. (2018), let alone what Herzog or Clack et al. (2017) assumed. Here is the description from the U.S. Bureau of Reclamation:

> "The uprating of existing hydroelectric generator and turbine units at powerplants is one of the most immediate, cost-effective, and environmentally acceptable means of developing additional electric power. Since 1978, Reclamation has pursued an aggressive uprating program which has added more than 1,600,000 kW to Reclamation's capacity at an average cost of $69 per kilowatt. This compares to an average cost for providing new peaking capacity through oil-fired generators of more than $400 per kilowatt. Reclamation's uprating program has essentially provided the equivalent of another major hydroelectric facility of the approximate magnitude of Hoover Dam and Powerplant at a fraction of the cost and impact on the environment when compared to any other means of providing new generation capacity."[13]

In addition, in a case study, Rahl and Kumar (2016) conclude that uprating of a hydropower facility by a factor of 3.1 returns a positive cash flow and is "economically feasible."

Lines 527-530:

Quoting Clack et al. (2017): "'…. In addition, a portion of U.S. hydropower facilities are "run-of-river" facilities without the ability to store water for on-demand power production behind the dams, and still more facilities have minimum and maximum flow rates imposed for environmental reasons that restrict their operating flexibility.'"

Response: Neither Jacobson et al. (2015b) nor Jacobson et al. (2018) treats run-of-river hydro as conventional hydro with a dam (it is not treated as stored hydro at all).

Lines 535-540:

"The dispatch of hydroelectric power is an important mechanism used by Jacobson in his LOADMATCH model to balance electricity supply and demand at all times. Constraints on how hydroelectric power can be dispatched appear to be missing from the model. The

[13] https://www.usbr.gov/power/edu/pamphlet.pdf

net effect of Jacobson over relying on hydroelectric power to balance load, is an underestimation in the need for other storage options, resulting in an underestimation of costs for his 100% WWS energy system and weakening his claim of technical feasibility."

Response: First, Jacobson et al. (2018) Cases A and C do not rely on increasing the peak discharge rate of hydropower at all, so it is inaccurate to claim the study is "over relying on hydroelectric power to balance load".

Second, in the scenarios where the peak discharge rate of hydropower was allowed, hydropower was constrained by the total amount of water in reservoirs in the annual average.

Third, Herzog provides no supporting research to suggest that the peak discharge rate cannot be increased at any hydropower dam. In fact, as cited above, the U.S. Bureau of Reclamation directly contradicts Herzog's assertion. They state that increasing the peak discharge rate is the most cost effective method of meeting peaking in the United States, see response to line 509.

Finally, another way to use the dams to smooth power output is to convert them to pumped-hydropower stations. In fact, the City of Los Angeles is embarking on a new project to spend $3 billion to turn Hoover Dam into the world's largest pumped storage facility, thus increasing its peak discharge rate and allowing it to be recharged[14].

Lines 614-617:

"There is no indication that Jacobson simulates the ability of his proposed energy system to match electricity supply and demand during extreme weather conditions, at which times there is the highest probability of failure."

Response: Herzog misrepresents our methods. The weather-climate model used to develop wind and solar fields accounted on the supply side for extremes in weather, thus very low solar and wind days and very high days. Nevertheless, stable solutions were found for every 30 seconds across the 5 year time period we modeled. This holds true for 20 world regions using 3 different storage conditions. Extremes on the supply side are statistically similar to extremes on the demand side so, from a statistical point of view, the model did capture extreme type events. Further, extreme hot or cold events on the demand side are much easier to solve with a 100% WWS system than with a fossil/nuclear system. For example, the most recent heatwave resulted in four nuclear reactors shutting down[15]. Coal plants similarly need to shut down in extreme heat to avoid overheating and to avoid adding too much heat to freshwater streams.

On the other hand, heat waves mean more solar energy is available to satisfy cooling demand because heat waves are associated with high-pressure systems, where descending

[14] https://cleantechnica.com/2018/07/26/city-of-los-angeles-wants-to-turn-hoover-dam-into-worlds-largest-pumped-energy-storage-facility/

[15] https://reneweconomy.com.au/nuclear-power-takes-a-hit-as-european-heatwave-rolls-on-87477/

air evaporates clouds, allowing more sunlight to reach the surface of the Earth. Similarly, cold waves are associated with more wind power because they are associated with low-pressure systems and fronts that have fast winds associated with them. As such, a 100% WWS system is far more likely to survive in a heat wave or cold wave than a fossil or nuclear powered system.

Lines 705-710:

"In my expert opinion, Jacobson fails to adequately define his transmission system, and he does not offer any modeling to show that his proposed system will work as advertised. Further, Jacobson does not address issues regarding siting and permitting, and he is silent on policy and governance issues regarding the U.S. energy grid. Finally, as with the storage technologies, Jacobson underestimates the costs associated with an expanded transmission and distribution system."

Response: Howard Herzog is not an expert on transmission and has no published papers on this subject. Herzog's own ad hoc calculations starting on line 1704 appear to be only 16% different from those of Delucchi and Jacobson (2011), and differences of that scale, even if correct, do not alter the conclusions of the studies of Jacobson et al. (2018) and (2015b), which find that that social cost of fossil fuels per kWh is four times that of WWS and the absolute social cost ($) is eight times greater. Further, transmission/distribution is only 3.3% of the overall energy cost of a 100% WWS system in North America (Jacobson et al., 2018, Table S9), so even if the difference were a factor of five, which is not realistic, this wouldn't change the main conclusions of the study.

Herzog further assumes in his calculations (line 1720) that transmission costs should be calculated based on the economic lifetime of transmission rather than the project lifetime. This is another erroneous assumption by Herzog. For a social cost analysis, the relevant lifetime is the actual physical lifetime before replacement or scrapping. Jacobson et al. (2015b) and (2018) assume a social perspective, and from the standpoint of society, what matters is the actual physical lifetime, *not* the economic lifetime.

Finally, Herzog claims Jacobson et al. may be using a capacity factor for long-distance transmission of 40% that has not been validated (lines 653, 1827) However, this claim is wrong. Archer and Jacobson (2007)[16] clearly show that for wind power alone, interconnecting geographically dispersed wind turbines over long distance transmission turns 33-47% of completely intermittent onshore wind power to baseload power with the same reliability as coal plants. Further, solar, wave, and offshore wind are less intermittent than onshore wind; and hydro, geothermal, and tidal power – all part of the WWS system – already provide baseload power. Combining such resources further reduces intermittency. For example, combining offshore wind and wave power reduces transmission requirements by increasing capacity factors just as combining geographically dispersed onshore wind does[17]. Therefore, it is more likely that

[16] https://web.stanford.edu/group/efmh/winds/aj07_jamc.pdf
[17] https://web.stanford.edu/group/efmh/jacobson/Articles/I/Wind&wave/StoutenburgIEEE11.pdf

interconnecting these geographically-dispersed resources will result in capacity factors larger than 40%, not less than 40%.

Line 1598 (Appendix D):

"Jacobson does not adequately document the sources for his UTES capital costs."

Response: Jacobson et al. (2015b) clearly provides two references for the lifecycle capital costs of UTES: Gaine and Duffy (2010), and Rehau (2011).

Lines 1618-1624 (Appendix D):

"Clack (2017) notes with regard to UTES capital costs: 'the known capital costs for the Drake Landing system suggest a UTES installation cost of at least $1.8 trillion for [Jacobson's proposed] 100% wind, solar and hydroelectric power system.' Clack's estimate of $1.8 trillion, based on the same project which Jacobson references as a demonstration of UTES storage, is nearly four times as high as Jacobson's central estimate of $463 billion, and more than double the high end of Jacobson's estimated range of $880 billion. This analysis shows that Jacobson's estimates for UTES capital costs are underestimated."

Response: The figure of $1.8 trillion, described in Clack et al. (2017), is incorrect. First, Clack did not derive the $1.8 trillion figure from Sibbitt et al. (2012, pp. 856-865), the published paper referenced in Jacobson et al. (2015b), since Sibbitt et al. (2012) contains no cost information nor a Table 3, which Clack refers to. Instead, Clack appears to have obtained those numbers from an unpublished draft of the Sibbitt et al. paper located online[18].

Table 3 of the unpublished draft of the Sibbitt et al. paper gives capital cost estimates from 2005-2007 of the Drake storage system of $2.245 million CAD. In 2006 (the mid year), the exchange rate between the U.S. and Canada was 1.12 CAD/USD (Clack erroneously used an exchange rate of 1:1, presumably based on 2007 rather than 2006 costs), giving a capital cost in USD of $2.00 million. Table 1 of Sibbitt et al. (2012) shows the peak design energy into the storage system of 3030 GJ (841,667 kWh). That alone gives a cost/kWh of USD $2.38/kWh, much less than the $3.5/kWh that Clack et al. (2017) claim.

However, the 3030 GJ into the storage system from Sibbitt et al. is *not* the "maximum deliverable-kWh-th" as used in Table S1 of Jacobson et al. (2015b). The "maximum deliverable-kWh-th" is a number based on what the reservoir can hold, not based on how many solar collectors have been installed to fill the thermal reservoir. The 3030 GJ is the maximum based on the number of solar collectors installed and resulting expected input into the thermal reservoir, not the maximum based on what the reservoir can hold, thus 3030 GJ should not be used.

In fact, the Drake Landing reservoir can hold much more heat simply by having more solar collectors installed and allowing a slightly higher temperature of the rocks

[18] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.453.3037&rep=rep1&type=pdf

underground. As such, it is easy for the cost of the storage at Drake landing to be on the order of $0.9/kWh, the mean used in Jacobson et al. (2015b) with a range of $0.071-$1.71/kWh.

Further, given that the Drake Landing reservoir is small and Gaine and Duffy (2010) clearly show that the cost can drop by 50% by going to a large reservoir, it is likely UTES will be even less expensive than Jacobson et al. (2015b) estimate.

Finally, since costs in 2020-2050 will be lower than 2005-2007 due to economies of scale, possibly even half to a fourth (just as battery and solar PV costs have plummeted), it is conceivable that the cost of UTES done on a large scale could be $0.1-0.3/kWh in that time frame.

In sum, Herzog misunderstands the definition of cost per maximum deliverable-kWh-th and cites inaccurate numbers from Clack et al. (2017) to support his case. He also fails to account for economies of scale or the drop in cost over time due to the well-understood dynamics of a technological learning curve.

Lines 1626-1627 (Appendix D):

"Jacobson understates UTES capital costs by using an unrealistically low cost of capital."

Response: First, as stated in response to line 1618, above, UTES capital for 2020-2050 are likely overestimated, not underestimated.

Second, as described in detail under the response to line 283, the cost of capital used in Jacobson et al. (2015b) is properly the social discount rate for an intergenerational project. Herzog wrongly uses a private cost in a social cost analysis. Further, Herzog fails to apply his erroneous interest rate to the BAU case, further compounding his error.

Lines 1640-1641(Appendix D):

"Jacobson does not acknowledge that retrofit costs for UTES systems will be substantially higher compared to greenfield situations such as Drake's Landing."

Response: There is no such thing as a UTES retrofit as UTES storage reservoirs will be installed on bare land, not by retrofitting existing buildings. The solar collectors, not the storage systems, will be installed on rooftops of existing or new buildings or on the ground just like PV, but costs are lower since the collectors are simpler (Table S2 of Jacobson et al., 2015b). Herzog fails to identify any storage facility that will be "retrofitted" for UTES installation.

RESPONSE TO JAMES L. SWEENEY EXPERT REPORT

Specific responses to Professor Sweeney's statements are provided below, referenced by the paragraphs in Sweeney's report where the claim is located.

Paragraph 24:

> "Unilateral U.S. action cannot possibly stabilize atmospheric CO_2 concentration levels, much less reduce concentrations to the level that Plaintiffs demand."
>
> *Response:* This comment is misleading. What matters most for limiting global warming is the *cumulative* amount of CO_2 emitted[19]. The globe has warmed just over 1° C above preindustrial temperatures. Thus, every ton of CO_2 that the U.S. prevents the emission of will reduce the chance that the world will be limited to only 1.5° or 2° C of global warming, reducing the risk of extreme events and other damaging impacts occurring upon higher average temperatures (Schleussner et al. 2016, Steffen et al. 2018). Any additional warming will worsen climate change impacts (Hansen et al. 2013).
>
> In addition, making the transition to 100% clean, renewable energy will also simultaneously eliminate the 65,000 American air pollution deaths per year and millions more air pollution illnesses per year. These deaths and injuries cost America over 3% of its GDP annually in terms of statistical cost of life (Jacobson et al., 2015a).
>
> Transitioning will also create two million net jobs, reduce costs of energy, and provide more energy security. As such, there are multiple benefits of such a transition.

Paragraph 56:

> "Plaintiffs, however adopt a one-dimensional view of energy policy in which policy is evaluated solely through the lens of a subset of concerns related to environmental welfare – climate change and GHG emissions – and not as tradeoffs between concerns of national security, economic welfare, and environmental welfare."
>
> *Response:* This statement misrepresents our studies, which are multidimensional. Our 100% renewable energy plans[20],[21] have always specifically been designed to maximize energy security, minimize catastrophic risk, and find low-cost solutions in terms of direct cost and externality costs, and maximize job production in addition to eliminating air pollution health problems, water contamination problems associated with fossil fuels, and global warming problems.

Paragraph 26:

> "The energy related carbon intensity of the U.S. economy – the energy related CO_2 per dollar of real GDP – has decreased by 66% since 1973."

[19] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountriesWWS.pdf
[20] https://web.stanford.edu/group/efmh/jacobson/Articles/I/ReviewSolGW09.pdf
[21] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountriesWWS.pdf

Response: This metric is not useful for the purposes of addressing climate change. It implies that no CO_2 problem would exist if GDP were infinite. Instead, what matters is the physics of the climate system and the absolute amount of CO_2 emitted, since cumulative CO_2 emitted, not CO_2 per unit GDP, is what determines if the Earth's temperature will increase 1.5 °C, 2 °C, or more.[22]

Reporting CO_2 per unit GDP obscures the fact that U.S. emissions have increased since 1973. In 1973, emissions were 4,730 Mt-CO_2/yr. In 2016, they were 5,170 Mt-CO_2/yr[23][24]

Further, emissions per person have also increased. For example, U.S. emissions per capita have increased from 16.0 tonnes-CO_2/person/yr in 1960 to 16.5 in 2014.[25] The U.S. still ranks tenth worldwide in CO_2 per capita[26].

Paragraph 30:

"c. CO2 emissions caused directly by the government through its consumption of fossil fuels comprise approximately 0.25% of global CO2 emissions; and"

"d. I estimate that CO2 emissions caused by all of the conduct at issue, including emissions allegedly caused directly by Defendants, emissions allegedly caused by Defendants' affirmative policy acts, and emissions allegedly caused by Defendants' alleged failure to act, comprise no more than 4% of global emissions. Note that this figure includes emissions from the actions of entities in the U.S. other than the federal government, including private sector firms, individual residents of the U.S., and state and local governments."

Response: I disagree. All emissions of criteria pollutants and carbon dioxide in the United States are under the purview of the United States government because the U.S. EPA has the ability to regulate all emissions and/or grant states the right to regulate emissions at the same or tougher levels than the EPA. In addition, for example, the U.S. has the ability to control vehicle carbon dioxide and other emissions by setting Corporate Average Fuel Economy (CAFE) standards. The U.S. Congress also has the ability to pass laws to control anything that might not be covered already under current emission laws. Further, the U.S. has the ability to and has historically regulated and authorized the mining of coal, oil, and gas in the United States. As such, the Federal Government can set the upper limit of all United States emissions, not 4%.

Further, Professor Sweeney admitted in his deposition that he simply estimated the amount of U.S. greenhouse gas emissions that he believed to be influenced by government policy to be no more than 20% of total U.S. emissions. He provided no source for this estimate – it was based solely on his experience. It is through this estimate

[22] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountriesWWS.pdf (pg. 118)
[23] http://www.wri.org/blog/2014/05/history-carbon-dioxide-emissions
[24] https://www.eia.gov/todayinenergy/detail.php?id=30712
[25] https://data.worldbank.org/indicator/EN.ATM.CO2E.PC
[26] https://www.telegraph.co.uk/travel/maps-and-graphics/co2-emissions-per-capita-ranking/

of emissions influenced by federal policy that Professor Sweeney derived the 4% figure cited above.

As an illustration of the federal government's significant influence over nationwide greenhouse gas emissions, I calculated the total CO_2 emissions associated with different federal activities using standard emissions conversion factors for different types and quantities of fuels, as shown in Attachments A and B to this report. The federal government authorizes the extraction, transportation, export, import, and combustion of fossil fuels through a variety of mechanisms. Attachment A contains examples of various quantities of fossil fuels that have been authorized for extraction (both onshore and offshore), transported throughout the U.S., imported, exported, leased, or combusted in the U.S. These fuel quantities are taken from documents produced and maintained by the federal government as shown in the column heading "Fact from Document" in Attachment A. This list is by no means exhaustive, but is rather intended to illustrate by way of examples, the significant quantities of CO_2 emissions attributable to activities of the federal government, not including the federal government's direct emissions from its own operations. Attachment B reflects the total amount of CO_2 emissions associated with the quantity of natural gas, when combusted, authorized by the Department of Energy for import or export between 1995 and 2018 pursuant to Section 201 of the Energy Policy Act. Because there are so many mechanisms for federal government influence, these are not intended to be a comprehensive inventory of United States GHG emissions - as combining each individual total amount would result in double counting.

Paragraph 32:

"The low carbon energy systems proposed by [Jacobson and Williams]…assume the existence of technologies that are in development and are decades from commercial acceptance. Neither Professor Jacobson nor Professor Williams provides a credible estimate of the full costs of their respective proposals. They both focus on changes in the cost of energy supply, but fail to explain the substantially larger costs that would arise from the macroeconomic impact of their proposal. Moreover, Professor Jacobson's prominent claim that his proposed system would provide electricity at prices lower than a conventional system relies on aggressive, implausible assumptions."

Response: 90-95% of the technologies used in the analysis are currently commercially available. In fact, Apple and Google have already transitioned 100% of their own operations to renewable energy as of 2018; California has transitioned 30% of its electric power and Iowa, over 40%. Viable examples of 100% or near 100% renewable energy systems exist throughout the world. For example, Iceland (100%), Costa Rica (99%), Norway (98%), Tajikistan (95%), and Paraguay (100%) have either 100% or near 100% of their electric power already coming from renewables[27].

Most everything (with limited exceptions, e.g. long-distance aircraft and long-distance ships) can be transitioned today or within the next few years with existing technologies at market cost, and the social cost savings (direct + health + climate costs) are far, far greater than any unforeseen investment costs. Long distance aircraft and ships should be

[27] https://www.clickenergy.com.au/news-blog/12-countries-leading-the-way-in-renewable-energy/

available no later than 2040.The transition is entirely possible, it just needs to be sped up through effective policies and making people more aware of what is possible.

Paragraph 32:

"Additionally, Professor Jacobson's and Professor Williams' proposals deviate from consensus views in the literature."

Response: The consensus view in the literature, and on the ground, is that 100% clean, renewable energy is possible. More than 30 independent, multi-author peer-reviewed published papers support 100% or virtually 100% clean, renewable energy systems throughout the world[28].

Further, the 100% wind-water-solar (WWS) roadmaps proposed here and now largely adopted in California and Hawaii in the electric power sector, were carried out by 96 coauthors among 18 peer-reviewed papers[29] that were reviewed by over 40 anonymous peer reviewers.

As such, the 18 100% WWS studies combined with the 30 independent 100% or near 100% studies define the consensus, as they comprise the largest body of literature and largest number of qualified researchers and peer reviewers on the subject. The "consensus" referred to by Prof. Sweeney in reality consists of a minority of authors with simplistic assumptions that miss most relevant information. In particular, none has attempted to simulate 100% clean and renewable energy systems among **all energy sectors** simultaneously over time, accounting for heat, cold, electricity, and hydrogen storage simultaneously with intermittent wind, solar, geothermal, hydro, tidal, and wave power. In other words, Prof. Sweeney misrepresents the published literature.

Within the United States, the state of California recently passed SB 100, calling for the electric power sector in California to be virtually 100% clean, renewable energy by 2045, five years before the end date (2050) proposed in the Jacobson et al. studies. Specifically, it requires a 60% conversion to "eligible renewables" by 2030 and the remaining 40% from eligible renewables plus large hydro (which is renewable but not considered an eligible renewable in California) plus any other zero-carbon technology yet to be invented.[30]

Because all nuclear power is being phased out in California and no new reactors are being built, and because natural gas with carbon capture emits over 300 g-CO2/kWh in the relevant 20-year time frame, thus is not even close to zero-carbon[31], the 2045 mix in California will therefore most likely be 100% clean, renewable energy as proposed in the Jacobson et al. studies.

[28] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/100PercentPaperAbstracts.pdf
[29] https://web.stanford.edu/group/efmh/jacobson/Articles/I/100Pct-WWS-Papers.pdf
[30] https://focus.senate.ca.gov/sb100/faqs
[31] Slide 15 of https://www.eia.gov/conference/2015/pdf/presentations/skone.pdf

Paragraphs 268-269:

"The California Council on Science and Technology ("CCST") concludes in its extensive analysis of decarbonization that (i) 60% mitigation by 2050 is feasible given technologies available today; and (ii) 80% mitigation may be feasible, but will be difficult, and will require solutions to the fuels problem that are not available today."

"The EMF 24 studies[32] find that (i) mitigation of 50% to 80% will require a dramatic transformation of the energy system; (ii) costs will be higher with fewer available technologies; (iii) the ability of models to produce mitigation scenarios is not sufficient to draw conclusions about the "feasibility" of these scenarios in a more applied sense."

Response: None of these studies is a grid integration study. Thus, none even attempts to match supply with demand among all energy sectors and electricity plus heat plus cold plus hydrogen storage over short time intervals with a clean, renewable wind-water-solar energy system. Those studies are also dated (2011 and 2014) and simplistic and not useful at all for the examination of whether it is possible to transition to 100% renewable energy.

The Energy Modeling Forum ("EMF") and CCST studies do not analyze electrification of all energy sectors and the associated reduction of demand among all sectors due to eliminating energy in the mining, transporting, and refining fossil fuels or due to the efficiency of electricity over combustion. They also did not use a) didn't use heat storage, cold, storage, hydrogen storage, nor b) demand response, nor c) heat pumps, nor d) CSP with storage, nor e) existing hydro to fill in gaps in demand. They did not model the time-dependent matching of supply with demand at the high time resolution needed to simulate the problem in question. Further, they did not simulate the time-dependent wind fields accounting for kinetic energy extraction by wind turbines, as has been done in the Jacobson et al. 100% WWS studies. In short, such studies compare apples to oranges. The EMF studies, in particularly, have never even examined the state-by-state transition to renewables.

Paragraph 271:

"The last IPCC review of such scenarios shows a small number of very idealized global scenarios with near-zero GHG emissions by the end of the century, but not by 2050 and not at zero or very low costs."

Response: The studies referred to are not relevant at all to the issue at hand. What is relevant is Section 7.6. P. 533 of the 2014 IPCC document, which states, "Studies of high variable RE (renewable energy) penetration (8 citations, including Delucchi and Jacobson, 2011) and the broader literature (2 citations) suggest that integrating significant RE generation technology is technically feasible, though economic and institutional barriers may hinder uptake… The determination of least-cost portfolios of those options that facilitate the integration of fluctuating power sources is a field of active and ongoing research (citations)."

[32] EMF 24 is an energy modeling research project coordinated by the Energy Modeling Forum at Stanford University.

Paragraph 37:

"Although the U.S. has historically contributed about 25% of global CO_2 emissions, it now emits only a small fraction of global GHG emissions (16%)."

Response: This is a manipulation of statistics by Professor Sweeney. Even Professor Victor disputes the relevance of this because it is the absolute and cumulative emissions of CO_2 that matters by far the most, not the percent U.S. contribution (see detailed response to Lines 182-194 of Professor Victor's report, below).

Paragraph 146:

"Policy Initiatives Demanded by Plaintiffs' Experts Have Been Considered, Debated, and Rejected by Congress or Federal Administrations"

Response: This statement is inaccurate. Congress has three pending laws (H.R. 3314, H.R. 3671, S.987) and two pending resolutions (HRes 540, SRes 632) for the U.S. to go to 100% renewable energy that have not come up for a vote or been debated.

Paragraph 205:

"Jacobson further assumes that (i) by 2040, hydrogen–and electric–powered airplanes will replace existing fossil-fuel-powered jet airplanes; and (ii)… underground thermal energy storage ("UTES") will replace existing heating and cooling systems for residential and commercial buildings, requiring a retrofit of almost all residential and commercial buildings in the United States."

Response: Jacobson (2018)[33] clearly shows that a transition in North America and worldwide is possible without any UTES at all, by substituting heat pumps that run on electricity. Both cases are low cost. UTES is only one option. The ultimate solution is likely a mixture of UTES and heat pumps and other thermal energy storage.

With regard to electric airplanes, Norway has already committed to a fleet of electric aircraft for short-haul flights by 2040[34] and many companies are currently developing electric and hydrogen fuel cell aircraft.

Paragraph 243:

"A complete accounting of economic impact must include cost changes in three different categories: (i) energy supply costs; (ii) costs for replacement of the stock of equipment necessary to use energy (e.g., appliances, systems for heating, ventilation, and cooling of residential and commercial buildings, and equipment for industrial and manufacturing processes); and (iii) macroeconomic effects arising from an energy price shock (i.e., effects throughout the economy, rather than the energy sector alone, in response to a change in energy prices). Professor Jacobson considers only the cost of electricity (i.e., the average or "levelized" cost of electricity),[271] and fails to analyze or report costs in the other two categories."

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[33] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/WorldGridIntegration.pdf

[34] http://www.bbc.com/future/story/20180814-norways-plan-for-a-fleet-of-electric-planes

Response: With regard to (ii), the cost of new appliances was assumed to be the same as the cost of existing appliances. This is likely a conservative assumption. In fact, new appliances are likely less. A home without gas also saves $3,000-8,000 on the gas hookup fee alone in addition to savings $1,000-$7,000 on pipes up front.

With regard to (iii), we did account for macro effects in Jacobson et al. (2015a,b; 2017, 2018), namely job creation and resulting revenues, plus reduced air pollution health costs and reduced climate costs. These are by far the greatest macro cost savings of such a transition. The health plus climate cost savings alone are on the order of 28.5 (11.2-72) cents/kWh[35], almost three times the direct energy cost.

As such, the social cost (energy + health + climate cost) of fossil fuels per unit energy is ~3.6-4 times that of a 100% WWS system, and the 100% WWS system uses one-half the energy as a fossil fuel system, so the cost to consumers of a 100% WWS is one-seventh to one-eighth that of a fossil system, as published in Jacobson (2018). The additional costs that Professor Sweeney referred to are in some cases non-existing and in other cases small in comparison.

Paragraph 253:

"Second, Professor Jacobson relies on artificially low discount rates in his computation of average costs."

Response: The Jacobson et al. studies are social cost analyses for intergenerational projects, where the proper discount rate is the social discount rate, as clearly referenced, and is lower than the private discount rate. Like Herzog,[36] Professor Sweeney confuses a private cost analysis with a social cost analysis for intergenerational projects, an analysis well established in the literature.

Paragraph 277:

"Furthermore, several of the studies cited in Professor Jacobson's Exhibit D (in addition to Professor Jacobson's study) were reviewed by Heard et al. 2017 who concluded that none of the studies reviewed provides convincing evidence that the basic criteria for feasibility can be met. In particular, Heard et al. 2017 states that Professor Jacobson's work "depends strongly on extraordinary assumptions relating to electrification, energy storage, and flexibility in demand… [T]he results of such a simulation are likely to be meaningless because the underlying assumptions are unrealistic."

Response: The inaccuracies contained within Heard et al. (2017) were debunked in two separate independent multi-authored peer-reviewed articles (Diesendorf and Elliston, 2018; Brown et al., 2018). These inaccuracies are summarized in the detailed responses to lines 97 and 138 of Herzog's report, above.

[35] http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountriesWWS.pdf

[36] See pp. 8-9 above.

It is also of note that Profs. Sweeney, Weyant, and Victor, who were among the coauthors of the Clack et al. (2015) paper, were all fully informed, prior to publication, of: (a) their mischaracterization of Table 1 in Jacobson et al. (2015b) as containing maximum values, when Table 1 contained average values; and (b) their mischaracterization of the hydropower assumption in Jacobson et al. (2015b) as being a "modeling error," when in fact no error occurred in the model because turbines were intentionally added to existing dams as acknowledged by the first author of the Clack et al. about a year prior to its publication. Notwithstanding having been provided with this information in advance, Profs. Sweeney, Weyant, and Victor engaged in the mischaracterizations described above in causing the Clack et al. (2015) paper to be published and apparently ignoring the hydropower assumption, as described in detail here: http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/18-02-Correction.pdf

RESPONSE TO DAVID G. VICTOR EXPERT REPORT

Specific responses to Professor Victor's statements are provided below, referenced by the lines in Victor's report where the claim is located.

Lines 109-111:

> "I estimate that: 1) federal fossil fuel subsidies are a tiny fraction of total value of the fossil fuel energy industry, and therefore not material to the industry's operations."
>
> *Response:* This is misleading. It is not a question of the amount of subsidy relative to the total value of the fossil fuel industry but a question of the amount of subsidy relative to the difference in cost between fossil fuels and renewables. The subsidy allows the fossil fuel industry to operate at slightly lower costs than it otherwise would, allowing it to stay more competitive with renewable energy. In addition, substantial subsidies for fossil fuels have been in place for much longer than subsidies for renewable energy – such that the fossil fuel industry benefits from a legacy of cumulative subsidies for fossil fuels. (Management Information Services, 2011)

Lines 168-171:

> "In fact, the U.S. has been at the forefront of efforts to engage with its trading partners on issues of global climate, including efforts associated with the Intergovernmental Panel on Climate Change (IPCC), the 1992 Framework Convention on Climate Change, and the 2015 Paris Agreement."
>
> *Response:* The U.S. failed to ratify the Kyoto Protocol and pulled out of the Paris Agreement.

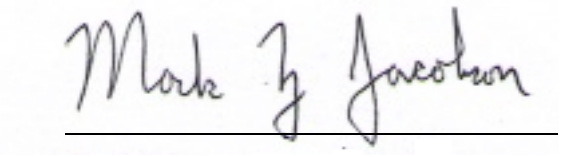
Lines 182-194:

> "The Plaintiffs in this case have put forth that 'The United States is responsible for more than a quarter of global historic cumulative CO_2 emissions.' The Federal Defendants have admitted that 'from 1850 to 2012, CO_2 emissions from the United States (including from land use) constituted more than one-quarter of cumulative global CO_2 emissions.' The Expert Report of Mr. Peter A. Erickson, dated April 12, 2018, states:
>
> > 'The U.S. is responsible for a substantial amount of global GHG [Greenhouse Gas] emissions.' (page 3)
>
> I examined the data relied upon, and the techniques applied by, Erickson to support his conclusion. It is my expert opinion that Erickson's analysis of the size and composition of U.S. emissions obscures the scope and complexity of policy interventions needed to control those emissions."
>
> *Response:* However, Professor Victor has previously stated the following: "In cumulative terms, we certainly own this problem more than anybody else does."[37]

[37] https://www.nytimes.com/interactive/2017/06/01/climate/us-biggest-carbon-polluter-in-history-will-it-walk-away-from-the-paris-climate-deal.html

In another article, Professor Victor observes: "In the US, Americans started burning fossil fuels at higher rates than the rest of the world early, which means that the US is responsible for almost a third of the excess CO_2 that's already in the atmosphere, despite having just more than 4% of the global population."[38]

Signed this 19th day of September, 2018 in Palo Alto, California.



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[38] https://www.businessinsider.com/us-effect-on-climate-change-co2-emissions-warming-2017-6

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Expert Report of David G. Victor, August 13, 2018.

Expert Report of Peter A. Erickson, April 12, 2018

Transcript, Deposition of Howard Herzog, August 23, 2018

Transcript, Deposition of James Sweeney, September 10, 2018

Abstracts of 18 Peer-Reviewed Published Journal Articles from 2009-2018 by 96 Co-Authors Forming the Scientific Basis of 100% Clean, Renewable Wind-Water-Solar (WWS) All-Sector Energy Roadmaps for Towns, Cities, States, Countries, and the World, Sept. 17, 2018. https://web.stanford.edu/group/efmh/jacobson/Articles/I/100Pct-WWS-Papers.pdf

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ATTACHMENT A

Rebuttal Expert Report of Mark Jacobson

Juliana et al. v. United States et al.
In the United States District Court
District of Oregon
Case No. 6:15-cv-01517-TC

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
270-36	Challenges Facing Domestic Oil and Gas Development: Review Of BLM/U.S. Forest Service Ban On Horizontal Drilling On Federal Lands: Hearing Before the H. Subcomm on Energy & Mineral Resources & the H. Subcomm. on Conservation, Energy, & Forestry	In 2010, 16.7 million barrels of oil…..were produced from almost 3,200 wells on FEDERAL LANDS managed by the DEPARTMENT OF AGRICULTURE.	P00000001203	oil	16,700,000	barrels	2.336E+09	3.09	7.220
270-36	Challenges Facing Domestic Oil and Gas Development: Review Of BLM/U.S. Forest Service Ban On Horizontal Drilling On Federal Lands: Hearing Before the H. Subcomm on Energy & Mineral Resources & the H. Subcomm. on Conservation, Energy, & Forestry	In 2010…...194 million cubic feet of natural gas were produced from almost 3,200 wells on FEDERAL LANDS managed by the DEPARTMENT OF AGRICULTURE.	P00000001203	natural gas	194,000,000	cubic feet	3.866E+06	2.75	0.011
270-36	Challenges Facing Domestic Oil and Gas Development: Review Of BLM/U.S. Forest Service Ban On Horizontal Drilling On Federal Lands: Hearing Before the H. Subcomm on Energy & Mineral Resources & the H. Subcomm. on Conservation, Energy, & Forestry	In Fiscal Year 2010, more than 114 million barrels of oil were produced from the BLM-managed mineral estate	P00000001198	oil	114,000,000	barrels	1.595E+10	3.09	49.284
270-36	Challenges Facing Domestic Oil and Gas Development: Review Of BLM/U.S. Forest Service Ban On Horizontal Drilling On Federal Lands: Hearing Before the H. Subcomm on Energy & Mineral Resources & the H. Subcomm. on Conservation, Energy, & Forestry	Also in 2010, the nearly three trillion cubic feet of natural gas produced from public lands made it the second most productive year on record	P00000001198	natural gas	3,000,000,000,000	cubic feet	5.978E+10	2.75	164.403
270-48	LNG Monthly (YTD – through December 2016)	In 2016, the U.S. exported approximately 183,773,189 thousand cubic feet of domestically produced liquefied natural gas by vessel	P00000012111	natural gas	183,773,189	cubic feet	3.662E+06	2.75	0.010

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
341-587	LNG Monthly (YTD – through December 2017)	In 2017, the U.S. exported approximately 706,303,241 thousand cubic feet of domestically produced liquefied natural gas by vessel.	Document page 9	natural gas	706,303,241	cubic feet	1.407E+07	2.75	0.039
270-53	Long Term Strategic Review of the U.S. Strategic Petroleum Reserve: Report to Congress	The DEPARTMENT OF ENERGY sold petroleum stocks from the STRATEGIC PETROLEUM RESERVE in the amount of 0.967 million barrels of oil in 1985.	P00000011682	oil	967,000	barrels	1.353E+08	3.09	0.418
270-137	Natural Gas Consumption (Billion Cubic Feet)	The U.S. natural gas PIPELINE transportation network delivered approximately 22,539 billion cubic feet of natural gas in 2000.	P00000029805	natural gas	22,539,000,000,000	cubic feet	4.491E+11	2.75	1,235.162
270-143	Movements of Crude Oil and Selected Products by Rail	In 2012, approximately 152,047 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	152,047,000	barrels	2.127E+10	3.09	65.733
270-143	Movements of Crude Oil and Selected Products by Rail	In 2013, approximately 296,064 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	296,064,000	barrels	4.142E+10	3.09	127.994
270-143	Movements of Crude Oil and Selected Products by Rail	In 2014, approximately 382,034 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	382,034,000	barrels	5.345E+10	3.09	165.160
270-143	Movements of Crude Oil and Selected Products by Rail	In 2015, approximately 318,782 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	318,782,000	barrels	4.460E+10	3.09	137.815
270-143	Movements of Crude Oil and Selected Products by Rail	In 2016, approximately 175,701 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	175,701,000	barrels	2.458E+10	3.09	75.959

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
270-143	Movements of Crude Oil and Selected Products by Rail	In 2017, approximately 139,092 thousand barrels of crude oil were transported by rail in the United States	P00000028481	oil	139,092,000	barrels	1.946E+10	3.09	60.132
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2000, U.S. air carriers with scheduled flights consumed 19,026.2 million gallons of AVIATION FUEL.	P00000029788	airline fuel	19,026,200,000	gallons	5.765E+10	3	172.948
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2001, U.S. air carriers with scheduled flights consumed 18,067.6 million gallons of AVIATION FUEL.	P00000029789	airline fuel	18,067,600,000	gallons	5.474E+10	3	164.234
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2002, U.S. air carriers with scheduled flights consumed 16,858.7 million gallons of AVIATION FUEL.	P00000029789	airline fuel	16,858,700,000	gallons	5.108E+10	3	153.246
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2003, U.S. air carriers with scheduled flights consumed 16,868.0 million gallons of AVIATION FUEL.	P00000029789	airline fuel	16,868,000,000	gallons	5.111E+10	3	153.330
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2004, U.S. air carriers with scheduled flights consumed 18,144.7 million gallons of AVIATION FUEL.	P00000029790	airline fuel	18,144,700,000	gallons	5.498E+10	3	164.935
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2005, U.S. air carriers with scheduled flights consumed 18,324.5 million gallons of AVIATION FUEL.	P00000029790	airline fuel	18,324,500,000	gallons	5.552E+10	3	166.570
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2006, U.S. air carriers with scheduled flights consumed 18239.7 million gallons of FUEL.	P00000029790	airline fuel	18,239,700,000	gallons	5.527E+10	3	165.799
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2007, U.S. air carriers with scheduled flights consumed 18426.8 million gallons of FUEL.	P00000029791	airline fuel	18,426,800,000	gallons	5.583E+10	3	167.500

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2008, U.S. air carriers with scheduled flights consumed 17978.4 million gallons of FUEL.	P00000029791	airline fuel	17,978,400,000	gallons	5.447E+10	3	163.424
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2009, U.S. air carriers with scheduled flights consumed 16234.0 million gallons of FUEL.	P00000029791	airline fuel	16,234,000,000	gallons	4.919E+10	3	147.567
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2010, U.S. air carriers with scheduled flights consumed 16303.2 million gallons of FUEL.	P00000029792	airline fuel	16,303,200,000	gallons	4.940E+10	3	148.196
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2011, U.S. air carriers with scheduled flights consumed 16349.3 million gallons of FUEL.	P00000029792	airline fuel	16,349,300,000	gallons	4.954E+10	3	148.615
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2012, U.S. air carriers with scheduled flights consumed 15859.2 million gallons of FUEL.	P00000029792	airline fuel	15,859,200,000	gallons	4.805E+10	3	144.160
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2013, U.S. air carriers with scheduled flights consumed 15904.7 million gallons of FUEL.	P00000029793	airline fuel	15,904,700,000	gallons	4.819E+10	3	144.574
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2014, U.S. air carriers with scheduled flights consumed 16192.2 million gallons of FUEL.	P00000029793	airline fuel	16,192,200,000	gallons	4.906E+10	3	147.187
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2015, U.S. air carriers with scheduled flights consumed 16729.6 million gallons of FUEL.	P00000029793	airline fuel	16,729,600,000	gallons	5.069E+10	3	152.072
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2016, U.S. air carriers with scheduled flights consumed 17044.7 million gallons of FUEL.	P00000029794	airline fuel	17,044,700,000	gallons	5.165E+10	3	154.936

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
270-147	Airline Fuel Cost and Consumption (U.S. Carriers – Scheduled)	In 2017, U.S. air carriers with scheduled flights consumed 17295.3 million gallons of FUEL.	P00000029794	airline fuel	17,295,300,000	gallons	5.240E+10	3	157.214
270-158	Discretionary Programmatic Environmental Impact Statement to Modernize the Federal Coal Program	As of Fiscal Year 2014, the DEPARTMENT OF THE INTERIOR, through the BLM, administered 310 coal leases encompassing over 475,692 acres in ten states on FEDERAL LANDS, which authorize the extraction of an estimated 7.75 billion tons of recoverable coal.	P00000024080	coal (unspecified grade)	7,750,000,000	tons	7.031E+12	3.18	22,357.574
299-16	Interior Department Supported $106 Billion in Recreation, Conservation, Water and Renewable Energy Investments, Supporting More than 860,000 Jobs in FY 2015	In Fiscal Year 2015, fossil fuel energy produced on FEDERAL LANDS managed by the DEPARTMENT OF THE INTERIOR included 782 million barrels of crude oil.	P00000024902	crude oil	782,000,000	barrels	1.094E+11	3.09	338.073
299-16	Interior Department Supported $106 Billion in Recreation, Conservation, Water and Renewable Energy Investments, Supporting More than 860,000 Jobs in FY 2015	In Fiscal Year 2015, fossil fuel energy produced on FEDERAL LANDS managed by the DEPARTMENT OF THE INTERIOR included five trillion cubic feet of natural gas.	P00000024902	natural gas	5,000,000,000,000	cubic feet	9.964E+10	2.75	274.006
299-16	Interior Department Supported $106 Billion in Recreation, Conservation, Water and Renewable Energy Investments, Supporting More than 860,000 Jobs in FY 2015	In Fiscal Year 2015, fossil fuel energy produced on FEDERAL LANDS managed by the DEPARTMENT OF THE INTERIOR included 421 million tons of coal.	P00000024902	coal (unspecified grade)	421,000,000	tons	3.819E+11	3.18	1,214.521
299-18	Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2014	Under leases administered by the DEPARTMENT OF THE INTERIOR, between FY 2003 and FY 2014 a total of 7,624 million barrels of oil were produced on federal lands	P00000024048	oil	7,624	million barrels	1.067E+12	3.09	3,295.999

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-18	Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2014	Under leases administered by the DEPARTMENT OF THE INTERIOR, between FY 2003 and FY 2014 a total of 1,294 million barrels of natural gas plant liquids were produced on federal lands	P00000024048	natural gas plant liquids	1,294	million barrels	1.810E+11	3.09	559.421
299-18	Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2014	Under leases administered by the DEPARTMENT OF THE INTERIOR, between FY 2003 and FY 2014 a total of 62,394 billion cubic feet of natural gas were produced on federal lands	P00000024048	natural gas	62,394	billion cubic feet	1.243E+12	2.75	3,419.261
299-18	Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2014	Under leases administered by the DEPARTMENT OF THE INTERIOR, between FY 2003 and FY 2014 a total of 5,300 million short tons of coal were produced on federal lands	P00000024048	coal (unspecified grade)	5,300	million short tons	4.808E+12	3.18	15,289.696
299-20	Annual Summary of Production for Entire Region 2005-2018	From 2005–2018, the DEPARTMENT OF THE INTERIOR, through the Bureau of Ocean Energy Management, authorized the production of 5,923,693,909 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024886	oil	5,923,693,909	barrels	8.288E+11	3.09	2,560.924
299-20	Annual Summary of Production for Entire Region 2005-2018	From 2005–2018, the DEPARTMENT OF THE INTERIOR, through the Bureau of Ocean Energy Management, authorized the production of 18,169,970,366 thousand cubic feet of gas from the OUTER CONTINENTAL SHELF.	P00000024886	natural gas	18,169,970,366,000	cubic feet	3.621E+11	2.75	995.735
299-21	Annual Summary of Production for Entire Region 2000-2004	From 2000–2004, the DEPARTMENT OF THE INTERIOR authorized the production of 2,220,043,831 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000020449	oil	2,220,043,831	barrels	3.106E+11	3.09	959.767

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-21	Annual Summary of Production for Entire Region 2000-2004	From 2000–2004, the DEPARTMENT OF THE INTERIOR authorized the production of 18,587,499,010 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000020449	natural gas	18,587,499,010,000	cubic feet	3.704E+11	2.75	1,018.616
299-22	Annual Summary of Production for Entire Region 1995-1999	From 1995–1999, the DEPARTMENT OF THE INTERIOR authorized the production of 1,706,311,628 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000020450	oil	1,706,311,628	barrels	2.387E+11	3.09	737.671
299-22	Annual Summary of Production for Entire Region 1995-1999	From 1995–1999, the DEPARTMENT OF THE INTERIOR authorized the production of 21,676,672,953 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000020450	natural gas	21,676,672,953,000	cubic feet	4.320E+11	2.75	1,187.906
299-23	Annual Summary of Production for Entire Region 1989-1994	From 1989–1994, the DEPARTMENT OF THE INTERIOR authorized the production of 1,498,671,635 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024887	oil	1,498,671,635	barrels	2.097E+11	3.09	647.904
299-23	Annual Summary of Production for Entire Region 1989-1994	From 1989–1994, the DEPARTMENT OF THE INTERIOR authorized the production of 25,398,257,187 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024887	natural gas	25,398,257,187,000	cubic feet	5.061E+11	2.75	1,391.853
299-24	Annual Summary of Production for Entire Region 1983-1988	From 1983–1988, the DEPARTMENT OF THE INTERIOR authorized the production of 1,781,399,499 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024888	oil	1,781,399,499	barrels	2.492E+11	3.09	770.133
299-24	Annual Summary of Production for Entire Region 1983-1988	From 1983–1988, the DEPARTMENT OF THE INTERIOR authorized the production of 22,898,102,797 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024888	natural gas	1,781,399,499,000	cubic feet	3.550E+10	2.75	97.623

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-25	Annual Summary of Production for Entire Region 1977-1982	From 1977–1982, the DEPARTMENT OF THE INTERIOR authorized the production of 1,433,091,277 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024889	oil	1,433,091,277	barrels	2.005E+11	3.09	619.552
299-25	Annual Summary of Production for Entire Region 1977-1982	From 1977–1982, the DEPARTMENT OF THE INTERIOR authorized the production of 24,823,636,080 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024889	natural gas	24,823,636,080,000	cubic feet	4.947E+11	2.75	1,360.363
299-26	Annual Summary of Production for Entire Region 1971-1976	From 1971–1976, the DEPARTMENT OF THE INTERIOR authorized the production of 1,863,430,843 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024890	oil	1,863,430,843	barrels	2.607E+11	3.09	805.596
299-26	Annual Summary of Production for Entire Region 1971-1976	From 1971–1976, the DEPARTMENT OF THE INTERIOR authorized the production of 16,998,950,183 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024890	natural gas	16,998,950,183,000	cubic feet	3.387E+11	2.75	931.562
299-27	Annual Summary of Production for Entire Region 1965-1970	From 1965–1970, the DEPARTMENT OF THE INTERIOR authorized the production of 1,275,412,482 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024891	oil	1,275,412,482	barrels	1.784E+11	3.09	551.385
299-27	Annual Summary of Production for Entire Region 1965-1970	From 1965–1970, the DEPARTMENT OF THE INTERIOR authorized the production of 7,430,653,344 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024891	natural gas	7,430,653,344,000	cubic feet	1.481E+11	2.75	407.208
299-28	Annual Summary of Production for Entire Region 1959-1964	From 1959–1964, the DEPARTMENT OF THE INTERIOR authorized the production of 376,011,321 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024892	oil	376,011,321	barrels	5.261E+10	3.09	162.557

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-28	Annual Summary of Production for Entire Region 1959-1964	From 1959–1964, the DEPARTMENT OF THE INTERIOR authorized the production of 2,112,777,969 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024892	natural gas	2,112,777,969,000	cubic feet	4.210E+10	2.75	115.783
299-29	Annual Summary of Production for Entire Region 1953-1958	From 1953–1958, the DEPARTMENT OF THE INTERIOR authorized the production of 41,507,127 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024893	oil	41,507,127	barrels	5.807E+09	3.09	17.944
299-29	Annual Summary of Production for Entire Region 1953-1958	From 1953–1958, the DEPARTMENT OF THE INTERIOR authorized the production of 463,238,164 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024893	natural gas	463,238,164,000	cubic feet	9.231E+09	2.75	25.386
299-30	Annual Summary of Production for Entire Region 1947-1952	From 1947–1952, the DEPARTMENT OF THE INTERIOR authorized the production of 1,372,553 barrels of oil from the OUTER CONTINENTAL SHELF.	P00000024894	oil	1,372,553	barrels	1.920E+08	3.09	0.593
299-30	Annual Summary of Production for Entire Region 1947-1952	From 1947–1952, the DEPARTMENT OF THE INTERIOR authorized the production of 20,251,438 MCF of natural gas from the OUTER CONTINENTAL SHELF.	P00000024894	natural gas	20,251,438,000	cubic feet	4.036E+08	2.75	1.110
299-60	Fact Sheet on Methane and Waste Prevention Rule	Between 2009 and 2015, oil and gas producers on FEDERAL AND INDIAN LANDS vented, FLARED, and LEAKED approximately 462 BCF of natural gas.	P00000024330	natural gas	462,000,000,000	cubic feet	9.207E+09	2.75	25.318
299-61	Regulatory Impact Analysis for 43 CFR 3179	In 2014, 30 BCF of natural gas was vented from producing operations from Federal and Indian leases.	P00000024341	natural gas *vented*	30,000,000,000	cubic feet	5.978E+08	2.75	1.644
299-61	Regulatory Impact Analysis for 43 CFR 3179	In 2014, 83 BCF of natural gas was flared from producing operations from Federal and Indian leases.	P00000024341	natural gas	83,000,000,000	cubic feet	9.964E+10	2.75	274.010

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-69	Gas Hydrates on Alaska's North Slope	In 2008 the DEPARTMENT OF THE INTERIOR U.S. Geological Survey conducted an assessment and found an estimated 85.4 trillion cubic feet of undiscovered, technically recoverable gas from natural GAS HYDRATES on the Alaskan North Slope.	P00000025005	natural gas	85,400,000,000,000	cubic feet	9.964E+10	2.75	274.010
299-71	New Interior Department Survey Shows Significant Increase in Recoverable Energy Resources in Federal, State and Tribal Lands and Waters in Alaska	The DEPARTMENT OF THE INTERIOR, through the U.S. Geological Survey and the Bureau of Ocean Energy Management, has estimated there are 17.6 billion barrels of technically recoverable oil in the National Petroleum Reserve in Alaska (NPR-A), the Western Beaufort Sea, adjacent State and Native lands, and State waters.	P00000024954	oil	17,600,000,000	barrels	2.462E+12	3.09	7,608.811
299-71	New Interior Department Survey Shows Significant Increase in Recoverable Energy Resources in Federal, State and Tribal Lands and Waters in Alaska	The DEPARTMENT OF THE INTERIOR, through the U.S. Geological Survey and the Bureau of Ocean Energy Management, has estimated there are more than 50 trillion cubic feet of technically recoverable natural gas in the National Petroleum Reserve in Alaska (NPR-A), the Western Beaufort Sea, adjacent State and Native lands, and State waters.	P00000024954	natural gas	50,000,000,000,000	cubic feet	9.964E+10	2.75	274.010
299-109	Coal and Coke: Monthly Indicator for Internal U.S. Waterways	Between Jan 2014 and March 2018, approximately 572.2 million short tons of coal and coke were transported via INTERNAL U.S. WATERWAYS.	P00000019924	coal (unspecified grade) and coke	572.20	million short tons	5.191E+11	3.18	1,650.710
299-110	The U.S. Waterway System: 2016 Transportation Facts & Information 4 (2017)	Domestic traffic transported 130 million short tons of coal through U.S. waterways in 2016	P00000019926	coal (unspecified grade)	130,000,000	short tons	1.179E+11	3.18	375.030
299-110	The U.S. Waterway System: 2016 Transportation Facts & Information 4 (2017)	Domestic traffic transported 89.5 million short tons of crude petroleum through U.S. waterways in 2016	P00000019926	crude petroleum	89,500,000	short tons	8.119E+10	3.09	250.887

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
299-112	Petroleum: Monthly Indicator for Internal U.S. Waterways	Between January 2014 and March 2018, 706.7 million short tons of petroleum were transported via INTERNAL U.S. WATERWAYS.	P00000020213	petroleum	706,700,000	short tons	6.411E+11	3.09	1,981.023
299-165	U.S. Exports of Crude Oil	Between 1900 and 2017, the United States exported 3,722,078 thousand barrels of crude oil.	P00000018181	oil	3,722,078	thousand barrels	5.208E+11	3.09	1,609.124
299-167	U.S. Crude Oil Exports: Licensing and Data Issues	The overall quantity of U.S. crude oil exports was 10 million barrels in 2007.	P00000018046	oil	10,000,000	barrels	1.399E+09	3.09	4.323
299-167	U.S. Crude Oil Exports: Licensing and Data Issues	The overall quantity of U.S. crude oil exports is over 24 million barrels in 2012, virtually all of which was destined for Canada.	P00000018046	oil	24,000,000	barrels	3.358E+09	3.09	10.376
341-110	Secretary Zinke Issues Lease for 56 Million Tons of Coal in Central Utah	The Utah BLM office held a competitive coal lease sale for 6,175 acres of the underground Greens Hollow coal lease tract following several stages of environmental analysis. It is estimated to contain more than 55 million tons of recoverable, high-energy-producing coal.	P00000048401	coal (unspecified grade)	55,000,000	tons	4.990E+10	3.18	158.667
341-111	Gulf of Mexico Region-Wide Oil and Gas Lease Sale Yields $121 Million in High Bids on 508,096 Acres	The estimated amount of resources projected to be developed as a result of the region-wide lease sale ranges from approximately 0.21 to 1.12 billion barrels of oil	P00000048407	oil	210,000,000	barrels	2.938E+10	3.09	90.787
341-111	Gulf of Mexico Region-Wide Oil and Gas Lease Sale Yields $121 Million in High Bids on 508,096 Acres	The estimated amount of resources projected to be developed as a result of the region-wide lease sale ranges from approximately 0.55 to 4.42 trillion cubic feet of gas.	P00000048407	natural gas	550,000,000,000	cubic feet	9.964E+10	2.75	274.010
341-132	USDA Final Report Pursuant to Exec. Order 13782 on Promoting Energy Independence and Economic Growth	In FY 2016, 14.1 million barrels of oil were produced from federal leases on NFS lands.	P00000049247	oil	14,100,000	barrels	1.973E+09	3.09	6.096

Docket #	Title of Document	Fact from document	Bates Number of citation	Fuel type	Quantity	Unit	Mass of Fuel (kg)	Emissions factor (kg-CO2/kg-fuel)	CO2 Emissions quantity (Tg, or million metric tonnes-CO2) (1 Tg = 10^12 g = 10^9 kg)
341-132	USDA Final Report Pursuant to Exec. Order 13782 on Promoting Energy Independence and Economic Growth	In FY 2016, 141 million cubic feet of natural gas were produced from federal leases on NFS lands.	P00000049247	natural gas	141,000,000	cubic feet	9.964E+10	2.75	274.010
341-132	USDA Final Report Pursuant to Exec. Order 13782 on Promoting Energy Independence and Economic Growth	Over 47 million tons of federally owned coal were produced from NFS lands in fiscal year 2016.	P00000049246	coal (unspecified grade)	47,000,000	tons	4.264E+10	3.18	135.588
341-135	Interior Announces Region-wide Oil and Gas Lease Sale for Gulf of Mexico	The Gulf of Mexico OCS, covering about 160 million acres, contains about 48 billion barrels of undiscovered technically recoverable oil	P00000049373	oil	48,000,000,000	barrels	6.716E+12	3.09	20,751.303
341-135	Interior Announces Region-wide Oil and Gas Lease Sale for Gulf of Mexico	The Gulf of Mexico OCS, covering about 160 million acres, contains about 141 trillion cubic feet of undiscovered technically recoverable gas.	P00000049373	natural gas	141,000,000,000,000	cubic feet	9.964E+10	2.75	274.010
341-136	Small-Scale Natural Gas Exports, Final Rule, 83 Fed. Reg. 35106	The application proposes to export natural gas in a volume up to and including 51.75 billion cubic feet (Bcf) per year (Bcf/yr)	P00000049377	natural gas	51,750,000,000	cubic feet	9.964E+10	2.75	274.010
341-218	Energy Policy: Options to Reduce Environmental and Other Costs of Gasoline Consumption	In 1991 the United States used gasoline at a rate of about 301 million gallons per day, or 109.9 billion gallons per year	P00000062382	gasoline	109,865,000,000	gallons	3.109E+11	3.3	1,026.029

Conversion units	Value	Emission factor type	Emission factor (kg-CO2/kg-fuel)
kg-crude oil/barrel-oil	139.909	Crude oil	3.09
kg-natural gas/cubic-foot-natural gas	0.01992768	Natural gas	2.75
kg-gasoline/gallon	2.83	Gasoline	3.3
kg-kerosene/gallon	3.03	Average U.S. coal	3.18
kg per U.S (short) ton	907.185	Kerosene (jet fuel)	3
		Diesel	3.15

ATTACHMENT B

Rebuttal Expert Report of Mark Jacobson

Juliana et al. v. United States et al.
In the United States District Court
District of Oregon
Case No. 6:15-cv-01517-TC

DOE/FE Order Number	FE Docket Number	Company	Date Approved	Title of Document	Volume	Duration of Permit	Duration of Permit in Days	Equation	Total Gas For Project (CF)	Link	Date Accessed
1068	95-44-NG	Consumers Power Company	June 30, 1995	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	28000 MCF/day	1 year, 11 months	700	28,000,000x700	19,600,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1995/orders/ord1068.pdf	9/10/2018
1088	95-64-NG	Altresco Pittsfield, L.P.	Sep. 28, 1995	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	22420 MCF/day	14 years, 10 months	5,414	22,420,000x5414	121,381,880,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1995/orders/ord1088.pdf	9/10/2018
1089	95-65-NG	Altresco Pittsfield, L.P.	Sep. 28, 1995	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	11757 MCF/day	16 years		11,757,000x365x16	68,660,880,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1995/orders/ord1089.pdf	9/10/2018
1115	95-100-LNG	Distrigas Corporation	Nov. 7, 1995	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS	100 BCF/year	40 years		100,000,000,000x40	4,000,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1995/orders/ord1115.pdf	9/10/2018
1135	95-109-NG	Enron Capital & Trade Resources Corp.	Dec. 20, 1995	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	15 MMCF/day	10 years		15,000,000x365x10	54,750,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1995/orders/ord1135.pdf	9/10/2018
1139	95-111-NG	Vermont Gas Systems	Jan. 2, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	19000 MCF/day	15 years		19,000,000x365x15	104,025,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1139.pdf	9/10/2018
1151	96-02-NG	Eastern Energy Marketing (Statoil)	Mar. 27, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	2677 MCF/day	20 years		2,677,000x365x20	19,542,100,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1151.pdf	9/10/2018
1152	96-03-NG	Eastern Energy Marketing (Statoil)	Mar. 27, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	2826 MCF/day	20 years		2,826,000x365x20	20,629,800,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1152.pdf	9/10/2018
1156	96-10-NG	Progas U.S.A., Inc.	Mar. 29, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	15000 MCF/day	5 years		15,000,000x365x5	27,375,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1156.pdf	9/10/2018
1165	96-22-NG	NUI Corp. / Tennessee Gas Pipeline Co.	May 16, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA AND AMENDING AUTHORIZATION	1960 MCF/day	~6.5 years	2,358	1,960,000x2358	4,621,680,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1165.pdf	9/10/2018
1190	96-26-NG	St. Lawrence Gas Co., Inc.	July 26, 1996	ORDER AMENDING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	5.26 BCF/year	10 years		5,260,000,000x10	52,600,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1190.pdf	9/10/2018
1178	96-31-NG	Crestar Energy Marketing Corp.	June 25, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	6347 MCF/day	5 years, ~4months	1,954	6,347,000x1954	12,402,038,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1178.pdf	9/10/2018
1182	96-39-NG	North Canadian Marketing Corp.	June 26, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	25000 MCF/day	15 years		25,000,000x365x15	136,875,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1182.pdf	9/10/2018

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1201	96-50-NG	Coastal Gas Marketing Co.	Sep. 18, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	18100 MCF/day	11 years		18,100,000x365x11	72,671,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1201.pdf	9/10/2018
1202	96-52-NG	Coastal Gas Marketing Co.	Sep. 24, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	48300 MCF/day	11 years		48,300,000x365x11	193,924,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1202.pdf	9/10/2018
1195	96-54-NG	Interenergy Sheffield Processing Co.	Sep. 11, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	3300 MCF/day	14 years		3,300,000x365x14	16,863,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1195.pdf	9/10/2018
1197	96-60-NG	Progas U.S.A., Inc.	Sep. 16, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	10309 MCF/day	6 years		10,309,000x365x6	22,576,710,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1197.pdf	9/10/2018
1198	96-61-NG	Progas U.S.A., Inc.	Sep. 16, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	7841 MCF/day	4 years		7,841,000x365x4	11,447,860,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1198.pdf	9/10/2018
1206	96-65-NG	Progas U.S.A., Inc.	Oct. 16, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	16402 MCF/day	10 years		16,402,000x365x10	59,867,300,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1206.pdf	9/10/2018
1220	96-73-NG	United States Gypsum Company	Oct. 31, 1996	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	13500 MCF/Day	10 years		13,500,000x365x10	49,275,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1996/orders/ord1220.pdf	9/10/2018
1273	97-24-NG	Aquila Energy Marketing Corp.	May 9, 1997	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA AND MEXICO	200 BCF total	2 years			200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1273.pdf	9/10/2018
1266	97-28-NG	Panenergy Trading and Marketing Services	Mar. 20, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	8782 MCF/day	10 years		8,782,000x365x10	32,054,300,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1266.pdf	9/10/2018
1272	97-35-NG	United States Gypsum Company	May 6, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	13600 MCF/day	10 years		13,600,000x365x10	49,640,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1272.pdf	9/10/2018
1327	97-81-NG	Sierra Pacific Power Company	Nov. 5, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	15000 MMbtu/day	3 years		(15,000,000,000x365x3)/ 1,037	15,838,958,535	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1327.pdf	9/10/2018
1329	97-87-NG	Progas U.S.A., Inc.	Nov. 6, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	26500 MCF/day	10 years		26,500,000x365x10	96,725,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1329.pdf	9/10/2018
1326	97-88-NG	Progas U.S.A., Inc.	Oct. 31, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	7850 MCF/day	10 years		7,850,000x365x10	28,652,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1326.pdf	9/10/2018

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1330	97-89-NG	Progas U.S.A., Inc.	Nov. 6, 1997	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	30000 MCF/day	10 years		30,000,000x365x10	109,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1997/orders/ord1330.pdf	9/10/2018
1354	98-05-NG	Tenaska Washington Partners, L.P.	Jan. 28, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	50000 MCF/day	12 years		50,000,000x365x12	219,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1354.pdf	9/12/2018
1361	98-08-NG	Vermont Gas Systems	Feb. 10, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	8000 MCF/day	10 years		8,000,000x365x10	29,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1361.pdf	9/12/2018
1367	98-12-NG	Enron Capital & Trade Resources Corp.	Mar. 6, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	9,051 MCF/day	10 years		9,051,000x365x10	33,036,150,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1367.pdf	9/12/2018
1373	98-19-NG	Husky Gas Marketing, Inc.	Apr. 7, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	21,881 MCF/day	5 years		21,881,000x365x5	39,932,825,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1373.pdf	9/12/2018
1382	98-20-NG	Transcanada Gas Services, Inc.	May 8, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	11 BCF/year	10 years		11,000,000,000x10	110,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1382.pdf	9/12/2018
1385	98-30-NG	Rock-Tenn Co., Mill Division, Inc.	May 20, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	0.8 BCF/year	10 years		800,000,000x10	8,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1385.pdf	9/12/2018
1430	98-76-NG	Chevron U.S.A., Inc.	Oct. 30, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	1500 MCF/day	13 years		1,500,000x365x13	7,117,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1430.pdf	9/12/2018
1434	98-83-NG	Rumford Power Associates Limited Partnership	Nov. 9, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA FOR SUBSEQUENT RE-IMPORT	46000 MCF/day	8 years		46,000,000x365x8	134,320,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1434.pdf	9/12/2018
1432	98-85-NG	Renaissance Energy (U.S.) Inc.	Nov. 2, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	23404 MCF/day	10 years		23,404,000x365x10	85,424,600,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1432.pdf	9/12/2018
1435	98-87-NG	Pemex Gas y Petroquimica Basica	Nov. 12, 1998	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS, INCLUDING LIQUEFIED NATURAL GAS FROM AND TO CANADA AND MEXICO	160 BCF total	2 years			160,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1435.pdf	9/12/2018
1444	98-92-NG	Union Pacific Fuels, Inc.	Dec. 17, 1998	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO	200 BCF total	2 years			200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1444.pdf	9/12/2018
1445	98-98-NG	Boston Gas Company	Dec. 17, 1998	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	43200 MCF/day	8 years		43,200,000x365x8	126,144,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1445.pdf	9/12/2018

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1470	99-19-NG	Enron Capital & Trade Resources Corp.	Mar. 18, 1999	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	20000 MCF/day	10 years		20,000,000x365x10	73,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1999/orders/ord1470.pdf	9/12/2018
1474	99-22-NG	Cascade Natural Gas Corp.	Apr. 6, 1999	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	1) 25000 MMbtu/day 2) 15000 MMbtu/day	1) 5 months 2) 7 months	1) 151 2) 214	1) 25,000,000,000 x 151/ 1,037 2) 15,000,000,000 x 214/ 1,037	6,735,776,278	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1999/orders/ord1474.pdf	9/12/2018
1479	99-26-NG	Progas U.S.A., Inc.	May 5, 1999	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	65000 MCF/day	15 years		65,000,000x365x15	355,875,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1999/orders/ord1479.pdf	9/12/2018
1484	99-27-NG	City of Duluth, MN	May 20, 1999	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	6120 MCF/day	10 years		6,120,000x365x10	22,338,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1999/orders/ord1484.pdf	9/12/2018
1543	99-92-NG	Transcanada Gas Services, Inc.	Nov. 23, 1999	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	68463 MCF/day	7 years		68,463,000x365x7	174,922,965,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1999/orders/ord1543.pdf	9/12/2018
1449	98-102-NG	St. Lawrence Gas Co., Inc.	Dec. 28, 1999	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	16.3 BCF total	2 years			16,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/1998/orders/ord1449.pdf	9/12/2018
1573	00-10-NG	RDO Foods Co.	Mar. 8, 2000	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	1423 MCF/day	8 years, 7 months	3,134	1,423,000x3134	4,459,682,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2000/orders/ord1573.pdf	9/12/2018
1678	01-15-NG	Energia Azteca X,S. De R.L. De C.V.	May 7, 2001	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	135000 MCF/day	15 years		135,000,000x365x15	739,125,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2001/orders/ord1678.pdf	9/12/2018
1694	01-28-NG	H.Q. Energy Services (U.S.) Inc.	June 25, 2001	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	48500 MCF/day	5 years		48,500,000x365x5	88,512,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2001/orders/ord1694.pdf	9/12/2018
1703	01-38-NG	Sierra Production Company	Aug. 10, 2001	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	5000 MCF/day	15 years		5,000,000x365x15	27,375,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2001/orders/ord1703.pdf	9/12/2018
1765	02-15-NG	Midland Cogeneration Venture Limited Partnership	Apr. 9, 2002	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	10000 MCF/day	8 years		10,000,000x365x8	29,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2002/orders/ord1765.pdf	9/12/2018
1780	02-26-LNG	El Paso Merchant Energy, L.P.	May 29, 2002	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS	91.25 million MMbtu total	22 years		(91,250,000x1,000,000)/ 1037	87,994,214,079	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2002/orders/ord1780.pdf	9/12/2018
1807	02-59-NG	Midland Cogeneration Venture Limited Partnership	Sep. 12, 2002	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	10000 MCF/day	3 years		10,000,000x365x3	10,950,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2002/orders/ord1807.pdf	9/12/2018

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1839	02-96-NG	Northern Utilities, Inc.	Jan. 2, 2003	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	62748 MCF/day	3 years, ~3 months	1,170	62,748,000x1170	73,415,160,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2003/orders/ord1839.pdf	9/12/2018
1843	02-97-NG	Bay State Gas Co.	Jan. 7, 2003	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	62748 MCF/day	2 years, ~ 3 months	805	62,748,000x805	50,294,790,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2003/orders/ord1843.pdf	9/12/2018
1932	03-76-LNG	BG LNG Services, LLC	Dec. 30, 2003	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE FEDERAL REPUBLIC OF NIGERIA	2600 Tbtus total	20 years		(2,600x1,000,000,000,000)/ 1037	2,507,232,401,157	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2003/orders/ord1932.pdf	9/12/2018
1877	03-30-NG	TransAlta Chihuahua S.A. de C.V.	July 15, 2003	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	49500 MCF/day	5 years		49,500,000x365x5	90,337,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2003/orders/ord1877.pdf	9/12/2018
1970	04-22-NG	Boston Gas Company	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1970.pdf	9/12/2018
1958	04-23-NG	Essex Gas Company	Mar. 30, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 37225 MCF/day	3 years		37,225,000x365x3	40,761,375,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1958.pdf	9/12/2018
1959	04-24-NG	Boston Gas Company	Mar. 30, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 37225 MCF/day	3 years		37,225,000x365x3	40,761,375,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1959.pdf	9/12/2018
1966	04-25-NG	Essex Gas Company	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1966.pdf	9/12/2018
1960	04-26-NG	The Brooklyn Union Gas Company	Mar. 30, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 37225 MCF/day	3 years		37,225,000x365x3	40,761,375,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1960.pdf	9/12/2018
1961	04-27-NG	Keyspan Gas East Corp.	Mar. 30, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 37225 MCF/day	3 years		37,225,000x365x3	40,761,375,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1961.pdf	9/12/2018
1971	04-28-NG	The Berkshire Gas Co.	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1971.pdf	9/12/2018
1969	04-29-NG	The Brooklyn Union Gas Company	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1969.pdf	9/12/2018
1967	04-30-NG	Keyspan Gas East Corp.	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1967.pdf	9/12/2018

DOE/FE Order Number	FE Docket Number	Company	Date Approved	Title of Document	Volume	Duration of Permit	Duration of Permit in Days	Equation	Total Gas For Project (CF)	Link	Date Accessed
1968	04-32-NG	EnergyNorth Natural Gas, Inc.	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 27508 MCF/day	3 years		27,508,000x365x3	30,121,260,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1968.pdf	9/12/2018
1962	04-33-NG	EnergyNorth Natural Gas, Inc.	Apr. 1, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	Up to 37225 MCF/day	3 years		37,225,000x365x3	40,761,375,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1962.pdf	9/12/2018
1977	04-39-NG	BG LNG Services, LLC	Apr. 19, 2004	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES	58 BCF/year	17 years		58,000,000,000x17	986,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord1977.pdf	9/12/2018
2045	04-106-NG	Cascade Natural Gas Corp.	Nov. 16, 2004	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	6.4 BCF/year	5 years		6,400,000,000x5	32,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord2045.pdf	9/12/2018
2046	04-107-NG	Cascade Natural Gas Corp.	Nov. 16, 2004	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	20000 MCF/day	4 years		20,000,000x365x4	29,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord2046.pdf	9/12/2018
2051	04-121-NG	Cascade Natural Gas Corp.	Dec. 6, 2004	ORDER GRANTING AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	0.5 BCF/year	4 years, 3 months (4.25 years)	1,550	500,000,000x4.25	2,125,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2004/orders/ord20512.pdf	9/12/2018
2104	05-24-NG	Ocean State Power II	June 24, 2005	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	25339 MMbtu/day	3 years, 8 months	1,340	(25,339,000,000x1340)/ 1037	32,742,777,242	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2005/orders/ord2104.pdf	9/12/2018
2103	05-25-NG	Ocean State Power I	June 24, 2005	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	50679 MMbtu/day	3 years, 8 months	1,340	(50,679,000,000x1340)/ 1037	65,486,846,673	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2005/orders/ord2103.pdf	9/12/2018
2105	05-27-NG	Ocean State Power II	June 24, 2005	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	25339 MMbtu/day	3.5 years	1,340	(25,339,000,000x1340)/ 1037	32,742,777,242	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2005/orders/ord2105.pdf	9/12/2018
2199	05-114-LNG	BG LNG Services, LLC	May 22, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUIFIED NATURAL GAS FROM THE REPUBLIC OF TRINIDAD AND TOBAGO	101.4 BCF/year	20 years		101,400,000,000x20	2,028,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2199.pdf	9/12/2018
2186	05-48-NG	Selkirk Cogen Partners, L.P.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA AND TO VACATING PRIOR AUTHORIZATION	20660 MCF/day	9 years, 10 months	3,589	20,660,000x3589	74,148,740,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2186.pdf	9/12/2018
2164	05-49-NG	Selkirk Cogen Partners, L.P.	Dec. 28, 2005	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	23000 MMbtu/day	10 years		(23,000,000,000x365x10)/ 1037	80,954,676,953	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2005/orders/ord2164.pdf	9/12/2018
2188	05-50-NG	Selkirk Cogen Partners, L.P.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA AND TO VACATING PRIOR AUTHORIZATION	17000 MCF/day	10 years		17,000,000x365x10	62,050,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2188.pdf	9/12/2018

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2183	05-108-NG	Puget Sound Energy, Inc.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years, 9 months	1,368	(10,000,000,000x1368)/ 1037	13,191,899,710	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2183.pdf	9/12/2018
2182	05-107-NG	Puget Sound Energy, Inc.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	20000 MMbtu/day	2 years, 9 months	1,003	(20,000,000,000x1003)/ 1037	19,344,262,295	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2182.pdf	9/12/2018
2181	05-106-NG	Puget Sound Energy, Inc.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	2 years, 9 months	1,003	(10,000,000,000x1003)/ 1037	9,672,131,147	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2181.pdf	9/12/2018
2180	05-105-NG	Puget Sound Energy, Inc.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years, 9 months	1,368	(10,000,000,000x1368)/ 1037	13,191,899,710	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2180.pdf	9/12/2018
2179	05-104-NG	Puget Sound Energy, Inc.	Mar. 20, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years, 9 months	1,368	(10,000,000,000x1368)/ 1037	13,191,899,710	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2179.pdf	9/12/2018
2288	06-06-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE REPUBLIC OF EQUATORIAL GUINEA	174.15 BCF total	17 years			174,150,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2288.pdf	9/12/2018
2287	06-05-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE ARAB REPUBLIC OF EGYPT	36.84 BCF total	5 years			36,840,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord22871.pdf	9/12/2018
2286	06-04-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE REPUBLIC OF TRINIDAD AND TOBAGO	24.46 BCF total	20 years			24,460,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2286.pdf	9/12/2018
2285	06-03-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE ARAB REPUBLIC OF EGYPT	184.24 BCF total	20 years			184,240,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2285.pdf	9/12/2018
2284	06-02-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES	25.09 BCF total	5 years			25,090,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2284.pdf	9/12/2018
2283	06-01-LNG	BG LNG Services, LLC	Nov. 17, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE ARAB REPUBLIC OF EGYPT	36.84 BCF total	5 years			36,840,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2283.pdf	9/12/2018
2282	06-53-LNG	Consolidated Edison Company of New York, Inc.	Oct. 27, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	44 BCF total	3 years			44,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2282.pdf	9/12/2018
2231	06-19-NG	Puget Sound Energy, Inc.	July 21, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	5000 MMbtu/day	2 years, 8 months	972	(5,000,000,000x972)/1037	4,686,595,949	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2231.pdf	9/12/2018

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2230	06-18-NG	Puget Sound Energy, Inc.	July 21, 2006	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	5000 MMbtu/day	2 years, 8 months	972	(5,000,000,000x972)/1037	4,686,595,949	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2006/orders/ord2230.pdf	9/12/2018
2351	07-22-NG	EnergyNorth Natural Gas, Inc.	May 14, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	3199 MCF/day	5 years		3,199,000x365x5	5,838,175,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2351.pdf	9/12/2018
2352	07-23-NG	Boston Gas Company	May 14, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10758 MCF/day	5 years		10,758,000x365x5	19,633,350,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2352.pdf	9/12/2018
2353	07-24-NG	The Brooklyn Union Gas Company	May 14, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	30571 MCF/day	5 years		30,571,000x365x5	55,792,075,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2353.pdf	9/12/2018
2354	07-25-NG	Keyspan Gas East Corp.	May 14, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	2551 MCF/day	5 years		2,551,000x365x5	4,655,575,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord23541.pdf	9/12/2018
2355	07-26-NG	Essex Gas Company	May 14, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	1661 MCF/day	5 years		1,661,000x365x5	3,031,325,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord23551.pdf	9/12/2018
2429	07-93-NG	Consolidated Edison Company of New York, Inc.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	56.3 BCF total	4 years			56,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2429.pdf	9/12/2018
2430	07-94-NG	Keyspan Gas East Corp.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	56.3 BCF total	4 years			56,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2430.pdf	9/12/2018
2431	07-95-NG	New York State Electric & Gas Corp.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	56.3 BCF total	4 years			56,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2431.pdf	9/12/2018
2432	07-96-NG	The Brooklyn Union Gas Company	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	56.3 BCF total	4 years			56,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2432.pdf	9/12/2018
2433	07-97-NG	Central Hudson Gas & Electric Co.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	56.3 BCF total	4 years			56,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2433.pdf	9/12/2018
2439	07-98-NG	Central Hudson Gas & Electric Co.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2439.pdf	9/12/2018
2434	07-99-NG	The Narragansett Electric Co.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2434.pdf	9/12/2018

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2435	07-100-NG	New York State Electric & Gas Corp.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2435.pdf	9/12/2018
2436	07-101-NG	Keyspan Gas East Corp.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2436.pdf	9/12/2018
2437	07-102-NG	Consolidated Edison Company of New York, Inc.	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2437.pdf	9/12/2018
2438	07-103-NG	The Brooklyn Union Gas Company	Oct. 31, 2007	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	101.5 BCF total	3 years			101,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2007/orders/ord2438.pdf	9/12/2018
2473	08-12-NG	Encinal Gathering, Ltd.	Feb. 29, 2008	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO MEXICO	30 MMCF/day	10 years		30,000,000x365x10	109,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2008/orders/ord2473.pdf	9/12/2018
2489	08-26-NG	Repsol Energy North America Corp.	Apr. 22, 2008	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	9125 BCF total	25 years			9,125,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2008/orders/ord2489.pdf	9/12/2018
2506	08-38-NG	TransAlta Chihuahua S.A. de C.V.	June 20, 2008	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	49500 MCF/day	5 years		49,500,000x365x5	90,337,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2008/orders/ord2506.pdf	9/12/2018
2527	08-64-LNG	BG LNG Services, LLC	Aug. 14, 2008	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE REPUBLIC OF TRINIDAD AND TOBAGO	75.6 Tbtu/year	19 years		(75,600,000,000,000x19)/1037	1,385,149,469,623	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2008/orders/ord2527.pdf	9/12/2018
2592	08-136-NG	Energia Chihuahua S.A. de C.V.	Dec. 18, 2008	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO AND VACATING PRIOR AUTHORIZATION	48000 MMbtu/day	5 years		(48,000,000,000x365x5)/1037	84,474,445,516	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2008/orders/ord2592.pdf	9/12/2018
2609	08-152-LNG	Total Gas & Power North America, Inc.	Feb. 9, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM QATAR	101.3 BCF/year	25 years		101,300,000,000x25	2,532,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2609.pdf	9/12/2018
2717	09-87-NG	Puget Sound Energy, Inc.	Oct. 26, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years		(10,000,000,000x365x3)/1037	10,559,305,690	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2717.pdf	9/12/2018
2718	09-88-NG	Puget Sound Energy, Inc.	Oct. 26, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years		(10,000,000,000x365x3)/1037	10,559,305,690	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2718.pdf	9/12/2018
2719	09-89-NG	Puget Sound Energy, Inc.	Oct. 19, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10000 MMbtu/day	3 years		(10,000,000,000x365x3)/1037	10,559,305,690	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2719.pdf	9/12/2018

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2707	09-95-NG	TransCanada Pipelines Limited	Oct. 7, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	358.5 MMCF/day	3 years		358,500,000x365x3	392,557,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2707.pdf	9/12/2018
2712	09-94-NG	TransCanada Pipelines Limited	Oct. 7, 2009	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	159.3 MMCF/day	3 years		159,300,000x365x3	174,433,500,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2009/orders/ord2712.pdf	9/12/2018
2749	10-06-NG	Cascade Natural Gas Corp.	Feb. 12, 2010	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	4.3 BCF total	4 years, ~8.5 months			4,300,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2749.pdf	9/12/2018
2781	10-36-LNG	Total Gas & Power North America, Inc.	Apr. 22, 2010	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM NORWAY	40 BCF/year	20 years		40,000,000,000x20	800,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2781.pdf	9/12/2018
2782	10-43-NG	LNGJ USA Inc.	Apr. 22, 2010	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA AND MEXICO, AND TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES	300 BCF total	2 years			300,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2782.pdf	9/12/2018
2783	10-37-LNG	Total Gas & Power North America, Inc.	Apr. 28, 2010	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM NIGERIA	59 BCF/year	20 years		59,000,000,000x20	1,180,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2783.pdf	9/12/2018
2833	10-85-LNG	Sabine Pass Liquefaction, LLC	Sep. 7, 2010	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS FROM SABINE PASS LNG TERMINAL TO FREE TRADE NATIONS	803 BCF/year	30 years		803,000,000,000x30	24,090,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord28332.pdf	9/12/2018
2885	10-110-LNG	Sempra LNG Marketing, LLC	Dec. 3, 2010	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS	250 BCF total	2 years			250,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2885.pdf	9/12/2018
2888	10-114-LNG	Chevron U.S.A., Inc.	Dec. 8, 2010	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS	72 BCF total	2 years			72,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2888.pdf	9/12/2018
2898	10-159-LNG	ExxonMobil LNG Supply LLC	Jan. 5, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM QATAR BY VESSEL	406 BCF/year	26 years		406,000,000,000x26	10,556,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord2898.pdf	9/12/2018
2889	10-143-LNG	ConocoPhillips Co.	Dec. 13, 2010	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM QATAR	390 BCF/year	25 years		390,000,000,000x25	9,750,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2010/orders/ord2889.pdf	9/12/2018
2923	10-152-LNG	ENI USA Gas Marketing LLC	Mar. 3, 2011	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS	100 BCF total	2 years			100,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord2923.pdf	9/12/2018

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2913	10-160-LNG	Freeport LNG Expansion and FLNG Liquefaction	Feb. 10, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS FROM FREEPORT LNG TERMINAL TO FREE TRADE NATIONS	511 BCF/year	25 years		511,000,000,000x25	12,775,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord2913.pdf	9/12/2018
2917	11-09-LNG	BG LNG Services, LLC	Feb. 17, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM THE ARAB REPUBLIC OF EGYPT	36.84 BCF/year	5 years		36,840,000,000x5	184,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord2917.pdf	9/14/2018
2986	11-51-LNG	Freeport LNG Expansion, L.P.	July 19, 2011	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	24 BCF total	2 years			24,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord29861.pdf	9/14/2018
2993	11-71-LNG	Carib Energy (USA) LLC	July 27, 2011	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS TO FREE TRADE AGREEMENT NATIONS IN CENTRAL AMERICA, SOUTH AMERICA, OR THE CARRIBEAN BY VESSEL IN ISO CONTAINERS	11.53 BCF/year	25 years		11,530,000,000x25	288,250,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/applications/ord2993.pdf	9/14/2018
2985	11-76-LNG	Puget Sound Energy, Inc.	July 18, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM CANADA BY TRUCK	1 BCF total	3 years, ~5.5 months			1,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/applications/ord2985.pdf	9/14/2018
2989	11-85-NG	Cascade Natural Gas Corp.	July 25, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	1.1 BCF total	3 years			1,100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/applications/ord2989.pdf	9/14/2018
2990	11-86-NG	Cascade Natural Gas Corp.	July 25, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	2.5 BCF total	2 years, 9 months			2,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/applications/ord2990.pdf	9/14/2018
3055	11-98-NG	Dominion Cove Point LNG, L.P.	Jan. 9, 2012	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	150 BCF total	2 years			150,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/applications/ord30551.pdf	9/14/2018
3038	11-109-LNG	ConocoPhillips Co.	Nov. 22, 2011	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	500 BCF total	2 years			500,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3038.pdf	9/14/2018
3019	11-115-LNG	Dominion Cove Point LNG, L.P.	Oct. 7, 2011	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE COVE POINT LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	1 BCF/day	25 years		1,000,000,000x365x25	9,125,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3019.pdf	9/14/2018
3022	11-116-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	17.8 BCF total	5 years			17,800,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3022.pdf	9/14/2018
3023	11-117-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	35.5 BCF total	5 years			35,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3023.pdf	9/14/2018

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3024	11-118-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	14.2 BCF total	4 years			14,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3024.pdf	9/14/2018
3025	11-119-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	14.2 BCF total	4 years			14,200,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3025.pdf	9/14/2018
3026	11-120-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	7.1 BCF total	4 years			7,100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3026.pdf	9/14/2018
3027	11-121-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	7.1 BCF total	4 years			7,100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3027.pdf	9/14/2018
3028	11-122-NG	Puget Sound Energy, Inc.	Oct. 31, 2011	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	7.1 BCF total	4 years			7,100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3028.pdf	9/14/2018
3041	11-127-LNG	Jordan Cove Energy Project, L.P.	Dec. 7, 2011	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE JORDAN COVE LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	438 BCF/year	30 years		438,000,000,000x30	13,140,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2011/orders/ord3041.pdf	9/14/2018
3059	11-145-LNG	Cameron LNG, LLC	Jan. 17, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE CAMERON LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	620 BCF/year	20 years		620,000,000,000x20	12,400,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3059.pdf	9/14/2018
3066	12-06-LNG	Freeport LNG Expansion and FLNG Liquefaction	Feb. 10, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE FREEPORT LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	511 BCF/year	25 years		511,000,000,000x25	12,775,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3066.pdf	9/14/2018
3104	12-47-LNG	Gulf LNG Liquefaction Co., LLC	June 15, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE GULF LNG ENERGY, LLC TERMINAL TO FREE TRADE AGREEMENT NATIONS	547.5 BCF/year	25 years		574,500,000,000x25	14,362,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3104.pdf	9/14/2018
3105	12-50-LNG	SB Power Solutions Inc.	June 15, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS TO FREE TRADE AGREEMENT NATIONS IN CENTRAL AMERICA, SOUTH AMERICA, OR THE CARRIBEAN BY VESSEL IN ISO CONTAINERS	26.78 BCF/year	25 years		26,780,000,000x25	669,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3105.pdf	9/14/2018

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3106	12-54-LNG	Southern LNG Co., L.L.C.	June 15, 2012	ORDER GRANTING LONG-TERM MULTI CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE ELBA ISLAND TERMINAL TO FREE TRADE AGREEMENT NATIONS	182.5 BCF/year	25 years		182,500,000,000x25	4,562,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3106.pdf	9/14/2018
3162	12-76-LNG	The Dow Chemical Company	Oct. 11, 2012	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	390 BCF total	2 years			390,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3162.pdf	9/14/2018
3147	12-88-LNG	Golden Pass Products LLC	Sep. 27, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE GOLDEN PASS LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	740 BCF/year	25 years		740,000,000,000x25	18,500,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3147.pdf	9/14/2018
3151	12-91-NG	TransCanada Pipelines Limited	Oct. 4, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	52.2 BCF/year	3 years		52,200,000,000x3	156,600,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3151.pdf	9/14/2018
3152	12-92-NG	TransCanada Pipelines Limited	Oct. 4, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	13 BCF/year	3 years		13,000,000,000x3	39,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3152.pdf	9/14/2018
3164	12-99-LNG	Cherniere Marketing, LLC	Oct. 16, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED CORPUS CHRISTI LIQUEFACTION PROJECT TO FREE TRADE AGREEMENT NATIONS	767 BCF/year	25 years		767,000,000,000x25	19,175,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3164.pdf	9/14/2018
3185	12-105-NG	Puget Sound Energy, Inc.	Nov. 13, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	5.5 BCF total	3 years			5,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3185correct.pdf	9/14/2018
3186	12-106-NG	Puget Sound Energy, Inc.	Nov. 13, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10.95 BCF total	3 years			10,950,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3186correct.pdf	9/14/2018
3187	12-107-NG	Puget Sound Energy, Inc.	Nov. 13, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10.95 BCF total	3 years			10,950,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3187correct.pdf	9/14/2018
3188	12-108-NG	Puget Sound Energy, Inc.	Nov. 13, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	21.9 BCF total	3 years			21,900,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3188.pdf	9/14/2018
3189	12-109-NG	Puget Sound Energy, Inc.	Nov. 13, 2012	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	21.9 BCF total	3 years			21,900,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3189.pdf	9/14/2018

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3193	12-123-LNG	CE FLNG, LLC	Nov. 21, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED CE FLNG LNG TERMINAL IN PLAQUEMINES PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	391 BCF/year	30 years		391,000,000,000x30	11,730,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3193.pdf	9/14/2018
3246	12-151-NG	J.P. Morgan Commodities Canada Corp.	Feb. 27, 2013	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA	440000 MCF/day	10 years		440,000,000x365x10	1,606,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3246.pdf	9/14/2018
3211	12-152-LNG	Waller LNG Services, LLC	Dec. 20, 2012	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED WALLER POINT LNG TERMINAL IN CAMERON PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	58.4 BCF/year	25 years		58,400,000,000x25	1,460,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2012/orders/ord3211.pdf	9/14/2018
3231	12-155-LNG	Sempra LNG Marketing, LLC	Feb. 13, 2013	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	250 BCF total	2 years			250,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3231.pdf	9/14/2018
3247	12-161-LNG	ENI USA Gas Marketing LLC	Mar. 5, 2013	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	100 BCF total	2 years			100,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3247.pdf	9/14/2018
3222	12-168-CNG	Xpress Natural Gas LLC	Jan. 8, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT COMPRESSED NATURAL GAS BY TRUCK FROM THE PROPOSED COMPRESSOR STATION IN BAILEYVILLE, MAINE, TO CANADA	12.5 BCF/year	12 years		12,500,000,000x12	150,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3222.pdf	9/14/2018
3227	12-174-LNG	Pangea LNG (North America) Holdings, LLC	Jan. 20, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED SOUTH TEXAS LNG EXPORT PROJECT TO FREE TRADE AGREEMENT NATIONS	398.5 BCF/year	25 years		398,500,000,000x25	9,962,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord32271.pdf	9/14/2018
3274	12-178-NG	Cascade Natural Gas Corp.	May 1, 2013	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	2.7 BCF total	3 years			2,700,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3274.pdf	9/14/2018
3275	12-179-NG	Cascade Natural Gas Corp.	May 1, 2013	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	6.4 BCF total	3 years			6,400,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3275.pdf	9/14/2018
3276	12-180-NG	Cascade Natural Gas Corp.	May 1, 2013	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	5.1 BCF total	3 years			5,100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3276.pdf	9/14/2018

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3245	12-183-LNG	Magnolia LNG, LLC	Feb. 26, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED MAGNOLIA LNG TERMINAL IN LAKE CHARLES, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	197.1 BCF/year	25 years		197,100,000,000x25	4,927,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3245.pdf	9/14/2018
3252	13-04-LNG	Trunkline LNG Exports, LLC	Mar. 7, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE LAKE CHARLES LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	730 BCF/year	25 years		730,000,000,000x25	18,250,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3252.pdf	9/14/2018
3253	13-06-LNG	Gasfin Development USA, LLC	Mar. 7, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED GASFIN LNG EXPORT PROJECT IN CAMERON PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	74 BCF/year	25 years		74,000,000,000x25	1,850,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3253.pdf	9/14/2018
3290	13-26-LNG	Freeport-McMoran Energy LLC	May 24, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED MAIN PASS ENERGY HUB™ DEEPWATER PORT 16 MILES OFFSHORE OF LOUISIANA TO FREE TRADE AGREEMENT NATIONS	1175 BCF/year	30 years		1,175,000,000,000x30	352,500,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3290.pdf	9/14/2018
3306	13-30-LNG	Sabine Pass Liquefaction, LLC	July 11, 2013	ORDER GRANTING AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL PURSUANT TO THE LONG-TERM CONTRACT WITH TOTAL GAS & POWER NORTH AMERICA, INC. FROM THE SABINE PASS LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	101 BCF/year	20 years		101,000,000,000x20	2,020,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3306.pdf	9/14/2018
3307	13-42-LNG	Sabine Pass Liquefaction, LLC	July 12, 2013	ORDER GRANTING AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL PURSUANT TO THE LONG-TERM CONTRACT WITH CENTRICA PLC FROM THE SABINE PASS LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	88.3 BCF/year	20 years		88,300,000,000x20	1,766,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3307.pdf	9/14/2018
3317	13-51-LNG	Freeport LNG Development, L.P.	July 19, 2013	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	24 BCF total	2 years			24,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3317.pdf	9/14/2018
3345	13-69-LNG	Venture Global LNG, LLC	Sep. 27, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED VENTURE GLOBAL LNG PROJECT IN CAMERON PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	243.6 BCF/year	25 years		243,600,000,000x25	6,090,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3345.pdf	9/14/2018
3359	13-97-LNG	ConocoPhillips Co.	Nov. 7, 2013	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	500 BCF total	2 years			500,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3359.pdf	9/14/2018

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3360	13-104-LNG	Advanced Energy Solutions, LLC	Nov. 14, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS LOADED AT THE FLORIDIAN FACILITY IN MARIN COUNTY, FLORIDA, AND EXPORTED VIA OCEAN-GOING VESSEL TO FREE TRADE AGREEMENT NATIONS IN CENTRAL AMERICA AND THE CARIBBEAN	8 BCF/year	25 years		8,000,000,000x25	200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3360.pdf	9/14/2018
3356	13-105-LNG	Argent Marine Management, Inc.	Nov. 6, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN APPROVED ISO CONTAINERS LOADED AT THE TRUSSVILLE, ALABAMA, LNG FACILITY AND EXPORTED VIA OCEAN-GOING VESSEL TO FREE TRADE AGREEMENT NATIONS	1 BCF/year	25 years		1,000,000,000x25	25,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3356.pdf	9/14/2018
3364	13-115-LNG	EOS LNG LLC	Nov. 26, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PORT OF BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	584 BCF/year	25 years		584,000,000,000x25	14,600,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3364.pdf	9/14/2018
3365	13-117-LNG	Barca LNG LLC	Nov. 26, 2013	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PORT OF BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	584 BCF/year	25 years		584,000,000,000x25	14,600,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3365.pdf	9/14/2018
3348	13-120-NG	Energia Chihuahua S.A. de C.V.	Oct. 24, 2013	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	50000 MMbtu/day	5 years		(50,000,000,000x365x5)/ 1037	87,994,214,079	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3348.pdf	9/14/2018
3384	13-121-LNG	Sabine Pass Liquefaction, LLC	Jan. 22, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE SABINE PASS LNG TERMINAL TO FREE TRADE AGREEMENT NATIONS	314 BCF/year	20 years		314,000,000,000x20	6,280,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3384.pdf	9/14/2018
3371	13-122-LNG	Goven Natural Gas Holdings, LLC	Dec. 12, 2013	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS TO DOMINICAN REPUBLIC, EL SALVADOR, GUATEMALA, HONDURAS, AND NICARAGUA IN ISO CONTAINERS BY VESSEL	2 BCF total	2 years			2,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2013/orders/ord3371.pdf	9/14/2018
3393	13-129-LNG	Delfin LNG LLC	Feb. 20, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM A PROPOSED FLOATING LIQUEFACTION PROJECT AND DEEPWATER PORT 30 MILES OFFSHORE OF LOUISIANA TO FREE TRADE AGREEMENT NATIONS	657.5 BCF/year	20 years		657,500,000,000x20	13,150,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3393.pdf	9/14/2018

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3406	13-131-LNG	Magnolia LNG, LLC	Mar. 5, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED MAGNOLIA LNG TERMINAL IN LAKE CHARLES, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	197.1 BCF/year	25 years		197,100,000,000x25	4,927,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3406.pdf	9/14/2018
3394	13-140-LNG	Annova LNG, LLC	Feb. 20, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED ANNOVA LNG TERMINAL IN BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	342 BCF/year	30 years		342,000,000,000x30	10,260,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3394.pdf	9/14/2018
3412	13-141-LNG	Jordan Cove LNG L.P.	Mar. 18, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA TO THE PROPOSED JORDAN COVE LNG TERMINAL IN THE PORT OF COOS BAY, OREGON	565.75 BCF/year	25 years		565,750,000,000x25	14,143,750,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3412.pdf	9/14/2018
3378	13-152-LNG	Encana Natural Gas Inc.	Jan. 30, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT LIQUEFIED NATURAL GAS FROM AND TO CANADA AND MEXICO BY TRUCK, RAIL, BARGE, AND NON-BARGE WATERBORNE VESSELS	12 BCF total	2 years			12,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3378.pdf	9/14/2018
3392	13-154-LNG	ConocoPhillips Alaska Natural Gas Corp.	Feb. 19, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE KENAI LNG FACILITY TO FREE TRADE AGREEMENT NATIONS	40 BCF total	2 years			40,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3392.pdf	9/14/2018
3447	13-157-CNG	Emera CNG, LLC	June 13, 2014	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT COMPRESSED NATURAL GAS BY VESSEL FROM A PROPOSED CNG COMPRESSION AND LOADING FACILITY AT THE PORT OF PALM BEACH, FLORIDA, TO FREE TRADE AGREEMENT NATIONS	9.125 BCF/year	20 years		9,125,000,000x20	182,500,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3447.pdf	9/14/2018
3443	13-160-LNG	Texas LNG LLC	June 11, 2014	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED TEXAS LNG TERMINAL IN BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	100 BCF/year	25 years		100,000,000,000x25	2,500,000,000,000	https://www.energy.gov/sites/prod/files/2014/06/f16/ord3443.pdf	9/14/2018
3434	14-48-NG	PAA Natural Gas Canada ULC	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO	60 BCF total	2 years			60,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3434.pdf	9/14/2018

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3433	14-46-NG	Shell Energy North America (US), L.P.	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO, TO EXPORT LIQUEFIED NATURAL GAS TO CANADA AND MEXICO BY VESSEL AND TRUCK, AND TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	1200 BCF total	2 years			1,200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3433.pdf	9/14/2018
3432	14-45-NG	Minnesota Energy Resources Corp.	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	2 BCF total	2 years			2,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3432.pdf	9/14/2018
3431	14-44-NG	BG Energy Merchants, LLC	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	40 BCF total	2 years			40,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3431.pdf	9/14/2018
3430	14-43-NG	West Texas Gas, Inc.	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	50 BCF total	2 years			50,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3430.pdf	9/14/2018
3429	14-42-NG	New York State Electric & Gas Corp.	May 8, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	50 BCF total	2 years			50,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3429.pdf	9/14/2018
3428	14-47-NG	Northwest Natural Gas Co.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	300 BCF total	2 years			300,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3428.pdf	9/14/2018
3427	14-41-NG	Alcoa Inc.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	5 BCF total	2 years			5,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3427.pdf	9/14/2018
3426	14-40-NG	National Fuel Resources, Inc.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	106 BCF total	2 years			106,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3426.pdf	9/14/2018
3425	14-39-NG	United Energy Trading Canada, ULC	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	20 BCF total	2 years			20,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3425.pdf	9/14/2018
3424	14-38-NG	Quicksilver Resources Inc.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA, AND TO EXPORT NATURAL GAS TO MEXICO	3 BCF total	2 years			3,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3424.pdf	9/14/2018
3423	14-37-NG	Socco, Inc.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	0.77 BCF total	2 years			770,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3423.pdf	9/14/2018
3422	14-36-NG	Pacific Gas and Electric Co.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA AND VACATING PRIOR AUTHORIZATION	600 BCF total	2 years			600,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3422.pdf	9/14/2018

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3421	14-34-NG	Sequent Energy Management, L.P.	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	5 BCF total	2 years			5,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3421.pdf	9/14/2018
3420	14-32-NG	Hess Energy Marketing, LLC	May 1, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	200 BCF total	2 years			200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3420.pdf	9/14/2018
3419	14-30-LNG	BG LNG Services, LLC	Apr. 10, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	2000 BCF total	2 years			2,000,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3419.pdf	9/14/2018
3417	14-33-NG	Toyota Motor Engineering & Manufacturing North America, Inc.	Apr. 10, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	1 BCF total	2 years			1,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3417.pdf	9/14/2018
3416	14-27-LNG	Shell NA LNG LLC	Apr. 10, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	1000 BCF total	2 years			1,000,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3416.pdf	9/14/2018
3415	14-26-NG	Noble Americas Gas & Power Corp.	Apr. 10, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO AND TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL, AND VACATING PRIOR AUTHORIZATION	400 BCF total	2 years			400,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3415.pdf	9/14/2018
3414	14-28-LNG	Universal LNG Solutions, LLC	Apr. 25, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS TO CANADA AND MEXICO IN ISO CONTAINERS TRANSPORTED BY VESSEL, AND TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES IN ISO CONTAINERS TRANSPORTED BY VESSEL	0.4 BCF total	2 years			400,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3414.pdf	9/14/2018
3411	14-25-NG	Iberdrola Canada Energy Services, Ltd.	Mar. 13, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	25 BCF total	2 years			25,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3411.pdf	9/14/2018
3410	14-24-LNG	Morgan Stanley Capital Group, Inc.	Mar. 13, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	545 BCF total	2 years			545,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3410.pdf	9/14/2018
3409	14-23-LNG	Morgan Stanley Capital Group, Inc.	Mar. 13, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO	30 BCF total	2 years			30,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3409.pdf	9/14/2018
3408	14-22-NG	Central Lomas de Real, S.A. de C.V.	Mar. 6, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO MEXICO	64 BCF total	2 years			64,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3408.pdf	9/14/2018

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3407	14-21-LNG	Prometheus Energy Group, Inc.	Mar. 6, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT LIQUEFIED NATURAL GAS FROM AND TO CANADA AND MEXICO BY TRUCK	75 BCF total	2 years			75,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3407.pdf	9/14/2018
3405	14-20-LNG	JP Morgan LNG Co.	Feb. 27, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	600 BCF total	2 years			600,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3405.pdf	9/14/2018
3404	14-17-NG	CNE Gas Supply, LLC	Feb. 27, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA AND MEXICO	20 BCF total	2 years			20,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3404.pdf	9/14/2018
3403	14-15-NG	Enserco Energy LLC	Feb. 27, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND TO EXPORT TO MEXICO	300 BCF total	2 years			300,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3403.pdf	9/14/2018
3402	14-14-NG	NJR Energy Services Co.	Feb. 27, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	200 BCF total	2 years			200,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3402.pdf	9/14/2018
3401	14-11-NG	Excelerate Energy L.P.	Feb. 27, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	400 BCF total	2 years			400,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3401.pdf	9/14/2018
3400	14-18-NG	Constellation Energy Gas Choice, Inc.	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	10 BCF total	2 years			10,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3400.pdf	9/14/2018
3399	14-16-NG	Houston Pipe Line Co. LP	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO MEXICO	204.4 BCF total	2 years			204,400,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3399.pdf	9/14/2018
3398	14-09-LNG	United Fuel Supply LLC	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL, AND TO EXPORT LIQUEFIED NATURAL GAS TO MEXICO BY VESSEL	0.1 BCF total	2 years			100,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3398.pdf	9/14/2018
3397	14-06-LNG	Golden Pass LNG Terminal LLC	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	50 BCF total	2 years			50,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3397.pdf	9/14/2018
3396	14-05-NG	Cannat Energy Inc.	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	100 BCF total	2 years			100,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3397.pdf	9/14/2018
3395	14-04-NG	Sacramento Municipal Utility District	Feb. 20, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	100 BCF total	2 years			100,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3395.pdf	9/14/2018
3390	14-12-NG	Phillips 66 Co.	Feb. 6, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT NATURAL GAS FROM CANADA	14 BCF total	2 years			14,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3390.pdf	9/14/2018

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3389	14-08-NG	NOCO Energy Corp.	Feb. 6, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	1 BCF total	2 years			1,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3389.pdf	9/14/2018
3388	14-10-NG	White Eagle Trading, LLC	Jan. 30, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	600 BCF total	2 years			600,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3389.pdf	9/14/2018
3387	14-07-NG	Rainbow Energy Marketing Corp.	Jan. 30, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO	75 BCF total	2 years			75,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3387.pdf	9/14/2018
3386	14-02-LNG	Applied LNG Technologies, LLC	Jan. 30, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT LIQUEFIED NATURAL GAS FROM AND TO CANADA AND MEXICO BY TRUCK	4 BCF total	2 years			4,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3387.pdf	9/14/2018
3383	14-03-NG	Cokinos Energy Corp.	Jan. 22, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	220 BCF total	2 years			220,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3383.pdf	9/14/2018
3382	14-01-NG	Energy Source Canada Inc.	Jan. 16, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	4 BCF total	2 years			4,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3382.pdf	9/14/2018
3381	13-159-NG	Brookfield Energy Marketing LP	Jan. 16, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	8 BCF total	2 years			8,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3381.pdf	9/14/2018
3380	13-156-NG	Colonial Energy, Inc.	Jan. 16, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA AND MEXICO	12 BCF total	2 years			12,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3380.pdf	9/14/2018
3379	13-148-LNG	Freeport LNG Development, L.P.	Jan. 9, 2014	ORDER GRANTING BLANKET AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM VARIOUS INTERNATIONAL SOURCES BY VESSEL	30 BCF total	2 years			30,000,000,000	https://fossil.energy.gov/ng_regulation/sites/default/files/programs/gasregulation/authorizations/2014/orders/ord3379.pdf	9/14/2018
3628	15-13-LNG	Eni USA Gas Marketing LLC	Apr. 23, 2015	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	100 BCF total	2 years			100,000,000,000	https://www.energy.gov/sites/prod/files/2015/08/f25/ord3628.pdf	9/14/2018
3656	15-19-LNG	American LNG Marketing LLC	May 29, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS LOADED AT THE PROPOSED TITUSVILLE FACILITY IN TITUSVILLE, FLORIDA, AND EXPORTED BY VESSEL TO FREE TRADE AGREEMENT NATIONS	30.2 BCF/year	20 years		30,200,000,000x20	604,000,000,000	https://www.energy.gov/sites/prod/files/2015/08/f25/ord3656.pdf	9/14/2018

DOE/FE Order Number	FE Docket Number	Company	Date Approved	Title of Document	Volume	Duration of Permit	Duration of Permit in Days	Equation	Total Gas For Project (CF)	Link	Date Accessed
3662	15-25-LNG	Venture Global Calcasieu Pass, LLC	June 17, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED VENTURE GLOBAL CALCASIEU PASS LNG PROJECT IN CAMERON PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	132.8 BCF/year	25 years		132,800,000,000x25	3,320,000,000,000	https://www.energy.gov/sites/prod/files/2015/06/f23/ord3662.pdf	9/14/2018
3681	15-33-LNG	Bear Head LNG Corp. and Bear Head LNG (USA), LLC	July 17, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA AND TO OTHER FREE TRADE AGREEMENT NATIONS	440 BCF/year	25 years		440,000,000,000x25	11,000,000,000,000	https://www.energy.gov/sites/prod/files/2015/07/f24/ord3681.pdf	9/14/2018
3680	15-36-LNG	Cameron LNG, LLC	July 10, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE CAMERON LNG TERMINAL IN CAMERON AND CALCASIEU PARISHES, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	515 BCF/year	20 years		515,000,000,000x20	10,300,000,000,000	https://www.energy.gov/sites/prod/files/2015/07/f24/ord3680.pdf	9/14/2018
3691	15-38-LNG	Floridian Natural Gas Storage Co., LLC	July 31, 2015	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS LOADED AT THE PROPOSED FLORIDIAN FACILITY IN MARTIN COUNTY, FLORIDA, AND EXPORTED BY VESSEL TO FREE TRADE AGREEMENT NATIONS	14.6 BCF/year	20 years		14,600,000,000x20	292,000,000,000	https://www.energy.gov/sites/prod/files/2015/08/f25/ord3691.pdf	9/14/2018
3661	15-39-LNG	Sandcastle Petroleum Gas & Energy, LLC	June 17, 2015	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS LOADED ON VESSELS AND IN LNG VESSELS TO FREE TRADE AGREEMENT NATIONS	19.2 BCF/year	2 years		19,200,000,000x2	38,400,000,000	https://www.energy.gov/sites/prod/files/2015/06/f23/ord3661.pdf	9/14/2018
3682	15-44-LNG	G2 LNG LLC	July 17, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED G2 LNG TERMINAL IN CAMERON PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	672 BCF/year	30 years		672,000,000,000x30	20,160,000,000,000	https://www.energy.gov/sites/prod/files/2015/07/f24/ord3682.pdf	9/14/2018
3698	15-53-LNG	Port Arthur LNG, LLC	Aug. 20, 2015	ORDER GRANTING LONG-TERM MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED PORT ARTHUR LNG PROJECT IN PORT ARTHUR, TEXAS, TO FREE TRADE AGREEMENT NATIONS	517 BCF/year	25 years		517,000,000,000x25	12,925,000,000,000	https://www.energy.gov/sites/prod/files/2015/08/f26/ord3698.pdf	9/14/2018

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3716	15-62-LNG	Texas LNG Brownsville LLC	Sep. 24, 2015	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED LNG TERMINAL AT THE PORT OF BROWNSVILLE IN BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	204.4 BCF/year	25 years		204,400,000,000x25	5,110,000,000,000	https://www.energy.gov/sites/prod/files/2015/09/f26/ord3716.pdf	9/14/2018
3740	15-139-NG	Puget Sound Energy, Inc.	Nov. 12, 2015	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10.65 BCF total	3 years			10,650,000,000	https://www.energy.gov/sites/prod/files/2015/11/f27/ord3740.pdf	9/14/2018
3741	15-140-NG	Puget Sound Energy, Inc.	Nov. 12, 2015	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10.65 BCF total	3 years			10,650,000,000	https://www.energy.gov/sites/prod/files/2015/11/f27/ord3741_1.pdf	9/14/2018
3742	15-141-NG	Puget Sound Energy, Inc.	Nov. 12, 2015	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	10.65 BCF total	3 years			10,650,000,000	https://www.energy.gov/sites/prod/files/2015/11/f27/ord3742.pdf	9/14/2018
3743	15-142-NG	Puget Sound Energy, Inc.	Nov. 12, 2015	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT AND EXPORT NATURAL GAS FROM AND TO CANADA	21.3 BCF total	3 years			21,300,000,000	https://www.energy.gov/sites/prod/files/2015/11/f27/ord3743.pdf	9/14/2018
3809	15-168-LNG	Flint Hills Resources, LP	Apr. 13, 2016	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS OR IN BULK LOADED AT THE STABILIS LNG EAGLE FORD, LLC FACILITY IN GEORGE WEST, TEXAS, AND EXPORTED BY VESSEL TO FREE TRADE AGREEMENT NATIONS	3.62 BCF/year	20 years		3,620,000,000x20	72,400,000,000	https://www.energy.gov/sites/prod/files/2016/04/f30/ord3809.pdf	9/14/2018
3767	15-171-LNG	Sabine Pass Liquefaction, LLC	Jan. 13, 2016	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE SABINE PASS LNG TERMINAL LOCATED IN CAMERON PARISH, LOUISIANA	600 BCF total	2 years			600,000,000,000	https://www.energy.gov/sites/prod/files/2016/01/f28/ord3767.pdf	9/14/2018
3754	15-130-LNG	ConocoPhillips Co.	Dec. 16, 2015	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	500 BCF total	2 years			500,000,000,000	https://www.energy.gov/sites/prod/files/2015/12/f27/ord3754.pdf	9/14/2018
3869	15-190-LNG	Rio Grande LNG, LLC	Aug. 17, 2016	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED RIO GRANDE LNG TERMINAL IN BROWNSVILLE, TEXAS, TO FREE TRADE AGREEMENT NATIONS	1318 BCF/year	30 years		1,318,000,000,000x30	39,540,000,000,000	https://www.energy.gov/sites/prod/files/2016/08/f33/ord3869.pdf	9/14/2018
3822	15-169-LNG	Flint Hills Resources, LP	June 13, 2016	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS TO FREE TRADE AGREEMENT COUNTRIES BY TRUCK, RAIL, BARGE, AND NON-BARGE WATERBORNE VESSELS	7.24 BCF total	2 years			7,240,000,000	https://www.energy.gov/sites/prod/files/2016/06/f32/ord3822.pdf	9/14/2018

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3867	16-15-LNG	Eagle LNG Partners Jacksonville, LLC	July 21, 2016	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM, OR IN ISO CONTAINERS LOADED AT, THE PROPOSED EAGLE LNG FACILITY IN JACKSONVILLE, FLORIDA, TO FREE TRADE AGREEMENT NATIONS	49.8 BCF/year	20 years		49,800,000,000x20	996,000,000,000	https://www.energy.gov/sites/prod/files/2016/07/f33/ord3867.pdf	9/14/2018
3866	16-28-LNG	Venture Global Plaquemines LNG, LLC	July 21, 2016	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED PLAQUEMINES LNG TERMINAL IN PLAQUEMINES PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	1240 BCF/year	25 years		1,240,000,000,000x25	31,000,000,000,000	https://www.energy.gov/sites/prod/files/2016/07/f33/ord3866.pdf	9/14/2018
3825	16-29-LNG	Cheniere Marketing, LLC	May 26, 2016	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	500 BCF total	2 years			500,000,000,000	https://www.energy.gov/sites/prod/files/2016/05/f32/ord3825.pdf	9/14/2018
3824	16-49-LNG	The Narragansett Electric Co.	May 16, 2016	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM CANADA BY TRUCK	0.54 BCF total	2 years, 8 months			540,000,000	https://www.energy.gov/sites/prod/files/2016/05/f31/ord3824.pdf	9/14/2018
3819	16-50-LNG	Boston Gas Company	May 12, 2016	ORDER GRANTING LONG-TERM AUTHORIZATION TO IMPORT LIQUEFIED NATURAL GAS FROM CANADA BY TRUCK	3.67 BCF total	2 years, 8 months			3,670,000,000	https://www.energy.gov/sites/prod/files/2016/05/f31/ord3819.pdf	9/14/2018
3912	16-118-NG	Seneca Resources Corp.	Oct. 31, 2016	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO CANADA	45.18 BCF total	7 years			45,180,000,000	https://www.energy.gov/sites/prod/files/2016/11/f34/ord3912.pdf	9/14/2018
3968	16-144-LNG	Driftwood LNG LLC	Feb. 28, 2017	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED DRIFTWOOD LNG FACILITY IN CALCASIEU PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	1496.5 BCF/year	30 years		1,496,500,000,000x30	44,895,000,000,000	https://www.energy.gov/sites/prod/files/2017/03/f34/ord3968.pdf	9/14/2018
4019	16-188-LNG	Okra Energy, LLC	Apr. 18, 2017	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS (LNG) IN ISO CONTAINTERS LOADED AT A PROPOSED LNG PLANT IN SOUTHERN ALABAMA AND EXPORTED BY BARGE OR VESSEL TO FREE TRADE AGREEMENT COUNTRIES IN THE CARIBBEAN AND LATIN AMERICA	20 BCF total	2 years			20,000,000,000	https://www.energy.gov/sites/prod/files/2017/05/f34/ord4019.pdf	9/14/2018
3827	16-55-NG	Iberdrola Energia Monterrey S.A. de C.V.	May 31, 2016	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	20 BCF/year	20 years		20,000,000,000x20	400,000,000,000	https://www.energy.gov/sites/prod/files/2017/04/f34/ord3827.pdf	9/14/2018
4054	17-23-LNG	Freeport LNG Development, L.P.	June 27, 2017	ORDER GRANTING BLANKET AUTHORIZATION TO EXPORT PREVIOUSLY IMPORTED LIQUEFIED NATURAL GAS BY VESSEL	24 BCF total	2 years			24,000,000,000	https://www.energy.gov/sites/prod/files/2017/06/f35/ord4054.pdf	9/14/2018

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4162	17-105-LNG	Fourchon LNG LLC	Mar. 11, 2018	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED FOURCHON LNG FACILITY IN LAFOURCHE PARISH, LOUISIANA, TO FREE TRADE AGREEMENT NATIONS	260 BCF/year	30 years		260,000,000,000x30	7,800,000,000,000	https://www.energy.gov/sites/prod/files/2018/03/f49/ord4162.pdf	9/14/2018
4200	17-167-LNG	Galveston Bay LNG, LLC	June 13, 2018	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED GALVESTON BAY LNG PROJECT TO BE LOCATED IN TEXAS CITY, TEXAS, TO FREE TRADE AGREEMENT NATIONS	785.7 BCF/year	20 years		785,700,000,000x20	15,714,000,000,000	https://www.energy.gov/sites/prod/files/2018/06/f53/ord4200.pdf	9/14/2018
4202	18-27-LNG	Blue Water Fuels, LLC	June 25, 2018	ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS IN ISO CONTAINERS OR IN BULK LOADED AT THE HR NU BLU ENERGY, LLC LIQUEFACTION FACILITY IN PORT ALLEN, LOUISIANA, AND EXPORTED BY VESSEL TO FREE TRADE AGREEMENT NATIONS	2.715 BCF/year	25 years		2,715,000,000x25	67,875,000,000	https://www.energy.gov/sites/prod/files/2018/06/f53/ord4202.pdf	9/14/2018
4227	18-87-NG	Copeq Trading Co.	Aug. 8, 2018	ORDER GRANTING LONG-TERM AUTHORIZATION TO EXPORT NATURAL GAS TO MEXICO	24.78 BCF/year	10 years		24,780,000,000x10	247,800,000,000	https://www.energy.gov/sites/prod/files/2018/08/f54/ord4227.pdf	9/14/2018

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Total Natural Gas Authorized (cu.ft.)	907,210,013,653,917
Conversion (kg-natural gas/cu. Ft.)	0.01992768
Emission factor (kg-CO2/kg-natural gas)	2.750000
Total kg-CO2 authorized	49,716,124,823,450
Total Tg (Teragrams, or million metric tonnes)-CO2 emitted	**49,716**