Comments on
Scoping
Supplemental Environmental Impact Statement (SEIS)
Rulemaking for Colorado Roadless Coal Exception #46470

U.S. Department of Agriculture Forest Service

Ian Goodman
Brigid Rowan

the goodman group, ltd.
www.thegoodman.com

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Appendices

1. Executive Summary

The US Department of Agriculture (USDA) Forest Service is preparing a Supplemental Environmental Impact Statement (SEIS) to propose reinstatement to the North Fork Coal Mining Area exception of the Colorado Roadless Rule. The Colorado Roadless Rule (including the North Fork Coal Mining Area exception that would be reinstated by the Proposed Action) was adopted based on a Final Environmental Impact Statement (FEIS).

To provide a proper analysis of the economic and environmental impacts of the Proposed Action, it is essential for the SEIS to undertake an updated and expanded analysis of how the Proposed Action could affect coal mine development and operations, and thus coal production, for the entire time period affected by the Proposed Action. The SEIS should disclose and clearly present the underlying data for estimated coal production year-by-year over the entire time period affected by the Proposed Action. It is clearly the Forest Service's duty to disclose such impacts as required by the National Environmental Policy Act, especially in light of the fact that the very purpose of the exception is to promote additional coal mining under the 19,600 acres of roadless lands.

The SEIS must include a full and meaningful analysis of how the Proposed Action could affect coal production, in terms of both physical output (tons) and the value of that output (dollars). This analysis needs to be rigorous, reviewable, and based on current and likely future conditions, coal prices, environmental regulations, and other information. Energy markets are very dynamic; they have been evolving very rapidly and will continue to evolve. Given the uncertainty as to how the Proposed Action could affect future coal production, the SEIS should provide guidance as to a range of potential outcomes and the likelihood of various outcomes.

The FEIS (and related documents) used Input-Output analysis with IMPLAN models, to estimate employment and other economic benefits associated with increased coal production. There are significant limitations and uncertainties in relation to IMPLAN models (and more generally Input-Output analysis). It is not sufficient for the SEIS to provide an updated version of what was done in the FEIS in regard to modeling methods, tools, and disclosure.

At an absolute minimum, if the SEIS also relies upon IMPLAN models (and more generally Input-Output analysis), more disclosure, customization, and analysis is required. The SEIS should fully and explicitly explain the limitations and uncertainties in relation to the IMPLAN models and the overall analysis. Moreover, the Forest Service should undertake additional model customization and analysis in order to mitigate the limitations and uncertainties in relation to IMPLAN-based analysis of the Proposed Action.

But given the limitations and uncertainties in relation to IMPLAN models (and more generally Input-Output analysis), the Forest Service should instead utilize a more sophisticated modeling

of economic benefits. Hybrid models are dynamic and offer the most flexibility and detail in tailoring an analysis. Hybrid models can provide realistic year-by-year estimates of both the short- and long-term total effects of the Proposed Action. In particular, REMI PI+ is appropriate for use by the Forest Service to evaluate the Proposed Action and estimate economic benefits such as employment.

There are sizable adverse environmental impacts from coal production and the entire fuel cycle associated with coal (including transport, consumption, and waste disposal). These adverse impacts occur both locally (including proximate to coal production) and nationally/globally (including impacts relating to GHG emissions). In turn, these adverse environmental impacts can have adverse economic impacts (costs), on both the local and national/international levels. These adverse environmental and economic impacts (costs) generally increase based on the amount of coal mine development and operations, and thus coal production, that could result from the Proposed Action.

Locally, coal production will adversely affect other economic activity, and especially other economic activity that is based on a high quality of life and environment. Especially in Colorado and specifically in the area proximate to North Fork Valley coal production, there is substantial outdoor recreation, in-migration of retirees, and other activity (including economic activity) that is based on a high quality of life and environment. So to the extent that coal production adversely impacts the environment, it will adversely impact other economic activity.

Nationally and internationally, coal production will adversely affect other economic activity, notably via impacts on GHGs, but also via other emissions and adverse impacts associated with coal.

The Proposed Action will have sizable adverse environmental impacts, which in turn would have sizable adverse economic impacts. The SEIS must analyze in full and disclose these adverse impacts.

Any SEIS consideration of the economic benefits from coal production must be balanced and also consider the economic costs from coal production. The SEIS must appropriately consider economic costs as well as benefits, rather than focus on benefits and fail to consider costs.

The SEIS must be based on credible and consistent assumptions regarding the energy supply alternatives to North Fork Valley coal production. For both North Fork Valley coal and alternative sources of energy supply, it is relevant to consider both benefits (jobs, lease payments, etc.) and costs (from adverse environmental impacts). This approach would provide a symmetrical, balanced consideration of costs and benefits, for both North Fork Valley coal and for alternatives to North Fork Valley coal.

Coal production can be measured in terms of both physical output (tonnage) and value (dollars). Both measures of coal production are relevant to consider in estimating economic impacts.

Future coal production may be economically challenged, such that price per ton is low and profitability marginal. Thus, if the Proposed Action leads to increased coal production, the added production may be low value with low associated economic benefits. Meanwhile, this added production could have large adverse environmental impacts (and associated adverse economic impacts).

2. Introduction

The US Department of Agriculture (USDA) Forest Service is preparing a Supplemental Environmental Impact Statement (SEIS) to propose reinstatement of the North Fork Coal Mining Area exception to the Colorado Roadless Rule. On April 7, 2015, the Forest Service published a Notice of Intent in the Federal Register explaining this process:[1]

> The U.S. Department of Agriculture is initiating a supplemental environmental impact statement (SEIS) to propose reinstatement of the North Fork Coal Mining Area exception of the Colorado Roadless Rule. The exception would allow for temporary road construction for coal exploration and/or coal-related surface activities in a 19,100-acre area defined as the North Fork Coal Mining Area. The Forest Service will use the SEIS to address specific deficiencies identified by the District Court of Colorado in High Country Conservation Advocates v. United States Forest Service (D. Colo. June 27, 2014).
> […]
> **Proposed Action**
> The proposed action for the Colorado Roadless Rule supplemental is to reinstate the North Fork Coal Mining Area exception as written in 36 CFR 294.43(c)(1)(ix).
> […]
>
> **Alternative to the Proposed Action**
> The other alternative being considered is the no-action alternative, which is the continuation of current management following the District Court ruling to vacate the North Fork Coal Mining Area exception. […] Currently, the North Fork Coal Mining Area is being managed the same as other non-upper tier Colorado Roadless Areas. Valid existing coal leases would operate according the terms of their leases.

The Colorado Roadless Rule[2] (including the North Fork Coal Mining Area exception that would be reinstated by the Proposed Action) was adopted based on a Final Environmental Impact Statement (FEIS)[3] and Regulatory Impact Analysis (RIA).[4] The FEIS and RIA in turn relied upon a USDA Economics Specialist Report.[5]

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[1] https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3834257.pdf, pp. 18595-18599.
[2] https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5378039.pdf
[3] https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5365953.pdf
[4] https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5365957.pdf
[5] USDA Forest Service (Rocky Mountain Region), Social and Economics Specialist Report: Final Roadless Area Conservation Rule for Colorado, prepared by NFI, Inc. and Economic Insights of Colorado, LLC., October 27, 2011.

The SEIS is currently in the Scoping Process, and the Comments now being submitted are in regard to Scoping. These Comments were prepared by Ian Goodman[6] and Brigid Rowan[7] of The Goodman Group, Ltd. (TGG), a consulting firm specializing in energy and regulatory economics.[8] TGG was retained by Sierra Club to comment on scoping of the Roadless Rule SEIS, and specifically how the SEIS should consider employment and other economic impacts.[9]

The SEIS will need to consider a wide range of issues regarding the Proposed Action and its potential impacts. In this context, scoping is very important to determine the appropriate contents of the SEIS. In particular, scoping will consider the scope of impacts to be examined, as well as the study methods and data that will be utilized to analyze these impacts.

While the SEIS will need to consider a wide range of issues regarding Proposed Action and its potential impacts, these comments narrowly focus on economic impacts such as employment.

Section 3 examines the impacts of the Proposed Action on coal production. As discussed in Section 3, the Proposed Action could affect coal mine development and operations, and thus coal production.

Section 4 examines in greater detail how the economic impacts estimated for the Proposed Action will generally be a function of how the Proposed Action is estimated to affect coal production. To the extent that the Proposed Action is estimated to result in more coal production (more tons and more dollar value of output), this will increase the estimated economic benefits (jobs, taxes, lease payments, etc.). But more coal production will also increase the estimated economic harms associated with coal mining, transport, consumption, and waste disposal.

As discussed in Section 4, coal production (and the entire fuel cycle related to coal) has adverse environmental impacts. In turn, these adverse environmental impacts will have adverse economic impacts (costs). These adverse environmental and economic impacts (costs) also generally increase based on the amount of additional coal production estimated for the Proposed Action.

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[6] Resume of Ian Goodman is provided as Appendix A to these Comments.
[7] Resume of Brigid Rowan is provided as Appendix B to these Comments.
[8] www.thegoodman.com
[9] These Comments were co-authored by Ian Goodman and Brigid Rowan, co-authors of numerous comments in regard to the EIS process for energy-related activities, as well as co-authors of numerous studies regarding employment and other impacts of energy-related activities. See resume of Ian Goodman and Brigid Rowan provided in Appendices A and B to these comments, as well as the listings of major projects on TGG's website.
http://www.thegoodman.com/economic-development-projects
http://www.thegoodman.com/manitoba-hydroelectric-system-planning
http://www.thegoodman.com/hydro-quebec-system-planning

Thus, the overall economic impacts for the Proposed Action include both economic benefits and costs. These economic benefits and costs will both increase based on the amount of additional coal production as a result of the Proposed Action.

The SEIS must provide a sound basis for accurately disclosing all of these benefits and costs, and so must properly evaluate all economic impacts, including costs as well as benefits.

3. Impacts on Coal Production

3.1. FEIS

As a starting point for considering how the Proposed Action could affect coal production, it is useful to review the analyses from the FEIS (and related documents, notably the RIA and USDA Economics Specialist Report).[10]

Most of the results for these analyses (from the FEIS and related documents) are reported as annual averages over a 15-year analysis period (2012-2026). For the analysis period, it is estimated that average annual coal production from the North Fork Valley mines would be 9.9 million tons with the North Fork Coal Mining Area exception, versus 8.5 million tons with the 2001 Rule (i.e. without the North Fork Coal Mining Area exception).[11] Thus, the North Fork Coal Mining Area exception is estimated to result in an additional 1.4 million tons of annual coal production, averaged over the 15-year analysis period. Put another way, average annual coal production from the North Fork Valley mines is estimated to be about 16% higher with the North Fork Coal Mining Area exception.

In these analyses (from the FEIS and related documents), coal production is valued based on average prices for all Colorado coal production in 2009 ($36.71/ton (2009$)).[12] For the 15-year analysis period, it is estimated that average annual value of coal production from the North Fork Valley mines would be $362 million (2009$) with the North Fork Coal Mining Area exception, versus $313 million (2009$) with 2001 Rule (i.e. without the North Fork Coal Mining Area

[10] The Proposed Action in the SEIS would reinstate the North Fork Coal Mining Area exception of the Colorado Roadless Rule. The SEIS Proposed Action would reinstate the provisions in FEIS Alternative 2 (the North Fork Coal Mining Area exception of the Colorado Roadless Rule) that were estimated to affect coal production. In terms of impacts on coal production, FEIS Alternative 2 is most similar to the SEIS Proposed Action; FEIS Alternative 1 (2001 Rule) is most similar, but not precisely identical, to the SEIS Alternative to the Proposed Action (No-Action Alternative). Also, in terms of provisions affecting coal production and estimated impacts on production, FEIS Alternative 4 is identical to FEIS Alternative 2.

[11] RIA, p. 121:

> Average annual coal production during the 15-year analysis period is estimated to be 8.5 million tons per year under the 2001 rule and 9.9 million tons per year under the final rule, Alternative 4, and forest plans; these production rates are multiplied by $36.71/ton (2009$) [footnote 16 in original: Price of Colorado coal from US Department of Energy, Energy Information Administration. Annual Coal Report 2009 (Table 30). Prices from 2009 are consistent with the economic impact model used to create the job and income multipliers based on 2009 data, as noted in the economic section in Chapter 3 of the FEIS.] to estimate output value which is used to estimate economic impacts (see Table 14).

[12] RIA, p. 121 (see footnote 11); USDA Economics Specialist Report, p. 63.

exception).[13] Thus, the North Fork Coal Mining Area exception is estimated to result in an additional $49 million (2009$) of annual value of coal production, averaged over the 15-year analysis period.[14] Put another way, average annual value of coal production from the North Fork Valley mines is estimated to be about 16% higher with the North Fork Coal Mining Area exception.

These analyses (from the FEIS and related documents) are based on the following assumptions made by the Forest Service regarding development and operation of mines in the North Fork Valley:[15]

- For all alternatives (with or without the North Fork Mining Area exception), current coal production levels for each mine were assumed to continue until leased reserves are exhausted. Based on remaining mine lives, the Bowie mine will cease operations in about 2015, Elk Creek mine in about 2017, and West Elk mine in about 2021.
- Unleased reserves available under each alternative would then be acquired and mined upon completion of the leasing and permitting processes. Unleased reserves under roadless areas would not be developed for ten years, allowing a reasonable time for existing or new companies to complete the lease process and establish new operations.
- Alternative 1 (2001 Rule) is assumed to have an additional 5 years of operations at one mine, ending in 2026.
- Alternative 2 (with the North Fork Coal Mining Area exception) is assumed to have an additional 39 years of operations at two mines, starting in 2022 and ending in 2060.
- Oxbow Mining, LLC (operator of the Elk Creek mine) plans to pursue coal under BLM and private lands, thereby shifting their operations from under National Forest System lands once current reserves under lease are exhausted. This shift will occur for all alternatives (with or without the North Fork Mining Area exception). Oxbow Mining, LLC will pursue their stated interest in the Oak Mesa project (on BLM and private lands) as a priority over reserves under roadless areas. Oxbow Mining, LLC will remain in the North Fork Valley, but their future operations are the same with or without the North Fork Mining Area exception.

Thus, the North Fork Coal Mining Area exception (FEIS Alternative 2 vs. Alternative 1) is estimated to result in an additional 39 years of operations at one mine, starting in 2022 and ending in 2060 and an additional 34 years of operations at a second mine, starting in 2027 and ending in 2060.

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[13] Direct value of coal production: FEIS, pp. 318; RIA, p. 123; USDA Economics Specialist Report, p. 27. Elsewhere in the FEIS (pp. 321-323), there are slightly lower figures for average annual value of coal production: $359.8 million (2009$) with the North Fork Coal Mining Area exception, versus $312.0 million (2009$) with 2001 Rule (i.e. without the North Fork Coal Mining Area exception).

[14] As detailed in footnote 13, there are also slightly lower figures in the FEIS for average annual value of coal production. Based on these slightly lower figures, the North Fork Coal Mining Area exception is estimated to result in an additional $48 million (2009$) of annual value of coal production, averaged over the 15-year analysis period.

[15] RIA, pp. 54, 79, 120-121; USDA Economics Specialist Report, pp. 23-24, 63-64.

Most of the results for the analyses in the FEIS (and related documents) are reported as annual averages over a 15-year analysis period. Thus, the results reported in the FEIS (and related documents) include only a very small portion of the additional coal production that could result from the North Fork Coal Mining Area exception. More specifically, these results include added production for only one mine, for only 5 years (from 2022 to 2026). But based on the assumptions in the FEIS (and related documents), the North Fork Coal Mining Area exception is estimated to also result in added production at two mines, for the 34 years following the 15-year analysis period (from 2027 to 2060).

Averaged over the 15-year analysis period, the estimated increase in coal production due to the North Fork exception is 1.4 million tons per year. This average is based on a zero increase for the first 10 years of the analysis period, and then an increase of 4.2 million tons per year in the last 5 years of the analysis period (when there is one additional mine due to the North Fork exception). The estimated annual increase in coal production would be even greater for the next 34 years (following the 15-year analysis period), when there are estimated to be 2 additional mines due to the North Fork exception.[16]

The results reported in the FEIS (and related documents) averaged over the 15-year analysis period do not show how the estimated increase in coal production (tons) due to the North Fork exception varies year-by-year. Likewise, the results reported in the FEIS (and related documents) do not show how the value of coal production (dollars) varies year-by-year.

Averaged over the 15-year analysis period, the North Fork Coal Mining Area exception is estimated to result in an additional $49 million (2009$) of annual value of coal production. This average is based on a zero increase for the first 10 years of the analysis period, and then an increase of $147 million per year over the last 5 years of the analysis period.[17]

3.2. SEIS

To provide a proper analysis of the economic and environmental impacts of the Proposed Action, it is essential for the SEIS to undertake an updated and expanded analysis of how the Proposed Action could affect coal mine development and operations, and thus coal production, for the entire time period affected by the Proposed Action. Therefore, as part of these Comments on Scoping, TGG will provide some guidance regarding how the Proposed Action

[16] The FEIS and supporting documents do not specify the increase in production due to the North Fork exception for the 34 years following the 15-year analysis period. But based on the information that is provided, the estimated increase in production could exceed 9 million tons per year and would likely be at least 5 million tons per year. The output of two mines is estimated to be 9.3 million tons per year in 2025 (USDA Economics Specialist Report, p. 54) and 5 million tons per year in 2061-2081 (RIA, pp. 64, 121, for FEIS Alternative 3).

[17] In the FEIS and related documents, coal production is valued based on average prices for all Colorado coal production in 2009 ($36.71/ton (2009$)). See footnotes 11 and 12.

could affect coal production in a context of rapidly evolving energy markets. This guidance is based on the limited analysis that TGG has been able to undertake for these Comments, as well as TGG's overall expertise in energy markets and economics.

Coal production has been declining in the North Fork Valley and elsewhere in Colorado.[18] Production peaked in 2004 with output of about 18 million tons in the North Fork Valley, 22 million tons elsewhere in Colorado, and 40 million tons statewide. By 2014, production was down to about 9 million tons in the North Fork Valley, 14 million tons elsewhere in Colorado, and 23 million tons statewide. Thus, while production statewide has dropped by about 40%, production in the North Fork Valley has dropped by one-half; elsewhere in Colorado, production has dropped by only one-third.

A Spring 2014 Colorado State Demography Office report describes the mix of factors affecting coal production in the North Fork Valley and elsewhere:[19]

> This report reviews important […] energy production trends and data in Colorado. Its principal focus is to identify how Colorado's extensive […] energy industry is faring vis-à-vis other states, how it fits into national and global energy markets, and how Colorado's […] resource intensive regions and counties are performing.
> […]
> 2013 production was approximately 24.2 million tons, a decrease of over 4.3 million tons or nearly 15%, from 2012 and 15.7 million tons below the peak 2004 figure. This year-over-year decline is significantly more than the anticipated 2.7% decrease in U.S. coal production from 2012 to 2013.
> […]

[18] North Fork Valley and Colorado coal production statistics are available from a variety sources, which provide similar (but not always identical) data:
Colorado Department of Natural Resources, Division of Reclamation, Mining and Safety. Colorado Coal Production Reports http://mining.state.co.us/Reports/Reports/Pages/Coal.aspx
Colorado Mining Association. Coal Production & Employment (various years)
https://www.coloradomining.org/mining-in-colorado/coal-reports/
U.S. Department of Energy, Energy Information Administration. Coal Data Browser (with various state and mine level annual data)
http://www.eia.gov/beta/coal/data/browser/
Colorado Geological Survey. 2010 and 2011 Coal Fact Sheets
http://coloradogeologicalsurvey.org/wp-content/uploads/2013/08/2010-Coal-fact-sheet-combined.pdf
http://coloradogeologicalsurvey.org/wp-content/uploads/2013/08/2011-Coal-fact-sheet-combined.pdf

[19] Colorado Department of Local Affairs, State Demography Office, Colorado Non-Renewable Resources Update, Spring 2014, pp. 1, 6-7.
http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22Colorado+Mineral+%26+Energy+Update.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251958795106&ssbinary=true

While the lower coal production can in part be explained by one-off occurrences such as the coal-seam fire in January 2013 at the Elk Creek Mine in Gunnison County, which resulted in an idled mine and layoffs of more than 250 employees that predominantly live in nearby Delta County, the competitive pressures on Colorado and U.S. coal production are more deep-seated. These concerns relate to emergence of low-priced and relatively cleaner natural gas as an alternative to coal in generating electricity and uncertainty posed by impending U.S. Environmental Protection Agency regulations. According to the EIA, U.S. coal consumption has fallen by almost 25% since 2007 as utilities switched to natural gas, and from 1990 to 2011 natural gas-fired plants accounted for 77% of additions to the nation's generating capacity. The EIA also reports that in 2012 utilities nationwide retired 57 aged, coal-fired power plants, with another 61 coal-fired units are slated to close in 2015.

In the longer term, the EIA[20] expects the competition between coal and natural gas as the premier fuel source of electricity production to continue, with the edge going to natural gas for the following reasons:

1) New Natural Gas-fired plants are generally 1.5 times more efficient than coal plants

2) Natural combined-cycle (gas) turbines are more flexible than steam turbines. Natural gas output can be calibrated upwards and downward more readily, resulting in reduced start-up and shutdown procedures in terms of cost and time.

3) Coal plants are poised to struggle with the cost of impending regulations. The EIA anticipates coal-fired plants will be required to have scrubbers systems installed by 2016 to comply with mercury and air toxics standards. These systems, combined with higher coal prices, and lower wholesale electricity prices will make it difficult for coal plants to compete.

Many factors will affect future coal production in the North Fork Valley and elsewhere. Some of these factors are more localized and specific to the area's mines (including geologic, mineralogical, metallurgical, and regulatory conditions, as well as transport costs from mines to markets).

Other factors are less localized and more regional, national, and international (including slow growth in energy demand, competition from other energy sources, and intensifying environmental concerns related to GHGs and other emissions). But even these less localized

[20] Footnote 5 in original: EIA. Annual Energy Outlook 2013. http://www.eia.gov/forecasts/aeo/IF_all.cfm#coal_gas

factors can significantly affect future production in the North Fork Valley, notably by affecting national and international markets for Colorado coal production.

The RIA acknowledges that markets and prices for coal production in the North Fork Valley (and elsewhere in Colorado) are heavily influenced by national prices, supplies, and market trends:[21]

> Approximately 53% of all coal produced from Colorado […] was exported to other states, suggesting that **regional markets and prices are likely to be heavily influenced by national prices, supplies, and market trends**.
> […]
> Just over half of Colorado coal is shipped by rail to 24 states in the U.S. Most of this is exported to the South and Midwest where it is used in electricity generation.
>
> Forty-five percent of Colorado coal is used in-state, primarily for electricity generation […] In 2009, coal from North Fork Valley mines accounted for 41 percent of all coal production in Colorado and 1.1 percent in the United States […] Like other coal in Colorado, coal from this area is highly valuable because of its high energy and low sulfur content. This coal is classified as "supercompliant" for electric generation because of these characteristics. Typically, it is mixed with coal from other parts of the country to meet air quality standards at electricity generation plants.

The analysis in the RIA is based on data from 2009.[22] Since then, coal production in the North Fork Valley (and elsewhere in Colorado) has dropped and become even more heavily influenced by national and international prices, supplies, and market trends.[23] Based on the most recent available data from 2013, only 32% of Colorado coal is used in-state, and only 41% goes to other states, mainly in the South.[24] The biggest shift is that 27% of Colorado coal goes to international markets, versus just 2% in 2009.

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[21] RIA, p. 79, 114, emphasis added.

[22] The analysis in the RIA regarding markets for Colorado coal (see quotation above and footnote 21) is based on data from Colorado Geological Survey, 2010 Coal Fact Sheet.
http://coloradogeologicalsurvey.org/wp-content/uploads/2013/08/2010-Coal-fact-sheet-combined.pdf
These data match US EIA coal distribution data for 2009.
http://www.eia.gov/coal/distribution/annual/archive.cfm
http://www.eia.gov/coal/distribution/annual/archive/2009/o_09state.pdf
http://www.eia.gov/coal/distribution/annual/archive/2009/o_09foreign.pdf

[23] See footnotes 18 and 19.

[24] US EIA. Annual Coal Distribution Report 2013.
http://www.eia.gov/coal/distribution/annual/pdf/acdr_fullreport2013.pdf

This big shift to international markets in an important factor affecting North Fork Valley coal production, with one-half of West Elk mine's 2013 output going to Europe, Latin America, and Asia. As reported by Arch Coal:[25]

> our West Elk mine in Colorado is heavily focused on the export market. […] 50% of the mine's output were sold in the Europe, Latin America and Asia in 2013. That penetration has been helpful as it has helped to offset a soft demand for Colorado coal domestically.

Competitive pressures are continuing to intensify in the markets for Colorado coal. And this is resulting in further loss of sales and productions cuts at Colorado mines, especially in the North Fork Valley.

Due to a fire and unfavorable market conditions, the Elk Creek mine has remained idled since 2013, and this mine is unlikely to have substantial production in the short- to medium-term.[26] In late 2014, the Bowie #2 mine sharply reduced operations in response to continued weakness in coal demand and termination of a contract to supply Tennessee Valley Authority (TVA), a large electric utility in the South:[27]

> A coal mine in Delta County […] is laying off 150 workers, over 40 percent of its workforce. The Bowie #2 mine layoffs follow the shutdown one year ago of another area mine, which laid off nearly 300 workers.
> […]
> "Coal production in Colorado hit its highest level in 2004, with coal production reaching about 40 million tons. It has fallen by about 40 percent since then," said Stuart Sanderson, president of the Colorado Mining Association.

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[25] Arch Coal Q4 2013 Earnings Call Transcript, February 4, 2014. http://seekingalpha.com/article/1993391-arch-coals-ceo-discusses-q4-2013-results-earnings-call-transcript

[26] After a fire in early 2013, the Elk Creek mine had very limited production (0.4 million tons in 2013, versus 3.4 million tons in 2012), and it was then completely idled late in 2013. Recent news reports indicate that the mine will auction off its moveable equipment in June 2015, which, despite the representations by the mine's staff, would appear to indicate that Elk Creek mine is unlikely to produce much coal in the short- to medium-term. See Dennis Webb, "Coal mine liquidation sale," Grand Junction Sentinel (May 15, 2015), available at http://www.gjsentinel.com/news/articles/coal-mine-liquidation-sale; see also Colorado Mining Association. Coal Production & Employment (various years) https://www.coloradomining.org/mining-in-colorado/coal-reports/

[27] Stephanie Paige Ogburn , "After More Mine Layoffs, Pondering What's Next For Colorado Coal Country," KUNC Radio, October 31, 2014 9:41 AM. http://www.kunc.org/post/after-more-mine-layoffs-pondering-whats-next-colorado-coal-country ; see also Bowie Resource Partners Press Release, "Bowie Resource Partners Announces Reductions at Bowie #2 Mine," October 29, 2014. http://www.prnewswire.com/news-releases/bowie-resource-partners-announces-reductions-at-bowie-2-mine-280845312.html

> The Bowie layoffs came as the company lost a contract for 250,000 tons of coal with the Tennessee Valley Authority, which found a cheaper source for that coal, a TVA official said.
> […]
> **Coal's Fortunes Change With Natural Gas, Climate Concerns**
> Typically, about two-thirds of Colorado coal has been sent out of state, often eastward. That's because it has a lower sulfur content and is cleaner burning, and mixed with Eastern coal in power plants allowed them to burn more cleanly.
> […]
> But many say coal's fortunes are changing, at least in the United States. One reason is a cheap, abundant supply of natural gas, which can replace coal in power plants.
>
> A second is a growing concern about climate change, with many states and now the U.S. Environmental Protection Agency setting targets for reducing greenhouse gas emissions. Since coal-fired power plants produce a lot of these, utilities like Xcel in Colorado are even transitioning some of their coal power plants to ones that run on natural gas.
>
> Due to the state's Clean Air Clean Jobs Act, which aims to convert coal power plants to cleaner energy sources, "about a third of Xcel Energy's coal generating capacity will either be shut down by 2017 or converted to natural gas," said the mining association's Sanderson, predicting that 4 million tons of coal production in Colorado will be affected by that switch.
> […]
> One hope for coal mines, however, is to export their product overseas.

In this rapidly evolving context (related to both energy markets and environmental concerns), there is substantial uncertainty as to how the Proposed Action will affect the amount of future coal production (tons), the value of that production (dollars), and the associated economic benefits and costs.[28] These issues require careful analysis and clear disclosure to the public in Forest Service's upcoming National Environmental Policy Act (NEPA) review.[29]

[28] See Section 4.3 for discussion of how economic benefits and costs are affected by the amount of coal production, in terms of both physical output (tonnage) and value of output (dollars).

[29] While there is substantial uncertainty as to how the Proposed Action will affect future coal production and the associated benefits and costs, this uncertainty does not relieve the Forest Service of its obligation for careful analysis and clear disclosure. In particular, uncertainty does not provide a justification for a selective and asymmetrical consideration of benefits and costs. Put more simply, the SEIS should not focus on benefits and fail to consider costs. Benefits and costs are both uncertain, but both can and should be analyzed, estimated, and disclosed in order to provide a sound and balanced basis for decision-making.

Various factors (including both more localized factors and more regional/national/international factors) could result in higher or lower future coal production in the North Fork Valley, either with or without the Proposed Action. But the uncertainties regarding future coal production would be substantially greater with the Proposed Action (i.e. with the North Fork Mining Area exception). As indicated by the analyses from the FEIS and related documents, with the North Fork Mining Area exception, future coal production could be substantially higher and might continue through 2060; without the North Fork Mining Area exception, coal production is estimated to phase out by 2026.

The uncertainties regarding future coal production relate to both physical output (tons) and the value of that output (dollars). The analyses from the FEIS and related documents value coal production based on average prices for all Colorado coal production in 2009 ($36.71/ton (2009$)).[30]

Colorado production, especially in the North Fork Valley, is disadvantaged by its remote, landlocked, mountainous location and high transport costs to supply distant markets. Despite these locational and cost disadvantages, Colorado coal has in the past been able to sell at relatively high prices owing to its high energy and low sulfur content. But this relatively high price niche for Colorado coal is being eroded by intensifying competitive pressures.

These evolving market dynamics are exemplified by TVA, a large, longstanding buyer of North Fork Valley coal. TVA is cutting the amount of electricity it gets from coal and buying less coal, especially from Colorado. North Fork Valley coal has a high delivered price, so TVA is switching to coal from the Power River (Wyoming) and Illinois Basins, which are more proximate and less expensive:[31]

> The TVA has been a large buyer of North Fork coal since the early 1990s. Back then, power plants around the country began buying low-sulfur Western coal to meet new requirements under the Clean Air Act. But now, like many utilities, the TVA is beginning to cut the amount of electricity it gets from coal.
>
> "Coal in the ‘70s was as much as 70% of our generation mix, and we’re now at about 40%," says Duncan Mansfield, a spokesman for the TVA.
>
> And they’re trying to cut that number even further. Eventually, Mansfield says the TVA will only get 20% of its power from coal. Cheap natural gas and stricter environmental regulations are driving the shift. Plus, the TVA’s coal plants are old and expensive to maintain.

[30] RIA, p. 121 (see footnote 11); USDA Economics Specialist Report, p. 63.
[31] Emily Guerin, “Future of Coal Uncertain as Tennessee Valley Authority Cuts Production,” KNF Radio, December 10, 2013 8:15 AM, emphasis added.
http://kvnf.org/post/future-coal-uncertain-tennessee-valley-authority-cuts-production

[…]
Since TVA is cutting its coal generation in half, it will buy less coal, especially from Colorado.

"**The primary reason is the delivered price**," says Mansfield, "**the ability to switch to lower cost basins in Powder River and Illinois Basin."**

In other words, **Colorado coal is too expensive. Surface mines like those in Wyoming's Powder River Basin can sell coal more cheaply than underground mines like the ones in the North Fork Valley. Wyoming and Illinois producers have another advantage, too: they have fewer mountains to cross.** That's according to industry analyst Bob Burnham.

"Getting the coal from, say, Somerset to Denver, it's an expensive haul," he says. "It costs more per mile."

Given evolving energy market conditions, future coal production may be economically challenged, such that the price per ton will be low and profitability marginal. Thus, historical prices may not be a sound basis for valuing future coal production and especially additional coal production as a result of the Proposed Action (which could extend for many years into the future).[32]

To provide a proper analysis of the economic and environmental impacts of the Proposed Action, it is essential for the SEIS to undertake an updated and expanded analysis of how the Proposed Action could affect coal mine development and operations, and thus coal production, for the entire time period affected by the Proposed Action. It is clearly the Forest Service's duty to disclose such impacts as required by the National Environmental Policy Act, especially in light of the fact that the very purpose of the exception is to promote additional coal mining under the 19,600 acres of roadless lands.

Most of the results for the analyses in the FEIS (and related documents) are reported as annual averages over a 15-year analysis period. This presentation of results does not disclose how coal production varies year-by-year. Moreover, this presentation does not disclose impacts after the 15-year analysis period. This presentation obscures the underlying time pattern of impacts

[32] The FEIS and related documents assume that the additional production due to the North Fork Coal Mining exception would not begin until after 10 years and would then continue for another 39 years. In particular, it is assumed that unleased reserves under roadless areas would not be developed for ten years, allowing a reasonable time for existing or new companies to complete the lease process and establish new operations. USDA Economics Specialist Report, pp. 23-24.

on coal production and excludes most of the production impacts (which could extend for many years into the future beyond a 15-year analysis period).[33]

While it may be useful and appropriate for the SEIS to provide results in this type of format (e.g., annual averages over a 15-year period) as one summary measure, the SEIS should disclose and clearly present the underlying data for estimated coal production year-by-year over the entire time period affected by the Proposed Action.

To provide a sound basis for decision-making, the SEIS must include a full and meaningful analysis of how the Proposed Action could affect coal production, in terms of both physical output (tons) and the value of that output (dollars). This analysis needs to be rigorous, reviewable, and based on current and likely future conditions, coal prices, environmental regulations, and other information. In other words, this analysis should not be just a minor updating of what has been done before in the FEIS and related documents.

The FEIS conducted a largely static, backward-looking analysis of energy market conditions. But energy markets are very dynamic. These markets have been evolving very rapidly since 2009, and they will continue to evolve.

At an absolute minimum, the SEIS must take into consideration current conditions, which are quite different from the historical conditions (year 2009) assumed in the FEIS and related documents. These current conditions include weakness in domestic demand for North Fork Valley coal, idling of the Elk Creek mine,[34] cutbacks at Bowie #2, and the West Elk mine being heavily focused on international markets.

Moreover, given the uncertainty as to how the Proposed Action could affect future coal production, the SEIS analysis should provide guidance as to a range of potential outcomes and the likelihood of various outcomes. In other words, the SEIS analysis should not just be based on a single, supposedly most likely scenario, but should also consider alternative scenarios.

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[33] Based on the assumptions in the FEIS (and related documents), the North Fork Coal Mining Area exception has the following underlying time pattern of impacts on coal mine development, operations, and production:

- zero increase for first 10 years of the analysis period (2012-2021),
- one added mine for last 5 years of the analysis period (2012-2026), producing 4.2 million tons per year, and
- two added mines for the next 34 years (2027-2060) following the analysis period, producing in the order of 5.0-9.3 million tons per year (see footnote 16).

[34] As discussed in footnote 26, the Elk Creek mine is idled following a mine fire and minimal production in 2013, and it is unlikely to produce much coal in the short- to medium-term. The North Fork Coal Mining exception will facilitate coal production from the Pilot Knob Roadless Area adjacent to the Elk Creek mine, so the SEIS must make reasonable assumptions about coal production from the area.

4. Economic Benefits and Costs from Coal Production

Section 4.1 discusses economic benefits from coal production. Section 4.2 discusses adverse environmental and economic impacts (costs) from coal production. Section 4.3 provides Summary and Conclusions.

4.1. Economic Benefits from Coal Production

4.1.1. FEIS

As a starting point for considering how the Proposed Action could have economic benefits, it is useful to review the analyses from the FEIS (and related documents, notably the RIA and USDA Economics Specialist Report). These analyses estimate employment and other economic impacts from coal production based on economic models developed using IMPLAN, a proprietary Input-Output (I-O) modeling system. As explained in the RIA (p. 60):

> Economic impact analysis is used to evaluate potential direct, indirect, and induced effects on the economy. Economic impacts are estimated using input-output analysis. Input-output analysis is a means of examining relationships in an economy, both between businesses and between businesses and final consumers. It captures all monetary market transactions for consumption in a given time period. The resulting mathematical representation allows one to examine the effect of a change in one or several economic activities on an entire economy, all else constant. This examination is called impact analysis. IMPLAN (MIG, Inc., 2011) translates changes in final demand for goods and services into resulting changes in economic effects, such as labor income and employment of the affected area's economy.

In order to capture the impacts throughout the supply chain and broader economy, the Input-Output analysis of coal production in the FEIS and related documents includes the following categories of effects:[35]

> *Direct effects* are realized by extraction companies from the sale of coal.
>
> *Indirect effects* are realized by local companies that provide goods and services to the extraction companies.
>
> *Induced effects* result from local spending of employee income paid by the companies directly and indirectly affected by extraction activities.

[35] FEIS, p. 316.

Total effects are the sum of the sum of the direct, indirect, and induced effects.

The input-output analysis of coal production in the FEIS and related documents estimates effects (direct, indirect, induced, and total), for the following two economic areas: [36]

- 5 counties proximate to North Fork Valley coal mines (Delta, Garfield, Mesa, Montrose, and Rio Blanco Counties),[37] and
- Colorado (statewide including the above 5 counties).

In the Input-Output analysis of coal production in the FEIS and related documents, the value of coal production (direct effect in dollars) is an input to the IMPLAN models. In turn, these models provide as outputs the estimates of economic impacts in terms of the following measures of economic activity:[38]

- value of production (dollars), for indirect, induced, and total effects;
- employment (jobs),[39] for direct, indirect, induced, and total effects; and
- labor income (dollars) for direct, indirect, induced, and total effects.

The Input-Output analysis of coal production in the FEIS and related documents is based on the value of coal production as previously discussed in Section 3. For the 15-year analysis period, the input-output analysis assumes that average annual value of North Fork Valley coal production would be $362 million (2009$) with the North Fork Coal Mining Area exception versus $313 million (2009$) with 2001 Rule (i.e. without the North Fork Coal Mining Area exception).[40] Thus, the North Fork Coal Mining Area exception is assumed to result in an additional $49 million (2009$) of annual value of coal production, averaged over the 15-year analysis period. Put another way, average annual value of North Fork Valley coal production is assumed to be about 16% higher with the North Fork Coal Mining Area exception.

[36] FEIS, pp. 318-309.

[37] As explained below, the economic area for the 5 counties includes all North Fork Valley coal production. One of the existing coal mines is in Delta County, with the other two existing mines and the roadless areas affected by the North Fork Mining Area just over the county line in Gunnison County. Highway and rail access to the mines is via the North Fork Valley in Delta County. Nearly all employees working at the mines live in Delta, Montrose, and Mesa Counties. All coal produced is transported out of the area by rail. To better account for these economic interactions in the Input-Output analysis, the IMPLAN model for the 5 counties was customized to include all North Fork Valley coal production (in Gunnison County as well as Delta County). FEIS, pp. 307-308; RIA, pp. 61-62; USDA Economics Specialist Report, pp. 8, 62.

[38] FEIS, p. 318.

[39] In IMPLAN analysis, employment is typically expressed in job-years. One job-year is equivalent to one full-time job for one person for one year.

[40] Direct value of coal production: FEIS, pp. 318-319; RIA, p. 123; USDA Economics Specialist Report, p. 27.

In the FEIS and related documents, the estimates of economic impacts for employment and other benefits (outputs of the IMPLAN models) are directly proportional to the value of coal production input to the IMPLAN models.[41]

For example, averaged over the 15-year analysis period, the annual value of North Fork Valley coal production with the North Fork Coal Mining Area exception ($362 million (2009$)) is estimated to result in 1741 jobs in the 5 counties, equivalent to 4.8 jobs per $1 million of coal production (2009$).[42] The annual value of coal production without the North Fork Coal Mining Area exception ($313 million (2009$)) is estimated to result in 1504 jobs in the 5 counties, also equivalent to 4.8 jobs per $1 million of coal production (2009$).[43] Thus, the additional annual value of coal production as a result of the North Fork Coal Mining Area exception ($49 million (2009$)) is estimated to result in 237 additional total jobs in the 5 counties, once again equivalent to 4.8 jobs per $1 million of coal production (2009$).

The results reported in the FEIS (and related documents) averaged over the 15-year analysis period do not show how the jobs estimated for coal production vary year-by-year.[44] As previously discussed in Section 3, the additional annual value of coal production as a result of the North Fork Coal Mining Area exception (averaging $49 million (2009$) per year over the 15-year) is based on a zero increase for the first 10 years of the analysis period, and then an increase of $147 million per year over the last 5 years of the analysis period. Thus, the additional jobs as a result of the North Fork Coal Mining Area exception is zero for the first 10 years of the analysis period, and then an increase of 711 total jobs per year in the 5 counties over the last 5 years of the analysis period, once again equivalent to 4.8 jobs per $1 million of coal production (2009$).

In the FEIS and related documents, the estimates of employment and other benefits provide some information regarding type and location of economic impacts. For example, averaged over the 15-year analysis period, the North Fork Coal Mining Area exception is estimated to result in an additional 119 jobs at the mines (direct effects), 118 jobs elsewhere in the 5 counties (indirect and induced effects), for a total of 237 jobs (total effects at mines and elsewhere in the 5 counties).[45] Also averaged over the 15-year analysis period, the North Fork Coal Mining Area exception is estimated to result in an additional 46 jobs elsewhere in Colorado (direct and

[41] Stated another way and in more technical language, IMPLAN models are linear; there is a linear relationship between inputs and outputs, as well as between the various measures of economic activity (value of production, employment, and labor income).

[42] FEIS, p. 318.

[43] FEIS, p. 318.

[44] The USDA Economics Specialist Report (p. 27) acknowledges that:

> the mining industry workforce in the North Fork Valley could be subject to some variation over time. The industry workforce could see modest reductions for five years in the middle of the 15-year analysis period before returning to current levels.

[45] FEIS, pp. 318.

induced effects), for a total of 283 jobs in Colorado (total effects statewide including the 5 counties). [46]

As reported in the FEIS and related documents, the North Fork Coal Mining exception is estimated to result in some jobs (and other economic impacts) directly at the mines, but many of the estimated jobs (and other impacts) are more widely dispersed through the broader economic and geographic context. Thus, it is particularly important that the SEIS properly situate its analysis within the broader economic and geographic context.

The FEIS and related documents provided only limited information in order to situate the jobs (and other impacts) estimated for coal production within the broader economic and geographic context. As reported in the FEIS and related documents for 2009 (the historical base year for modeling), employment for the entire economy (all industries) was more than 146,000 jobs in the 5 counties and more than 2.8 million jobs in Colorado.[47] Thus, total jobs estimated for the North Fork Coal Mining Area exception are equivalent to about 0.16% of total jobs in the 5 counties (as of 2009) and about 0.01% of total jobs in Colorado (as of 2009). But the FEIS (and related documents) did not explicitly compare the jobs (and other economic benefits) estimated for coal production to the relevant totals for the entire economy. The SEIS should provide such comparisons.

Moreover, these comparisons should reflect projected future conditions, rather than be based solely on historical data for the broader economy. The North Fork Coal Mining exception could affect future coal production for many years into the future, in a period when economic conditions are projected to be quite different from the past. The FEIS and related documents assume that the additional production due to the North Fork exception would not begin until after 10 years and would then continue for another 39 years.[48] During this period, the economy is expected to grow very substantially, even if there is no coal production from a North Fork Coal Mining Area exception.[49]

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[46] FEIS, pp. 319.

[47] Data for 2009, FEIS, pp. 305-306, 309; RIA, p. 112; USDA Economics Specialist Report, p. 11.

[48] See footnote 15. In particular, it is assumed that unleased reserves under roadless areas would not be developed for ten years, allowing a reasonable time for existing or new companies to complete the lease process and establish new operations. USDA Economics Specialist Report, pp. 23-24.

[49] USDA Economics Specialist Report, pp. 53-54, showing that growth is very similar with and without a North Fork Coal Mining exception, based in part on economic forecast data from Colorado Department of Local Affairs, State Demography Office (SDO); updated economic forecast data on SDO website
Regions 9-14 (counties proximate to North Fork Valley)
http://www.colorado.gov/cs/Satellite?c=Document_C&childpagename=DOLA-Main%2FDocument_C%2FCBONAddLinkView&cid=1251610045838&pagename=CBONWrapper
Statewide Colorado
http://www.colorado.gov/cs/Satellite?c=Document_C&childpagename=DOLA-Main%2FDocument_C%2FCBONAddLinkView&cid=1251610045771&pagename=CBONWrapper

For example, total employment in the 5 counties proximate to the North Fork Valley is projected to be one-third higher by 2027, adding about 50,000 jobs.[50] And with many jobs being added in the broader economy, unemployment is projected to drop and remain relatively low in the counties proximate to the North Fork Valley, as well as statewide.

Economic growth is projected to be higher in the 5 counties than elsewhere in the state. In-migration of retirees to the 5 counties will contribute to higher employment and labor income.[51]

4.1.2. SEIS

To provide a sound basis for decision-making, the SEIS must include full and meaningful analyses of how the Proposed Action could affect economic benefits. These analyses need to be rigorous, reviewable, and based on current and likely future economic conditions, coal production (in terms of both physical output (tonnage) and value (dollars)), and other information. In other words, these analyses should not be just a minor updating of what has been done before in the FEIS and related documents.

To provide guidance on scoping for the SEIS, it is relevant to consider whether the FEIS (and supporting documents) undertook appropriate analyses of economic benefits and discussed the results in a fair and full way. For the reasons set for below, the FEIS omitted important factors and relied upon analysis and modeling unlikely to provide a sufficient basis for decision-making.

Most of the results for the analyses in the FEIS (and related documents) are reported as annual averages over a 15-year analysis period. This presentation of results does not disclose how benefits vary year-by-year. Moreover, this presentation does not disclose impacts after the 15-year analysis period. This presentation obscures the time pattern of impacts on economic benefits.[52]

While it may be useful and appropriate for the SEIS to provide results in this type of format (e.g., annual averages over a 15-year period) as one summary measure, the SEIS should disclose

[50] See footnote 49, and specifically the updated economic forecast on SDO website.
[51] Ibid.
[52] Based on the assumptions in the FEIS (and related documents), the North Fork Coal Mining Area exception has the following underlying impacts on employment in the 5 counties:

- zero increase for first 10 years of the analysis period (2012-2021),
- 711 total jobs per year, for last 5 years of the analysis period (2012-2026), and
- potential impacts from additional coal production for the next 34 years (2027-2060) following the analysis period, but magnitude of these impacts unclear given lack of analysis and disclosure in the FEIS (and related documents).

and clearly present the underlying data for estimated benefits year-by-year over the entire time period affected by the Proposed Action.[53]

The analyses in the FEIS (and related documents) are based (in part) on statewide averages for Colorado coal production.[54] While it is possible that these statewide averages are reasonably representative for the mines that would be affected by the Proposed Action, it is also possible that these mines could differ significantly from the statewide averages. The SEIS should undertake a fuller, more customized analysis of the mines that would be affected by the Proposed Action. At an absolute minimum, the SEIS must better justify the appropriateness and accuracy of any statewide or other data and methodology utilized

The FEIS conducted static, backward-looking analyses of economic conditions. But the economy is very dynamic. The economy has been evolving very rapidly since 2009, and it will continue to evolve.

At an absolute minimum, the SEIS must take into consideration current conditions. Current energy market and economic conditions are quite different from the historical conditions (year 2009) assumed in the FEIS and related documents.[55]

Moreover, given the uncertainty as to how the Proposed Action could affect future coal production and economic benefits, the SEIS analyses should provide guidance as to a range of potential outcomes and the likelihood of various outcomes. In other words, the SEIS analyses should not just be based on a single, supposedly most likely scenario, but should also consider alternative scenarios.

The FEIS (and related documents) used standard and widely-used modeling methods and tools, notably Input-Output analysis with IMPLAN models, to estimate employment and other economic benefits associated with increased coal production. And the FEIS (and related documents) provide a significant amount of disclosure.

But as summarized in Table 1 and elaborated upon in Section 4.1.3, there are significant limitations and uncertainties in relation to IMPLAN models (and more generally Input-Output

[53] The estimated benefits over the entire time period affected by the Proposed Action may extend for many years in the future. Economic benefits that occur in later years can be (and often are) considered to be of less value than a similar amount of economic benefits that occur in earlier years.
[54] USDA Economics Specialist Report, pp. 62-63.
[55] As discussed in Section 2, current energy market conditions must be considered in the SEIS analysis of how the Proposed Action could affect coal production. And in turn, estimates of coal production are a key input to the analysis of economic benefits. Current energy market conditions include weakness in domestic demand for North Fork Valley coal, idling of the Elk Creek mine, cutbacks at Bowie #2, and the West Elk mine being heavily focused on international markets.

analysis). It is not sufficient for the SEIS to provide an updated version of what was done in the FEIS in regard to modeling methods, tools, and disclosure.

TABLE 1: OVERVIEW OF SOPHISTICATED MODELING APPROACHES AND TOOLS FOR STATE ECONOMIC ANALYSIS[56]

Example of State Tools	Advantages	Disadvantages	Considerations	When to Use
METHOD: Input-Output *(also called multiplier analysis)*				
IMPLAN	▪ Quantifies the total economic effects of a change in the demand for a given product or service. ▪ Can be inexpensive.	▪ Static; multipliers represent only a snapshot of the economy at a given point in time. ▪ Generally assumes fixed prices. ▪ Typically does not account for substitution effects, supply constraints, and changes in competitiveness or other demographic factors.	▪ Provides rich sectoral detail (NAICS-based). Could be appropriate if the need is to analyze detailed impacts by sector.	▪ Short-term analysis.
METHOD: *Econometric Models*				
RAND	▪ Usually dynamic, can estimate and/or track changes in policy impacts over time. ▪ Coefficients are based on historical data and relationships, and statistical methods can be used to assess model credibility.	▪ Historical patterns may not be best indicator or predictor of future relationships. ▪ Some econometric models do not allow foresight.	▪ Important to understand if model is myopic or has foresight.	▪ Short- and long-term analysis.
METHOD: Computable General Equilibrium (CGE) Models				
BEAR	▪ Account for substitution effects, supply constraints, and price adjustments.	▪ Not widely available at state level. ▪ Most CGE models available at state level are static, although a few are dynamic.	▪ Important to examine how the energy sector is treated within any specific CGE model.	▪ Long-term analysis.
METHOD: Hybrid				
REMI Policy Insight	▪ Most sophisticated, combining aspects of all of the above. ▪ Dynamic, can be used to analyze both short- and long -term impacts. ▪ Can be used to model regional interactions. ▪ Flexibility of looking at 2-, 3-, or 4-digit NAICS sectors.	▪ Can be expensive, especially if there is a need to analyze impacts on multiple sub-regions (e.g., counties within a state). ▪ Can require a fair amount of massaging inputs, especially with energy sector inputs.	▪ Important to examine how energy sector is treated. ▪ May need to update default data to account for most recent energy assumptions .	▪ Short- and long-term analysis.

At an absolute minimum, if the SEIS also relies upon IMPLAN models (and more generally Input-Output analysis), more disclosure, customization, and analysis is required. The SEIS should fully and explicitly explain the limitations and uncertainties in relation to the IMPLAN

[56] Source: US EPA, Assessing the Multiple Benefits of Clean Energy: A Resource for States, EPA-430-R-11-014, Revised September 2011, Table 5.2.3, p. 144; for additional information regarding this source, see Sections 4.1.3 and 4.1.4, and specially footnotes 59 and 62.
http://www.epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits.pdf

models and the overall analysis. Moreover, the Forest Service should undertake additional model customization and analysis in order to mitigate the limitations and uncertainties in relation to IMPLAN-based analysis of the Proposed Action.[57]

But given the limitations and uncertainties in relation to IMPLAN models (and more generally Input-Output analysis), the Forest Service should instead utilize a more sophisticated modeling of economic benefits. As summarized in Table 1 and elaborated upon in Section 4.1.4, Hybrid models are dynamic and offer the most flexibility and detail in tailoring an analysis. Hybrid models can provide realistic year-by-year estimates of both the short- and long-term total effects of a specific policy initiative (such as the Proposed Action). In particular, REMI PI$^+$ (the next generation of REMI Policy Insight) is appropriate for use by the Forest Service to evaluate the Proposed Action and estimate economic benefits such as employment.

4.1.3. IMPLAN Models and Input-Output Analysis

IMPLAN models, and more generally Input-Output analysis, are useful but highly simplified representations of how the economy actually operates. As summarized in Table 1 and elaborated upon in this Section 4.1.3, there are significant limitations and uncertainties in relation to IMPLAN models (and more generally Input-Output analysis).

The US EPA has prepared a very useful guide for assessing the benefits of energy options, including macroeconomic benefits such as employment.[58] This guide is the source of Table 1 in these Comments. This guide also provides a concise description of Input-Output Models and their limitations:[59]

> **Input-Output Models**
> Input-output (I-O) models, also known as multiplier analysis models, are useful for quantifying macroeconomic impacts because they estimate relationships among industries in a state, regional, or national economy. Policy impacts in I-O models are driven by changes in demand for goods and services.
> […]
> The strength of I-O based models is their ability to quantify the total economic effects of a change in the demand for a given product or service. In this context, "total" means the cumulative direct, indirect, and induced effects. The I-O model

[57] See footnote 61 for an example of model customization and analysis that could be undertaken to mitigate the limitations of IMPLAN-based analysis of the Proposed Action.
[58] US EPA, Assessing the Multiple Benefits of Clean Energy: A Resource for States, EPA-430-R-11-014, Revised September 2011. http://www.epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits.pdf
This document was specifically prepared to assist in evaluation of clean energy options. Nonetheless, the content in this document regarding modeling approaches and tools for state economic analysis is generally applicable for evaluation of other energy options, including the Proposed Action affecting coal production.
[59] Ibid, pp. 144-145, emphasis added.

produces a set of multipliers that describe changes in employment, output, or income in one industry given a demand change in another industry. **It is important to note, however, that the multipliers derived from I-O models only represent a snapshot of the economy at a given point in time. Due to their static nature, I-O models generally assume fixed prices and do not account for substitution effects and changes in competitiveness or other demographic factors; thus they are suitable for static or short-term analysis only** (RAP, 2005).

The significant assumptions, limitations, and uncertainties in relation to IMPLAN models (and more generally Input-Output analysis) are routinely recognized and disclosed, notably in studies assessing the benefits of energy options.[60] The assumptions, limitations, and uncertainties routinely recognized and disclosed are described below, together with some discussion of their nexus with analyses of the North Fork Valley Coal Mining exception:

Static, Linear, and Backward-looking based on Lagged Historical Data: Fixed Patterns for Production, Consumption, and Savings

The industrial structure and supply chain relationships that underlay the I-O model are based on the economy at a fixed point in time, which is typically based on historical data that is at least 2 years old. For example, the IMPLAN models and I-O analysis in the FEIS and related documents are based on 2009 data. There is a time lag for historical data to become available and then be processed to create the most recent version of the I-O models.

The model results do not take into account how changes in relative prices for different inputs, productivity, technology, and trading relationships can impact supply chains over time. The I-O model assumes there are no economies of scale; productivity of labor and other inputs are constant.

These assumptions are also pertinent in regard to induced effects. The I-O model assumes fixed consumption and savings patterns for consumers over time. In

[60] See for example, studies by TGG and others assessing the benefits of energy and other policy options, as well as guides from I-O model developers:
http://www.thegoodman.com/pdf/TGG20150204_SFU_EconCostBen_TMX.pdf
http://www.bea.gov/papers/pdf/WP_IOMIA_RIMSII_020612.pdf
http://www.nrel.gov/analysis/jedi/limitations.html
http://www.nma.org/pdf/coal_export_report.pdf p. 15
http://www.doleta.gov/performance/results/AnnualReports/PY2012/Economic%20Impact%20Analysis.pdf
http://www.synapse-energy.com/sites/default/files/SynapseReport.2005-05.RAP-EPA.Efficiency-and-Renewable-Energy-in-New-England.04-23.pdf (RAP, 2005, cited in quotation from footnote 59)
http://www.statsnwt.ca/economy/multipliers/NWT%20IO%20Model-Overview.pdf
http://www.energyeastpipeline.com/wp-content/uploads/2014/10/Conference-Board-Of-Canada-Report.pdf pp. 59-60

reality, spending and saving patterns are influenced by a variety of factors including economic circumstances and demographics.

As a result of the above assumptions, the farther in the future an activity will occur, the less likely it is that the I-O model will accurately describe future economic activity.

No Constraints on Supply of Labor and Other Inputs

I-O assumes all of the workers and other inputs needed to conduct the proposed activity are readily available, and that the proposed activity will not be competing with other activities for labor and other inputs.[61]

In reality, especially if the context is tight markets for labor and other inputs, undertaking the proposed activity may lead to higher wages (and/or prices for other inputs), as the proposed activity pulls workers and other inputs away from competing activities. At least to some extent, the proposed activity could have the effect of displacing competing activities. Thus, the actual overall net impacts of the proposed activity could be less than the impacts estimated by the I-O model (which assumes that the proposed activity will not be competing with other activities for labor and other inputs).

The I-O assumption of no constraints on labor supply is particularly pertinent in regard to induced effects. Induced effects result from local spending of employee income paid by the companies directly and indirectly affected by the proposed activity. The induced effects assume that the people employed as a result of the direct and indirect effects would otherwise be unemployed

In reality, at least some of these workers would likely find other employment, though their pay may be less. Thus, including the induced effects will tend to overstate the total economic effects, especially in a context of tight markets for labor and other inputs. But not including induced effects may tend to understate the total economic effects, especially in a context of slack markets for labor and other inputs.

Constraints on supply of labor and other inputs are more likely to occur in small, remote economies that are not strongly interconnected with broader markets, versus larger, more interconnected economies. The counties proximate to North Fork Valley have small economies and are physically remote, such that constraints are more likely to occur. But these counties do have an established

[61] Stated another way and in more technical language, I/O assumes that supply is infinite and perfectly elastic.

developed mining industry and supply chain that could facilitate development and operation of additional mines

Industry Homogeneity
I-O models typically assume that all firms within an industry are characterized by a common production process. In practical terms, the model reflects an industry average. If the production structure of the firm undertaking the proposed activity is significantly different from the industry average than the economic impact results may be different from what is estimated by the I-O Model.

Capital Stock not explicitly represented
I-O models are flow models; stocks are not explicitly represented, which implicitly assumes that output can be produced without additions to capital stock

4.1.4. REMI PI+ and Hybrid Models

As summarized in Table 1 and elaborated upon in this Section 4.1.4, Hybrid models are dynamic and offer the most flexibility and detail in tailoring an analysis. Hybrid models can provide realistic year-by-year estimates of both the short- and long-term total effects of a specific policy initiative (such as the Proposed Action). In particular, REMI PI+ (the next generation of REMI Policy Insight) is appropriate for use by the Forest Service to evaluate the Proposed Action and estimate economic benefits such as employment.

The US EPA guide that is the source of Table 1 also provides a concise description of Hybrid Models including REMI and their advantages compared other modeling approaches: [62]

Hybrid Models
Hybrid models incorporate aspects of two or more of the modeling approaches […], with most models linking an I-O model to an econometric model. […]

These models include five analytic elements: (1) output, (2) labor and capital demands, (3) population and labor supply, (4) wages, prices, and profits, and (5) market shares. The integrated structure of these models allows them to capture everything from economic migration to changes in relative prices and the overall competitiveness of businesses in the economy. **These models also include dynamic frameworks that support forecasting of both what will happen in response to an initiative and when it will happen.**

Of the general approaches described in this section, **the hybrid modeling approach offers the most flexibility and detail in tailoring an analysis to**

[62] See footnote 58 for information on source, pp. 147-148, emphasis added.

> **estimate the effect of a specific […] energy initiative on a state's economy.** A user can specify and forecast numerous different model inputs, including: industry output, industry demand, government, investment and/or consumer spending, employment, factor productivity, labor supply, production costs, business taxes and credits, fuel and/or labor costs, wages, housing and consumer prices, and market shares. **The results of the complex, dynamic simulations produced by hybrid models can be distilled into net impacts on key economic policy indicators, such as employment, income, and overall economic output. Hybrid models can be effective at estimating both the long- and short-term impacts of policies.**
>
> **Hybrid models used for policy analyses include REMI Policy Insight** […]

The REMI Model is a high quality Hybrid Model, incorporating Input-Output, as well as three other major modeling approaches:[63]

> The REMI model incorporates aspects of four major modeling approaches: Input-Output, General Equilibrium, Econometric, and Economic Geography. Each of these methodologies has distinct advantages as well as limitations when used alone. The REMI integrated modeling approach builds on the strengths of each of these approaches.
>
> The REMI model at its core, has the inter-industry relationships found in Input-Output models. As a result, the industry structure of a particular region is captured within the model, as well as transactions between industries. Changes that affect industry sectors that are highly interconnected to the rest of the economy will often have a greater economic impact than those for industries that are not closely linked to the regional economy.
>
> General Equilibrium is reached when supply and demand are balanced. This tends to occur in the long run, as prices, production, consumption, imports, exports, and other changes occur to stabilize the economic system. For example, if real wages in a region rise relative to the U.S., this will tend to attract economic migrants to the region until relative real wage rates equalize. The general equilibrium properties are necessary to evaluate changes such as tax policies that may have an effect on regional prices and competitiveness.

[63] http://www.eremi.com/index.php/the-remi-model/. Regional Economic Models, Inc. (REMI), the developer of the REMI model, provides extensive model documentation and other information on its corporate website. http://www.remi.com/ See also footnote 64.

REMI is sometimes called an "Econometric model," as the underlying equations and responses are estimated using advanced statistical techniques. The estimates are used to quantify the structural relationships in the model. The speed of economic responses is also estimated, since different adjustment periods will result in different policy recommendations and even different economic outcomes.

The New Economic Geography features represent the spatial dimension of the economy. Transportation costs and accessibility are important economic determinants of interregional trade and the productivity benefits that occur due to industry clustering and labor market access. Firms benefit having access to a large, specialized labor pool and from having access to specialized intermediate inputs from supplying firms. The productivity and competitiveness benefits of labor and industry concentrations are called agglomeration economies, and are modeled in the economic geography equations.

REMI PI^{+} (the next generation of REMI Policy Insight) is appropriate for use by the Forest Service to evaluate the Proposed Action and estimate economic benefits such as employment:[64]

> **PI+, the next generation of Policy Insight, generates realistic year-by-year estimates of the total regional effects of any specific policy initiative**. A wide range of policy variables allows the user to represent the policy to be evaluated, while the explicit structure in the model helps the user to interpret the predicted economic and demographic effects. The model is calibrated to many sub-national areas for policy analysis and forecasting, and is available in single- and multi-area configurations. Each calibrated area (or region) has economic and demographic variables, as well as policy variables so that any policy that affects a local economy can be tested.
>
> **PI+ is used by government agencies (including most U.S. state governments)**, consulting firms, nonprofit institutions, universities, and public utilities. **Model simulations estimate comprehensive economic and demographic effects in wide-ranging initiatives such as: economic impact analysis; policies and programs for economic development, infrastructure, environment, energy and natural resources**; and state and local tax changes.

[64] http://www.remi.com/products/pi, emphasis added.

4.2. Adverse Environmental and Economic Impacts (Costs) from Coal Production

Within the constraints of these Comments on SEIS Scoping, TGG has not been able to undertake a detailed analysis of the adverse environmental and economic impacts (costs) that could result from the Proposed Action. Nonetheless, as part of these Comments on Scoping, TGG can provide some guidance regarding how the Proposed Action could result in adverse environmental and economic impacts (costs). This guidance is based on the limited analysis that TGG has been able to undertake for these Comments, as well as TGG's overall expertise in the environmental and economic impacts of energy-related activities.

There are sizable adverse environmental impacts from coal production and the entire fuel cycle associated with coal (including transport, consumption, and waste disposal). These adverse impacts occur both locally (including proximate to coal production) and nationally/globally (including impacts relating to GHG emissions). In turn, these adverse environmental impacts can have adverse economic impacts (costs), on both the local and national/international levels. These adverse environmental and economic impacts (costs) generally increase based on the amount of coal mine development and operations, and thus coal production, that could result from the Proposed Action.

The Proposed Action could thus have sizable adverse environmental impacts, both locally and nationally/globally. And these adverse environmental impacts could in turn have adverse economic impacts, on both the local and national/international levels.

As acknowledged in the FEIS, the North Fork Valley Coal Mining exception would result in substantial additional ground disturbing activities in roadless areas: 34 miles of temporary road, and up to 420 Methane Drainage Well Pads (with up to 126 acres of temporary surface disturbance could result from installation of methane drainage wells needed for mine safety purposes).[65]

As also acknowledged in the FEIS, coal mining (notably venting from underground mines) is a major emitter of methane, which is a potent GHG; some methane will also be released during coal, storage, transport, and processing:[66]

> Methane gas (CH4) is […] a greenhouse gas that contributes to global climate change. Methane is considered approximately 20 times more potent as a

[65] FEIS, pp. 72-77, especially Table 3-8, p. 72. With the North Fork Valley Coal Mining exception: 50 miles of temporary road, and up to 600 Methane Drainage Well Pads (with up to 180 acres of temporary surface disturbance); versus with 2001 Rule: 16 miles of temporary road, and up to 180 Methane Drainage Well Pads (with up to 54 acres of temporary surface disturbance).
[66] FEIS, pp. 128-129.

> greenhouse gas than carbon dioxide (CO2), though it is emitted to a lesser degree than carbon dioxide in terms of overall quantity of emissions. […] Approximately 10 percent of U.S. methane emissions in 2009 resulted from coal mining (EPA 2011i). […]
>
> Methane resulting from underground mining activities is vented to the atmosphere for safety reasons, as accumulated methane can cause explosions. Coal extracted from surface mines generally has lower methane content than coal found in underground mines. Although most methane is released during mining operations, some will remain in the coal and can be released during storage, transport, and processing.

And as further acknowledged in the FEIS,[67]

> Once the coal is burned, there will be additional emissions from the combustion process. These emissions include nitrogen oxides, particulates, volatile organic compounds, sulfur dioxide, carbon dioxide, and small amounts of mercury. Mercury is not a criteria pollutant, but it is readily converted to toxic methyl mercury once it is deposited into water-bodies. A neurotoxin, methyl mercury can accumulate in fish to levels that are not safe for human consumption.

Locally, coal production will adversely affect other economic activity, and especially other economic activity that is based on a high quality of life and environment. Especially in Colorado and specifically in the area proximate to North Fork Valley coal production, there is substantial outdoor recreation, in-migration of retirees, and other activity (including economic activity) that is based on a high quality of life and environment. So to the extent that coal production adversely impacts the environment, it will adversely impact other economic activity.

Nationally and internationally, coal production will adversely affect other economic activity, notably via impacts on GHGs, but also via other emissions and adverse impacts associated with coal.

The Proposed Action will have sizable adverse environmental impacts, which in turn would have sizable adverse economic impacts. The SEIS must analyze in full and disclose these adverse impacts.

[67] FEIS, p. 129.

4.3. Summary and Conclusions

Any SEIS consideration of the economic benefits from coal production must be balanced and also consider the economic costs from coal production. Put more simply, to the extent that the Proposed Action is bad for environment, it is also bad for the economy. The SEIS must appropriately consider economic costs as well as benefits, rather than focus on benefits and fail to consider costs.[68]

In order for the SEIS to appropriately consider both economic benefits and costs, the SEIS must be based on credible and consistent assumptions regarding the energy supply alternatives to North Fork Valley coal production.

If it is assumed that North Fork Valley coal will displace other coal, then the benefits analysis should net out the impacts of the other coal that will be displaced. Thus, the North Fork Valley exception could result in more jobs and lease payments from coal production there, but it could also result in less jobs and lease payments from coal production somewhere else. A NEPA analysis should consider this loss of benefits from coal production elsewhere (at least if in the US). This was not done in the analyses of benefits in the FEIS (and related documents), or seemingly even considered.[69]

Next, if it is assumed that North Fork Valley coal instead displaces some other energy sources (such as natural gas or renewables used to generate electricity, instead of coal being used), then the benefits analysis should net out the foregone benefits of the other energy source that will be displaced. Thus, the North Fork Valley exception could result in more jobs and lease payments from coal production there, but it could also result in less jobs and other benefits from energy production somewhere else. A NEPA analysis should consider this loss of benefits from energy production somewhere else (at least if in the US).

Likewise, in the analysis of adverse environmental and economic impacts (costs), the SEIS should consider both the impacts from North Fork Valley coal and the impacts from the other energy source that will be displaced. Thus, the North Fork Valley exception will result in more adverse impacts (such as methane emissions) from coal production there, but it could also

---

[68] Benefits and costs are both uncertain, but both can and should be analyzed, estimated, and disclosed in order to provide a sound and balanced basis for decision-making. See footnote 29 for a discussion of uncertainty.

[69] But before the District Court that then ruled to vacate the North Fork Coal Mining Area exception, the Forest Service concluded that that there would be perfect substitution between coal provided by the North Fork Valley and coal mined elsewhere (High Country Conservation Advocates v. United States Forest Service, United States District Court for the District of Colorado, Civil Action No. 13-cv-01723-RBJ, June 27, 2014, p. 29): https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3834111.pdf

> the agencies argue that the same amount of coal will be burned whether or not the CRR exempts the North Fork Valley. The agency concluded that there would be perfect substitution between coal provided by the North Fork Valley and coal mined elsewhere.

result in less adverse impacts (such as methane emissions) from coal production somewhere else.

For both North Fork Valley coal and alternative sources of energy supply, it is relevant to consider both benefits (jobs, lease payments, etc.) and costs (from adverse environmental impacts). This approach would provide a symmetrical, balanced consideration of costs and benefits, for both North Fork Valley coal and for alternatives to North Fork Valley coal.

Coal production can be measured in terms of both physical output (tonnage) and value (dollars). Both measures of coal production are relevant to consider in estimating economic impacts. Some economic benefits (such as taxes and lease payments) may be tied to value of output, while employment could also be affected by amount of physical output.[70] Meanwhile, to the extent that coal production has adverse environmental impacts (and associated adverse economic impacts), these impacts may be mainly a function of physical output. Put more simply, more tons of production could result in more pollution.

Future coal production may be economically challenged, such that price per ton is low and profitability marginal. Thus, if the Proposed Action leads to increased coal production, the added production may be low value with low associated economic benefits. Meanwhile, this added production could have large adverse environmental impacts (and associated adverse economic impacts).

[70] In the FEIS (and related documents), the estimates of employment and other benefits are based on Input-Output analysis with IMPLAN models. This analysis with IMPLAN assumes that the relationships between dollar value of output at the mines and employment (number of jobs) and labor income (dollars of compensation) will be a continuation of the relationships that existed in 2009; it is assumed that these relationships will not change over time.

In reality, these relationships may shift over time, based in part on coal pricing (the relationship between value and physical output, in terms of dollars per ton). Future coal production may be economically challenged, such that price per ton is low and profitability marginal. In such a context, dollar value of output at the mines would be lower, but employment (number of jobs) might be tied to physical output; workers would be needed to mine the tonnage, even if the tonnage was less valuable. A context of low coal prices could also put downward pressure on labor income; workers would be needed, but they would be paid less.

Other factors could also shift over time, with implications for employment and labor income. Notably, productivity could increase, such that per dollar value of output, there would be less employment and less labor income.

APPENDICES

A: Resume of Ian Goodman

B: Resume of Brigid Rowan

APPENDIX

A. Resume of Ian Goodman

Ian Goodman

The Goodman Group, Ltd.

(510) 841-1200 (office)
(510) 684-9800 (cell)
(510) 841-1210 (fax)

2515 Piedmont Ave., Suite11
Berkeley, CA 94704-3142
ian@thegoodman.com

Professional Profile

Ian Goodman is President and founder of The Goodman Group, Ltd. He has conducted research and consulted in energy regulation and economics for over 35 years. His practice has addressed a broad range of issues, including evolving North American oil, gas and electric markets, and economic development and environmental impacts of various energy supply and transportation options. Mr. Goodman has a particular expertise in the planning and operations of energy systems, as well as interjurisdictional energy trade in North America. Since 2011, his practice has focused on oil supply and transportation (notably Canadian tar sands, shale, pipelines and rail). Mr. Goodman has co-authored reports and expert testimony on the most controversial oil projects in North America.

He has provided expert evidence in almost 50 regulatory, environmental assessment, and legal proceedings in various North American jurisdictions including California, New York, three New England states, Florida, Manitoba, Ontario, Quebec, as well as the Federal Energy Regulatory Commission (FERC) in the US and the National Energy Board (NEB) in Canada. He has also assisted counsel in those and other proceedings. His clients have included energy sector companies (electric and gas utilities, marketers, project developers, and equipment providers), regulators, government, customer and environmental groups, and North American Native/First Nations organizations. Mr. Goodman is the author or co-author of over 60 publications and major reports relating to the energy industry. Ian Goodman co-authored an influential and widely publicized study on the employment impacts of the Keystone XL pipeline ("Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL").

Professional Experience

1989 – present **President, The Goodman Group, Ltd.,**
Berkeley, California (formerly Boston, Massachusetts)

Collaborating with a team of associates to provide an array of expert consulting services such as expert testimony, reports, research, policy assessment and litigation support related to energy regulation and economics.

Specializing in the evolving North American oil, gas and electric markets, the economic development and environmental impacts of various energy supply and transportation options, and energy system planning and operations.

Major Projects:

Economic Development and Environmental Impacts of Energy Options

- Since 1991, has conducted over 20 national, regional, and state/provincial studies on the economic development impacts (notably jobs) and environmental impacts of various energy supply and transportation options in the US and Canada.

- Since 2011, has co-authored seven expert reports on the economic development impacts and environmental impacts of crude oil transportation (particularly interjurisdictional tar sands crude pipeline projects and crude by rail projects).

- Co-authored the "Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver" with Brigid Rowan in collaboration with Simon Fraser University's Centre for Public Policy Research. The report, released in November 2014 and re-released in February 2015, refutes Kinder Morgan's claims regarding the positive economic development benefits of its controversial pipeline project. Goodman and Rowan show that the benefits of the pipeline are very small and have been significantly overstated by Kinder Morgan, whereas the worst-case costs of a catastrophic spill are very large and have been vastly understated.

- Co-authored the "Economics of Transporting and Processing Tar Sands Crudes in Quebec" with Brigid Rowan in collaboration with Équiterre and

Greenpeace Canada. The January 2014 report demonstrates that the economic development benefits for Quebec of moving and refining tar sands crudes would be insignificant while the costs and risks are very high.

- Co-authored an "Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail" with Brigid Rowan on behalf of Oil Change International (OCI). The November 2013 report demonstrates that the economic costs of crude by rail accidents can be very large and concludes that a major crude by rail (CBR) unit train accident/spill could cost $1 billion or more for a single event. The report was incorporated into Comments filed by NRDC, Sierra Club and OCI before PHMSA as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, December 5, 2013.

- Co-authored expert testimony, entitled "The Relative Economic Costs and Benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project" with Brigid Rowan. The expert report was filed in August 2013 at Canada's National Energy Board on behalf of the Équiterre Coalition, a coalition of Quebec- and Ontario-based environmental groups.

- Co-authored "Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project Benicia, California" with Brigid Rowan on behalf of NRDC. The July 2013 report provides a Market Analysis of a proposed crude by rail project for the Valero Benicia Refinery. Goodman and Rowan conclude that the proposed project could significantly affect crude supply (and thus quality) for the refinery, and recommend that a full Environmental Impact Report be undertaken. The report was included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by Rail Project, filed with the City of Benicia on July 1, 2013.

- Co-authored a “Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis” with Brigid Rowan, and filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations in April 2013. Based on

their evaluation of the early 2013 market conditions (including emerging crude markets, factors driving tar sands expansion, availability and cost of crude oil transportation, and tar sands breakeven costs), Rowan and Goodman concluded that (i) the US State Department's DSEIS Market Analysis was deeply flawed and not a sound basis for decision-making; and (ii) KXL, and specifically its impact on tar sands logistics costs and crude prices, would have a significant impact on tar sands expansion under a very broad range of conditions and assumptions.

- Co-authored an influential and widely publicized study of the Keystone XL pipeline employment impacts ("Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL") with Brigid Rowan and the Cornell Global Labor Institute. Goodman and Rowan provided economic impact analysis to demonstrate that TransCanada Pipelines Ltd had substantially exaggerated the US job numbers related to the KXL project. The report was originally released in September 2011 and updated in January 2012.

- Co-authored "Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants" with Brigid Rowan. This November 2011 study for Sierra Club National estimated the employment impacts of Air-Pollution Controls at North Dakota Coal Plants.

- Provided expert testimony on behalf of The Greenlining Institute on economic development impacts (focusing on job creation and stimulus) of capital expenditures and rate increases proposed by the Pacific Gas & Electric Company in its 2011 General Rate Case.

- Co-authored the Avoided Energy Supply Costs in New England: 2009 Report, prepared for Avoided-Energy-Supply-Component (AESC) Study Group, which represents all major electric and gas utilities in New England, as well as efficiency program administrators, state energy offices and regulators. TGG's contribution to this report was an analysis of the economic development impact of Massachusetts electricity and gas energy efficiency programs.

- Co-developed E^3AS (Energy, Economic, and Environmental Analysis System) software on behalf of the US EPA in 1996 and made it available to assist government agencies in evaluating the economic and environmental impacts of energy supply and efficiency programs, and in considering both the benefits and costs of energy alternatives.

- Has incorporated E^3AS model analysis in all studies of economic and environmental impacts since 1996.

Manitoba Hydroelectric System Planning, Operations, Project Assessment, and US Exports

Wuskatim Generating Station and Transmission Project (1999-2005)

On behalf of the Pimicikamak Cree Nation (PCN):

- Evaluated Manitoba Hydro system planning, environmental review, and disclosure relating to the Churchill-Nelson hydro project
- Assessed the environmental and other impacts from existing hydro and the proposed 200 MW Wuskwatim hydro project
- Analyzed the need for comprehensive assessment of the entire Churchill-Nelson project (existing, proposed, and future)
- Reviewed precedents regarding comprehensive assessment of existing major hydro projects
- Submitted comments to the Minnesota Public Utilities Commission on Northern States Power's supply requirements in relation to Manitoba energy exports from Wuskatim.

Conawapa Generating Station (1990, 1992)

On behalf of a coalition of citizens', conservation and environmental groups:

- Filed expert evidence in the 1992 Conawapa Project Environmental Assessment concerning:
    - the need for environmental reviews to evaluate the justification of design alternatives to the 1290 MW Conawapa hydro project
    - a description of the changes in the utility industry and new supply source options affecting the design alternatives included in an environmental review
    - a review of the treatment of the project justification in North American environmental assessments.

- Filed expert evidence before the Manitoba Public Utilities Board in the context of the 1990 Manitoba Hydro Submission for the Conawapa generating station, which included:
    - a review of the Manitoba Hydro submission; a review of Manitoba Hydro load forecasting; an estimation of economic and attainable conservation potential; development of principles of conservation program design and delivery; a critique of the utility's proposed demand-side management program, an evaluation of supply-side alternatives and analysis of avoided costs; an assessment of

employment and economic development effects of hydroelectric development and conservation; and an analysis of profitability and risks of the proposed power sales contracts.

Hydro-Québec System Planning, Operations, Project Assessment, and US Exports

Great Whale Project (1989-1994)

Submitted evidence and testified before various regulatory and legal bodies in the US and Canada on behalf of the Grand Council of the Crees (of Québec) and/or a coalition of environmental groups to assess the economic and environmental impacts of the proposed 3160 MW Great Whale Project, as well as the long-term US export contracts based on the project.

Mr. Goodman's wide-ranging efforts were instrumental in Hydro-Québec's eventual cancellation of the Great Whale Project. Key interventions included:

- Submitting evidence between 1989 and 1991, before the Vermont Public Service Board, including a review of a proposed thirty year, 450 MW purchase by twenty-four Vermont utilities of Hydro-Québec power derived from the development of the Great Whale Project; and an analysis of planning and operation of Hydro-Québec power supply and modeling of hydro reservoir levels.

- Testifying in 1991 before the State of Vermont Supreme Court regarding the same 450 MW purchase and providing a summary of changes concerning load forecasts and supply-side alternatives and an analysis of the cost effectiveness of the contract.

- Submitting an analysis of the nexus between New York Power Authority purchases and the construction of specific Hydro-Québec facilities (notably Great Whale), as well as the operation of fossil fuel electric generation before the State of New York Supreme Court in 1990.

- Presenting a review of Hydro-Québec's proposed export contracts to Vermont (450 MW) and New York State (1000 MW) before Canada's National Energy Board in 1990.

- Analyzing confidential risk-sharing electric supply contracts between Hydro-Québec and large industrial customers, including an assessment of the resulting implications for Hydro-Québec and its ratepayers in 1991.

- Submitting evidence in 1992 for the Canadian and Québec governments' Environmental Review of the Great Whale Project including a discussion of changes in the utility industry and new supply resource options affecting design alternatives included in an environmental review.

- Assessing an 800 MW seasonal diversity contract in the context of the 1994 energy market before the State of New York Assembly Standing Committees on Energy and Conservation.

1986 – 1989 Consulting Associate, PLC, Inc., Boston, Massachusetts

Research and consulting in various aspects of utility regulation and economics. Advised utilities and regulatory commissions on electric and gas least-cost planning. Assessed potential for conservation, non-utility generation, and other supply alternatives. Reviewed prudence of power supply investment decisions. Analyzed rate design and allocation issues. Developed end-use demand estimates. Evaluated district heating system management. Analyzed markets and rates of regulated transportation services.

1981 – 1986 Consulting Associate, Analysis and Inference, Inc., Boston, Massachusetts

Research and consulting in various aspects of utility regulation and statistical applications. Reviewed prudence of utility power plant construction programs with emphasis on cost and schedule of nuclear plants. Researched utility rate design and allocation issues. Reviewed demand forecasts. Analyzed taconite industry economics and electricity supply. Analyzed causal factors for statistical theft estimation of fuel oil overbilling and diversion of parking meter and transit revenue.

1978 – 1987 Consultant, Salgo & Lee, Boston, Massachusetts

Research and consulting in electric utility regulation and civil damage litigation. Reviewed nuclear construction programs and alternatives, demand forecasts, transmission line proposals, and state rate-making policies. Analyzed effects of regional power pool rules on independent power producers. Evaluated damage claims arising from power plant equipment outages.

Education

1977	S.B., Civil Engineering, Massachusetts Institute of Technology

Advisory Assignments to Regulatory and Investigatory Commissions and Staff

1996	Commission of Inquiry on Hydro-Québec's Purchase Policy for Electricity from Independent Power Producers (*Commission d'enquête sur la politique d'achat par Hydro-Québec d'électricité auprès de producteurs privés*), Commission Staff.
1993 – 2000	Maine Public Utilities Commission Staff, Docket Nos. 92-331, 95-598, 98-791, 2000-441, and 2000-47; Special Industrial Rate Contracts
1993	Maine Public Utilities Commission Staff, Docket No. 93-147; Certificate of Public Convenience to Erect a Transmission Line
1987 – 1988	District of Columbia Public Service Commission, Docket No. 834 Phase II; Least-cost Planning Procedures and Goals.

Appointments

1991 – 1995	Committee to Review the Glen Canyon Environmental Studies, National Research Council Water Science and Technology Board
1978	New England Energy Congress, Regulatory and Institutional Process Committee.

Publications and Major Reports

Comments on Draft Environmental Impact Report (DEIR) Analysis of Oil and Gas Well Stimulation Treatments in California on behalf of NRDC, *March 16, 2015* (co-author with B. Rowan), incorporated as an attachment to Comments filed by Natural Resources Defense Council (NRDC), Center for Biological Diversity (CBD), Sierra Club, Los Angeles Waterkeeper on the Department of Conservation's, through its Division of Oil, Gas and Geothermal Resources (DOGGR), Draft Environmental Impact Report (DEIR) for Well Stimulation in California (the Project) prepared pursuant to the California Environmental Quality Act (CEQA), *March 16, 2015*.

Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver in collaboration with The Centre for Public Policy Research, Simon Fraser University, *November 10, 2014* (co-author with B. Rowan, re-released *February 4, 2015*).

Report on the Economics of Transporting and Processing Tar Sands Crudes in Quebec in collaboration with Équiterre and Greenpeace Canada, *January 2014* (co-author with B. Rowan).

Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail, *November 8, 2013* (co-author with B. Rowan) on behalf of Oil Change International (OCI), incorporated as Attachment 3 to Comments filed by NRDC, Sierra Club and OCI before The Pipeline and Hazardous Materials Safety Administration, U.S. Department Of Transportation as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, *December 5, 2013*.

Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project, Use Permit Application 12PLN-00063, Benicia, California, *July 1, 2013* (co-author with B. Rowan) on behalf of NRDC, included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by Rail Project, filed with the City of Benicia Community Development Department on *July 1, 2013*.

Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis, *April 22, 2013* (co-author with B. Rowan), filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations.

Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL, *September 28, 2011* (co-author with B. Rowan, TGG, and L. Skinner and S. Sweeney, Cornell Global Labor Institute; *revised January 18, 2012*).

Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants, prepared for Sierra Club, *November 21, 2011* (co-author with B. Rowan).

The Economics of Supplier Diversity Examining Areas of Potential Interest for GLI with respect to GRC 2011 and Potential Amendments to GO 156, prepared for The Greenlining Institute, *August 6, 2010* (co-author with B. Rowan).

Avoided Energy Supply Costs in New England: 2009 Report, prepared for Avoided-Energy-Supply-Component (AESC) Study Group, *August 21, 2009* (co-author with R. Hornby, P. Chernick, et al.; *revised October 23, 2009*).

Reallocation of Funds from National Grid's Current Energy Efficiency Programs to Other Uses, prepared for National Grid USA, *October 24, 2006*

National Grid's Energy Efficiency Programs: Benefits for Rhode Island's Economic Development and Environment, prepared for National Grid USA, *July 28, 2006*.

Comment of Pimicikamak Cree Nation (PCN) on Minnesota Draft State Energy Planning Report, sponsored by Minnesotans for an Energy-Efficient Economy (ME3), *November 21, 2001.*

Proposal for PV and Energy Efficiency at State Facilities: Benefits for California's Economic Development and Environment, prepared for PowerLight Corporation, *November 15, 2001.*

Narragansett Electric's Energy Efficiency Programs: Benefits for Rhode Island's Economic Development and Environment, prepared for Narragansett Electric Company, *August 14, 2001.*

Comment Submitted By Pimicikamak Cree Nation on An Investigation Into Environmental And Socio-Economic Costs Under Minnesota Statute §216B.2422, Subd. 3, submitted in Minnesota Public Utilities Commission Docket No. E999/CI-00-1636, *January 16, 2001* (co-author with P. Chernick and A. Orkin).

Comment Submitted By Pimicikamak Cree Nation on Northern States Power's 1999 Request for Proposals for Supply Resources Needed Starting 2001-2005, submitted in Minnesota Public Utilities Commission Docket No. E002/M-99-888,

March 1, 2000, Supplemental Comment *August 18, 2000* (co-author with R. McCullough, A. Orkin, A. Stewart, et al.).

Analysis of Special Industrial Rate Contracts: Maine Public Service Company with McCain Foods (Docket 2000-441) and J.M. Huber (Docket 2000-47), prepared for Maine Public Utilities Commission Staff, *July 2000.*

Energy, Economic, and Environmental Analysis System (E3AS) User's Guide: Version 2, prepared for the US Environmental Protection Agency, *July 1998* (co-author with R. Carlson and B. Krier).

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Expert Testimony and Formal Submissions

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1. **Canadian National Energy Board Hearing Order OH-002-2013; Enbridge Pipelines Inc. Line 9B Reversal and Line 9 Capacity Expansion Project Application; Équiterre (Coalition); August 8, 2013 (joint testimony with B. Rowan).**
   Analysis of relative economic costs and benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project. Evaluation of the Project, which would transport a mix of tar sands dilbit, Bakken, and conventional WCSB crudes through Ontario and Quebec, crossing major waterways and Canada's most populous urban areas, (including Toronto and Montreal). Recommendation that the Enbridge Project be rejected, based on (i) the results of this relative economic cost-benefit analysis, demonstrating that the potential economic costs could exceed (and, under a range of malfunction/accident conditions, greatly exceed) the potential economic benefits; (ii) the highly uneven allocation of costs and benefits among the stakeholders, and across regions; and (iii) the conclusion of international pipeline safety expert, Richard Kuprewicz, that there is a high risk of pipeline rupture in the early years following Project implementation due to a combination of cracking and corrosion.

2. **California Public Utilities Commission Application No. 09-12-020; Pacific Gas & Electric Company General Rate Case 2011; The Greenlining Institute; May 19, 2010; Rebuttal Testimony June 4, 2010.**
   Analysis of economic development impacts (focusing on job creation and stimulus) of PG&E's proposed capital expenditures and associated rate increases. Consideration of the impacts of these expenditures and rate increases on customers and communities. Recommendation that PG&E increase its supplier diversity activities in order to offset adverse impacts on customers and communities while addressing equity concerns. Analysis of PG&E's Customer Retention and Economic Development (Load Attraction and Retention) activities. Analysis of the direct testimony of other intervenors with respect to economic development impacts of the proposed capital expenditures and quantification of these impacts in the Rebuttal Testimony.

3. **Manitoba Clean Environment Commission Public Registry Files 4724/4725; Wuskwatim Generating Station and Transmission Project; Pimicikamak Cree Nation (PCN); August 8, 2003 (joint affidavit with R. McCullough).**
   Evaluation of Manitoba Hydro system planning, environmental review, and disclosure relating to the Churchill-Nelson hydro project. Consideration of environmental harm and other impacts from existing hydro and proposed 200 MW Wuskwatim project. Analysis of need for comprehensive assessment of the entire Churchill-Nelson project (existing, proposed, and other future). Discussion of precedents regarding comprehensive assessment of existing major hydro projects.

4. **United States District Court, Northern District of New York Case 01-CV-0951; Pogliani, et al. v. Army Corps of Engineers; Stand Together Oppose Power Plant (STOPP); June 29, 2001.**
   Analysis of need for proposed 1080 MW gas combined cycle power plant in Athens, New York. Consideration of locational requirements for supply. Evaluation of potential for other in-state sources and imports.

5. **Vermont Public Service Board Docket 6300; Proposed Sale of Vermont Yankee Nuclear Power Station; New England Coalition on Nuclear Pollution and Vermont Public Interest Research Group; April 14, 2000.**
   Consideration of power supply planning in the context of risk and uncertainly. Evaluation of whether the proposed plant sale is consistent with sound utility planning, regulatory oversight, and electricity restructuring.

6. **Maine Public Utilities Commission Docket 98-791; Bangor Hydro-Electric Company; Maine Public Utilities Commission Staff; May 4 1999 (Bench Analysis joint with A. Monroe and M. Force).**
   Assessment of request for extension and amendment of special industrial rate. Analysis of the economic and physical viability of paper mill self-generation options. Evaluation of whether the contract extension would be beneficial for other utility ratepayers. Development of recommendations for amended contract termination provisions.

7. **California Public Utilities Commission A. 96-03-031; Southern California Gas Company; The Utility Reform Network (TURN); December 30, 1998; Rebuttal Testimony February 26, 1999.**
   Review of claims by gas utility and other parties that economic development would be promoted by allocating transition costs away from large industrial and other noncore gas customers. Evaluation of how economic development will be impacted by the period selected for

amortization of these transition costs. Provision of recommendations regarding consideration of economic development issues by the Commission.

8. **California Public Utilities Commission A. 97-12-048; Southern California Gas Company; The Utility Reform Network (TURN); April 17, 1998; Rebuttal Testimony May 4, 1998.**
   Review of claims by gas utility and other parties that economic development would be promoted by allocating transition costs away from large industrial and other noncore gas customers. Provision of recommendations regarding consideration of economic development issues by the Commission.

9. **Ontario Energy Board E.B.O. 177-17; Union Gas Ltd./Centra Gas Ontario, Inc. Application to Transfer Appliance Businesses to Union Energy; Pollution Probe; January 19, 1998.**
   Review of gas utilities' proposal to transfer their appliance sales, financing, renting and servicing businesses to an unregulated subsidiary. Evaluation of costs and benefits for gas consumers. Assessment of impacts upon competition, DSM, and the environment. Discussion of precedents regarding large-scale divestiture of utility assets, tender processes, and market-based valuation. Provision of recommendations regarding the future of the appliance businesses and development of competitive markets.

10. **United States Federal Energy Regulatory Commission Dockets ER97-1079-000 and OA97-237-000; New England Power Pool; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; July 1, 1997 (joint affidavit with R. Carlson).**
    Review of the market power analysis and market power mitigation principles submitted by New England Power Pool. Development of applicable standard for market power analysis. Evaluation of the potential for exercise of horizontal and vertical market power by Hydro-Québec. Assessment of possible market power mitigation measures.

11. **State of Vermont House Commerce Committee and House Judiciary Committee; April 30, 1997.**
    Review of a contract for purchases of Hydro-Québec power by Vermont utilities. Analysis of how changes in load forecasts, supply-side alternatives, and the wholesale power markets affect contract cost-effectiveness. Evaluation of decisions by Vermont utilities and state agencies to approve the contract. Discussion of implications for utility restructuring.

12. **United States Federal Energy Regulatory Commission Docket ER97-851-000; Petition of H.Q. Energy Services (U.S.) Inc. for Order Accepting Initial Rate Schedule, Authorizing Market-Based Rates, and Granting Certain Waivers and Blanket Approvals; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; March 27, 1997; Affidavit August 19, 1997 (joint affidavit with R. Carlson); Supplemental Affidavit September 25, 1997 (joint affidavit with R. Carlson).**
    Review of Hydro-Québec subsidiary's request for power marketer status. Assessment of Hydro-Québec transmission tariff and conformity with FERC Transmission Pricing Principles and Order 888. Development of applicable standard for market power analysis and critique of applicant's analysis under traditional Hub-and-Spoke and Merger Policy Statement frameworks. Identification of potential affiliate abuse, anti-competitive behavior, and environmental impacts. Assessment of possible market power mitigation measures. Discussion of reciprocal access to Québec markets.

13. **Massachusetts Department of Public Utilities 96-25; Massachusetts Electric Restructuring Proposal; Wheeled Electric Power Company; November 21, 1996.**
    Review of Massachusetts Electric's proposed Restructuring Settlement. Analysis of effects upon the utility's financial position and retail competition. Evaluation of the financial and rate reduction implications of an alternative proposal for Standard Offer retail prices to be market-based, rather than pre-specified.

14. **Commission d'enquête sur la politique d'achat par Hydro-Québec d'électricité auprès de producteurs privés; Commission Staff; September 16, 1996.**
    Analysis of Hydro-Québec's cycle of electricity surpluses and sales promotion in domestic and export markets. Evaluation of the relationship between sales promotion and the utility's independent power program. Review of mechanisms used elsewhere to acquire independent power. Discussion of transfer of utility small hydro projects to independent producers.

15. **Ontario Energy Board E.B.R.O. 493/494; Union Gas Ltd./Centra Gas Ontario, Inc. 1997 Rates Hearing; Pollution Probe; September 6, 1996 (joint testimony with R. Carlson).**
    Evaluation of the utilities' gas avoided cost methodology, and avoided cost estimates used in their 1997 DSM Plan. Review and verification of the utilities avoided cost analysis. Development of recommendations for future avoided cost submissions.

16. **Ontario Energy Board HR 24; Ontario Hydro 1997 Rate Proceeding; Green Energy Coalition; June 11, 1996 (joint testimony with R. Carlson).**
    Examination of social and economic consequences affiliated with Ontario Hydro's existing and proposed industrial, residential, and commercial optional rates. Specific analysis of load retention/expansion, surplus power, real time, and aggregation rates, with reference to the Board's stated concerns regarding transparency, consideration of environmental impacts, and due diligence to prevent free ridership.

17. **Vermont Public Service Board Docket 5870; Tariff filing of Green Mountain Power requesting authority to implement its Customer Pilot Pricing Program; Grand Council of the Crees (of Québec), New England Coalition for Energy Efficiency and the Environment, and Vermont Public Interest Research Group; March 19, 1996.**
    Review of a proposed rate discount for incremental sales to residential and small commercial customers. Analysis of impacts upon sales, energy efficiency, and net revenues. Evaluation of program design, evaluation plan, equity considerations, environmental impacts, and potential for free ridership.

18. **Maine Public Utilities Commission Docket 95-598; Central Maine Power Company's Annual Demand-Side Management Targets; Maine Public Utilities Commission Staff; June 26, 1995 (joint testimony with J. Raab).**
    Discussion of the rationale for Central Maine Power Company's continued acquisition of demand-side management resources and the need for utility efficiency programs. Review of Central Maine Power Company's 1996 DSM targets and presentation of alternative efficiency targets and associated budgets. Evaluation of CMP's DSM proposal in the context of basic program design principles.

19. **Ontario Energy Board HR 23; Ontario Hydro 1996 Rate Proceeding; Green Energy Coalition; June 16, 1995 (joint testimony with R. Carlson).**
    Examination of social and economic consequences affiliated with Ontario Hydro's existing and proposed industrial discount rates. Specific analysis of load retention and risk-sharing rates, with reference to the Board's stated concerns regarding transparency, consideration of environmental impacts, and due diligence to prevent free ridership.

20. **Ontario Energy Board E.B.L.O. 251; 1995/96 Trafalgar Facilities Expansion Program of Union Gas Limited; Pollution Probe; May 5, 1995; Supplemental Testimony February 8, 1996 (joint testimony with R. Carlson).**
    Evaluation of Union Gas Ltd.'s application for a natural gas pipeline expansion. Verification of its discounted cash flow analysis. Critique of Union's expected energy cost savings to participants from displacement of alternative fuels, and development of alternative energy cost savings estimates. Verification and validation of its long-term transmission facilities expansion model and its total resource cost savings analysis.

21. **Ontario Energy Board E.B.R.O. 486; Union Gas Ltd. 1995 Rate Hearing; Pollution Probe; December 5, 1994 (joint testimony with R. Carlson).**
    Evaluation of Union Gas Ltd.'s gas avoided cost methodology and avoided cost estimates used in its 1995 DSM Plan. Review of Union's avoided cost analysis. Verification of Union's results. Discussion of the limitations inherent in the utility's avoided cost modeling approach, and provision of an alternative perspective to that approach. Development of recommendations for future avoided cost submissions.

22. **New York Public Service Commission Case 94-E-0334; Consolidated Edison Company of New York Rate Proceeding; Enersave, Inc., Natural Resources Defense Council, Pace Energy Project, and New York Energy Efficiency Council; September 23, 1994; Revised Testimony October 11, 1994 (joint testimony with J. Peters).**
    Assessment of proposed changes to Consolidated Edison's demand-side management programs, focusing on the Commercial & Industrial Lighting Program. Analysis of the impacts on rates, revenue requirements, and societal costs associated with demand- and supply-side resources. Discussion of the interaction between electricity rates and economic competitiveness. Provision of recommendations concerning changes to the utility's proposed DSM program.

23. **Maine Public Utilities Commission Docket 92-345, Phase II; Central Maine Power Company's Proposed Increase in Rates; Office of the Maine Public Advocate; June 15, 1994 (joint testimony with R. Carlson).**
    Discussion of Central Maine Power Company's load-building programs, including fuel-switching, within the context of Maine's economic and regulatory environment. Assessment of short-run and long-run risks associated with Central Maine Power Company's flexible pricing proposal. Review of pricing flexibility impacts from surplus energy auctions. Provision of recommendations concerning appropriate cost-effectiveness

tests for load-building activities, limitations to auction of surplus electricity, and the insulation of residential rates from the impact of commercial/industrial sector promotional activities.

24. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Grand Council Treaty #3; June 2, 1994.**
    Summary of First Nation concerns relating to the proposed corporate restructuring of Ontario Hydro and potential impacts on price of electricity and quality of service. Discussion of the potential impact of restructuring on the settlement of outstanding grievances.

25. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Nishnawbe Aski Nation and Grand Council Treaty #3; June 2, 1994 (joint testimony with R. Carlson).**
    Review of First Nation concerns related to Ontario Hydro's ratesetting policies and orientations, including proposed discount rates and market-based pricing. Assessment of the potential impacts of rate restructuring on rural rates and equity. Critique of Ontario Hydro's cost allocation process and its potential impacts on rural customers.

26. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Green Energy Coalition; June 2, 1994 (joint testimony with R. Carlson).**
    Summary of general considerations relating to discounted industrial rates. Outline of the problems inherent in Ontario Hydro's proposed strategy of offering discount rates to industrial customers. Description of the applicable standard for granting special discount rates. Recapitulation of Hydro-Québec's experiences and financial difficulties associated with a strategy promoting discount rates.

27. **Florida Public Service Commission Case Nos. 930548-EG to 930551-EG; Adoption of Numeric Conservation Goals and Consideration of National Energy Policy Act Standards by Florida's Investor-Owned Utilities; Florida Department of Community Affairs; April 29, 1994 (joint testimony with B. Krier).**
    Discussion of precedents for utility commission consideration of employment and economic development issues. Summary of the role of energy efficiency programs in Florida's economic development. Interpretation of the qualitative findings contained in a companion Goodman Group report entitled The Employment Impacts of Electricity Efficiency in Florida. Comparison of this analysis with standards and practices utilized in similar studies in other jurisdictions.

28. **Ontario Energy Board E.B.L.O. 246 Amended; 1994/95 Trafalgar Facilities Expansion Program of Union Gas Limited; Pollution Probe; April 4, 1994; Supplemental Oral Direct Testimony April 22, 1994 (joint testimony with R. Carlson).**
    Assessment of utility's demand-supply framework. Review of gas use projections and potential impacts of DSM and greenhouse gas restrictions. Critique of utility's application of cost-benefit test. Evaluation of fuel-switching analysis. Critique of fuel price forecasts utilized. Analysis of economic risk associated with proposed facility expansion.

29. **State of New York Assembly Standing Committee on Energy and Assembly Standing Committee on Environmental Conservation; March 2, 1994.**
    Assessment of 800 MW Hydro-Quebec/New York Power Authority seasonal diversity contract in the context of reduced load forecasts, increased projections for independent power production and demand-side management, and the changing wholesale power markets. Analysis of the contract's cost-effectiveness. Analysis of risk, reliability, and economic development considerations.

30. **Maine Public Utilities Commission Docket No. 93-147; Central Maine Power Company Petition for a Certificate of Public Convenience and Necessity to Erect a Transmission Line Carrying 100 Kilovolts or More in York County; Maine Public Utilities Commission Staff; September 21, 1993 (joint testimony with R. Carlson and W. Scott).**
    Assessment of peak load forecasts through 2008 for York County. Economic analysis of the need for a transmission line. Cost-effectiveness analysis of alternative line routes.

31. **Maine Public Utilities Commission Docket No. 92-331; Airco Industrial Gases Request for Interruptible Load Retention Service Rate with Central Maine Power Company; Maine Public Utilities Commission Staff; July 9, 1993; Supplemental Testimony August 10, 1993 (joint testimony with R. Carlson and R. McCullough).**
    Assessment of request for a special industrial rate. Review of supply and demand trends in the industrial gases industry. Analysis of production scheduling and transportation cost models. Calculation of internal rates of return based on alternative assumptions. Development of recommendations for the framework, evidentiary standards, and evaluation criteria to be used in consideration of special industrial tariffs.

32. **Ontario Energy Board 169-III; Integrated Resource Planning for Ontario's Local Gas Distribution Companies; Ontario Metis and Aboriginal Association; November 20, 1992.**
Identification of importance of considering environmental and social externalities in energy planning generally and in Ontario natural gas industry specifically. Formulation of recommendations for incorporating externalities into the planning process. Consideration of externalities from the standpoint of the Aboriginal population.

33. **Government of Canada and Government of Manitoba; Conawapa Project Environmental Assessment; Concerned Citizens of Manitoba, Sierra Club of Western Canada (Manitoba Branch), Manitoba Naturalists Society, Inc., Manitoba Branch of the Canadian Parks and Wilderness Society, and Time to Respect Earths' Ecosystems (TREE) Inc.; June 4, 1992 (joint testimony with C. Goodwin and W. Marcus).**
Discussion of the need for environmental reviews to evaluate justification of design alternatives to the proposed 1290 MW Conawapa Project. Description of changes in the utility industry and new supply resource options that will affect the design alternatives included in an environmental review. Review of the treatment of project justification in North American environmental assessments.

34. **Government of Canada and Government of Québec; Great Whale River Project Environmental Review; Grand Council of the Crees (of Québec); March 18, 1992 (joint testimony with R. McCullough).**
Discussion of the need for environmental reviews to evaluate justification of design alternatives to the 3160 MW Great Whale River Project. Description of changes in the utility industry and new supply resource options that will affect the design alternatives included in an environmental review. Review of the treatment of project justification in North American environmental assessments.

35. **New York Public Service Commission Case 90-E-0775; Petition to Reopen Proceeding and Determine the Prudence of the Contracts for Delivery of Hydro-Quebec Power; Environmental Defense Fund, Center for Environmental Legal Studies of the Pace University School of Law, Natural Resources Defense Council, National Audubon Society, Sierra Club, (Atlantic Chapter), Greenpeace U.S.A., Environmental Planning Lobby, and Hudson River Sloop Clearwater; November 25, 1991.**
Review of the need for a contract for purchases of Hydro-Québec power by New York utilities. Summary of declining load forecasts and changes in the supply outlook. Analysis of the cost-effectiveness of the proposed purchase. Discussion of risk, reliability, and other considerations.

36. **State of Vermont Supreme Court and Public Service Board; In re: Application of Twenty-Four Electric Utilities for a Certificate of Public Good Authorizing Execution and Performance of a Firm Power and Energy Contract with Hydro-Québec and a Hydro-Québec Participation Agreement, and Specifically Concerning Motions for a Remand to the Board for a New Trial; October 15, 1991; Reply Affidavit October 28, 1991.**
    Review of a contract for purchases of Hydro-Québec power by Vermont utilities. Summary of changes concerning load forecasts and supply-side alternatives. Analysis of how these changes affect the cost-effectiveness of the contract.

37. **State of New York Assembly Energy Committee Senate Environmental Conservation Committee; September 30, 1991 (updated October 7, 1991).**
    Assessment of Hydro-Quebec contract in the context of reduced load forecasts, increased projections for independent power production, and the changing wholesale power markets. Analysis of the contract's cost-effectiveness. Estimation of risk, reliability, and economic development considerations.

38. **New York Public Service Commission Case 91-E-0462; Consolidated Edison Company of New York Rate Proceeding; City of New York; September 6, 1991.**
    Review of Consolidated Edison's demand-side management programs. Analysis of program delivery mechanisms and incentive levels. Identification of additional cost-effective efficiency measures. Discussion of opportunities for increased cooperation between Consolidated Edison and the City of New York to achieve greater efficiency.

39. **New York Public Service Commission Case 91-E-0462; Consolidated Edison Company of New York Rate Proceeding; Environmental Defense Fund, National Audubon Society, Greenpeace, and Center for Environmental Legal Studies; September 6, 1991.**
    Analysis of Consolidated Edison's resource planning process with respect to demand-side management programs and the 482 MW Hydro-Québec purchase. Evaluation of demand-side management and the Hydro-Québec purchase in context of long run avoided cost estimates. Determination of cost-effectiveness of Hydro-Québec contract. Discussion of risk, reliability, environmental and economic development considerations relating to the Hydro-Québec purchase.

40. **New York Public Service Commission Case 90-E-1185; Long Island Lighting Company Rate Proceeding; Vladeck, Waldman, Elias and Englehard, Natural Resources Defense Council, and Center for Environmental Legal Studies; June 3, 1991 (joint testimony with C. Komanoff).**
    Evaluation of Long Island Lighting Company's proposed 20 year, 218 MW purchase of electricity from Hydro-Québec. Comparison of Long-Run Avoided Cost and the Hydro-Québec purchase. Review of supply and demand options as alternatives to the purchase. evaluation of risk, reliability, environmental, and economic development considerations.

41. **Québec Access to Information Commission No. 90-04-07; Risk-Sharing Contracts; Grand Council of the Crees (of Québec); May 3, 1991.**
    Analysis of confidential risk-sharing electricity supply contracts between Hydro-Québec and thirteen large industrial customers. Description of participants by company ownership, location, principal activities, and business relationships. Estimation of energy and capacity required to service contracts. Assessment of resulting implications for Hydro-Québec and its ratepayers. Review of treatment of electricity contracts for aluminum smelters and other large industrial customers in North American jurisdictions.

42. **Massachusetts Department of Public Utilities 90-261-A; Massachusetts Electric Fuel Switching; Massachusetts Division of Energy Resources; April 17, 1991.**
    Evaluation of fuel switching as a demand-side management option. Review of current status of fuel-switching technologies. Formulation of cost and benefit allocation algorithms to optimize program participation and maximize societal benefits by incorporating fuel choice options, including renewables and active and passive solar, as part of utility least-cost planning.

43. **State of Vermont, Chittenden County Superior Court, Docket S518-91 CnC; March 5, 1991 Burlington Municipal Election Question 8; Grand Council of the Crees (of Québec); March 28, 1991.**
    Analysis of Burlington Electric Department Assessment provided as "voter information" in referendum concerning power purchase contract with Hydro-Québec. Evaluation of accuracy and impartiality of information concerning cost estimates, alternative sources of supply, environmental effects, and economic benefits.

44. **Manitoba Public Utilities Board; Manitoba Hydro Submission in Respect to Major Capital Projects; Concerned Citizens of Manitoba, Sierra Club of Western Canada (Manitoba Branch), and Conservation Strategy Association of Manitoba; July 23, 1990; Surrebuttal Testimony August 30, 1990 (joint testimony with W. Marcus).**
Review of Manitoba Hydro's submission and the proposed: construction of 1290 MW Conawapa generating station and other northern hydro projects; 100 MW demand-side management program; twenty-two year, 1000 MW power sale to Ontario Hydro; and two 150 MW seasonal diversity exchanges. Review of Manitoba Hydro load forecasting. Estimation of economic and attainable conservation potential. Development of principles of conservation program design and delivery. Critique of utility's proposed demand-side management program. Evaluation of alternative supply-side resources. Analysis of avoided costs. Assessment of employment and economic development effects of hydroelectric development and conservation. Analysis of profitability and risks of proposed power sales contracts.

45. **State of New York Supreme Court; Application of Sierra Club, Inc. et al. For Judgment Under Article 78 Against the Power Authority of the State of New York, et al.; April 18, 1990; Reply Affidavit August 6, 1990; Supplemental Reply Affidavit September 13, 1990.**
Analysis of nexus between New York Power Authority purchases and construction of specific Québec hydro facilities and operation of fossil fuel electric generation. Evaluation of power imports in New York State Energy Plan. Assessment of energy conservation as a potential substitute for hydro and fossil generation. Comparison of employment and economic development impacts of power purchase and conservation options.

46. **Canadian National Energy Board Hearing Orders No. EH-3-89 and AO-1-EH-3-89; Application of Hydro-Québec for Export License for Firm Power and Energy Contracts with Vermont Joint Owners and New York Power Authority; Grand Council of the Crees (of Québec); February 14, 1990 (joint testimony with W. Marcus).**
Review of a proposed thirty year, 450 MW sale of Hydro-Québec power to twenty-four Vermont utilities and review of a proposed twenty year, 1000 MW sale of Hydro-Québec power to the New York Power Authority. Analysis of planning and operation of Hydro-Québec power supply. Modeling of hydro reservoir levels. Determination of marginal supply resources associated with sales to Vermont and New York. Estimation of acid rain and greenhouse gases emissions from fossil and hydro generation. Analysis of reliability including adequacy of energy, capacity, and transmission supply. Estimation of achievable conservation potential

in Québec. Analysis of the profitability of the proposed power sales on both a private cost and social cost basis.

47. **Vermont Public Service Board Docket 5330; Application of Vermont Utilities for Approval of a Firm Power and Energy Contract with Hydro-Québec; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; December 19, 1989; Supplemental Testimony January 18, 1990 (joint testimony with W. Marcus). Docket 5330-A; Testimony April 30, 1991.**
Review of a proposed thirty year, 450 MW purchase of Hydro-Québec power by twenty-four Vermont utilities. Analysis of planning and operation of Hydro-Québec power supply. Modeling of hydro reservoir levels. Determination of marginal supply resources associated with sales to Vermont. Estimation of acid rain and greenhouse gases emissions from fossil and hydro generation. Analysis of risk and reliability including supply diversity, and adequacy and security of energy and transmission supply. Estimation of achievable conservation potential in Québec. Development of proposal for exports to Vermont based on conservation and alternative supply resources in Québec. Evaluation of costs and benefits of Vermont Joint Owners' proposed Waiver and Release to extend the date for cancellation of export contracts without penalty.

48. **Massachusetts Department of Public Utilities 89-72; Statewide Towing Association, Police-Ordered Towing Rates; Massachusetts Automobile Rating and Accident Prevention Bureau; September 13, 1989 (joint testimony with P. Chernick).**
Review of study supporting proposed increase in towing rates. Critique of study sample and methodology. Comparison with competitive rates. Supply of towing services. Effects of joint products and joint sales on profitability of police-ordered towing.

APPENDIX

B. Resume of Brigid Rowan

Brigid Rowan

The Goodman Group, Ltd.

Mobile: (514) 962-0318
Citizenships: Canadian, Irish (EU)
Email:
Skype:

682 Morin St
Ottawa, ON, K1K 3G9
brigid@thegoodman.com
brigidrowan

Professional Profile

Brigid Rowan is an energy economist with over 20 years of experience in the areas of energy and regulatory economics, energy efficiency and renewables. Ms. Rowan's practice addresses the economic development and environmental impacts of various energy supply and transportation options, interjurisdictional energy trade in North America, as well as the regulation of natural gas and electricity distributors (with a particular expertise in energy efficiency for lower-income consumers). She also has extensive experience in marketing and communications in the energy field. Ms. Rowan has provided consulting services in energy economics and regulation in Quebec, Ontario, Manitoba, British Columbia, California, Nevada, North Dakota, South Dakota, New York and New England. Brigid has worked with public interest, environmental and indigenous groups, start-ups, large corporations and governments in consulting, senior management and public affairs positions throughout Canada and the US, and internationally.

She has provided testimony in over 25 regulatory proceedings before the *Régie de l'énergie du Québec* (Quebec Energy Board) and co-authored expert evidence at the National Energy Board (NEB) in Canada. Since 2011, her practice has focussed on oil supply and transportation (notably Canadian tar sands, shale, pipelines and rail). She has co-authored reports and expert testimony on the most controversial oil projects in North America, including "Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL." "Pipe Dreams" is an influential and widely publicized study on the employment impacts of the Keystone XL pipeline.

Energy Economics and Energy Industry Experience

2006 – present **Senior Energy Economist, The Goodman Group, Ltd., Berkeley, California**

Provide energy consulting services including expert reports, testimony, policy assessment, research, intervenor and litigation support related to energy regulation and economics.

Specialize in the evolving North American oil, gas and electric markets, the economic development and environmental impacts of various energy supply and transportation options, and the regulation of natural gas and electricity distributors.

Major Projects:

Economic Development and Environmental Impacts of Energy Options

- Since 2006, has co-authored or collaborated in 15 national, regional, and state/provincial studies on the economic development impacts (notably jobs) and environmental impacts of various energy supply and transportation options in the US and Canada.

- Since 2011, has co-authored seven expert reports on the economic development impacts and environmental impacts of crude oil transportation (particularly interjurisdictional tar sands crude pipeline projects and crude by rail projects).

- Co-authored the "Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver" with Ian Goodman in collaboration with Simon Fraser University's Centre for Public Policy Research. The report, released in November 2014 and re-released in February 2015, refutes Kinder Morgan's claims regarding the positive economic development benefits of its controversial pipeline project. Goodman and Rowan show that the benefits of the pipeline are very small and have been significantly overstated by Kinder Morgan, whereas the worst-case costs of a catastrophic spill are very large and have been vastly understated.

- Co-authored the "Economics of Transporting and Processing Tar Sands Crudes in Quebec" with Ian Goodman in collaboration with Équiterre and Greenpeace Canada. The January 2014 report demonstrates that the

economic development benefits for Quebec of moving and refining tar sands crudes would be insignificant while the costs and risks are very high.

- Co-authored an "Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail" with Ian Goodman on behalf of Oil Change International (OCI). The November 2013 report demonstrates that the economic costs of crude by rail accidents can be very large and concludes that a major crude by rail (CBR) unit train accident/spill could cost $1 billion or more for a single event. The report was incorporated into Comments filed by NRDC, Sierra Club and OCI before PHMSA as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, December 5, 2013.

- Co-authored expert testimony, entitled "The Relative Economic Costs and Benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project" with Ian Goodman. The expert report was filed in August 2013 at Canada's National Energy Board on behalf of the Équiterre Coalition, a coalition of Quebec- and Ontario-based environmental groups.

- Co-authored "Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project Benicia, California" with Ian Goodman on behalf of NRDC. The July 2013 report provides a Market Analysis of a proposed crude by rail project for the Valero Benicia Refinery. Goodman and Rowan conclude that the proposed project could significantly affect crude supply (and thus quality) for the refinery, and recommend that a full Environmental Impact Report be undertaken. The report was included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by Rail Project, filed with the City of Benicia on July 1, 2013.

- Co-authored a “Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis” with Ian Goodman, and filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations in April 2013. Based on their evaluation of the early 2013 market conditions (including emerging crude markets, factors driving tar sands expansion, availability and cost of crude oil transportation, and tar sands breakeven costs), Goodman and

Rowan conclude that (i) the US State Department's DSEIS Market Analysis was deeply flawed and not a sound basis for decision-making; and (ii) KXL, and specifically its impact on tar sands logistics costs and crude prices, would have a significant impact on tar sands expansion under a very broad range of conditions and assumptions.

- Co-authored an influential and widely publicized study of the Keystone XL pipeline employment impacts ("Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL") with Ian Goodman and the Cornell Global Labor Institute. Goodman and Rowan provided economic impact analysis to demonstrate that TransCanada Pipelines Ltd had substantially exaggerated the US job numbers related to the KXL project. The report was originally released in September 2011 and updated in January 2012.

- Co-authored "Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants" with Ian Goodman. This November 2011 study for Sierra Club National estimated the employment impacts of Air-Pollution Controls at North Dakota Coal Plants.

- Collaborated in the preparation of expert testimony on behalf of The Greenlining Institute on economic development impacts (focusing on job creation and stimulus) of capital expenditures and rate increases proposed by the Pacific Gas & Electric Company in its 2011 General Rate Case; co-authored an analysis of the Economics of Supplier Diversity with Ian Goodman, as supplementary evidence for the same case.

- Collaborated in the analysis for the Avoided Energy Supply Costs in New England: 2009 Report, prepared for Avoided-Energy-Supply-Component (AESC) Study Group, which represents all major electric and gas utilities in New England, as well as efficiency program administrators, state energy offices and regulators. TGG's contribution to this report was an analysis of the economic development impact of Massachusetts electricity and gas energy efficiency programs.

- Co-authored several national and regional analyses with Ian Goodman for SunPower Corporation (an international solar electric manufacturer based in California) focussing on the economic development and environmental benefits of solar manufacturing and reduction of coal use.

**2004 – 2013 Senior Energy Economist,
Econalysis Consulting Services,
Montreal, Quebec**

Provided written evidence and/or testified in over 25 regulatory proceedings before the *Régie de l'énergie du Québec* (Quebec Energy Board) on behalf of Option consommateurs in energy regulatory proceedings. The cases involved Quebec gas distributors (Gaz Metro and Gazifère), as well as Hydro-Québec Distribution (the electricity distributor) and Hydro-Québec Transport (the electricity transmission company).

Offered strategic advice and analytical expertise to public interest intervenors and their counsel in energy regulatory proceedings through the preparation of interrogatories, testimony, cross-examination, and final argument.

Actively participated in working groups, negotiations and consultations related to energy stakeholder issues in Quebec.

Hired, coordinated and collaborated with subject-matter experts in various energy regulatory proceedings.

Coordinated Econalysis' team of Quebec-based energy analysts from 2005-2007.

Major Projects:

- Prepared evidence and coordinated expert participation on behalf of Option consommateurs in Gaz Métro's 2013 case with respect to the renewal of its Distribution Incentive Mechanism.

- Prepared evidence and testified on behalf of Option consommateurs in Gaz Métro's 2013 rate case with respect the Supply Plan, a Gas Procurement Incentive Mechanism, operating costs and other rate issues.

- Prepared evidence and testified on behalf of Option consommateurs in Gaz Métro's 2012 rate case with respect to the profitable development of the residential market, cost allocation and rate strategy.

- Prepared evidence and testified on a range of regulatory issues (notably energy efficiency programs for lower-income consumers) on behalf of Option consommateurs in 2004-2007 regulatory hearings relating to Hydro-Québec and Gaz Métro.

2001 – 2004 **Principal, Energy and Communications Consultant, Just Brigid Energy & Communication Montreal, Quebec**

- Provided comprehensive English communications and website production services with a specialization in energy and the environment
- Clients included: Quebec Ministry of the Environment, Équiterre, Quebec Centre for Action on Climate Change, Madinina Software
- Managed the redesign, production and relaunch of a new website for Équiterre, Québec's largest environmental group (www.equiterre.org) and advised on the web strategy for the Quebec Centre for Action on Climate Change.

1998 – 1999 **Energy Consultant, Econalysis Consulting Services Toronto, Ontario**

- Assisted in the preparation of expert testimony in English and French and conducted research for public interest intervenors in Quebec, Ontario and Manitoba energy regulatory proceedings.

1998 **IBM Canada, Client Manager, Utility & Energy Services Industry Toronto, Ontario**

- Managed IBM client relationships at Canada's largest energy utilities via the direct marketing channel.

1996 – 1997 **IBM Canada, Direct Marketing Specialist, Industry Solutions Unit, Toronto, Ontario**

- Managed diverse teams (database specialists, graphic designers, copywriters, translators, ad agencies, direct mail houses) to implement Quebec-based B2B direct marketing campaigns for the energy and telecommunications industry, including pioneering web campaigns
- Successfully implemented five campaigns, three of which generated response rates of 10-35% and respective revenues of over $2.5 million.

1995 – 1996 **Energy Analyst, The Goodman Group, Ltd., Boston, Massachusetts**

- Collaborated in the preparation of expert testimony regarding Hydro-Québec's cycle of electricity surpluses and sales promotion in domestic and export markets on behalf of Commission Staff for a Quebec Government Commission on Hydro-Québec's purchasing policies with respect to independent power producers

- Assisted with the research and writing of various expert reports on energy economics for environmental and indigenous groups.

1992 – 1993 Energy Analyst, Stephen Graham Associates, Ottawa, Ontario

- Prepared a series of documents for policymakers on the economic, political and technical feasibility of various alternative energy options in developing countries.

Marketing, Communications and Management Consulting Experience

1999 – 2001 Acting CEO and Co-Founder Sites.com, New York, NY and Toronto, Ontario

- Oversaw operations for this New-York-based search engine/publishing start-up including web content development, book production (circulation 15,000 copies), sales and marketing, human resources, finances, facilities, telecommunications, information technology
- Developed marketing strategy including branding, advertising, marketing channels and media relations; managed the development of offline and online marketing communications
- Participated in all aspects of strategy and business plan development.

1995 – 1995 Director of Communications, International Children's Institute, Toronto, Ontario

- Created and presented several successful proposals to obtain government and foundation funds in excess of $500,000 for this Canadian NGO, which assists traumatized refugee children
- Managed the production of communications materials for Institute pilot projects in Toronto and Croatia.

1993 – 1994 Management Consultant, Groupe SECOR, Ottawa, Ontario

Selected Projects:
Republic of BENIN

- Co-produced a study in French on public sector reform in Benin as a member of a team assisting the President of Benin in strengthening government systems to support the political transition to democracy

Marketing Communications for the World Bank

- Developed a marketing package for Groupe SECOR to familiarize World Bank officials with the firm's capabilities and experience.

1988 – 1989 **IBM Canada,**
Co-operative Education Positions
Vancouver, BC, Ottawa and Toronto, Ontario

- Marketing Representative (1989): Promoted IBM PCs at trade shows across Western Canada.
- Public Affairs Specialist (1988): Produced an IBM position paper encouraging high tech initiative in Canada; prepared political briefing material for company executives.

1988 **IBM Europe,**
Public Affairs Specialist
Brussels, BELGIUM

- Wrote an article on the effects of the 1988 US Trade Bill on American subsidiaries in Europe for *Commerce in Belgium*, a business journal.
- Prepared a report on broadcast advertising in a united Europe and the effects of EU advertising directives on IBM's business.
- Researched the potential effects of the Montreal Protocol on IBM Europe and recommended that IBM Europe not align itself with companies opposing the Protocol.

Education

Master of Arts, International Affairs, International Political Economy (Environmental Specialization),
Norman Paterson School of International Affairs,
Carleton University, Ottawa, Ontario, 1996.

Thesis examines how the Cree of Northern Quebec (a Canadian First Nations group) used economic arguments and energy regulation to successfully oppose Hydro-Québec's construction of the Great Whale dam.

Bachelor of Arts, Honours Economics, Computer Science Minor
(Cooperative Education Program),
University of Waterloo, Waterloo, Ontario, 1990.

Other: Financial Literacy Program for Directors and Executives,
Rotman School of Management, University of Toronto, 2007.

Languages: English, French, Spanish, Italian.

Appointments, Achievements and Awards

Greenpeace Canada (2006 – present): Board member; Treasurer and Chair of the Finance Committee

Quebec Centre for Action on Climate Change (2004): provided pro-bono web strategy advice and website production oversight

Équiterre (2003-2004): managed the redesign, production and relaunch of a new website for Équiterre, Québec's largest environmental group (www.equiterre.org)

Humber School for Writers (2002): scholarship for a fiction-writing workshop

Sites.com (2000): edited and published *best of the best sites.com*, a 210-page guide to the Internet's top sites

IBM Canada Team Success Award (1997 and 1998) and **IBM Canada Public Affairs Award** (1988): presented for an outstanding contribution to the Public Affairs Department

Canadian Club at Harvard University (1996): participated in a round table discussion on energy exports with former Quebec Premier, Robert Bourassa

Ottawa Co-Director, Pollution Probe (1993): co-directed the 1993 Ottawa fund-raising drive for this Ontario-based ENGO

Ontario Public Interest Research Group (1992): co-organized a panel discussion at the Canadian Parliament Buildings on hydro projects in the Canadian North for Indigenous and federal politicians and members of the public

Carleton University Grant for Graduate Studies (1991-93): grant requirements included conducting tutorials for undergraduate Economics courses

University of Waterloo Nordic Ski Team (1988-90): competed at the provincial level

Competitive Cycling (1986-89): competed at the national and provincial levels.

Publications and Major Reports

Comments on Draft Environmental Impact Report (DEIR) Analysis of Oil and Gas Well Stimulation Treatments in California on behalf of NRDC, *March 16, 2015* (co-author with Ian Goodman), incorporated as an attachment to Comments filed by Natural Resources Defense Council (NRDC), Center for Biological Diversity (CBD), Sierra Club, Los Angeles Waterkeeper on the Department of Conservation's, through its Division of Oil, Gas and Geothermal Resources (DOGGR), Draft Environmental Impact Report (DEIR) for Well Stimulation in California (the Project) prepared pursuant to the California Environmental Quality Act (CEQA), *March 16, 2015*.

Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver in collaboration with The Centre for Public Policy Research, Simon Fraser University, *November 10, 2014* (co-author with Ian Goodman, re-released *February 4, 2015*).

Report on the Economics of Transporting and Processing Tar Sands Crudes in Quebec in collaboration with Équiterre and Greenpeace Canada, *January 2014* (co-author with Ian Goodman).

Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail, *November 8, 2013* (co-author with Ian Goodman) on behalf of Oil Change International (OCI), incorporated as Attachment 3 to Comments filed by NRDC, Sierra Club and OCI before The Pipeline and Hazardous Materials Safety Administration, U.S. Department Of Transportation as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, *December 5, 2013*.

The Relative Economic Costs and Benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project, *August 8, 2013* (co-author with Ian Goodman), expert testimony filed at Canada's National Energy Board on behalf of the Équiterre Coalition, a coalition of Quebec- and Ontario-based environmental groups.

Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project, Use Permit Application 12PLN-00063, Benicia, California, *July 1, 2013* (co-author with Ian Goodman) on behalf of NRDC, included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by Rail Project, filed with the City of Benicia Community Development Department on *July 1, 2013*.

Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis, *April 22, 2013* (co-author with Ian Goodman), filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations.

Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL, *September 28, 2011* (co-author with Ian Goodman, TGG, and L. Skinner and S. Sweeney, Cornell Global Labor Institute; *revised January 18, 2012*).

Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants, prepared for Sierra Club, *November 21, 2011* (co-author with Ian Goodman).

The Economics of Supplier Diversity Examining Areas of Potential Interest for GLI with respect to GRC 2011 and Potential Amendments to GO 156, prepared for The Greenlining Institute, *August 6, 2010* (co-author with Ian Goodman).

Expert Testimony and Formal Energy Analyst Submissions

Information is presented in the following order: jurisdiction and docket number; title of case; client; date testimony filed; and subject matter covered.

1. **Assemblée Nationale du Québec Commission de l'agriculture des pêcheries, de l'énergie de des resources naturelles (Quebec Parliamentary Commssion); Parliamentary Hearings to study the acceptability for Quebec of Enbridge Pipelines Inc. proposed project to reverse the flow of Line 9B between North Westover and Montreal; Équiterre; December 3, 2013 (joint testimony with S. Guilbeault and S. Ribaux).**
   Provided oral testimony before the Quebec Parliament on the acceptability for Quebec of Enbridge Pipelines Inc. Line 9B Reversal and Line 9 Capacity Expansion Project Proposal before the Canadian National Energy Board (Hearing Order OH-002-2013). Answered parliamentarians' technical questions on the need for hydrostatic testing at an appropriate pressure and identified the key threats to pipeline safety. Explained to the Commission why international pipeline safety expert Richard Kuprewicz had assessed the risk of rupture on Line 9B at 90% in the years following the reversal.

2. **Canadian National Energy Board Hearing Order OH-002-2013; Enbridge Pipelines Inc. Line 9B Reversal and Line 9 Capacity Expansion Project Application; Équiterre (Coalition); August 8, 2013 (joint testimony with I. Goodman).**
   Analysis of relative economic costs and benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project. Evaluation of the Project, which would transport a mix of tar sands dilbit, Bakken, and conventional WCSB crudes through Ontario and Quebec, crossing major waterways and Canada's most populous urban areas, (including Toronto and Montreal). Recommendation that the Enbridge Project be rejected, based on (i) the results of this relative economic cost-benefit analysis, demonstrating that the potential economic costs could exceed (and, under a range of malfunction/accident conditions, greatly exceed) the potential economic benefits; (ii) the highly uneven allocation of costs and benefits among the stakeholders, and across regions; and (iii) the conclusion of international pipeline safety expert, Richard Kuprewicz, that there is a high risk of pipeline rupture in the early years following Project implementation due to a combination of cracking and corrosion.

3. **Régie de l'énergie du Québec (Quebec Energy Board) File R-3693-2009 Phase 3; Société en commandite Gaz Métro (SCGM or Gaz Métro) Application for the Renewal of the Incentive Mechanism for the Improvement of the Performance of Gaz Métro; Option consommateurs; April 9, 2013 (joint comments with J.F. Wilson).**
   Analysis of various scenarios outlined by the Régie de l'énergie du Québec regarding a proposed Incentive Mechanism for Gaz Métro's distribution rates from the perspective of regulatory efficiency, equity between the distributor and customers, as well as equity between rate classes.

4. **Régie de l'énergie du Québec (Quebec Energy Board) File R-3809-2009 Phase 2; Société en commandite Gaz Métro (SCGM or Gaz Métro) Application for the Approval of the Supply Plan and the Modification of the Conditions of Service and Tariff as of October 1st, 2012; Option consommateurs; March 20, 2013; Oral testimony April 30, 2013.**

   Evaluation of the reasonableness of SCGM's Operating Costs (including 2013 increase in salaries and wages relative to the years under SCGM's Incentive Mechanism; total operating costs for 2013 relative to the years under SCGM's Incentive Mechanism; benchmarking of total operating costs for 2013 based on a comparison with three other Canadian gas distributors; and pension costs and a valuation of the pension plan and deficit). Review of the 2013 Revenue Forecast (including customer and volume forecast methodology for D1, an analysis of the historic forecasts). Evaluation of affiliate transactions (including recovery of costs from affiliates: Valener and ANR; use of standard labour rates; allocation of common costs). Analysis and recommendations regarding the following: an Interim Sharing Mechanism for underearnings and overearnings for 2013; a method to hold regulated customers harmless in the transfer of the debt from the Unregulated Activities to the Regulated Activities; and the application of a uniform rate increase in D1 and related concerns regarding SCGM's Rate Vision and Rate Strategy.

5. **Régie de l'énergie du Québec (Quebec Energy Board) File R-3809-2009 Phase 1; Société en commandite Gaz Métro (SCGM or Gaz Métro) Application for the Approval of the Supply Plan and the Modification of the Conditions of Service and Tariff as of October 1st, 2012; Option consommateurs; October 1, 2012 (Phase 1a) and December 7, 2012 (Phase 1b); Oral testimony November 6, 2012 (Phase 1a) and March 12, 2013 (Phase 1b).**

   Analysis and recommendations regarding the general acceptability of the overall Supply Plan in light of Option consommateur's interest in balancing security of supply with cost minimization; the multipoint supply proposal

and the strategy for displacement of the supply structure from Empress to Dawn; and proposed rate modifications relative to interruptions (Phase 1a). Evaluation and recommendations concerning SCGM's proposed Gas Procurement Incentive Mechanism (GPIM), a "Performance Indicator for the Optimization of Supply Tools" (Phase 1b).

6. **Régie de l'énergie du Québec (Quebec Energy Board) File R-3752-2011 Phase 2; Société en commandite Gaz Métro (SCGM or Gaz Métro) Application for the Modification of Rates and Service Conditions for the 2011/2012 Rate Year; Option consommateurs; July 8, 2011 (Revised September 9, 2011); Oral testimony September 9, 2011.**
   Analysis of: (i) the profitable development of the residential market; (ii) cost allocation, the links between the costs and the rates; and SCGM's long-term vision for the rate strategy; (iii) the 2011/2012 rate strategy (including correction of the cross-subsidization of residential consumers).

Note: This list includes only formal submissions and expert testimony at major cases since 2011. A complete list of all testimony and formal submissions since 2004 is available upon request.