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Response to Fountain Wind Staff Assessment: Net Economic Impact Analysis

The CEC team has done a commendable and thorough job with their Net Economic Impact Analysis, contained in the document "Fountain Wind Project Staff Assessment". The team examined multiple scenarios, and identified many important data points. However, there are two errors in the impact calculations involving the size of the multipliers in the economic impact models and the valuation of the forest.

1) Impact Multiplier Sizes

The applicant and the CEC both rely on the JEDI (Jobs and Economic Development Impact) model for their economic impact analysis. The JEDI model is an input-output tool developed by the U.S. Department of Energy to estimate the gross economic impacts—such as jobs, earnings, and output—of energy projects.[1] However, Beacon Economics finds that the multipliers used in the applicant's and CEC's models are both significantly higher than industry standards. In the case of the Economic Output of the Operations Phase, for example, the multipliers are 10 to 20 times larger than what the numbers reported by industry-leading Input-Output modeling software, IMPLAN, reports the numbers should be. Clearly, this implies that the total economic impact is overestimated.

To understand this issue more deeply, it is helpful to review how Input-Output models function. Input-Output (IO) models measure two types of secondary impacts called "indirect effects" and "induced effects." Indirect effects measure economic impacts that occur because of supply chain-related activity from direct spending, and induced effects measure changes in household spending. It is important to consider *where* these impacts are occurring when reporting Input-Output models, not simply how large they are. For example, if a large building is constructed in Los Angeles County, the vast majority of the materials (cement, aggregate, glass, labor, machinery equipment, etc.) can be sourced from within Los Angeles County, and therefore almost all of the indirect and induced effects are

[1] https://www.nrel.gov/analysis/jedi/models#:~:text=The%20Jobs%20and%20Economic%20Development,are%20intended%20to%20be%20estimates.

absorbed by the Los Angeles County economy. In this scenario, the multiplier effects would be large – between 0.5 and 0.75 for each type of secondary effect. That means for every dollar spent on this construction project, it would generate between 50 and 75 cents in indirect supply chain effects, and another 50 to 75 cents in induced household spending.

However, the opposite is true of rural areas. If a large building were constructed in Shasta County, most of the supplies and supply chain effects would occur outside of the County. Shasta simply does not have the materials and construction infrastructure to source everything from within its borders. Thus, the indirect supply chain effects, and the induced household spending effects would not be absorbed by Shasta County, and would "leak" to other locations. This means the multiplier effects would be small, between 0.10 and 0.3.

Spatial precision is very important in Input-Output models. To illustrate, we model $1M of energy construction expenditures in different levels of geographic specificity, using IMPLAN. First, we tell the model $1M is spent in Shasta County, and report the impact effects in Shasta County. Next, we tell the model that $1M is spent in California, and to measure the effects across California. Finally, we do the same for the whole country. As one increases the geographic "net" or scope of analysis, more indirect and induced effects are captured. As Table 1 illustrates, the total multiplier is 0.5 when the analysis is confined to Shasta County, and is 1.33 when it is expanded to the national level. This means national multipliers are about 2.7 times as large as the Shasta County multipliers.

Table 1: Multipliers for the Construction of Power Structures

Impact	Shasta County-level Impacts	California-level Impacts	National-level Impacts	Shasta County Multipliers	California Multipliers	National Multipliers
1 - Direct	$1,000,000	$1,000,000	$1,000,000	-	-	-
2 - Indirect	$184,297	$287,601	$521,025	0.18	0.29	0.52
3 - Induced	$313,006	$471,002	$805,360	0.31	0.47	0.81
Total	$1,497,303	$1,758,603	$2,326,385	0.50	0.76	1.33

Source: IMPLAN. Model Specifications: 2023 data year, 2025 dollar years, event type is "industry output" analysis

IMPLAN's underlying economic interconnections data, or SAM (Social Accounting Matrix), is based on 2023 figures, and is customizable down to the zip-code level. The JEDI model uses data from 2020, and is not well-suited to provide spatially precise estimates. It is intended to offer coarse estimates based on state-level SAM numbers.[2] This means the applicant is likely using multipliers for the whole state of California, which would include the advanced high-tech industries in Silicon Valley and Los Angeles that are high-value sectors of the Wind Energy industry supply-chain. It allows for local conditions to be incorporated, but it is not clear what the applicant entered in this regard, and these adjustments primarily impact how much of the expenditures occur locally, and do not change the multipliers. Thus, their underlying economic model is not reporting the dynamics of Shasta County, but rather reflect the economic dynamics of the wind industry across the entire state of California.

This partially explains why their multipliers are so much larger than IMPLAN's. Likewise, this may explain why the CEC staff multipliers are even higher than the applicants. Beacon is not exactly sure what the CEC's methodology is, but it notes, "Staff did not have Shasta County-specific data so used generic U.S.-wide data from the NREL JEDI model" (page 10-9).[3] As illustrated in Table 1, the larger the geography included in the model, the more economic activity is captured. If the Staff used nation-wide data, this would explain why their multipliers are higher than the applicants in all of their models.

For comparison, the table below compares multipliers from IMPLAN to the applicant's and CEC staff's. These multipliers are from TABLE 10-1 CONSTRUCTION PHASE, CEC VS FW GROSS ECONOMIC BENEFITS (TOTAL), in the Fountain Wind Project Staff Assessment report. They are calculated by dividing the indirect and induced effects by the direct effects. There is clearly a substantial and significant difference here. To illustrate what typical multiplier effects are, Beacon has included a table of all multipliers for energy project construction and operations, at the National level, in the Appendix. At the national level, which would encompass the largest economic net possible, the average indirect multiplier is 0.70 and the average induced multiplier is 0.77.

[2] https://www.nrel.gov/analysis/jedi/limitations

[3] California Energy Commission. *Fountain Wind Project: Staff Assessment*. Sacramento (CA): California Energy Commission; 2025 Mar. Report No.: CEC-700-2024-007-SA. Docket Number: 23-OPT-01. Available from: California Energy Commission Docket Log.

Table 2: Construction Multiplier Comparison

Economic Output Multipliers	Shasta County Multipliers from IMPLAN	Applicant Multipliers*	CEC Multipliers*
Indirect	0.18	2.43	6.05
Induced	0.31	1.45	3.79
Total	0.50	3.89	9.84

*calculated by dividing the direct effects by the indirect and induced effects, noted in table 10-1

Some of this difference may be explained by the fact that it appears the JEDI model uses a slightly different classification of “indirect effects”. Still, it is hard to imagine multipliers as large as 3.89 for a rural county like Shasta, which has a population of just over 180,000.[4] A multiplier of 3.89 would mean that for every dollar spent, 3.89 additional new dollars are generated in the Shasta economy. How could this be? This is especially, when the high value components of the Wind industry are outside of the County. Turbines, wind blades, gearboxes, power converters, etc. will all be manufactured elsewhere and shipped into the county, not built within it.

The CEC’s multipliers are even higher – 9.89. This means every dollar that is spent on construction supposedly turns into $9.89 dollars in Shasta County.

Let us consider the Operations Phase as well, as reported in Table 10-2. If we divide the indirect and induced effects of the Economic Output by the direct effects, we get total multipliers of 3.32 from the applicant’s figures and 12.82 from the CEC’s figures, as detailed in Table 3 below. However, using the Wind Farm industry for Shasta County in IMPLAN, the multipliers are 0.56. This means that the applicant’s multipliers are 5.9 times higher than IMPLAN’s, and the CEC’s multipliers are 22.9 times higher than IMPLAN’s. Even if there is some slight difference in how IMPLAN and JEDI classify indirect impacts, a 22.9X difference is hard to account for.

[4] https://www.census.gov/quickfacts/fact/table/shastacountycalifornia/PST045224

Table 3: Multipliers for the Operations of Wind Farms

Economic Output Multipliers	Shasta County Multipliers from IMPLAN	Applicant Multipliers*	CEC Multipliers*
Indirect	0.23	2.92	12.33
Induced	0.33	0.40	0.49
Total	0.56	3.32	12.82

*calculated by dividing the direct effects by the indirect and induced effects, noted in table 10-2

Of course, this has large impacts on the calculations of the Net Economic Impact figure. IMPLAN's wind farm operations multiplier is 0.56. If we assume it is "1", to be highly optimistic and account for any effect classification issues, and use the applicant's direct effect size of $1.2M, that would mean a total impact of $2.4M. If we use the CEC's direct effect size of $0.6M, this would mean a total impact of $1.2M. These numbers are many times smaller than what is reported by the applicant and CEC. Using a very high multiplier of "1" for both the indirect and induced effects would still mean a total impact 2.5 times smaller than what the applicant reported, and 9.67 times smaller than what the CEC reported.

Table 4: Economic Impact from Operations Based on Different Multipliers, Table 10-2

Economic Output (Million $)	Applicant Figures	CEC Figures	Applicant Figures with a multiplier of "1"	CEC Figures with a multiplier of "1"	Applicant Figures with IMPLAN multipliers	CEC Figures with IMPLAN multipliers
Direct	1.2	0.6	1.2	0.6	1.20	0.60
Indirect	3.5	7.4	0.6	0.3	0.28	0.14
Induced	1.4	3.6	0.6	0.3	0.39	0.20
Total	6.1	11.6	2.4	1.2	1.87	0.94

Source: Direct effect sizes come from the Fountain Wind Project Staff Assessment

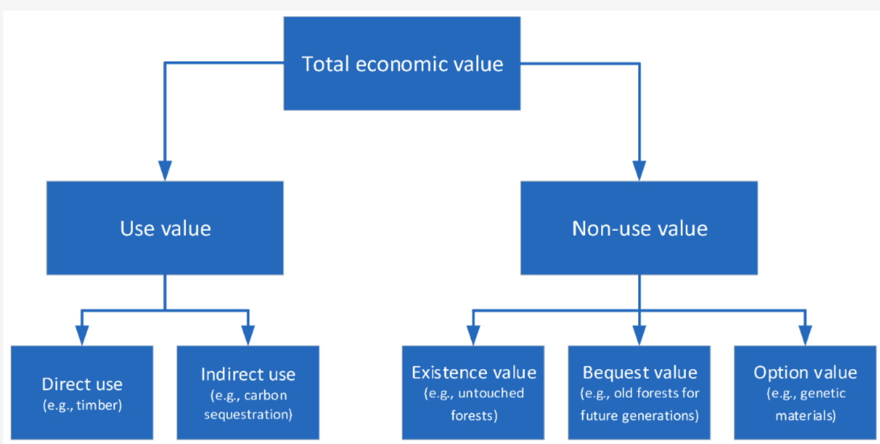
Again, it is worth asking what is reasonable. Does it seem reasonable, that if the wind farm spends $0.6M on their operations, that it will grow into $11.6M, each year? Based on Beacon Economics' experience conducting hundreds of economic impact studies, we do not find this reasonable. If Wind Farms generated this type of economic impact, every town that had one would be making large sums of money each year, but this is not the case. While we are advocates of efforts to decarbonize the economy and appreciate the many benefits of renewable energy, we have never seen an example of such extraordinary economic impacts.

2) Forest Valuation:

A key consideration in the net impact analysis, is the economic value of the forest that would be lost in the event of a fire. To estimate this value, the CEC applied a direct market-based valuation approach, which assesses the forest's worth based on its potential revenue if harvested and sold as lumber. This method relies on current market prices, offering a straightforward and tangible measure of the forest's economic value.

However, many would understandably argue that a forest is worth more than what it can be cut down and sold for. The direct market-based approach only incorporates part of the "use value" of the forest. Economic Literature differentiates between the "use value" and "non-use value", and considers both when calculating the total economic value of a forest.[5] Essentially, the non-use value recognizes that forests have value other than simply being cut down and made into products. The forest itself provides a lot to nearby communities in the form of tourism, recreation, and many environmental benefits that have positive economic externalities such as flood mitigation. To encompass these additional benefits, there are several broader valuation methodologies that economists commonly use, as illustrated in the graphic below, from Nolander et al., 2024.

Figure 1. Total economic value and its subcategories.



[5] Nolander C, Lundmark R. A Review of Forest Ecosystem Services and Their Spatial Value Characteristics. *Forests*. 2024; 15(6):919. https://doi.org/10.3390/f15060919

Source: Nolander C, Lundmark R. A Review of Forest Ecosystem Services and Their Spatial Value Characteristics. *Forests*. 2024

Revealed-Preference methods use the amount people are willing to pay for proximity or access to a forest.[6] For example, looking at how much more people pay for property that is close to a forest, or how much people pay in travel expenses to get to a forest. Economists use hedonic pricing models to calculate these figures.[7]

Stated-Preference methods are another valuation approach. While there are variations, essentially stated-preference methods look at how much people are willing to pay to preserve the forest.[8,9] This helps encompass a broad array of factors into the valuation process, and are based on contingent valuation modeling and choice modeling. Shasta County, for example, has demonstrated it is willing to pay a high amount in order to preserve the forests near the Fountain Wind Project.

There are more encompassing methods as well that take into account a broader definition of economic wellbeing and incorporate life evaluation metrics.[10] This could be useful in quantifying the impacts to the Pit River Tribe for example, and taking into non-tangible factors, such as the forest's cultural importance and the tribal viewshed.

The direct market-based valuation method, used by the CEC, results in the lowest forest valuation of all approaches. This method applies a narrow, incomplete lens to valuing a forest, and typically values forests at least 3 times lower than revealed-preference or stated-preference methods.[11] This means the $40M forest valuation used by the CEC, could be roughly $120M if more broadly encompassing economic valuation methods were used – though further data collection would be necessary to confirm this. Still, even a valuation close to this would change the conclusions from the Net Impact Analysis.

[6] Whitehead, J. C., Landry, C. E., & Hindsley, P. (2019). Improving stated preference analysis: Combining stated and revealed preference data. *Review of Environmental Economics and Policy, 13*(1), 1–21. https://doi.org/10.1093/reep/rez003

[7] Bartkowski, B., Bartke, S., Hansjürgens, B., & Marggraf, R. (2021). Methods for monetary valuation of ecosystem services: A scoping review. *Journal of Forest Science, 67*(11), 425–439. https://doi.org/10.17221/86/2021-JFS

[8] Champ, P. A., Boyle, K. J., & Brown, T. C. (2017). *A primer on nonmarket valuation*. In J. K. Hammitt (Ed.), *Review of Environmental Economics and Policy, 13*(1), 151–153. https://doi.org/10.1093/reep/rez005

[9] Merlo, M., & Croitoru, L. (2005). Valuing Mediterranean forests: Towards total economic value. In M. Merlo & L. Croitoru (Eds.), *Valuing Mediterranean forests: Towards total economic value* (pp. 17–36). Dordrecht: Springer. https://doi.org/10.1007/978-94-017-0219-5_18

[10] Holmes, T., & Koch, F. (2019). Bark Beetle Epidemics, Life Satisfaction, and Economic Well-Being. Forests, 10(8), 696. https://doi.org/10.3390/f10080696

[11] Nolander C, Lundmark R. A Review of Forest Ecosystem Services and Their Spatial Value Characteristics. *Forests*. 2024; 15(6):919. https://doi.org/10.3390/f15060919

Appendix:

National-Level Multipliers for the Energy Sector:

Display Description	Indirect Multiplier	Induced Multiplier
Electric power generation - Wind	0.629507	0.298145
Electric power generation - Hydroelectric	0.742136	0.609086
Electric power generation - Fossil fuel	0.681058	0.388519
Electric power generation - Nuclear	0.631864	0.494523
Electric power generation - Solar	0.701758	0.588203
Electric power generation - Geothermal	0.694523	0.579278
Electric power generation - Biomass	0.813596	0.472872
Electric power generation - All other	0.79785	2.549527
Construction of new power and communication structures	0.524179	0.801257
Construction of new health care structures	0.543749	0.865339
Construction of new manufacturing structures	0.728328	0.696445
Construction of new educational and vocational structures	0.621386	0.890393
Construction of new highways and streets	0.76811	0.786978
Construction of new commercial structures, including farm structures	0.829197	0.78145
Construction of other new nonresidential structures	0.659598	0.804835
Construction of new single-family residential structures	0.693312	0.817347
Construction of new multifamily residential structures	0.69973	0.725669
Construction of other new residential structures	0.922218	0.671919

Source: IMPLAN

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- Directs Economic Impact policy studies for a wide array of clients, including large multinational corporations, city and county government entities, industry associations, and non-profits.
- Conduct predictive analysis on the impact of proposed legislation, regulatory changes, infrastructure initiatives, and shifting social dynamics. Helps governments and industries understand key decision making factors, and communicate results to the general public. Has studied policies related to wellbeing, environmental policy, equality, energy, climate change, housing, economic development, and others.
- Manages team – responsible for hiring, training, reviewing hours, promoting, and holding team members accountable.

Associate Principal at Gallup, ***Washington DC, 2020-2022***

- Architected and directed sustainability research initiatives for multinational corporations, NGOs, and national governments.
  - Designed new research initiative, leading to the creation of a climate risk model for 160 countries for Citibank.
  - Conducted global survey to measure attitudes and behaviors towards climate change in 135 countries.
- Annually surveyed 140 countries (representing 98% of the world's adult population) to collect official statistics for the U.N.'s Sustainable Development Goals, including SDG 2:Zero Hunger, SDG 16:Peace, Justice and Strong Institutions, and SDG 8:Decent Work and Economic Growth

Regional Director at Gallup, ***Washington DC, 2016-2019***

- Directed survey research in 22 countries in Asia – including Afghanistan, China, India, Japan, Indonesia, and Australia.
  - Directed the collection of the United Nations Food Insecurity Experience scale, to establish the metrics measuring world hunger for the first time

Senior Methodologist at Gallup, ***Bangalore, India 2014-2015***

- Visited 21 countries to oversee surveys and ensure high-quality research methods. Observed fieldwork and conducted qualitative research in high-conflict, politically unstable regions
- Developed "Geospatial Sampling" - an innovative sampling methodology useful for accurately sampling difficult-to-reach populations

Research Consultant at Gallup, ***Washington DC, 2011-2013***

- Analyzed client data and extrapolated key insights. Helped grow business divisions by 18%, by redesigning pricing models and reorganizing the proposal writing process

Select Publications

- Nichols, Dietricht, (2023) "More than a feeling: A global economic valuation of subjective well-being damages resulting from rising temperatures"
- Nichols, Dijkstra, Papadimitriou (2020) "The Degree of Urbanisation's Effect on Happiness"
- Nichols, Dijkstra, Papadimitriou (2020) "UN Approves New Way to Define Cities and Urban, Rural

Areas"
- Nichols, Reinhart (2019) "Wellbeing Inequality May Tell Us More about Life than Income"
- Nichols, Ritter, (2018) "U.S. Defense Promise Still Credible in Asia-Pacific"
- Nichols, (2017) "Many in Asia See Better Living Standards for Next Generation"
- Nichols, Smith, (2016) "Mixed Reaction in Asia on Whether US Would Defend Them"
- Nichols, (2016) "Confidence High in Myanmar After Historic Elections"
- Nichols, Singh, (2015) "India's New Leadership Faces High Expectations"
- Nichols, Richter, (2014) "Higher Fines Compel Uninsured Americans to Sign Up"
- Nichols, Moore, (2014) "Americans Still Favor Energy Conservation Over Production"
- Nichols, (2012) "Suffering in Iraq Highest Since 2008"