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Evaluating Community Benefits: Trends in Job Creation and Funding Metrics for the Industrial Demonstrations Program

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Executive Summary

This report examines the integration of Community Benefits Plans (CBPs) within the Industrial Demonstrations Program (IDP) managed by the Office of Clean Energy Demonstrations (OCED) under the U.S. Department of Energy (DOE). The IDP, supported by over $25 billion in federal funding, aims to decarbonize high-emission industrial sectors by demonstrating the viability of innovative clean energy technologies (1). CBPs are a critical component of these projects, designed to ensure that the transition to clean energy is equitable and beneficial to all communities (2).

Key Findings:

- **Uniform Application of CBPs:** Analysis reveals no significant differences in job creation or CBP funding across industries, suggesting that CBP integration strategies are being uniformly applied. This uniformity may be attributed to communication and best practice sharing among recipients across different industry types.
- **Implications for Future Negotiations:** The consistency in CBP implementation across industries offers insights for future rounds of negotiations. Understanding this uniformity can help tailor more effective and targeted community engagement strategies.
- **Need for Further Exploration:** While the results indicate uniformity, there may be underlying strengths or challenges in CBP implementation that are not immediately apparent. These aspects, such as disparities in resource allocation or variations in community impact, should be further explored to improve community engagement strategies.
- **Policy and Accountability:** The findings underscore the importance of transparent reporting mechanisms and the need for ongoing policy refinement. Ensuring that CBPs are effectively designed and executed is crucial for meeting DOE's policy priorities and enhancing community benefits.

Conclusion:

CBPs are essential in bridging the gap between industrial goals and community needs. Their successful integration and continuous refinement are vital for achieving sustainable and equitable outcomes in the transition to a clean energy future. The insights gained from this analysis highlight the importance of transparent, accountable, and innovative approaches to community engagement, ensuring that the benefits of clean energy projects are realized across all impacted communities.

Introduction

This section presents an overview of the Industrial Demonstrations Program (IDP), situates the importance of community benefit plans (CBP), and explains the motivation and objectives for this research. Subsequent sections outline data and methods utilized, results, and conclusions.

Industrial Demonstrations Program

The Office of Clean Energy Demonstrations (OCED), established by the U.S. Department of Energy (DOE), plays a pivotal role in scaling the technologies necessary to address critical climate challenges and achieve net-zero emissions by 2050 (3). With an allocation of over $25 billion from the Bipartisan Infrastructure Law and the Inflation Reduction Act, OCED is dedicated to advancing large-scale clean energy demonstration projects (1).

The IDP under OCED is a crucial mechanism for achieving emission reductions in high-emitting and challenging industrial sectors where decarbonization technologies can have the greatest impact. By demonstrating the technical and commercial viability of innovative decarbonization approaches, the IDP aims to drive widespread technology implementation, establish a market for low-carbon products, and maintain the U.S.'s competitive edge in low- and net-zero carbon manufacturing. In total, 33 projects have been selected for negotiation, ranging across several industrial sectors including iron and steel, cement and concrete, chemicals and refining, food and beverage, paper and forest products, aluminum, and other energy-intensive manufacturing industries (4). Below, **Table 1** presents the breakdown of IDP selectees by industry type.

Table 1. IDP Project Portfolio

Industry	Count	Percent of Total
Aluminum and Metals	5	15%
Cement and Concrete	6	18%
Chemicals and Refining	7	21%
Food and Beverage	3	9%
Glass	3	9%
Iron and Steel	6	18%
Process Heat	2	6%
Pulp and Paper	1	3%

Although vast amounts of technical and engineering expertise, planning, and coordination are required to make these projects successful, community engagement plays a crucial role as well.

Community Benefits Plans

Specifically, community benefits are designed to ensure that the transition to a clean energy future is equitable and beneficial to all communities. The DOE mandates that CBPs be included in all funding opportunity announcements (FOAs) and loan applications associated with the

Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) (2). These plans are founded on four core policy priorities:

1. **Engaging Communities and Labor:** Ensuring that local communities and workers are actively involved in and benefit from the projects.
2. **Investing in Workers through Quality Jobs:** Creating high-quality job opportunities in the clean energy sector.
3. **Advancing Diversity, Equity, Inclusion, and Accessibility:** Promoting fair and inclusive recruitment and training practices.
4. **Implementing Justice40:** Directing 40% of the benefits of certain federal investments to disadvantaged communities.

CBPs are intentionally flexible to encourage the best approaches from applicants and their partners. They must be specific, actionable, and measurable. For grant programs focused on deploying clean energy infrastructure, CBPs are assessed as 20% of the technical merit review (2). This assessment is divided into four sections, each emphasizing project success, effective use of taxpayer funds, timely project implementation, and private sector uptake. Once an applicant is selected, their CBP becomes a contractual obligation, and a summary of the plan is publicly posted on DOE's website for transparency and accountability.

Research Objectives

Given the significance of CBPs in the IDP application and award process, this research aims to examine how CBPs are integrated into IDP projects across different industries. This is important for several reasons, including:

1. **Informing Future Rounds of Negotiation**: Understanding current CBP integration can help inform future rounds of negotiation with selectees from the same industries, ensuring more robust and effective community engagement strategies.
2. **Identifying Strengths and Challenges:** Assessing CBPs can reveal their strengths, such as innovative/outlier approaches to community engagement and effective job creation strategies in some industries, as well as challenges in visioning for CBP implementation.
3. **Increasing Transparency and Accountability**: Understanding the integration of CBPs can help increase transparency and accountability in how projects are designed and executed, ensuring that commitments to communities are met and publicly reported.
4. **Enhancing Policy Development**: The insights gained from this research can help refine and develop more effective policies and guidelines for CBPs, ensuring they better meet the needs of communities and align with DOE's policy priorities.

Data and Methods

This section outlines the data used and variables constructed for this report, as well the one-way analysis of variance (ANOVA) method used to assess whether there are significant differences in the averages between industry groups.

CBP Data Tracker

The primary data source used for this analysis was an internal CBP data tracker, which consisted of information derived from application documents submitted by recipients. **Table 2** outlines the key variables from the data tracker used in this analysis. the ANOVA assessment, these values were log-transformed

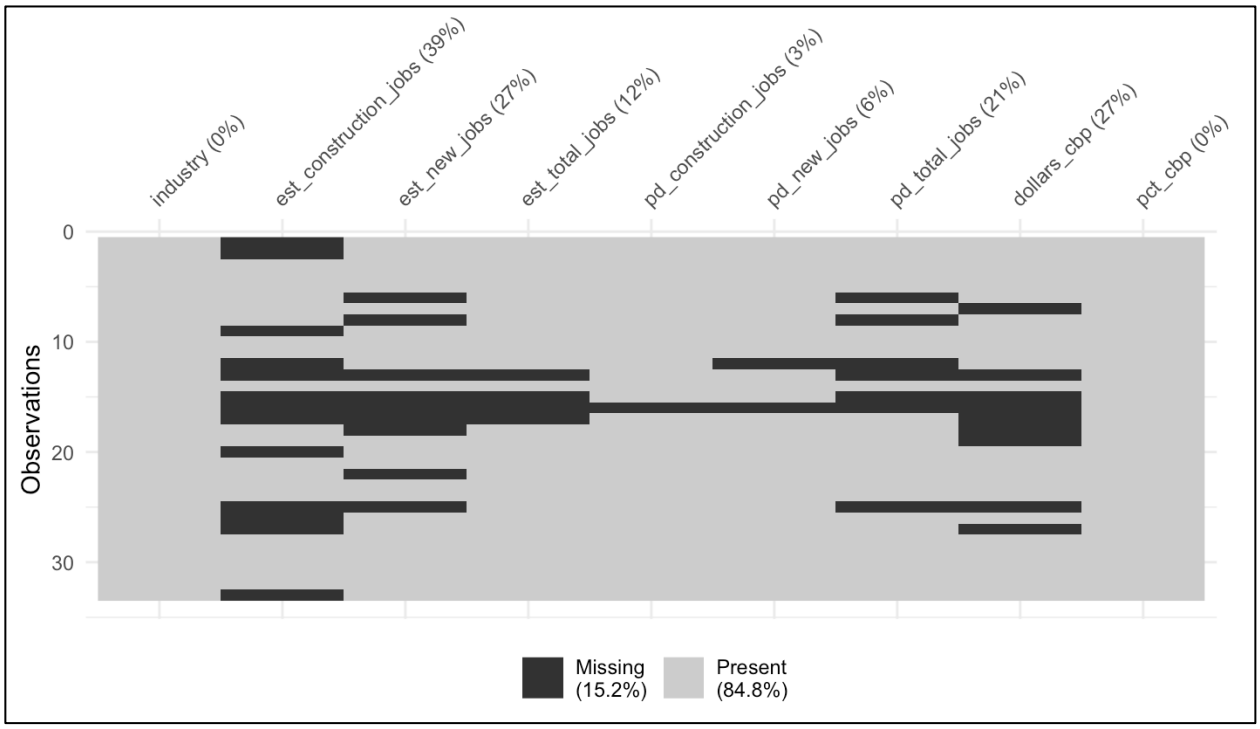
Table 2. Variable Overview

Variable	Description	Mean	SD
Industry	Eight industrial categories (iron, steel and steel mill products; chemicals and refining; cement and concrete; aluminum and metals; food and beverage; glass; pulp and paper; cross-cutting; and other) used to classify recipients.	N/A	N/A
Estimated Job Creation			
est_construction_jobs	Estimated number of temporary or construction jobs expected to be created by the recipient project as specified in the CBP.	698.05	1,195.787
est_new_jobs	Estimated number of permanent jobs expected to be created by the recipient project as specified in the CBP.	142.8333	231.0847
est_total_jobs	Estimated total number of jobs expected to be created by the recipient project as specified in the CBP.	616.1724	1217.65
pd_construction_jobs	Estimated number of temporary or construction jobs expected to be created by the recipient project as specified in the project description.	610.5312	1393.26
pd_new_jobs	Estimated number of permanent jobs expected to be created by the recipient project as specified in the project description.	102.1935	208.5479
pd_total_jobs	Estimated total number of jobs expected to be created by the recipient project as specified in the project description.	1,027.115	1,802.898

CBP Funding			
dollars_cbp	Total dollar amount recipient has pledged for CBP.	7,849,748	1,114,0603
pct_cbp	Percentage of total recipient spending allocated to CBP.	1.424242	2.437087

Before conducting the ANOVA, the missing values present in the CBP data tracker were assessed for their type of missingness. Out of the 33 observations, 19 had at least one missing value for the range of variables above. Below, **Figure 1** displays the extent to which each variable had missing data.

Figure 1. Data Missingness



To determine the type of missingness, Little's MCAR (Missing Completely at Random) test was conducted. Results outlined in **Table 3** indicate that the missing data is likely MCAR, meaning that the missingness does not depend on the observed or unobserved data, and it can be considered random.

Table 3. Little's MCAR Test

N	nIncomp	nPattern	X^2	Df	P-value
33	19	12	75.67	67	0.219

This is favorable to conducting an ANOVA, since MCAR ensures that the results of the analysis are unbiased and that the missing data does not systematically affect the outcome. As a result, missing values were omitted in the ANOVA.

Analysis of Variance

A one-way ANOVA was performed to determine whether there are significant differences between industry groups. Assumption checks and limitations are presented below.

Assumptions

To ensure valid results, data must fulfil the following assumptions for a one-way ANOVA:

1. **Normality:** The data must be normally distributed within each group.
2. **Homogeneity:** variance among the groups should be approximately equal.
3. **Independence:** the observations should be independent of each other.

Normality was assessed using measures like the Shapiro-Wilk test, and Kolmogorov-Smirnov test. Likewise, homogeneity of variance was determined through Levene's test. Independence is assumed because each selectee applied separately and the acceptance of one selectee did not influence the selection of others.

Normality Tests

The Shapiro-Wilk test and Kolmogorov-Smirnov test are formal statistical tests for normality, where the Shapiro-Wilk test is generally more powerful for small sample sizes, and the Kolmogorov-Smirnov test is more flexible but may be less sensitive. For Shapiro-Wilk, a p-value below 0.05 suggests that the data is not normally distributed, while the opposite is true for Kolmogorov-Smirnov.

Table 4 results suggest that the logged form of estimated construction jobs (*est_construction_jobs*), estimated total jobs (*est_total_jobs*), and projected total jobs (*pd_total_jobs*) exhibit non-normal distribution patterns.

Table 4. Shapiro-Wilk Test Results

Variable	W	P-value
est_construction_jobs (logged)	0.8827	0.01979
est_new_jobs (logged)	0.91467	0.2124
est_total_jobs (logged)	0.89483	0.01021
pd_construction_jobs (logged)	0.91419	0.08841
pd_new_jobs (logged)	0.88204	0.165
pd_total_jobs (logged)	0.89441	0.01943
dollars_cbp (logged)	0.95331	0.3191
pct_cbp (logged)	0.972	0.537

However, the Kolmogorov-Smirnov test results describe a different picture. **Table 5** shows that estimated total jobs (*est_total_jobs*) is the only variable exhibiting marginally non-normal behavior, given its small p-value. As explained above, this is likely a result of the Shapiro-

Wilk test being more sensitive to deviations from normality, especially in the tails of the distribution.

Table 5. Kolmogorov-Smirnov Test Results

Variable	D	P-value
est_construction_jobs (logged)	0.1672	0.1509
est_new_jobs (logged)	0.1985	0.1737
est_total_jobs (logged)	0.1887	0.01465
pd_construction_jobs (logged)	0.1327	0.509
pd_new_jobs (logged)	0.25463	0.09553
pd_total_jobs (logged)	0.17923	0.05355
dollars_cbp (logged)	0.10749	0.6721
pct_cbp (logged)	0.104	0.829

Homogeneity Test

To test for homogeneity, Levene's test was used to determine equality of variances across groups, with a p-value less than 0.05 indicating that variances are significantly different. **Table 6** shows the Levene's test results for the independent and control variables used in this analysis, indicating homogeneity of variance across groups. This fits the assumption necessary to conduct a one-way ANOVA.

Table 6. Levene's Test Results

Variable	F-value	P-value
est_construction_jobs (logged)	0.4506	0.806
est_new_jobs (logged)	0.5055	0.7649
est_total_jobs (logged)	0.7079	0.6471
pd_construction_jobs (logged)	2.8806	0.05769
pd_new_jobs (logged)	0.8709	0.5517
pd_total_jobs (logged)	0.9885	0.4652
dollars_cbp (logged)	2.5777	0.06297
pct_cbp (logged)	0.189	0.828

Because the assumption of homogeneity of variances is more critical for the validity of ANOVA than normality, Levene's test was conducted to assess this assumption, and the results confirmed that the variances are equal across groups. This validation ensures that ANOVA remains a suitable method for analysis.

Results

This section details the results of the one-way ANOVA, categorized by estimated job creation and CBP funding metrics.

Estimated Job Creation

Below, **Table 7** presents the ANOVA results for various job creation variables, including estimated construction jobs, new jobs, and total jobs.

Table 7. ANOVA Results

Variable	F-value	P-value	Interpretation
est_construction_jobs (logged)	0	0.991	No significant differences across industries.
est_new_jobs (logged)	0.069	0.795	No significant differences across industries.
est_total_jobs (logged)	0.236	0.633	No significant differences across industries.
pd_construction_jobs (logged)	0.992	0.339	No significant differences across industries.
pd_new_jobs (logged)	0.022	0.884	No significant differences across industries.
pd_total_jobs (logged)	0.348	0.563	No significant differences across industries.

The results indicate that there are no significant differences in estimated job creation metrics across the industries examined. The p-values for all job creation variables are well above the 0.05 threshold, suggesting that industry group does not have a statistically significant impact on the number of estimated construction jobs, new jobs, or total jobs. This lack of significant differences suggests that job creation estimates are consistent across the different industry groups, regardless of the specific job category being analyzed.

CBP Funding

Likewise, **Table 8** outlines the ANOVA results for CBP dollar pledges and the percentage of overall recipient funding being directed to CBP efforts.

Table 8. ANOVA Results

Variable	F-value	P-value	Interpretation
dollars_cbp (logged)	0.02	0.888	No significant differences across industries.
pct_cbp (logged)	0.38	0.551	No significant differences across industries.

Similar to the job creation metrics, there are no significant differences across industries. The p-values are high above the 0.05 level, indicating that industry group does not impact these variables to a statistically significant degree.

Conclusions

The analysis reveals a lack of significant variation in job creation and CBP funding across industries, suggesting that current CBP integration strategies are being uniformly applied. Although unclear from the results of this report, this uniformity might be a result of recipients across different industry types communicating and sharing best practices with one another. This insight can inform future rounds of negotiation, guiding more targeted strategies to enhance

community engagement. Despite the consistency in results across different job creation and funding metrics, there may be underlying strengths or challenges in CBP implementation that warrant further exploration. Identifying these aspects (e.g., disparities in resource allocation, differences in stakeholder involvement, or variations in community impact) could highlight innovative approaches or areas for improvement in community engagement strategies.

The importance of CBPs cannot be overstated, as they serve as a vital tool for ensuring that large-scale projects bring tangible benefits to the communities they impact. CBPs help bridge the gap between industry objectives and community needs, fostering trust and collaboration between stakeholders. By effectively implementing and refining these plans, industries can not only enhance local economic development but also address social and environmental concerns, leading to more sustainable and equitable outcomes. The insights gained from this analysis underscore the need for ongoing attention to the design, execution, and evolution of CBPs to ensure they continue to meet the diverse needs of communities while supporting broader policy goals.

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References

1. U.S. Department of Energy [DOE]. [cited 2024 Aug 8]. Industrial Demonstrations Program. Available from: https://www.energy.gov/oced/industrial-demonstrations-program-0

2. U.S. Department of Energy [DOE]. [cited 2024 Aug 8]. About Community Benefits Plans. Available from: https://www.energy.gov/infrastructure/about-community-benefits-plans

3. U.S. Department of Energy [DOE]. [cited 2024 Aug 8]. Office of Clean Energy Demonstrations. Available from: https://www.energy.gov/oced/office-clean-energy-demonstrations

4. U.S. Department of Energy [DOE]. [cited 2024 Aug 8]. Biden-Harris Administration Announces $6 Billion to Transform America's Industrial Sector, Strengthen Domestic Manufacturing, and Slash Planet-Warming Emissions. Available from: https://www.energy.gov/articles/biden-harris-administration-announces-6-billion-transform-americas-industrial-sector

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