AN INCENTIVE-BASED FRAMEWORK FOR SMALL-LOAD FLEXIBILITY PROVIDERS: INSIGHTS FROM A PRE-TEST OF A DISCRETE CHOICE EXPERIMENT

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Overview

This research addresses a critical gap in the literature on demand-side flexibility by evaluating how a combination of monetary and non-monetary incentives can effectively engage Small-Load Flexibility Providers (SLFPs) in electricity markets. Using Discrete Choice Experiments (DCE), the study tests an Incentive-Based Framework to identify the most valued attributes by SLFPs. Four key attributes were selected: monetary incentives (e.g., financial rewards), non-monetary benefits (e.g., environmental impact), surcharge mechanisms, and ancillary economic benefits. This pre-test provides insights into consumer preferences and sets the stage for large-scale deployment.

Methods

The methodology follows a rigorous design using a full factorial DCE. Attributes and levels were derived from an extensive literature review and stakeholder interviews, ensuring relevance and clarity. The pre-test survey was conducted online with a sample of 35 residential energy consumers in urban Spain. The analysis employed Mixed Logit Models and Bayesian techniques to evaluate the relative importance of each attribute and the utility of individual levels.

Results

The results of the Discrete Choice Experiment (DCE) provide valuable insights into consumer preferences for different attributes and levels across the various plans evaluated. Among all the attributes assessed, annual bill discounts emerged as the most important, with relative importance ranging from 30.74% to 44.74% across the samples. Within this attribute, a 15% annual discount proved to be significantly more attractive, achieving the highest utility values (86.52 in one case). Similarly, surcharges also had a substantial impact, with their relative importance ranging from 25.68% to 27.26%. Notably, plans that did not apply any surcharges generated the highest utility values (+65.49 and +63.45).

Additional economic benefits, such as discounts on future purchases (e.g., equipment or batteries) and reward programs, positively influenced perceived utility. However, their impact was less consistent across samples. For the electric vehicle (EV) segment, discounts on battery replacements had a particularly strong appeal, yielding a utility value of +54.50.

Environmental and personal benefits had comparatively lower relative importance, ranging from 10.53% to 17.62%. Within this category, applications that showcased environmental impact (+9.83 to +27.99) were more highly valued than visibility in the company's social media posts, which had negative utility values (−24.23 to −37.82).

Regarding attribute levels, the avoidance of surcharges consistently produced the highest utility values (+63.45 to +65.49). Consumers demonstrated greater tolerance for surcharges when they were accompanied by flexible provisions, such as allowing three penalty-free occurrences, which mitigated the negative impact (−7.47 to −19.67).

In terms of discounts for reduced consumption, higher discount levels (€3.00) were much more appealing (+44.28) than lower ones (€0.50), which had a negative utility (−46.87).

The "None" option exhibited a positive utility value in several scenarios, ranging from +24.51 to +33.52. This suggests that some consumers might prefer not to engage in any of the proposed plans under certain configurations, particularly when the benefits were perceived as insufficiently attractive, or the surcharges were excessively restrictive.

For the specific segment of electric vehicle (EV) owners, discounts on batteries (+54.50) and applications providing energy-saving advice (+27.99) were highly valued. However, this group appeared less interested in reward programs, which yielded a negative utility value (−33.11).

These findings highlight the heterogeneity of consumer preferences and underscore the importance of tailoring plan attributes and levels to align with the priorities of different consumer segments. By addressing the nuances of attribute importance and level preferences, energy providers can design more appealing plans to meet consumer needs effectively.

Conclusions

This study highlights the potential of integrating diverse incentives to engage SLFPs effectively. Findings suggest the need for customized, integrative incentive structures, considering consumer heterogeneity. Future research should expand to larger and more diverse samples, explore long-term engagement strategies, and test dynamic models to refine the framework further. This research provides actionable recommendations for policymakers and aggregators, contributing to the development of sustainable and efficient energy systems.

References

(References available upon request)