Community preferences and expectations for the end-of-life management strategies of wind farms: Evidence from the China mountain wind farms

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Presenter: ZHANG WEI

Background

Wind energy is increasingly recognized as a sustainable and low-carbon solution to global energy needs, drawing considerable investment, as seen in large-scale projects like the Hornsea Offshore Wind Farm in the UK. However, despite its environmental advantages, wind farms have raised concerns among nearby communities due to issues such as noise pollution, visual impacts, and changes to the local landscape.

While the majority of research has focused on the development and operation of wind farms, there is a gap in understanding local communities' preferences when it comes to the end-of-life phase of wind farms. This includes decisions regarding decommissioning, repowering, or extending the operational lifespan of turbines.

This study adopts a community-centered approach to explore how residents of areas with existing wind farms perceive and prioritize four potential end-of-life pathways—decommissioning, repowering, lifespan extension, and continued operation with upgrades. It also investigates how residents' experiences with existing turbines, including their concerns and benefits, shape their support for these options.

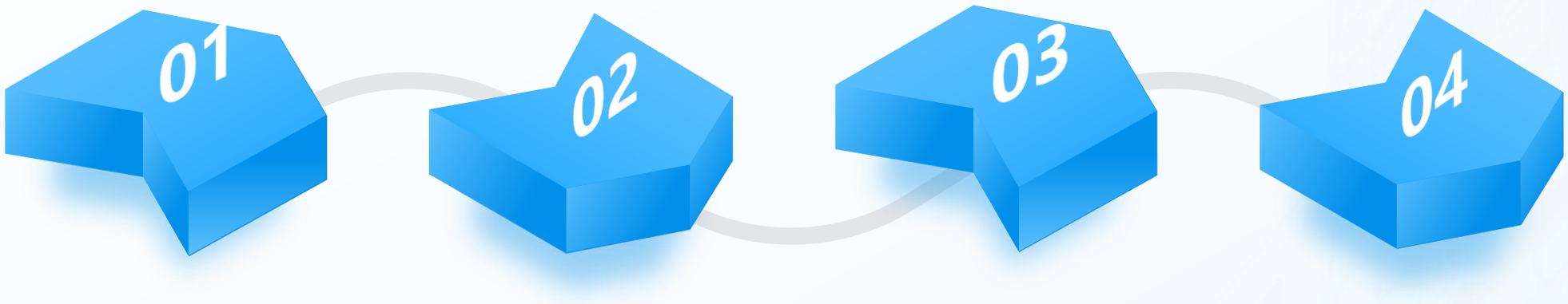
Objective

To identify local residents' preferences regarding various future end-of-life management for wind farms, including decommissioning, repowering (with unchanged or increased capacity), and lifespan extension.

To examine the key factors that influence residents' preferences concerning the future end-of-life management of wind farms.

To assess how expectations for future wind farm development vary among residents with different end-of-life management preferences.

Method



Chi-square analysis

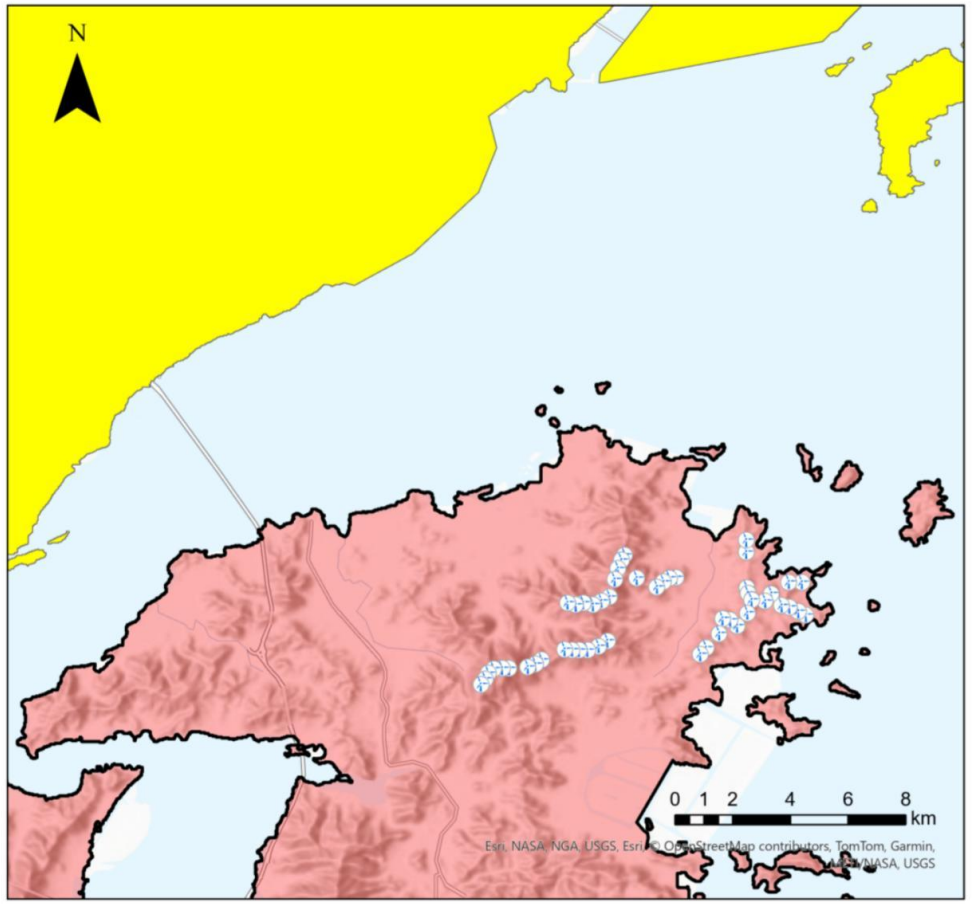
Principal component analysis（PCA）

Multinomial logistic regression

Multivariate Analysis of Variance

Case Study: Wind Farm in City A

- This study was conducted at the City A Wind Farm, which is operated by a regional electric utility. The City A Wind Farm, developed by Developer A, comprises two phases—Phase I and Phase II—with a combined capacity of 75 MW. It is equipped with 50 Model A turbines (20 in Phase I; 30 in Phase II), each rated at 1.5 MW and manufactured by Manufacturer A. Construction began in April 2012, and on December 25, 2012, the 35 kV substation was energized and the turbines entered commercial operation. As part of the country's broader renewable energy strategy, the City A Wind Farm plays a vital role in regional clean power production.

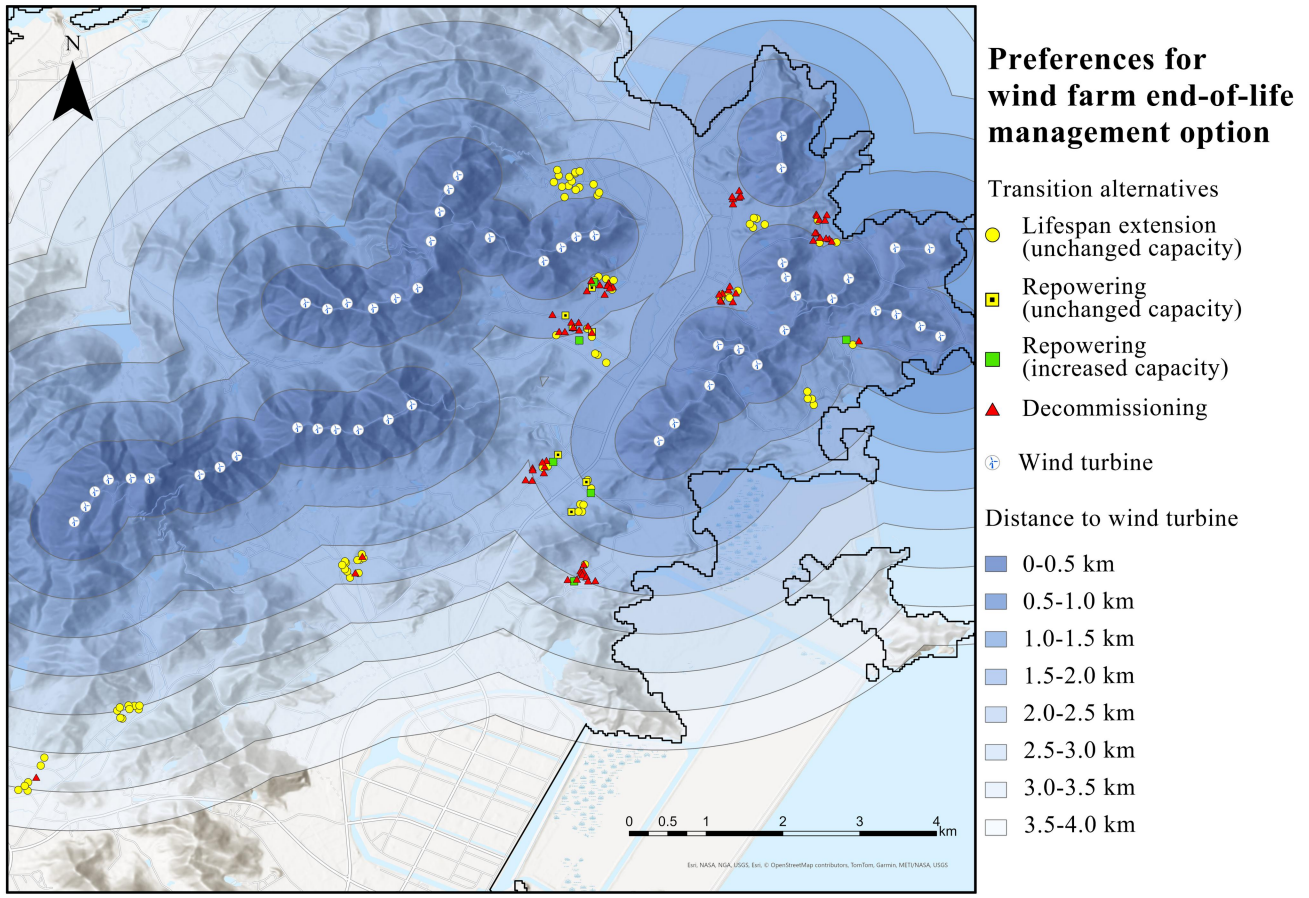


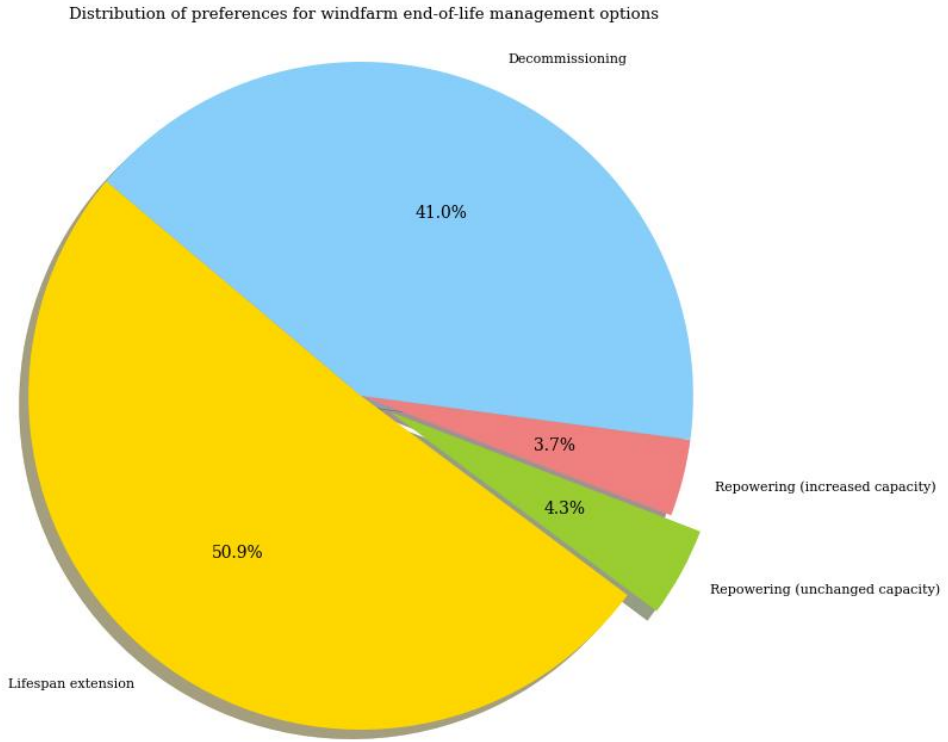
The location of study area – City A Wind Farm

Overview of the Questionnaire Survey

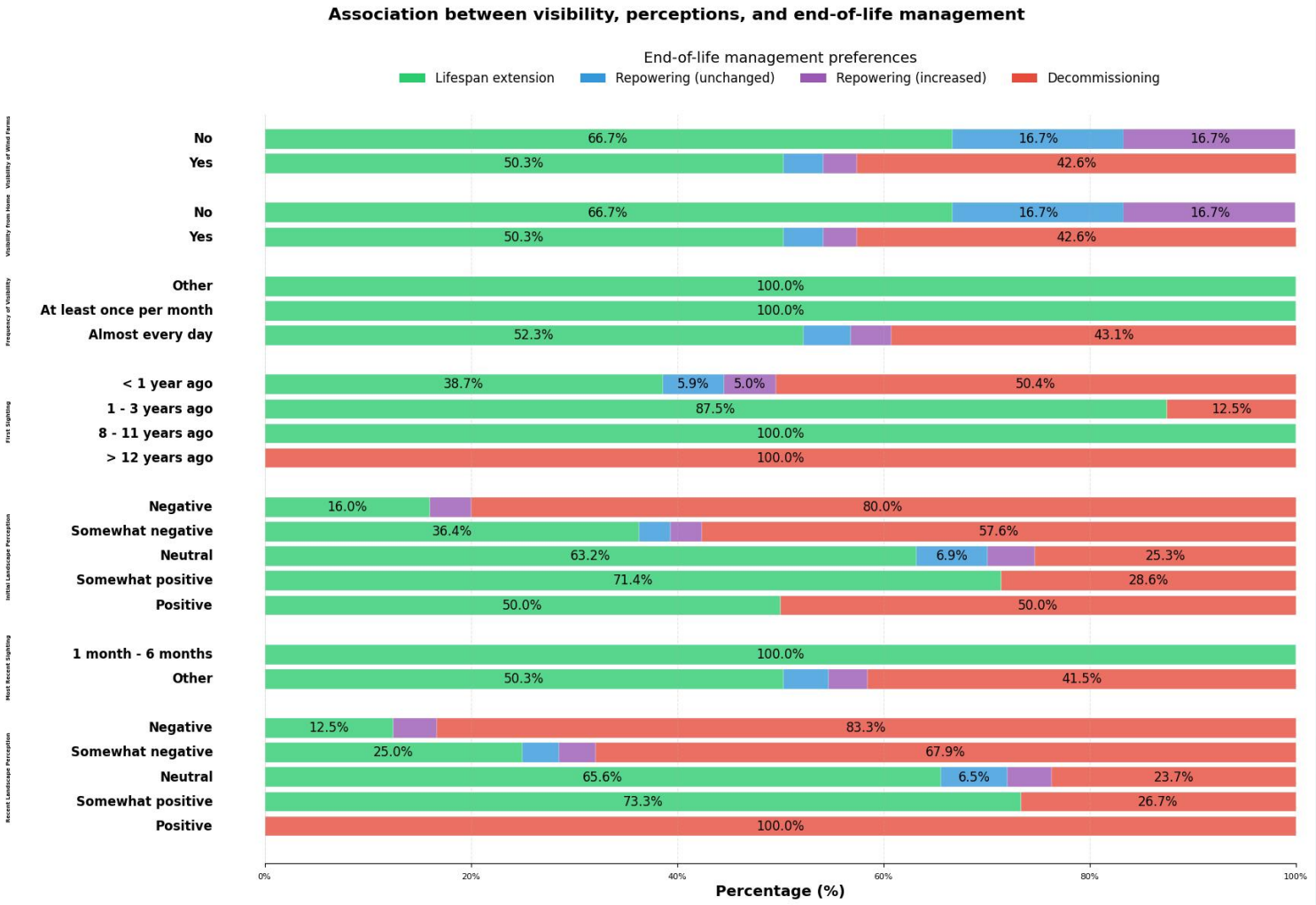
In this study, between April 30 and May 5, 2025, a interview survey was conducted within a 4 km radius of the wind farm, resulting in 161 valid responses. The primary aim of the survey was to explore the local residents' preferences regarding various future disposal options for the wind farm, including decommissioning, continued operation with unchanged capacity, continued operation with increased capacity, or extending the lifespan of the turbines. Additionally, the study sought to identify the key factors that influence residents' decisions regarding the future disposition of the wind farm. The findings from the survey provide valuable insights into the community’ s views on the wind farm's future and its impact on the local population.

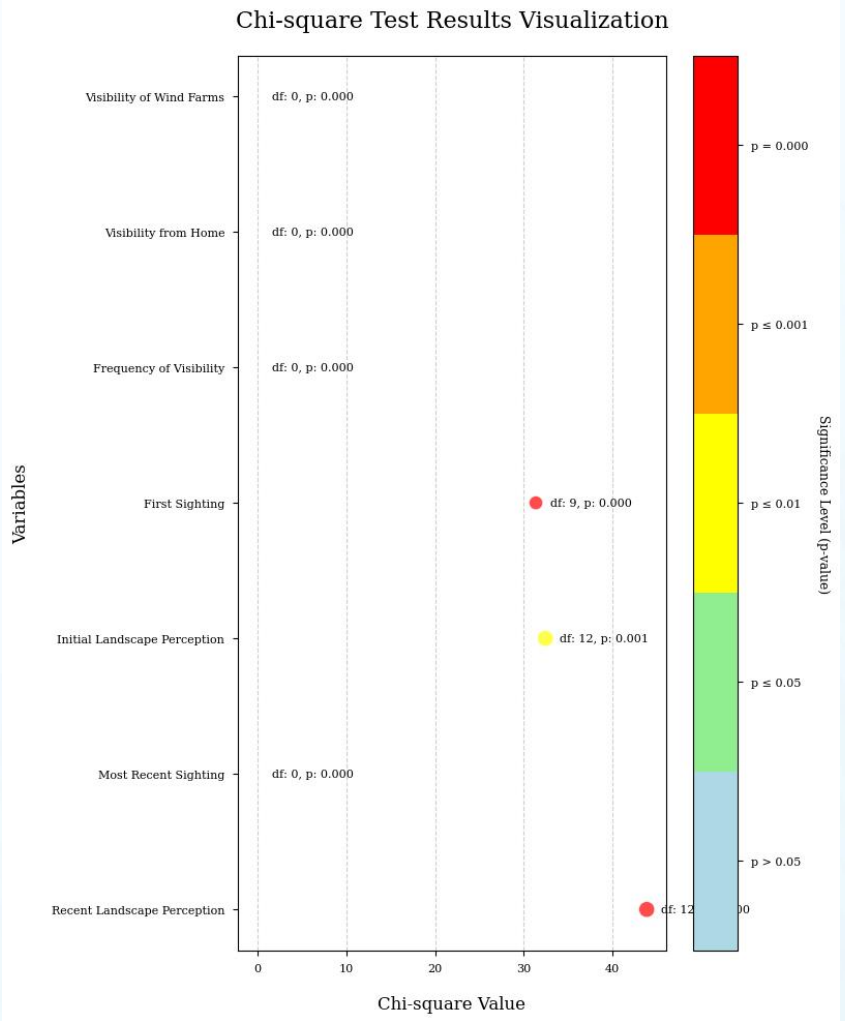
Result


N
0 0.5 1 2 3 4 km
Preferences for wind farm end-of-life management option
Transition alternatives
Lifespan extension (unchanged capacity)
Repowering (unchanged capacity)
Repowering (increased capacity)
Decommissioning
Wind turbine
Distance to wind turbine
0-0.5 km
0.5-1.0 km
1.0-1.5 km
1.5-2.0 km
2.0-2.5 km
2.5-3.0 km
3.0-3.5 km
3.5-4.0 km

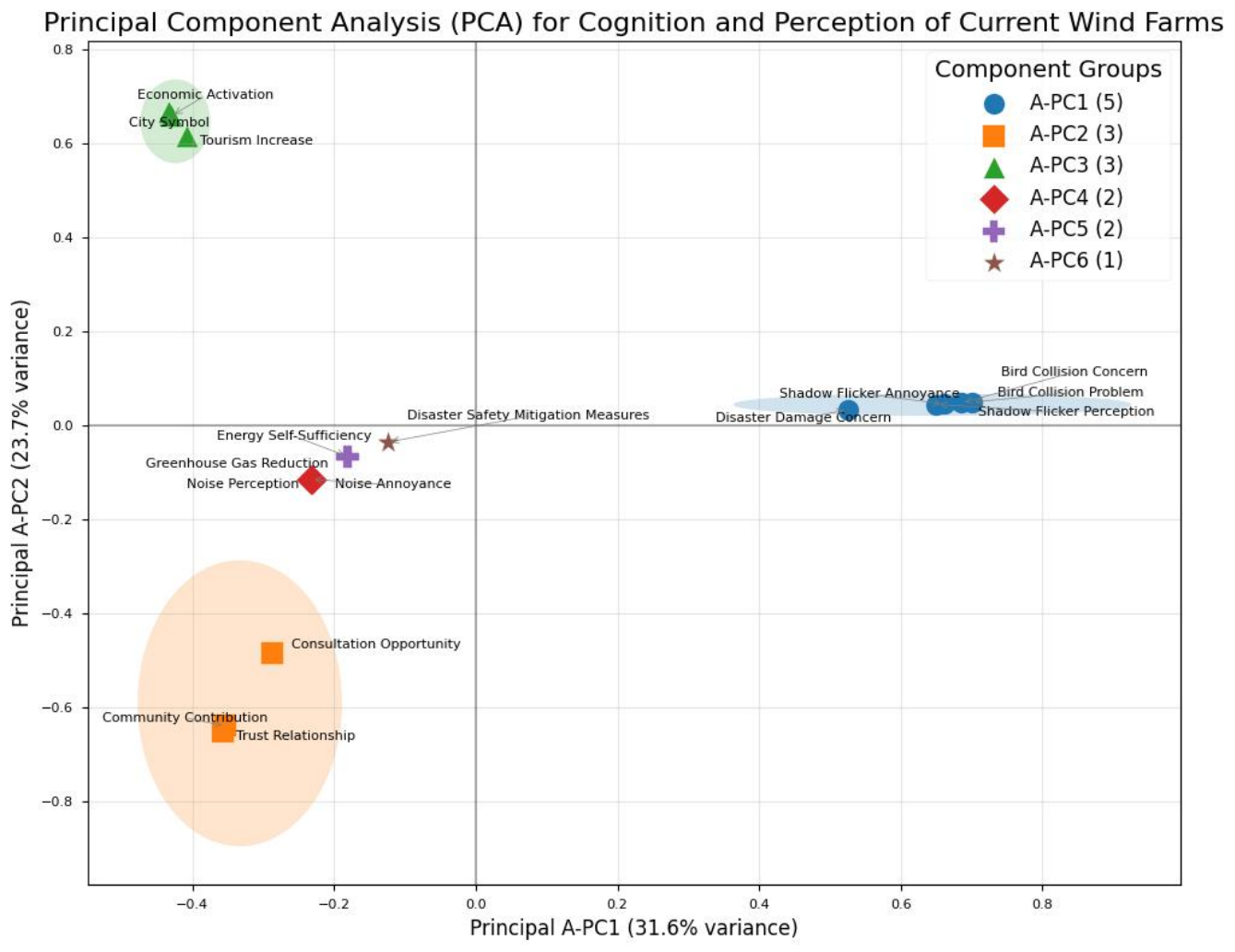

Distribution of preferences for windfarm end-of-life management options
Decommissioning
41.0%
3.7%
Repowering (increased capacity)
4.3%
Repowering (unchanged capacity)
50.9%
Lifespan extension

Association between visibility, perceptions, and end-of-life management: Chi-square analysis.



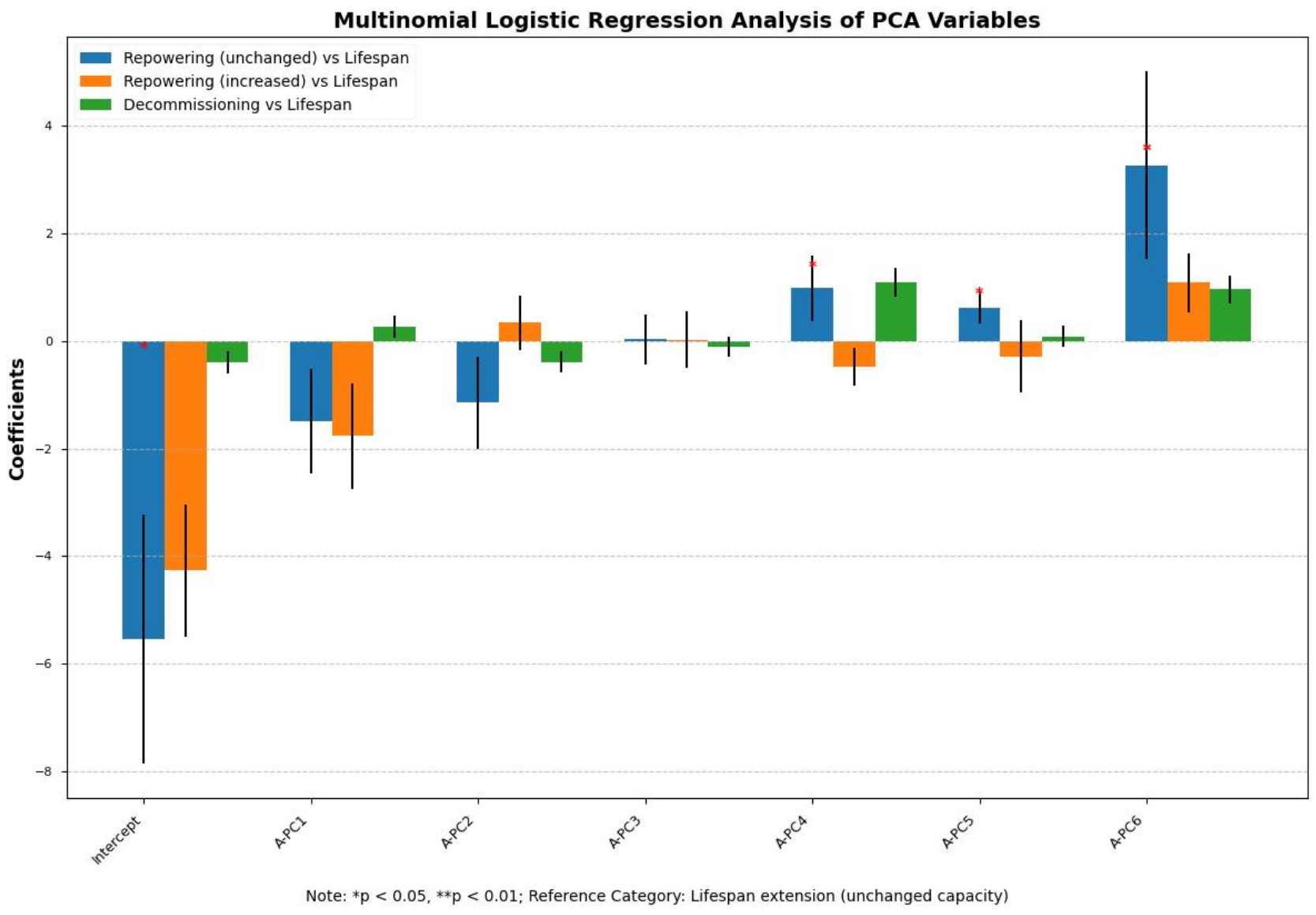


Principal Component Analysis (PCA) on the Perceptions of Current Wind Farms



A-PC1	Shadow Flicker Perception
	Shadow Flicker Annoyance
	Bird Collision Concern
	Bird Collision Problem
	Disaster Damage Concern
A-PC2	Mitigation Measures
	Consultation Opportunity
	Trust Relationship
	Community Contribution
A-PC3	Tourism Increase
	City Symbol
	Economic Activation
A-PC4	Noise Perception
	Noise Annoyance
A-PC5	Greenhouse Gas Reduction
	Energy Self-Sufficiency
A-PC6	Disaster Safety

Multinomial Logistic Regression Results for Current Wind Farms



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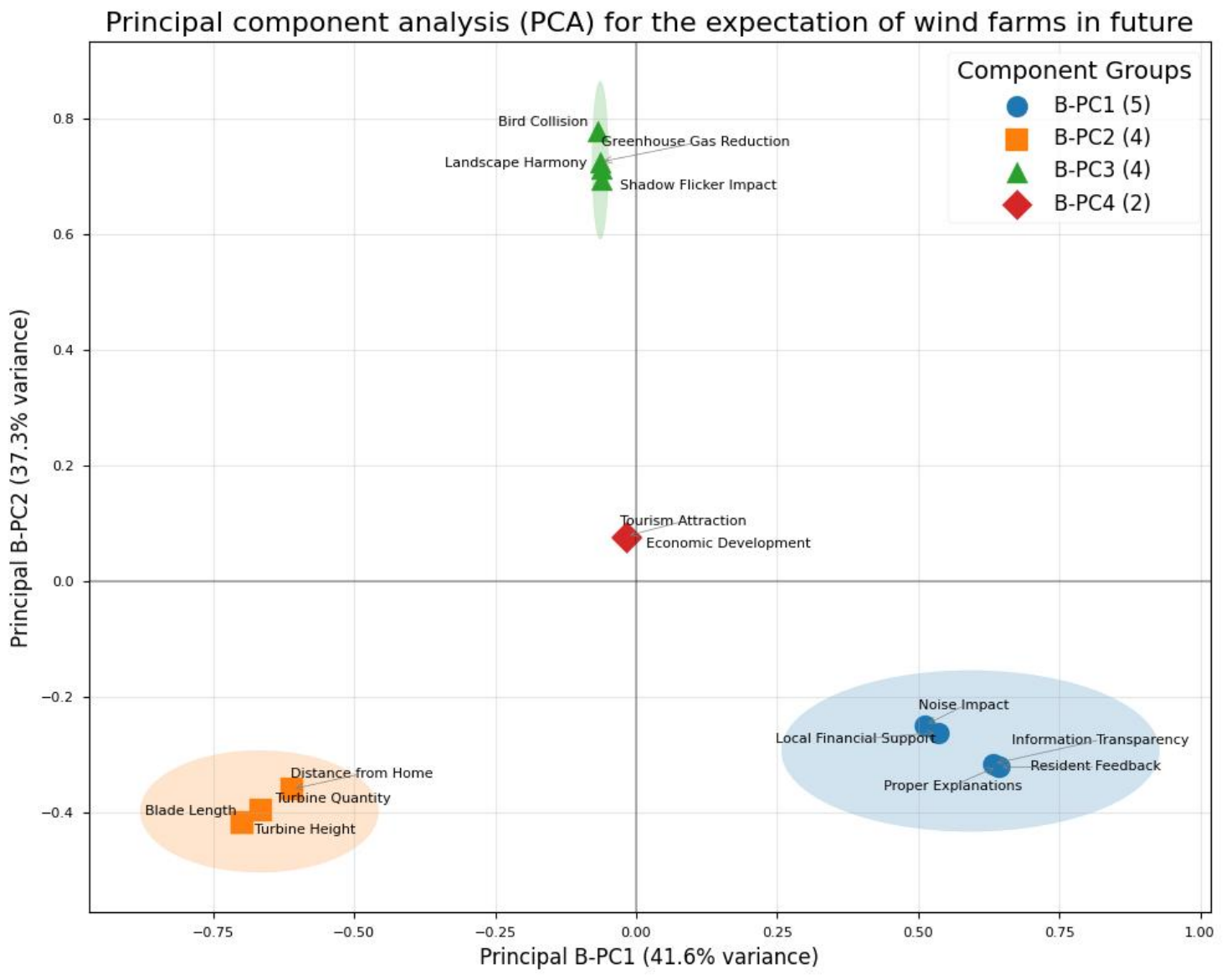
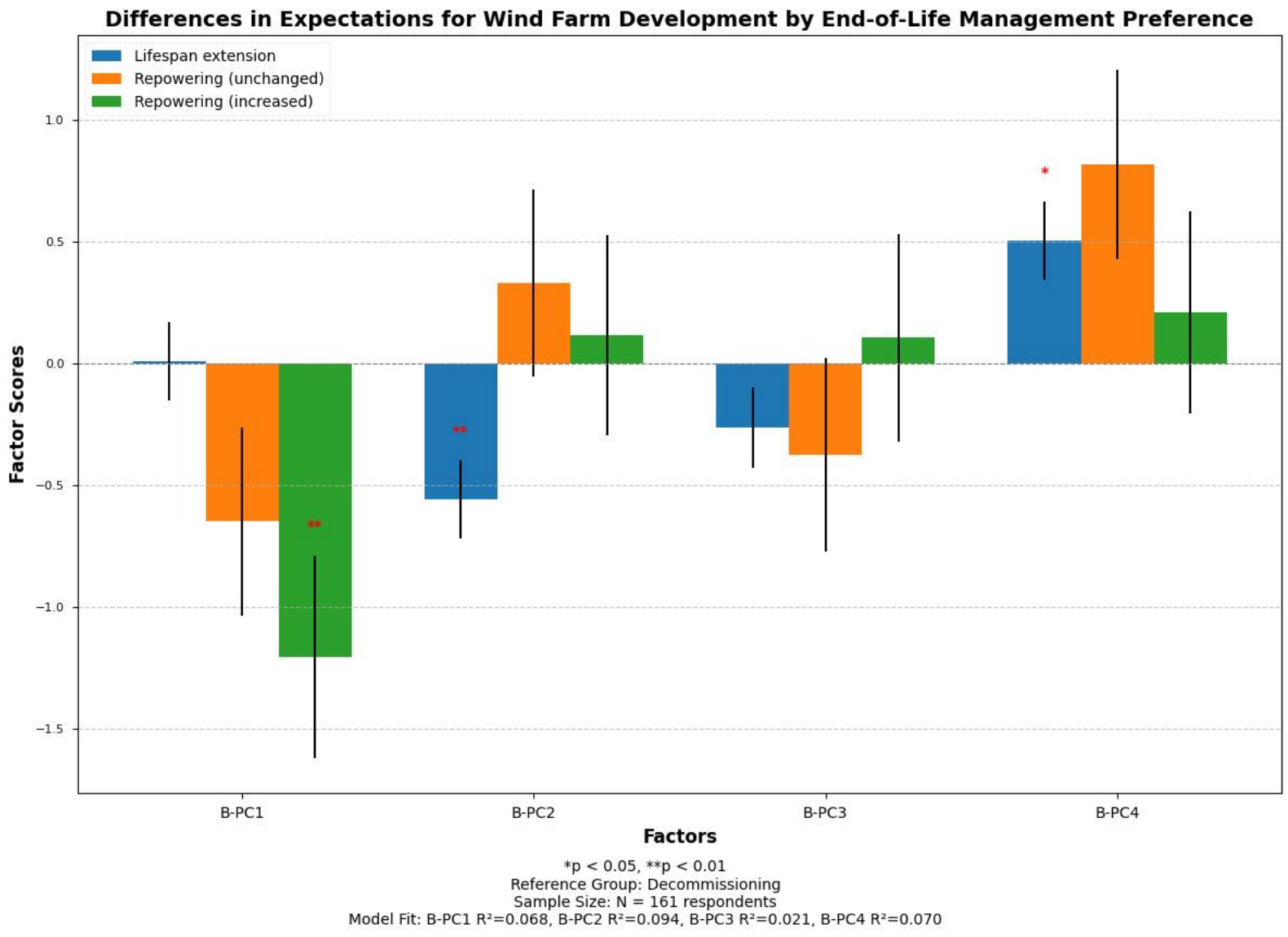
Principal Component Analysis (PCA) on the Expectations for Future Wind Farm Development



B-PC1	Noise Impact
	Local Financial Support
	Information Transparency
	Proper Explanations
	Resident Feedback
B-PC2	Turbine Quantity
	Turbine Height
	Blade Length
	Distance from Home
B-PC3	Shadow Flicker Impact
	Bird Collision
	Landscape Harmony
	Greenhouse Gas Reduction
B-PC4	Economic Development
	Tourism Attraction

Multivariate Analysis of Variance (MANOVA) Results on the Expectation of Future Wind Farm Development



B-PC1	Noise Impact
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B-PC2	Turbine Quantity
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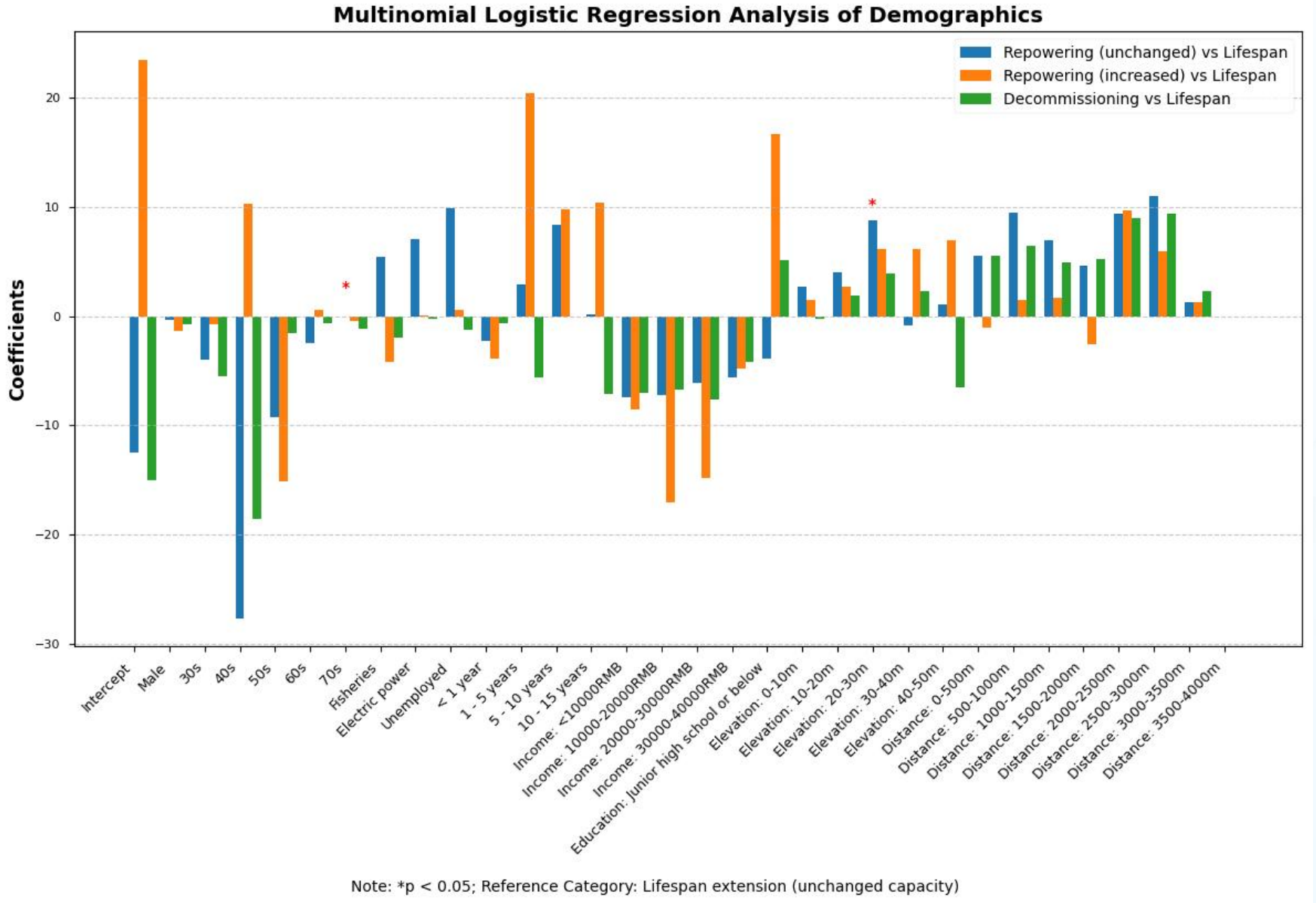
	Distance from Home
B-PC3	Shadow Flicker Impact
	Bird Collision
	Landscape Harmony
	Greenhouse Gas Reduction
B-PC4	Economic Development
	Tourism Attraction

Multinomial Logistic Regression Analysis of Demographics



Note: *p < 0.05; Reference Category: Lifespan extension (unchanged capacity)

Conclusion

- The percentages for Lifespan extension, Repowering (unchanged capacity), Repowering (increased capacity), and Decommissioning are approximately 50.9%, 4.3%, 3.7%, and 41% respectively.
- The analysis indicates that first sighting, initial landscape perception, and recent landscape perception are significantly associated with the decommissioning of wind farms.
- Perceptions of current wind farms, particularly the A-PC4, A-PC5 and A-PC6 components, significantly influence the choice of end-of-life management options for wind farms..
- There are significant differences in expectations for future wind farm development across different end-of-life management preferences, particularly on the B-PC1 and B-PC2 factors.
- Age and elevation significantly influence end-of-life management preferences for wind farms.

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THANK YOU