Household Energy Consumption-Investment Behavior and Microgrid Development

a School of Economics and Management, North China Electric Power University, Beijing, 102206, China.
b Beijing Key Laboratory of New Energy and Low-Carbon Development, Beijing, 102206, China.
c Institute of Banking and Finance, North China Electric Power University, Beijing, 102206, China.
E-mail addresses: wuzhongqun@ncepu.edu.cn (Zhongqun Wu), 120212106011@ncepu.edu.cn (Chan Yang), 13261203258@163.com (Ruijin Zheng), ibs14wylj@126.com (Jing Luo)

Zhongqun Wu [a b c]   Chan Yang [a c]   Ruijin Zheng [a c]   Jing Luo [a c]

Introduction

1. Renewable energy micro grid can integrate a multiple distributed energy sources, such as wind power and photovoltaic power generation. It is a reliable way for urban households to choose consumption-investment in low-carbon energy.

2. Households' energy consumption-investment behavior has a invisible influence on the construction and development of micro grid . The research on the factors of households' energy consumption-investment behavior is in the initial stage. Until now, there is no complete analytical framework that can be compatible with households' energy consumption-investment behavior and micro grid development.

Research questions/aims

1. Incorporate the basic characteristics of micro grid and other important factors into the households' energy consumption-investment behavior analysis system based on the TPB-VBN model and behavioral finance theory;

2. Comprehensively analyze the mechanism of interaction between micro grid and households' energy consumption-investment behavior, and the influence from policy factors on the relationship between them.

3. Construct a prediction model of micro grid development based on households' consumption-investment behavior. Establish a comprehensive analytical framework that takes into account households' behavior, policy interventions and micro grid development.

4. Use Beijing households' energy consumption-investment behavior as a sample, the model is applied for the first time to map the main influencing factors of micro grid and the relationship between their interactions.

Methodology

1. The ETPB-VBN analysis framework was constructed, and two aspects were made as follows.
a) First, add knowledge level, behavioral expectation and consumption habits as new constructs, which deepen the foundation of the formation of behavioral Intention.
b) Incorporate economic factors, policy impact, and convenience of consumption as important external influencing factors into the analysis system.

2. Structural equation modeling (SEM) used to clarify the linear relationship between the variables, and the basic hypothesis of H1-H7 are generated.

3. "Affects the households' low-carbon energy-investment behavior and micro grid development factors questionnaire" is designed. We obtained 505 Beijing household questionnaire data, so the ETPB-VBN analysis framework is inspected and proved.
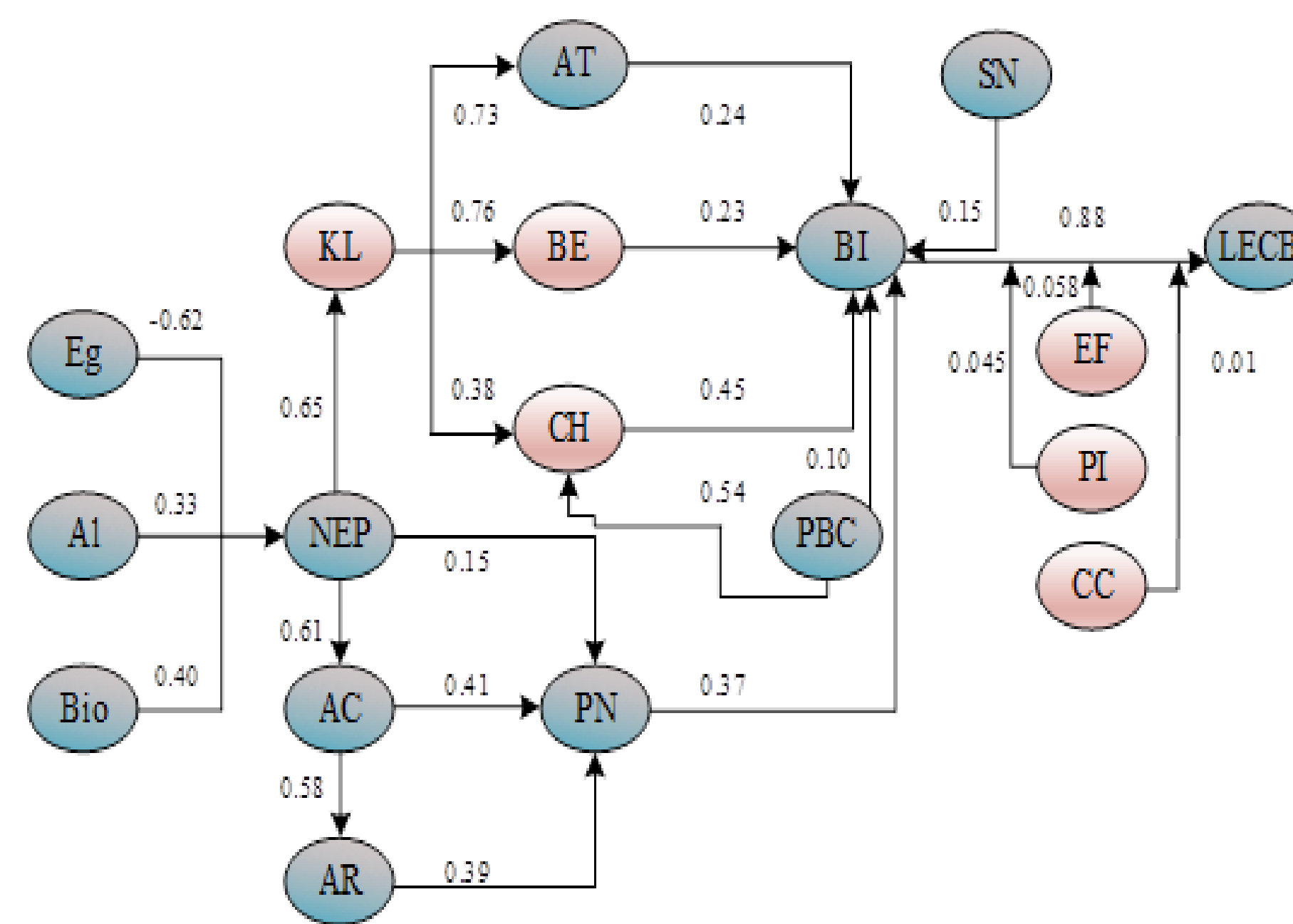
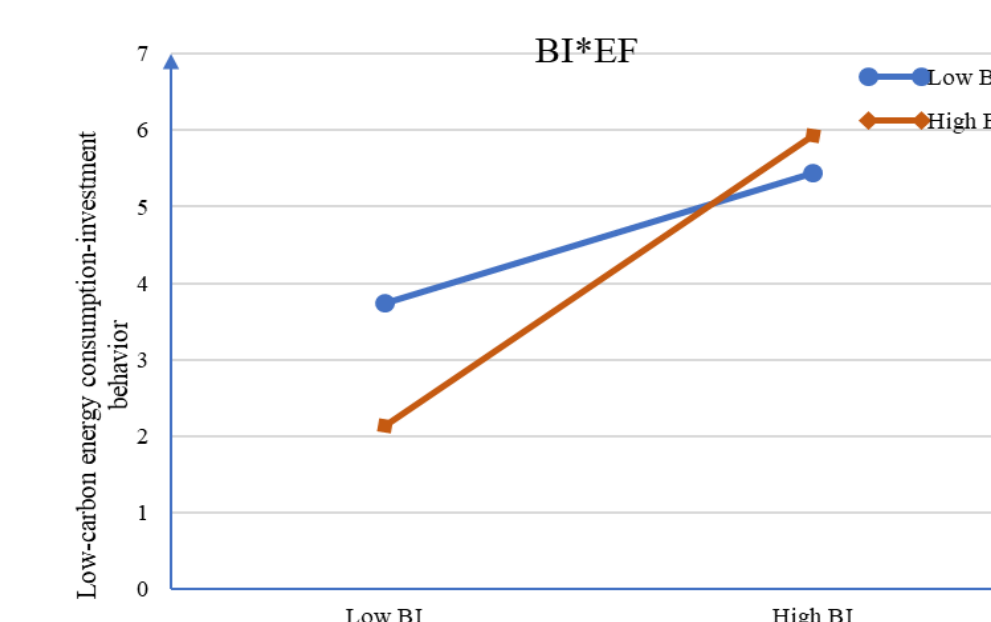## Results

Figure 2 Factors and interaction diagram

Figure 3 Economic factors adjustment effect diagram
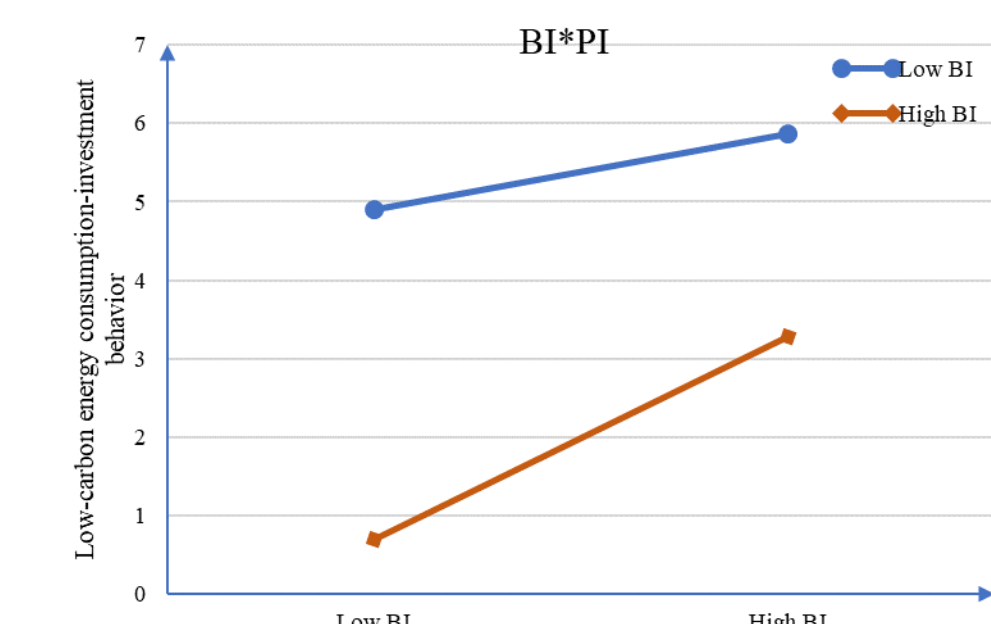

Figure 4 Policy Impact adjustment effect diagram
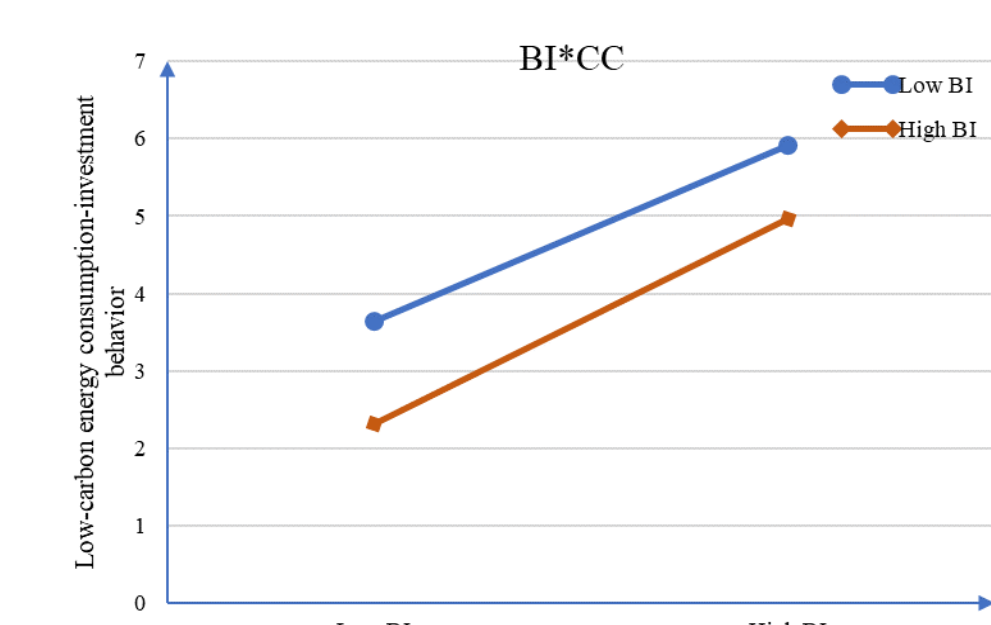

Figure 5 Convenience of consumption adjustment effect diagram

Conclusions

1. The ETPB-VBN model constructed by introducing three psychological factors: knowledge level, behavioral expectation, and consumption habit. It has about 29% higher explanatory power for behavioral intention than the commonly used TPB-VBN model, which originally had only 62% explanatory power.

2. A diagram of the factors influencing households' energy consumption-investment behavior and their interactions with micro grid development is drawn, which significantly refreshes the findings of analyzing households' low-carbon energy consumption behavior in Beijing. The causes of the formation of households' willingness to consume-invest in low-carbon energy in Beijing are abundant. Except the conventional behavioral willingness source factors, consumption habits and behavioral expectations have significantly contribution to the formation of households' intention.

a) To promote the complex antecedents of the formation of Beijing households' willingness, this paper further decomposes the front-end causes, from personal norms to three causes: ecological paradigm, awareness of consequences, and attribution of responsibility. Knowledge level is an important contributor to factors such as energy consumption attitudes and behavioral expectations.

b) The three moderating effect maps visually give the effect of economic factors, policy influence and consumption convenience, which become the key reference for future improvement of households' consumption environment and micro-grid development.

Policy implications

1. The low -carbon policy promotion system should be designed to promote the development of the micro grid from the six dimensions.

2. The design of the policy system should highlight the four key points.

3. Pay attention to the volatility of equipment prices, the completeness of subsidy policy, and the completeness of physical facilities.