# Objective Modeling and Analysis of Interstate Energy Contract

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**Abstract:** First, selects four indices, the development of energy in four states: climate, heat transfer factor, GDP, population, and genetic algorithm GEAT verified the rationality of the choice, so that improved LSTM deep recurrent neural network good generalization ability to forecast, and the establishment of four state energy rating model to predict the quantitative results. Second, consumption is regarded as the best user criterion for renewable energy evaluation. The TOPSIS method is used to sort them and get the best performance of CA in 2009. Then used DEA to verify it, it was found well.

**Keywords:** GEAT genetic algorithm; LSTM deep recurrent neural network; TOPSIS evaluation method; DEA Data Envelopment Method

## 1. Introduction

1960-2009 energy profile of four states

## 1.1. The rationality test of index data selection based on GEATbx genetic algorithm

Data on the selection of the influencing factors of the States. First of all, Arizona as an example, we use genetic algorithm for GEATbx analysis of the four factors and the consumption of renewable energy related. The result shows that the correlation of the selected four indexes to the renewable energy of the state is 92.8, which is more significant. Similarly, using this method, the correlation between CA, NM and TX is 93.3, 91.4, 88.6 respectively, so the four indicators that affect the renewable energy in four states are reasonable.

## 1.2. LSTM deep recurrent neural network model

### 1.2.1. Multi-layer recurrent neural network based on LSTM

LSTM adds a state to the original recurrent neural network.

The above figure is the final output diagram of LSTM. The connection between the hidden layer units of LSTM is cyclic, and the connection is only stored between the two layers of hidden layer nodes. When it circulate, a single prediction data is generated at each time node.In this way, the gradient of any time can be calculated backwards from the time t, and the update of the weight wash can be completed by the random gradient descent.

### 1.2.2. Fitting of index data based on LSTM multi-layer recurrent neural network

Still selected AZ, Zcli , Z pop , Ztc , Zgdp the four index is used as the input of the neural network, and the consumption of renewable energy is used as output, and et the corresponding parameters. Then 45 sets of data were selected from the AZ to be trained to predict the renewable energy consumption under the impact of these indicators. It is found that the training error is gradually reduced with the increase of the training step. Then use the remaining 5 groups of data as actual data to verify the results of the prediction, and draw the following figure. Then found that the fitting effect is better, and the data of the other three states are selected to be trained and verified, and the conclusion is the same. Therefore, it is feasible to analyze the general situation of energy development in four states from 1960 to 2009.

### 1.2.3. Energy level evaluation model based on LSTM neural network

#### 1.2.3.1. Make 0-1 of the improved neural network output interval

Based on an improved model, the results of the neural network output layer are between (0,1). Instead of predicting the consumption of specific renewable energy, it directly outputs the value before the reverse normalization. The index data of four states are entered into the MATLAB to get the following figure:

The 1,2,3,4 of the abscissa is CA, AZ, TX and NM. The energy consumption level of the four states is quite different. The difference between them is quite obvious. Therefore, a qualitative measure is needed to determine the grade.

#### 1.2.3.2. The establishment of the grade of energy consumption

The four states of the renewable energy consumption level of more divided into 4 grades: Grade I, II, III, IV. They were set the score as 0.8-1.0, 0.6-0.8, 0.4-0.6, <0.4 and they respected “obviously enhanced”, “slightly enhanced”, “slightly weakened”, “obviously weakened”. According to CA, AZ, NM, TX in four states from 1960 to 2009 the score and the development are: 0.85, 0.36, significantly increased 0.54, 0.61 increase slightly weakened slightly weak, it is their differences, the same point is four, the upward trend for renewable energy, but the growth the rate is different, so as to describe the similarities and differences of the four states of renewable energy.

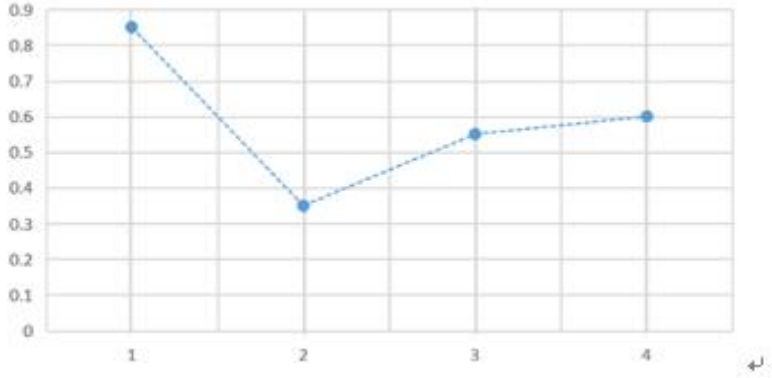


**Figure 1. Date**

## 2. The Selection of the Ambassador for the best Renewable Energy Use

### 2.1. Evaluation based on TOPSIS method

It can be evaluated according to its relationship with climate, population, GDP and heat transfer factors. The best distance between the nearest and the ideal solutions is the best distance to convert to the largest point of renewable energy consumption. The decision matrix is introduced into MATLAB,founded that the renewable energy consumption of CA, AZ, NM and TX four states was ranked as 1,4,2,3. It was found that the largest amount of renewable energy was used in CA2009, showing the "best" phenomenon, with a score of 0.9725.

### 2.2. DEA data envelopment method

In order to verify the optimality of CA, it is to verify whether multiple independent variables affect the best dependent variable, and then we can regenerate energy consumption and decompose it into two goals: expenditure and consumption. From the point of view, it is to verify the relative efficiency of its multi - index input and output, so DEA can be used to verify the results.

Based on this model, $Z_{cli}, Z_{pop}, Z_{tc}, Z_{dp}$ as an input variable, the expenditure and consumption of renewable energy are taken as output variables. The data of 10 years from 2000 to 2009 are selected and solved by Lingo. Therefore, from 2000 to 2009, CA's renewable energy consumption and consumption were sustainable development, and showed the best characteristics in 2009. Therefore, it is reasonable to choose CA as the best image of renewable energy.

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