A New Energy Contract For States Along The Border Between The US And Mexico

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Abstract: The production and use of energy are an important part of any economy. Four states along the border between the United States and Mexico have formed a new energy contract in order to increase the use of clean and renewable energy. We conducted a study to find new and more realistic energy profile targets for the new contract. First, we classify the logarithm according to the classification of energy, summarizing the energy profile by state, and give an overview of 2009 (Figure 1, 3). At the same time, we choose the average price of renewable energy, share of clean electricity, share of oil and coal and electricity consumption loss rate as the guideline levels. Based on the AHP model of the optimal allocation of clean energy, it is concluded that the configuration of clean energy in California is the best. Second, we fit each energy evolution of each state from the year of 1964 to 2009 by MATLAB, and then formulate the function expression with the guaranteed rate up to 95%, finding out the corresponding parameters of each energy evolution. At the same time, we analyze the similarities and differences between the state and the icon. Third, we identify and remove the abnormal data to find out the degree of dissimilarity in each energy development trend, that is to say, carrying out the correlation analysis, and then generate the raw data to find the law of energy changes and generate more. While, a corresponding differential equation model is established. The gray forecast model is used to predict the energy profile in the year of 2025 and 2050 (Table 4-10), and the prediction results are analyzed. Fourth, we find through Model 2 that California remains the most energy-prone state in 2025 and 2050 projections, with all its policies intact. Therefore, we use the energy profile of California in 2025 as the evaluation index and energy profile of the four states' energy contracts and quantify them as the proportion of renewable energy to total energy consumption, which is the sum of the predicted values of total renewable energy consumption and total Compare the predicted values of energy consumption and then calculate the ratio. We use this percentage as a target for the new energy continent of Four Continents and give the direction of the adjustment of the respective state government policies according to the different situations in each state. Finally after the sensitivity test, our model has a higher sensitivity and higher guaranteed rate, the problem has a high degree of credibility.

Keywords: Energy configuration application of MATLAB; Analytic hierarchy model; Grey forecast model; Clean energy; Best configuration

1. Introduction

1.1. Background

Energy is the material basis for the survival of human society and an indispensable part of any economy. [1]In the United States, under the federal-based political system, many energy policies were delegated by the federal government to the next state. However, due to their different development directions, different states also have a great difference in energy production and use. In order to achieve consensus on specific policy issues, establishing a compact among two or more states on the same set of standards or on a particular regional issue or cooperation among states is called an interstate compact. [2]In 1970, the twelve western states of the United States signed the famous Western Interstate Energy Compact to promote the development of nuclear energy management technologies.

1.2. Restatement of the problem

We were asked to provide a new target for the governors of the four states: California (CA), Arizona (AZ), New Mexico (NM) and Texas (Texas) at the United States-Mexico border. In order to help them get a new, realistic and credible compact, they can achieve their target of increasing the demand for clean and renewable energy. Therefore, we need to analyze the following three parts.
In the first part we have three problems to solve. First, we need to analyze the data given of the four states to give the energy profile of each state. Of course, the profile must contain the data necessary for our modeling. Next, our modeling of the evolution of each energy consumption in each state during 1960-2009 is illustrated, and our analysis of the similarities and differences among the four states is given. In 2009, for example, we identify one of the four states with the best energy profile based on

clean and renewable energy. Finally, we need to predict the energy profile for the 2025 and 2050 based on the above research.

In the second part, on the one hand, we need to compare the energy profile of the four states again, and use the identified optimal energy profile as the new compact target. On the other hand, we give three actions to achieve this target.

Finally, the last part, we need to prepare an one-page memo to governors who summarize the situation of the state in 2009 and make predictions about the use of energy and give our recommendations to meet new four-state energy compact.

1.3. Our approach

After we deal with the data, then we analyze the energy changes in different states, importing it into MATLAB for fitting, getting each corresponding expression of energy consumption, and then make a difference analysis of our fitting model, and finally reflect the evolution of each energy consumption through the parameter changes will ensure that the guarantee rate of 95%.

We will screen among the factors affecting the clean energy profile to find the four factors that have the greatest impact: Average price of renewable energy, Share of oil and coal, Share of clean electricity, Electric loss rate, then regards the best configuration of clean energy as the target layer, and the four states as the program level analysis. [3]

We screened the irrational data of each energy consumption variable, and we carried out the correlation analysis, and then processed the original data to find the law of energy variation and generate the data sequence with strong regularity. [4]Finally, we established the corresponding differential equation, getting the Gray Prediction (1,1) Model.

2. General Assumption

We assume that human-induced catastrophes such as earthquakes and tsunamis will not occur during the forecast period.

We assume that in the forecast period no new nuclear power plants will be established in all states.

We assume that new types of energy ethanol can be recognized and grow at lower rates.

Supposing our data is based on the terminal consumption data.

Assuming there is no excessive growth or excessive decline in the relative resources of the states after their respective political, demographic, resource reserves, industrial development directions ,etc. leading to the stabilization of their respective resources after reaching a fixed value.

3. Notations

Table 1. Form One

Variable	Means
Z_x	The state's annual average renewable energy prices
w_x	The average selling price of renewable energy in the United States during the year
c_x	The same day the arithmetic average of renewable energy prices
Q_i	The arithmetic average of renewable energy prices on the same day
A_i	The total annual oil consumption in the United States in those years
$B_{i\max}$	The largest number of chemical plants in the United States the year
D_j	The state's traditional annual electricity consumption and annual clean electricity consumption ratio
G_y	Indicates the state power loss rate
h_y	Represents the mean value of power loss in the UnitedStates during the year

4. The Model

4.1. State resource profiles

4.1.1. Definition and comprehension of concepts

For the data given, we conduct the following classification:

Total energy: the sum of all the energy given in the annex, includes clean and unclean resources.

Cleaner energy: those do not emit pollutant or emit little pollutant. Clean energy includes four categories of nuclear energy, ethanol, natural gas and renewable energy.

Renewable energy: Wind energy, solar energy, hydropower, geothermal energy and biomass energy given in the annex are not discussed in detail due to the content issues and the convenience of handling.

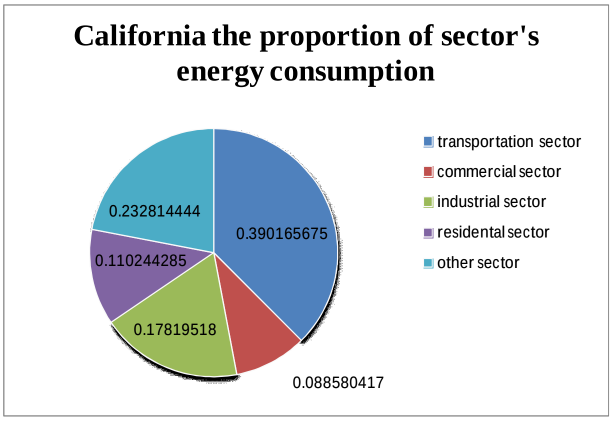
Unclean energy: the sources of producing much pollutant (not including those with lower pollutant that is to say, the sources of energy excluding clean energy, and we only describe the petroleum and fossil fuels because of the content problems.

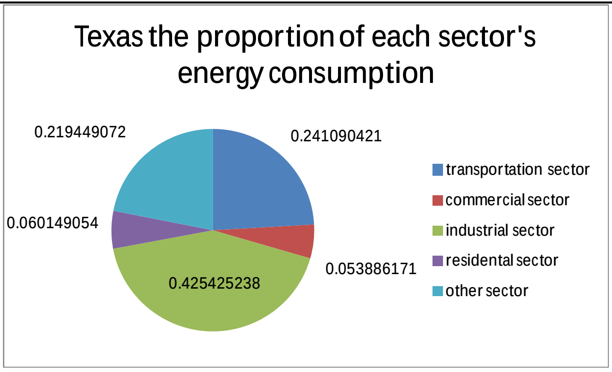
4.1.2. Energy profiles for each state

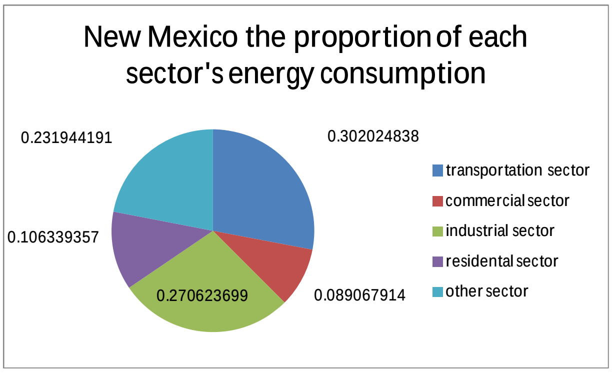
The distribution of total energy consumption: Through the data found that we can easily find that the energy consumption of the four states is transportation sector department, commercial sector department, industrial sector department, residential sector department and other departments. Among them, except Texas, the industrial sector accounts for the largest amount of total energy consumption, all other states have the largest share of energy consumption in the transport sector, but the consumption of the total energy consumption in the transportation sector in Texas is also. [5] This shows that the transportation industry in each state has a long-term and significant impact on energy consumption. In Arizona, the industrial sector is developing at a slower pace compared with other states. Therefore, energy consumption in the industrial sector accounts for the proportion of energy consumption is very small, while the industries of oil and natural gas in Texas and New Mexico occupy a relatively large proportion of the total energy. [6] Meanwhile, the ratio of energy consumption to total energy in other industries in Arizona Large, Arizona is more developed in agriculture than any other.

The Annex gives the energy data from 1960 to 2009. Because of the huge amount of data, we select recent year 2009 as an example to give an overview of energy profile for the states in the year. The following is our analysis.

Clean energy profile: From the table, we can see that the proportion of clean energy in the total energy in Arizona accounts for 55% of the total energy. [7]The number of other states is relatively small, only about 40% of their respective total energy consumptions. However, there is a big gap between the amount of clean energy consumption and total energy consumption in Arizona and New Mexico, which is much smaller than those in California and Texas.







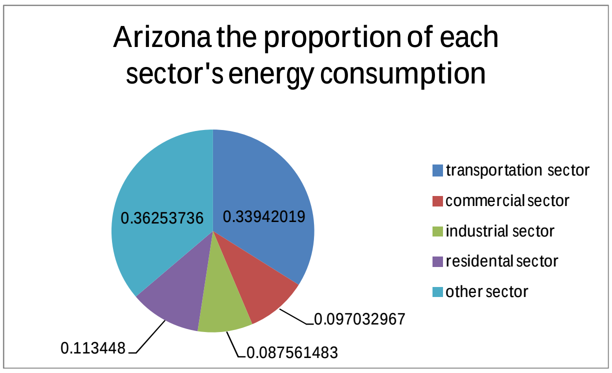


Figure 1. The ratio of energy consumption of each department to total energy

Table 2. 2009 State Clean Energy and Total Energy

	AZ	CA	NM	TX
Clean energy	805374.5	3518049	286869.7	4319641
Total energy	1454313	8005515	670094.5	11297411
Clean energy and total energy ratio	0.553783	0.439453	0.428103	0.382357

Pie charts can easily help us figure out the proportion of clean energy consumptions in every state and come to the following conclusions:

Texas is dominated by natural gas and nuclear power, with only a small percentage of other energy sources, of

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which up to 80% of natural gas is an indispensable energy consumption for the state.

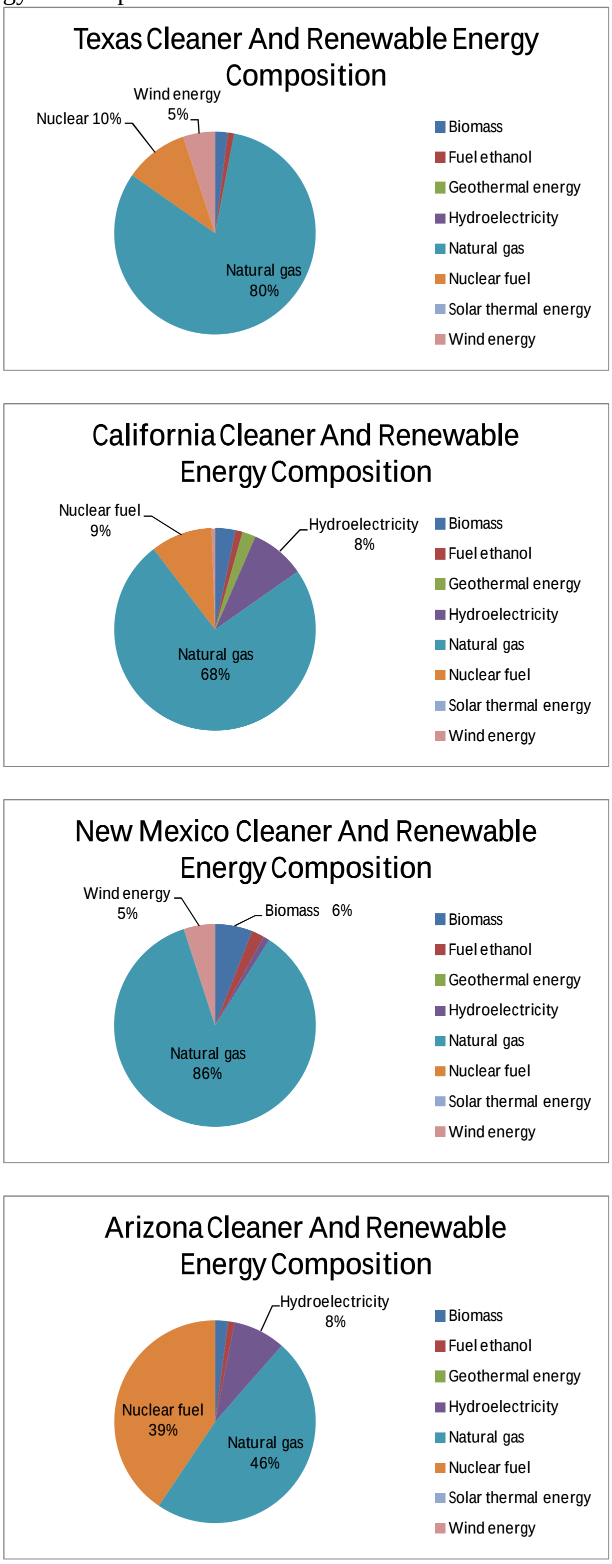

Figure 2. Pie chart of clean energy percentage of clean energy

New Mexico also has 86% of natural gas consumption. Other forms of energy consumption are extremely scarce, with only 6% of biomass energy consumption and 5% of wind energy consumption.

In addition to 68% of the natural gas consumption in California, nuclear energy consumption.

4.2. Establishment of the model

We fit the data for each of the four states into a functional expression using MATLAB. We derive the evolution of each energy consumption component based on a 95% guarantee rate, analyzing and discussing the function, and we come to all the trends are in line with the following function expression: [8]

$$f_{(x)} = ax^3 + bx^2 + cx + d \quad (1)$$

Among them, a, b, c, d are parameters, x is an independent variable (year), $f_{(x)}$ is dependent variable (the ratio of total energy consumption to clean energy consumption in corresponding year)

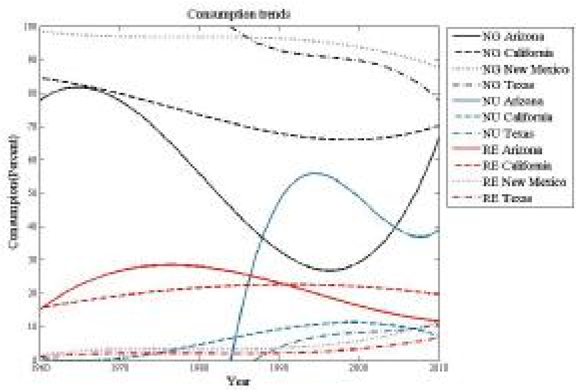

Figure 3. A summary of the evolution of each energy share in the percentage of clean energy

By fitting the evolution diagram (Fig.), we found that most of the evolutionary changes in energy are based on the cubic function of the expression changes, however, ethanol changes showed a constant value or non-existent. Because of the absence of nuclear energy in New Mexico, there is no expression at all. And Texas's renewable resources show a slow growth, so the fit to its function expression is a one-way change. [9]

4.2.1. Interpretation and analysis of model results

As a new type of energy source, ethanol energy appears in recent years, and its technology and properties are not accepted or recognized by people, and only the data of recent years shows that the ratio of ethanol fuel consumption to clean energy consumption in each state is few, we do not consider its changes and the impact, so set its function's value to 0 or 1; [10]Natural gas, as the main energy consumption in each state, has a good development in the energy consumption of oil and natural gas.

Natural gas accounts for a large proportion of clean energy consumption, and is used in the earlier time
It has much data to support our equations. We obtained equation parameter values by fitting the energy for each state; [11] The output of nuclear energy is related to the number of nuclear power plants. Theoretically, the number of nuclear power plants keeps stable. However, the proportion of nuclear energy consumption in clean energy consumption now varies greatly with the change of year. Therefore, we conclude that the total amount of clean energy consumption fluctuates over the time. By fitting, we obtain the parameter when the ratio of nuclear energy to clean energy changes, which can reflect the change of the total amount of clean energy consumption from the side. [12].

Table 3. Parameter List

CA	**Renewable Energy**	**Ethanol**	**Natural gas**	**Nuclear energy**	**AZ**	**Renewable Energy**	**Ethanol**	**Natural gas**	**Nuclear energy**
a	-2.79E-05	0	0.0004341	0.0004341	a	0.0007121	0	0.003456	1.64E-02
b	0.1585	0	-2.574	-2.574	b	-4.261	0	-20.54	-98.65
c	-299.3	0	5086	5.09E+03	c	8499	0	4.07E+04	1.97E+05
d	1.88E+05	0	-3.4E+06	-3.4E+06	d	-5.7E+06	2	-2.7E+07	2.20E+08
NM	**Renewable Energy**	**Ethanol**	**Natural gas**	**Nuclear energy**	**TX**	**Renewable Energy**	**Ethanol**	**Natural gas**	**Nuclear energy**
a	-0.000283	0	-0.000283	0	a	0	0	-0.00361	0.002139
b	1.678	0	1.678	0	b	0	0	21.61	-12.85
c	-3320	0	-3320	0	c	0.06473	0	-4.3E+04	2.57E+04
d	2.19E+06	0or1	2.19E+06	0	d	-125.9	0	2.9E+07	-1.7E+07

For other forms of renewable resources, due to the differences in geographical location, industry, climate, policies and other aspects, the speed of development is also different. Such as: other forms of renewable resources in Texas develop in a much stable rate, while in other states change unobviously, However, renewable energy consumptions in California and Arizona account for a larger share of clean energy consumption.

4.2.2. Commonalities and differences between states

The figures show that from the year of 1960 to 1972 the total energy consumption of all states is on the rise. While the share of clean energy in total energy is reduced from 60% to 40%.[13] We find that the fiscal policy of expanding aggregate demand and the loose monetary policy have provided a good space for the rapid economic growth in the developed capitalist countries. It leads the demands getting great, meanwhile, the amount of cleaner energy has no change; Between 1972 and 1984, On account of the rising international oil prices and the inflation in the United States, it leads the economic crisis and its industries are severely affected, what' more the ratio of clean energy keeps at around 40%.[14] In the next few years (1984 to 1995), due to the fact that the federal government did not take any effective measures to solve the economic crisis, but instead two economic crises occurred, causing the stagflation crisis. The U.S. economy grew extremely slowly at that time, the energy demand grew slowly. The ratio of clean energy consumption to total energy consumption remains unchanged, and the curve is gentle. [15]

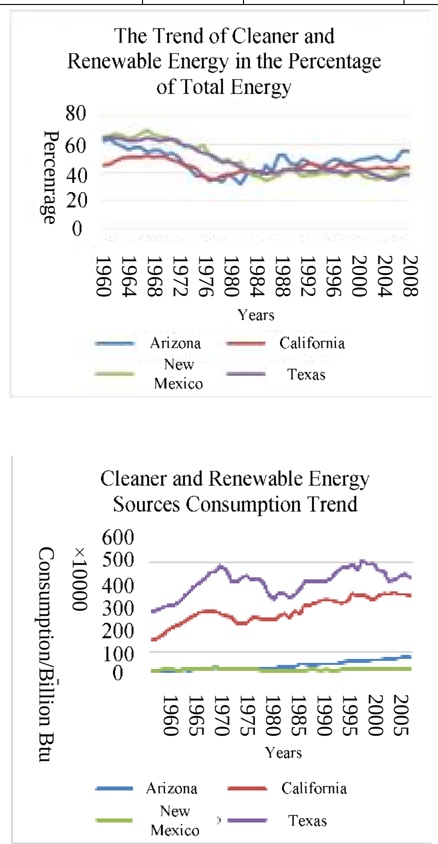

Figure 4. A summary of the evolution of each energy share in the percentage of clean energy

The trend of total energy consumption in California and Texas equaling to the amount of total energy consumption, the both of their demand is great. The content of Arizona and New Mexico is less than that of total energy. The overall slow growth trend. Through data query and analysis, we find that the number of population in California and Texas is extremely large, and the industrialization is near the coast (coastal), the oil and natural gas are well developed, the amount of energy consumed by the rapid development of new industries increases at the same time. However, the population of Arizona and New Mexico is relatively small, industries which are off the coast (mainland China) develops relatively backward, especially in New Mexico, where agriculture is predominant, industrial development is slow, and energy demand is low. [16]

4.3. Establishment of the model

Use Evaluation of Indicator System to evaluate the Same Indicator for the State of best using Clean Energy, and it is possible to set the target for different degrees of impact on states by the average price of renewable energy, the proportion of petrochemical products used, Share of clean electricity, Each evaluation indicator is a guideline, California, Arizona, New Mexico, and Texas as a hierarchical hierarchy model of the program to study the impact of different factors on determining the best states that use clean energy.

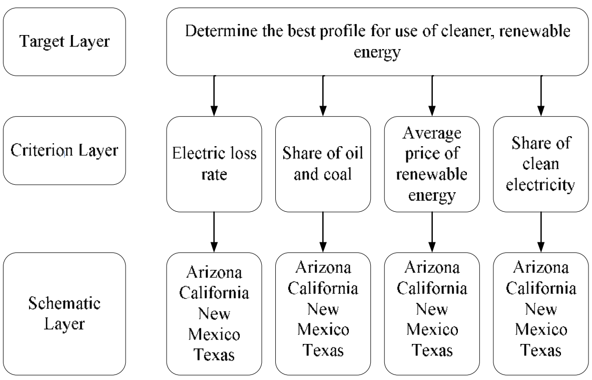

Figure 5. Hierarchy flowchart

4.3.1. Effect factor

Cleaner Resources: Energy that does not emit pollutants or discharges pollutants. Very low energy sources include four major categories of nuclear energy, ethanol, natural gas and renewable resources. The use of clean energy is affected by many factors, We analyze the various factors and the proportion of the following four main factors are as follows:

The average price of renewable energy：

$$Z_x = \frac{W_x}{36} \times C_x$$

Z_x: The state's annual average renewable energy price

W_x: The average selling price of renewable energy in the United States during the year

C_x: The arithmetic average of renewable energy prices on the same day

Petrochemical products accounted for the proportion:

$$Q_i = \frac{A_i}{q_i} B_i \times 100\%$$

Q_i: The state petrochemical products accounted for the proportion

A_i: The total oil consumption in the United States of the year

q_i: In the United States the number of oil-consuming factories

B_i: The number of local oil consumption plants of the year

Power loss rate:

$$G_y = 3\times10^6 h_y g^{-e}$$

G_y: The state power loss rate

h_y: The mean value of power loss in the United States during the year

g : Parameter

Traditional electricity consumption and clean electricity consumption ratio:

$$D_j = 2\times10^3 \times e_j \times \partial^{-b}$$

D_j: The traditional electricity consumption and clean electricity consumption ratio

e_j : Traditional power consumption

∂, b : Parameter

4.3.2. Constructing judgment matrix

Compare four evaluation indicators $x = \{x_1, x_2, x_3, x_4\}$, The impact on the size of the target, of which x_1 = The average price of renewable energy, x_2 = Petrochemical product consumption, x_3 = Petrochemical product consumption, x_4 = Petrochemical product consumption, One can take the comparison of evaluation indicators to establish a pair of comparison matrix approach, That is, each time to take two evaluation indicators, x_i and x_j, and by means of a_{ij}, indicate the Impact ratio of x_i and x_j, then x_i and x_j by means of a_{ij}, indicate the Impact ratio of x_i and x_j, then the Impact ratio of x_i and x_j is $a_{ij} = \frac{1}{a_{ij}}$. All comparison results for the matrix is $A = (a_{ij})_{3\times3}$ matrix A. Then is the judgment matrix of the paired matrix. [17]

4.3.3. The total hierarchy

According to the ranking weight of the guideline layer, the ranking weight of the program layer to the target layer can be calculated. [18] There are four factors in the guideline layer, and their rank ordering weights are $a_1\ a_2\ a_3\ a_4$ .There are 4 factors in the program layer, and their weight of single ordering in the guideline layer is respectively $b_{ij}\ b_{2j}\ b_{3j}\ b_{4j}$. Then the level of the program layer of the total weight of the order of $b_1\ b_2\ b_3\ b_4$ .The calculation formula is:

$$b_i = \sum_{j=1}^{4} b_{ij} a_j \quad j = 1234 \quad i = 1234$$

4.3.4. Solve the problem

In the process of constructing the comparison judgment matrix, Although turn out the measures of confirming a_{ij} , However, due to different types of factors on the selection of the best use of clean energy state effect is not the case. Therefore, it is necessary to construct judgment matrix according to different factors into the specific situation so as to solve the evaluation model. [18]

Table 4. The Meaning of Scale

Scale	The meaning
1	Indicating two factors compared, they have the same importance.
3	Indicating two factors compared, The former is slightly more important than the latter.
5	Indicating two factors compared, The former is obviously more important than the latter.
7	Indicating two factors compared, The former is more important than the latter.
9	Indicating two factors compared, The former is more important than the latter.
2,4,6,8	Indicates the middle value of the above adjacent judgment.

Construction of discriminant matrix pairs of three evaluation indicators for comparison, the use of 1 to 9 scale, and the resulting matrix is as follows:

$$A = \begin{pmatrix} 1 & 1/2 & 1/3 & 1/4 \\ 1/2 & 1 & 1/3 & 1/4 \\ 1/3 & 1/2 & 1 & 1/2 \\ 1/4 & 1/2 & 1/2 & 1 \end{pmatrix}$$

Write MATLAB program (see appendix), through the judgment matrix to find the weight of the three evaluation indicators and consistency test, the results are as follows: Eigen values $l = 0.425$ Weight vector $\omega = (0.43181, 0.2114, 0.091234)$

Consistency index $CI = 0.0083$; Consistency ratio $CR = 0.009$, due to $CR < 0.10$. Therefore, the consistency of the judgment matrix is acceptable.

Table 5. The Priority of Each Standard

Average price of renewable energy

	CA	AZ	NM	TX	Pr
CA	0.25	0.25	0.25	0.25	0.25
AZ	0.25	0.25	0.25	0.25	0.25
NM	0.25	0.25	0.25	0.25	0.25
TX	0.25	0.25	0.25	0.25	0.25

Electric loss rate

	CA	AZ	NM	TX	Pr
CA	0.25	0.20	0.29	0.25	0.25
AZ	0.25	0.20	0.14	0.25	0.21
NM	0.25	0.40	0.29	0.25	0.30
TX	0.25	0.20	0.29	0.25	0.25

Share of oil and coal

	CA	AZ	NM	TX	Pr
CA	0.25	0.20	0.25	0.29	0.25
AZ	0.25	0.20	0.25	0.14	0.21
NM	0.25	0.20	0.25	0.29	0.25
TX	0.25	0.40	0.25	0.29	0.30

Share of clean electricity

	CA	AZ	NM	TX	Pr
CA	0.29	0.35	0.29	0.20	0.28
AZ	0.29	0.35	0.43	0.40	0.39
NM	0.14	0.12	0.14	0.20	0.15
TX	0.29	0.18	0.14	0.20	0.20

Compare each other matrix:

	CA	AZ	NM	TX	Pr
CA	0.43	0.40	0.40	0.50	0.43
AZ	0.22	0.20	0.20	0.17	0.20
NM	0.22	0.20	0.20	0.17	0.20
TX	0.14	0.20	0.20	0.17	0.24

The priority matrix for each state under each standard:

	CA	AZ	NM	TX
CA	0.25	0.25	0.25	0.28
AZ	0.25	0.21	0.21	0.39
NM	0.25	0.30	0.25	0.15
TX	0.25	0.25	0.30	0.20

The priority of California:

$0.25\times0.433+0.197\times0.247+0.247\times0.197+0.281\times0.241=0.273$

The priority of Arizona:

$0.25\times0.433+0.211\times0.197+0.211\times0.197+0.387\times0.197=0.267$

The priority of New Mexico:

$0.25\times0.433+0.297\times0.197+0.247\times0.197+0.151\times0.197=0.245$

The priority of Texas:

$0.25\times0.433+0.247\times0.197+0.297\times0.197+0.202\times0.242=0.264$

By calculating, we get the highest level of resource allocation among the four states in the state's resource allocation, indicating that state's clean energy consumption allocation is the best among the four states.

4.4. State energy consumption GM (1, 1) model forecast

Every change in energy consumption in each state contains uncertainties, by identifying and excluding abnormal data in the data, we find out the degree of dissimilarity in the development trend of each energy consumption, then conduct a correlation analysis to process the raw data and find the law of energy changes. We can generate a strong regularity of the data sequence, and then establish the corresponding differential equation model to predict the allocation of resources in 2025 and 2050. [19]

4.4.1. Establishment of the model

Let $x(t)$ be the dependent variable for time t.

If $x(t)$ satisfies first-order linear differential equation:

$$\frac{dx(t)}{dt}+ax(t)=b \quad (1)$$

That is to say:

$$x(t)=ce^{-at}+\frac{b}{a},c=\left[x(t_0)-\frac{b}{a}\right]e^{at_0} \quad (2)$$

It exists:

$$x(1)=x(2)=\mathbf{L}=x(n-1)=\frac{e^a}{e^a-1}-\frac{1}{a}\overset{\Delta}{-}x \quad (3)$$

Make:

$$[x(k+1)-x(k)]+a[(1-x)x(k)+xx(k+1)]=b(k\in K-|n|) \quad (4)$$

For the original data, when $t_k=k(k\in N)$, make iteration steps $S=0$, initial value $a_s=0$, then we can get:

$$x_s=x(a_s)=\lim_{a\to a_s}x(a)=\frac{1}{2} \quad (5)$$

Give $(x(t_k^*),x'(t_k^*))$ whitening value:

$$((1-x_s)x(k)+x_s x(k+1),\ x(k+1)-x(k))(k\in K-|n|) \quad (6)$$

Make a linear regression to give a whitening value:

$$a_{s+1}=-\frac{S_{xx\Delta S}}{S_{xxs}}$$

Among them:

$$S_{xx\Delta s}=\sum_{k=1}^{n-1}(x_{sk}-\bar{x}_s)(x_{\Delta k}-\bar{x}_\Delta)$$

$$S_{xx\Delta s}=\sum_{k=1}^{n-1}(x_{sk}-\bar{x}_s)^2$$

$$x_{sk}=(1-x_s)x(k)+x_s x(k+1)$$

$$x_{\Delta k}=x(k+1)-x(k)$$

$$\bar{x}_s=\frac{1}{n-1}\sum_{k=1}^{n}x_{sk}$$

$$\bar{x}_\Delta=\frac{1}{n-1}\sum_{k=1}^{n}x_{\Delta k}=\frac{x(n)-x(1)}{n-1}$$

We can get the index model M_{s+1} from the linear regression of $(e^{-a_{s+1}k},x(k))(k\in K)$:

$$\overset{\Lambda}{x}^{s+1}(t)=c_{s+1}e^{-a_{s+1}t}+b_{s+1} \quad (7)$$

Among them:

$$b_{s+1}=\frac{1}{n}\sum_{k=1}^{n}x(k)-c_{s+1}\frac{1}{n}\sum_{k=1}^{n}e^{-a_{s+1}k}$$

$$c_{s+1}=\frac{\sum_{k=1}^{n}\left[e^{-a_{s+1}k}-\frac{1}{n}\sum_{k=1}^{n}e^{-a_{s+1}k}\right]\left[x(k)-\frac{1}{n}\sum_{k=1}^{n}x(k)\right]}{\sum_{k=1}^{n}\left[e^{-a_{s+1}k}-\frac{1}{n}\sum_{k=1}^{n}e^{-a_{s+1}k}\right]^2}$$

4.4.2. Every state energy consumption GM (1,1) forecast results

In the process of data processing, we process the following and get our conclusions:

With the government policy unchanged, the number of nuclear power plants will not increase any more. So, nuclear power will not make new changes (with small fluctuations) over time. Therefore, we consider 2009 nuclear energy allocation as nuclear energy allocation in 2025 and 2050.

Since ethanol is a recent source of energy with limited data, we cannot accurately predict it. In the meantime, in order to be consistent with objective facts, we assume that ethanol consumption will increase by 1% of the available data.

Due to the data's own flaws and objective facts, under the premise of constant government policies, the total energy consumption will not be over-increased or over-depressed, but will tend to a value and become stable. Since we found that there is over-growth or over-recession in the 2050 data after the forecast, we discarded the 2050 forecast and replaced the 2050 forecast with 2025 forecast (with 5% fluctuation).

Table 6. Forecast results table

2025	Natural gas	Renewable Energy	Clean energy	Total energy consumption	Clean energy consumption share
Arizona	1032674	160251	1283473	2029795	0.632316476
California	2445547	853202.3	3876314	8671881	0.44699804
New Mexico	251672.6	742322.7	389498.9	768813	0.506623728
Texas	2055777	6271116	3241583	10875291	0.298068613

4.5. The target of new interstate compact

In Model 3, we derive the comprehensive evaluation index of the four states through the AHP, and from this we can determine that the energy profile of California is the best energy profile. Then with all the same policies, California is still the one with the best energy profile in both 2025 and 2050 projections. Therefore, we take the energy profile of California in 2025 as the evaluation index of the four states energy compact. We process the energy profile and quantify it as the share of renewable energy consumption in total energy consumption. That is, the predicted value of renewable energy consumption is compared with the predicted value of total energy consumption, its value is 9.8387%. We regard this percentage as the target of the target of new interstate compact.

According to the 2009 four continents pie chart, the current four states' clean energy profiles are mainly composed of four major energy sources: nuclear energy consumption, natural gas consumption, renewable energy consumption, and ethanol consumption. Although the share of clean energy in each of the four states is broadly similar, the use of clean energy in all states varies significantly in total energy consumption. Among them: Arizona accounted for the largest share of clean energy use, followed by California, followed by Texas and then New Mexico. Therefore, each state should move closer to the best indicator of energy use based on its own specific situation. In California and Arizona, natural gas accounts for the largest share of clean energy and nuclear is second. Among the consumption of renewable energy, hydroelectric power and biomass power are also the most widely used ones. We can infer that California and Arizona have abundant hydraulic resources and solar energy resources. Therefore, in order to optimize the energy profile in the states of California and Arizona, policy support and assistance should be provided for hydropower and solar power generation in the future. Unlike Arizona, California also has a certain amount of geothermal energy that can be widely used.

In New Mexico, natural gas accounts for the largest share of clean energy, but New Mexico does not develop nuclear power. Among the consumption of renewable energy, wind power and biomass power are also the most widely used ones. We can find that New Mexico is rich in wind resources and biomass resources and can vigorously develop wind power and biomass power generation industries in the future. In Texas, natural gas and nuclear energy account for a similar share of clean energy use, and the nuclear industry is more developed. In the use of renewable energy, wind resources and biomass resources occupy a major part. Making the energy profile of Texas and New Mexico resources closer to each other. In the future, we can support the use of wind power and biomass energy. Due to advanced nuclear power industry in Texas, it can maintain the development and use of nuclear energy while continuing to build nuclear power plant. Through these measures, we can further enhance the energy profile.

In order to enhance the energy profile, we should focus our efforts on the development and exploration of renewable energy. The energy profile in each state varies from each other. Therefore, we need to optimize the energy profile in each state by selecting the most appropriate route in each state. Above all, the use of renewable energy in all states in 2025 and 2050 should be consistent. So, we identify wind power and biomass power as targets for use of renewable energy in Texas; identify biomass power and wind power as targets for renewable energy use in New Mexico; identify hydropower, solar power and geothermal resources as targets for use of renewable energy in California; Identify hydropower and solar power as targets for the use of renewable energy in Arizona.

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